



# **SATHYABAMA**

**INSTITUTE OF SCIENCE AND TECHNOLOGY  
(DEEMED TO BE UNIVERSITY)**

**Accredited "A" Grade by NAAC | 12B Status by UGC | Approved by AICTE**

**[www.sathyabama.ac.in](http://www.sathyabama.ac.in)**

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

**PROFESSIONAL TRAINING (S84APT)  
DEC 2021 - JAN 2022**

Name of the Student : Divya Ezhilarasu

Semester : III

Reg No. : 40840004

Batch : 2020-2022



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DEPARTMENT OF ARCHITECTURE

M. Arch (Building management)

VIVA-VOCE EXAMINATION

This is to certify that the Professional Training Report (S84APT) is the work of **Divya Ezhilarasu** who had undergone training in **EPMCR PVT LTD** and has been monitored by the continuous assessment during Dec 2021 to Jan 2022.

**Dr. Devyani Gangopadhyay**  
HOD AND DEAN

Submitted for Viva voce Examination held on 01.02.2022

Internal Examiner  
(Ar. SUKIRTHA SURESH)

External Examiner  
(Ar. HENA DAMODHARAN)



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## DECLARATION

I, **Divya Ezhilarasu** hereby declare that this Professional Training Report for the period of 30 days from **1<sup>st</sup> Dec 2021 to 14<sup>th</sup> Jan 2022** 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 : 01.02.2022

PLACE : Chennai

A handwritten signature in blue ink, appearing to read 'Divya', is written over a faint, larger blue signature.

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,Director,EPMCR** 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.

I would also like to express my sincere thanks to EPMCR PVT LTD for their patience and guidance during the course of my training.



Ref. No. EPMCR/Internship/2021-22/12/05  
Date: 03<sup>rd</sup> December 2021

To

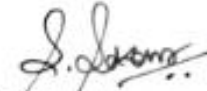
The Head of the Department  
Department of Architecture, School of Building and Environment  
Sathyabama Institute of Science and Technology  
Rajiv Gandhi Salai  
Jeppiar Nagar  
Chennai - 600 119  
TamilNadu

**Subject: Confirmation letter for Internship in our organization for Ms. Divya E, Reg. No. 40840004 - reg.**

Dear Sir,

This is to confirm you that, we would like to induct **Ms. Divya Ezhilarasu, (Reg. No. 40840004)** M.Arch in Building Management (Sathyabama Institute of Science And Technology) as a project management trainee in our organization will commence from 01.12.2021 as requested.

Thanks & regards,  
for Engineering Project Management Consultancy & Research Pvt. Ltd.,

  
(S Sekar Mahalingam)  
HR & Admin.



Ref. No. EPMCR/Internship/2021-22/01/08  
Date: 21<sup>st</sup> January 2022

To

The Head of the Department  
Sathyabama Institute of Science & Technology  
Rajiv Gandhi Salai, Jeppiar Nagar  
Chennai - 600119

**Sub: Completion Letter for Professional Training - reg.**

Respected Sir,

This is to certify that Ms. Divya Ezhilarasu (Reg. No. 40840004) has undergone project management student professional training with us from 01.12.2021 to 14.01.2022 and has successfully completed the 45 days period training.

During her tenure as a trainee with us, we found her to be diligent, intelligent and hard working. We wish her all the best & success for the future endeavors.

Thanks & regards,  
for Engineering Project Management Consultancy & Research Pvt. Ltd.,

  
(S Sekar Mahalingam)  
HR & Admin.



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



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



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# MONTHLY REPORT



**SATHYABAMA**  
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SCHOOL OF BUILDING & ENVIRONMENT, DEPARTMENT OF ARCHITECTURE  
M. Arch (Building management) Batch 2020-2022  
Continuous Assessment Report for Professional training

(Continuous progress report of the trainee architect/Project Manager for the period of 15 working days in the office to be submitted to HOD)

|                                                   |                                                                                       |
|---------------------------------------------------|---------------------------------------------------------------------------------------|
| 1. Name of the office / organization              | :EPMCR                                                                                |
| 2. Address & Contact Number                       | :2A Balaji Nagar Main Road, Bharathi Avenue,<br>New Perungalathur, Chennai - 600 063. |
| 3. Name of the student                            | :Divya Ezhilarasu                                                                     |
| 4. Duration                                       | : From -1.12.21 To - 31.12.21                                                         |
| 5. Total No. of 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;

| 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 : \_\_\_\_\_

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

*S. L. L. L.*  
CHENNAI-63



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| 2. Address & Contact Number                       | :2A Balaji Nagar Main Road, Bharathi Avenue,<br>New Perungalathur, Chennai - 600 063. |
| 3. Name of the student                            | :Divya Ezhilarasu                                                                     |
| 4. Duration                                       | : From - 1.1.22 To - 14.1.22                                                          |
| 5. Total No. of 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;

| Description of works                       | Excellent | Good | Fair | Poor | NA |
|--------------------------------------------|-----------|------|------|------|----|
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| 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 : \_\_\_\_\_

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

*S. L. L. L.*  
CHENNAI-63

# WORK DIARY

| DAY      | PROJECT NAME  | WORK DONE                                                                                                                  | DAY      | PROJECT NAME         | WORK DONE                                                                                                                                |
|----------|---------------|----------------------------------------------------------------------------------------------------------------------------|----------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 1.12.21  | PROJECT 1-GTE | <ul style="list-style-type: none"> <li>Introduction to the project</li> <li>Introduction to AYOA.</li> </ul>               | 24.12.21 | PROJECT 1-GTE        | Cash flow calculation-for production building                                                                                            |
| 2.12.21  | PROJECT 1-GTE | Understanding prefab construction and the project contract                                                                 | 27.12.21 | PROJECT 1-GTE        | Cash flow calculation-for security block                                                                                                 |
| 3.12.21  | PROJECT 1-GTE | Understanding prefab construction                                                                                          | 28.12.21 | PROJECT 1-GTE        | Cash flow calculation-for land works                                                                                                     |
| 6.12.21  | PROJECT 1-GTE | Breakdown of activities and sequencing                                                                                     | 29.12.21 | PROJECT 2- Bangalore | Introduction project                                                                                                                     |
| 7.12.21  | PROJECT 1-GTE | <ul style="list-style-type: none"> <li>Sequencing and revision</li> <li>Extracts from soil reports</li> </ul>              | 30.12.21 | PROJECT 2- Bangalore | Analyzing drawings and identifying scope of work                                                                                         |
| 8.12.21  | PROJECT 1-GTE | <ul style="list-style-type: none"> <li>Preliminary WBS MSP,</li> <li>Checklist for inspection</li> </ul>                   | 31.12.21 | PROJECT 2- Bangalore | Analyzing drawings and identifying scope of work                                                                                         |
| 9.12.21  | PROJECT 1-GTE | <ul style="list-style-type: none"> <li>Checklist of site activities</li> <li>Introduction to A3 Japanese Sheets</li> </ul> | 3.1.22   | PROJECT 2- Bangalore | Identifying elements and quantifying                                                                                                     |
| 10.12.21 | PROJECT 1-GTE | <ul style="list-style-type: none"> <li>Ideation and problem solving'</li> <li>Quadrant formulation.</li> </ul>             | 4.1.22   | PROJECT 2- Bangalore | Work Breakdown for the project                                                                                                           |
| 13.12.21 | PROJECT 1-GTE | <ul style="list-style-type: none"> <li>Ideation and problem solving'</li> <li>Quadrant formulation.</li> </ul>             | 5.1.22   | PROJECT 2- Bangalore | Work Breakdown and scheduling                                                                                                            |
| 14.12.21 | PROJECT 1-GTE | Calculation of schedule days-Preliminary                                                                                   | 6.1.22   | PROJECT 2- Bangalore | <ul style="list-style-type: none"> <li>Work Breakdown and scheduling</li> <li>Video Conferencing on water proofing strategies</li> </ul> |
| 15.12.21 | PROJECT 1-GTE | GTE -Site visit                                                                                                            | 7.1.22   | PROJECT 2- Bangalore | <ul style="list-style-type: none"> <li>Project presentation</li> <li>Equipment analysis</li> </ul>                                       |
| 16.12.21 | PROJECT 1-GTE | Calculation For Site Excavation                                                                                            | 8.1.22   | PROJECT 2- Bangalore | <ul style="list-style-type: none"> <li>Project presentation</li> <li>Site Mapping and Zoning</li> </ul>                                  |

|          |               |                                                                                                                                                   |         |                      |                                                                                                             |
|----------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------|-------------------------------------------------------------------------------------------------------------|
| 17.12.21 | PROJECT 1-GTE | Calculation For Site Excavation                                                                                                                   | 10.1.22 | PROJECT 2- Bangalore | <ul style="list-style-type: none"> <li>• Project presentation</li> <li>• Division of work fronts</li> </ul> |
| 20.12.21 | PROJECT 1-GTE | Template creation for excavation capacity calculation                                                                                             | 11.1.22 | PROJECT 2- Bangalore | Project presentation                                                                                        |
| 21.12.21 | PROJECT 1-GTE | A3 Sheets for prefabrication                                                                                                                      | 12.1.22 | PROJECT 2- Bangalore | Project presentation                                                                                        |
| 22.12.21 | PROJECT 1-GTE | <ul style="list-style-type: none"> <li>• Scheduling the site activities</li> <li>• ISI Code Specifications-Steel(Template Formulation)</li> </ul> | 13.1.22 | PROJECT 2- Bangalore | Project presentation                                                                                        |
| 23.12.21 | PROJECT 1-GTE | Cash flow calculation                                                                                                                             | 14.1.22 | PROJECT 2- Bangalore | Project presentation                                                                                        |

PM Signature:

*S. Karthikeyan*



Office seal:

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## GENERAL

EPMCR is a well-known fore runner in the construction industry ,offering sustainable solutions to infrastructure projects. The firm is also closely associated with research related to construction automation, Intelligent & smart systems, 3D printing, Smart Supply Chain Infrastructure Building Biology and so on.

### The initial driving factors:

My decision to conduct my training at EPMCR stemmed from two key reasons.

- The primary reason being feedback from seniors on their training experience and the immense scope for learning.
- The second driving point was my experience with EPMCR,being project partners during the Solar Decathlon competition.



### What was the focal point in decision making?

I believed that training with EPMCR would provide the experience I needed to be competent in the field. Further EPMCR is well known for their training program that has assisted several others in their journey as project managers.

The hands-on experience and involvement in a real time ,ongoing project would undoubtedly help me understand how to handle large scale constructions, identify the requirements and the basics of work front division. Simply the theoretical exposure till date i.e., by the book solutions is not feasible for the project in progress considering the several constraints and risk factors.



### Why EPMCR?

The aim of taking up my masters in Building Management was to equip myself with the knowledge to handle projects. The extensive portfolio of projects that the firm displays gives an insight to the exposure I could expect during the course of my training period .This is something that I identified as vital ,given my lack of actual field experience.

## ABOUT EPMCR:

EPMCR(P)LTD is an IIT Madras incubated Engineering and Project Management consulting company that offers civil engineering solutions right from Architecture to delivery of the infrastructure facilities. The firm specialises in planning, design and construction of Building Infrastructure, Transportation Infrastructure and Water Infrastructure.

The vision is to optimize value & quality for client investment in infrastructure projects within the time and budget. The firm's effort focuses on developing innovative & cost-effective solutions to improve productivity through waste reduction and other new technologies.

## VISION STATEMENT:

- To become world class Engineering & Project Management consultants and professional trainers.
- Enabling high quality Indian infrastructure development
- Create innovation in construction technology and Management techniques via continuous research.
- Enhance the construction work force through skill training.



## PROJECT-1: DETAILS

- **Client name** : GT ELECTRONICS (INDIA) PVT LTD
- **Team/ Group** : EPMCR
- **Site location** : Tindivanam-Pondicherry Highway, Vanur Taluk, Villupuram District, Tamilnadu.
- **Project Status** : Under Construction (Excavation and footings)
- **Site area** : 6.26 acres

| S.NO | DESCRIPTION                | BUILT UP AREA IN SQ.M |
|------|----------------------------|-----------------------|
| 1.   | PRODUCTION BLOCK           | 4464.5                |
| 2.   | ADMIN BLOCK                | 622.73                |
| 3.   | SECURITY BLOCK             | 65.8                  |
| 4.   | LOADING BAY                | 101.2                 |
| 5.   | GAS BANK                   | 38.8                  |
| 6.   | GENERATOR YARD             | 69.5                  |
| 7.   | OIL STORAGE YARD           | 38.7                  |
| 8.   | STAFF AND VISITORS PARKING | 976.32                |

## ABOUT THE PROJECT:

GT Electronics provides standard and customized solutions for Inductive Components, Coils, Chokes, HF Transformers and Current Transformers in small, medium and large-scale production, from handmade to fully automated production. The company started its business operation in India in 2002 for designing and manufacturing magnetic components.

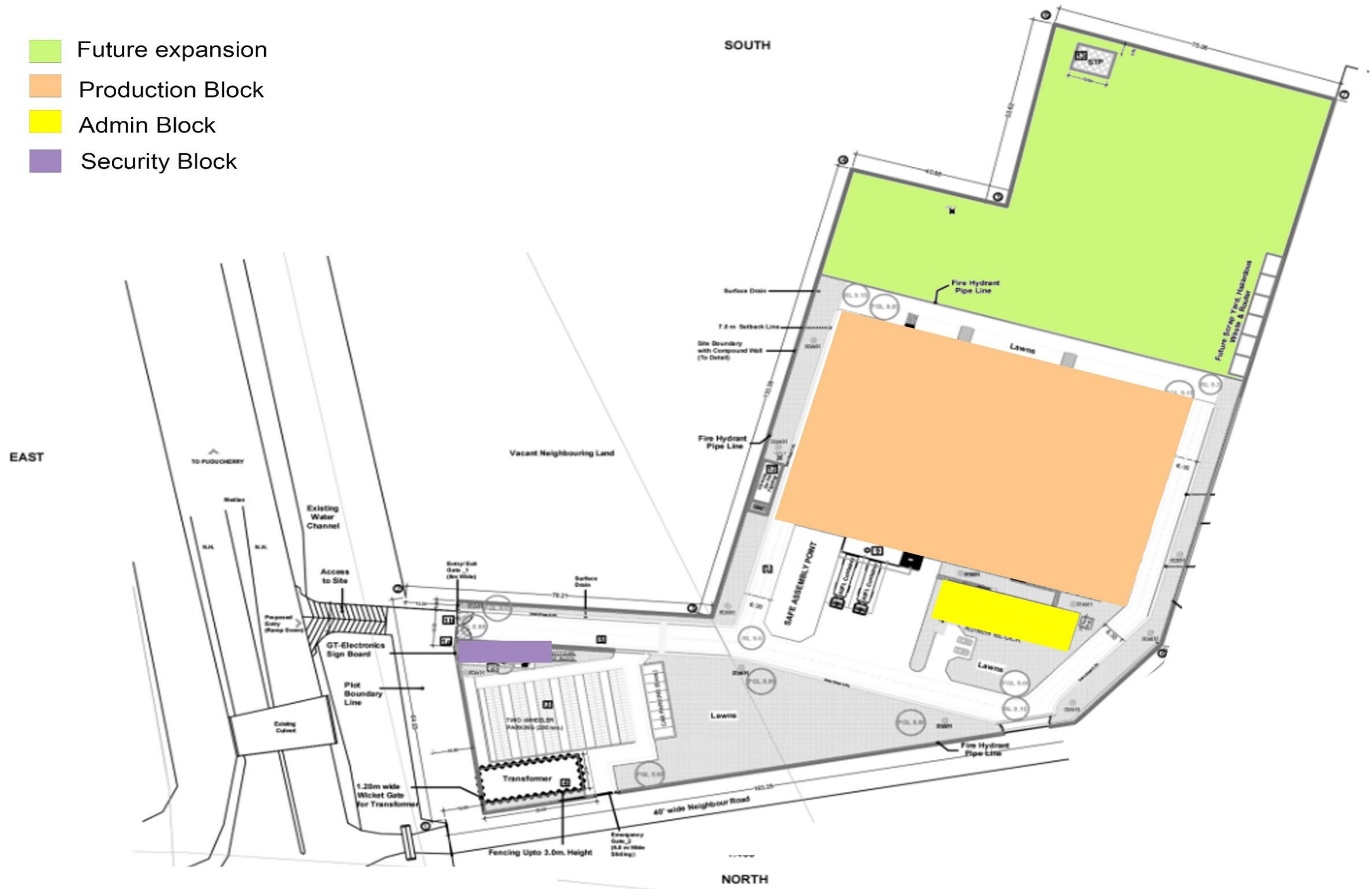
The project is a factory building, where the scope of work includes the following buildings:

- Production Block
- Admin Block
- Security Block.

The Production Block is the focal building and is a Prefab construction. The initial soil tests conducted via boring at 4 different locations concluded that the soil on site is silty clay.

## SITE ZONING

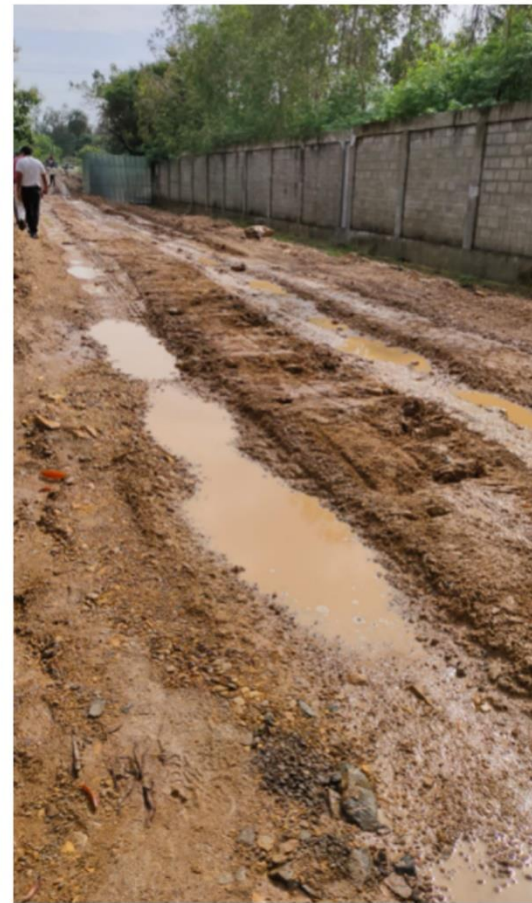
- Future expansion
- Production Block
- Admin Block
- Security Block



**SITE IMAGES -GTE (15.12.21)**



**Dumping site**



**Access to the site**



**Excavated pits**



**Soil Testing- Bore drilling**



**Access to the site**



**Rebar Yard**



| CHECKLIST - PRE CONSTRUCTION |                                                                 |              |                  |         |
|------------------------------|-----------------------------------------------------------------|--------------|------------------|---------|
| S.NO                         | DESCRIPTIONS                                                    | SATISFACTORY | NOT SATISFACTORY | REMARKS |
| <b>1</b>                     | <b>SITE CONDITION</b>                                           |              |                  |         |
| 1.1                          | Check the condition of site entry.                              |              |                  |         |
| 1.2                          | Check that the setbacks and boundaries are marked as per        |              |                  |         |
| 1.3                          | Are there any unclear/unmarked areas.                           |              |                  |         |
| 1.4                          | Check the levels on site with respect to drawing specifications |              |                  |         |
| 1.5                          | Verify provision of site utilities                              |              |                  |         |
| 1.6                          | Verify the site access provisions                               |              |                  |         |
| 1.7                          | Check the ease of vehicular movement on site                    |              |                  |         |
| 1.8                          | Inspection of the full perimeter of the work site               |              |                  |         |
| 1.9                          | Site access is controlled and the number of access points       |              |                  |         |
| 1.1                          | Availability of job documents - permits, work method statements |              |                  |         |
| 1.11                         | Availability of safety gears                                    |              |                  |         |
| 1.12                         | Adequate safety aid kits                                        |              |                  |         |
| 1.13                         | Warning signs placement                                         |              |                  |         |
| <b>2</b>                     | <b>SITE DRAINAGE</b>                                            |              |                  |         |
| 2.1                          | Identify the current site drainage conditions                   |              |                  |         |
| 2.2                          | Assess areas of water stagnation                                |              |                  |         |
| 2.3                          | Adequate drainage controls have been placed around the site     |              |                  |         |
| 2.4                          | The site is adequately prepared for the anticipated weather     |              |                  |         |
| 2.5                          | Drainage Control measures are being adequately maintained in    |              |                  |         |
| 2.6                          | Stormwater runoff diverted away from unstable slopes            |              |                  |         |
| 2.7                          | Culverts are free of obstructions/clogging                      |              |                  |         |
| 2.8                          | All open ditches should be protected                            |              |                  |         |
| <b>3</b>                     | <b>SAFTEY PARAMETERS</b>                                        |              |                  |         |
| 3.1                          | Has the risk assessment for initial activities been done?       |              |                  |         |
| 3.2                          | Safety guidelines and rules implemented on site                 |              |                  |         |
| 3.3                          | Are there proper saftey signages in place?                      |              |                  |         |
| 3.4                          | Availability of saftey gears                                    |              |                  |         |
| 3.5                          | Emergency training before constuction                           |              |                  |         |
| 3.6                          | Emergency first aid kits availability                           |              |                  |         |
| <b>4</b>                     | <b>HAZARD MATERIALS</b>                                         |              |                  |         |
| 4.1                          | Log of all the hazardous materials .                            |              |                  |         |
| 4.2                          | Precautionary measures should be instructed to the workers      |              |                  |         |
| 4.3                          | Labelling , marking and tag of all the materials .              |              |                  |         |
| <b>5</b>                     | <b>MATERIAL STORAGE AND HANDLING</b>                            |              |                  |         |
| 5.1                          | Are there designated areas for machines and equipment set up?   |              |                  |         |
| 5.2                          | Is the material delivery to the sity seampless and on time?     |              |                  |         |
| 5.3                          | Adequate starage facilities and handling procedure              |              |                  |         |
| 5.4                          | Inspection of materials and quality checking                    |              |                  |         |
| 5.5                          | Check the site security management effeciency                   |              |                  |         |
| 5.6                          | Are the materials stores in the assigned locations and storage  |              |                  |         |
| 5.7                          | Check for the labels in all the stored materials                |              |                  |         |
| 5.8                          | Are saftey procedures followed while unloading fabricated       |              |                  |         |

## SITE CONDITION — Why is it important?

Climatic conditions at the time of project start.

Changes in site levels

Impact on other elements- compound wall elevation etc.

Soil characteristics.

## SITE DRAINAGE

Changes in site levels impacts the plans for site drainage.

Presence of culverts at the site entrance.

Impact of water stagnation on site storage and activities.

## SAFETY AND HAZARD MATERIALS

Safety and security for man,material and machine.

Adequate safety provisions.

Nature of the production unit.

## MATERIAL STORAGE AND HANDLING

Location of fabrication, rebar, shuttering yards and material store rooms.

Ease of movement on site.

| CHECKLIST - PRE CONSTRUCTION |                                                               |  |  |  |
|------------------------------|---------------------------------------------------------------|--|--|--|
| <b>6</b>                     | <b>LOADING AND UNLOADING</b>                                  |  |  |  |
| 6.1                          | Access to trailers , electrical lines and other overhead      |  |  |  |
| 6.2                          | Trailers condition should be checked - brakes ,lights, horns, |  |  |  |
| 6.3                          | Display of saftey signages                                    |  |  |  |
| 6.4                          | Ensure flat base for movement of machineries                  |  |  |  |
| 6.5                          | Position of sling                                             |  |  |  |
| 6.6                          | Inspection of log book - service date, working load etc .     |  |  |  |
| 6.7                          | Check the vehicle for hydrauli leakage, pressure and other    |  |  |  |
|                              |                                                               |  |  |  |
| <b>7</b>                     | <b>LABOUR PERFORMANCE</b>                                     |  |  |  |
| 7.1                          | Track the progress of each activities                         |  |  |  |
| 7.2                          | Review of labour capacity on site                             |  |  |  |
| 7.3                          | Asses the lag in work performance                             |  |  |  |
| 7.4                          | Are the work hours adhered to?                                |  |  |  |
|                              |                                                               |  |  |  |
| <b>8</b>                     | <b>WASTE MANAGEMENT</b>                                       |  |  |  |
| 8.1                          | Is there a proper waste/ scrap disposal method in place       |  |  |  |
| 8.2                          | Scrap with nails and debris cleared from the work area .      |  |  |  |

| S.NO                  | LABOUR ONSITE      | NUMBER |
|-----------------------|--------------------|--------|
| 1                     | FITTER             | 5      |
| 2                     | CARPENTER          | 6      |
| 3                     | MALE WORKER        | 1      |
| 4                     | FEMALE WORKER      | 1      |
| 5                     | TRACTOR OPERATOR   | 2      |
| 6                     | JCB OPERATOR       | 2      |
| 7                     | EXCAVATOR OPERATOR | 1      |
| 8                     | COMPACTOR OPERATOR | 1      |
| 9                     | MASON              | 1      |
| TOTAL WORKERS ON SITE |                    | 20     |

This workforce is allocated during the initial stages of excavation for the project.

The preliminary checklist was formulated upon understanding the general work scope for a prefab factory construction. The checklist sets a guideline for inspection during the site visit. It allowed a thorough overview of the activities carried out.

It also helped estimate the labour productivity and establish whether there is an over allocation or insufficient resources.

#### REFER TO THE EXCAVATION CALCULATION CHART:

- The observation of site machinery established that there is excessive idle time of the excavator.
- The number of dumpers assigned to each excavator has to be calculated to reaffirm efficiency.
- The dump yard has to be relocated to reduce travel time .This may in turn impact the dumper allocation.
- The slope excavation methodology due to the clayey nature of soli is established.
- The route of the dumpers/tractors is rescheduled taking into account safety and accuracy.

#### LOADING AND UNLOADING

#### Why is it important?

Mapping vehicular movement on site.

Work front division (Quadrants)

Prioritisation and scheduling.

Log maintenance.

#### LABOUR PERFORMANCE

Deployment of additional labour.

On time project completion.

Reduce the idel time of labour and machinery.

Changes in the schedule to bridge the performance gap.

Determines the fabrication start date.

#### WASTE MANAGEMENT

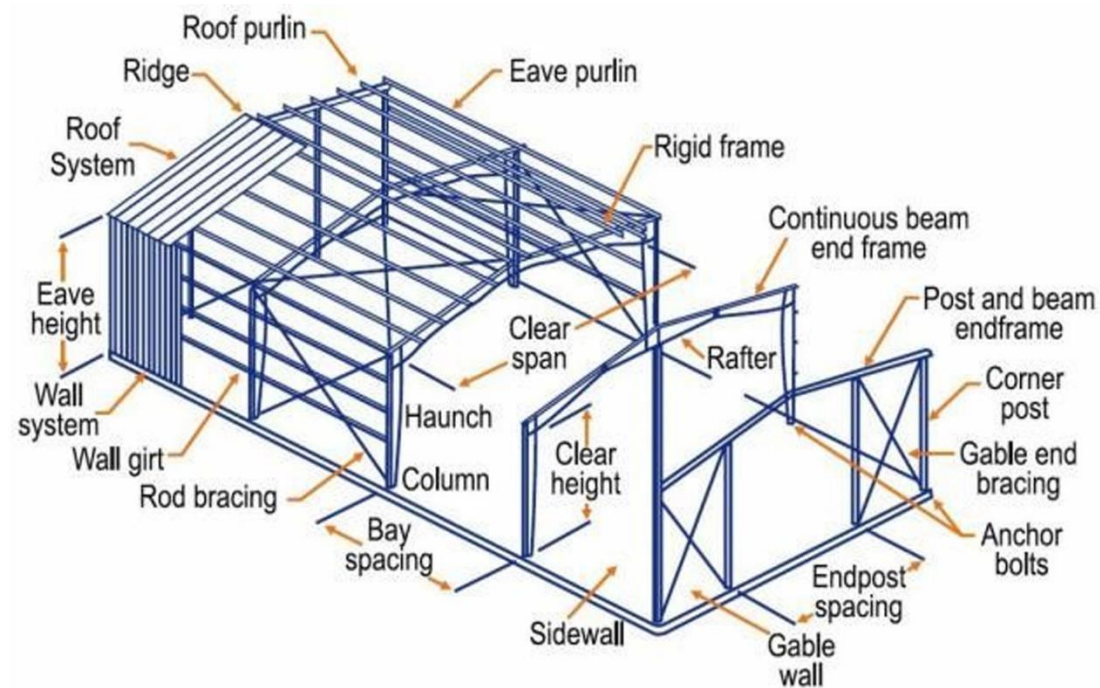
Lean concept.

Safety and management effeciency.

### A3 SHEETS FOR PREFAB FACTORY CONSTRUCTION:

These sheets identify the stakeholders involved, their participation, locations, trends, facts and technology related to prefabricated construction. This compiles the key points in the project in a nutshell and enables understanding before the project kick starts.

| S<br>T<br>A<br>K<br>E<br>H<br>O<br>L<br>D<br>E<br>R<br>S | PASSIVE PARTICIPANTS -INDIRECT INVOLVEMENT |                                         |                                         | L<br>O<br>C<br>A<br>T<br>I<br>O<br>N<br><br>/<br><br>P<br>L<br>A<br>C<br>E<br>S | STAKEHOLDER INVOLVEMENT AT DIFFERENT LOACTIONS |                           |                                                                                                                              |                                                                                            |                  |               |
|----------------------------------------------------------|--------------------------------------------|-----------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------|------------------------------------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|------------------|---------------|
|                                                          | 1                                          | Client                                  | Investors<br>Operations management team |                                                                                 | 1                                              | OFFICE                    | Architect<br>PMC<br>Suructural engineer<br>Consultants<br>Contractor<br>Client management<br>Legal team<br>Government office |                                                                                            |                  |               |
|                                                          | 2                                          | Insurance companies                     |                                         |                                                                                 | 2                                              |                           | Fabrication yard                                                                                                             |                                                                                            |                  |               |
|                                                          | 3                                          | Financial Consultants                   |                                         |                                                                                 | 3                                              |                           | Production units and factories                                                                                               |                                                                                            |                  |               |
|                                                          | 4                                          | Safety and security management          |                                         |                                                                                 | 4                                              |                           | SITE                                                                                                                         | SITE ACCESS<br>Entry into the site from main road<br>Transportation proximity for material |                  |               |
|                                                          | 5                                          | Material Supplier/Vendor                | Cement                                  |                                                                                 | 5                                              |                           |                                                                                                                              | STORAGE FACILITIES                                                                         |                  |               |
|                                                          |                                            |                                         | Aggregates                              |                                                                                 | 6                                              |                           |                                                                                                                              |                                                                                            | PRODUCTION BLOCK |               |
|                                                          |                                            |                                         | Reinforcement material                  |                                                                                 |                                                |                           |                                                                                                                              |                                                                                            |                  | Dining area   |
|                                                          |                                            |                                         | Flooring                                |                                                                                 |                                                |                           |                                                                                                                              |                                                                                            |                  | Process rooms |
|                                                          |                                            |                                         | Partitions                              |                                                                                 |                                                | Marking rooms             |                                                                                                                              |                                                                                            |                  |               |
|                                                          |                                            |                                         | Joinery                                 |                                                                                 |                                                | Varnish room              |                                                                                                                              |                                                                                            |                  |               |
|                                                          |                                            |                                         | Wall Cladding                           |                                                                                 |                                                | Oven area                 |                                                                                                                              |                                                                                            |                  |               |
|                                                          | Roofing Sheets                             |                                         | Potting room                            |                                                                                 |                                                |                           |                                                                                                                              |                                                                                            |                  |               |
|                                                          | 6                                          | Equipment/machinary lessor              |                                         |                                                                                 |                                                | Testing rooms             |                                                                                                                              |                                                                                            |                  |               |
|                                                          | 7                                          | Neighbours                              |                                         |                                                                                 |                                                | Packing area              |                                                                                                                              |                                                                                            |                  |               |
|                                                          | 8                                          | End user                                |                                         |                                                                                 |                                                | Cold storage              |                                                                                                                              |                                                                                            |                  |               |
|                                                          |                                            |                                         |                                         |                                                                                 |                                                | Raw material storage      |                                                                                                                              |                                                                                            |                  |               |
|                                                          |                                            | LAWMAKERS/GOVERNING AUTHORITY           |                                         |                                                                                 |                                                | Operations area           |                                                                                                                              |                                                                                            |                  |               |
|                                                          |                                            |                                         |                                         |                                                                                 |                                                | Machine rooms             |                                                                                                                              |                                                                                            |                  |               |
|                                                          | 9                                          | Govenment agencies(approvals)           |                                         |                                                                                 |                                                | Maintenance rooms         |                                                                                                                              |                                                                                            |                  |               |
|                                                          | 10                                         | Lisencing agencies                      |                                         |                                                                                 |                                                | Electrical panel room     |                                                                                                                              |                                                                                            |                  |               |
|                                                          | 11                                         | Safety inspector                        |                                         |                                                                                 |                                                | Hand production area      |                                                                                                                              |                                                                                            |                  |               |
|                                                          |                                            |                                         |                                         |                                                                                 |                                                | Steel storage             |                                                                                                                              |                                                                                            |                  |               |
|                                                          |                                            | KEY PLAYERS- DIRECT INVOLVEMENT         |                                         |                                                                                 |                                                | Core production areas     |                                                                                                                              |                                                                                            |                  |               |
|                                                          |                                            |                                         |                                         |                                                                                 |                                                | Annealing area            |                                                                                                                              |                                                                                            |                  |               |
|                                                          | 12                                         | EPMCR (architects and project managers) |                                         |                                                                                 |                                                | Power coating room        |                                                                                                                              |                                                                                            |                  |               |
|                                                          | 13                                         | Structural consultants                  |                                         |                                                                                 |                                                | Scrap collection areas    |                                                                                                                              |                                                                                            |                  |               |
|                                                          | 14                                         | Facility manager                        |                                         |                                                                                 |                                                | Storage of finished goods |                                                                                                                              |                                                                                            |                  |               |
| 15                                                       | Lighting consulants                        |                                         |                                         |                                                                                 |                                                |                           |                                                                                                                              |                                                                                            |                  |               |
| 16                                                       | MEP Consultants                            |                                         |                                         |                                                                                 |                                                |                           |                                                                                                                              |                                                                                            |                  |               |
| 17                                                       | Landscape architects                       |                                         |                                         |                                                                                 |                                                |                           |                                                                                                                              |                                                                                            |                  |               |
| 18                                                       | Fire safety consultants                    |                                         |                                         |                                                                                 |                                                |                           |                                                                                                                              |                                                                                            |                  |               |
| 19                                                       | Contractor                                 |                                         |                                         |                                                                                 |                                                |                           |                                                                                                                              |                                                                                            |                  |               |
| 20                                                       | Subcontractor                              |                                         |                                         |                                                                                 |                                                |                           |                                                                                                                              |                                                                                            |                  |               |
| 21                                                       | PEB Fabricator                             |                                         |                                         |                                                                                 |                                                |                           |                                                                                                                              |                                                                                            |                  |               |
| 22                                                       | On site personnel(supervisors)             |                                         |                                         |                                                                                 |                                                |                           |                                                                                                                              |                                                                                            |                  |               |
| 23                                                       | Construction workers                       |                                         |                                         |                                                                                 |                                                |                           |                                                                                                                              |                                                                                            |                  |               |



In prefabrication, steel can be easily customised, panelised and acts as modular units-making assembly easy.

Standardized processes allow the work to occur in a controlled environment.



This type of construction results in 25% of scheduled savings.

It reduces disruption of the jobsite in terms of noise, pollution and waste generation.



## F A C T S

- Reduces 15-25% of project costs
- Reduced CO2 emission and construction waste
- Rigid frameworks that have long spans(exceeds 30m)
- Decrease in noise levels of on site construction and pollution
- Scope to carry out parallel activities
- Requires high precision planning with a small labour force
- Enhanced quality and finish
- Speed of construction increases between 30-50%
- Eliminates 80% of onsite activities
- Value of work onsite is 25% ;off site is 75%
- prefabrication minimizes the margin of error

## T R E N D S

- Scope to combine BIM and ERP
- Incorporation of Augmented Reality and 3D printing solutions.
- Elimination of communication and project roadblocks using Digital Management
- Increasing demand creates a stable workforce
- Speed of construction has created a market demand post COVID
- Current market trend shows CAGR of 8.5%
- Integration of the triad of modular, prefabricates and sustainable constructions are currently popular
- In the new normal construction scenario, prefabrication is more adaptable and

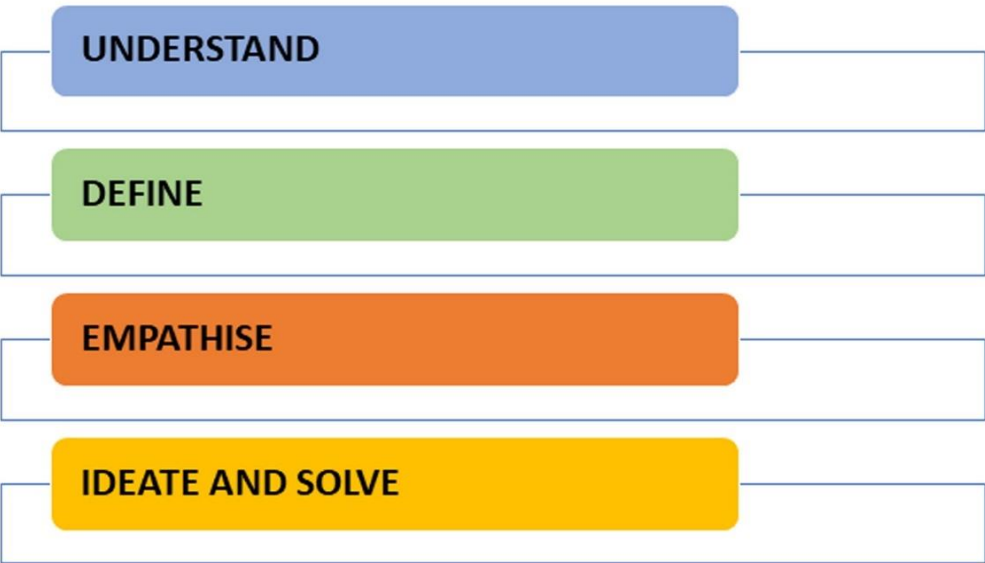
### AVAILABLE PREFAB MARKET MATERIAL

|                         |                                                           |
|-------------------------|-----------------------------------------------------------|
| PANELS                  | Structural Insulated Panels                               |
|                         | Insulating Concrete Forms                                 |
|                         | Color Coated Galvalume Sheets                             |
|                         | PUF Panel                                                 |
|                         | Sandwich Panel                                            |
| COMPONENTS              | Light weight steel frame panels                           |
|                         | Trusses                                                   |
|                         | Doors                                                     |
|                         | Beam                                                      |
|                         | Windows                                                   |
| MODULES                 | Columns                                                   |
|                         | Four sided module                                         |
|                         | Partially Open Sided module                               |
|                         | Open frame module                                         |
| HYBRID FORM             | Open frame module                                         |
|                         | Mixed modular and panel systems                           |
| COMPLETE PREFABRICATION | Create parts of the whole construction projectt           |
|                         | For the whole building that is considered a single module |
|                         | Stand alone modules                                       |

DESIGN THINKING

Design thinking provides a frame work about how to organize human/equipment activities to add value and eliminate waste.

It is divided into broad categories to :



This process helps strategically locate the pain points, lag areas,risks,potential delays ,areas of optimisation and the pull activities.

Once these are categorised it allows to schedule with ease.

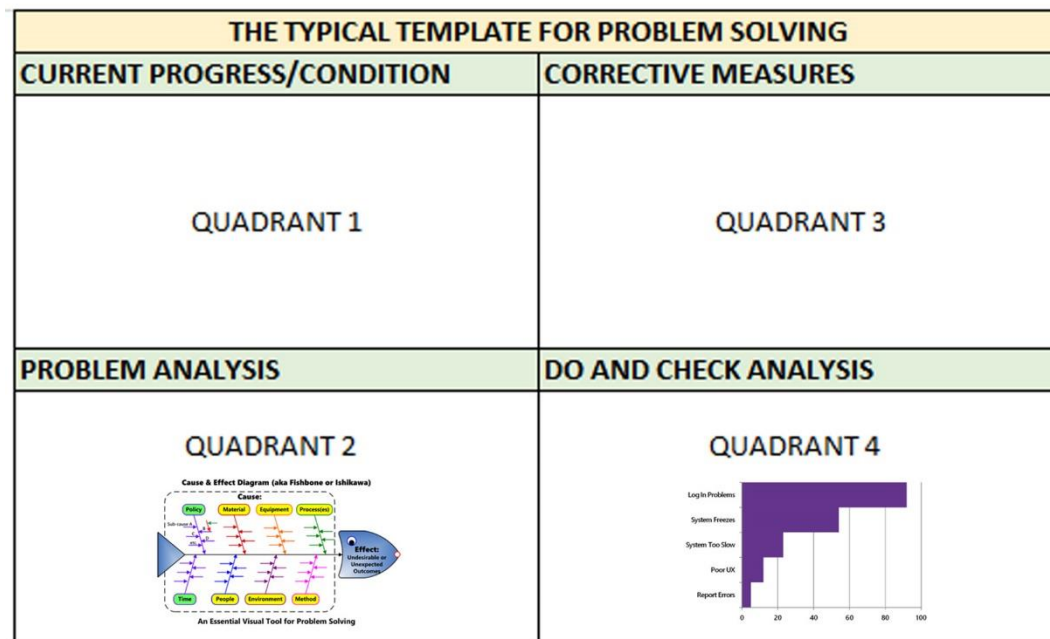
It provides the basis to formulate two week schedules.

The system of establishing a “pull ” system is based on the actual demand of the activity and not on the forecast.This permits better accuracy in scheduling.

| DESCRIPTION OF WORK /ACTIVITY/TASK                  |                         |                      |                                               |                                     |                                                 |                 |       |
|-----------------------------------------------------|-------------------------|----------------------|-----------------------------------------------|-------------------------------------|-------------------------------------------------|-----------------|-------|
| PROJECT: GTE                                        |                         | ACTIVITY: EXCAVATION |                                               | DURATION                            | START DATE:                                     | 14.12.21        | DELAY |
| CLIENT: GTE ELECTRICALS                             |                         |                      | ESTIMATED END DATE:                           |                                     | 24.12.21                                        | ACTUAL END DATE |       |
|                                                     |                         |                      | DAYS REMAINING:                               |                                     | 9 days                                          |                 |       |
| PMC: EPMCR                                          |                         |                      |                                               |                                     |                                                 |                 |       |
| MILESTONES                                          |                         | ACHIEVED: YES/NO     | WHO TO COORDINATE WITH (STAKEHOLDERS)         |                                     | DOCUMENTS AND REPORTS NEEDED                    |                 |       |
| Filling and leveling                                |                         | yes                  | PMC - Site Supervisor - Contractor - Labourer |                                     | Detailed drawings of footings                   |                 |       |
| Corner benchmarking                                 |                         | yes                  | Site Supervisor - Contractor - Labourer       |                                     | Site plan and topography plan                   |                 |       |
| Marking the footing positions                       |                         | yes                  | Site Supervisor - Contractor - Labourer       |                                     | Log of work hours,labour capacity and equipment |                 |       |
| Assigning resources to the work front               |                         | yes                  | Site Supervisor - Contractor - Labourer       |                                     | Daily progress report                           |                 |       |
| Excavation to the set daily target                  |                         |                      | PMC - Site Supervisor - Contractor - Labourer |                                     | Safety records                                  |                 |       |
| BUDGET PLAN SUMMARY                                 |                         |                      |                                               | BROAD CATEGORY RISK IDENTIFICATION  |                                                 |                 |       |
| INITIAL COST PROJECTION                             |                         |                      |                                               | 1. Unpredictable weather            |                                                 |                 |       |
| EXPENSE TO DATE                                     |                         |                      |                                               | 2. Work schedule efficiency         |                                                 |                 |       |
| DIFFERENCE                                          |                         |                      |                                               | 3. Inefficiency in machine planning |                                                 |                 |       |
| COST OVER RUN                                       | WHERE?                  |                      |                                               | 4. Cost over runs                   |                                                 |                 |       |
|                                                     | HOW MUCH?               |                      |                                               | 5. Idle time                        |                                                 |                 |       |
| PROJECT INDICATORS                                  |                         |                      |                                               |                                     |                                                 |                 |       |
| TASKS PLANNED:                                      |                         |                      |                                               | TASKS COMPLETED:                    |                                                 |                 |       |
| ACTIVITY SCHEDULED                                  |                         | ACTIVITY IN PROGRESS |                                               |                                     | ACTIVITY COMPLETED                              |                 |       |
| Footing excavation                                  |                         | work in progress     |                                               |                                     |                                                 |                 |       |
| Excavation at A11                                   |                         |                      |                                               |                                     | Completed                                       |                 |       |
| Excavation at A8                                    |                         | work in progress     |                                               |                                     |                                                 |                 |       |
|                                                     |                         |                      |                                               |                                     |                                                 |                 |       |
| Barbending                                          |                         | work in progress     |                                               |                                     |                                                 |                 |       |
| Reinforcement tying                                 |                         | work in progress     |                                               |                                     |                                                 |                 |       |
| Site access way leveling                            |                         |                      |                                               |                                     | Completed                                       |                 |       |
| PROJECT PROGRESS INDICATOR: PREDECESOR/CURRENT TASK |                         |                      |                                               |                                     |                                                 |                 |       |
|                                                     | Excavation daily target |                      |                                               |                                     |                                                 |                 |       |
| EARLY FINISH                                        | ON TIME COMPLETION      |                      | LATE FINISH                                   |                                     | TASK AT RISK                                    |                 |       |
| CLIFF NOTES:                                        |                         |                      |                                               |                                     |                                                 |                 |       |
| Site meeting - with- PMC,contractor and client.     |                         |                      |                                               |                                     |                                                 |                 |       |
| DISCUSSION TAKE AWAYS:                              |                         |                      |                                               |                                     |                                                 |                 |       |
| 1.Address the equipment idle time                   |                         |                      |                                               |                                     |                                                 |                 |       |
| 2.Replan the order dates for the prefabrication     |                         |                      |                                               |                                     |                                                 |                 |       |
| 3.Revised site levels and drainage points           |                         |                      |                                               |                                     |                                                 |                 |       |
| 4.Raised height of the compound walls               |                         |                      |                                               |                                     |                                                 |                 |       |
| 5.Estimate of the additional cost                   |                         |                      |                                               |                                     |                                                 |                 |       |

## THE NEED FOR A3 PRESENTATION SHEETS

- The A3 size sheet is split into sections, each with a key piece of information.
- They are used from the grass root level to promote better understanding and improve the work productivity.
- It is an important tool for communication within the organization.
- The need for voluminous documents is eliminated and the vital data is brought together in a single sheet.



## A3 JAPANESE SHEETS - EMPATHISE

• The “UNDERSTAND” Quadrant gives a general overview. The “EMPATHISE” Quadrant details the involved stakeholders. The next step is to list each stakeholder's job scope and responsibilities.

- The possible challenges in achieving these respective target responsibilities are narrowed down.
- This allows to find the “pain points” of every involved party.

These considerations give an understanding on the issues and conflicts faced in the project and the possible mitigation means that they should be equipped with.

| DESCRIPTION OF WORK /ACTIVITY/TASK |                                                                    |                                                                                       |
|------------------------------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| STAKEHOLDER                        | TASK/RESPONSIBILITY                                                | CHALLENGES                                                                            |
| PMC                                | The authority figure for the complete project.                     | Coordination with stakeholders and project estimates.                                 |
|                                    | Establish cash flow models and feasibility reports.                | Convincing the client about strategies.                                               |
|                                    | Coordination with client and contractor.                           | Realistic budgets.                                                                    |
|                                    | Precision in planning and accurate estimation of work packages.    | Avoiding overoptimistic timelines.                                                    |
| ARCHITECT                          | Timely delivery of drawings.                                       | Constant revision till plan finalisation.                                             |
|                                    | Adherence to standards and budgets.                                | Inability to meet deadlines and communication gaps.                                   |
| STRUCTURAL ENGINEER                | Sets the base for design development.                              | Prompt revisions and effective communication.                                         |
|                                    | Efficient planning to control costs and deliver optimal solutions. |                                                                                       |
| CONSULTANTS                        | Accurate estimates and plan revisions.                             | Conflicts between different consultants.                                              |
|                                    | Expert opinion and specialised services, specific to the project.  |                                                                                       |
| CONTRACTOR                         | Timely deployment of labour.                                       | Time and resource management.                                                         |
|                                    | Follow the contract conditions.                                    | Delays in work, leading to cost over run.                                             |
|                                    | Maintain a good relationship with other stakeholders.              | Violation of instructions with regard to resource, quality and safety.                |
| CLIENT MANAGEMENT                  | State their requirements for the project and monitor the progress. | Clarity in requirements.                                                              |
|                                    | Place emphasis on time, cost and quality.                          | Flexibility in working with constraints.<br>Clearly identify who to communicate with. |
| LEGAL TEAM                         | Contract drafting and management.                                  | Comprehensive understanding of the project.                                           |
|                                    | Factor all risks and drawbacks.                                    | Factor the risks and liabilities involved.<br>Fair to all parties under contract.     |
| GOVERNMENT AGENCY                  | Document submission and approval for licensing.                    | Delay in the approval and licensing process.                                          |
|                                    |                                                                    | Delays due to poor ethics.                                                            |

| DESCRIPTION OF WORK /ACTIVITY/TASK                                                                                                                                                                                                                                                                                                                                                                                      |                                                                      |                                                                                                       |                                                                                    |                                                                                                                                                     |                                      |                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------------------------------------------------------|
| PHASE OF THE PROJECT                                                                                                                                                                                                                                                                                                                                                                                                    | WHO IS INVOLVED?                                                     |                                                                                                       | INFORMATION FLOW                                                                   |                                                                                                                                                     | HINDERANCES TO THE PROCESS           |                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                         | KEY PLAYERS                                                          | CREW                                                                                                  | WHAT MUST BE MOBILISED                                                             | DATA TO AUTHORISE THE MOBILISATION                                                                                                                  | POSSIBLE HURDLES                     | PINPOINT THE SOURCE OF DELAY                                      |
| CONSTRUCTION PHASE                                                                                                                                                                                                                                                                                                                                                                                                      | SITE SUPERVISOR                                                      | Tractor Operator                                                                                      | JCB and Excavator                                                                  | Equipment capacity                                                                                                                                  | Equipment breakdown                  | Preventive /routine maintenance not done                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                      | JCB/Excavator Operator                                                                                | Tractor - 2 numbers                                                                | Volume of excavation                                                                                                                                | Tractor capacity may be insufficient | Error in cycle time estimation                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                      |                                                                                                       |                                                                                    | Parallel activites planned                                                                                                                          | May require additional tractors      | Insuffucient utilization of equipment                             |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                      |                                                                                                       |                                                                                    | Travel time to dump site                                                                                                                            | Increases idle time of excavtor      | Alternative sites can be identified for dumping                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                         | CONTRACTOR                                                           | Male Coolie                                                                                           | Indication of dumping site location                                                | The weekly forecast of climatic conditions                                                                                                          | Rains - unsuitable work condition    | Forecasting/Potential risks not considered in planning.           |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                      | Female Coolie                                                                                         | The workforce needed                                                               | Estimating the labour requirement                                                                                                                   | Insufficient/excess labour onsite    | Overly positive work estimate                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                      | Fitter                                                                                                | Safety equipment for workers                                                       | Compilation of drawings and support documents                                                                                                       | Unforeseen accidents and injury      | Safety standards not followed, worker coonditions not prioritized |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                      |                                                                                                       |                                                                                    |                                                                                                                                                     |                                      |                                                                   |
| DESCRIPTION OF WORK /ACTIVITY/TASK- EXACVATION ON 14.12.21                                                                                                                                                                                                                                                                                                                                                              |                                                                      |                                                                                                       |                                                                                    | A3 JAPANESE SHEETS - DEFINE                                                                                                                         |                                      |                                                                   |
| WHAT IS THE HURDLE?                                                                                                                                                                                                                                                                                                                                                                                                     | WHAT WILL THIS INFLUENCE?                                            |                                                                                                       | MITIGATION STRATEGIES                                                              |                                                                                                                                                     |                                      |                                                                   |
| Work scheduling                                                                                                                                                                                                                                                                                                                                                                                                         | The scope of work-machine,labour and completion time                 |                                                                                                       | Reference similar projects use real time experience to analyse and evaluate scope. |                                                                                                                                                     |                                      |                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                      |                                                                                                       | Comprehensive surveys and testing.                                                 |                                                                                                                                                     |                                      |                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                      |                                                                                                       | Verify resource availability.                                                      |                                                                                                                                                     |                                      |                                                                   |
| Resource planning                                                                                                                                                                                                                                                                                                                                                                                                       | Labour management                                                    |                                                                                                       | WBS to assign daily activities.                                                    |                                                                                                                                                     |                                      |                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                         | Material management                                                  |                                                                                                       | Prioritise activities and determine the parallel works.                            |                                                                                                                                                     |                                      |                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                         | Machine management                                                   |                                                                                                       | Optimise equipment selection and quantification.                                   |                                                                                                                                                     |                                      |                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                         | Cost management                                                      |                                                                                                       | Decide the assignmment of resources and activities on the time schedule.           |                                                                                                                                                     |                                      |                                                                   |
| Communication gaps                                                                                                                                                                                                                                                                                                                                                                                                      | The workflow and coordination                                        |                                                                                                       | Regular meetings.                                                                  |                                                                                                                                                     |                                      |                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                         | Relationship between players                                         |                                                                                                       | Sessions to update on daily progress.                                              |                                                                                                                                                     |                                      |                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                         | Cost ,time and quality                                               |                                                                                                       | Maintain detailed records and logs.                                                |                                                                                                                                                     |                                      |                                                                   |
| IMPACT ON                                                                                                                                                                                                                                                                                                                                                                                                               | LABOUR                                                               | MATERIAL/EQUIPMENT                                                                                    | COST                                                                               | TIME                                                                                                                                                |                                      |                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                         | The current labour onsite may have to be re evaluated and mobilised. | May need to mobilise more numbers of dumpers on site to eliminate the downtime and ensure effeciency. | The hiring cost will increase due to additional equipment provision.               | Early completion of the task occurs since there are more resources available to fast track the process.The daily productivity of work is enhanced.. |                                      |                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                      |                                                                                                       |                                                                                    | A3 JAPANESE SHEETS - IDEATE                                                                                                                         |                                      |                                                                   |
| <ul style="list-style-type: none"><li>• “DEFINE” is oriented to the current site activity carried out.</li><li>• It highlights the stage of construction, the men ,material and machinery involved.</li><li>• It separates the pull items, the challenges in achieving each activity and finally compiles a list of project associated risks to be taken into consideration.</li></ul>                                  |                                                                      |                                                                                                       |                                                                                    |                                                                                                                                                     |                                      |                                                                   |
| A3 JAPANESE SHEETS - IDEATE                                                                                                                                                                                                                                                                                                                                                                                             |                                                                      |                                                                                                       |                                                                                    |                                                                                                                                                     |                                      |                                                                   |
| <ul style="list-style-type: none"><li>• Similar to the process of mind mapping ,”IDEATE” puts forth all the possible methods to mitigate the risks involved.</li><li>• The challenges are clubbed into broad categories and their impacts /influences are mapped to identify the corrective plans.</li><li>• The final analysis includes the changes with regard to labour,equipment,materials,cost and time.</li></ul> |                                                                      |                                                                                                       |                                                                                    |                                                                                                                                                     |                                      |                                                                   |

A3 JAPANESE SHEET - SOLVER

| BACKGROUND                                               |  |                                                               |  |          |  | ANALYSIS                                                                                                                                                                                                            |     |             |         |          |          |                                           |  |
|----------------------------------------------------------|--|---------------------------------------------------------------|--|----------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------|---------|----------|----------|-------------------------------------------|--|
| WORK:                                                    |  | Excavation                                                    |  |          |  | WHAT TO SEE                                                                                                                                                                                                         | MAN |             | MACHINE |          | MATERIAL |                                           |  |
| WHERE ON SITE?                                           |  | The footings to be excavated are located in Workfront 1 and 2 |  |          |  | ROUTINE                                                                                                                                                                                                             |     |             |         |          |          |                                           |  |
| COST                                                     |  |                                                               |  |          |  |                                                                                                                                                                                                                     |     |             |         |          |          |                                           |  |
| DONE BY:                                                 |  | AUTHORISED BY:                                                |  |          |  | <div>WHAT IF?</div> <div>Records changes in resource allocation ,costing etc in an unexpected scenario.<br/><br/>(or)<br/>Records the plan changes if the initial work plan is not feasible during execution.</div> |     |             |         |          |          |                                           |  |
| MACHINE: excavator,JCB,tractor(2)                        |  | Site supervisor                                               |  |          |  |                                                                                                                                                                                                                     |     |             |         |          |          |                                           |  |
| LABOUR:                                                  |  |                                                               |  |          |  |                                                                                                                                                                                                                     |     |             |         |          |          | Operators for JCB ,excavator and tractor. |  |
|                                                          |  |                                                               |  |          |  |                                                                                                                                                                                                                     |     |             |         |          |          | Male coolie                               |  |
|                                                          |  |                                                               |  |          |  |                                                                                                                                                                                                                     |     |             |         |          |          | Female coolie                             |  |
| WHAT WILL BE DONE?                                       |  | WHEN TO START?                                                |  |          |  |                                                                                                                                                                                                                     |     |             |         |          |          |                                           |  |
| Excavation of 5 numbers of footing in work front 1 and 2 |  | 14.12.21                                                      |  |          |  |                                                                                                                                                                                                                     |     |             |         |          |          |                                           |  |
| WHAT HAS TO BE DONE?                                     |  | IS IT DONE AS SPECIFIED ?                                     |  |          |  |                                                                                                                                                                                                                     |     |             |         |          |          |                                           |  |
| Site leveling and marking has to be completed.           |  | YES                                                           |  |          |  |                                                                                                                                                                                                                     |     |             |         |          |          |                                           |  |
| The equipment has to be leased out.                      |  |                                                               |  |          |  |                                                                                                                                                                                                                     |     |             |         |          |          |                                           |  |
| Sufficient labour has to be available.                   |  |                                                               |  |          |  |                                                                                                                                                                                                                     |     |             |         |          |          |                                           |  |
|                                                          |  |                                                               |  |          |  |                                                                                                                                                                                                                     |     |             |         |          |          |                                           |  |
| REVIEW                                                   |  |                                                               |  |          |  | ACTION PLAN                                                                                                                                                                                                         |     |             |         |          |          |                                           |  |
| PERFORMANCE TRACKING                                     |  |                                                               |  |          |  | PLAN                                                                                                                                                                                                                |     | GAME PLAN   |         |          |          |                                           |  |
|                                                          |  |                                                               |  |          |  |                                                                                                                                                                                                                     |     | END GOAL    |         |          |          |                                           |  |
| PROGRESS AND KEY DECISIONS                               |  |                                                               |  |          |  | DO                                                                                                                                                                                                                  |     | WHAT TO DO? |         |          |          |                                           |  |
| IS THE ACTUAL PROGRESS IN LINE WITH THE ANALYSIS         |  |                                                               |  |          |  |                                                                                                                                                                                                                     |     | HOW TO DO?  |         |          |          |                                           |  |
|                                                          |  |                                                               |  | CHECK    |  | WHAT NEXT?                                                                                                                                                                                                          |     |             |         |          |          |                                           |  |
| DATE (WHEN)                                              |  | IN WHAT                                                       |  |          |  | ACT                                                                                                                                                                                                                 |     | WHO TO ACT? |         |          |          |                                           |  |
|                                                          |  | MAN                                                           |  | MATERIAL |  |                                                                                                                                                                                                                     |     | MACHINE     |         | OTHERS   |          |                                           |  |
| REQUEST FOR CHANGE                                       |  |                                                               |  |          |  |                                                                                                                                                                                                                     |     | BY WHEN     |         | DEADLINE |          |                                           |  |
|                                                          |  |                                                               |  |          |  |                                                                                                                                                                                                                     |     | MILESTONE   |         |          |          |                                           |  |

## **EXCAVATION DATA SHEET AND FORMULAS**

### **FACTORS TO BE CONSIDERED IN THE EARTHWORK CALCULATION:**

While calculating the volume of earth work excavation there are several factors to be considered. These include the bucket volume of the equipment, bucket fill rate, cycle time, swing angle, type of soil, excavation methodology, environment and weather conditions.

- The soil factor is otherwise known as the digging factor. It is the measure of resistance of the soil or the ease with which the soil can be penetrated.
- The load factor can be used to estimate the weight of the material per cubic meter from the bank to loosened state.
- It is related to the shrink and swell factors. It draws reference from the principle that soil occupies less areas/volume in a compacted state than in a loose condition.

### **For calculation of the soil factor, the three categories of classification are :**

- For loamy,sandy,gravel the factor is 1.
- For common earth the factor is 0.85.
- For silt clay and soft rock, the factor in 0.67.

The swinging factors considers two aspects – the angle of swing and the depth of excavation. Both these influence the cycle time.

### **AIM OF THE ESTIMATION:**

- The aim of calculating the cycle time is to analyze the number of equipment and machinery requires for efficient working without any idle time. It helps in resource optimization.
- This calculation helps assign the required number of dump trucks/tractors for each excavator .
- This in turn impacts the cost estimation,labour requirements and the time of completion.

| ESTIMATED<br>CYCLE TIME |      | ESTIMATED BUCKET LOAD |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | ESTIMATED<br>CYCLE TIME |                |                 |
|-------------------------|------|-----------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------------------------|----------------|-----------------|
| CYCLE TIME              |      | 0.2                   | 0.3 | 0.5 | 0.7 | 0.9 | 1.1 | 1.3 | 1.5 | 1.7 | 1.9 | 2.1 | 2.3 | 2.5 | 2.7 | 2.9 | 3.1 | 3.3 | 3.5 | 4                       | CYCLES<br>/MIN | CYCLES<br>/HOUR |
| SECONDS                 | MINS |                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |                         |                |                 |
| 10                      | 0.17 |                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |                         | 6              | 360             |
| 11                      | 0.18 |                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |                         | 5.5            | 330             |
| 12                      | 0.2  | 60                    | 90  | 150 | 210 | 270 |     |     |     |     |     |     |     |     |     |     |     |     |     |                         | 5              | 300             |
| 13.3                    | 0.22 | 54                    | 81  | 135 | 189 | 243 | 297 | 351 | 405 | 459 | 513 | 567 | 621 | 675 | 729 | 783 | 837 | 891 | 945 | 1080                    | 4.5            | 270             |
| 15                      | 0.25 | 48                    | 72  | 120 | 168 | 216 | 264 | 312 | 360 | 408 | 456 | 504 | 552 | 600 | 648 | 696 | 744 | 792 | 840 | 960                     | 4              | 240             |
| 17.1                    | 0.29 | 42                    | 63  | 105 | 147 | 189 | 231 | 273 | 315 | 357 | 399 | 441 | 483 | 525 | 567 | 609 | 651 | 693 | 735 | 840                     | 3.5            | 210             |
| 20                      | 0.33 | 36                    | 54  | 90  | 126 | 162 | 198 | 234 | 270 | 306 | 342 | 378 | 414 | 450 | 486 | 522 | 558 | 544 | 630 | 720                     | 3              | 180             |
| 24                      | 0.4  | 30                    | 45  | 75  | 105 | 135 | 165 | 195 | 225 | 255 | 285 | 315 | 345 | 375 | 405 | 435 | 465 | 495 | 525 | 600                     | 2.5            | 150             |
| 30                      | 0.5  | 24                    | 36  | 60  | 84  | 108 | 132 | 156 | 180 | 204 | 228 | 252 | 276 | 300 | 324 | 348 | 372 | 396 | 420 | 480                     | 2              | 120             |
| 35                      | 0.58 | 20                    | 31  | 51  | 71  | 92  | 112 | 133 | 153 | 173 | 194 | 214 | 235 | 255 | 275 | 296 | 316 | 337 | 357 | 408                     | 1.7            | 102             |
| 40                      | 0.67 |                       |     |     |     | 81  | 99  | 177 | 135 | 153 | 171 | 189 | 207 | 225 | 243 | 261 | 279 | 297 | 315 | 360                     | 1.5            | 90              |
| 45                      | 0.75 |                       |     |     |     |     |     |     |     | 133 | 148 | 164 | 179 | 195 | 211 | 226 | 242 | 257 | 273 | 312                     | 1.3            | 78              |
| 50                      | 0.83 |                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |                         | 1.2            | 72              |

The bucket load-cycle time estimation data sheet is targeted towards the Caterpillar made of excavators.

**TABLE 1: FORMULAS USED IN CALCULATION**

| S.NO | FORMULA                                                       | VALUE      |
|------|---------------------------------------------------------------|------------|
| 1.   | PLANNED OUTPUT =IDEAL OUTPUT X TOTAL FACTOR                   | 126.48 CUM |
| 2.   | IDEAL OUTPUT (31 CUM @6 hours for a cycle time of 35 sec)     | 186 CUM    |
| 3.   | PERFORMANCE FACTOR                                            | 1          |
| 4.   | CORRECTION FACTOR= SOIL FACTORX LOAD FACTOR X SWINGING FACTOR | 0.68       |
| 5.   | SOIL FACTOR                                                   | 0.85       |
| 6.   | LOAD FACTOR                                                   | 0.8        |
| 7.   | SWINGING FACTOR                                               | 1          |

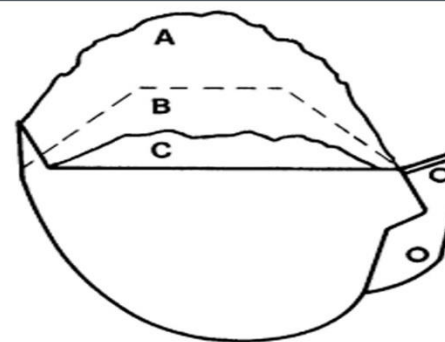


Image 1:  
Excavator loading the dump truck

Image 2:  
Excavator idle time till the arrival of next dump truck

**TABLE 2: SWING FACTOR**

| SWING FACTOR TABULATION FOR EXCAVATORS |                                |       |
|----------------------------------------|--------------------------------|-------|
| S.NO                                   | ANGLE OF SWING                 | VALUE |
| 1.                                     | AT ANGLE OF SWING: 45 DEGREES  | 1.20  |
| 2.                                     | AT ANGLE OF SWING: 60 DEGREES  | 1.16  |
| 3.                                     | AT ANGLE OF SWING: 75 DEGREES  | 1.07  |
| 4.                                     | AT ANGLE OF SWING: 90 DEGREES  | 1.00  |
| 5.                                     | AT ANGLE OF SWING: 120 DEGREES | 0.88  |
| 6.                                     | AT ANGLE OF SWING: 150 DEGREES | 0.79  |



| Material                 | Fill Factor Range<br>(Percent of heaped bucket capacity) |
|--------------------------|----------------------------------------------------------|
| Moist Loam or Sandy Clay | A — 100-110%                                             |
| Sand and Gravel          | B — 95-110%                                              |
| Hard, Tough Clay         | C — 80-90%                                               |
| Rock — Well Blasted      | 60-75%                                                   |
| Rock — Poorly Blasted    | 40-50%                                                   |

| FOOTING CATEGORY | GRID NUMBERS                                                   | PEDESTAL SIZE |       | FOOTING |       | FOOTING TYPE | TOTAL |
|------------------|----------------------------------------------------------------|---------------|-------|---------|-------|--------------|-------|
|                  |                                                                | L (m)         | B (m) | L (m)   | B (m) |              |       |
| F1               | A2,A11                                                         | 0.6           | 0.4   | 1.2     | 1     | PAD          | 2     |
| F2               | B2,B11,R2,R11                                                  | 0.735         | 0.63  | 1.4     | 1.3   | PAD          | 4     |
| F3               | C2,C11,D2,D11,E2,E11,G2,G11,H2,H11,J2,J11,L2,L11,M2,M11,P2,P11 | 0.655         | 0.3   | 1.4     | 1     | PAD          | 18    |
| F4               | F2,F11,K2,K11                                                  | 0.85          | 0.63  | 1.6     | 1.4   | PAD          | 4     |
| F5               | A3,A4,A5,A7,A8,A9,A10                                          | 0.4           | 0.3   | 1.15    | 1.05  | PAD          | 7     |
| F6               | B3,B4,B5,B7,B8,B9,B10,R3,R4,R5,R7,R8,R9,R10                    | 0.735         | 0.4   | 1.75    | 1.4   | PAD          | 14    |
| F7               | F4,F7,F9,K4,K7,K9                                              | 0.85          | 0.4   | 2.65    | 2.2   | PAD          | 6     |
| F8               | N4,N5,N6,Q4,Q7,Q6,R6                                           | 0.4/0.675     | 0.4   | 1.4     | 1.4   | PAD          | 7     |
| F9               | C1,D1,E1,F1                                                    | 0.45          | 0.45  | 2.3     | 2.3   | PAD          | 4     |
|                  |                                                                |               |       |         |       |              | 66    |

| EXCAVATION       |                     |                |               |                         |                        |       |
|------------------|---------------------|----------------|---------------|-------------------------|------------------------|-------|
| FOOTING CATEGORY | FOOTING VOLUME (m3) | PCC OFFSET (m) | PCC DEPTH (m) | SOIL FILLING OFFSET (m) | SOILFILL ING DEPTH (m) | SLOPE |
| F1               | 0.42                | 0.15           | 0.2           | 0.15                    | 0.15                   |       |
| F2               | 0.637               | 0.15           | 0.2           | 0.15                    | 0.15                   |       |
| F3               | 0.49                | 0.15           | 0.2           | 0.15                    | 0.15                   |       |
| F4               | 0.784               | 0.15           | 0.2           | 0.15                    | 0.15                   |       |
| F5               | 0.422625            | 0.15           | 0.2           | 0.15                    | 0.15                   |       |
| F6               | 0.91875             | 0.15           | 0.2           | 0.15                    | 0.15                   |       |
| F7               | 11.077              | 0.15           | 0.2           | 0.15                    | 0.15                   |       |
| F8               | 0.735               | 0.15           | 0.2           | 0.15                    | 0.15                   |       |
| F9               | 10.051              | 0.15           | 0.2           | 0.15                    | 0.15                   |       |

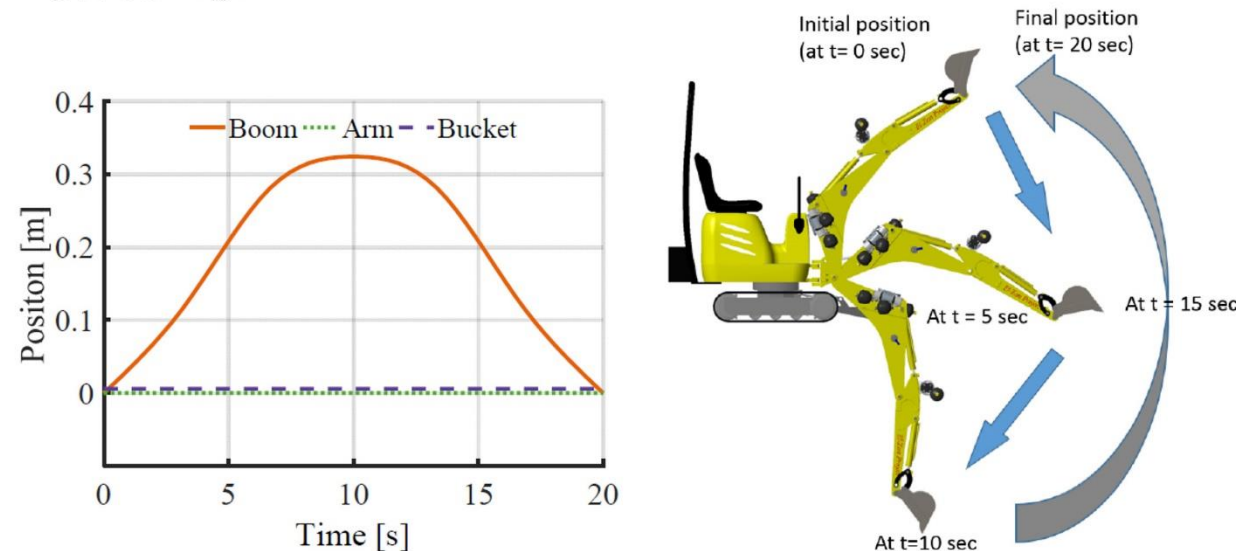
| EFFECIENCY CALCULATION- FILLING 1 DUMP TRUCK |     |             | NO. OF FILLS       | % EFFECIENCY |
|----------------------------------------------|-----|-------------|--------------------|--------------|
| Loading capacity of dumper                   | 5   | CUM         | 14                 | 100          |
| Minimum number of fills                      | 3   | Nos         | 3                  | 21.42857143  |
| Maximum number of fils                       | 8   | Nos         | 8                  | 57.14285714  |
| Average number of fills                      | 5.5 | Nos         | 6                  | 42.85714286  |
| FOOTING CATEGORY                             |     | PER FOOTING | NUMBER OF FOOTINGS | TOTAL VOLUME |
|                                              |     | CUM         |                    | CUM          |
| F1                                           |     | 15.2        | 2                  | 30.4         |
| F2                                           |     | 18.44       | 4                  | 73.76        |
| F3                                           |     | 16.4        | 18                 | 295.2        |
| F4                                           |     | 20.48       | 4                  | 81.92        |
| F5                                           |     | 15.215      | 7                  | 106.505      |
| F6                                           |     | 21.5        | 14                 | 301          |
| F7                                           |     | 35.06       | 6                  | 210.36       |
| F8                                           |     | 19.2        | 7                  | 134.4        |
| F9                                           |     | 32.98       | 4                  | 131.92       |

| DIRECTION              | GRIDS                         | FOOTING                | CATEGORY                  | NUMBER OF FOOTINGS |        | TOTAL | EXCAVATION VOLUME | TOTAL VOLUME TO BE EXCAVATED |       |        |
|------------------------|-------------------------------|------------------------|---------------------------|--------------------|--------|-------|-------------------|------------------------------|-------|--------|
|                        |                               |                        |                           | CATEGORY           | NUMBER |       | CUM               | CUM                          |       |        |
| SOUTH EAST: QUADRANT 1 | 11,10,9,8,7,6,A,B,C,D,E,F,G,H | A11                    | F1                        | F1                 | 1      | 18    | 15.2              | 353.1                        |       |        |
|                        |                               | B11                    | F2                        | F2                 | 1      |       | 18.44             |                              |       |        |
|                        |                               | C11                    | F3                        | F3                 | 5      |       | 82                |                              |       |        |
|                        |                               | D11                    | F3                        | F4                 | 1      |       | 20.48             |                              |       |        |
|                        |                               | E11                    | F3                        | F5                 | 4      |       | 60.86             |                              |       |        |
|                        |                               | F11                    | F4                        | F6                 | 4      |       | 86                |                              |       |        |
|                        |                               | G11                    | F3                        | F7                 | 2      |       | 70.12             |                              |       |        |
|                        |                               | H11                    | F3                        | F8                 | 0      |       | 0                 |                              |       |        |
|                        |                               | A10                    | F5                        | F9                 | 0      |       | 0                 |                              |       |        |
|                        |                               | B10                    | F6                        |                    |        |       |                   |                              |       |        |
|                        |                               | A9                     | F5                        |                    |        |       |                   |                              |       |        |
|                        |                               | B9                     | F6                        |                    |        |       |                   |                              |       |        |
|                        |                               | F9                     | F7                        |                    |        |       |                   |                              |       |        |
|                        |                               | A8                     | F5                        |                    |        |       |                   |                              |       |        |
|                        |                               | B8                     | F6                        |                    |        |       |                   |                              |       |        |
|                        |                               | A7                     | F5                        |                    |        |       |                   |                              |       |        |
|                        |                               | B7                     | F6                        |                    |        |       |                   |                              |       |        |
|                        |                               | F7                     | F7                        |                    |        |       |                   |                              |       |        |
| NORTH EAST: QUADRANT 2 | 5,4,3,2,1,A,B,C,D,E,F,G,H     | A5                     | F5                        | F1                 | 1      | 19    | 15.2              | 413.245                      |       |        |
|                        |                               | B5                     | F6                        | F2                 | 1      |       | 18.44             |                              |       |        |
|                        |                               | A4                     | F5                        | F3                 | 5      |       | 82                |                              |       |        |
|                        |                               | B4                     | F6                        | F4                 | 1      |       | 20.48             |                              |       |        |
|                        |                               | F4                     | F7                        | F5                 | 3      |       | 45.645            |                              |       |        |
|                        |                               | A3                     | F5                        | F6                 | 3      |       | 64.5              |                              |       |        |
|                        |                               | B3                     | F6                        | F7                 | 1      |       | 35.06             |                              |       |        |
|                        |                               | A2                     | F1                        | F8                 | 0      |       | 0                 |                              |       |        |
|                        |                               | B2                     | F2                        | F9                 | 4      |       | 131.92            |                              |       |        |
|                        |                               | C2                     | F3                        |                    |        |       |                   |                              |       |        |
|                        |                               | D2                     | F3                        |                    |        |       |                   |                              |       |        |
|                        |                               | E2                     | F3                        |                    |        |       |                   |                              |       |        |
|                        |                               | F2                     | F4                        |                    |        |       |                   |                              |       |        |
|                        |                               | G2                     | F3                        |                    |        |       |                   |                              |       |        |
|                        |                               | H2                     | F3                        |                    |        |       |                   |                              |       |        |
|                        |                               | C1                     | F9                        |                    |        |       |                   |                              |       |        |
|                        |                               | D1                     | F9                        |                    |        |       |                   |                              |       |        |
|                        |                               | E1                     | F9                        |                    |        |       |                   |                              |       |        |
| F1                     | F9                            |                        |                           |                    |        |       |                   |                              |       |        |
| SOUTH WEST: QUADRANT 3 | 11,10,9,8,7,6,J,K,L,M,N,P,Q,R | J11                    | F3                        | F1                 | 0      | 15    | 0                 | 318.24                       |       |        |
|                        |                               | K11                    | F4                        | F2                 | 1      |       | 18.44             |                              |       |        |
|                        |                               | L11                    | F3                        | F3                 | 4      |       | 65.6              |                              |       |        |
|                        |                               | M11                    | F3                        | F4                 | 1      |       | 20.48             |                              |       |        |
|                        |                               | P11                    | F3                        | F5                 | 0      |       | 0                 |                              |       |        |
|                        |                               | R11                    | F2                        | F6                 | 4      |       | 86                |                              |       |        |
|                        |                               | R10                    | F6                        | F7                 | 2      |       | 70.12             |                              |       |        |
|                        |                               | R9                     | F6                        | F8                 | 3      |       | 57.6              |                              |       |        |
|                        |                               | K9                     | F7                        | F9                 | 0      |       | 0                 |                              |       |        |
|                        |                               | R8                     | F6                        |                    |        |       |                   |                              |       |        |
|                        |                               | K7                     | F7                        |                    |        |       |                   |                              |       |        |
|                        |                               | R7                     | F6                        |                    |        |       |                   |                              |       |        |
|                        |                               | R6                     | F8                        |                    |        |       |                   |                              |       |        |
|                        |                               | Q6                     | F8                        |                    |        |       |                   |                              |       |        |
|                        |                               | N6                     | F8                        |                    |        |       |                   |                              |       |        |
|                        |                               | MORTH WEST: QUADRANT 4 | 5,4,3,2,1,J,K,L,M,N,P,Q,R | R5                 | F6     | F1    | 0                 | 14                           | 0     | 280.88 |
|                        |                               |                        |                           | Q5                 | F8     | F2    | 1                 |                              | 18.44 |        |
|                        |                               |                        |                           | N5                 | F8     | F3    | 4                 |                              | 65.6  |        |
| R4                     | F6                            |                        |                           | F4                 | 1      | 20.48 |                   |                              |       |        |
| Q4                     | F8                            |                        |                           | F5                 | 0      | 0     |                   |                              |       |        |
| N4                     | F8                            |                        |                           | F6                 | 3      | 64.5  |                   |                              |       |        |
| K4                     | F7                            |                        |                           | F7                 | 1      | 35.06 |                   |                              |       |        |
| R3                     | F6                            |                        |                           | F8                 | 4      | 76.8  |                   |                              |       |        |
| R2                     | F2                            |                        |                           | F9                 | 0      | 0     |                   |                              |       |        |
| P2                     | F3                            |                        |                           |                    |        |       |                   |                              |       |        |
| M2                     | F3                            |                        |                           |                    |        |       |                   |                              |       |        |
| L2                     | F3                            |                        |                           |                    |        |       |                   |                              |       |        |
| K2                     | F4                            |                        |                           |                    |        |       |                   |                              |       |        |
| J2                     | F3                            |                        |                           |                    |        |       |                   |                              |       |        |
| TOTAL                  |                               |                        |                           |                    | 66     |       | 1365.465          |                              |       |        |

| SITE LOCATION | NUMBER OF FOOTINGS |        |       | TOTAL EXCAVATION TIME | TIME FOR QUADRANT 1 | TOTAL TIME | DAYS NEEDED | EXVACATIONS PER DAY | RATE OF DOING WORK                                               |
|---------------|--------------------|--------|-------|-----------------------|---------------------|------------|-------------|---------------------|------------------------------------------------------------------|
|               | CATEGORY           | NUMBER | TOTAL | HOURS                 | HOURS               | DAYS       |             | NOS                 |                                                                  |
| QUADRANT 1    | F1                 | 1      | 18    | 1.125925926           | 26.15555556         | 3.2694444  | 4           | 4.5                 | THE RATE OF EXCAVATION IS CALCULATED AS APPROXIMATELY 5 PER DAY. |
|               | F2                 | 1      |       | 1.365925926           |                     |            |             |                     |                                                                  |
|               | F3                 | 5      |       | 6.074074074           |                     |            |             |                     |                                                                  |
|               | F4                 | 1      |       | 1.517037037           |                     |            |             |                     |                                                                  |
|               | F5                 | 4      |       | 4.508148148           |                     |            |             |                     |                                                                  |
|               | F6                 | 4      |       | 6.37037037            |                     |            |             |                     |                                                                  |
|               | F7                 | 2      |       | 5.194074074           |                     |            |             |                     |                                                                  |
|               | F8                 | 0      |       | 0                     |                     |            |             |                     |                                                                  |
|               | F9                 | 0      |       | 0                     |                     |            |             |                     |                                                                  |
| QUADRANT 2    | F1                 | 1      | 19    | 1.125925926           | 30.61074074         | 3.8263426  | 4           | 4.75                |                                                                  |
|               | F2                 | 1      |       | 1.365925926           |                     |            |             |                     |                                                                  |
|               | F3                 | 5      |       | 6.074074074           |                     |            |             |                     |                                                                  |
|               | F4                 | 1      |       | 1.517037037           |                     |            |             |                     |                                                                  |
|               | F5                 | 3      |       | 3.381111111           |                     |            |             |                     |                                                                  |
|               | F6                 | 3      |       | 4.777777778           |                     |            |             |                     |                                                                  |
|               | F7                 | 1      |       | 2.597037037           |                     |            |             |                     |                                                                  |
|               | F8                 | 0      |       | 0                     |                     |            |             |                     |                                                                  |
|               | F9                 | 4      |       | 9.771851852           |                     |            |             |                     |                                                                  |
| QUADRANT 3    | F1                 | 0      | 15    | 0                     | 23.57333333         | 2.9466667  | 3           | 5                   |                                                                  |
|               | F2                 | 1      |       | 1.365925926           |                     |            |             |                     |                                                                  |
|               | F3                 | 4      |       | 4.859259259           |                     |            |             |                     |                                                                  |
|               | F4                 | 1      |       | 1.517037037           |                     |            |             |                     |                                                                  |
|               | F5                 | 0      |       | 0                     |                     |            |             |                     |                                                                  |
|               | F6                 | 4      |       | 6.37037037            |                     |            |             |                     |                                                                  |
|               | F7                 | 2      |       | 5.194074074           |                     |            |             |                     |                                                                  |
|               | F8                 | 3      |       | 4.266666667           |                     |            |             |                     |                                                                  |
|               | F9                 | 0      |       | 0                     |                     |            |             |                     |                                                                  |
| QUADRANT 4    | F1                 | 0      | 14    | 0                     | 20.80592593         | 2.6007407  | 3           | 4.666666667         |                                                                  |
|               | F2                 | 1      |       | 1.365925926           |                     |            |             |                     |                                                                  |
|               | F3                 | 4      |       | 4.859259259           |                     |            |             |                     |                                                                  |
|               | F4                 | 1      |       | 1.517037037           |                     |            |             |                     |                                                                  |
|               | F5                 | 0      |       | 0                     |                     |            |             |                     |                                                                  |
|               | F6                 | 3      |       | 4.777777778           |                     |            |             |                     |                                                                  |
|               | F7                 | 1      |       | 2.597037037           |                     |            |             |                     |                                                                  |
|               | F8                 | 4      |       | 5.688888889           |                     |            |             |                     |                                                                  |
|               | F9                 | 0      |       | 0                     |                     |            |             |                     |                                                                  |

## EXCAVATION CALCULATION AND TEMPLATE

- The template for excavation was created as a tool that could be used for the successive projects.
- The input values are variable and each of the cells are linked to data sheets and formulas to give accurate output for changing values.
- The time for one bucket excavation, also known as the cycle time -includes the time for digging,scooping,swinging to the dumper and the time for loading.
- An important aspect to be considered here includes the time taken for the excavator arm to swing back after unloading and position itself over the pit location.
- This value can differ depending on the type of soil, the depth and width of excavation.
- The deeper the excavation the more will be the time lag for positioning.



The travel time is calculated taking the two-way travel distance (i.e.) from the excavator to the dump site and back to the excavator after unloading.

The lesser the travel distance the higher the productivity .

| EXCAVATOR       |                                           | VALUES | UNITS   |
|-----------------|-------------------------------------------|--------|---------|
| 1               | No. of Excavator                          | 1      | Nos     |
| 2               | Bucket capacity                           | 0.35   | Cum     |
| 3               | Time Taken For one Bucket Excavation      |        |         |
| a               | Digging Time                              | 7      | Sec     |
| b               | Scrubbing/ Scooping Time                  | 10     | Sec     |
| c               | Swinging time                             | 12     | Sec     |
| d               | Loading                                   | 5      | Sec     |
| e               | Moving and Position                       | 5      | Sec     |
| 4               | Total Time                                | 0.70   | Min     |
| 5               | Working hours for Excavator               | 8      | hrs     |
| 6               | Effective work of Excavator               | 75%    |         |
| 7               | Effective work of Excavator in "min"      | 360    | min     |
| 8               | Production Per day                        | 180    | Cum/day |
| DUMPER ANALYSIS |                                           | VALUES | UNITS   |
| 9               | Capacity of Dumper                        | 5.00   | Cum     |
| 10              | Dumper Avg. Speed (Km/h)                  | 30     | Km/h    |
| 11              | Leading distance(Two way travel)          | 1.00   | Km      |
| f               | ( REFER CHART ) Loading Time              | 10     | min     |
| g               | Unloading Time                            | 2      | min     |
| h               | Travel Time                               | 2      | min     |
| j               | Position Time                             | 2      | min     |
| 12              | Total Time/Dumper                         | 16     | Min     |
| 13              | Working hours for Dumper                  | 8      | hrs     |
| 14              | Effective work of Dumper                  | 75%    |         |
| 15              | Effective work of Dumper in "min"         | 360    | min     |
| A               | No of trips required/Dumper               | 23     | Nos     |
| B               | Productivity Per day per Dumper           | 115    | Cum/day |
| C               | Total dumper required/day (Theoretically) | 2      | Nos     |
| D               | Total dumper required/day (Practically)   | 2      | Nos     |

| ID |  | Task Mode                                                                            | Task Name                                                   | Duration        | Start               | Finish              |
|----|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------|---------------------|---------------------|
| 1  |                                                                                   |    | <b>GT. ELECTRICALS - PRODUCTION HOUSE</b>                   | <b>140 days</b> | <b>Mon 01-11-21</b> | <b>Thu 21-04-22</b> |
| 2  |                                                                                   |    | <b>JOB SITE PREPARATION</b>                                 | <b>5 days</b>   | <b>Mon 01-11-21</b> | <b>Fri 05-11-21</b> |
| 3  |                                                                                   |    | PRELIMINARY INSPECTION - SITE DETAILS ACCORDING TO DRAWINGS | 1 day           | Mon 01-11-21        | Mon 01-11-21        |
| 4  |                                                                                   |    | CHECK FOR SITE ACCESS                                       | 1 day           | Mon 01-11-21        | Mon 01-11-21        |
| 5  |                                                                                   |    | MAPPING OF SITE OBSTRUCTIONS                                | 1 day           | Mon 01-11-21        | Mon 01-11-21        |
| 6  |                                                                                   |    | VERFYING EXISTING UTILITIES                                 | 1 day           | Mon 01-11-21        | Mon 01-11-21        |
| 7  |                                                                                   |    | CHECKING STORAGE AND BARBENDING YARD                        | 1 day           | Mon 01-11-21        | Mon 01-11-21        |
| 8  |                                                                                   |    | LEVELLING AND COMPACTION                                    | 5 days          | Mon 01-11-21        | Fri 05-11-21        |
| 9  |                                                                                   |    | CHECKING BASIC FACILITIES - SHED , WASHROOMS , OFFICE ROOMS | 1 day           | Mon 01-11-21        | Mon 01-11-21        |
| 10 |                                                                                   |    | <b>MATERIAL LAYOUT</b>                                      | <b>20 days</b>  | <b>Mon 01-11-21</b> | <b>Tue 23-11-21</b> |
| 11 |                                                                                   |    | SITE MARKING                                                | 1 day           | Sat 06-11-21        | Sat 06-11-21        |
| 12 |                                                                                   |    | MOBILIZATION                                                | 10 days         | Mon 01-11-21        | Thu 11-11-21        |
| 13 |                                                                                   |  | EXCAVATION                                                  | 10 days         | Fri 12-11-21        | Tue 23-11-21        |
| 14 |                                                                                   |  | <b>FOUNDATION</b>                                           | <b>71 days</b>  | <b>Mon 01-11-21</b> | <b>Thu 27-01-22</b> |
| 15 |                                                                                   |  | SITE PLAN INSPECTION                                        | 1 day           | Mon 01-11-21        | Mon 01-11-21        |
| 16 |                                                                                   |  | <b>BAY 1 AND BAY 2</b>                                      | <b>41 days</b>  | <b>Fri 12-11-21</b> | <b>Thu 30-12-21</b> |
| 17 |                                                                                   |  | PCC                                                         | 3 days          | Wed 24-11-21        | Fri 26-11-21        |
| 18 |                                                                                   |  | REINFORCEMENT TIEING                                        | 5 days          | Fri 12-11-21        | Wed 17-11-21        |
| 19 |                                                                                   |  | SHUTTERING AND CONCRETING                                   | 2 days          | Sat 27-11-21        | Mon 29-11-21        |
| 20 |                                                                                   |  | CURING                                                      | 14 days         | Tue 30-11-21        | Wed 15-12-21        |
| 21 |                                                                                   |  | DESHUTTERING                                                | 1 day           | Sat 18-12-21        | Sat 18-12-21        |
| 22 |                                                                                   |  | BACKFILLING AND CONSOLIDATION                               | 2 days          | Mon 20-12-21        | Tue 21-12-21        |
| 23 |                                                                                   |  | RCC PEDESTAL                                                | 5 days          | Wed 22-12-21        | Tue 28-12-21        |
| 24 |                                                                                   |  | UNLOADING AND CHECKING OF ANCHOR BOLT                       | 1 day           | Wed 29-12-21        | Wed 29-12-21        |
| 25 |                                                                                   |  | PEDESTAL REINFORCEMENT TEING                                | 1 day           | Sat 18-12-21        | Sat 18-12-21        |
| 26 |                                                                                   |  | SHUTTERING -1ST LIFT                                        | 1 day           | Thu 18-11-21        | Thu 18-11-21        |
| 27 |                                                                                   |  | CONCRETING                                                  | 1 day           | Mon 20-12-21        | Mon 20-12-21        |
| 28 |                                                                                   |  | BACKFILLING AND CONSOLIDATION                               | 4 days          | Tue 21-12-21        | Fri 24-12-21        |
| 29 |                                                                                   |  | PEDESTAL SHUTTERING - 2ND LIFT                              | 1 day           | Mon 27-12-21        | Mon 27-12-21        |
| 30 |                                                                                   |  | CONCRETING                                                  | 2 days          | Tue 28-12-21        | Wed 29-12-21        |
| 31 |                                                                                   |  | <b>BASE PLATE ERECTION</b>                                  | <b>10 days</b>  | <b>Sat 18-12-21</b> | <b>Thu 30-12-21</b> |
| 32 |                                                                                   |  | MARKING AND CUTTING                                         | 2 days          | Wed 29-12-21        | Thu 30-12-21        |
| 33 |                                                                                   |  | TEMPLATE CHECKING                                           | 1 day           | Sat 18-12-21        | Sat 18-12-21        |
| 34 |                                                                                   |  | RECTIFICATION                                               | 1 day           | Sat 18-12-21        | Sat 18-12-21        |
| 35 |                                                                                   |  | WELDING TO THE REINFORCEMENTS                               | 2 days          | Mon 20-12-21        | Tue 21-12-21        |
| 36 |                                                                                   |  | <b>ANCHOR BOLT</b>                                          | <b>1 day</b>    | <b>Wed 22-12-21</b> | <b>Wed 22-12-21</b> |
| 37 |                                                                                   |  | CHECK USING THE TEMPLATE                                    | 1 day           | Wed 22-12-21        | Wed 22-12-21        |
| 38 |                                                                                   |  | ANCHOR BOLT SETTING                                         | 1 day           | Wed 22-12-21        | Wed 22-12-21        |

| ID  |  | Task Mode                                                                            | Task Name                                         | Duration       | Start               | Finish              |
|-----|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------|----------------|---------------------|---------------------|
| 39  |                                                                                   |    | DIAGONAL CHECKING                                 | 1 day          | Wed 22-12-21        | Wed 22-12-21        |
| 40  |                                                                                   |    | <b>GRADE BEAM</b>                                 | <b>14 days</b> | <b>Thu 23-12-21</b> | <b>Tue 11-01-22</b> |
| 41  |                                                                                   |    | GRADE BEAM EXCAVATION                             | 5 days         | Thu 23-12-21        | Wed 29-12-21        |
| 42  |                                                                                   |    | GSB LAYING                                        | 5 days         | Thu 23-12-21        | Wed 29-12-21        |
| 43  |                                                                                   |    | PCC LAYING                                        | 5 days         | Thu 23-12-21        | Wed 29-12-21        |
| 44  |                                                                                   |    | BEAM REINFORCEMENT TYING                          | 10 days        | Thu 23-12-21        | Thu 06-01-22        |
| 45  |                                                                                   |    | BEAM SHUTTERING                                   | 10 days        | Thu 23-12-21        | Thu 06-01-22        |
| 46  |                                                                                   |    | BEAM CONCRETING                                   | 14 days        | Thu 23-12-21        | Tue 11-01-22        |
| 47  |                                                                                   |    | <b>PLINTH BEAM</b>                                | <b>12 days</b> | <b>Wed 12-01-22</b> | <b>Thu 27-01-22</b> |
| 48  |                                                                                   |    | BLOCK WORK TILL PLINTH BEAM BOTTOM                | 3 days         | Wed 12-01-22        | Fri 14-01-22        |
| 49  |                                                                                   |    | LEVELLING                                         | 1 day          | Mon 17-01-22        | Mon 17-01-22        |
| 50  |                                                                                   |    | PCC                                               | 5 days         | Tue 18-01-22        | Sat 22-01-22        |
| 51  |                                                                                   |    | REINFROCEMENT                                     | 5 days         | Tue 18-01-22        | Sat 22-01-22        |
| 52  |                                                                                   |    | SHUTTERING                                        | 5 days         | Tue 18-01-22        | Sat 22-01-22        |
| 53  |                                                                                   |    | CONCRETING                                        | 8 days         | Tue 18-01-22        | Thu 27-01-22        |
| 54  |                                                                                   |    | <b>PEB MEMBER ERECTION</b>                        | <b>13 days</b> | <b>Fri 28-01-22</b> | <b>Fri 11-02-22</b> |
| 55  |                                                                                   |    | <b>COLUMN AND GRIT INSTALLATION</b>               | <b>13 days</b> | <b>Fri 28-01-22</b> | <b>Fri 11-02-22</b> |
| 89  |                                                                                   |    | <b>BLOCK WORK</b>                                 | <b>15 days</b> | <b>Sat 05-02-22</b> | <b>Tue 22-02-22</b> |
| 90  |                                                                                   |    | BRICK WORK TILL 3M                                | 15 days        | Sat 05-02-22        | Tue 22-02-22        |
| 91  |                                                                                   |    | <b>ROOF AND WALL ERECTION</b>                     | <b>16 days</b> | <b>Sat 05-02-22</b> | <b>Wed 23-02-22</b> |
| 92  |                                                                                   |    | <b>BAY 1</b>                                      | <b>16 days</b> | <b>Sat 05-02-22</b> | <b>Wed 23-02-22</b> |
| 93  |                                                                                   |   | CHALK MARKING FOR DRILLING                        | 1 day          | Sat 05-02-22        | Sat 05-02-22        |
| 94  |                                                                                   |  | IDENTIFICATION OF BAY PLACEMENTS                  | 1 day          | Sat 05-02-22        | Sat 05-02-22        |
| 95  |                                                                                   |  | PLACEMENT OF CLADDING -WALL                       | 5 days         | Mon 07-02-22        | Fri 11-02-22        |
| 96  |                                                                                   |  | EAVE FLASHING                                     | 1 day          | Sat 12-02-22        | Sat 12-02-22        |
| 97  |                                                                                   |  | PLACEMENT OF CLADDING - ROOF                      | 5 days         | Mon 14-02-22        | Fri 18-02-22        |
| 98  |                                                                                   |  | RIDGE FLASHING                                    | 2 days         | Sat 19-02-22        | Mon 21-02-22        |
| 99  |                                                                                   |  | LAP AND SEAL FLASHING                             | 1 day          | Mon 21-02-22        | Mon 21-02-22        |
| 100 |                                                                                   |  | GUTTER AND DOWNSPROUT INSTALLATION                | 1 day          | Tue 22-02-22        | Tue 22-02-22        |
| 101 |                                                                                   |  | VENTILATOR , CURBS INSTALLATION                   | 1 day          | Tue 22-02-22        | Tue 22-02-22        |
| 102 |                                                                                   |  | FASCIA FIXING                                     | 1 day          | Wed 23-02-22        | Wed 23-02-22        |
| 103 |                                                                                   |  | FIXING CORNERS AND EAVE TRIMS                     | 1 day          | Wed 23-02-22        | Wed 23-02-22        |
| 104 |                                                                                   |  | <b>LINTEL BEAM AND SUNSHADE</b>                   | <b>16 days</b> | <b>Wed 23-02-22</b> | <b>Sat 12-03-22</b> |
| 105 |                                                                                   |  | BEAM & SUNSHADE REINFORCEMENT TYING               | 1 day          | Wed 23-02-22        | Wed 23-02-22        |
| 106 |                                                                                   |  | BEAM & SUNSHADE SHUTTERING                        | 1 day          | Thu 24-02-22        | Thu 24-02-22        |
| 107 |                                                                                   |  | CONCRETING AND CURING                             | 14 days        | Fri 25-02-22        | Sat 12-03-22        |
| 108 |                                                                                   |  | <b>FLOORING</b>                                   | <b>23 days</b> | <b>Fri 28-01-22</b> | <b>Wed 23-02-22</b> |
| 109 |                                                                                   |  | GOOD EARTH FILLING                                | 2 days         | Fri 28-01-22        | Sat 29-01-22        |
| 110 |                                                                                   |  | GSB                                               | 1 day          | Mon 31-01-22        | Mon 31-01-22        |
| 111 |                                                                                   |  | PCC                                               | 1 day          | Tue 01-02-22        | Tue 01-02-22        |
| 112 |                                                                                   |  | HDPE SHEET LAYING                                 | 1 day          | Wed 02-02-22        | Wed 02-02-22        |
| 113 |                                                                                   |  | REINFORCEMENT TYING                               | 1 day          | Thu 03-02-22        | Thu 03-02-22        |
| 114 |                                                                                   |  | FLOOR CONCRETING                                  | 1 day          | Fri 04-02-22        | Fri 04-02-22        |
| 115 |                                                                                   |  | CURING AND EPOXY COATING                          | 10 days        | Sat 05-02-22        | Wed 16-02-22        |
| 116 |                                                                                   |  | GROOVE CUTTING AND SEALANT FILLING                | 2 days         | Thu 17-02-22        | Fri 18-02-22        |
| 117 |                                                                                   |  | INDUSTRIAL FLOOR TILE LAYING INCLD PARTITION BEAM | 2 days         | Sat 19-02-22        | Mon 21-02-22        |
| 118 |                                                                                   |  | TOILET & DINING AREA FLOOR TILE LAYING            | 2 days         | Tue 22-02-22        | Wed 23-02-22        |
| 119 |                                                                                   |  | <b>MEZZANINE FLOOR WORK</b>                       | <b>13 days</b> | <b>Sat 05-02-22</b> | <b>Sat 19-02-22</b> |

| ID  |  | Task Mode                                                                             | Task Name                                        | Duration       | Start               | Finish              |
|-----|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------------------------------|----------------|---------------------|---------------------|
| 120 |                                                                                   |    | G.I DECK SHEET FIXING                            | 5 days         | Sat 05-02-22        | Thu 10-02-22        |
| 121 |                                                                                   |    | REINFORCEMENT TYING                              | 7 days         | Fri 11-02-22        | Fri 18-02-22        |
| 122 |                                                                                   |    | FLOOR CONCRETING                                 | 1 day          | Sat 19-02-22        | Sat 19-02-22        |
| 123 |                                                                                   |    | <b>JOINERY WORK</b>                              | <b>9 days</b>  | <b>Wed 06-04-22</b> | <b>Tue 19-04-22</b> |
| 124 |                                                                                   |    | FLASHING WINDOWS AND DOORS                       | 2 days         | Wed 06-04-22        | Thu 07-04-22        |
| 125 |                                                                                   |    | INSTALLATION OF ROLLING SHUTTERS                 | 4 days         | Fri 08-04-22        | Tue 12-04-22        |
| 126 |                                                                                   |    | INSTALLATION OF DOORS AND WINDOWS                | 7 days         | Fri 08-04-22        | Tue 19-04-22        |
| 127 |                                                                                   |    | SEALING JOINTS                                   | 1 day          | Fri 08-04-22        | Fri 08-04-22        |
| 128 |                                                                                   |    | <b>ELECTRICAL</b>                                | <b>12 days</b> | <b>Mon 21-02-22</b> | <b>Sat 05-03-22</b> |
| 129 |                                                                                   |    | MARKING , INSTALLATION                           | 10 days        | Mon 21-02-22        | Thu 03-03-22        |
| 130 |                                                                                   |    | CHECK FOR CONTINUITY                             | 2 days         | Fri 04-03-22        | Sat 05-03-22        |
| 131 |                                                                                   |    | <b>PLUMBING</b>                                  | <b>45 days</b> | <b>Fri 25-02-22</b> | <b>Thu 21-04-22</b> |
| 132 |                                                                                   |    | LINE WORK                                        | 14 days        | Fri 25-02-22        | Sat 12-03-22        |
| 133 |                                                                                   |    | INSTALLATION OF IWC AND EWC                      | 14 days        | Mon 14-03-22        | Tue 29-03-22        |
| 134 |                                                                                   |    | WASH BASIN FIXING                                | 5 days         | Wed 30-03-22        | Mon 04-04-22        |
| 135 |                                                                                   |    | SS HAND WASH BASIN FIXING                        | 5 days         | Tue 05-04-22        | Sat 09-04-22        |
| 136 |                                                                                   |    | URINAL AND GRANITE FIXING                        | 7 days         | Mon 11-04-22        | Thu 21-04-22        |
| 137 |                                                                                   |   | <b>INTERIOR WORKS</b>                            | <b>38 days</b> | <b>Tue 22-02-22</b> | <b>Wed 06-04-22</b> |
| 138 |                                                                                   |  | DRY WALL INSTALLATION                            | 10 days        | Tue 22-02-22        | Fri 04-03-22        |
| 139 |                                                                                   |  | ALUMINIUM PARTITION INSTALLATION                 | 7 days         | Sat 05-03-22        | Sat 12-03-22        |
| 140 |                                                                                   |  | METAL FENCING                                    | 4 days         | Mon 14-03-22        | Thu 17-03-22        |
| 141 |                                                                                   |  | FALSE CEILING - 600 X 600 TILE FIXING            | 7 days         | Fri 18-03-22        | Fri 25-03-22        |
| 142 |                                                                                   |  | FALSE CEILING -8mm BISON BOARD SUSPENDED CEILING | 7 days         | Wed 30-03-22        | Wed 06-04-22        |
| 143 |                                                                                   |  | <b>FIRE FIGHTING AND PROTECTION</b>              | <b>24 days</b> | <b>Mon 21-02-22</b> | <b>Sat 19-03-22</b> |
| 144 |                                                                                   |  | EXTINGUISHER PLACEMENTS                          | 2 days         | Mon 21-02-22        | Tue 22-02-22        |
| 145 |                                                                                   |  | CHECK FOR SPRINKLER LINES                        | 1 day          | Mon 21-02-22        | Mon 21-02-22        |
| 146 |                                                                                   |  | SPRINKLER INSTALLATION                           | 14 days        | Thu 24-02-22        | Fri 11-03-22        |
| 147 |                                                                                   |  | HOSE REEL INSTALLATION                           | 7 days         | Sat 12-03-22        | Sat 19-03-22        |
| 148 |                                                                                   |  | <b>PLASTERING</b>                                | <b>28 days</b> | <b>Mon 07-03-22</b> | <b>Thu 07-04-22</b> |
| 149 |                                                                                   |  | INTERNAL PLASTERING                              | 12 days        | Mon 07-03-22        | Sat 19-03-22        |
| 150 |                                                                                   |  | EXTERNAL PLASTERING                              | 12 days        | Mon 21-03-22        | Sat 02-04-22        |
| 151 |                                                                                   |  | WALL DADOING                                     | 14 days        | Wed 23-03-22        | Thu 07-04-22        |
| 152 |                                                                                   |  | <b>PAINTING</b>                                  | <b>14 days</b> | <b>Mon 21-03-22</b> | <b>Tue 05-04-22</b> |
| 153 |                                                                                   |  | INTERNAL PAINTING                                | 7 days         | Mon 21-03-22        | Mon 28-03-22        |
| 154 |                                                                                   |  | EXTERNAL PAINTING                                | 7 days         | Tue 29-03-22        | Tue 05-04-22        |
| 155 |                                                                                   |  | <b>POST ERECTION AND COMPLETION</b>              | <b>7 days</b>  | <b>Sat 09-04-22</b> | <b>Wed 20-04-22</b> |
| 156 |                                                                                   |  | FINAL FINISHING WORKS                            | 3 days         | Sat 09-04-22        | Tue 12-04-22        |
| 157 |                                                                                   |  | CHECK FOR DEFECTS                                | 2 days         | Sat 16-04-22        | Mon 18-04-22        |
| 158 |                                                                                   |  | CLEAN UP OF SITE                                 | 4 days         | Sat 16-04-22        | Wed 20-04-22        |
| 159 |                                                                                   |  | PREPARATION OF PUNCH LIST                        | 1 day          | Tue 19-04-22        | Tue 19-04-22        |
| 160 |                                                                                   |  | HANDING OVER                                     | 1 day          | Wed 20-04-22        | Wed 20-04-22        |

## GTE CASH FLOW MODEL FOR ADMIN BLOCK:

[illegible]

## PROJECT-2: DETAILS

- **Client name** : Bengaluru International Airport Limited (BIAL)
- **Team/ Group** : EPMCR
- **Site location** : KIA (Kempegowda International Airport), Devanahalli, Bengaluru
- **Project Status** : Under Construction (Excavation)

## ABOUT THE PROJECT:



This project is currently at the tender stage. The process of preparation allowed an understanding on how to work within a short time frame. It also gave an overview of how to present data, emphasise key notes and selective presentation. The project helped identify the areas of focus that have to be brought into discussion with other stake holders. It allowed a thorough understanding of Environment, Health & Safety (EHS) Compliance and QAQC (Quality Assurance and Quality Compliance).



| LEVEL             | TOTAL AREA ( SQM) |
|-------------------|-------------------|
| BELOW TRACK LEVEL | 300               |
| UNDERCROFT        | 11140             |
| RAIL LEVEL        | 2350              |
| PLATFORM LEVEL    | 11000             |
| LEVEL 0           | 9000              |
| CONCOURSE LEVEL   | 10700             |

- Kempegowda International Airport is located approximately 30 Km from the city of Bangalore.
- Owned and operated by Bengaluru International Airport Limited (BIAL), which is a consortium, KIA is the third busiest airport.
- In 2019 ,the Karnataka Government approved the Bangalore Airport Metro line connecting the city with the airport. Under this plan there are two metro stops being built in the airport campus, one of which is a Multi Modal Transportation Hub opposite the proposed Terminal 2 construction.
- The total cost of the complete expansion project is estimated around to be Rs14,788 Crores.
- The new terminal is designed to feature trees, small gardens ,ponds with local species of plants and is expected to serve approximately 25 million passengers a year.
- The plan includes well placed lagoons. The purpose of the lagoon is to recycle the rainwater, to be reused in greywater processes, like cooling and irrigation.
- The new terminal project uses advanced technology and cutting-edge tools to enhance airport operations awarded the contract of design, procurement, engineering, construction, testing and operations of T2 construction to L&T's Buildings & Factories business .
- The scope of the project for EPMCR is the T2 connectivity and allied civil works.



## WORK PROCESS FOR KIA- TERMINAL CONNECTIVITY FROM INCEPTION TO FINAL PRESENTATION

|                                                       |                                                                                                                                         |                             |                                                                  |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------|
| UNDERSTANDING THE WORK DESCRIPTION                    | HOW DID WE START?                                                                                                                       | IDENTIFYING THE CONSTRAINTS | WHAT WERE THE CHALLENGES?                                        |
|                                                       | Studying the drawings, documents, reports, sections, elevations and models.                                                             |                             | The need to adhere to the presentation timeline.                 |
|                                                       | WHAT NEXT?                                                                                                                              |                             | Reading through extensive amount of information in a short time. |
|                                                       | Separating our scope of work from the complete project.<br>Identifying different levels and scope in each .                             |                             | Sequence the activities to meet the milestone schedule.          |
|                                                       | Using the existing images and maps to visualise the construction for better understanding.                                              |                             | Correlate data from different softwares.                         |
| WHAT WERE THE MEASURES TAKEN TO OVERCOME THE HURDLES? | Priliminary work breakdown to verify the sequence of activities.                                                                        |                             |                                                                  |
|                                                       | Brainstorming the optimal option for excavation, concreting ,rebar methodology etc.                                                     |                             |                                                                  |
|                                                       | Coming up with different scaffolding options and narrowing via process of elimination.                                                  |                             |                                                                  |
|                                                       | Division of entire construction into several work fronts to simplify work and for resource optimisation.                                |                             |                                                                  |
|                                                       | Analysis for equipment selection like cranes and quantifying,                                                                           |                             |                                                                  |
|                                                       | Based on the work front division estimating quantities of material- steel ,concrete after the documentation of the structural elements. |                             |                                                                  |
|                                                       | Scheduling with dates and approximate cost estimation                                                                                   |                             |                                                                  |

The initial scope for presentation included the development of construction methodology for Excavation works; Formwork and handling; Rebar work and Concrete batching .

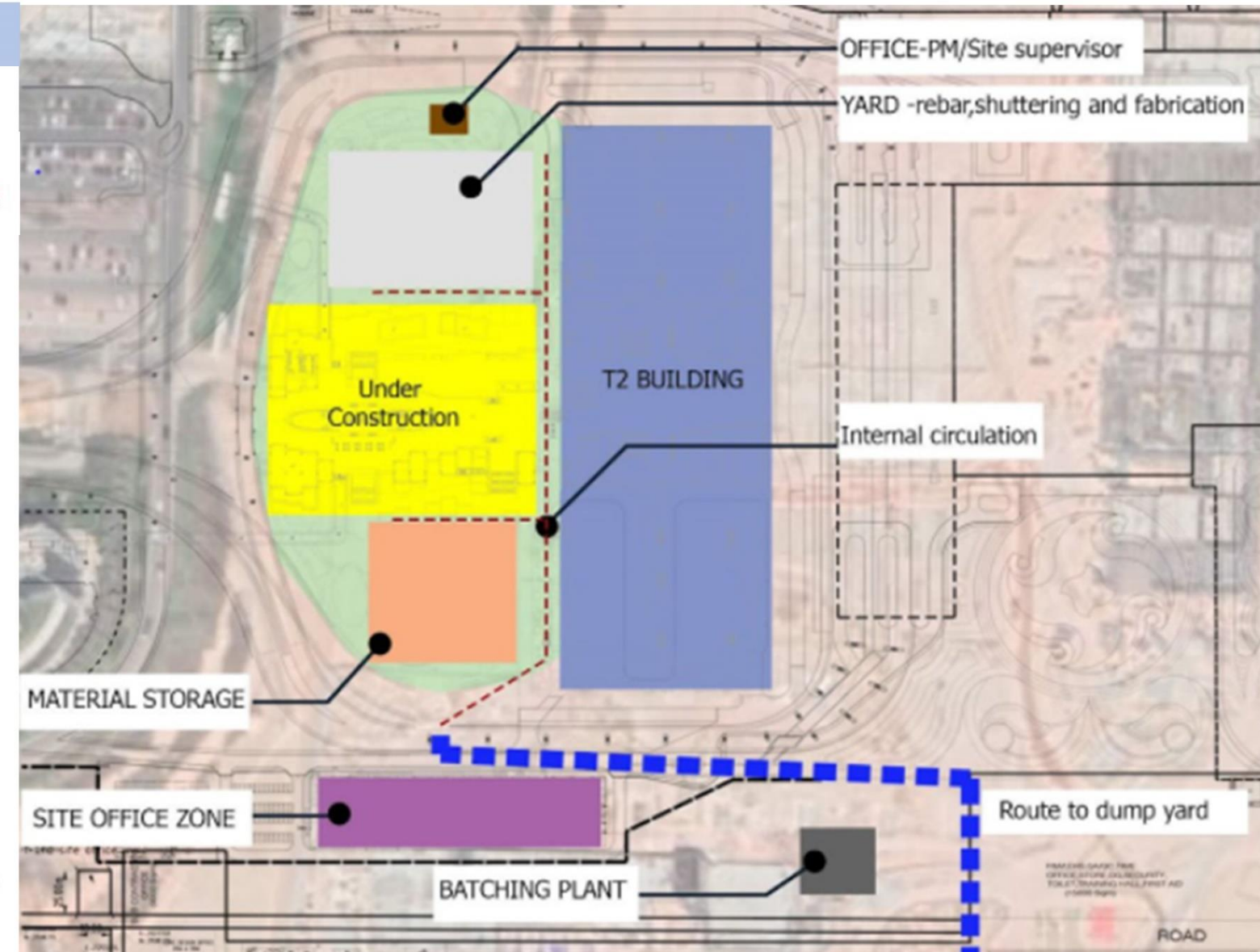
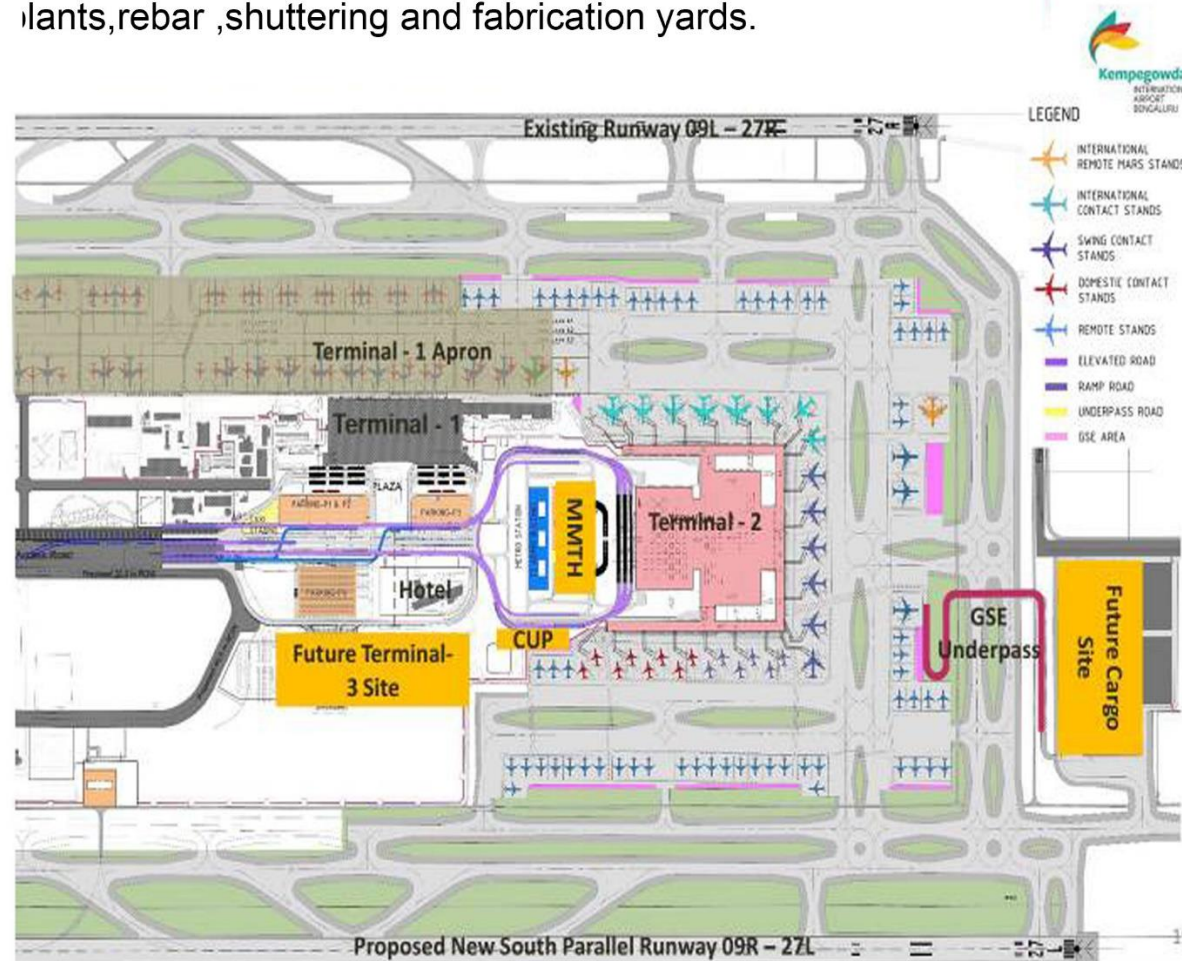
This required analysis of existing machinery, batching plants and labour on site.

The crucial factors to adhere to are the:

1. PROJECT HANDOVER DATE- (TIMELINE)
2. THE MILESTONE SCHEDULE
3. EHS GUIDELINES
4. QAQC SPECIFICATIONS
5. SITE CONSTRAINTS

## PRELIMINARY SITE ZONING:

The zoning depicts the potential areas for the site office, batching plants, rebar ,shuttering and fabrication yards.



## PROJECT SCHEDULING : TERMINAL 2 CONNECTIVITY

| PROJECT SCHEDULING - TERMINAL 2 CONNECTIVITY |                                    |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|----------------------------------------------|------------------------------------|------|-----------------|----------|------------|----------|-----------|----|----|----------|-----------|----|----|----------|-----------|----|----|----------|-----------|----|----|----------|-----------|----|----|----------|-----------|----|----|----------|
| S.NO                                         | DESCRIPTION OF WORK                | UNIT | TOTAL SCOPE QTY | DURATION | START DATE | END DATE | ZONE - 01 |    |    |          | ZONE - 02 |    |    |          | ZONE - 03 |    |    |          | ZONE - 04 |    |    |          | ZONE - 05 |    |    |          | ZONE - 06 |    |    |          |
|                                              |                                    |      |                 |          |            |          | SCOPE     | SD | ED | DURATION | SCOPE     | SD | ED | DURATION | SCOPE     | SD | ED | DURATION | SCOPE     | SD | ED | DURATION | SCOPE     | SD | ED | DURATION | SCOPE     | SD | ED | DURATION |
| A                                            | DESIGN AND APPROVAL STAGE          |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | DESIGN AND DRAWING                 | LS   |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | APPROVAL, TENDERING & AWARD OF CON | LS   |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              |                                    |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
| B                                            | CONSTRUCTION STAGE                 |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | SITE MOBILISATION                  | LS   |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              |                                    |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
| C                                            | BELOW TRACK LEVEL TO UNDERCROFT    |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | SUMP                               |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 1 EARTHWORK EXCAVATION             | Cum  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 2 ANTI TERMITE TREATMENT           | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 3 GSB FILLING                      | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 4 SAND FILLING                     | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 5 PCC                              | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 6 WATER PROOFING - UNDER RAFT      | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 7 HDPE SHEET LAYING                | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 8 RAFT                             |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 8.1 Reinforcement                  | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 8.2 Shuttering                     | Rmt  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 8.3 Concreteing                    | Cum  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 9 WALL                             |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 9.1 Reinforcement                  | Rmt  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 9.2 Shuttering                     | Rmt  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 9.3 Concreteing                    | Cum  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
| D                                            | STAIRCASE & PASSAGE                |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 1 EARTHWORK EXCAVATION             | Cum  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 2 ANTI TERMITE TREATMENT           | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 3 GSB FILLING                      | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 4 SAND FILLING                     | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 5 PCC                              | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 6 WATER PROOFING-UNDER RAFT        | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 7 HDPE SHEET LAYING                | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 8 RAFT(R,S,C)                      |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 8.1 Reinforcement                  | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 8.2 Shuttering                     | Rmt  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 8.3 Concreteing                    | Cum  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 9 WALL(R,S,C)                      |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 9.1 Reinforcement                  | Rmt  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 9.2 Shuttering                     | Rmt  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 9.3 Concreteing                    | Cum  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 10 WAIST SLAB AND STEPS (R,S,C)    |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 10.1 Reinforcement                 | Each |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 10.2 Shuttering                    | Each |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 10.3 Concreteing                   | Each |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              |                                    |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
| E                                            | UNDERCROFT LEVEL TO PLATFORM LEVEL |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
| F                                            | RAFT & FOOTINGS                    |      |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 1 EARTHWORK EXCAVATION             | Cum  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 2 ANTI TERMITE TREATMENT           | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 3 GSB FILLING                      | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 4 SAND FILLING                     | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |
|                                              | 5 PCC                              | Sqm  |                 |          |            |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |           |    |    |          |

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## SELECTION OF FORM WORK:

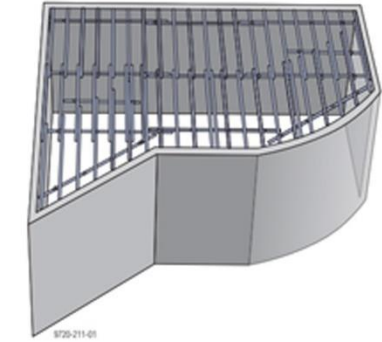
### CLIMBING FORM WORK:

- Allows easy adaptation to construction projects with vertical walls.
- Provides 1.65 m wide working platforms with an up to 70 cm roll-back for the formwork.
- Allows fast set-up and stripping of the formwork without crane assistance.
- It has a high load-bearing capacity (35 kN per Climbing bracket).



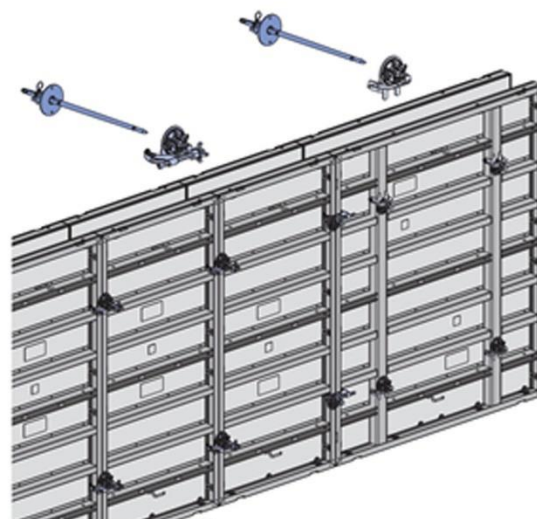
### BEAM- FLOOR FORM WORK:

- The system is ideal for enclosed spaces where the form work superstructure can rest up against walls on all sides.
- Infill zones are managed within the system, making it easy to adapt to walls and columns.
- They are used for shoring heights of up to 5.50 m and can use any type of form facing.
- The form work adapts to difficult shapes.



### TIE ROD SYSTEM:

- This form work can be tied by just 1 man working from one side only.
- There are no time-consuming fitting of jacket tubes.
- It has a long lifespan, as the tie is operated using a ratchet, minimizing wear-and-tear on the equipment.
- The ties are easy to unscrew, so the formwork can be stripped out faster.



### SUPPORTING CONSTRUCTION FRAME:

- The Supporting construction frame is an easy, straightforward way of combining standard walling with add-on components to make supporting construction frames to 4.0 m in height.
- It is suitable for timber-beam and framed formwork.
- The tensile forces are reliably transferred by means of diagonal anchors.



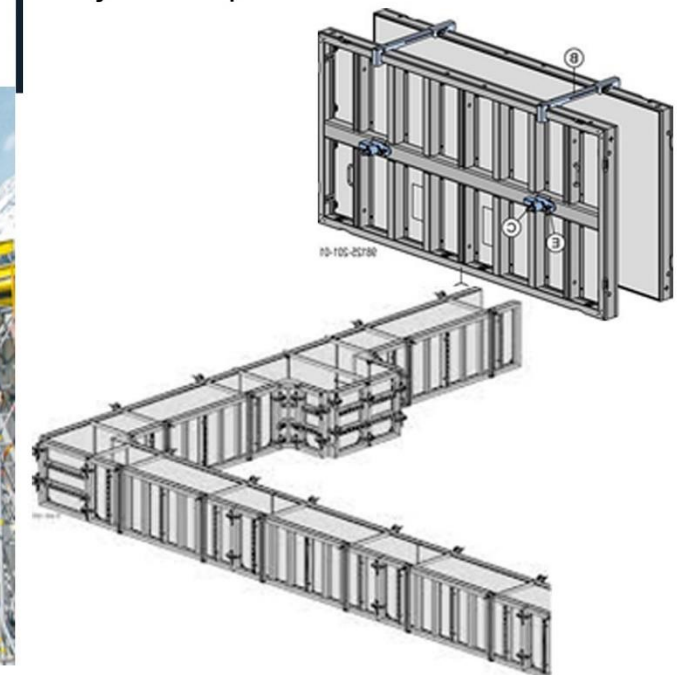
### FRAMED FORM WORK:

- The high-strength, torsional rigid frame profile makes this form work extremely sturdy and resistant to damage.
- It saves time and cuts labour costs.
- It is lightweight, easy to handle and eliminates the necessity for cranes.
- The multi-ply formwork sheets facilitate nailing and the attachment of diverse form-work add-on.



### FOUNDATION FORM WORK:

- This is used where the formwork is intended to continue forming (i.e. the walls) using the same panels.
- Foundations can quickly be formed with the panels either upright or horizontal.
- Quick acting clamps and a blow with the hammer are all it takes to join the panels.



# EFFECTIVE COMMUNICATION

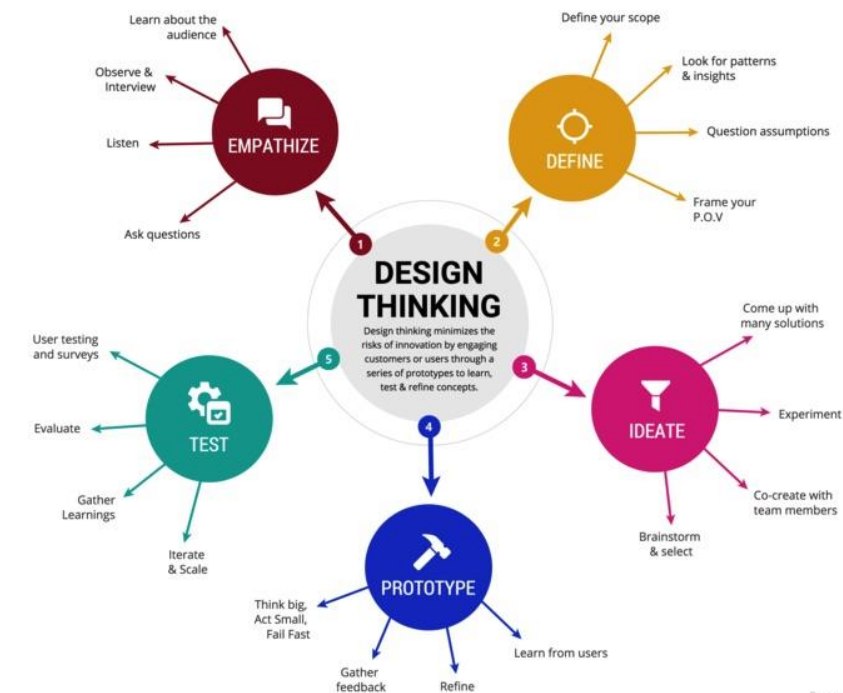
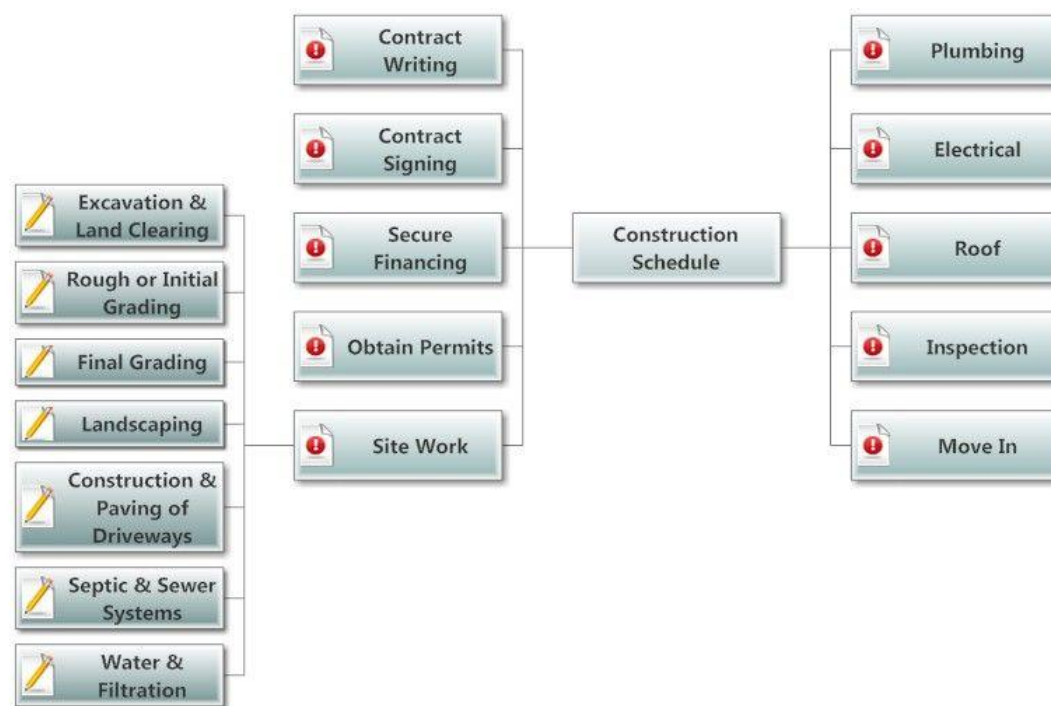


## Experience Using AYO:

AYOA is a platform to brainstorm ideas and connect teams specific to the project. It links creativity and productivity to allow ease of collaboration. It allows remote access and promotes seamless functioning.

Mind maps allow to visualize and break down information. This helps isolate the key concepts .It also maps the relations and inter relationships between the selected concepts. The final picture developed represents the thought process through the event.

- Apart from allowing the creation of a range of mind- maps, charts and work flow matrix, it also shows the progress of work and creates checklists.
- It allows data centralization and team building.



Source 1  
Source 2



### Excel for Project activities:

- EPMCR primarily works with excel sheets to generate work breakdown structures, cash flow sheets and daily progress reports (DPR's).
- The documents and reports formulated are exhaustive, well detailed and in a way that makes it easy for a stakeholder with no prior software exposure understand at a glance.
- Working on these reports helped explore the excel tool for a wide range of shortcuts, commands and formulas that significantly simplify the work load.

### SOLAR DECATHLON:

EPMCR are project partners guiding and assisting in the participation of the solar decathlon competition.

The poster features a light blue background with a repeating pattern of small, stylized human figures. At the top center is the Solar Decathlon India logo, which consists of a colorful, abstract figure made of interconnected loops in red, orange, yellow, green, and blue, followed by the text "Solar Decathlon India" in a dark blue sans-serif font. Below the logo, the text "Are you a Young Leader for net-zero?" is written in a bold, orange sans-serif font. Underneath that, "Join the Solar Decathlon India Challenge" is written in a bold, dark green sans-serif font. At the bottom, the text "A joint initiative by:" is centered in a small, grey sans-serif font. Below this text are three logos: on the left, the IUSSTF logo (a stylized 'i' and 'f' in blue and orange); in the center, the iihs logo (the letters "iihs" in a bold, dark red font, with "INDIAN INSTITUTE FOR HUMAN SETTLEMENTS" in a smaller, dark red font below it); and on the right, the aee logo (the letters "aee" in a bold, green font, with "Alliance for an Energy Efficient Economy" in a smaller, dark green font below it).

**Solar Decathlon India**

**Are you a Young Leader for net-zero?**

**Join the Solar Decathlon India Challenge**

A joint initiative by:

**IUSSTF**

**iihs**  
INDIAN INSTITUTE FOR HUMAN SETTLEMENTS

**aee** Alliance for an Energy Efficient Economy

## What is it?

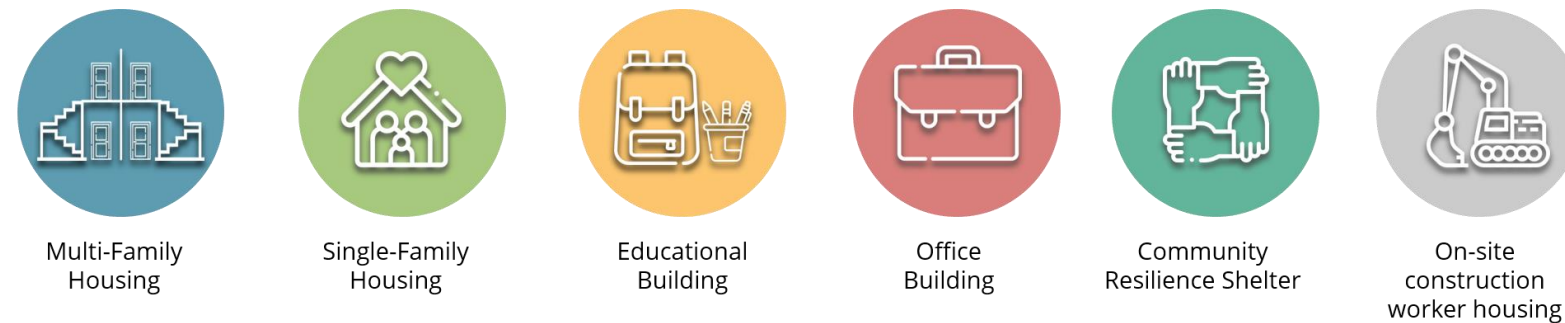
Solar Decathlon India promotes the design and development of net-zero-energy-water buildings in relation to real time projects. This allows the participants to partner with top players in real estate development. The competition spanning over months allows a comprehensive understanding of net zero energy practices and provides an insight into the technical aspects.

## The goal:

The aim is to introduce innovative and sustainable solutions that create resilient structures. The reduction in the carbon footprint of the proposal is an important consideration.

It encourages the inclusion of passive methods of achieving sustainability in buildings.

## Category of participation (Extract from design brief):



## On site construction workers Housing

## Areas of Consideration (Extract from design brief):



## Extracts of Requirements:

- Adhere and comply to specifications under acts and regulations for construction workers.
- The proposed design should be adaptable for subsequent sites.
- Important design features include: modular nature, ease of transportation, scale, flexibility and zero waste.
- Priority is given to speed of construction, dismantling and the variation in worker population.

## How has it helped?

- Online learning modules cover topics like building science, energy efficiency, water sufficiency, cost estimation, and resilience.
- Exposure to software like design builder and Climate Studio.
- Interaction with project partners.
- Participation in webinars conducted by industry leaders.

## CRITICAL OVERVIEW:



### Impact on the thought process:

My internship experience has clearly allowed me to identify areas that I would have to improve. The change begins from the way the thought process stems. My experience with the design thinking process has enabled a better, in depth understanding of the topic.

- It helps to identify the players, problems and the possible solutions.
- It moves on to establishing priority between the suggestions to narrow down to the most optimal “solver”.
- Lean thinking allows to pinpoint and highlight the pull activities.

I found it to be a looping process where every activity inevitably has an impact on another activity, type of labour, equipment, movement and even the schedule.



### Effective communication:

Another facet of the internship that I found to be extremely useful is the exposure to the wide applications of MS-Excel. It allowed me to realize how effectively the spread sheets could be put in use to convey information. The take away here was that while sophisticated software do perform well, say Microsoft Project, it is not user friendly to all the project stake holders. In the real time scenario communication and understanding the information is the core. The way data is presented should be effective, clear, concise and accurate.



### **Project Exposure:**

Having only handled residential projects and interiors, this training period allowed me to experience working with large scale projects. My learning here was how to enhance the speed of reading through information, data, details and drawings. The ability to filter and prioritize information in the time frame is the key.



### **Emphasis on key notes and presentation skills:**

An aspect of the training that proved to be immensely helpful was exposure to the client presentations and meetings. It provided an insight of how to get across ideas and strategies, convince the client and demonstrate complete understanding of the project within the brief meeting period. This is linked with how the presentation to the other party is documented. The short and concise visual aids go a long way in accurately conveying the information in an impressive manner.