



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

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

**PROFESSIONAL TRAINING (S84APT)
JUL 2022 - AUG 2022**

Name of the Student : J.SHALIYA MARY

Semester : III

Reg No. : 41840012

Batch : 2021-2023



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VIVA-VOCE EXAMINATION

This is to certify that the Professional Training Report (S89APT) is the work of **J.SHALIYA MARY** who had undergone training in **LARSEN AND TOUBRO CONSTRUCTION** has been monitored by the continuous assessment during Jul 2022 to Aug 2022.

Dr. Devyani Gangopadhyay
HOD AND DEAN

Submitted for Viva voce Examination held on 20.12.22

Internal Examiner
(A. RAMESH KUMAR)

External Examiner
(A. DEVIPRASADH)



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DECLARATION

I **J.SHALIYA MARY** hereby declare that this Professional Training Report done by me under the guidance of **Mr.SWAMINATHAN** is submitted in partial fulfillment of the requirements for the completion of practical training session.

DATE : 20.12.2022

PLACE : CHENNAI



SIGNATURE OF CANDIDATE

ACKNOWLEDGEMENT

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

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

I would also like to express my sincere thanks to **AR. SURYA RAJKUMAR** our Internal coordinator for her valuable guidance, during the entire Professional Training period.

I would like to express my special thanks to **L&T CONSTRUCTION BUILDINGS AND FACTORIES** for this wonderful opportunity. Secondly, I, sincerely, express my gratitude to **Mr.SWAMINATHAN, Mr.JAIGANESH, Mr.ARUN, Mr. UMAR BELAL, and Mr. VISHNU VARTHAN** for accepting and providing me the opportunity to work under their expert guidance and close supervision.

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.



Larsen & Toubro Limited,
Construction
Buildings & Factories
P. B. No. 979, Mount Poonamallee Road,
Manapakkam,
Chennai - 600 089, INDIA
Tel : +91-44-2252 6000, 2252 8000
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www.Lntec.com

B&F IC/EDRC-HR/Training/596-2022

07 July 2022

Head of the Department
Sathyabama Institute of Science & Technology
Kamaraj Nagar, Semmancheri, Chennai - 600119

Dear Sir/Madam,

Sub: Project Training

This has reference to your letter dated **11-May-2022** regarding Project Training for your student, **Ms. Shaliya Mary J (41840012)**. As a special case, we agree to admit her for Project Training from **11-July-22 to 20-Aug-22**

Please advise her to carry 3 Passport size photographs, copy of her College ID card and Adhaar card copy while reporting for the project training.

Please note that:

- She has to undergo the training without any financial commitment to our Company and fully at her own risk and responsibility.
- She must strictly comply with safety & other rules applicable at the project site/Office.
- She will be awarded her Project Training completion certificate on submission of the Project Report.

Thanking You,

Yours faithfully,
For LARSEN & TOUBRO LIMITED

SUNEET KUMAR
DGM - HUMAN RESOURCES

Registered Office: L&T House, N. M. Marg, Ballard Estate, Mumbai - 400 001, INDIA
Licence No.: CIN - L99999MH1946PLC004768

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Fax : +91-44-2249 3317
www.Lntec.com

B&F IC/HQ-HR/Training/2022-23/33
August 18, 2022

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Ms. Shaliya Mary J** student from Sathyabama Institute of Science & Technology Chennai has completed her Internship in the Corporate Strategy Department at our Head Quarters, Chennai, during July 11, 2022 – August 18, 2022.

We wish her all success in her professional career.

Yours faithfully,
for LARSEN & TOUBRO LIMITED

(S VIJAYARAGHAVAN)
MANAGER - HR



Registered Office: L&T House, N. M. Marg, Ballard Estate, Mumbai - 400 001, INDIA
Sensitivity: LNT Construction Internal Licence No.: CIN - L99999MH1946PLC004768

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

* **Note:** Kindly grade the student as per his/her overall performance in the office during the assessment month;

AC road.

V. S. Wamy (V. S. Wamy International)





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A Good

: V. S. [Signature]
CV-50

KARSEN & TOUROS LIMITED
Chennai

WORK DIARY

DAY	PROJECT NAME	WORK DONE	DAY	PROJECT NAME	WORK DONE
1.	Introduction	Lean Construction	16.	L&T Innovation Centre	Site Visit
2.	ILCC 2022 Conference	Lean Construction	17.	L&T Innovation Centre	EHS(induction programme)
3.	ILCC 2022 Conference	Lean Construction	18.	L&T Innovation Centre	Time Office and 3d printing
4.	Prestige finsbury park	Lean Construction	19.	L&T Innovation Centre	Lean Construction-Constrain analysis
5.	Prestige finsbury park	Lean Construction	20.	L&T Innovation Centre	Lean Construction-Constrain analysis
6.	Prestige finsbury park	Lean Construction	21.	L&T Innovation Centre	Quality assurance and quality control
7.	Office building (WIPRO)	Contract document	22.	L&T Innovation Centre	Plant and machinery
8.	WIPRO office building	Contract document	23.	L&T Innovation Centre	Planning
9.	WIPRO office building	Contract document	24.	L&T Innovation Centre	formwork, Reinforcement
10.	WIPRO office building	Contract document	25.	L&T Innovation Centre	Stores & Batching Plant
11.	WIPRO office building	Contract document	26.	L&T Innovation Centre	Presentation
12.	WIPRO office building	Contract document	27.	L&T Innovation Centre	Presentation
13.	WIPRO office building	Contract document	28.	L&T Innovation Centre	Scheduling
14.	WIPRO office building	Contract document	29.	L&T Innovation Centre	Scheduling
15.	WIPRO office building	Contract document	30.	L&T Innovation Centre	Scheduling

Project manager Signature: _____

Office seal:



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FIRM HISTORY

- Larsen & Toubro Ltd, commonly known as L&T, is an Indian multinational conglomerate company, with business interests in engineering, construction, manufacturing, technology, information technology and financial services, headquartered in Mumbai. The company is counted among world's top five construction companies.
- It was founded by Henning Holck-Larsen and Søren Kristian Toubro, who were two Danish engineers taking refuge in India.
- As of 2020, L&T Group comprises 118 subsidiaries, 6 associates, 25 joint-venture and 35 joint operations companies, operating across basic and heavy engineering, construction, realty, manufacturing of capital goods, information technology, and financial services.
- L&T Construction is among the world's top 15 contractors. The business involves the construction of Buildings & Factories, Heavy Civil Infrastructure, Transportation Infrastructure, Power transmission & Distribution Infrastructure, Water & Effluent Treatment plants, Metallurgical & Material Handling Infrastructure and Smart World & Communication Infrastructure.



PROJECTS



LEAN CONSTRUCTION **IN ACTION**

LEAN CONSTRUCTION



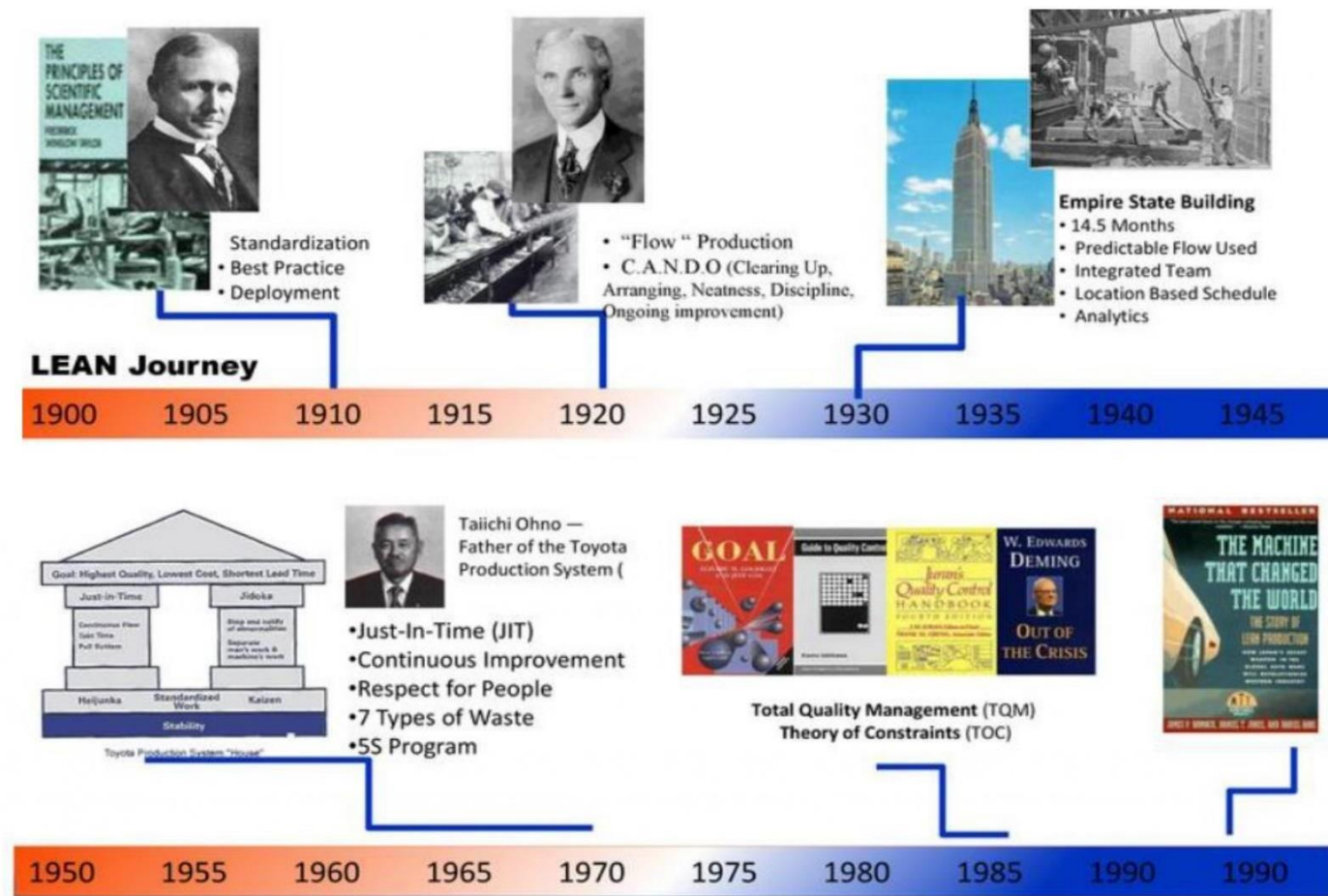
- Lean construction is a way to design production systems **to minimize waste of materials, time, and effort in order to generate the maximum possible amount of value** .
- It is using the same principles as lean production to reduce waste and increase the productivity and effectiveness in construction work.

- **Improve coordination**

- **Reduce waste**

- **ILCC** - Indian Lean Construction Conference

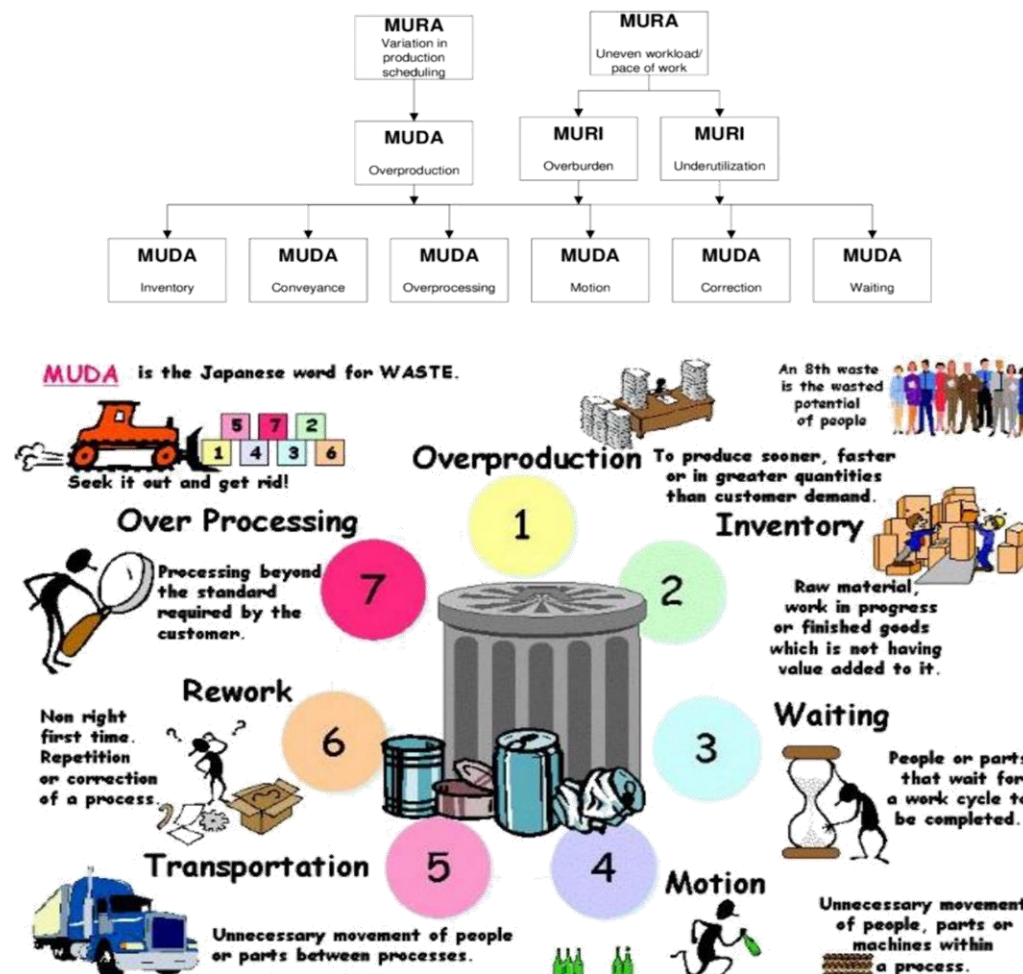
History of Lean:



Waste :

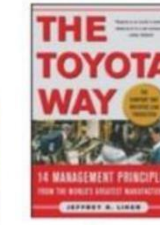


- Muda is non-value adding actions within your processes
- Muri is to overburden or be unreasonable
- Mura is unevenness



Lean Construction Institute

Last Planner System™
Construction Teams Start to use with great success.



AGC Lean Construction Forum Created



The Toyota way – 14 principles :

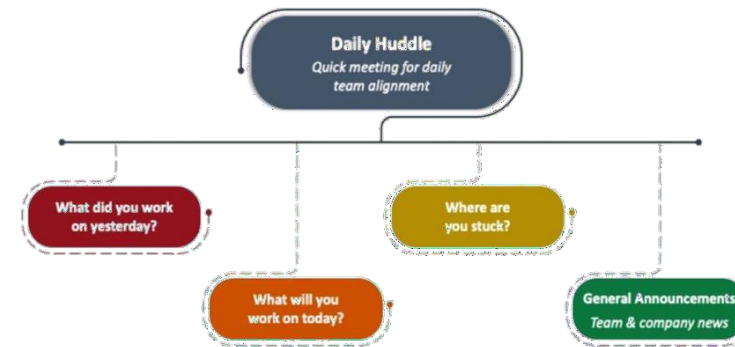
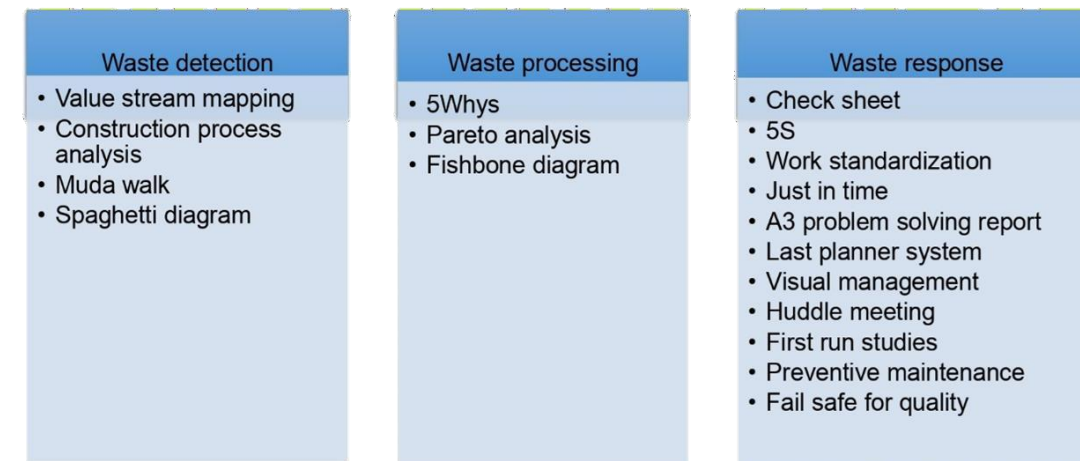
Section I: Long-Term Philosophy
1 Base your management decisions on a long-term philosophy, even at the expense of short-term financial goals
Section II: The Right Process Will Produce the Right Results
2 Create a continuous process flow to bring problems to the surface
3 Use "pull" systems to avoid overproduction
4 Level out the workload
5 Build a culture of stopping to fix problems, to get quality right the first time
6 Standardized tasks and processes are the foundation for continuous improvement and employee empowerment
7 Use visual control so no problems are hidden
8 Use only reliable, thoroughly tested technology that serves your people and processes
Section III: Add Value to the Organization by Developing Your People
9 Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others
10 Develop exceptional people and teams who follow your company's philosophy
11 Respect your extended network of partners and suppliers by challenging them and helping them improve
Section IV: Continuously Solving Root Problems Drives Organizational Learning
12 Go and see for yourself to thoroughly understand the situation
13 Make decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly
14 Become a learning organization through relentless reflection and continuous improvement

Principles of Lean construction :



- The basic principles of Lean Construction include **planning carefully to reduce waste**, **increasing communication** between team members as well as the construction company and the customer, and using data to create a predictable process.

Tools in lean construction:



Daily huddle meeting



5S Tool

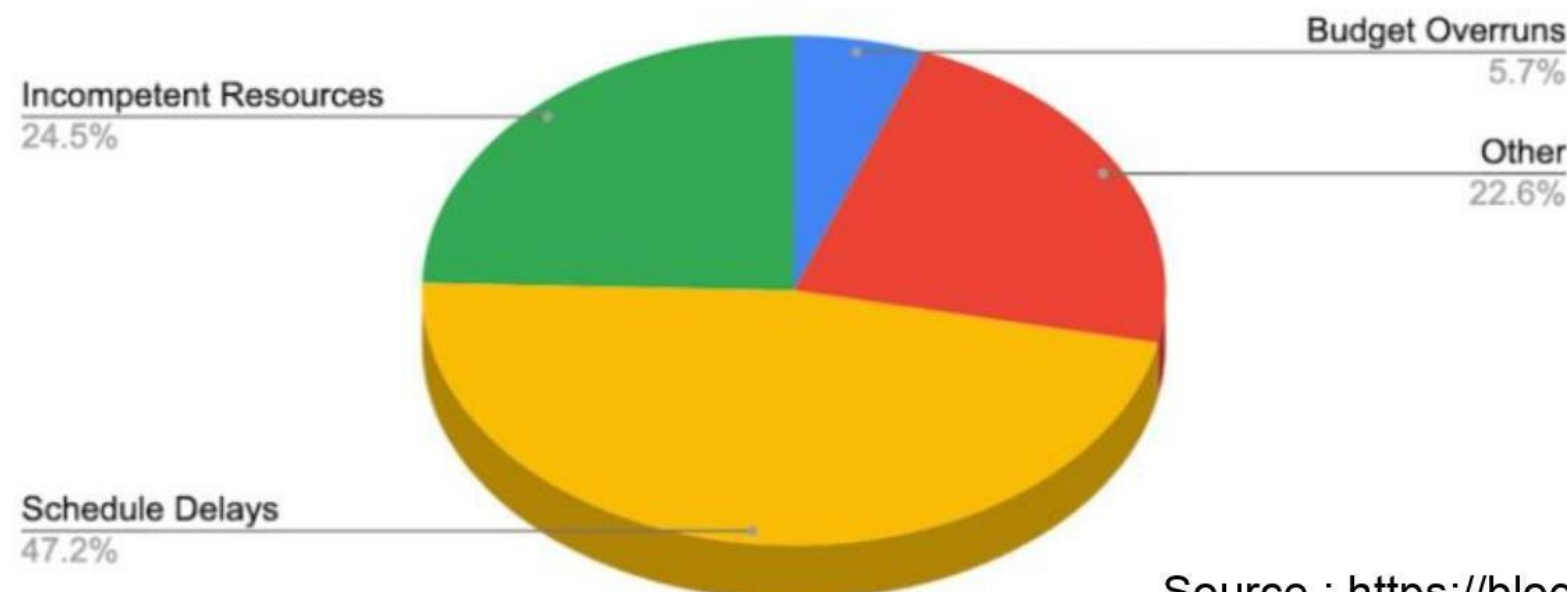
What is Project Delay?

- There is a magic triangle in project management. **There are three fundamental aspects or boundaries of each project. These are cost, scope, and schedule.**
 - i. The **scope** defines what will be delivered throughout the project and the end results of the project.
 - ii. There is a defined **budget** to complete the project that is planned to be spent throughout the project.
 - iii. The project team works on the project scope and spends the project budget to complete the project on time. The **schedule** of a project defines the planned dates to complete project activities and the overall project.
- If the planned activities cannot be completed on time in a project, this is called a “delay”. **Delays can be on activity level, phase level, or the overall project level.** For instance, if one of the project team members is completing an activity in eight days while the planned duration was five days, this is an activity level schedule delay.



Project schedule delay:

- When surveyed 425 participants who attended the corporate training programs, **47.2% of the respondents reported that schedule delays are the top project management issue in their organization.**



- As you can see from the pie chart, **schedule delays were the number one issue for their organization** for the majority of the project managers.

Source : <https://blog.masterofproject.com/project-schedule-delays/>

Lean Construction Scheduling:

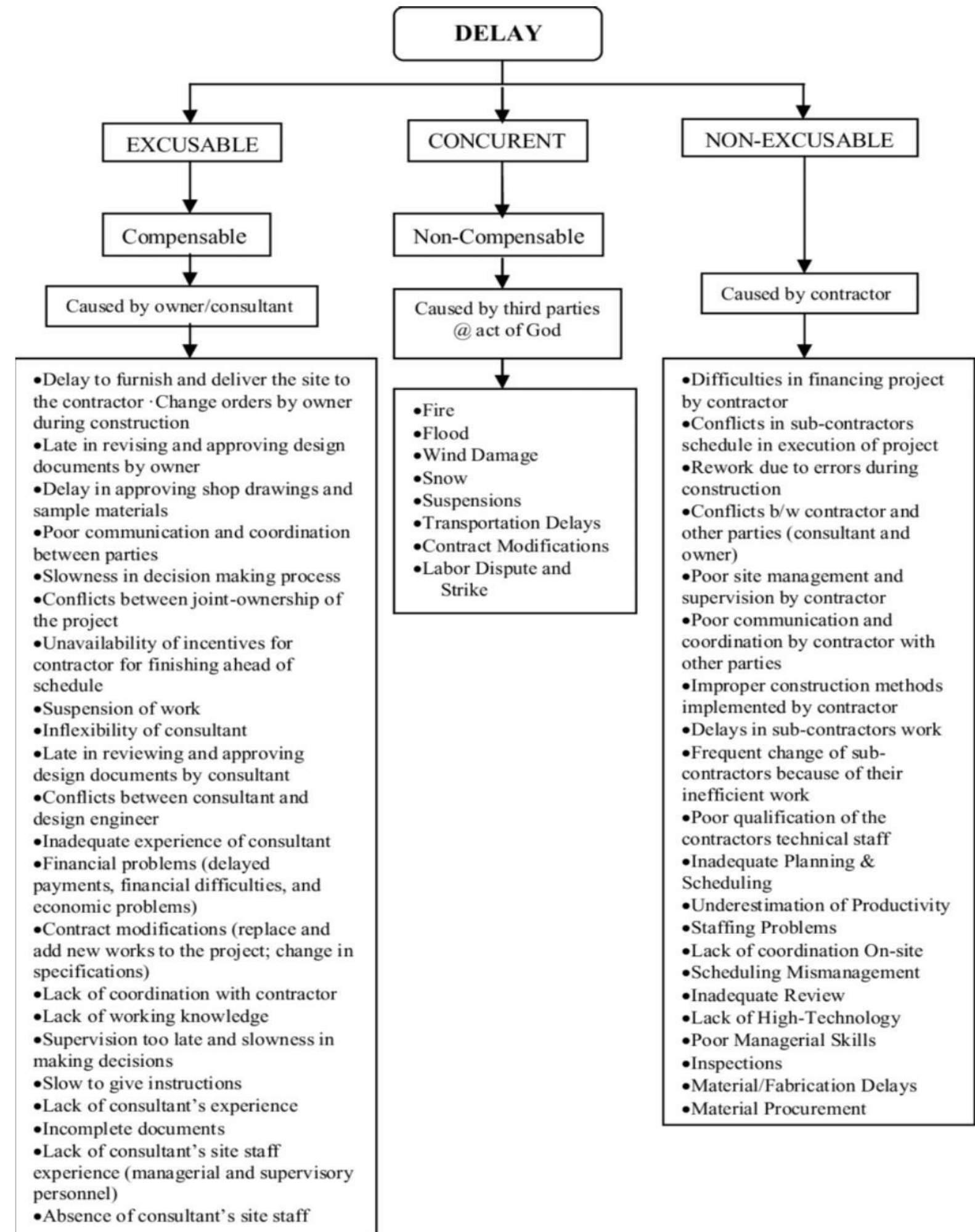
- Scheduling is an important part of project management in construction. It is a **list of project milestones, activities and deliverables with start and end dates** . This includes budgets, resource allocation and activity timelines. It will also list links to dependencies and scheduled events.
- Elements in the project schedule are usually based on the **work breakdown structure** for the whole project. Keeping a construction project on track is the difference between finishing a project on time and making a profit, or not. It is a way to design processes and procedures to minimize waste in the workplace to maximize value.
- Schedules detail each construction activity for the project team and how long it should take to complete each one. Lean construction scheduling is vital to all parts of the daily management and reporting process of a project's status. It **helps reduce all forms of waste in the construction process**.

Benefits :

- Making it possible to **move a project through the critical path of activities** of the construction process . It is easy to change priorities for activities and resources when the need arises. This reduces the peak demand for resources. It eliminates standing down other resources and bringing them back later at an extra cost.
- **Showing clear team goals and milestones**. It also shows the path of how to meet them on time. The schedule will give the team a pathway to follow to achieve those milestones on time. A schedule defines the sequence of activities to let project managers what to plan for.
- Providing **dates for material deliveries**.
- **Monitoring the progress of work** activities as well as those of subcontractors and suppliers.
- Providing subcontractors and suppliers with schedules at the time of the tender and **contract sign-off** prevents misunderstandings and disputes down the track.
- Allowing for **planning what resources you need where and when**. The last thing you need is too many or too few people on the job to get it done on time.

Types of delay in construction:

- **Excusable delays** - caused by conditions that are reasonably unforeseen and not within the contractor's / owner's control.
- **Non-excusable delays** - result of a delay that was within control of the Owner / Contractor. The Owner/Contractor is fully responsible for the activity delays.
- **A compensable delay** - where there's going to be some compensation involved for the delay to the project. That means that the owner or contractor is liable for an extension of time or cost compensation or both.
- **Concurrent delay** - There are many moving parts between an owner and a contractor on a construction project and, at times, a concurrent delay can occur.
- This type of schedule delay happens when 2 or more parties are at fault. The complexity here lies in determining to what extent each party contributed to the delay.



Reason for delay in scheduling?

- **Construction site access** - Site access may lead to delays in the project construction schedule. Examples of factors cause construction schedule delay are Inability of the owner, when he/she controls the construction site, to provide information needed for the constructor to achieve permit.
- **Differing site conditions** - Delays in project construction occurs when site conditions is different from those that expected from contract documents.
- **Force majeure** events are not only predictable and avoidable but also uncontrollable. These events are external that influence the performance of contractor and cause the delay of construction schedule.
- **Adverse weather** The majorities of project construction phases are sensitive to weather and influence by it. The influence of weather events varies crucially between construction activities and construction locations.
- **Budget Inaccuracies** - Getting the estimate wrong for a construction can be massively detrimental. Accurate estimates ensure there is always enough money for materials, wages, and more .
- **Labour challenges** - One of the biggest reasons for construction delays today is labor.. Correctly allocating a work crew can make or break a construction timeline.
- **Approvals** - Waiting for someone, somewhere to make a decision that is keeping the entire project from moving forward. Coordinating actions and approving items quickly can keep construction jobs on time and in some cases, under budget.
- **Subcontractor Schedules and Compliance** - General contractors typically work with a number of subcontractors for each project. Effectively managing them, their timelines and schedules, compliance documentation, and collaborating with other contractors is vital to a project's success.
- **Lacking Good Communication** - When the right hand isn't talking to the left hand, projects can get delayed, and in some cases, done incorrectly. Whether it's communication from an owner, client, in the field or at the office, everyone should be apprised as new updates like change or redesigns, or data like job progress or job costs become available.
- **Ineffective Scope Management** - The project team must gather detailed customer requirements and make the scope as clear as possible. If the scope is not clear, there will be misunderstandings between the customer and the project team. And, this will result in rework and project schedule delays.
- **Improper Risk Management** - Every project has a certain level of risk. However, when you have proper risk management in place, you would look more deeply into risks. Once you have identified the risks, now you should properly assess their probability and impact then categorize and prioritize the risks.
- **Incompetent Resources** - Assigning competent resources for the project activities is crucial. Assigning an incompetent resource may be good in terms of saving money. However, your project activities may end up delaying just because of them.

How to avoid delay in scheduling ?

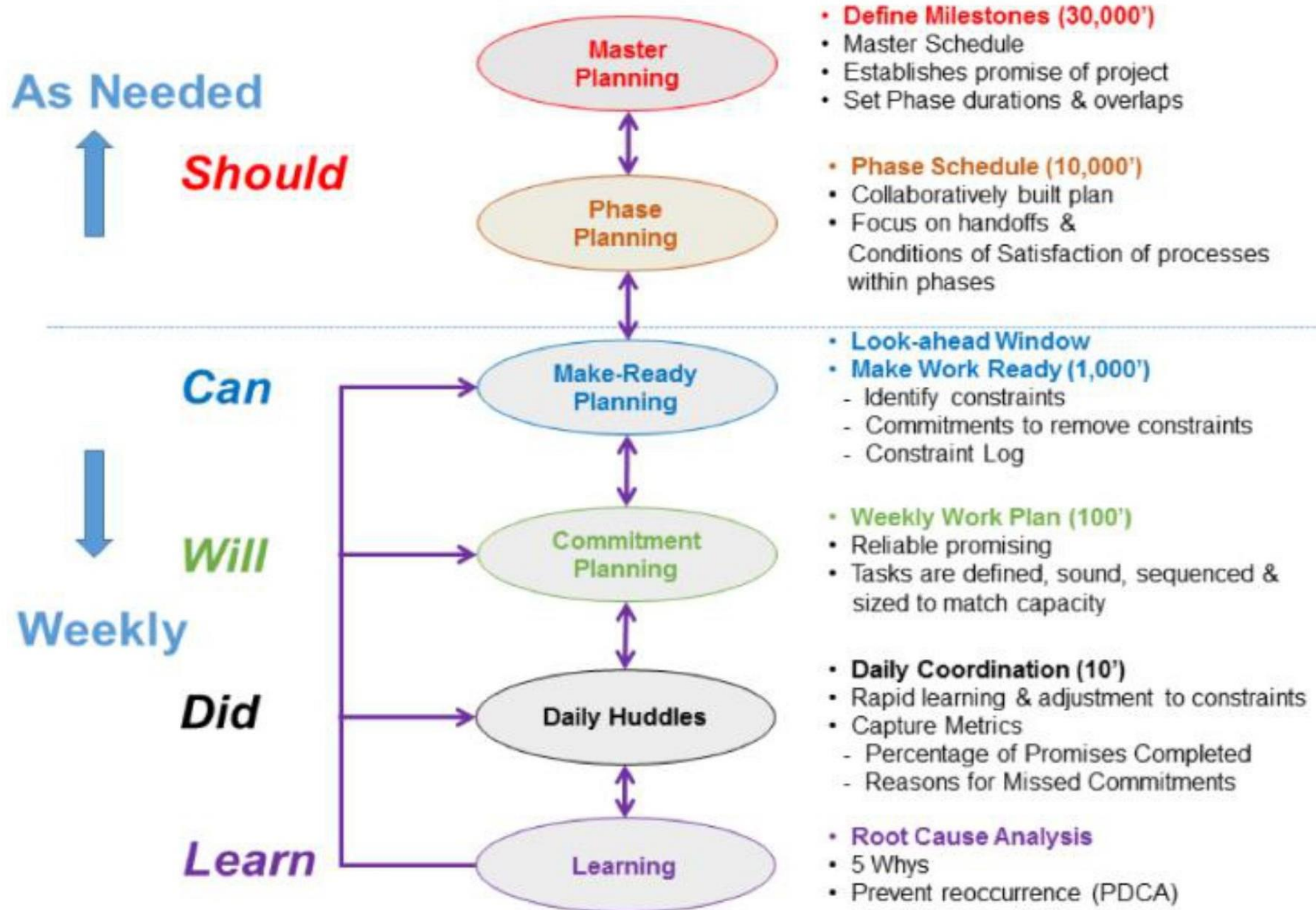
- **Provide accurate estimates** - During the project, you can use automated workflow software to generates regular updates about whether you're within budget. You should also stay aware of overall market trends. Talk with your distributor to find out what you can expect for prices.
- **Manage materials more efficiently** - Having the right material in the right place at the right time is key for job site productivity. Each job site is different, though, you'll want to consider potential traffic chokepoints before you begin work.
- **Communicate effectively** - Effective communication between the field, the office and the customer can help you avoid delays in construction projects. Instead of relying on ad hoc communication pathways, establish a communication structure and follow an organized schedule.

- **Review designs thoroughly**- If there's an error in the design phase of a project, it may not show up until execution. Fixing these issues can drastically affect the project timeline. This is where it becomes crucial to review designs before a project starts and check the specifications.
- **Streamline approvals** - Waiting for approvals can prevent your crew from moving forward on a project. The good news is that these inefficiencies are easily avoidable with structured workflows and automatic notifications.
- **Clarify project scope** - Unexpected scope changes can happen during construction projects. If the owner changes their mind about a crucial area, the rest of the project can experience major setbacks.
- **Prepare for weather delays** - Some delays are beyond anyone's control. A rainy day can slow construction activity or bring it to a dead halt. Add flexibility to your schedule so that weather-dependent activities like pouring concrete don't stall the project. You can also keep water pumps, waterproof gear and other safeguards around the job site to help you begin work faster after inclement weather.
- **Hold a team meeting** - At the beginning of your project, gather your project team to communicate the vision for the project. Make sure everyone understands their roles as well as the purpose of the project as a whole. Highlight the key project milestones you've set in your project plan and explain the benchmarks for success.
- **Track and measure progress** - Data collection is crucial to project success. You must have systems for tracking task completion, quality, and budget. Take account regularly to see if your team is on target.
- **Accommodate Risks' Schedule Effect** -When a risk occurs in a project, there will be two effects to the project immediately. It will require a budget and you will also need time to overcome the effect. Therefore, risk management must ensure that schedule buffers exist for the probable risks that can affect the project schedule.
- **Effective Change Management** - To ensure a consistent, measurable, and structured environment to deal with the change requests . The PM should ensure that every change request should go through proper change management . During project execution, there is often a need to make changes . The project manager, along with other key stakeholders should assess the change requests.

Last planner system (LPS) – Before scheduling – constrain analysis :

- (LPS) is one of the most important tools that have been developed within the Lean Construction area .It was developed to improve the reliability of construction schedules by introducing several scheduling phases that are to be defined in collaboration.
- The LPS has been introduced to improve performance in construction process execution by supporting it with reliable mechanisms for scheduling.
- The **methodology introduces several scheduling phases** that are defined in collaboration among the project participants.
- **The master schedule** depicts the main project phases and milestones covering the entire project duration.
- **The phase schedule** further details the master schedule by showing explicitly the hand-offs between the trades involved in a phase.
- **The look ahead plan schedules** the activities to be performed within the next four to six weeks with the aim to remove potential constraints that hinder the execution of tasks.
- **The weekly work plan** is negotiated between the different foremen involved with the aim to define a feasible plan and commit to its execution.
- The LPS encompasses also a monitoring phase to analyze planning failures and initiate a continuous improvement process. Therefore, the **Percent Plan Complete (PPC) indicator** is computed as the ratio between the number of activities completed and the number of activities scheduled in a specific week.
- When a scheduled task had not been completed, a so-called **Reason for Non Completion (RNC)** must be provided, which is analyzed by the foremen involved to understand its causes and to apply improvement actions.

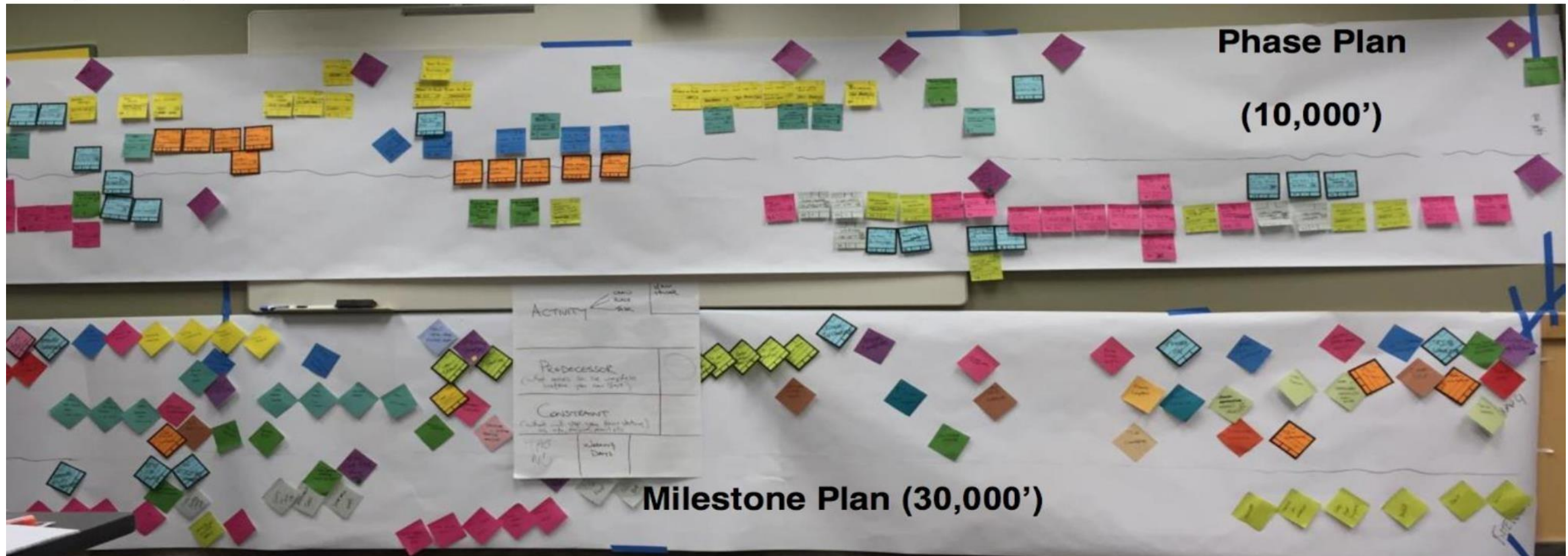
Last planner schematic :



Creating and maintaining reliable work flow

Level -1 : What should be done ?

- This includes milestone planning for the entire project (30,000ft view from a plane) and phase planning approx. 2 months long (10,000ft view) to create a shared understanding of scope, key milestones, major constraints, and a logical sequence of work.

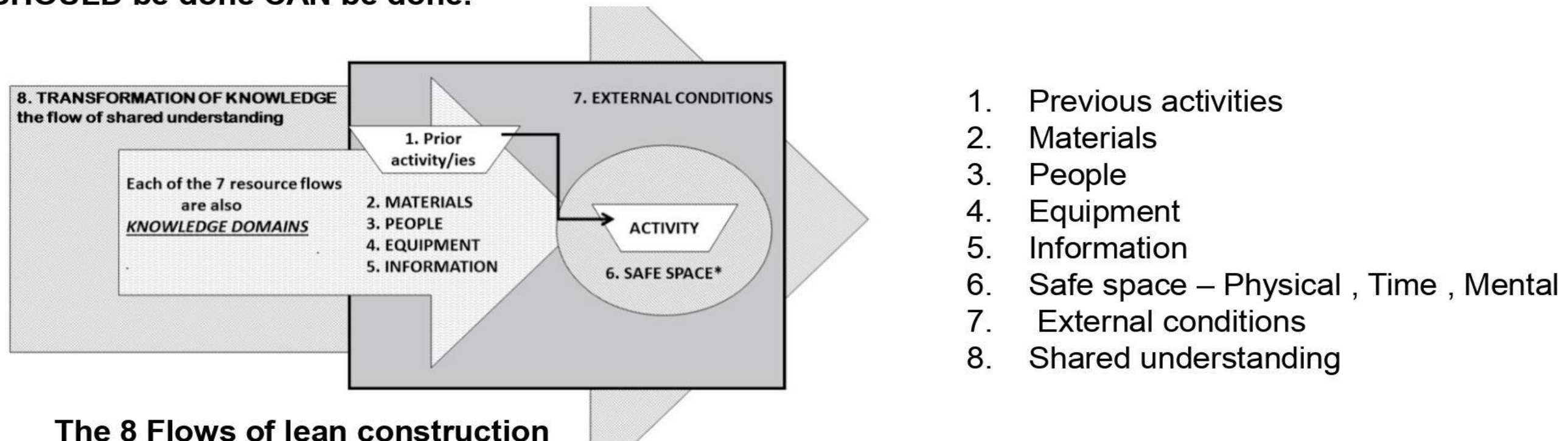


- Pull planning** is used to identify the project's strategy, to create a understanding of how the project SHOULD be delivered and create an environment to plan and coordinate collaboratively.
- Deliver bad news early such as grey areas in a contract between gaps in project scope at front end planning and procurement stages by focusing on handoffs while working back from specific milestones. Thus the team to **explore alternative solutions at the wall rather than in the field**.

Level -2 : What can be done ?

- Construction projects use a **six week look ahead plan**. LPS uses a look ahead window and make ready planning. Every activity is actively screened for constraints.

- The make ready plan is then created directly from the phase plan. The length of the plan depends on the length of time required to remove the longest constraint. Typically it is 6 to 8 weeks long. **This ensures the work that SHOULD be done CAN be done.**

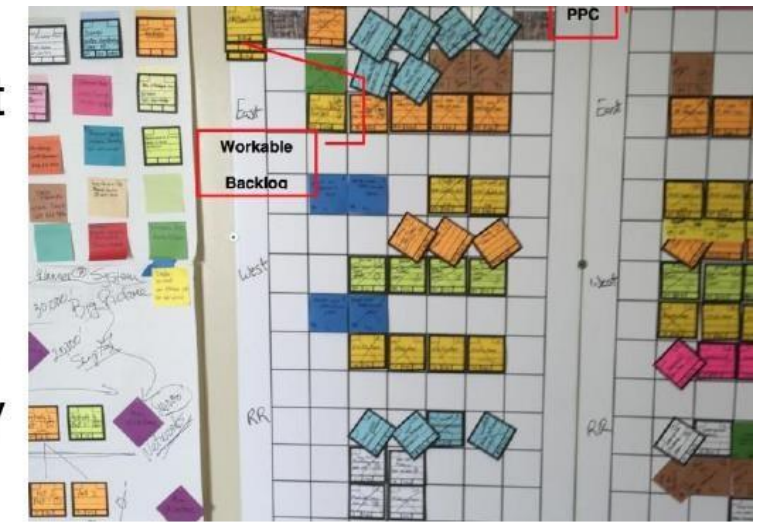


- The constraint log records any actions required by whom and the Last Responsible Moment (when) to remove constraints. By ensuring each activity is screened for constraints against the 8 Flows, work that CAN be done then converts into what WILL be done.

Level -3 : What will be done ?

- A reliable **Weekly Work Plan (WWP)** evolves from the make ready plan as all activities are understood to be constrain free. Then, reliable promises are made for the **next two weeks of work** - creating predictable work.
- There are **five rules for making a reliable promise**. Last Planners must say "NO" if they have any doubts about achieving them. This triggers a path clearing activity. Otherwise you are stating "YES" without qualification and it becomes their commitment and is used as the activity metric - **Percentage of Promises Completed (PPC)**.
 - Access competency before making promise
 - Understand the condition for satisfaction
 - Including a realistic time for completion, quality/safety considerations etc.
 - Ensure unspoken conversations conflicting with the promise are not taking place
 - Accept responsibility for failure and re-review the process for learning

- **Different color tags** - different trades - demolition, electrical, mechanical etc.
diamond shaped tags - missed commitments from the previous weeks WWP board. It also shows PPC and a workable backlog (or Plan B) of tasks that will be done in the event that new constraints arise to Plan A.
- The LPS is resilient and agile enough to facilitate the inevitable changes to plan. Plans are kept real and the **WWP boards reflect the actual ongoing work** in a colorful easy to read visual format.



Typical Weekly Work Plan (WWP) board

Level -4 : What was done i.e. did ?

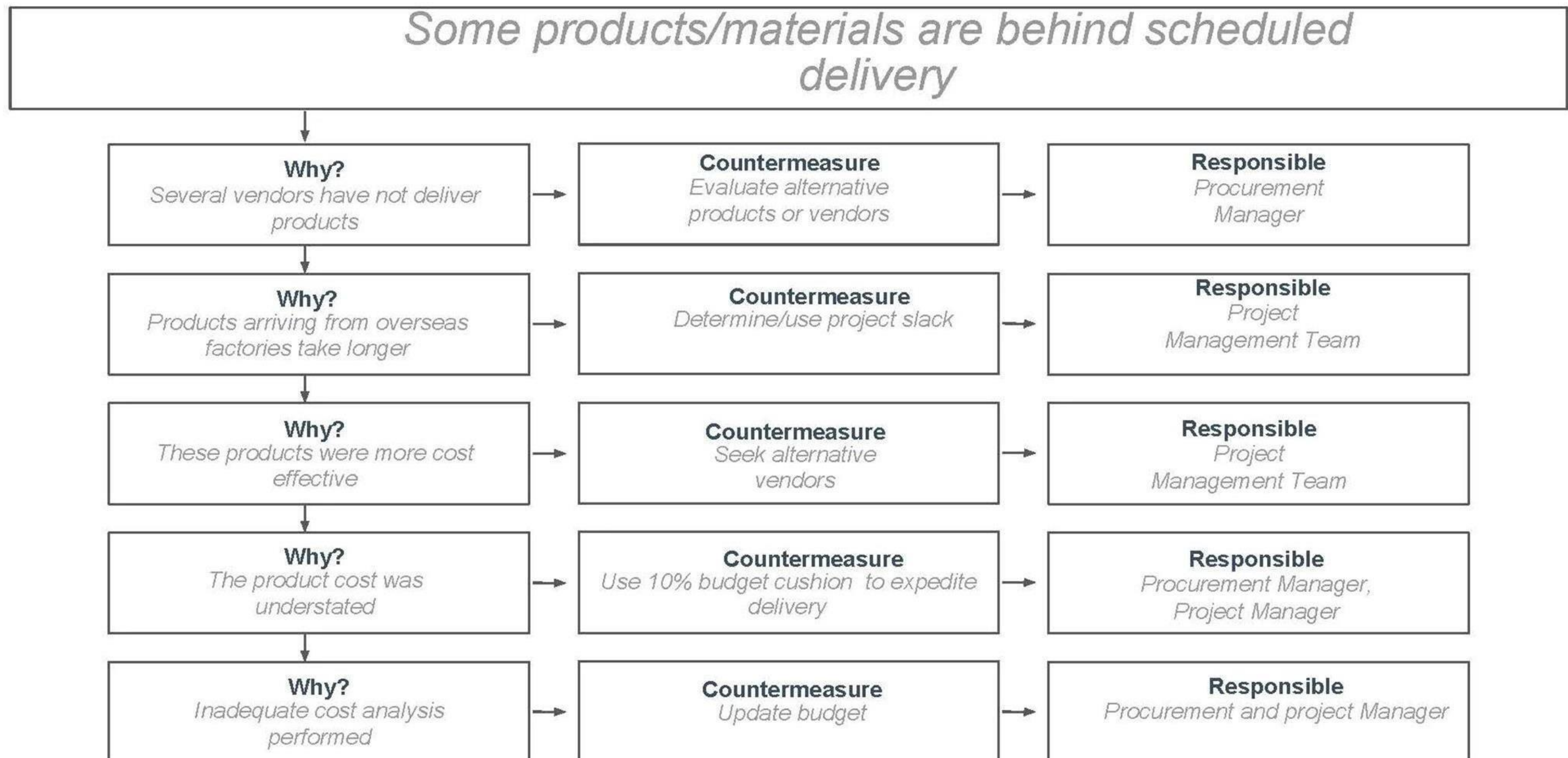
- New constraints arise daily , addressing these a reliable workflow is maintained. PPC is calculated daily and trended weekly using Pareto charts. It shows how the team is working and coordinating action together. The Reason for Missed Commitment (RMC) category list must reflect system issues. The content of the RMC list will vary between teams and also depends on the type or phase of project that LPS is being used on.
- A typical construction phase example ,The number assigned to the RMC list (and 5 Why analysis where possible) gets logged on the back of each activity tag that is missed (diamond shapes). The issues with the greatest impact on the schedule get investigated ASAP using a dedicated root cause analysis workshop.

1. Bad planning	8. Prior work
2. Design issue	9. Failed inspection
3. Materials not available	10. Equipment not available
4. Labor not available	11. Information not available/updated
5. Submittals/approvals	12. Contracts/change orders
6. Weather	13. I forgot
7. Unforeseen conditions	14. Misunderstanding
- RMC list relates to each of the 8 Flows mentioned before . This emphasizes the value of the make ready process and how learning gets incorporated into the system at each level.

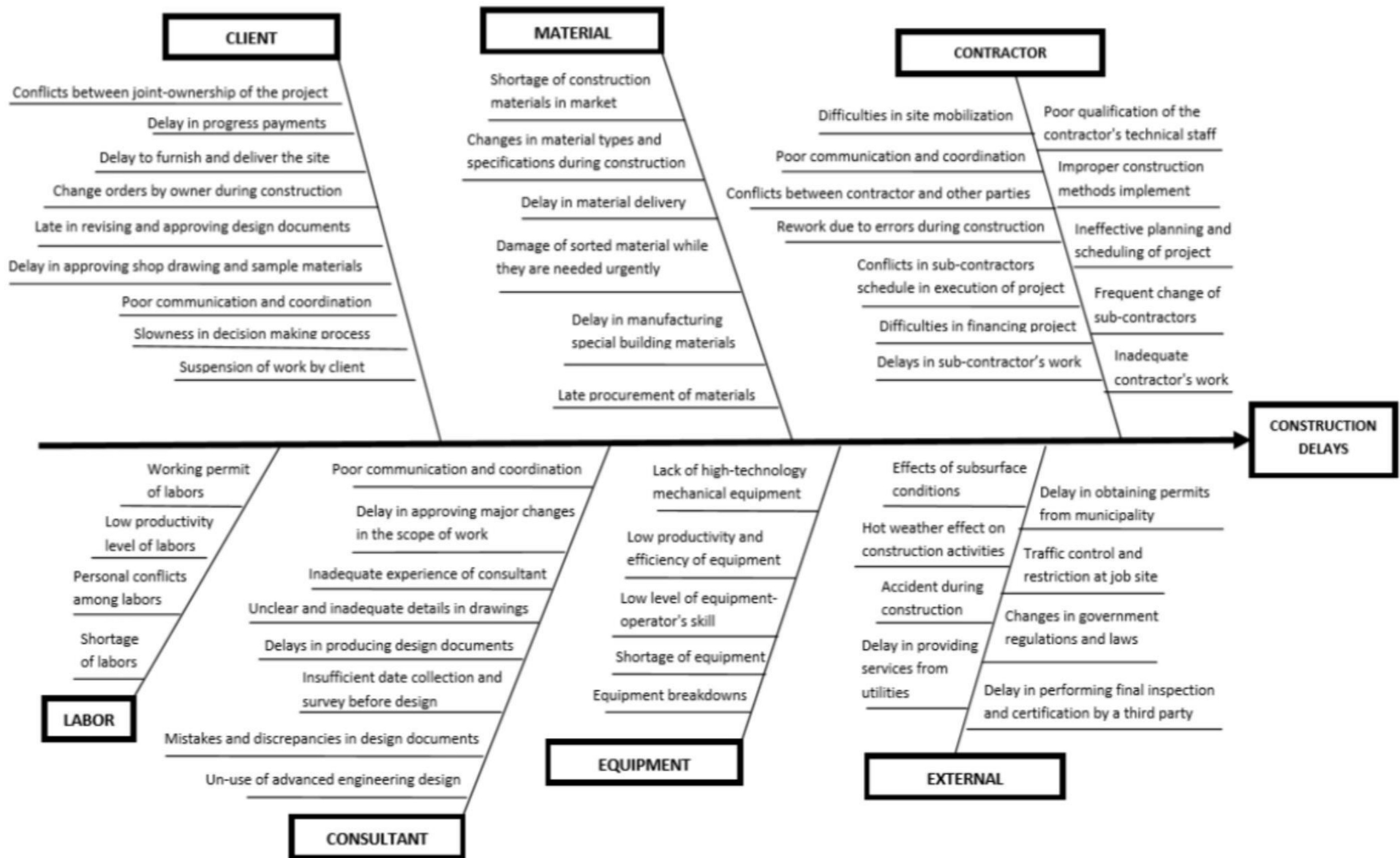
Level -5 : What the team needs to learn from?

- Learning from plan failures (root cause analysis) is critical to prevent the same issues happening again. This improves the system as a whole and the flow of the project. This happens through plus/deltas (what was good/what can be improved), takeaways (what did you learn today), 5 why analysis of RMCs, and also root cause analysis workshops.

5whys – schedule delay:



Root cause analysis :



Fish bone diagram

(Source: Assaf et al, 2006)

Prestige Finsbury Park Project, Bangalore

Broad Scope of Works	Design and Build contract for civil works for Tower and Non - Tower Areas at Prestige Finsbury Park (18 Towers – 2B+G+19/20/21)
Expected date of Completion of Project	24-Apr-2023

Revised Contract Value	491 Cr
Percentage Completion	32 %



Lean Tools	Current Status	Coverage at site	Further Implementation
PPC	June'21 – 83%, July'21 – 90%	Excavation & Concreting	Finishing Activities to be included – Gypsum & Waterproofing
VA for shortfall on PPC	Reason for Shortfall identified & steps taken	All areas covered	
Big Room Meeting	Team Meetings & weekly s/c Meetings	1 st Iteration Towers – Weekly s/c Meeting, Daily Meetings – for all areas	Big Room Meeting with Finishing Team
Cycle Time Analysis	Minimum Cycle time achieved 8 days in Tower 10	1 st Iteration all 9 towers covered	Continue till terrace Floor & 2 nd Iteration towers after 1 st Setting
Constraint Analysis	Weekly Review Meeting with s/c, Constraints discussions and measures to ensure on time closure	All areas covered	Same to be sustained
5S System	B1- 78% , B3B – 73%, B1B – 69%	1 st Iteration Buildings Covered – B1, B3B, B1B & Stores	2 nd Iteration Buildings – B2,B3A & B1B in Aug'21

5S Implementation status:



- 5S Audit Walk down Photographs at site in Building 3B & B1B
- 1st Iteration Buildings B1, B3B & B1B – 5S Audits Conducted. • Further 2nd Iteration Buildings – B2, B3A & B1B to be covered in the Month of Aug'21 & Sep'21.
- 5S Audit Building 3B during and after audit Photos with compliances



Big room Meeting – Weekly s/c Meetings :



20/06/21 39

Building-3B

Tower-11 - Kalyani Sarkar
Bimal Roy
Ali Ahmad.

Tower-10 - Gautam Biswal
Ganesh Jais.

Tower-12 - Bina Biswal
Narekh Kumar Royke
Bilal Khan.

Points

- Target to achieve 8 days slab cycle time.
- Material Shifting of Reinforcement
- Bracket fixing within 1-5 days.

Task 12 - engage rebar gang from 2 sides to ensure good scope for 2 carpenter gangs.

- Colony drinking & bathing water issue.
- No. of toilets take increased.
- Survey point → next day

Building-3B

1. Bimal Roy.
2. Ganesh Jais.
3. Ali Ahmad.
4. Narekh Kumar Royke
5. Kalyani Sarkar
6. Gautam Biswal.
7. Bilal Khan.

- * Co-ordination b/w sub-Contractors required for 8 days cycle.
- * Sub-Contractors to take responsibility & ensure quality work to reduce checking time for pour clearance.
- * Timely bracket completion
- * Vertical post not available.
- * Advance one slab reinforcement material required.
- Concrete walls
- Thermal.
- * Material issue take ensured on time. (advance material issue).

- S/c working in typical floor towers were invited for the weekly meetings to discuss the constraints faced by them to achieve target cycle time.
- All constraints/issues faced were recorded in a register and assigned to the concerned person to resolve it within target date.
- Meetings also helped to improve co-ordination between sub-contractors.

Constraint Analysis - S/c Meeting :

Building 3B S/c Meeting - 30.06.21						
S. No.	Activity	Constraints / Points Discussed	Constraints	Remedial action	Responsibility	Status
1	Bracket Fixing Work	Khalasi Gang (Ali Ahmad) to increase Manpower	Delay in Bracket fixing activity	Manpower augmentation required	Mr. Ali Ahmad	Completed
2	Bracket Fixing Work	Khalasi Gang (Ali Ahmad) to increase Manpower	Delay in Bracket fixing activity	Other Khalasi Gang to be allocated	Planning	Completed
3	Rebar Tying	Delay in Material supply from Rebar Yard	Material Fabrication delayed at yard	Prioritize immediate requirements	Mr. Prasanna	Completed
4	Workmen Habitat	Workmen Colony water availability issue	Irregular supply of drinking/bathing water, excessive use of water for bathing by workmen	Fixing of water taps for bathing water, replace with bath tubs	Time Office	Completed

Building 1 S/c Meeting - 02.07.21						
S. No.	Activity	Constraints / Points Discussed	Constraints	Remedial action	Responsibility	Status
1	Bracket Fixing Work	Khalasi Gang (Ali Ahmad) to increase Manpower	Delay in Bracket fixing activity	Manpower augmentation required	Mr. Ali Ahmad	Completed
2	Rebar Tying	Rebar Gang (Naresh Rajak) to increase Manpower	Delay in Rebar tying	Manpower augmentation required	Mr. Deepak	Completed
3	Concrete	Slab top level to be ensured during concreting	Undulations at slab top level	Top level check during concreting work thru Autolevel	Tower Incharge	Completed
4	Issue of Materials	Extended time wastage at stores to collect materials	workmen idling	FW Consumables to be issued at once for every floor	FW Incharge	Completed

Constraint Analysis – Site :

S. No.	Activity	Constraints / Points Discussed	Constraints	Remedial action	Responsibility	Status
1	Concreting	Delay in Start of Concreting	Limited Resources	Additional Pump & Pipeline Gang to be mobilized	P&M/Planning	Completed
2	Revised Logistic Plan	Alternate Vehicle Movement path finalization around B1B by shifting Boundary Line towards Marketing Office.	To facilitate Excavation for Club House & DG Room in Regent	Additional 6m width area towards client marketing office boundary	Planning	In Progress
3	Manpower Mobilization - Finishes	Finishes Workmen requirement for Look Ahead Plan for next 2 months	Shortage of Manpower for finishing activities	Workmen mobilization for Gypsum & Tiling Works	Building Incharges	In Progress
4	Backfilling/ Alternate Vehicle Route	Tower 5 Footings to complete by Sep'21	Footing Casting on Hold	Vehicle Movement path to be diverted through another route	Planning	In Progress

CONTRACT

This Contract is entered into by and between _____

The term of this Agreement shall begin on _____
termination date of _____

This Contract may not be modified in any
Parties. This document and any attachments
the Parties. This Contract shall be binding
assigns and shall be enforced under
In consideration of the mutual promises
agrees that it shall

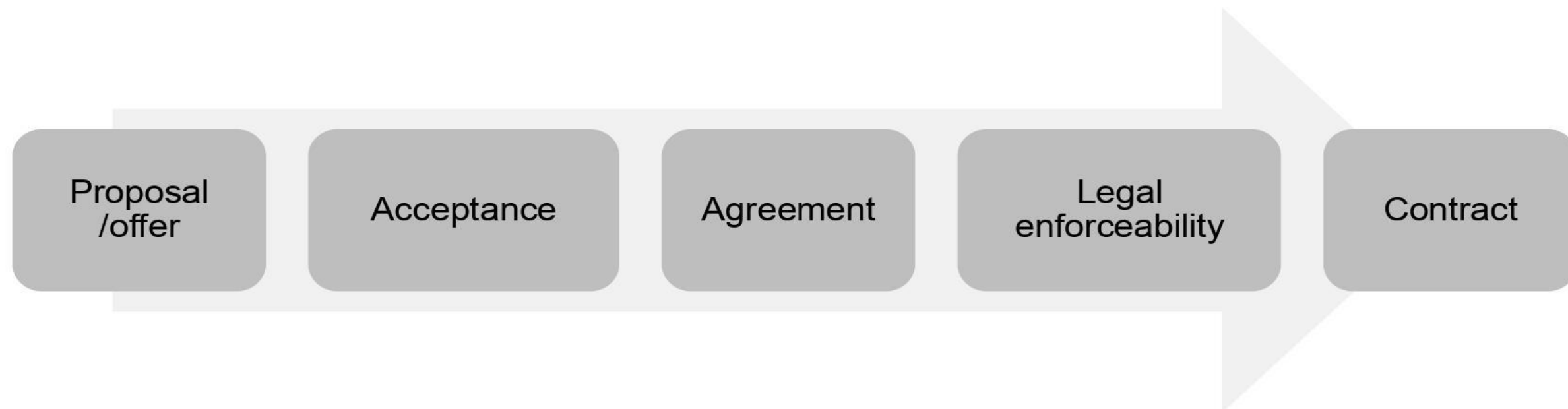
_____ shall continue through its
_____ constitute the entire agreement between
the Parties, their successors, heirs and
the State of _____
with herein, the First Party covenants and
the Second Party covenants and agrees that

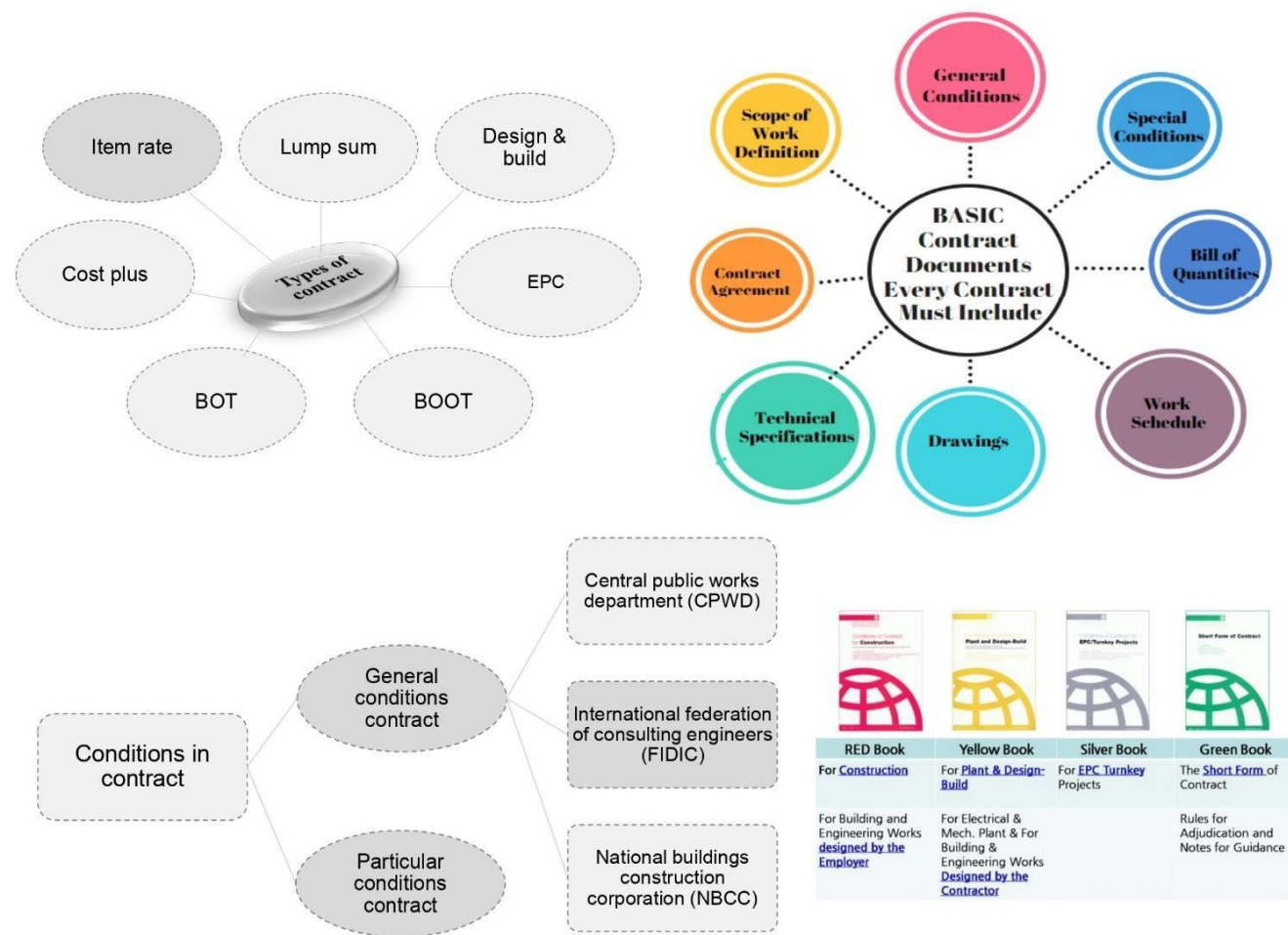
CONTRACT

- A contract is a **legally binding agreement between two or more parties** who agree to buy or sell goods and services from one another.



- **In construction a written contract would be able to allocate risks to save time and money in the execution of the project.** Contracts are the medium within which project risks are allocated and dealt with.
- The form of contract used for each project is critical to the potential for optimum performance and execution of the project.





Item	Sub-clause	Data
Name of the project		WIPRO IT - SEZ at Kodathi , Bengaluru
Employers name	1.1.2.2 &1.3	WIPRO Limited
Contractor name	1.1.2.3 &1.3	Larsen and Toubro limited
Type of building		Office building
Scope of work		Ground works , civil and structural works , Architectural works and interior finishes .
Contract type		Item rate contract
Bill of quantities	1.1.1.10	1.Ground works 2.Civil and structural work 3.Architectural works 4.Finishes works 5&6.Miscellaneous work 7.Others
General conditions		FIDIC red book
Commencement of the work	1.1.3.2	28 th January 2016
Defects notification period	1.1.3.7	365 days from the date of issuance of the last taking over certificate
Milestone completion certificate	1.1.3.10	Certificate issued by engineer upon successful completion of milestone under sub clause 8.2 (time for completion)
Governing law	1.4	Law of India

Item	Sub-clause	Data
Time of completion of works		
Section -1 : Completion of Block B4,Block B5 and utility block along with all the associated work including but not limited to roads ,trenches ,parking and utilities fit for regular business operations including obtaining necessary statutory approvals including but not limited to occupancy certificate for these buildings .	1.1.3.3 and 8.2	24 months from the commencement date
Whole work		30 months from the commencement date
Ruling language	1.4	English
Language for communication	1.4	English
Time to access to site	2.1	Within 7 days from the day of issuance of letter of acceptance
Amount of performance security	4.2	5% of contract price in the form of bank guarantee from any nationalized bank valid up to end of defects notification period plus 90 days.
Normal working hours	6.5	Working hours shall be in accordance with statutory regulations
Commencement date	8.1	28 th January 2016
Delay damages for the work	8.7&14.5(b)	Whole Work: 0.5% of the Contract Price per week
Maximum amount of delay damages	8.7	5% of the contract price
Delay damage for milestone completion for the following milestones	8.7	
MS6	8.7	5% of value of work certified up to MS6 from the date of commencement
MS12	8.7	5% of value of work certified between MS6 and MS12
MS15	8.7	5% of value of work certified between MS12 and MS15
MS18	8.7	5% of value of work certified between MS15 and MS18
MS21	8.7	5% of value of work certified between MS18 and MS21
MS24	8.7	5% of value of work certified between MS21 and MS24
MS27	8.7	5% of value of work certified between MS24 and MS27
Bonus for the milestone completion	8.13	Whole work :INR 1,50,000 per week of earlier completion
Maximum amount of bonus for the milestone completion	8.13	2% of the accepted contract amount

Item	Sub-clause	Data
Percentage adjustment of provisional sums	13.5(b)	9%
Adjustments or change in cost	13.8	Not applicable
Total advance payment	14.2	15% of the contract price for the respective part against bank guarantee excluding provisional sum upon - Signing of contract and - Submission of performance bank guarantee - Submission of advance payment bank guarantee of equivalent to advance payment amount and - Submission of retention bank guarantee of equivalents to 5% of the contract price.
Number and timing of installments	14.2	One installment
Currencies and proportions	14.2	All in Indian currency
Start repayment of advance payment	14.2 (a)	Once certified work value is more than 10% of the contract price
Repayment of advance payment	14.2 (b)	Repayment shall be at 16.7% of interim certified bill value and shall be completed when the certified amount reaches 90% of the contract price.
Percentage of retention	14.3	5% of the contract price in the form of retention bank guarantee from any nationalized bank valid up to the end of defects notification period plus 90 days to be submitted along with performance bank guarantee.
Limit of retention money	14.3	5% of the contract price
Plant and materials for payment when shipped on route to the site	14.5(b)	Not applicable
Plant and materials for payment when delivered to site	14.5 (c)	Not applicable
Currency /currencies of payment	14.15	Indian rupees
Currencies of payment if currencies are to be made in a currency / currencies not named on the first page of the letter of tender	14.15	Not applicable
Insurance	18	The contractor to take all the insurance except third party having the employer as beneficiary.
Insurance cover of contractors all risk policy	18	105 % of the contract price valid till the time of completion
All other insurance policies	18	Valid till the time of completion
Periods for submission of insurance a, evidence of insurance b, Relevant policies	18.1 18.1	7 days 21 days

Specification :

- Specifications simply amplify the information given in the contract drawings and bill of quantities. It describes in **details the work to be executed under the contract and the nature and quality of materials, components, and workmanship.**
 - Mandates general criteria to be followed for execution
 - Specifies the applicable standards
 - Details the list of approved makes
 - Describes the methodology of work
 - In case of item rate contract ,details the scope of the mentioned rate
 - Inspection parameters
- Example : For structural & other steel works first describes the general criteria for execution of the work , followed by its Indian standard codes .
- Then the bill of quantity of the materials for steel works were mentioned and the preparation of materials like marking ,cutting and drilling were explained along with the preparation and process for welding & bolting .
- Next the inspection of material is done followed by packing ,transportation ,delivery ,final acceptance and handling over the structure.

Method of measurement :

- IS 1200 (part -1) – 1992 : Method of measurement of building and civil engineering works : part 1 earth work

Excavation in Earthwork Including Rock Cutting :

- All excavation shall be measured in successive stages of 1.5 m stating the commencing level. This shall not apply to cases where no lift is involved as in hillside cutting.
- All excavation shall generally be described as ‘excavate and get out’ . Getting out shall include throwing the excavated earth at least one meter or 1/3 depth of excavation whichever is more clear of edge of the excavation

Surface dressing:

- Trimming of natural ground, excavated surface and filled up area to remove vegetation and/or small inequalities not exceeding 150 mm deep shall be described as surface dressing and measured in square meters.

Surface Excavation:

- Excavation exceeding 1.5 m in width as well as 10 sq.m on plan but not exceeding 300 mm in depth shall be described as ‘surface excavation’ and measured in square meters.

Excavation over area :

- Excavation exceeding 1.5 m in width as well as 10 sq.m on plan, and 300 mm in depth shall be described as excavation over areas and measured in cubic meters.

Excavation in Trenches for Foundations and for Pipes, Cables, etc:

- Excavation in trenches for foundations and for pipes, cables, etc. , not exceeding 1.5 m in width and for shafts, wells, cesspits and the like not exceeding 10 sq.m on plan shall be so described and measured in cubic meters.

Excavation Trenches for foundation :

- Foundations For depth exceeding 1 m, an allowance of 50 mm/m depth for each side of trench shall be added to the specified width.

Post Holes :

- Independent post holes (or similar holes), each not exceeding 0.5 cubic meters, shall be enumerated and the description shall include return, fill and ram and removal of surplus spoil.

Return, Fill and Ram :

- Returning, filling and ramming of excavated earth where not described with the item of excavation shall be measured in cubic meters and shall include spreading in layers not exceeding 200 mm in depth, watering, well ramming and levelling.

SITE VISIT



L&T INNOVATION CAMPUS, CHENNAI

Project name	L&T Innovation campus
Client	L&T reality
Location	Chennai
Contractor	L & T Constructions - Buildings and Factories
Consultant	Architectural consultant –Chakrapani & sons Structural consultant – Vastech Consultants & Engineers LLP MEP Consultant - QDC India Consulting Pvt Ltd
Sub-contractors	PAV Infra (For Earthwork) UTRACON (Water Resistant Membrane) Stress tech Engineers (Anchoring & Post-Tensioning Tendon works)
Type of contract	Item rate
Project time	29 Months
Plot area	22 acres
Built-up area	4.6 acres
manpower required	1400
Excavation	2,92,450 cum



- The Focus is to create A grade IT/ITES office space with world class features and facilities to attract long term tenants and to full fill by creating sufficient, sustainable, mixed used development with local retail, public and semi-public amenities, parks, open spaces and urban streets.
- Two Towers of Phase 1 is on under Construction which is located on south west corner of the plot with an abutting road. The project is developed in two phases.
- The excavation work is the major activity going on the site, all the departments in the site are more focused in the Excavation process.
- Total Built-up area of Phase I of the project is about 1.58 million Sq. Ft having 3 Basements, Ground Floor and 12 Office Floors in each tower. There will be 2 towers with a combined basement.
- Infrastructure facilities like roads, power, water, storm water and sewer management system, waste management system (solid & sewage), high-tech optical fibre connectivity, etc., are expected to be seamlessly integrated into the development.

- Approximate distances to major Locations

- Chennai central – 17 km
- Marina Beach – 19 Km
- High court – 18 Km
- Chennai Airport – 7 Km
- Koyambedu bus terminal – 8 Km



Scope of work	
By owner	To obtain Land, Specifications and Drawings, Permissions, Approval for construction Payment for initial connection for obtaining electricity on a single point.
By contractor	All Materials, Plant and Machinery, tools with resources shall supplied by contractor . Water supply for initial connection shall obtained by the contractor and consumption of electricity and water for usage and for drinking including testing made by the Contractor. Contractor should provide site office and provide major site infrastructure for other contractors eg. Tower crane, Material hoist, labor, Passenger hoist.
Key clauses of project	
Variation	The owner has right to make any variation in quality or quantity of the work or any part owner has to decide for completing the work or owner has right to order the contractor on increase or decrease in quantity Omission/ addition/ alteration of work/part Work or Change in specification/quality of Work/part Work.
Payment Terms	Stage 1- 75% of RA bill shall be paid within 10 days. Stage 2 - Balance of RA shall be made within 30 days after its certification Monthly RA bills shall be submitted by the contractor as per agreed milestone .
Mobilization Advance	10% of advance of Total order value shall be paid against with bank guarantee of equivalent amount . Recovery of same shall be made on pro rata basis of RA Bill from Second (2nd) RA Bill and shall be fully recovered till Eighty-Five (85) % of Total Order Value .

Retention Money	5% of R. A bill shall be retained up to 5% of value of order as retention money. In according to cash retention Contractor shall submit Indemnity Bond, equivalent to Five (5) % of the Value of order within Seven (7) Days of issue of this Work Order.
Secure Advance	75 % for material advances of invoice value shall be paid through monthly R.A bills. The Secured Advance will be recovered from the subsequent R.A Bills to the extent of the value of advance against these materials is consumed.
Performance Guarantee	5% of Total order Value within 7 days. The contractor shall extend the bank guarantee/Indemnity bond with 1 month prior to expiry date or within 7 days.
Liquidated Damages	In case of failure to meet construction, schedule LD shall be payed 0.5% of total ordered valued shall be recovered from bank Guaranteed shall be applicable on intermediate milestone and worked out on prorated basis.
Defects liability period	DLP Shall be 24 months from the date of issue of LOA.EIC shall prepare snag for every 4 months during DLP and rectified by the contractor within 7 days from the date of issue of snag list. If the contractor fails to remedy the defect or damage owner shall execute the work and contractor is liable to pay expenses with overhead cost.
Price Escalation	BOQ Rates in the Contract is fixed for the entire duration of contract and extended period(s) granted to the Contractor by the Owner. No price escalation whatsoever is payable.

Order of Precedence	For Contract Condition, Special condition shall prevail over General condition For Technical clarification and general guidelines towards workmanship and contract condition shall prevail over technical specification. BOQ should be considered for over all items, Unit and scope of work. For execution of work, Good for construction drawings will be worked over tender drawings.
Insurance	The contractor shall be responsible for safety of employees/workers and shall report all cases of accidents to any of them whenever caused, shall make arrangement for assistance and aid to victims of the accident. Contractor should make provision for Workmen's compensation insurance, Group personal accident policy, Third party liability insurance, Contractor plant and machinery insurance.
Termination	Owner may terminate the contract at any time at any cause, Upon such termination owner liability will be limited to work already executed or reduced quantity or communicated within the reasonable time.
Closure / Suspension	The owner reserves right to terminate the contract in part or in full due to business contingencies or any other reason whatsoever. The Contractor on receipt of such notice shall discontinue the work on date and to stop all other sub contract and purchasing activity. The Contractor shall be paid by the contractor only for the completed work, The owner shall have rights to temporarily suspend and reinstate the execution of the whole.



Departments in site



Accounts

Stores

Time office

Environment ,health &safety department

Formwork department

Civil work

Mechanical ,electrical and plumbing(MEP)

Plant and machinery (P&M)

Planning

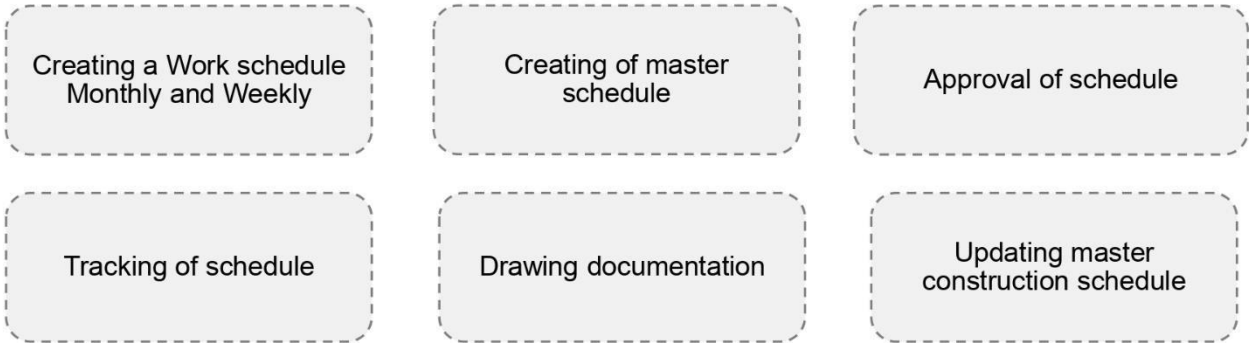
Quality assurance & Quality control

Reinforcement

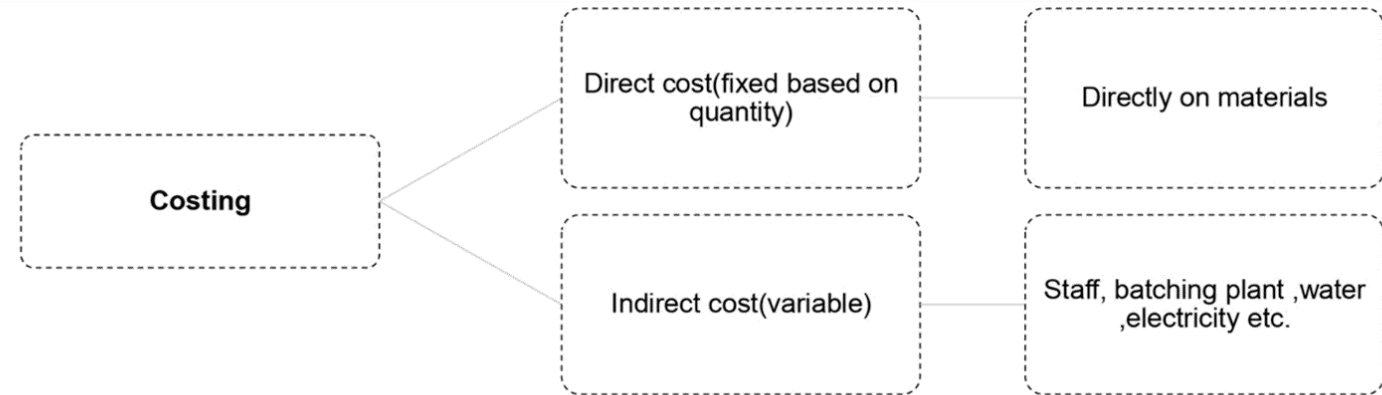
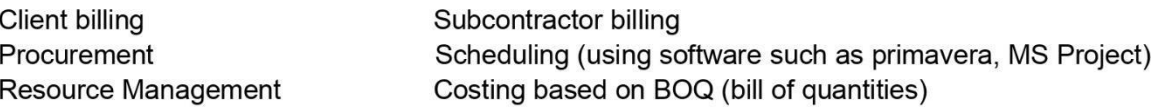
PLANNING

- Planning plays a very important role in today's construction. The effectiveness of the planning and preparation lead to the success of a project including the quality and time consumed in completing the project.
- A good and properly planned construction site can improve the efficiency and even the safety of the construction operation. Therefore, to construct a good building, the step of planning cannot be eliminated or skipped in order to save the construction time and money.

Various Functions :



Roles and responsibilities :



Client Billing:

- Contractor prepares the measurement sheets based on the monthly progress & certifies the same from client's representative at site. Based on certified measurement contractor prepares the running account bill according to the approved BOQ.
- There after the bill is submitted to client's project team for their certification. Client's representative checks the bill & certifies the same and forwards to their account's department. Before sending to account's department client's project team representative make the SAP entry.
- After the bill submission account's department checks it. After checking & realization of bill, the final payment is released by client through check.

ACTIVITIES

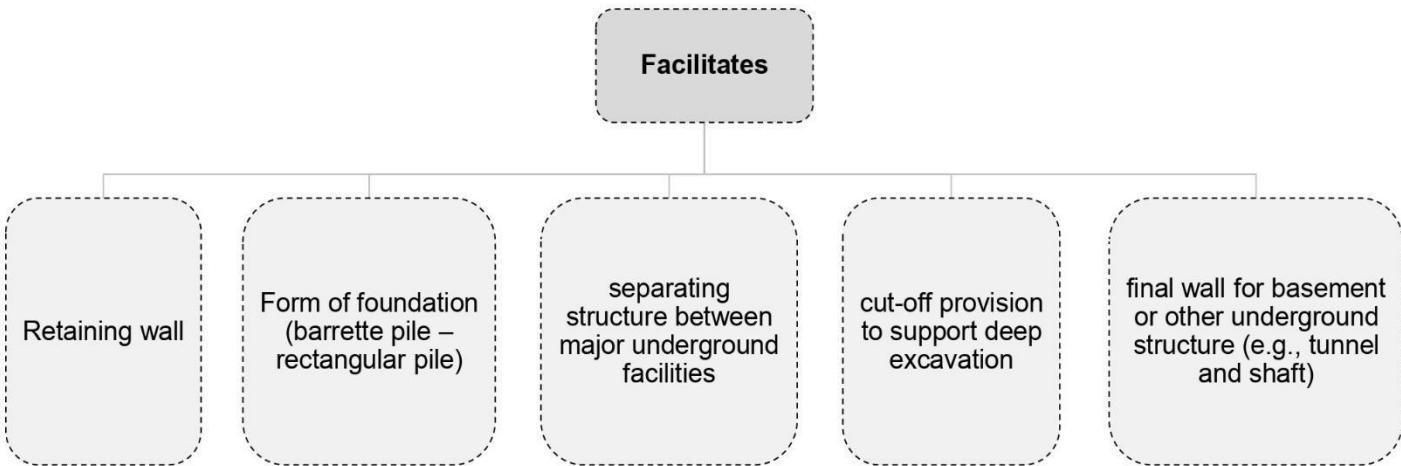
Diaphragm wall (D-WALL):

- The IT Campus project was a (G+12) ground plus 3 level basement car parks. As the site was near to the residential structure there was very little space for the construction activity.
- Any conventional approach would lead to use of more space on the ground level. IT Construction carried the project by constructing a diaphragm wall. This requires very less space in excess to rather on deep and sloped excavation.



D - wall

- It is a structural concrete wall constructed in a deep trench excavation, either cast in situ or using precast concrete components.
- Diaphragms walls are often used on congested sites, close to existing structures, where there is restricted headroom, or where the excavation is of a depth that would otherwise require the removal of greater volumes of soil to provide stable battered slopes.
- They are suitable for most subsoils and their installation generates only a small amount of vibration and noise, which increases their suitability for works carried out close to existing structures. In addition, floor slab connections and recessed formwork can be incorporated into the walls.



D - wall

Construction procedure

Guide wall:

- Guide walls are two temporary parallel beams constructed along the side of the wall in order to provide permanent alignment for the grabbing of diaphragm wall, to provide edge protection to the diaphragm wall and to prevent the collapse of top soil during excavation. To act as platform to hand reinforcement cage and maintain the level

Excavation :

- Hydraulic Machine of 600mm will be setup vertically either on one side of guide wall axis. The trenching will be carried out by the grab attached to hydraulic rig.
- In the event of weathered hard rock trenching is difficult then it is carried out by hydraulic rotatory rig. Excavation by grabbing will be done in presence of polymer mud solution.
- The density of polymer mud solution for circulation will be kept more than normal density to ensure the stability of the trench.



Stop End Pipes :

- After completion of excavation, the stop end will be installed. Two stop end tubes will be placed at the ends of the excavated trench before concreting. The tubes are withdrawn at the same time of concreting so that a semi-circular end section is formed.
- Wall sections are formed alternatively leaving an intermediate section in between. The in-between sections are built similarly afterward but without the end tube. At the end a continual diaphragm wall is constructed with the panel sections tightly joined by the semi-circular groove.



Reinforcement Cage fabrication & Lowering

- The specified reinforcement cage will be fabricated on the ground and welded depending upon the site condition and fabricated and lowered in two or four parts.
- Lifting & placing of cage will be done with the help of 02 no's of crane. After completion of lifting process, the cage will be lowered slowly into the panel and positioned with verifying the line verticality with plumb-bob.



Tremie pipe Lowering:

- With the steel reinforcement in place the tremie pipe of internal diameter of 200mm along with the hopper attachment is lowered at the centre of the point to have uniform fill of compacting concrete in panels.



Placing of Concrete:

- Concreting of diaphragm wall shall be done continuously without interruption to ensure no mixing of polymer with Concrete

Waterproofing vertically on Diaphragm wall

- The membrane shall be applied over the smooth and prepared surface of Diaphragm wall. It shall be applied with the sanded face uppermost to receive fresh concrete to which it will adhere by pressure sensitive adhesive technology.
- Cut the membrane to a convenient length & width of the diaphragm wall for installation. Carefully align the membrane and roll it out with the sanded surface uppermost. Membrane can be spot bonded to the Diaphragm wall using sealed tape 22 .
- Lay the adjacent sheets accurately so they overlap the previous sheet 75mm along the adhesive edge.



Anchoring on diaphragm wall :

- In diaphragm wall construction, ground anchor bolts are used in order to link the structural and non-structural elements of the D-wall to the concrete. The process of casting these anchors into the diaphragm wall is known as Anchoring. The Anchoring activity begins 7 days after the diaphragm wall panels are cast.
- Anchoring assists in transferring the tension and shear forces between these structural elements and lateral support to the diaphragm wall to sustain force from the top.

Methodology:

- A drill rig is used to drill boreholes of 150 to 180 mm, at 15 to 30 degrees till the hard strata after that rig will be used mean time casing pipe is used till the level of hard strata and the casing pipe is put into the hole in the centre.

Excavation

- Upon completion of boring, the borehole is cleaned through compressed air. A low relaxation prestressed steel (LRPC) strand is inserted into the bore and the anchor is grouted. The anchor head is then pre-tensioned by jacking after 7 to 10 days.

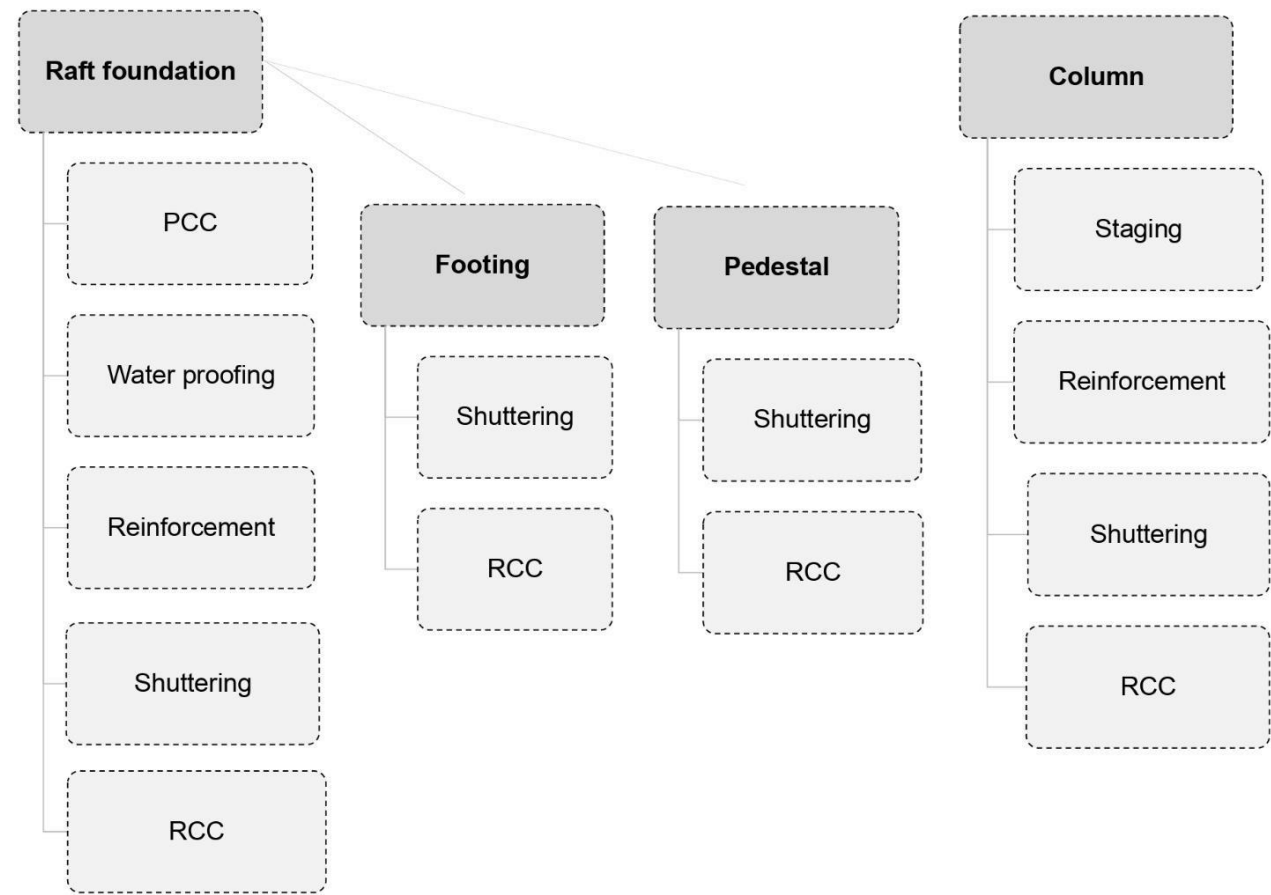


Excavation

- Excavation delay happens due to hard rocks in the site.
- The depth of the excavation is 16m .
- Excavators are used to excavate the soil in the site.



Raft foundation



Raft foundation

- A raft foundation is a continuous slab resting on the soil that extends over the entire footprint of the building, thereby supporting the building and transferring its weight to the ground.
- In site the raft foundation is considered due to the presence of black soil known to be weak soil majorly used for purpose of filling , as it distributes the weight of the building over the entire area of the building, and not over smaller zones (like individual footings) or at individual points (like pile foundations).This reduces the stress on the soil.
- It will be very good for basements as this building has level of 3 basements. The raft is constructed at 50 ft ground below and diaphragm wall around the periphery makes an excellent basement.

Methodology :

- A 100mm of thin Plain Cement Concrete (PCC) is poured just to create flat and without any undulation as a base. The water proofing plastic sheet is laid over the PCC.
- After this, reinforcement steel for the raft slab is tied in place. After all the steel has been put in place, RCC is poured to the thickness of 500mm for heavy loads to be carried.



Water proofing membrane

- It is a layer of water-tight material that is laid onto a surface of PCC to prevent water leaks or damage. Waterproofing membranes generally consist of liquid applied or pre-formed sheets.
- The membrane is installed around the 21 foundations (Raft slab) to prevent water penetration to protect building's basement, waterproofing will help stop water from infiltrating in foundation and protect structure from water damage. Waterproofing membrane is added to the concrete that will help make water impenetrable for the water to penetrate.

HDPE membrane :

- High Density Poly Ethylene is a membrane HDPE film pressure sensitive adhesive which allows poured concrete to bond fully with the membrane.
- It provides water, water vapour protection from aggressive ground salts, chemicals and hydrocarbons. It is a self-adhesive along one side of the roll to provide sealed laps to simplify the application process.

Methodology :

- Waterproofing Horizontally Cleaning the surface free from dust, dirt by grinder or wire brush. Dewatering should be done before placing and the surface should be dry. Cutting the membrane to the following length.
- Align the membrane and roll it out with facing on sanded side and then adjacent sheet to be laid with the overlapping of 75mm. Overlaps between sheets to be rolled to ensure good adhesion by gently releasing the release film End joint and cut edges should be sealed with tape.
- Remove the sanded particles inside the membrane with hot air shovel gun



Reinforcement

- The reinforcements are the bone of the structures. They are used to provide the tensile strength to the building. There are different structural elements provided in the reinforcements like space bar, chair rod, dowels ,tie rod, stirrups etc.....
- **BBS** : Bar Bending Schedule is a way of organizing rebars for each structural unit, giving detailed reinforcement requirements .



Post tension slab (PT slab)

- Post tension slab is a combination of conventional slab reinforcement and additional protruding high-strength steel tendons, which are consequently subjected to tension after the concrete has set.
- Use of PT slabs results in small sections, better serviceability, durable structures and faster construction compared to reinforced concrete construction.



Advantage :

- Speedier construction.
- Reduces occurrences of cracks. Increases durability of freezing and thawing effect.
- Economical and superior design
- Reduction in dead load due to thinner slab which will make cost savings
- Less number of work force engaged for post tensioning works than RCC slab.
- It act as a tension member.



Reinforcement

Column rebar :

- Columns are the vertical supports given to the building which rises from the foundation. It transmits the compression loads of the entire structure to the foundation evenly.

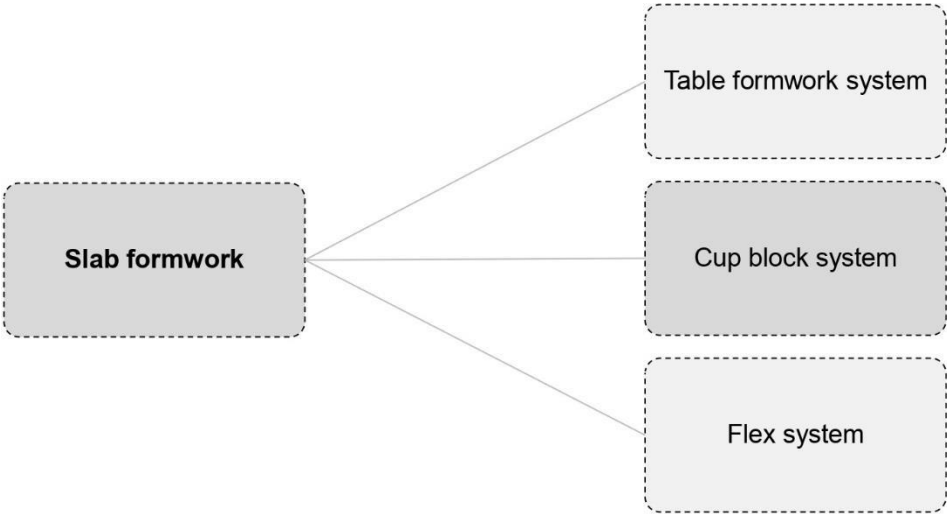


Slab rebar:

- Slab is an important structural component. It provides a covering shelter or working flat surface in buildings. Its primary function is to transfer the load by bending in one or two directions. The upper slab becomes the ceiling for the storey beneath it.



Form work



System selection :



Form work

- On rapid changing of construction industry with changes new process and materials are used in order to save time, cost, and utility of space are major considered factor. When concrete is placed, it is in a plastic state.
- It requires to be supported by temporary supports and casings of the desired shape till it becomes sufficiently strong to support its own weight. This temporary casing is known as the formwork or forms or shuttering. One of the better approaches is the use of Aluminium to make panels and props to form the formwork system.
- Unlike other construction systems, Formwork Systems of **Aluminium forms** can be erected by unskilled labor and without the need for hoisting cranes. The largest panel weighs not more than 25 kgs which means it can be handled by a single worker.



10. Joint bar

Weight (kg) 0.68

Used to joint the prop heads with the beams (Middle beam and/or End beam)



11. Special prop head

Dependent upon each structure

Used to joint the beams together (Middle beam and/or End beam), this special prop head will be placed where a normal prop head cannot be installed

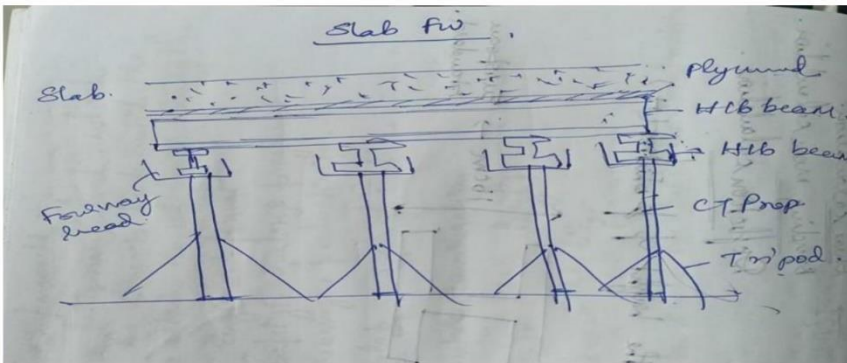


12. AL - (A/G) Release

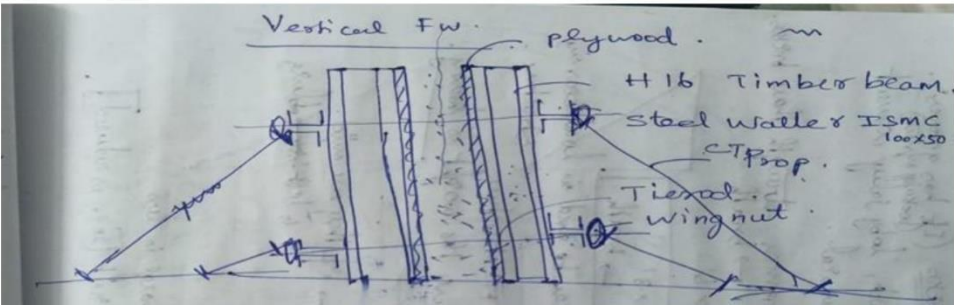
Size 63.5 x 63.5 | Weight (kg/m) 1.931

Used to join panels together around the corners

Form work



Vertical and horizontal formwork



QUALITY ASSURANCE AND QUALITY CONTROL

Slump Cone Test	Methodology
- Concrete slump test or slump cone test is to determine the workability or consistency of concrete mix prepared at the laboratory or the construction site during the progress of the work. - Concrete slump test is carried out from batch to batch to check the uniform quality of concrete during construction. The slump test is the simplest workability test for concrete, involves low cost and provides immediate results .	- After the Slump is obtained from batching fill the mold with the prepared concrete Tamp each layer with 25 strokes of the rounded end of the tamping rod in a uniform manner over the cross section of the mold. - For the subsequent layers, the tamping should penetrate into the underlying layer. Raise the mold from the concrete immediately and slowly in vertical direction. The Value should range between 15 – 20, then it considered as true slump.



QUALITY ASSURANCE AND QUALITY CONTROL

- This department takes care of quality of all the materials that are used in the construction site and follow various check list and provide method statements for each and every works . By doing so they assure the quality of the product.
- Various Quality test for material is been tested in QA/QC lab with the proper approval from client the material will be used for various activities on the site .



VICAT apparatus test (for finding initial & final setting time of cement)	Sieve analysis(for sand)	Tolerance test (for steel)
Slump test (for workability of concrete)	Fineness test (for cement)	Compression test (for concrete cube)
Moisture content test	Elongation index & Flakiness index (coarse aggregate)	Abrasion test, Attrition test (Coarse aggregate)

QUALITY ASSURANCE AND QUALITY CONTROL

Sieve analysis test	Methodology
- Sieve analysis of fine aggregates is one of the most important tests performed on-site.(IS 2386 - part 1 – 1993) - Aggregates are inert materials that are mixed with binding materials such as cement or lime for the manufacturing of mortar or concrete. It is also used as fillers in mortar and concrete.	- A series of IS sieves 4.75 mm, 2.36 mm, 1.18 mm, 600 mic, 300 mic, 150 mic, 75 mic is taken to measure sieve, Weight the sample to exactly 1000g, clean all the sieves using a wire brush to be clear of aggregates stuck in some gaps. - Arrange the sieves from top to bottom the size from biggest (4,75mm) to smallest (0.075mm). The sample is sieved by using the set of IS Sieves for 10 minutes. After the sieving is done, the aggregates 34 on each sieve are weighed individually. - Cumulative weight passing through each sieve is calculated as a percentage of the total sample weight. The same procedure is followed for two more samples.



QUALITY ASSURANCE AND QUALITY CONTROL

Cement Consistency Test	Methodology
Vick at Apparatus (IS 4031- part4 -1993) - A Minimum quantity of water required to initiate the chemical reaction between water and cement to form a paste is known as consistency of cement. - The cement consistency which will allow the Vicat plunger to penetrate to 5-7 mm point from the bottom of Vicat mold is known as standard consistency.	- Take 400g of cement and place it in a bowl or tray. Now Assume standard consistency of water is 28% and add the same quantity of water in cement and mix it. - Mix the paste thoroughly within 3-5 minutes. The time taken to obtain cement paste after adding water is gauging time. Now fill the paste in Vicat mold correctly any excessive paste remained on mold is taken off using a trowel. - Then, place the VICAT mold on Glass plate and see that the plunger should touch the surface of VICAT mold gently. Release the Plunger and allow it to sink into the test mold. Note down the penetration of the plunger from the bottom of mold indicated on the scale. - Repeat the same experiment by adding different percentages of water until the reading is in between 5-7mm on the Vicat apparatus scale.

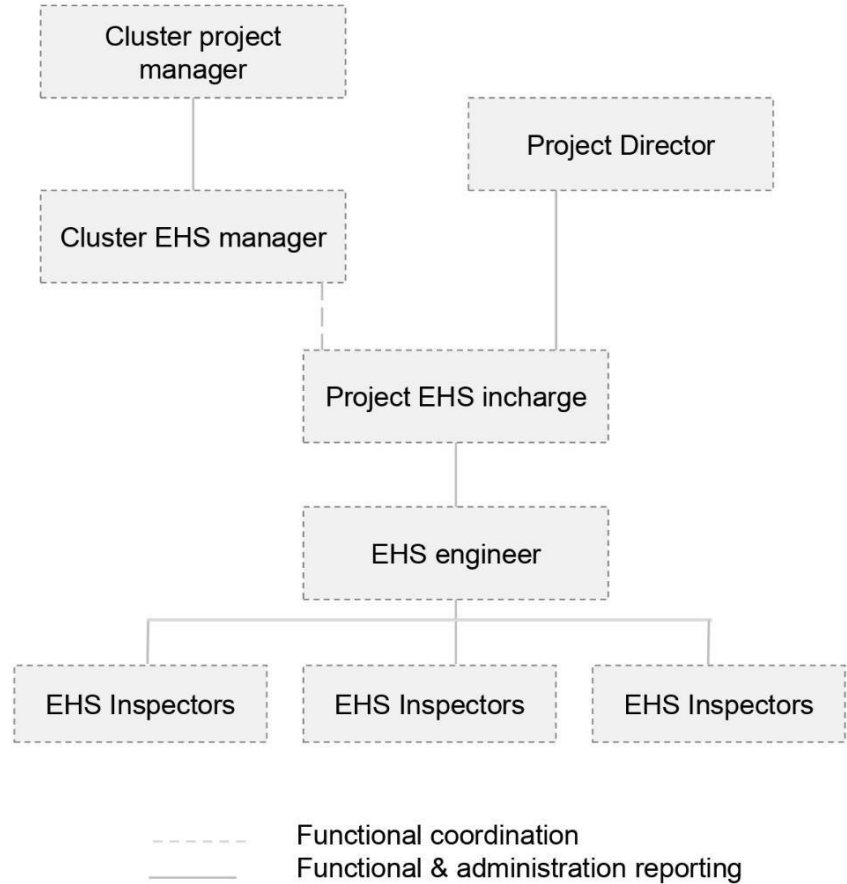


QUALITY ASSURANCE AND QUALITY CONTROL

Elongation index & Flakiness index	Methodology
- Particle shape and surface texture influence the properties of freshly mixed concrete more than the properties of hardened concrete. - To determine the particular shape distribution of coarse aggregate. (IS 2386 –part 1 – 1993)	- Take a representative air dried sample by quartering method or by a sample driver. - The sample shall be prepared for the above test with the following sieves, 63mm passing & 50mm retained 50mm passing & 40mm retained 40mm passing & 25mm retained 20mm passing & 16mm retained 16mm passing & 12.5mm retained 12.5mm passing & 10mm retained 10mm passing & 6.3mm retained - Weight the above individual weight of each sieve fraction consisting at least 200 pieces in each. - Allow each pieces to pass in the thickness gauge by placing the individual practice by hand . - Weigh the material passed in each size of the thickness gauge and record it.



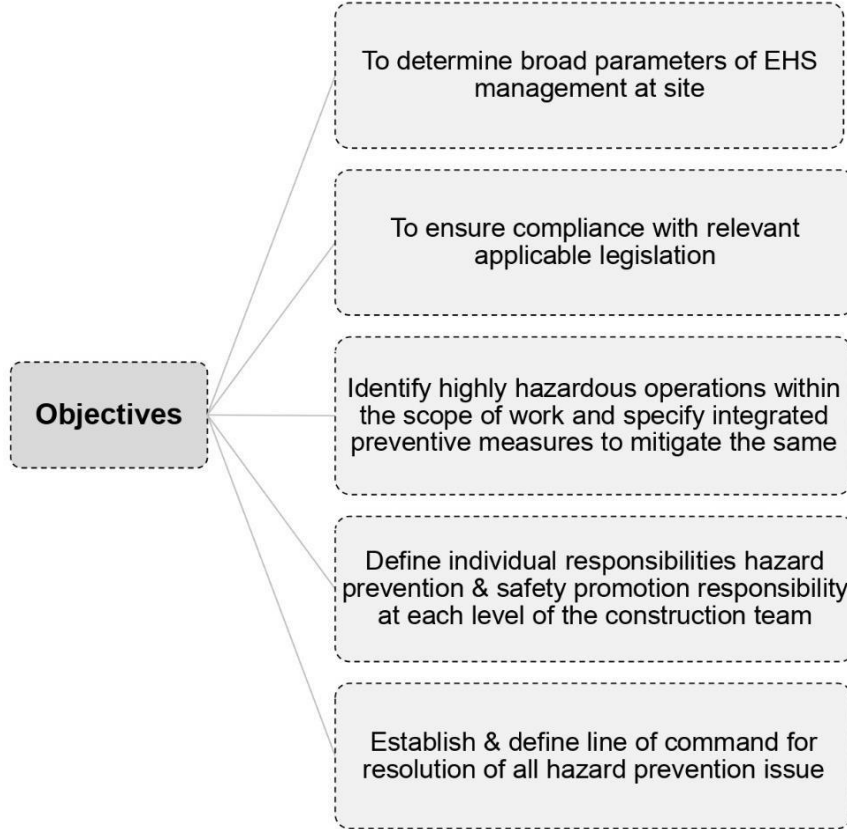
ENVIRONMENT ,HEALTH & SAFETY



- The construction industry is very vast and there are so many potential risks that can occur while a building is under construction.
- Workers should take preventive equipment as it is their first line of defense.
- There are several kinds of equipment that can be used to prevent exposure to certain risks and illnesses that may occur in case of an accidents.



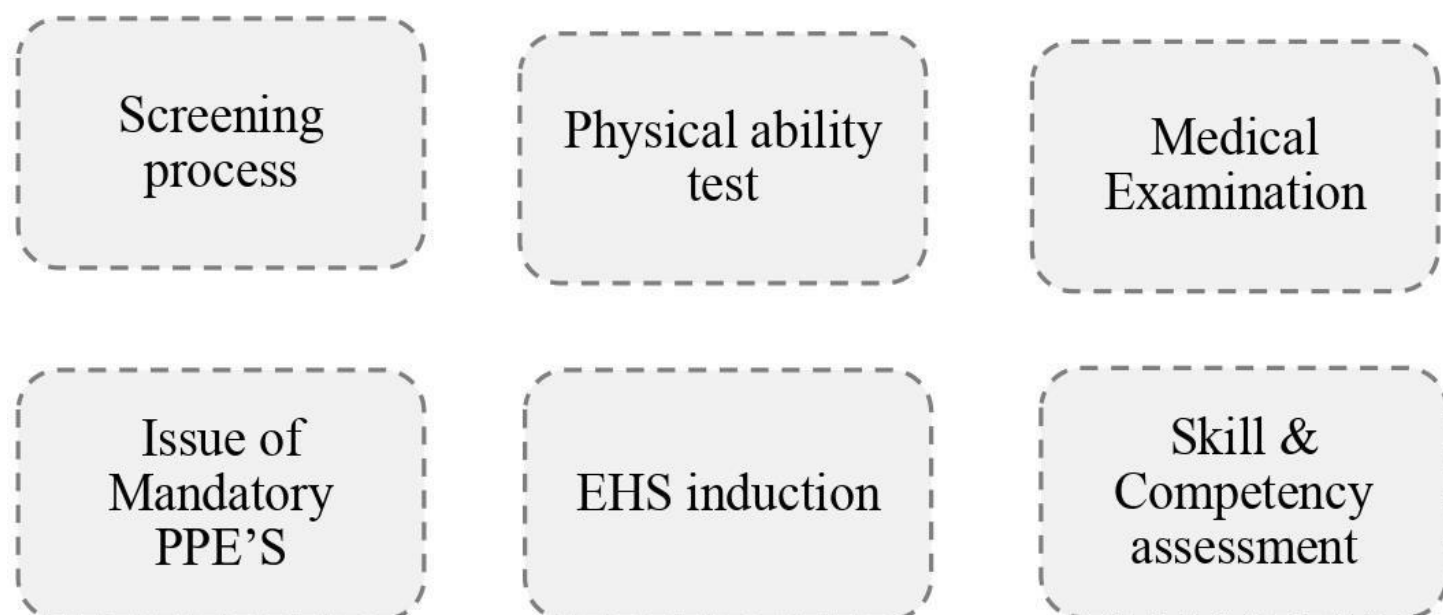
ENVIRONMENT ,HEALTH & SAFETY



Personnel protective equipment

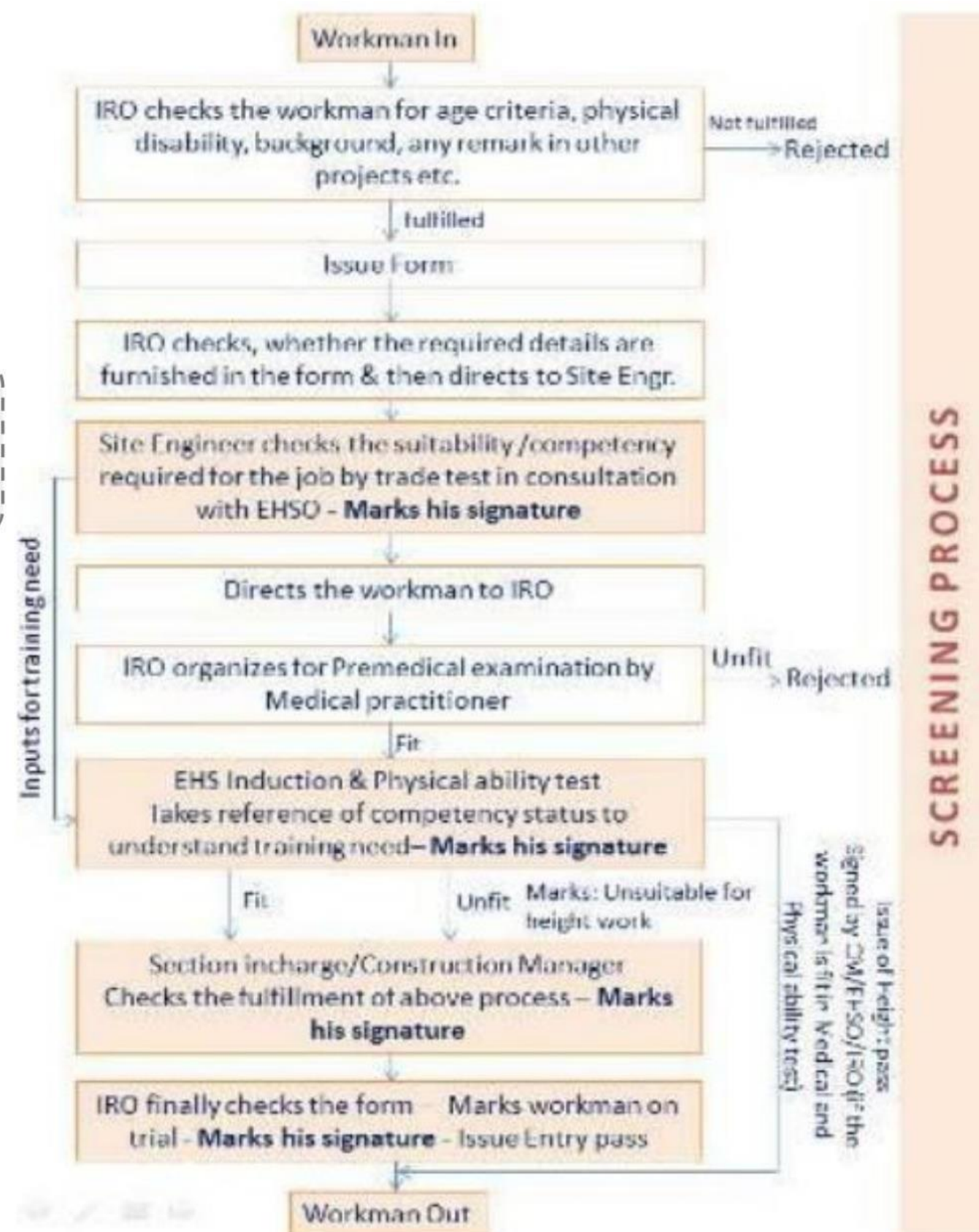


Workplace EHS standards:

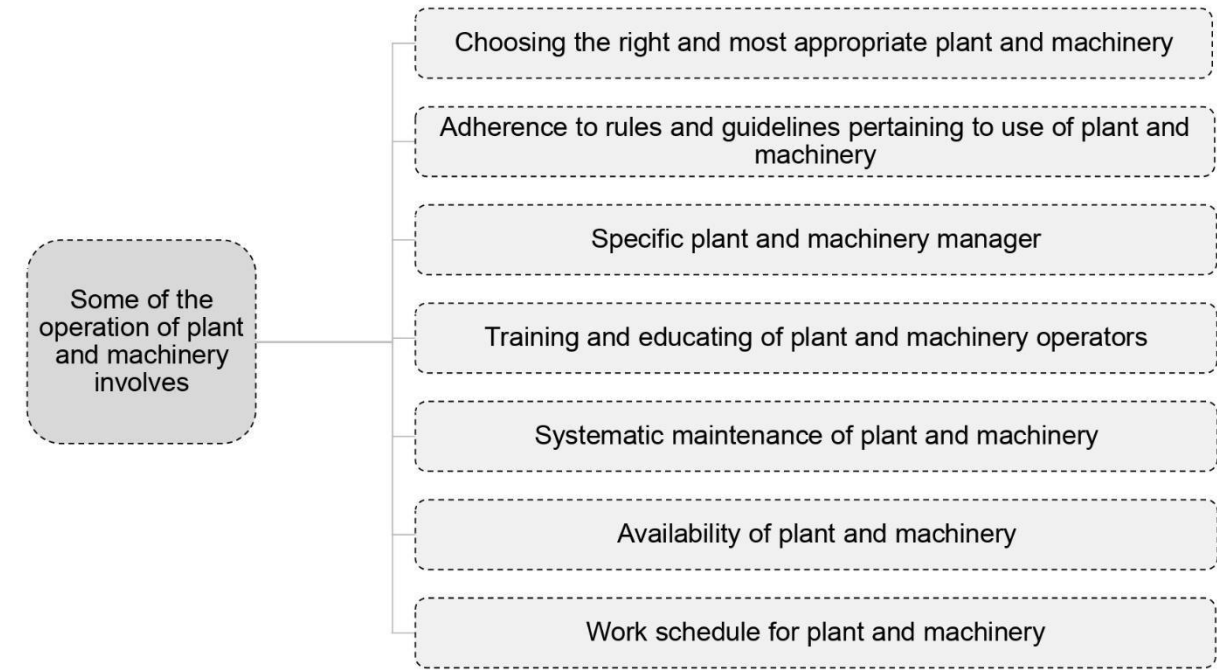


EHS Induction room:

- A worker shall provided with the ID card by the contractor and which shall be stamped EHS Inducted.



PLANT AND MACHINERY



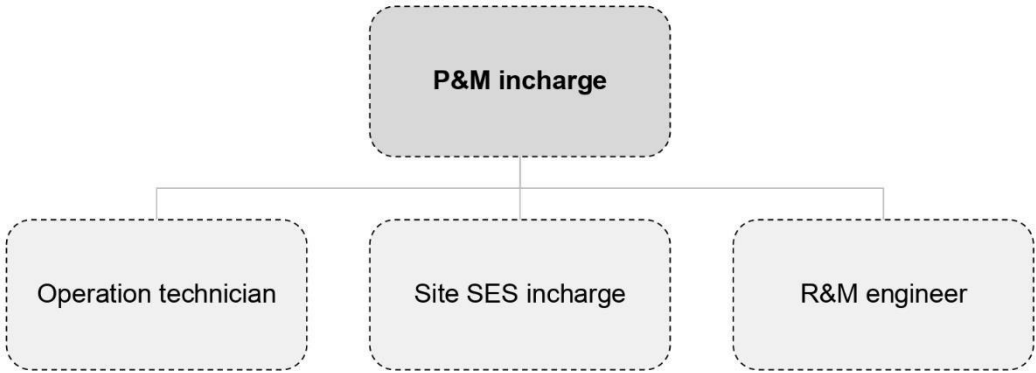
Utility Equipment's :



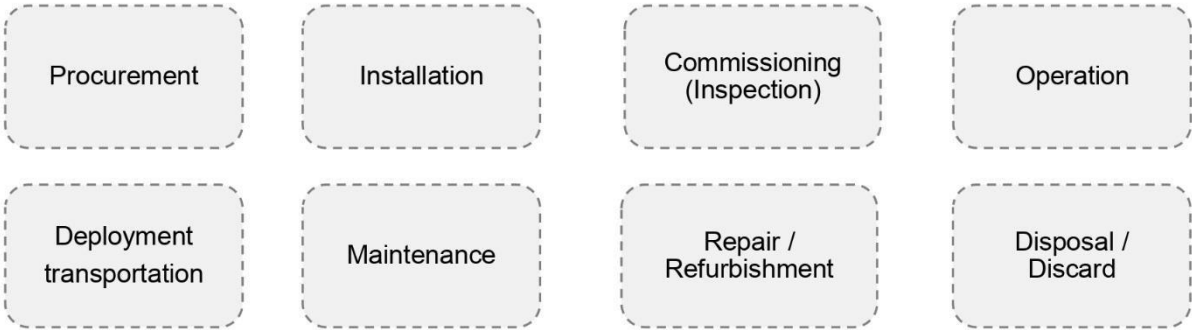
PLANT AND MACHINERY



PLANT AND MACHINERY



Main functions:



PLANT AND MACHINERY

Asset code :

- It gives history of the equipment
- XXXX***\$
- XXXX - Denotes group code.
- *** - Denotes nth number of the same material.
- \$ - Denotes the efficiency grade.



- log sheet is maintained for every equipment manually.
- To monitor the performance of the machine automatically IOT devices are fixed in each in every machines. It gives the following details.



Various IOT devices used :



PLANT AND MACHINERY

Concrete Handling Equipment's

Batching Plant :

- The batching plant is an equipment that efficiently combines the various ingredients to make up concrete. The ingredients are sand, aggregate, water, air, cement, fly ash, and silica fume. These ingredients are mixed at different ratios depending on the final type of desired concrete.
- Main Components of Batching plant Main components of the plant include the cement batchers, aggregate batchers, conveyors, aggregate bins, cement silos, Hoppers batch control panels and dust collectors. At the centre of the batching plant is the mixer, which is a key component of the equipment.



Operation of the Batching plant :

- System Activation; the mixing formula is input through the control panel, this also includes the concrete slump, grade and productivity. This is the calibration that will be used for the individual components of the mix.

PLANT AND MACHINERY

- The hoppers are tested and calibrated for accuracy before the operation begins. The belt conveyor is initiated to transmit the aggregate to the weighing hopper. The control valve of the water sump and admixtures are opened to allow water and admixtures to flow into hopper.
- Once all weights have met the required volumes the doors of the weighing hopper is opened automatically. The materials are released into the mixer where mixing continues until the setting time is over. The loading doors are then opened and the mix flows into a concrete mixer truck.



Concrete bulker

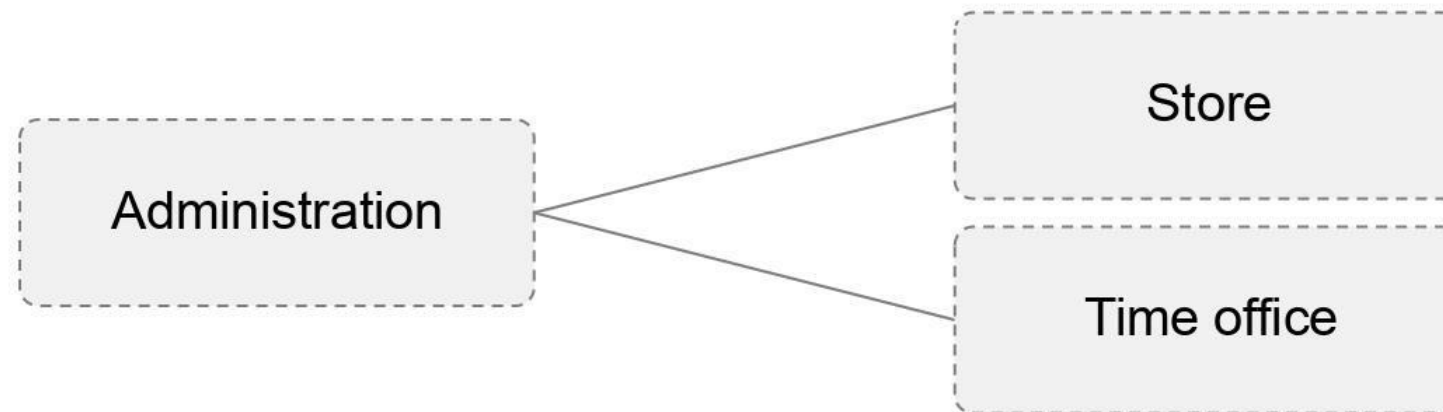


Transit Mixer :

- It is a vehicle which has a rotating drum used as a mixer. It is possible for this drum to rotate while the vehicle is travelling. The purpose of the rotation ability is to ensure the concrete remains usable and of good quality.
- The main purpose of this type of machine is to be able to deliver the concrete to a working site (in most cases a remote site) while still maintaining its quality. The Capacity of transit mixer used in the site is 6 Cum.



ADMINISTRATION



Store :

- Store is a department which handles material requirement for the site. Store Keeping and material stacking is one of the most important activities at construction site. In total construction costs ,Over 65% of is the material cost.
- The store keeping and material stacking at construction site can control wastage by maintaining material stacking receipts and consumption records at the site .



Various records and registers maintained in the stores

Material register

Staff register

Diesel Register

Sub-contractor
register

Perishable
register

Non perishable
register

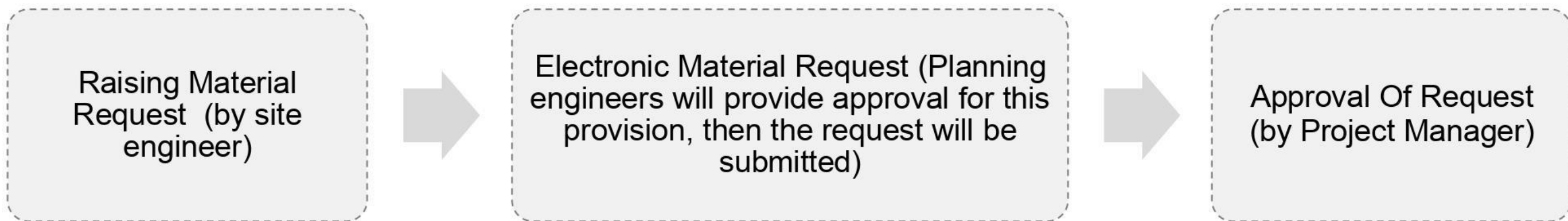
Gas cylinder
register

Manual DG
register

STORE

Procedure for material request process :

- The site engineer will demand the material required for the day's work by creating the indent to issue the material with the respective mentioned labor to the in charge of store keeper. The Storekeeper will verify the process and checked before the issuing of the materials



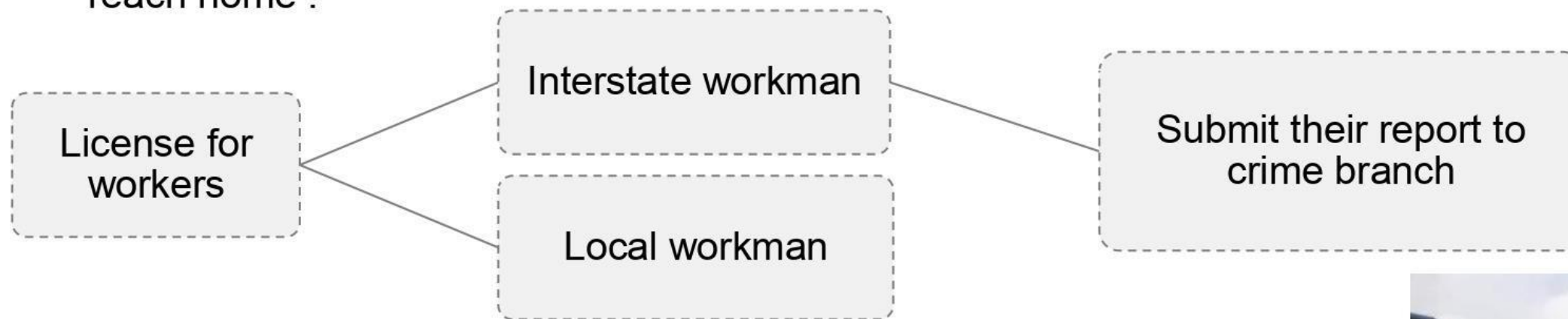
Purchase of Material :



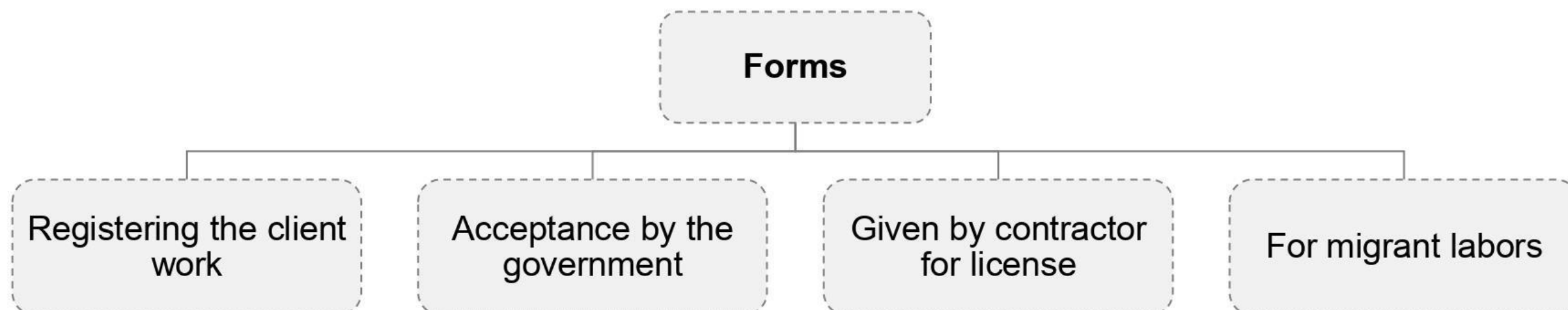
- The material should be checked for quantity, measurement of material, type, quality, make, damages, defects, if quality does not match the material should be rejected without unloading it on site.

TIME OFFICE

- Time office takes care of documentation and licensing work for the labor. It monitors the labor from the entry till they reach home .



- It provides facility for the labors to work in the site.
- It also maintains the attendance , accommodations and food requirements of the labors.
- Provide first aid and medical support .First aid Centre will facilitate as per BOCW Rules 2006.



TIME OFFICE

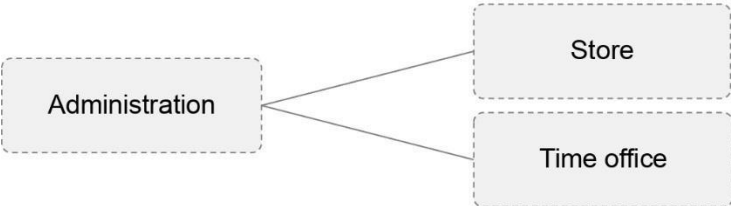
Category of workmen	Rate of wages to be payable
a, Unskilled b, Semi skilled c, skilled	673.15 689.15 788.65
Hours of work	8.30 to 17.30 hours (13.00 – 14.00 – lunch hour)
Wages paid	Monthly
Date ,time & place of disbursement of wages	All working days between 15.00 to 17.00
Weekly rest day	All Sundays
Name of the license issuing authority under act 1970 & authority under minimum wages act 1948	The office of the joint director industrial safety and health (BOCW)

3D CONSTRUCTION PRINTING

- It is an emerging technology, which is being tested in the campus by doing sample 3D residential structure using 3D printer.
- In the construction industry, 3D printing can be used to create construction components or to print the entire buildings. Construction 3D printing may allow, faster and more accurate construction of complex items as well as lowering labor costs and producing less waste.



ADMINISTRATION

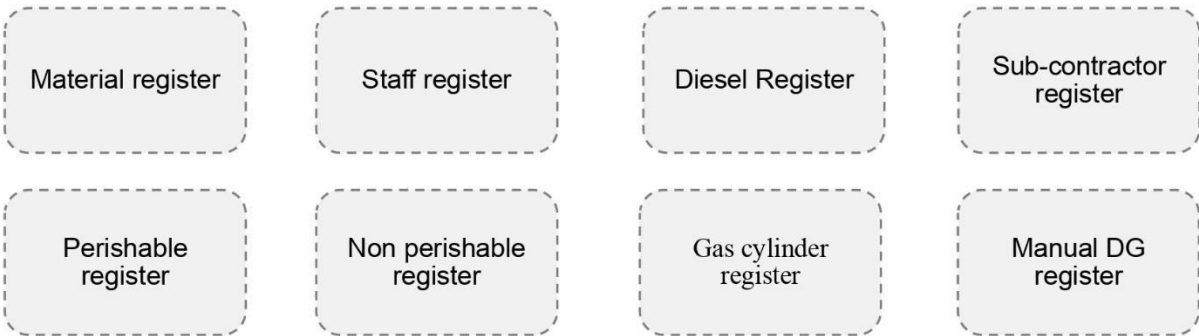


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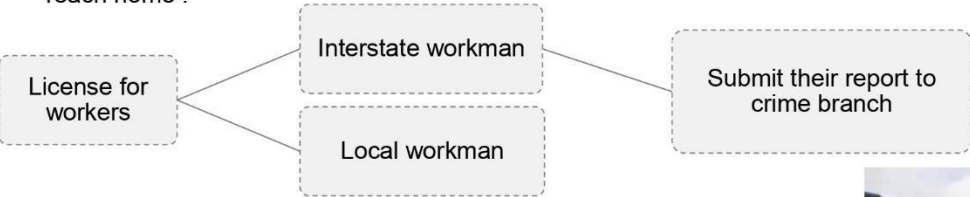


Various records and registers maintained in the stores

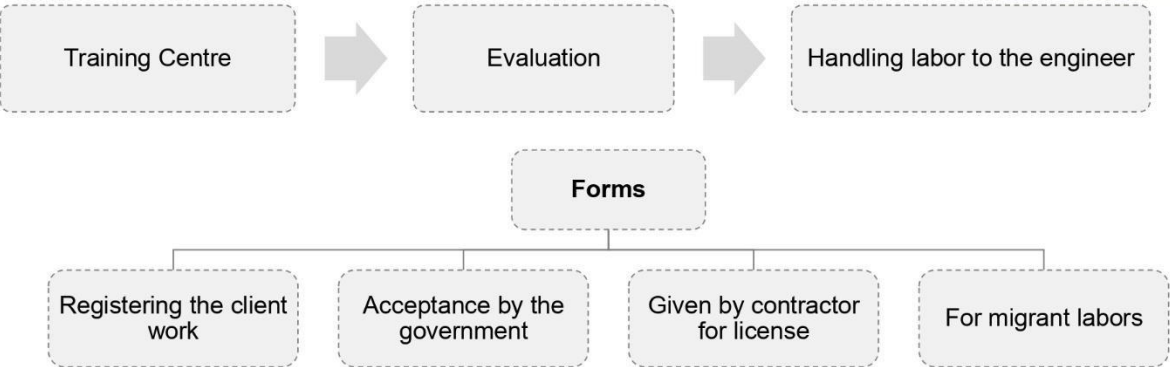


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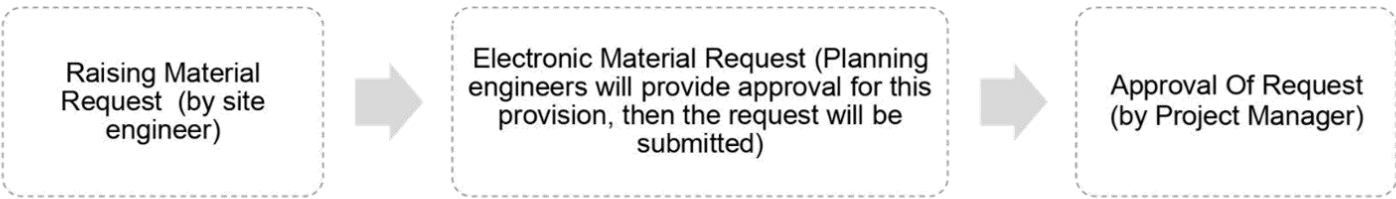
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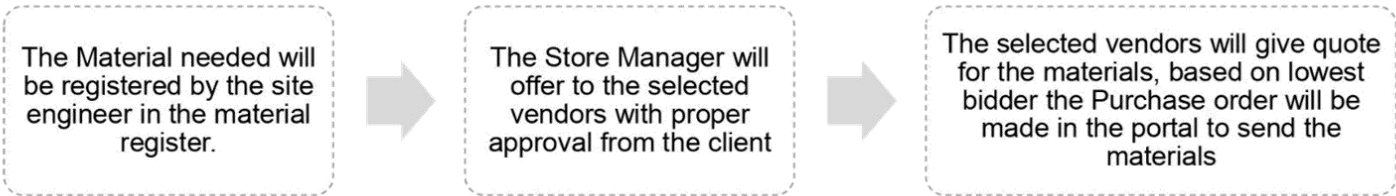
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LEAN INITIATIVE IMPLEMENTATION GUIDELINES

CONSTRAINT ANALYSIS WORKSHEET

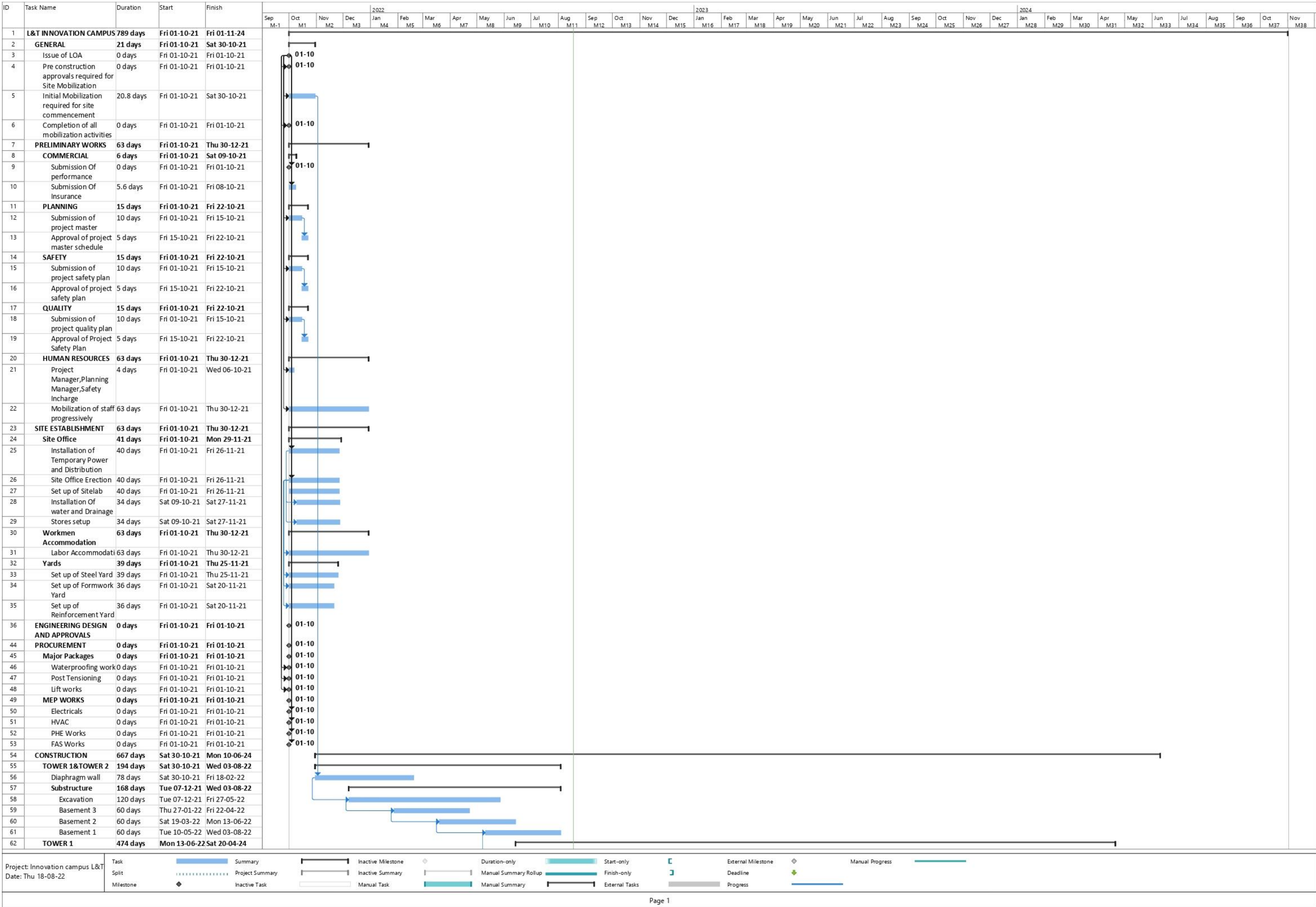
Name of Project : Innovation Campus (Tower 02)

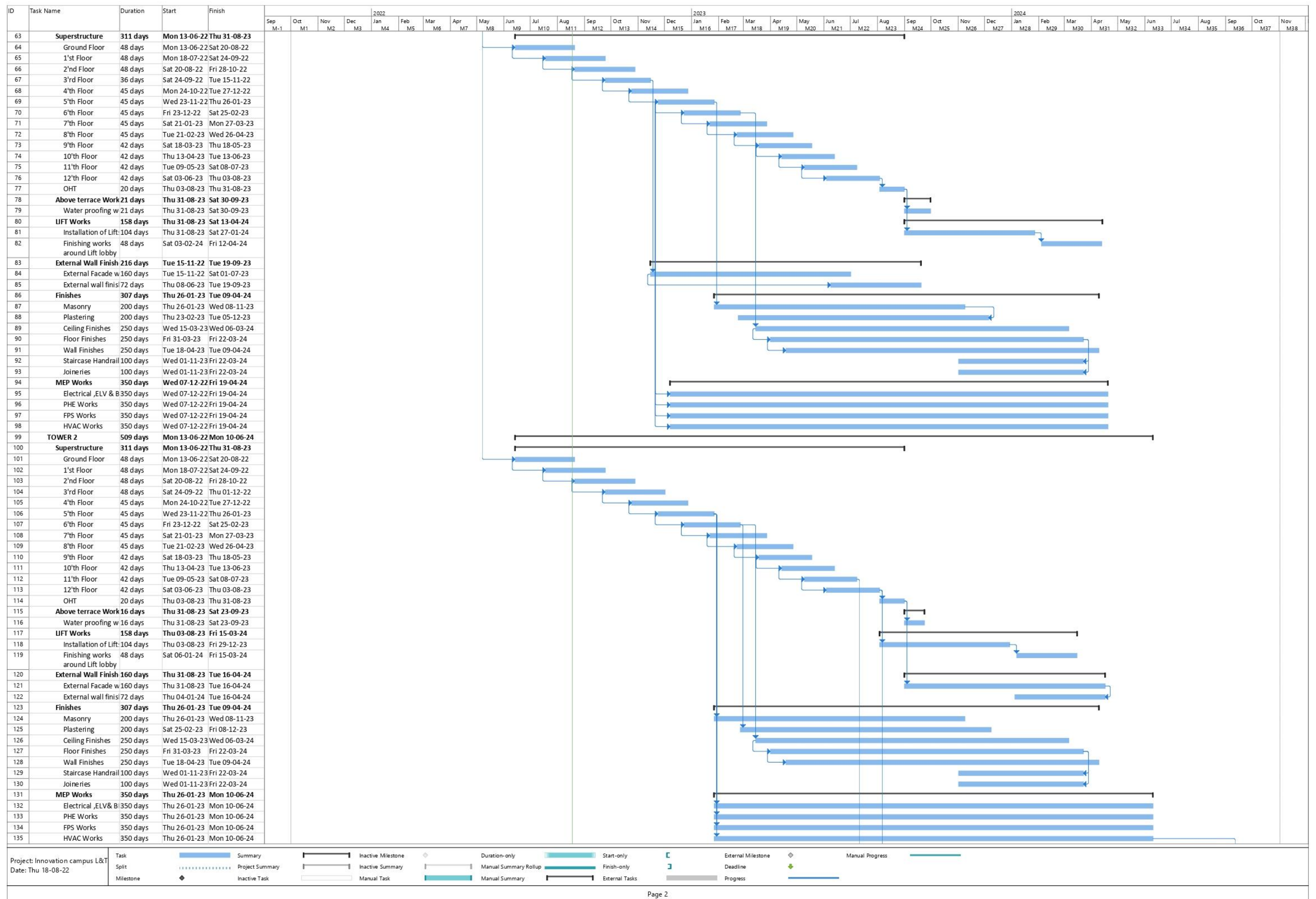
Reference : PQP/8.1-C/GL-01/F-02

Weekly Review - Constraint Meeting 01

Month - August

[illegible]





Critical Overview

- It was a great experience working at L&T Constructions –L & T Innovation Campus project, Chennai, Tamil Nādu. It is a pleasure to be a part in one of their prestigious projects. During the training program, Working on site has given me an opportunity to apply my theoretical knowledge on a real time project.
- It also helped me in improving my skills in MS Project. The staffs of the company are cooperative and very helpful. They maintained patience in explaining me things and helped me in rectifying my mistakes with a positive attitude.
- This training has given me clear picture about the execution process, Lean implementation, and Quality check in construction Sites which helped to identify the areas where I should concentrate more and has instigated curiosity to improve my skills.
- Friendly welcome by all the staffs is appreciable and everybody was ready to share their piece of knowledge. I hope this knowledge empowers me to gain more success and shape my career in better way. I am really working forward to work with L&T Constructions in future too.
- Assessment in Lean Implementation and Project schedule analysis gave me immense knowledge on planning and execution process of the Project.
- Different area of Services, Organizational structure of Project Management was thought to me in a most interactive way by various department
- Overall, it was a great learning experience. It helped me explore the various faucets of the site that is essential for the project to run successfully. This learning has helped me discover the key aspects of the project and has bridged the gap between the theory and actual practice. This newly gained knowledge has not only instigated curiosity but have also made me confident.