SCHOOL OF CIVIL ENGINEERING

INTERNSHIP REPORT

SOBHA DREAM ACRES TROPICAL GREEN,

BALEGRE, PANATHUR, BANGALORE

(25th JULY 2022 to 25th AUGUST 2022)

Submitted in fulfilment of the requirements for the award of Degree of

BACHELOR OF TECHNOLOGY
IN
CIVIL ENGINEERING

Submitted by

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CERTIFICATE

Certified that the internship report entitled **"SOBHA DREAM ACRES TROPICAL GREEN"** Carried out by **HARSHITHA TR (R19CV179)**bonafide student of REVA University during the academic year **2022-23** have submitted the Project report in partial fulfilment for the award of **Bachelor of Technology in Civil Engineering**during the academic year **2022-23**. The Internship report has been approved as it satisfies the academic requirements in respect of the prescribed said degree.

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ACKNOWLEDGEMENT

I am pleased to express my gratitude and sincerity to Sobha Limited and Reva University for providing me with an opportunity to take up internship at Sobha Dream Acres for a time period of One month. It was contemptible for learning and experiencing on practical knowledge and career development.

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ABSTRACT

As part of the current curriculum of Bachelor of Technology in Civil Engineering at Reva university, it is required that a student undergo an internship for a period to gain an insight and hands on experience on the engineering practices being employed in the industry in the current conditions. Therefore, this report details the day-to-day engineering operations involved in the planning and construction of pre-cast buildings made by Sobha Limited.

Over the four-week period the activities including production work, Installation work, developmental work, finishes in buildings, planning, costing, quantity and auditing, marketing processes were observed and documented. Therefore, this report summarizes the experience of the internship in a conglomerate format, by involving all the methodologies and procedures of the processes, which has been noted after careful inspection and observation of the practices and operations conducted by the engineers, technicians, as well as the labours.

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ABOUT SOBHA

Sobha Private Limited: Building Excellence, Creating Destinations

Sobha Private Limited is a renowned real estate development company based in India. Established in 1995, Sobha has consistently delivered exceptional projects and redefined the standards of quality and luxury in the industry. With a commitment to architectural finesse, meticulous craftsmanship, and customer satisfaction, Sobha has earned a stellar reputation as one of the leading developers in the country. This paper provides an overview of Sobha Private Limited, highlighting its key strengths, values, notable projects, and contributions to the real estate sector.

Commitment to Excellence:

At the heart of Sobha's success lies its unwavering commitment to excellence. The company embraces a customer-centric approach and places great emphasis on delivering projects that exceed expectations. Sobha's dedication to quality is evident in every aspect of its work, from meticulous planning and innovative design to superior construction techniques and the use of high-quality materials. With an uncompromising focus on delivering world-class residential and commercial spaces, Sobha has become synonymous with quality and trust in the real estate market.

Architectural Finesse and Innovation:

Sobha is known for its iconic architectural designs that blend aesthetics with functionality seamlessly. The company's projects stand out for their unique and contemporary designs, harmoniously integrating modern amenities with the surrounding environment. Each development showcases a careful balance of form and function, creating living spaces that are not only visually appealing but also practical and sustainable. Sobha's commitment to innovation is reflected in its adoption of advanced construction technologies and sustainable practices, ensuring eco-friendly and energy-efficient buildings.

Customer Satisfaction:

Sobha's success is built on a strong foundation of customer satisfaction. The company believes in understanding the needs and aspirations of its customers and strives to create spaces that fulfill their dreams. Sobha's customer-centric approach involves maintaining transparent communication, providing personalized services, and delivering projects on time. By prioritizing customer satisfaction,

Sobha has fostered long-term relationships with its clients, resulting in a loyal customer base and numerous referrals.

Notable Projects:

Sobha Private Limited has an impressive portfolio of projects that spans residential, commercial, contractual, and plotted developments. Some of its notable projects include:

1. Sobha Silicon Oasis: A residential project in Bengaluru offering meticulously designed apartments with modern amenities and lush green landscapes.

2. Sobha City: A sprawling residential township in Gurugram featuring luxurious villas and apartments amidst serene surroundings.

3. Sobha Hartland: An integrated community in Dubai offering waterfront villas, stylish apartments, and world-class amenities.

4. Sobha Palladian: A landmark residential project in Bengaluru, known for its elegant architecture, spacious apartments, and serene ambience.

Contributions to the Real Estate Sector:

Sobha Private Limited has played a significant role in shaping the real estate sector in India. The company's emphasis on quality, transparency, and ethical business practices has raised the bar for the entire industry. Sobha's projects have not only transformed skylines but also enhanced the quality of life for residents by creating sustainable and vibrant communities. The company's commitment to environmental sustainability, social responsibility, and employee welfare further exemplifies its holistic approach to development.

Fig 1(a)- SOBHA CITY

SOBHA

PASSION AT WORK

Fig 1(b)- LOGO

CHAPTER 2

INTRODUCTION OF THE PROJECT

SOBHA Private Limited is a leading real estate developer with a strong presence in South India. With a legacy spanning over three decades, the company has established itself as a trusted brand known for its high-quality construction, innovative design, and timely delivery of projects. One of the notable projects under the SOBHA Dream Series is SOBHA Dream Acres, located in Balegere, Bangalore's Golden Quadrilateral. This strategic location offers excellent connectivity to major IT/ITES companies, educational institutions, healthcare facilities, and entertainment options. It is a sought-after area for young professionals working in the IT sector, making it an ideal choice for homeowners.

SOBHA Dream Acres is designed to meet the growing housing demands of the vibrant workforce in the area. The project embodies the principles of smart living, offering a range of amenities and facilities within the complex. Residents can enjoy well-designed apartments that combine aesthetics, functionality, and sustainability. The project focuses on creating a harmonious living environment that promotes a healthy and fulfilling lifestyle. The Balegere area has witnessed significant development over the years, becoming a prominent IT/ITES hub and attracting major corporations. Here are some key features and highlights of the project:

1. Location: The project is strategically situated in Panathur, Bangalore, offering easy accessibility to major IT hubs, educational institutions, healthcare facilities, and entertainment zones.

2. Spacious Apartments: Sobha Dream Acres Tropical Garden offers well-designed and spacious apartments, ranging from 1 BHK to 2 BHK units, catering to the diverse needs of residents.

3. Amenities: The project offers a range of amenities and facilities, including a clubhouse, swimming pool, gymnasium, landscaped gardens, children's play area, sports courts, jogging tracks, and 24/7 security.

4. Green Spaces: Sobha Dream Acres Tropical Garden is known for its lush greenery and beautifully landscaped gardens. The project emphasizes creating a serene and eco-friendly living environment for residents.

5. Quality Construction: Sobha Limited is renowned for its high-quality construction and attention to detail. The project reflects the developer's commitment to delivering homes that meet the highest standards of craftsmanship and aesthetics.

6. Safety and Security: The project ensures the safety and security of residents through modern security systems, CCTV surveillance, and well-trained security personnel.
7. Community Living: Sobha Dream Acres Tropical Garden fosters a sense of community living with its well-planned infrastructure, recreational spaces, and opportunities for social interactions among residents.
8. Sustainability: The project incorporates sustainable features and practices, such as rainwater harvesting, efficient waste management systems, and energy-saving measures, contributing to a greener and more sustainable living environment.

Fig 2(a)- MASTER PLAN OF SOBHA DREAM ACRES

Fig 2(b)- SOBHA DREAM ACRES MODEL

CHAPTER-3

DEPARTMENTS

3.1 SAFETY DEPARTMENT

The Safety Department plays a crucial role in ensuring the safety and well-being of individuals within the plant. During the induction process, interns are provided with an overview of safety regulations and guidelines. These include wearing helmets while moving around the plant, following designated pathways to avoid obstacles, and adhering to one-way traffic flow to prevent collisions. The safety engineer takes the responsibility of conducting regular inspections and checks to ensure the proper functioning of machines. They also identify potential hazards and conduct a Hazard Identification and Risk Assessment to assess risks associated with the surroundings and equipment. Overall, the Safety Department focuses on maintaining a safe working environment and minimizing potential risks to safeguard the lives and health of all individuals within the plant.

Safety equipment plays a vital role in ensuring the well-being and protection of workers in a construction setting. The provided information highlights the different colors of helmets used by Sobha, each representing a specific role or position:

- Orange helmets: Used for visitors to easily identify them on-site.

- White helmets: Worn by engineers and foremen.

- White helmets with green strip: Designated for safety engineers.

- White helmets with red strip: Assigned to quality engineers.

- Purple helmets: Worn by operators who handle crane operations.

- Red helmets: Used by electricians for electrical works before and during concreting.

- Green helmets: Worn by erectors who assist in wall and slab installation.

- Blue helmets: Used by plumbers for plumbing works.

- Dark grey helmets: Assigned to security guards.

- Yellow helmets: Worn by laborers.

In addition to helmets, other safety equipment is also mentioned:

- Rope harness: Essential for workers involved in slab installation and exterior wall activities, providing protection from falls.

- Safety goggles and welding goggles: Required during welding and cutting activities to shield the eyes from flames and debris.

- Safety gloves: Necessary for general tasks, preventing cuts from sharp objects and providing hand protection.

- Welding apron: Used during welding operations to protect clothing from catching fire.

These safety measures ensure the safety and well-being of workers, reducing the risk of accidents and injuries on the construction site.

Fig 3.1- SAFETY EQUIPMENTS

3.2 ENVIRONMENTAL HEALTH AND SAFETY DEPARTMENT

The Environmental Health and Safety (EHS) department is responsible for addressing various cross-cutting issues related to environmental, health, and safety concerns in different industry sectors. The following aspects are commonly included in EHS considerations:

- Energy conservation: Implementing measures to conserve energy and promote energy efficiency.

- Waste water and ambient water: Managing and treating wastewater generated from domestic activities and maintaining the quality of ambient water sources.

- Water conservation: Implementing practices to conserve water resources.

- Hazardous material management: Proper handling, storage, and disposal of hazardous materials to prevent harm to the environment and human health.

- Waste management: Managing waste materials generated during operations and ensuring proper disposal or recycling methods.

- Noise: Addressing noise pollution concerns and implementing measures to reduce excessive noise levels.

The EHS department also handles specific responsibilities related to regulatory compliance and obtaining necessary approvals. These include:

- Clearance from the BBMP (Bruhat Bengaluru Mahanagara Palike) for tree cutting and survey number.

- Requesting temporary power supply from the BESCOM (Bangalore Electricity Supply Company) department.

- Obtaining ground water drawing approval from the Central Government Water Authority.

The treatment process follows the principle of the Activated Sludge process, involving aerobic decomposition of organic matter through active microbial growth in the aeration tank. The main activities in the STP process include equalization, aeration, settling, filtration, ultrafiltration, and disinfection. These activities help in maintaining a uniform load, achieving oxidation of organic matter, solid-liquid separation, removal of suspended solids and odors, TDS (Total Dissolved Solids) removal, and disinfection using hypochlorite as a disinfectant. Overall, the EHS department plays a crucial role in ensuring compliance with environmental regulations, conserving resources, and maintaining a safe and healthy environment within the residential complex.

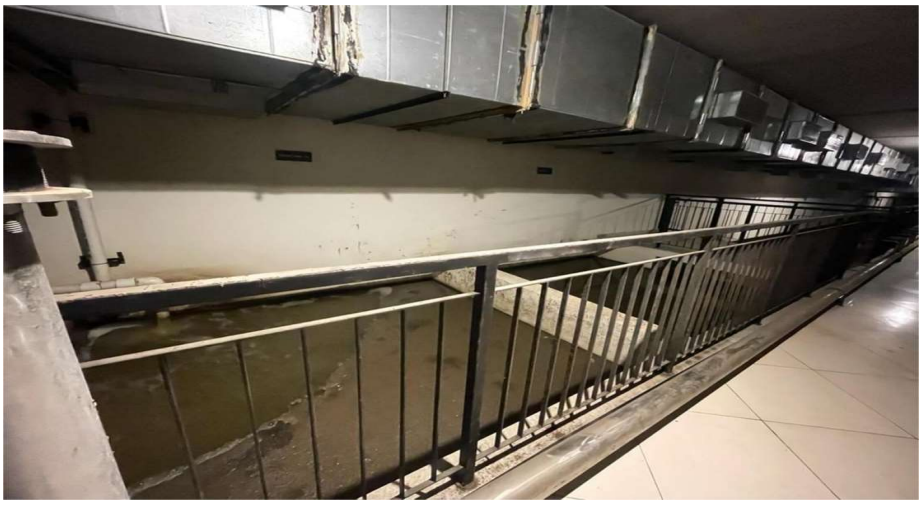

Fig 3.2- SEWAGE TREATMENT PLANT

3.3 COSTING DEPARTMENT

The Costing Department plays a crucial role in ensuring that the actual costs of various activities do not exceed the estimated costs. Within the department, there are specific units for Production, Erection, and Finishing, each responsible for managing costs related to their respective areas.The Costing Department oversees various aspects of cost management, including cash flow, preliminary activities, site operating expenses, materials, labor charges, machinery, customer relationship management, and legal expenses such as taxes. Preliminary activities involve setting up site offices, managing electricity charges, and budgeting. The department handles expenses related to labor charges, tools, profit, and overhead costs. This includes monthly expenditures for the precast plant, such as labor boots, gloves, helmets, water supply, finishing oil, and corrugated pipes. They also manage costs associated with equipment used in erection and finishing, such as shim levels, backer rods, hammers, grinders, trowels, drills, and various accessories.The Costing Department is responsible for regulating costs related to steel and concrete consumption, vehicular machinery (cranes, hydras, tractors, compactors, excavators, rollers), and other necessary items like silica gel, eye anchors, loop boxes, junction boxes, fan boxes, distribution boxes, and switch boxes. They also oversee expenses related to work orders for hiring vehicular machinery and procuring materials.To maintain control over inventory, the department conducts store audits to ensure all items are accounted for. Labor bills are issued every fortnight, and a stock breakup sheet is maintained, updating the list of items and their quantities. At the end of the month, this sheet is submitted to the planning team, who determine the amount of material needed for the following month. The planning team then initiates purchase requests, which are handled by the finance department.

In summary, the Costing Department ensures effective cost management throughout various aspects of the project, from labor and materials to machinery and miscellaneous expenses. Their goal is to maintain cost control and adherence to budgetary limits.

3.4 STORE

The Store Department is responsible for managing materials and inventory within the project. Here are the key points related to the Store Department:

1. Material Receipt and Quality Check: Upon receiving materials based on the purchase order, the Store Department checks both the quality and quantity of the items. Any excess or additional items are returned.

2. Classification of Materials: Materials are categorized into three classes: A, B, and C. Class A includes essential elements like plywood, steel, cement, aggregates, etc., while Classes B and C comprise tools, safety helmets, and other accessories.

3. Material Movement Requisition: To send or receive materials from other parties, a Material Movement Requisition form is issued.

4. Monthly Stock Verification: Regular monthly stock verification is conducted to ensure all elements are in place. Additionally, fixed assets, such as vehicles, are checked.

5. Provision for Safety Materials: The Store Department ensures there is always a provision for safety materials, emphasizing the importance of maintaining a safe working environment.

6. Billing and Approval: The bills for materials are submitted to the head office, which then forwards them to the finance department within 48 hours. The purchase order is approved by the audit team.

7. Examples of Materials and Their Uses: Some examples of materials used in the project include a 9-inch cutter for steel cutting, 4- and 9-inch grinding wheels for concreting, 4-inch cutter wire for concreting, drilled beads for wood holes, 3- and 9-inch DC couplers for concrete cutting, 4-cup wire brush for cleaning dust, brick layer brush for oiling, wire brush for smoothing surfaces, glue for markings, welding clamp and holder for welding, welding shield for welding safety, and earthing clamp for earthing.

3.5 QUALITY CONTROL LAB

The Quality Control Lab is responsible for conducting tests to ensure the quality of production materials used in the precast plant. Here are the tests conducted for different materials:

1. Tests on Cement:

- Fineness Test: Determines the fineness of cement particles.

- Initial and Final Setting Time: Measures the time taken for cement to set.

- Soundness Test: Checks the stability of cement against volume changes.

- Consistency Test: Determines the water content required for cement paste to reach a certain consistency.

2. Tests on Aggregates:

- Impact Test: Assesses the resistance of aggregates to sudden impacts.

- Abrasion Test: Measures the resistance of aggregates to wear and tear.

- Flakiness and Elongation Index Test: Evaluates the shape and size of aggregates.

- Crushing Test: Determines the strength of aggregates under compressive forces.

3. Tests on Concrete:

- Slump Cone Test: Measures the workability and consistency of fresh concrete.

- Rebound Hammer Test: Assesses the compressive strength of hardened concrete.

- Compressive Strength Test: Determines the maximum compressive load concrete can withstand.

- Penetration Resistance Test: Evaluates the resistance of concrete against penetration by external substances.

4. Tests on Steel:

- Tensile Strength: Measures the maximum tension a steel sample can withstand.

- Percentage of Elongation: Determines the ability of steel to stretch without breaking.

- Bend-Rebend Test: Assesses the flexibility and ductility of steel.

- Carbon Content and Sulphur Content: Checks the composition of steel for quality control.

- Carbon Equivalent: Measures the weldability of steel.

Fig 3.5– TESTING EQUIPMENTS

CHAPTER 4

PRE-CAST CONSTRUCTION

Precast concrete is a form of concrete that is prepared, cast and cured off site usually in a controlled environment using reusable molds, transported to construction site and maneuvered into place. It is typically used for structural components such as; wall panels, beams, columns, floors, staircase, pipes, tunnels, and so on. It means the transfer of work from sites to factories. This improves productivity and quality and shortens construction time of a building. It lowers the costs of the construction.

Precast concrete is employed in both interior and exterior applications, from highway, bridge, and hi-rise projects to tilt up building construction producing precast concrete in a controlled environment (typically referred to as a precast plant), the precast concrete is afforded the opportunity to properly cure and be closely monitored by plant employees.Using a precast concrete system offers many potential advantages over onsite casting. Precast concrete production can be performed on ground level, which maximizes safety in its casting. There is greater control over material quality and workmanship in a precast plant compared to a construction site. The forms used in a precast plant can be reused hundreds to thousands of times before they have to be replaced, often making it cheaper than onsite casting in terms of cost per unit of formwork.

Precast also has lower lifetime costs than any other building solution. It is possible due to consistent high quality of industrially produced products. Precast minimizes the structural and facade maintenance. With precast, logistics needs are minimal. Precast floors, walls, frames and foundations are transported to a construction site ready-to-install. Logistics to building site is arranged with just one delivery vehicle instead of several raw material transfers back and forth. Precast concrete suits well for any type of building like residential, commercial, industrial, public to name a few. There is a suitable solution for both indoor and outdoor precast production. The smart match can be found for different kinds of building projects in terms of elements produced, factory capacity and labor needs.

Precast can be made into any shape or color and finished with several techniques. This together with longer span gives architects and designers more freedom than ever. Precast is used within exterior and interior walls, the precast concrete is affording the opportunity to properly cure and be closely monitored by plant employees.

4.1 Advantages:

- The construction is done on the ground rather than at height.

- Quality Assurance
- Accuracy in construction
- Advantages in Design
- Aesthetic appearance
- Reduced wastage
- Mass production
- It can be done inside a climate-controlled structure, eliminating problems of rain, dust, cold, or heat
- Specialised equipment can be used to make, move, and pour the liquid concrete.
- Safety and protection

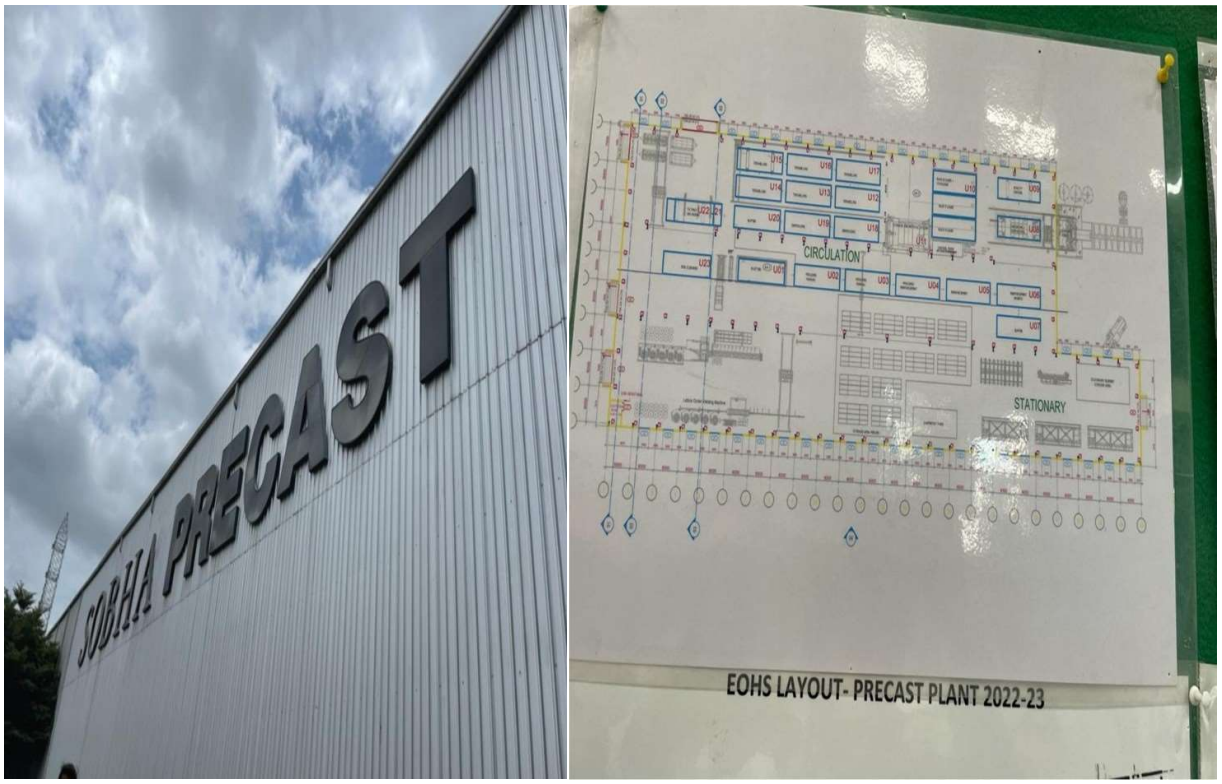

Fig 4- SOBHA PRECAST

4.1 PRODUCTION

The pre-cast plant consists primarily of 4 sections: Two of the four sections are named after the technology used, namely the Vollert and NUSPL technology. These technologies are German and advanced in functioning. The other two sections are the Stockyard, adjacent to the pre-cast plant, and the reinforcement section, present in the plant.The concrete is cast by gantry-guided smart cast concrete distributor. A pneumatic screw-discharged unit assures precise concrete batching and can be infinitely adjusted for various concrete consistencies. A rotating distribution roller prevents formation of dump cones and ensures optimal concrete flow up to the point of discharge. The concrete ID supplied by a state-ofthe-art concrete mixer plant with Liebherr technology. Concrete compaction takes place in a low-frequency, low-noise smart compact vibration station by eccentric drives.

SOBHA Precast plant manufactures elements in two systems:

Circulation System

In the circulation system, pallets are used for production of precast elements. Pallets are defined as mild steel tables which move from one station to another station with the help of rollers.There are different sections(components) in the circulation system such as U1- U23.

- Pre pour section
- Finishing section
- Post pour section
- Reinforcement section
- Control Room
-

Pre-pour section

The pre pour section ranges from U01-U09 where each section its specific work to perform like plotting, setting up mould, placing steel cages etc

Clean the pallet to remove dead mortar and apply shuttering oil at U23 Station. Move the pallet to the plotting section at U01 and plot the dimensions as per the shop drawing. Set up the mould for casting elements at U02 and identify the correct shutters. Clean the magnets that hold the shutters in place at U02. Apply silicon sealant at the joint locations of the pallet and shutter at U02. Apply hot glue for grooves/shear key and paste it on the pallet at U02. Lift the steel cage using an EOT crane and place it

on a frame, fixing cover blocks and ensuring the presence of corrugated tube, couplers, and lifting anchors. Place the steel cage inside the mould using the crane at U03. Place the accessories (loop box, shear key, dowel tube, electrical and mechanical) as per the drawing at U04 and U05. Perform welding for dowel bars (couplers) at U05, U06, and U07. Conduct quality check of the mould with relevant drawings before pouring concrete at U06. Label the element appropriately once the quality check is satisfactory at U06. Move the subsequent pallet using the Vollert Car movement system, depending on the pre-pour execution (from U06 to U07 buffer Station or U07 to U08 Concreting Section or U06 to U08). Pour concrete on the mould using a concrete spreader machine at U08. Perform table oscillation for compaction at U08. After compaction, level the concrete using appropriate tools at U09.

Reinforcement Section:

The reinforcement section is a crucial part of the precast plant where the primary reinforcement works are carried out. This section ensures that the steel used in the construction meets the stringent quality standards set by Sobha. Before the steel can be utilized, it undergoes a thorough testing and approval process. Sobha follows stringent quality control measures to ensure that only the highest quality steel is used in their projects. The steel used in the precast plant is typically Fe550 grade, known for its strength and durability. To ensure efficient operations in the reinforcement section, the quantity of steel (Fe550) required for the day is estimated in advance. This estimation is based on the production schedule and the specific requirements of each element to be cast. The daily steel usage is then laid out in the bar bending schedule, which serves as a guideline for the workers in the reinforcement section.

The bar bending schedule provides detailed information about the lengths, shapes, and quantities of steel bars required for each element. It helps the workers accurately cut and bend the steel bars to the specified dimensions. The reinforcement team meticulously follows the bar bending schedule to ensure that the reinforcement elements are prepared with precision.

The process in the reinforcement section involves cutting and bending the steel bars according to the required shapes and sizes. Specialized machines, such as bar cutting and bending machines, are used to efficiently handle and shape the steel bars. Skilled workers meticulously carry out the reinforcement works, ensuring that the steel bars are accurately positioned and securely tied together.

Quality control is of paramount importance in the reinforcement section. Each steel bar is inspected for any defects or imperfections. Only approved steel bars that meet the specified standards are used in the production process. Sobha's commitment to quality extends to every aspect of their operations, and the reinforcement section plays a vital role in upholding this commitment.

The reinforcement section operates in close coordination with other sections of the precast plant. Once the steel reinforcement is prepared and approved, it is transferred to the pre-pour section for further processing. The timely and accurate completion of reinforcement works is crucial to ensure the structural integrity and strength of the precast elements.

Finishing Section:

This section includes stations from U12 to U17 and involves the following steps:

Use the rack operating system or helicopter machine to transfer the pallet from the curing chamber to the finishing section. Check the dimensions of the elements as per the shop drawing and rectify any errors. Use a bull float for surface finishing if the concrete slump is normal or high. If the concrete slump is low, utilize a power troweling machine for surface leveling and finishing. Achieve a smooth finish on the surface using German finishing tools.

Post-Pour Section:

This section includes stations ranging from U18 to U23 and involves activities such as de-shuttering and demoulding that occur after the curing process.

Control Room:

The control room displays the activities of the precast plant on the master computer based on the casting schedule. It utilizes Vollert software to track the progress of elements at all stations in the precast factory.

Stockyard:

If the elements do not require major rectifications, they are shifted to the stockyard using hydra and trailers.

NUSPL Section (Stationary System):

In the NUSPL section, special elements that cannot be cast in the circulation system are casted in a stationary system, such as sun shades and staircases. The process of casting takes place at a single location. Set up the mould for casting the special elements as per the shop drawing and identify the correct shutters. Clean the magnets that hold the shutters in place. Apply shuttering oil and silicon on the mould face and joints, respectively. Lift the cage and fix the required reinforcement. Place the steel

cage inside the mould using the crane. Place the accessories (loop box, shear key, dowel tube) as per the drawing details.

Fig 4.1(a)- PRE-POUR SECTION

Fig 4.1(b)- CAGE BINDING

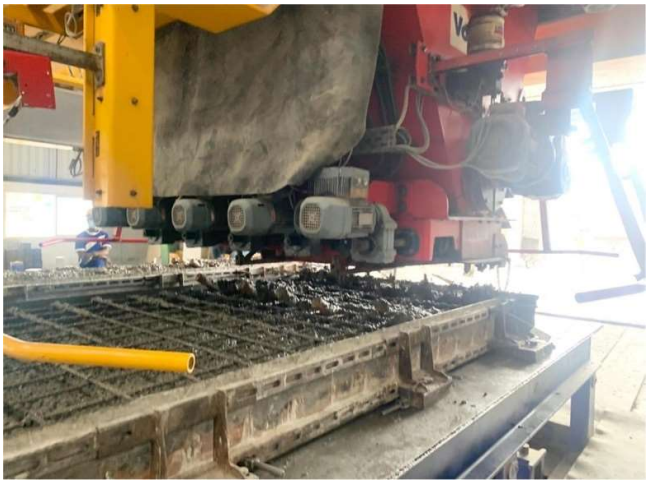

Fig 4.1(c)-CONCRETING AT U08

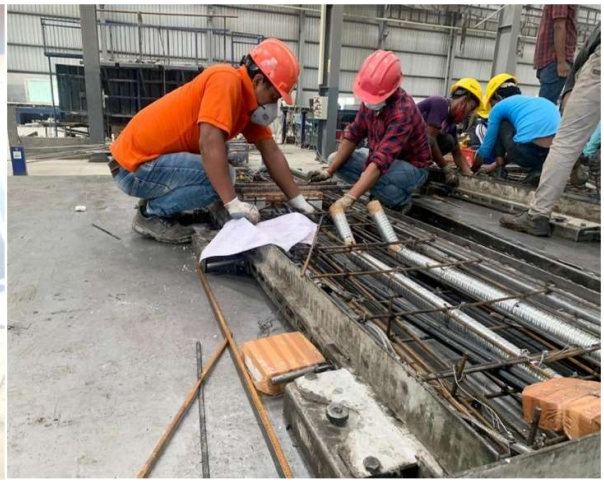

Fig 4.1(d)- REINFORCMENTS

4.2 SURVEYING

Soon after obtaining clearance from the BBMP (local authorities), electrical and plumbing clearances, a topographical survey is conducted to gather data on the site. This survey involves the preparation of a topographical map that includes man-made and natural features, power transmission lines, contour lines, elevations, and graphical names. The survey is carried out using a Total Station, a surveying instrument that allows for accurate measurements and data collection.The steps involved in the surveying process using a Total Station are as follows:

1. Instrument Setting: The Total Station is set up and calibrated using the resection and station backsight methods.

2. Area Calculation: The traverse method is used to calculate the area of the surveyed region.

3. Remote Elevation Method (REM): This method is used to determine the elevation of specific points on the site.

4. Missing Line Measurement (MLM): MLM is employed to find the cross-section of the area between two points.

5. Setting-out Line: This step involves accurately defining the outline and width of the excavation and determining the centerline of the proposed building walls.

The survey data collected is then handed over to the architect and structural design department, who use it to create the design drawings for the project.

4.3 EXCAVATION

Excavation is the next step in the installation process and involves moving earth, rocks, soil, and other materials to prepare the site for construction. It is a crucial preliminary activity in any construction project and is carried out to create solid foundations and grade the land. The following steps are involved in the excavation process:

1. Land Clearance: The site is cleared of any objects, and the soil profile of the surrounding land is studied. Checks for water and electrical lines below the soil are conducted by the local authorities.

2. Borewell Test: A borewell test is conducted to determine the soil substrata. The results of the borewell test are used to determine the locations for borewells on the site.

3. DCP Test (Dynamic Cone Penetration Test): This test is performed to assess the strength of the subsurface and the soil's bearing capacity.

4. Soil Excavation: The soil is excavated to the desired depth using methods such as slope cutting and step cutting to prevent soil sliding. Ramps are constructed for the transportation of materials within the excavation site.

5. Soil Filling: After excavation, the soil is leveled using a grader and a vibro compactor to ensure a smooth and even surface.

6. Protection from Rainwater: During rainy seasons, measures are taken to protect the excavated area from rainwater. LDP (Low-Density Polyethylene) sheets are provided around the concrete to prevent soil contact and potential damage.

7. Excavation Drawing: An excavation drawing is prepared, which represents the length, width, and depth of the excavation. The boundaries are determined based on the general excavation and topographical survey.

Footing:

Footing is an essential component of the foundation and provides support to the structure. Two types of footings commonly used are isolated footings and raft footings.

Isolated Footing:

- Isolated footings, also known as pad or spread footings, are used to support individual columns independently.

- They are typically square, rectangular, or circular in shape.

- Before laying the plain cement concrete (PCC) for the footing, termite control measures are taken to prevent damage.

- Isolated footings are cost-effective and used when the soil bearing capacity is relatively high.

- They consist of a thick slab that may be flat, stepped, or sloped.

Advantages of isolated footings:

- More economical when columns are spaced at longer distances.

- Ease of construction, including excavation, formwork, reinforcement, and concrete placement.

- Can be constructed by workers with little or no specialized knowledge.

Raft Footing:

- Raft footings are used when the soil has low bearing capacity or when column loads are heavy.

- They are designed to spread the load over a large area by overlapping footings, rather than providing individual footings for each column.

- A raft foundation is a solid reinforced concrete slab that covers the entire area beneath the structure and supports all the columns.

- Raft footings are suitable for shallow depths and are well-suited for soils with low bearing capacity.

- Due to their rigidity, raft footings help minimize differential settlements.

Advantages of raft footings:

- Require less excavation since they cover a large area.

- Well-suited for soils with low bearing capacity.

Both isolated footings and raft footings are important components of the foundation system and are selected based on factors such as soil conditions, column loads, and the desired cost-effectiveness of the construction project.

Fig 4.3- ISOLATED FOOTING

4.4 INSTALLATION

The installation of wall panels in precast construction involves several steps to ensure accurate placement and secure attachment. The method and sequence of installing wall panels are outlined as follows:

Erection of Wall Panels:

1. Precast walls are manufactured off-site and transported to the construction site. They are delivered by trucks and require the use of a crane to lift them off and into the correct spots for installation.

2. The walls are lifted one after the other using the crane. The installation points for the walls are initially fixed with dowel rods, typically with a diameter of 20mm or as specified in the design.

3. The precast walls have inbuilt holes called dowel tubes, which were made during the manufacturing process. These dowel tubes align with the dowel rods and allow for precise placement and connection of the walls.

4. The dowel tubes of the precast walls are joined onto the dowel rods, ensuring a secure connection between the walls and the supporting structure.

Lifting of Wall using Tower Crane:

The use of a tower crane facilitates the lifting and precise positioning of the wall panels. The tower crane allows for controlled movement and ensures that the walls are accurately placed according to the design specifications.

Types of Wall Joints:

There are three main types of wall joints used in precast construction:

1. Shear Loop Joint: Shear loop joints are used in retaining walls and areas where significant shear loads are expected. These joints consist of single or double looped wires embedded in the walls, with overlapping sections and a shear key (a 12mm diameter steel bar) inserted between adjacent loops.

2. Profile Joint: Profile joints are provided in areas where shear forces are considerable. These joints feature grooves in the walls, typically measuring 80mm by 210mm and 20mm in depth. The walls have multiple grooves to ensure structural stability.

3. Plain Joint: Plain joints are used in areas with negligible shear forces. These joints are usually provided between non-load bearing walls and have a thickness of 100mm.

Support and Leveling:

After fixing the walls in their designated positions, push and pull props are attached to provide additional support. Two push and pull props are typically used for each wall to ensure stability and prevent any shifting during the construction process.

The level of the walls is checked using a level staff and a right-angle staff. Any deviations from the desired level are immediately rectified to ensure proper alignment and stability.

Installation of Bearing Pads:

Square-shaped slim pads are placed between the concrete members to act as buffers and prevent damage during movement. These bearing pads are installed beneath the end of each double-tee beam and under other beams and panels. They help distribute loads and facilitate the smooth transfer of forces between separate concrete members.

Reinforcement and Grouting:

Reinforcement is an essential component of precast construction, providing strength and stability to the structure. The walls and slabs are reinforced according to the design specifications, ensuring that they can withstand the anticipated loads and forces.

Grouting is the process of filling the gaps and joints between the precast elements with a mixture of cement and sand. Before grouting, the joints and edges of the walls are shuttered using steel plates to cover the gaps. Grouting is carried out using a grouting machine, such as Putzmeister, which mixes cement (GP2N) and water in the appropriate ratio. The grout is poured into the joints and dowel tubes, and after curing, any remaining gaps are filled with a mixture of cement and M-sand.

Slab Installation:

The precast slabs are erected on top of the walls using cranes and supported by H-beams and heavy-duty props. The tops of the precast walls are designed with L-shaped features to provide a proper fit for the slabs. The slabs, typically with a thickness of 60mm and reinforced with lattice girders, are carefully placed on the wall supports.

Reinforcement for the conventional slab, usually with a thickness of 90mm, is installed as per the design specifications. This includes providing edge bars or bottom bars at the edges, bending seismic bars from the walls onto the slabs alternately and tightening them with lattice girders. U-bars of appropriate length and diameter are also provided for reinforcement.

Special considerations are made for specific areas. For example, in bathrooms, upstand bars of 8mm thickness are provided to make the surface even, and crank bars are used. Balconies, with their cantilever property, require additional reinforcement such as 10mm connecting rods and U-bars connected to the 8mm crank bars. All the slab reinforcement is tightened to the precast slabs using lattice grids to ensure structural integrity. Once the reinforcement is in place, a layer of concrete is poured, and the surface clearance is checked after the cement has cured. During the construction process, multiple activities occur simultaneously, including the pouring of cement after reinforcement, erection of slabs, and marking of points for the placement of walls on the next floor. Markings are made using different colors to indicate wall placement and safeguard electrical pipes. Corbel supports are also installed at the slab edges to accommodate the installation of staircases.

By following these detailed steps, the installation of wall panels and slabs in precast construction is carried out with precision and attention to structural integrity. This meticulous approach ensures that the building is constructed to the highest standards, meeting design specifications and safety requirements.

FIG 4.4 (a) LIFTING OF WALL USING TOWER CRANE

Fig 4.4(b) MIXING GP2N

4.5 FINISHING

After the installation and erection of precast elements in a construction project, the finishing stage begins. This stage involves several activities aimed at enhancing the appearance and functionality of the precast elements and preparing them for occupancy. Here is a brief overview of the finishing process in precast construction:

1. Surface Finishing:

- Cleaning: The precast elements are thoroughly cleaned to remove any dirt, dust, or debris accumulated during transportation and installation.

- Patching and Repair: Any visible defects or imperfections on the surface of the precast elements are patched and repaired using appropriate materials to ensure a smooth and uniform finish.

- Surface Treatment: Depending on the desired appearance, the precast elements may undergo surface treatments such as sandblasting, acid etching, or applying coatings or sealants to achieve the desired texture, color, or finish.

2. Joint Treatment:

- Joint Sealing: The joints between the precast elements are sealed using suitable sealants to provide weatherproofing and prevent the infiltration of water, air, or other contaminants.

- Joint Filling: Gaps or voids between the precast elements may be filled with appropriate materials to enhance structural integrity and aesthetics.

3. Architectural Features:

- Architectural Enhancements: Additional architectural features such as decorative elements, moldings, or trim pieces may be installed to enhance the aesthetic appeal of the precast elements and complement the overall design of the structure

4. Installation of Finishing Components:

- Windows and Doors: Installing windows and doors within the precast elements, including frames, glass panels, hardware, and weather sealing.

- Fixtures and Fittings: Mounting fixtures such as lights, electrical outlets, switches, plumbing fixtures, and other necessary components.

- Interior and Exterior Finishes: Applying finishes to the interior and exterior surfaces of the precast elements, which may include painting, wallpaper, cladding, or other decorative treatments.

5. Quality Checks and Inspections:

- Thoroughly inspecting the precast elements to ensure they meet the required quality standards and specifications.

- Conducting tests, if necessary, to verify the performance and durability of the precast elements.

The finishing stage in precast construction plays a vital role in achieving the desired aesthetics and functionality of the structure. It involves attention to detail, coordination with different trades, and adherence to architectural and design plans. Once the finishing stage is complete, the precast elements are ready for occupancy, and any remaining issues or deficiencies are addressed during the snagging phase, which involves a comprehensive inspection and rectification of any defects or shortcomings in the construction.

Snagging:

In the construction industry, snagging is a commonly used term that refers to a process carried out a fortnight or so before practical completion of a project. It involves inspecting an area that is considered complete and ready for inspection to compile a list of minor defects or omissions in the building works for the contractor to rectify. While "snagging" does not have an agreed-upon meaning and is not a contractual term, it is widely used to describe the inspection process. Typically, a snag is something that is damaged, broken, not fitted properly, or looks unfinished. Examples of snags can include a large scratch on a wall, a missing handle on a cupboard, or a faulty tap. While most snags tend to be cosmetic in nature, more serious defects can also arise, such as poor tiling in a bathroom or malfunctioning radiators. Ideally, snagging takes place a few weeks before practical completion and is usually carried out by the project manager, who acts as the contract administrator. In residential building projects, it is often done in conjunction with the client. In larger projects with multiple buildings, the snagging list may be divided into phases, allowing each section of the project to be inspected as it becomes ready.

For a successful snagging inspection, the area should be thoroughly cleaned and fully accessible. There should be no tools or materials obstructing the spaces, and adequate lighting should be in place to ensure a comprehensive inspection. Systems such as hot water, alarms, ventilation, or underfloor heating should also be checked to ensure they are in good working order. Companies like SOBHA have their own procedures in the snagging process and typically prepare and issue snagging lists to the

engineers involved. These lists detail various stages of the process from the beginning to the end, ensuring that all identified defects or omissions are addressed.

Basement:

A basement is a floor or level of a building that is partly or entirely below ground level. It is commonly used for parking vehicles or for other purposes. In this apartment, two types of basements can be found in each wing: the lower basement and the upper basement.

Activity of Lower Basements - Compaction of Soil:

Compaction of soil is a crucial process in construction that involves mechanically increasing the density of soil. This step is significant as it ensures the stability and load-bearing capacity of the building's foundation. Improper soil compaction can lead to settlement issues, resulting in unnecessary maintenance costs or even structural failure. Therefore, mechanical compaction techniques are widely employed in various building sites and construction projects. During the compaction process, the soil is compacted layer by layer, with each layer having a minimum thickness of 100mm. After compacting each layer to the required height, the soil density is tested using the dynamic cone penetration test (DCP) method. The DCP is a test that estimates the strength of soils and determines the thickness and location of subsurface soil layers. The DCP test involves driving a steel rod with a tempered steel cone attached into the soil using an 8kg hammer with a dropping height of 575mm. The penetration depth of the cone (D) is measured in millimeters based on the drops of the hammer. The maximum penetration depth is 20mm, and if the penetration exceeds this limit, additional soil compaction is required. Once the soil compaction is completed, the next step is the installation of a granular sub-base (GSB). The GSB layer serves as a foundation for the flooring and typically consists of crushed stone with a thickness of 10 to 15cm, along with manufactured sand mixed with an appropriate water content. After laying the GSB layer, a polyethylene sheet is placed on the GSB surface to provide surface protection and ensure proper drainage. The polyethylene sheet acts as a barrier between the GSB layer and the subsequent layers of the basement construction. It helps prevent moisture penetration and acts as a moisture barrier, ensuring the longevity and integrity of the basement structure. Proper surface clearance is also maintained to ensure a smooth transition to the next phase of basement construction.

With the completion of the lower basement activities, including soil compaction and the installation of the GSB layer, the foundation for the basement is established. This solid foundation provides stability and support for the entire building structure above it. It is essential to ensure that the lower basement is

properly constructed and meets all the required specifications and standards to ensure the safety and durability of the building.

Upper Basement:

In addition to the lower basement, the apartment complex also features an upper basement. The upper basement serves as an additional level below ground, providing extra space for parking or storage purposes. Similar to the lower basement, the upper basement undergoes a series of construction activities to ensure its functionality and structural integrity. The construction process for the upper basement involves activities such as excavation, foundation preparation, reinforcement placement, and concrete pouring. Excavation is carried out to create the necessary space for the upper basement, followed by the preparation of the foundation, which includes marking the location of footings based on the structural engineer's drawings.Once the foundation is prepared, the reinforcement bars are placed in accordance with the specified design and layout. Reinforcement plays a critical role in strengthening the concrete structure and providing it with the necessary tensile strength to withstand loads. The reinforcement bars are securely fixed and tied together to form a robust framework within the basement structure. After the reinforcement is in place, the next step is the pouring of concrete. Concrete is carefully mixed and poured into the excavated area, surrounding and encapsulating the reinforcement. This process requires precision and attention to detail to ensure proper compaction and the absence of any voids or air pockets within the concrete. Once the concrete is poured, it undergoes a curing process, during which it gradually hardens and gains strength. Proper curing is essential to achieve the desired durability and structural integrity of the basement. Various curing techniques, such as covering the concrete with curing compounds or providing a moist environment, may be employed to facilitate the curing process.

Following the completion of the upper basement construction, quality checks and inspections are conducted to ensure compliance with the specified standards and regulations. Any necessary rectifications or adjustments are made to address any identified defects or issues. This meticulous attention to detail in the construction process ensures the creation of a robust and functional upper basement that meets the required standards of safety and reliability.

Fig 4.5(a)- PLUMBING

Fig 4.5(b)- SNAGGING 1

Fig 4.5(c) -SNAGGING 4

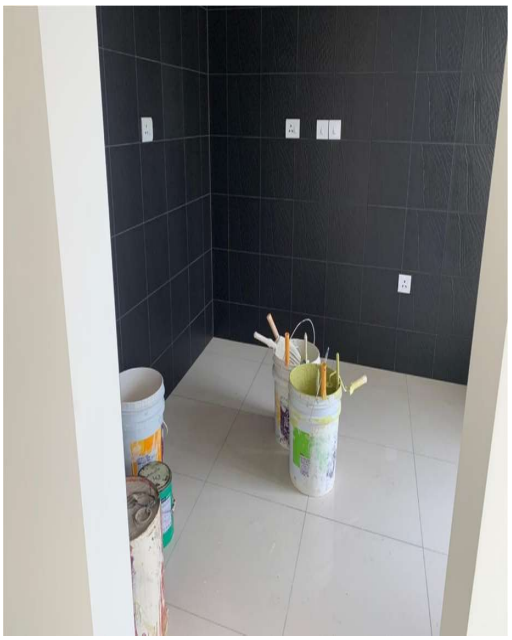

Fig 4.5(d)- FLOORING

CONCLUSION

I would like to take this opportunity to express my sincere gratitude for the internship program I had the privilege to be a part of. It has been an immensely satisfying experience to gain practical knowledge and hands-on experience in the field of construction. I am particularly grateful for the opportunity to learn about Precast construction, as it was my first exposure to this innovative method.

I would like to extend my heartfelt thanks to Sobha Limited for their consideration and for providing me with this invaluable opportunity. Throughout my internship, I have learned about the working procedures of the Precast method, its uses, and its importance in the construction industry. I have also gained insights into various aspects such as marketing, environmental considerations, and safety protocols associated with this new technique and technology in civil engineering. Witnessing firsthand how this method has enabled faster construction and improved quality has been truly inspiring.

I am immensely grateful to everyone who dedicated their time and knowledge to help me understand the intricacies of Precast construction. The guidance and support I received from the team at Sobha Limited have been instrumental in my learning journey.

Moreover, working as an intern at Sobha Limited has not only enhanced my technical knowledge but has also taught me valuable lessons in work ethics, punctuality, teamwork, and team spirit. The collaborative environment fostered within the organization has made a lasting impression on me.

Once again, I would like to express my deepest appreciation to Sobha Limited for providing me with this opportunity to learn and grow. It has been an enriching experience, and I am truly thankful for the knowledge and skills I have gained during my time here.

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GALLERY