Summer Industrial Training Report

On

CONSTRUCTION OF

APJ ABDUL KALAM SCIENCE CITY

Submitted by

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Under

BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOY PATNA

ASHOK RAJPATH PATNA, BIHAR – 800005

DECLARATION

I, **Rishav Raj**, Roll No.- **2103078**, hereby declare that I have undertaken 6 weeks Industrial Training at **Building Construction Department, Government of Bihar at Construction Division-1**, Patna under the guidance of **Shapoorji Pallonji Constructions** during a period from **25-05-2024 to 07-07-2024** while pursuing the Degree of Bachelor of Technology in Civil Engineering at **National Institute of Technology Patna.** The work, which is being presented in the industrial training report, is an authentic record of training work and true to the best of my knowledge.

ACKNOWLEDGEMENT

It gives me an immense pleasure to have successfully completed my industrial training in a very well-reputed company **SHAPOORJI PALLONJI CONSTRUCTIONS (INDIA)**, under **Building Construction Department (BCD)**, Government of Bihar. Industrial training is a golden opportunity for learning and enhancing the practical knowledge of the booming infrastructural professional world and thereby, I owe my special acknowledgement to my institute **DEPARTMENT OF CIVIL ENGINEERING, NATIONAL INSTITUTE OF TECHNOLOGY PATNA** for providing me this excellent hands-on experience of the actual field work.

I owe special debt of gratitude to **Er. Neeraj Kumar** Sir (Executive Engineer, Construction Division - 1, BCD Patna), and **Er. Hasmat Ali** Sir (Site Engineer, Shapoorji Pallonji Constructions) for their guidance and support during the whole training.

Moreover, I would also like to express my sincere gratitude to our faculty members especially **Prof. Anshuman Singh** Sir, Head of the Department (HOD), Dept. of Civil Engineering and **Dr. Shiva Shankar Choudhar**y Sir, Course Coordinator, for their constant support and valuable guidance throughout the course of my work. It is only their cognizant efforts that my endeavors have seen light of the day. I would also like to thank Professor in the Department of Civil Engineering, NIT Patna for his continuous support and guidance.

All the practical knowledge that we have gained in this training is no less than a treasure for us. I hope that I can build upon the experience and knowledge that I have gained and make valuable contributions towards this industry in the coming future.

CONTENTS

1. COMPANY PROFILE

BUILDING CONSTRUCTION DEPARTMENT
GOVERNMENT OF BIHAR

The **Building Construction Department** (abbreviated BCD) Before the year 1982, Road Construction, Building Construction and Rural Engineering Organisation were all under the Public Works Dept. (PWD). In the administrative view, Public Works Dept. was split into three different departments named: Road Construction Dept., Building Construction Dept. and Rural Engineering Organisation Dept. by the Cabinet Secretariat and Co-ordination Department's Memorandum No. CS-2-M2-10157/80-878, Patna dated 16th March, 1982. In this way, the Building Construction Department came into existence in the year 1982. Its head-quarter is located at Vishveshwaraiya Bhawan, Jawahar Lal Nehru Marg, Bailey Road, Patna - 800 015.

VISION:

1. Planning and designing building network to provide optimized connectivity to residential and non-residential govt. buildings of different departments.

2. Construction, renovation, up gradation and maintenance of residential and non-residential government buildings of different departments.

SHAPOORJI PALLONJI

Shapoorji Pallonji & Company Private Limited, trading as **Shapoorji Pallonji Group**, is an Indian conglomerate headquartered in Mumbai. It operates in construction, real estate, textiles, engineered goods, home appliances, shipping, publications, power, and biotechnology. The company was headed by a grandson of founder Pallonji Mistry, also named Pallonji Mistry, until 2012, when he announced his retirement and the succession of his son, Shapoor Mistry.

Shapoorji Pallonji is regarded as "one of India's most valuable private enterprises". The US$2.5 billion Shapoorji Pallonji Group have two listed companies, **Forbes & Company Ltd.** and **Gokak Textiles**. Forbes was already listed when bought by Shapoorji Pallonji, though there was speculation in 2006 that group company **Afcons** Infrastructure would go public via an IPO.

MISSION

"SP E&C will be the company of the first choice in construction industry. We shall be driven by our commitment to customer satisfaction."

VISION

"Fostering an environment that helps in the creation of knowledge and its application to work, we seek to excel in all our business activities and strive to build SP E&C into a creative organization"

VALUES

Passion to move on the upward growth trajectory and position ourselves as the numerounochoice for our customers and ensure that our frowth is attained without compromising for our core values and the brand identity which defines – SP E&C."

Core Values : Trust and reliability, Nuture people, Adaptive and agile.

Work Values: Quality, Safety, Innovation

Service Values : Relationship with stakeholders, Synergy to enhance group values, Enviornment and social responsibility.

Major Projects of SHAPOORJI PALLONJI CONSTRUCTIONS

The company is known for building some of

1. Mumbai's landmarks around the **Fort area**, including the **Hong Kong Bank, Grindlays Bank**
2. **Standard Chartered Bank and Reserve Bank of India** building,
3. **Bombay Stock Exchange** building and Taj Intercontinental.
4. Apart from these, the company has built **Al Alam Palace** for the **Sultan of Oman** in 1972. After the 2008 Mumbai Attacks,
5. The company was involved in the repairs and renovation of **Taj Mahal Palace & Tower** that was severely damaged by the attack.
6. Other notable projects include The Imperial in Mumbai, Jumeirah Lake Towers in Dubai and Ebene Cyber City in Mauritius.

2. PROJECT DETAILS

CATEGORY	DESCRIPTION
Project	Construction of **APJ Abdul Kalam Science City**
Name of Client of Project ,	Building Construction Department, Govt. of Bihar
Name of Contractor	Shapoorji Pallonji Constructions
Name of Architect	M/s Muralage, Lucknow, Uttar Pradesh
Total Area	24 acres
Contract Price	INR 405 Crores
Location	Rajendra Nagar, Patna, Bihar
Foundation Stone	6 th May, 2021
Duration	4 years

Dr. A. P. J. Abdul Kalam Science City is a science city that is currently under construction. It is being built by Department of Science and Technology Government of Bihar to promote and popularize Science among people. It is located at **Rajendra Nagar, Patna** in the Indian state of Bihar. It aims to promote and popularize science as well as demonstrating and preserving the history of scientific development in Bihar.

Fig.1.1: Fututе view of Science City

Fig.1.2 : Top view of Science City

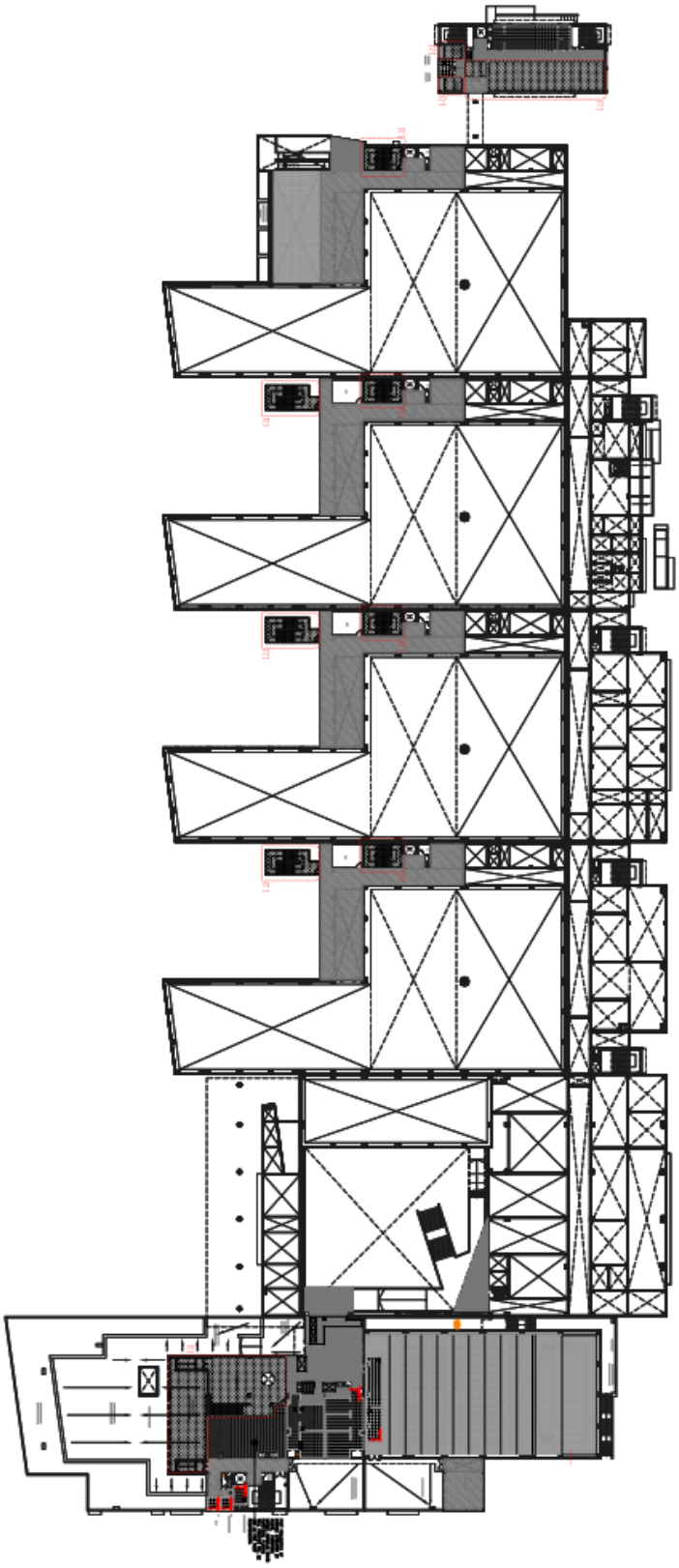


Fig.1.3: Top Plan View

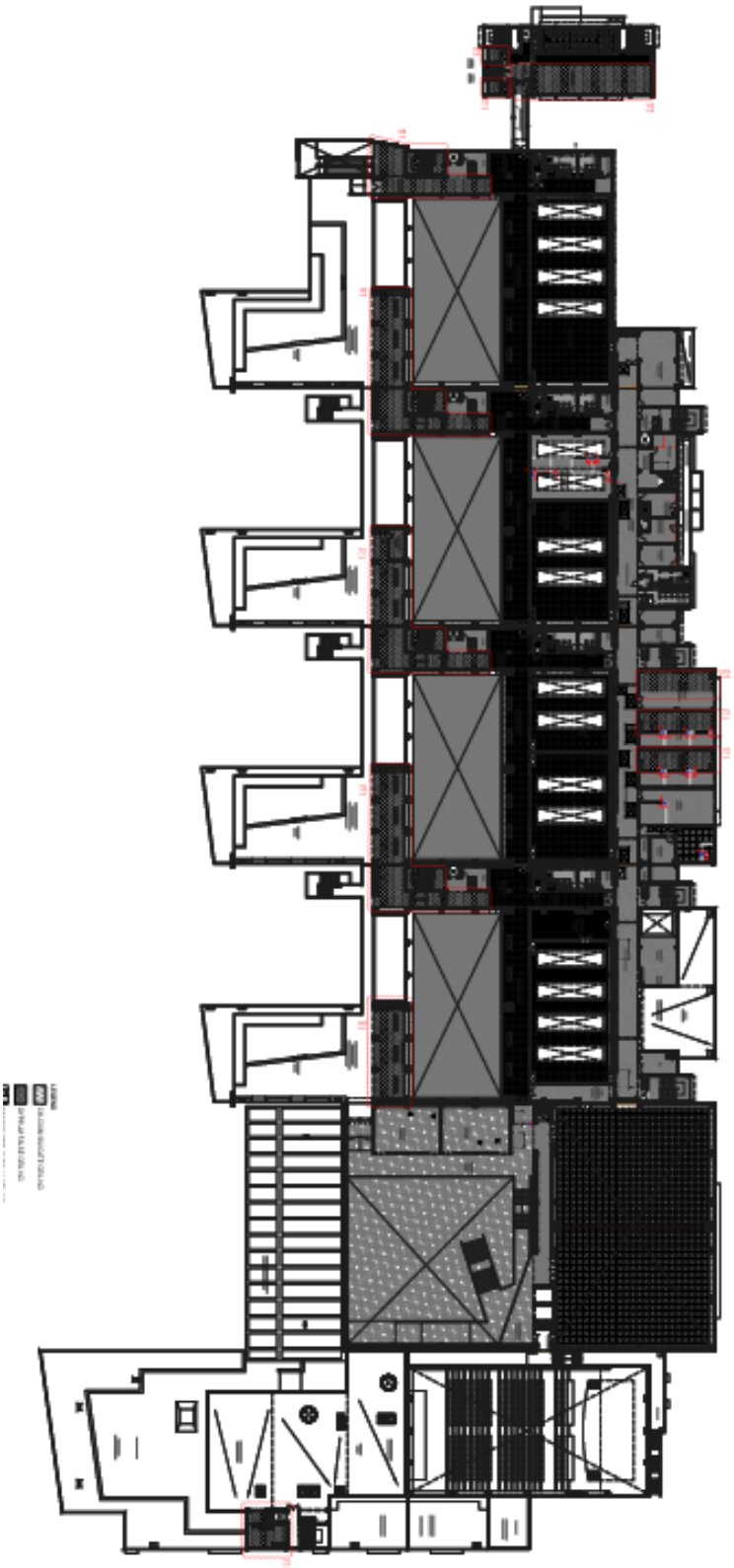


Fig.1.4 : Plan Layout

Design

The Building adopts state of the art technology. It is designed as a G+1 building, covering 30,000 square metres (320,000 sq ft) on a 8.9-hectare (22-acre) site near the Moin-Ul-Haq Stadium in Rajendra Nagar, Patna with an estimated cost ₹6,400,000,000 (US$77 million). The construction works of Dr A P J Abdul Kalam Science City is likely to be completed by November 2026, whereas other technical works like installation of science exhibits are expected to be completed by June, 2023.

Exhibition

It is to have four galleries: Body and Mind, Space and Astronomy, Basic science, Sustainable planet consisting of 243 interactive and realistic exhibits. Along with the same there will be a Grand Atrium lobby for entrance, Orientation Theatre, Multipurpose Halls, Temporary Exhibition Halls, 500 seater Auditorium, 300 seater Cafeteria, 4D Theatre, Retails spaces, Bio Diversity Park and many more to enchant the commuters to its beauty.

The company is known for building some of Mumbai's landmarks around the **Fort area**, including the **Hong Kong Bank, Grindlays Bank, Standard Chartered Bank and Reserve Bank of India** building, **Bombay Stock Exchange** building and Taj Intercontinental. Apart from these, the company has built **Al Alam Palace** for the **Sultan of Oman** in 1972. After the 2008 Mumbai Attacks, the company was involved in the repairs and renovation of **Taj Mahal Palace & Tower** that was severely damaged by the attack. Other notable projects include The Imperial in Mumbai, Jumeirah Lake Towers in Dubai and Ebene Cyber City in Mauritius.

Facilities

It is to have four learning suites: Marker Space, Big Data Centre, Demo Kitchen and a gym on first floor for children who visit during a study tour or excursion. The dormitory is to accommodate 250 students connected to the learning suites.

Stakeholders Involved

Prime Stake holder is Department of Science & Technology, Govt. of Bihar Partnered with Building Construction Department, Govt. of Bihar for Excitation of Building works. Prime Consultant for the project is Flying Elephant Studio, Bangalore formed consortium along with Gleeds Consulting India Pvt Ltd (Project and Cost management consultant) and Studio Nabila birjis (Interior Consultant) (now known as Atelier birjis[6]) and Gallagher & Associates (Exhibit Consultant) . Execution Agency is Shapoorji Pallonji.

3. TRAINING SUMMARY

The 6 weeks long industrial training at **APJ Abdul Kalam Science City Patna** comprised of extensive site visits covering all the green field and brown field sites as per the master plan with a special emphasis Auditorium and Gallery.

- Various soil tests were carried out with different samples from the proposed site and results indicate that the soil in this region has a **safe bearing capacity of 11.6 tn/m^2**. Therefore, Raft Foundation is being provided for this project.

- Though Patna lies in Seismic Zone IV, in order to ensure durability and earthquake resistance, all the buildings have been designed keeping in view the parameters of Seismic Zone V as per **IS 1893 (2002)**.

SEQUENCE OF CONSTRUCTION

➢ Planning

➢ Surveying

➢ Construction Project Equipment

➢ Quality Assurance (QA)/Quality Control (QC)

➢ Excavation

➢ Laying of PCC Layer

➢ Providing Reinforcements as per Bar Bending Schedule (BBS) for footings & pedestals as per layout plan.

➢ Casting and Curing of Pedestals & Footings

➢ Sub structure water proofing of Raft & Retaining Wall using Colphene BSWH & Colphene 3000 Sheet.

- Execution of project is a very challenging part, we need to consider all the plans we have created and since construction is a complex process, we need to have considerations on the safety & health of workers, environmental factors, and financial claims.

- This Industrial Training also comprised of a detailed tour and go through of all the technical know how associated with various other departments along with execution viz. Planning, Quality Assurance & Quality Control (QA/QC), Billing and Enviornment, Health and Safety (EHS).

Fig.3.1: Construction Phase

Fig.3.2 : Parking area

4. GENERAL TERMINOLOGIES

Tender: A tender is an invitation to bid for a project or accept a formal offer such as a takeover bid. Tendering usually refers to the process whereby governments and financial institutions invite bids for large projects that must be submitted within a finite deadline. The term also refers to the process whereby shareholders submit their shares or securities in response to a takeover offer

DPR: A Detailed Project Report is a very extensive and elaborative outline of a project, which includes essential information such as the resources and tasks to be carried out in order to make project into a success

GAD: General Alignment Drawing represents the overall composition of a project. Such as- Nearby buildings, Alignment of road, other physical properties. GFC drawings (good for construction drawings): They are construction drawings and specifications for a designated project. They are approved by local governing bodies and by clients.

Foundation: The lowest part of a building structure that transfers the load to the ground. Foundations are designed to provide stability and support to the building and are typically made of concrete, stone, or brick.

Beam: A horizontal structural element that supports loads, typically by bending. Beams transfer loads from floors, roofs, and walls to columns or foundations.

Column: A vertical structural member that supports compressive loads, transferring them from the structure above to the foundation below.

Slab: A flat, horizontal surface in a building, typically made of concrete, that forms floors or roofs. Slabs are usually reinforced with steel to increase their strength.

Masonry: Construction using individual units, such as bricks, stones, or concrete blocks, bonded together with mortar to form walls and other structural elements.

Rebar (Reinforcing Bar): Steel bars used to reinforce concrete, providing additional strength and helping the concrete resist tensile stresses.

Cladding: Material applied to the exterior surfaces of a building to provide thermal insulation, weather resistance, and aesthetic appeal.

Shuttering: A type of formwork used specifically for supporting and molding concrete for columns, beams, slabs, and other structural elements.

Plinth: The part of a building that forms the base above the ground level. It raises the floor above the surrounding ground level and protects against water seepage.

Concrete Mix: A combination of cement, sand, aggregate (gravel or crushed stone), and water. The proportions of these ingredients determine the strength and durability of the concrete.

Curing: The process of maintaining adequate moisture, temperature, and time conditions to allow the concrete to achieve its desired strength and durability.

Load-Bearing Wall: A wall that supports the weight of the roof, floors, and other loads, in addition to its weight, and transfers them to the foundation.

Non-Load-Bearing Wall: A wall that does not carry structural loads other than its weight. It primarily serves as a partition or divider within a building.

DPC (Damp Proof Course): A layer of waterproof material, such as bitumen, plastic, or cement, laid at the base of walls to prevent moisture from rising through the structure.

HVAC (Heating, Ventilation, and Air Conditioning): The system used to provide heating, ventilation, and cooling in a building to maintain comfortable and safe indoor air quality.

Footing: Part of the foundation that directly contacts the ground, spreading the load of the building over a larger area to prevent settlement.

Retaining Wall: A wall constructed to hold back or support soil, rocks, or water, preventing erosion or collapse of the adjacent ground.

5. SAFETY MANGEMENT

Construction safety management is a method which is used to control safety activities in order to ensure a safe working environment in the construction site.

“Safety first”, every construction work is done with this line keeping in mind. Safety of people should be the first priority of any construction work. Some of the safety equipment are as follows:

1. Safety helmet
2. Safety jacket
3. Safety Shoes
4. Safety gloves

Fig.5.1 : Safety Equipments

1 SAFETY HELMET

Safety helmet act as the first line of defense against head injury, but they only work when they are worn correctly. Thus, it’s safe to say safety Helmet save lives and reduce the risk of brain injury.

Fig.5.2: Safety Helmet

SIGNIFICANCE OF COLOURED HELMETS

Fig.5.3 : Significance of helmet

2. SAFETY JACKET

A safety jacket is an essential accessory for anyone taking part in industrial activities. This clothing makes workers visible in low light and dark conditions. Safety jackets are worn by people that work at construction sites who have to follow a particular dress code. These safety clothes serve as the first line of defense for the workers who work at construction sites

Fig.5.4: Safety Jacket

3. Safety Gloves:

1. **Purpose:** Protect hands from cuts, abrasions, chemical exposure, and electrical hazards.
2. **Types:**
    - Cut-resistant gloves: Protect against sharp objects.
    - Chemical-resistant gloves: Made of materials like nitrile, latex, or PVC for handling hazardous chemicals.
    - Electrical gloves: Insulated gloves for electrical work to prevent shocks.
    - General-purpose gloves: For general handling, offering basic protection.

Fig.5.5: Gloves

Safety Shoes:

1. **Purpose:** Protect feet from heavy objects, sharp materials, slips, and falls.
2. **Types:**
    - Steel-toe shoes: Reinforced toe area to prevent injuries from falling objects.
    - Electrical hazard shoes: Made with non-conductive materials to protect against electrical shocks.
    - Waterproof or chemical-resistant boots: For protection against water and chemical exposure.

Fig.5.6 : Safety Shoes

6. TYPES OF BUILDING

BUILDINGS:- A building is any man-made structure that rests on a **foundation** and has walls made from **architectural cladding systems**, floors, roofs, chimneys, plumbing, and other building services, as well as permanent features like a veranda, balcony made from **floor grating plastic**, cornice, or projection that is attached to or forms a part of a building..

The list of types of buildings below is based on the 'National Building Code of India', which categorises buildings based on occupancy.

1. Residential Buildings
2. Institutional Buildings
3. Educational Buildings
4. Assembly Buildings
5. Business Buildings
6. Mercantile Buildings
7. Hazardous Buildings
8. Storage Buildings
9. Industrial Buildings

Fig.6.1: Types of building

1. Residential Buildings: Buildings that provide at least one habitable bedroom, with or without associated kitchens and eating areas, are considered residential buildings. The dwelling's name and function are both indicative of its significance. If more than 50% of a building's square footage is devoted to dwelling quarters, it is classified as a residential building.
Eg:- Lodging or rooming houses, one or two family privet dwellings, Dormitories, apartment houses (flats), hotels are the different types of residential buildings.

2. Institutional Buildings: Institutions are large structures used for various reasons, including medical care for those with physical or mental illness, care for infants and the elderly, and penal or correctional imprisonment where convicts' freedom is severely limited. Most of these structures have some sort of sleeping quarters for their occupants.

Eg:- Hospitals, museums, courts, post offices, prisons, libraries, community centers etc. are all examples of common institutional structures.

3. Educational Buildings: Educational buildings serve as a home for many academic pursuits. All levels of schooling, from pre-kindergarten to college, are covered. Buildings such as schools, colleges, universities, training institutes etc. are prime examples of educational structures. Institutions of learning can be public or private.

4. Assembly Buildings: Assembly buildings are the type of public buildings typically constructed for social events. Types of public buildings like hotels, restaurants, clubs, theatres, exposition halls, auditoriums, and so on are all common assembly venues where people congregate for various purposes, including social, religious, and recreational activities.

Eg: Places of worship, dance halls, Theatres, cinemas, banquet halls, town halls, auditoriums, exhibition halls, assembly halls, and museums are all examples of public assembly buildings.

5. Business Buildings: A business building might be a single building or a cluster of establishments. These can be a single building or a cluster of businesses in a single location. These can be small or large. The primary purpose of these structures is to house various commercial enterprises. Such structures are typically used for business, maintaining vital records and finances, and similar functions. Offices, banks, professional institutions, courthouses, libraries, and similar structures are used for business conduct, maintaining accounts and records, and related activities

6. Mercantile Buildings: Wholesale and retail establishments constitute most of the mercantile buildings. Commercial structures fall into this category, including places like convenience stores and shops. Therefore, it is one of the many buildings in society that people use on a regular basis to assist and help others.

7. Hazardous Buildings: Hazardous buildings are those that are used for the storage, handling, processing, or manufacturing of materials that are toxic to living things and can burn with tremendous velocity and cause harm to health.

8. Storage Buildings: The storage buildings are used for sheltering or storing goods, commodities, merchandise etc. Warehouses, transit sheds, cold storage plants, freight depots, storehouses, truck terminals, marine terminals, garages, hangars, stables, grain elevators, barns etc. are examples of storage buildings.

9. Industrial Buildings: Industrial buildings are used to manufacture, process, and assemble goods and materials. This type of building consists of manufacturing units, factories, mills, assembly plants, power plants, gas plants, oil refineries, dairy plants, etc.

7. COMPONENTS OF BUILDING

Construction of the building is done in at least two steps, which are as following:

- Sub Structure
- Super Structure

1. SUB STRUCTURE

The purpose of the substructure of a building is to transfer loads of the superstructure to the soil that is underneath. This is why the substructure is right against the soil that supports it. Now, it is important that you spend time working with structural engineers to ensure that all support beams, columns, and foundations are incorporated properly to ensure that nothing will collapse within the substructure.

Components of a Building Substructure

1. Foundation

The foundation is the most critical component of the substructure. It distributes the weight of the building to the ground, providing stability and preventing settlement or movement. Foundations are broadly classified into two types:

1.1 Shallow Foundations: These are used when the soil near the surface has sufficient bearing capacity. Types of shallow foundations include:

- **Spread Footing**: Supports individual columns, spreading the load to a larger area.
- **Strip Footing**: Supports walls by distributing the load along the length of the wall.
- **Raft or Mat Foundation**: A single, thick slab supporting multiple columns and walls, used when the soil bearing capacity is low or loads are heavy.

1.2 Deep Foundations: Used when the surface soil does not have sufficient bearing capacity, requiring the foundation to reach deeper, more stable soil layers. Types include:

- **Pile Foundation**: Long, slender columns driven deep into the ground, transferring loads to deeper, stronger soil layers.
- **Caisson or Well Foundation**: Hollow, cylindrical structures sunk into the ground to provide support in underwater construction or areas with high water tables.

2. Plinth

- The plinth is the portion of the building between the ground level and the top of the foundation. It serves as a transition element between the foundation and the superstructure. The plinth level is generally raised above the ground to prevent water infiltration and moisture from entering the building.

- **Plinth Beam**: A reinforced concrete beam constructed between the foundation and the walls. It provides additional support, especially in earthquake-prone areas.

3. Damp Proof Course (DPC)

- A layer of waterproof material, typically a membrane or concrete, is applied to prevent moisture from rising through the substructure into the walls and floors of the building. DPC is placed above the plinth level or at the ground floor level.

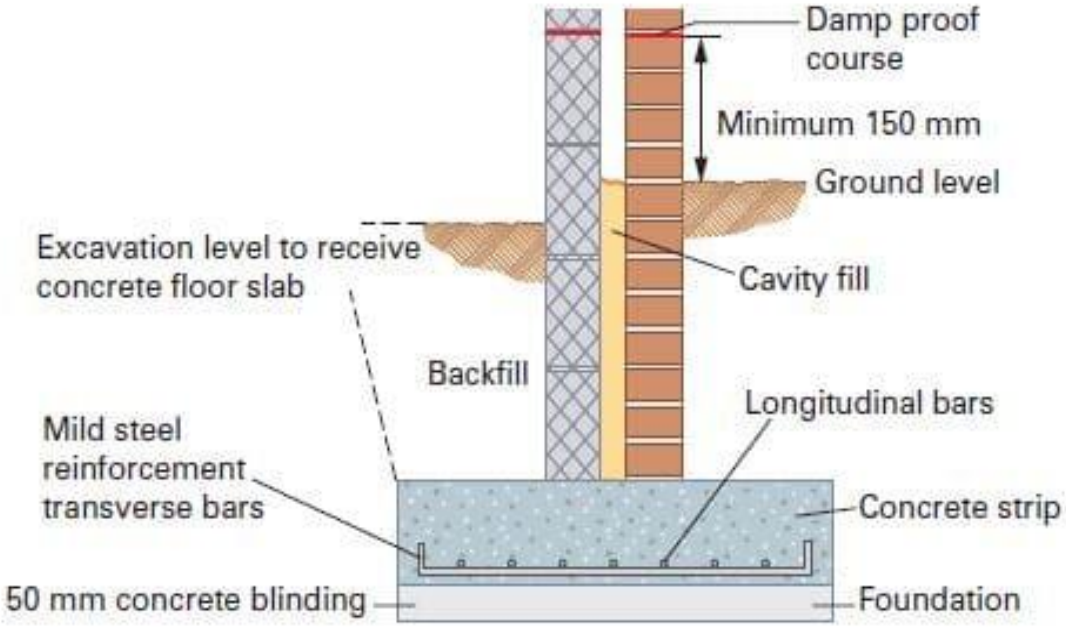


Fig 7.1: Components of Substructure

2.SUPERSTRUCTURE

Some parts of the superstructure may include;

- **Floors:** Floors separate the levels within the superstructure.
- **Beams:** These are the horizontal elements within the superstructure that support all the vertical loads.
- **Lintel:** This refers to the area over the doors and windows. It provides support to the wall area over larger openings. The lintel is made from reinforced cement concrete or concrete and brick.
- **Walls:** Walls help to provide enclosure and privacy. Walls also carry some of the weight from the beams and slabs.
- **Roof:** The roof protects the inside of the building from the elements such as rain and wind. There are countless roofing options available. However, sloped roofs are recommended in highland areas, while flat roofs work well within the plains.
- **Parapet:** Parapets are external walls that extend past the roof slab and are chiefly used to prevent water from pouring over onto the entrance of the building.
- **Columns:** These are the vertical structures that hold most of the loads from the superstructure and transfer this weight to the foundation. Columns are essential in tall buildings.
- **Doors, windows, and other openings:** Doors, windows, and other openings above the ground level are considered part of the superstructure.
- **Stairs, ramps, and lifts:** Stairs, ramps, and lifts are also part of the superstructure, allowing movement around the building.

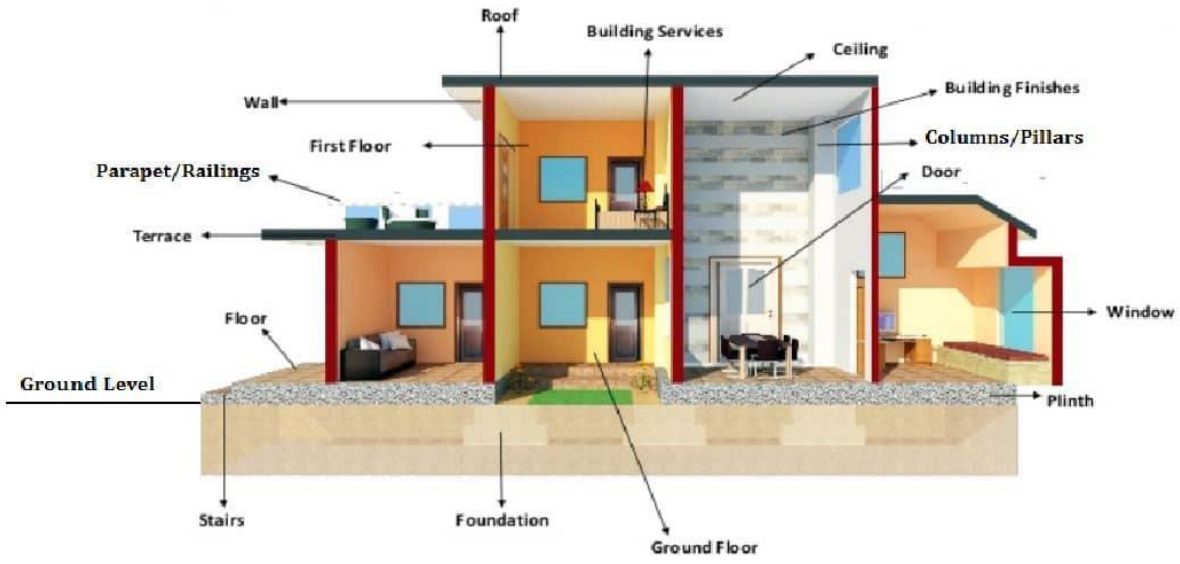


Fig 7.2: Superstructure elements of Building

8. MATERIALS USED FOR CONSTRUCTION

Building materials are commonly classified into two origins: natural and manmade. However, both must be made or treated before they are utilised in construction. The list of materials used in building construction is as follows:

1) Steel: Steel is a strong metal made from iron and carbon, with other materials mixed in to make it even stronger and resistant to damage than iron. Stainless steel, for example, resists corrosion and oxidation because it contains extra chromium. Despite its weight, it's the top choice for constructing modern buildings and large industrial facilities due to its incredible strength

2) Cement: Cement is a crucial building material that hardens and sticks to other materials, helping them stick together. It's not typically used alone; instead, it's mixed with sand and gravel. Cement is often blended with fine sand to create mortar, which is used for bricks and stones in building construction. When mixed with sand and gravel, it becomes concrete, a versatile material used in various construction projects. Its ability to solidify and bond makes it a cornerstone of construction, ensuring that buildings and structures stand the test of time**.**

3) Concrete: Concrete is a special construction material formed by mixing small and large pieces like gravel, crushed stone, recycled concrete, and synthetic materials. These pieces stick together with a liquid binder, usually cement, which gradually hardens as it dries. The most common type of cement used is called Portland cement, which is made by heating limestone and clay and then adding gypsum. When you blend Portland cement with water and these aggregates, it transforms into the sturdy substance we call concrete.

4) Ready Mix Concrete: Ready mix concrete is a convenient building material produced in a plant away from the site and arrives at construction sites pre-mixed and ready for use. It's a blend of cement, aggregates like sand and gravel, and water, precisely measured and mixed at a concrete plant. This ready-to-use mixture ensures consistency and quality, saving time and effort on construction sites. Contractors can simply pour it into moulds or formwork, allowing for precise placement and curing.

5) Binding Wire: Binding wire plays a crucial role in construction, helping hold different components together securely. It's particularly useful for tying reinforcing bars (rebars) at connection points, ensuring the stability of the structure. Binding wire is usually made from mild steel.

6) Wood: Wood is a versatile natural building material derived from trees and has been a trusted construction material for centuries. There are various types of stones, each with its own unique characteristics and uses. Wood is a construction material valued for its strength, durability, and aesthetic appeal, making it a popular choice for construction, furniture, flooring, and countless other applications in the building industry. It's used in

construction when it's cut or pressed into various forms like lumber, timber, boards, and planks.

7) Stone: Stone is a natural building material formed over centuries through geological processes. It comes in various types, including granite, limestone, marble, and more, each with unique colours and textures. Stones are building materials used in construction for foundations, walls, flooring, and decorative elements, adding strength to buildings.

8) Bricks: Bricks are one of the oldest and most fundamental building materials used in construction. They are typically made from clay that's fired in a kiln. Bricks are widely used for constructing walls, buildings, and various masonry constructions. They come in different shapes, sizes, and colours, and are materials used to build a house that allows for versatile design possibilities. Known for their durability and insulating properties, bricks are construction materials that have stood the test of time in the construction industry, providing both strength and a classic, traditional look to architectural projects.

9) Blocks: Blocks are modular construction units made from materials like concrete, clay, or aerated concrete. These units vary in shape and size, each tailored for specific construction needs. They play a fundamental role in creating walls, partitions, and structural elements in construction projects. Blocks are construction materials known for their strength, stability, and ease of installation, making them a practical choice for both residential and commercial buildings.

10) Aggregates: Aggregates are granular materials used in construction, typically comprising crushed stone, gravel, sand, or recycled materials like concrete and asphalt. These components serve as the foundational building blocks for various construction projects, such as roads, buildings, and bridges. Aggregates provide structural support, aiding in the distribution of weight and enhancing the strength of concrete and asphalt mixtures. With a diverse range of sizes and types available, aggregates can be precisely tailored to meet specific construction requirements.

Fig 8.1: Different Types of Materials used for Building Construction

9. QUALITY ASSURANCE AND QUALITY CONTROL

Before putting the construction materials to use, it is pertinent to ensure the viability of the material in terms of strength and durability, including a multitude of other engineering properties. Testing of building materials to be used in new engineering projects or existing projects is known as construction materials testing. Material testing is important for checking the viability and safety of a building project. Testing the building materials ensures that every material used in the construction of the project conforms to the pre-determined prerequisite criteria laid down in the respective codal provisions.

Aggregate Impact Value (IS 2386 – (Part 4):1986)

The aggregate impact value gives a comparative measurement of aggregate resistance to impact. It is expressed in terms of the proportion of fines that the aggregate sample produces after being subjected to **15 blows by a hammer (14kg)** falling freely from a **height of 380mm**.

Subsequently, the weight of the sample passing the 2.36 mm sieve is measured to arrive at the Aggregate Impact Value of the soil sample. As per IS 383, just like the Aggregate Crushing Value, the Aggregate Impact Value should not exceed 30% for aggregates used in wearing courses and 45 % for aggregates used in concrete (in cases other than wearing courses).

So, impact test is performed on the aggregates to make sure that they have the sufficient toughness required to resist its disintegration due to impact. Toughness: The property of a material to resist impact

Fig.9.1: Aggregate Impact Value Machine

Fig 9.2: Sieves of different sizes

Limits:

For Road Surface:

Exceptionally strong	<10%
Strong	10-20%
Satisfactory	20-30%
Weak	>35%

Table 1

For concrete: The aggregate impact value should not exceed 45% by weight for aggregates used for concrete other than for wearing surfaces

Apparatus used:

1. **Oven:** Thermostatically controlled drying oven (aggregates are dried at a temperature of 1001100C). 2.
2. **Balance/ Weighing machine**: To measure the weight of the aggregates.
3. **Sieve:** IS sieve is sizes 12 mm, 10 mm and 2.36 mm is used4.
4. **Tamping Rod:** A straight metal rod with circular cross-section, having diameter of 10 mm and a length of 230 mm. 5.
5. **Cylindrical Measure:** It is a cylindrical measure (of metal) having an internal diameter of 75mm and a depth of 50mm. The measure is filled to about with test aggregates (in three rounds) and then tamped 25 times with the rounded end of the tamping rod. 6.
6. **Impact Testing Machine:** The machine consists of a cylindrical steel cup of internal diameter 102 mm and depth 50 mm. A metal cup or hammer weighing 13.5 to 14.0 kg, the lower end of which shall be cylindrical in shape, 100.0 mm in diameter and 50 mm long, with a 2-mm chamfer at the lower edge.

Results: The mean value for 20mm aggregates=**18%**
The mean value for 10mm aggregates=**16%**

Specific Gravity of Aggregates (IS 2386 - Part 3)

The aggregate specific gravity connotes the density of the aggregate about the density of water at 4 °C.

- It is an important property of aggregates. It gives an indirect measure of their strength and hardness.
- Low specific gravity of aggregates pertains to weaker aggregates.
- Specific Gravity of Aggregates can be measured by **Pycnometer,** and its value generally lies between **2.5 to 3 for fine aggregates.**

Fig.9.3: Specific gravity test equipment

Flakiness Index (IS 2386 - Part 1)

Flaky particles are those coarse-sized particles that have their least dimension 0.6 times smaller than the mean particle size.

Flakiness index of aggregates that are used to be used in road construction should not be less than 15% and should not exceed 25%

Elongation Index (IS 2386 - Part 1)

The fraction of elongated aggregates by weight is known as the elongation index. More specifically, elongated aggregates are those aggregates that have their greatest dimension larger than 1.8 times the other dimensions.

Aggregates smaller than **6.3 mm** are not applicable for this test.

Fig.9.4: Flakiness And Elongation Test Equipment

COMPRESSIVE STRENGTH TESTS ON CONCRETE CUBES (IS 516:1959)

Compressive strength is the capacity of a material or structure to withstand loads or Compressive strength can be defined as the capacity of concrete to withstand loads before failure.

Compressive strength test is done for concrete to determine the ability of concrete to resist compressive stresses among structures and it has less tensile strength for this we follow IS:516.

Apparatus used:

1. **Moulds for the test cubes:** Mould that is use for compressive strength test is of size 150 x 150 x 150 having least count of ±0.2 mm and Tolerance angle of 900± 0.5
2. **Tamping Rod**: It is a cylindrical rod having a conical shape at the base having a radius of 8 mm at the base and 600 mm in length. This is generally used to curing the concrete sample when the sample is placed in mould.
3. **CTM:** Compression testing machine is a machine that is often used on brittle materials such as concrete, metals, plastics, ceramics, composites and corrugated materials like cardboard.

Material used: Cement, Sand, Aggregate and Water

Fig.9.5: Moulding of Cube

Fig.9.6: Compression test

Result: Peak Load of cube was: **1056.7 kN**

Peak stress of Cube was: **46.96 Mpa**

Slump Cone Test (IS 1199 (Part-II) : 2018)

Workability is the ease of mixing, transporting, placing, and compacting easily without any segregation of the concrete (IS: 6461(PART-VII)) at site.

Any concrete needs sufficient workable to be easily transport from one to place to another without losing its plastic property and then placed, curing it easily surround the reinforcement and other embedded items.

There are three test methods by which we can measure the workability. These are:

a) **Slump flow test method**
b) Compaction factor method
c) Vee-Bee consistometer

Slump flow test method: This a method by which we measured the workability by using standard slump cone having height 300 mm, upper diameter is 100 mm and lower diameter is 200 mm dimension and then placed concrete paste in 4 layer and each layer given 25 no. of blow with standard tempering rod and finally measure the slump height. Higher is the slump value high is the workability and vice- versa.

Theory: The word– "workability" or workable concrete signifies much wider and deeper meaning than the other terminology "consistency" often used loosely for workability. Consistency is a general term to indicate the degree of fluidity or the degree of mobility.

The factors helping concrete to have more lubricating effect to reduce internal friction for helping easy compaction are given below:

(a) Water Content (b) Mix Proportions (c) Size of Aggregates (d) Shape of Aggregates (e) Surface Texture of Aggregate (f) Grading of Aggregate (g) Use of Admixtures

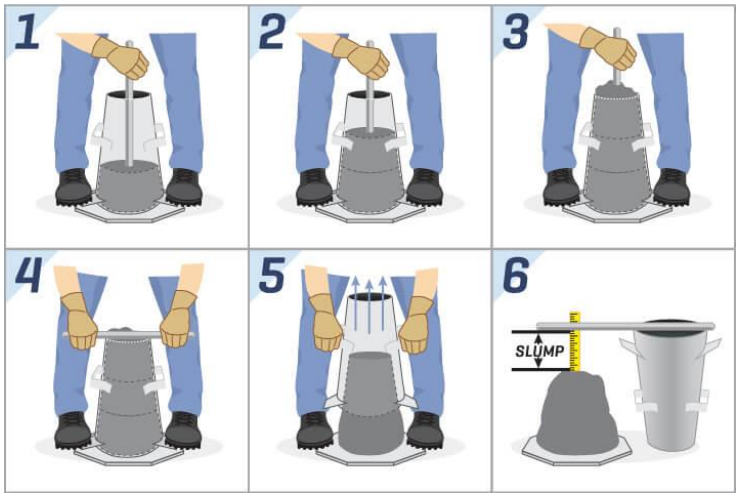


Fig 9.7: Slump cone test steps

Fig.9.8: Slump Cone Test

PROCEDURE:

- We prepare concrete by using the material.
- And then placed in standard cone in 4 layer and each layer is proper cured with the help of 25 no. of blow of tampering rod.
- And finally measure the slump height by using tampering rod.

Limits

Slump height(mm)	<25	25-50	50-100	100-175	>175
Workability	Very Low	Low	Medium	High	Very High

Table 2

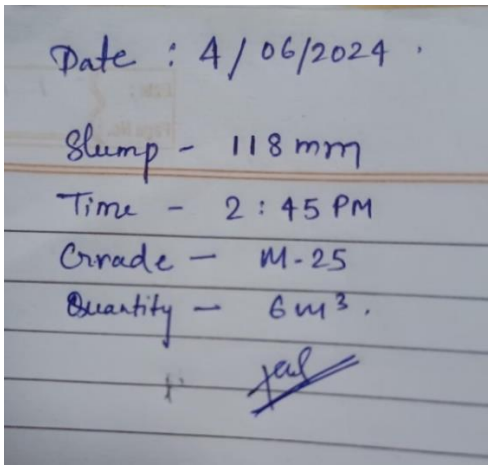


Fig 9.9: Result obtained at site

Result: The given concrete sample having good workability and true and collapsing nature of slump

10.TEMPORARY STRUCTURES

Structures / systems that allow or enable construction of, protect, support orprovide access to, the permanent works and which might or might not remain in place after the completion of the works.

• Scaffolding

• Formworks

• Falsework/shoring

• Shuttering

• Staging

• Earth Retaining Structure

• Construction Ramp, runway and platform

• Underpinning

Scaffolding:

Scaffolding is a temporary structure made of wooden planks, metal poles, or other materials that provides a safe and stable platform for workers and materials during the construction, repair, or maintenance of buildings and other structures. It allows access to high or hard-to-reach areas, ensuring safety and efficiency for tasks like painting, bricklaying, and other construction activities.

Scaffolding is designed to be easily assembled and dismantled and comes in various types to suit different construction needs and site conditions..

The types of scaffolding in building construction are:

1. Single Scaffolding (Brick Layer's Scaffolding)

2. Double Scaffolding (Mason's Scaffolding)

3. Cantilever Scaffolding

4. Suspended Scaffolding

5. Trestle Scaffolding

6. Steel Scaffolding

7. Patented Scaffolding

Fig.10.1 : Scaffolding

Formwork:

Formwork is a temporary or permanent structure used to contain and mold fresh concrete or other materials into specific shapes and dimensions during construction. It acts as a mold that holds the poured material in place, providing support and alignment until the material sets and achieves sufficient strength.

Formwork is designed to:

- **Support Loads**: Formwork must withstand not only the weight of the wet concrete but also the live loads of workers, equipment, and potential environmental factors such as wind.
- **Shape and Align**: It helps shape structural elements (like beams, columns, slabs, and walls) to their intended design specifications, ensuring proper dimensions, surface finish, and alignment.

Fig.10.2: Frame work

Staging

"Staging" in construction refers to the temporary platforms or scaffolding erected to support workers, materials, and equipment during construction, maintenance, repair, or demolition of buildings and other structures. Staging provides access to higher elevations, allowing workers to perform tasks like bricklaying, painting, plastering, or installing components at different heights safely and efficiently.

Key components of staging include:

1. Standards (Uprights): Vertical supports that carry the weight of the scaffold and its load to the ground.
2. Ledgers: Horizontal members that connect the standards and provide lateral stability.
3. Transoms: Horizontal cross supports that provide additional stability and hold the platform boards in place.
4. Platform Boards or Decking: The surfaces on which workers stand and place materials. These can be made of wood, steel, or aluminum.
5. Braces: Diagonal members that provide additional stability to prevent the scaffold from swaying or collapsing.
6. Base Plates or Sole Plates: Placed at the bottom of the standards to distribute the load evenly and provide a stable foundation.

Staging is critical for ensuring safety and accessibility on construction sites. Properly erected and maintained staging helps minimize the risk of accidents and allows work to be performed efficiently at various heights.

Fig.10.3: Staging

11. FOUNDATION

INTRODUCTION

Foundation is a substructure which is always in contact with soil to transfer super imposed load safely to the soil, so that the soil should not fail in shear as well as soil should not fail in excessive settlement. Considering good bearing capacity, pile foundation is proposed below the non-tower area.

FOOTING

A footing is the bottom most portion of the foundation which is always contact with soil to transfer super imposed load safely to the soil. For the design of various foundations for the proposed site, open spread/strip isolated footing and raft foundation will be used. The allowable bearing capacities shall be calculated for different type of foundation.

STRUCTURAL SYSTEM

The structure is being designed as a RCC Framed structure with a Shear Wall, Normal Slab and Beam. All basement slabs are being designed as Flat Earthquake Resistant Structure having base isolation system.

FUNCTIONS OF FOUNDATION

Now let's come to the actual purposes of the foundation.

- **Providing level structure**: Foundation gives the structure the ability to stand on the ground. Without the foundation bed being strong, it is bound to fall. The stronger the foundation, the more stable the structure.

- **Distributing weight of the structure**: Foundation disseminates the weight of the construction over a huge area in such a way that there is likely any possibility of unequal settlement to not cause overload on the soil beneath. So, the load needs to be distributed in a uniform way.

- **Supporting structure against natural disasters**: The foundation is most vulnerable to damage during a natural disaster as it is the part of the building that is in contact with the ground. When the ground shakes during an earthquake, or when high winds blow during a hurricane, the foundation is needs to be able to anchor the structure during those times.
- **Preventing lateral movements:** The foundation blocks lateral movement by laying a stable base for the structure to rest on. The foundation prevents the structure from moving from side to side and also keeps it from shifting up and down

TYPES OF FOUNDATION

- SHALLOW FOUNDATION
- DEEP FOUNDATION

SHALLOW FOUNDATION

A shallow foundation is a type of foundation that transfers building loads to the earth very near the surface, rather than to deeper soil or rock layers. Shallow foundations are typically used for small, simple structures such as houses, garages, and sheds. They are also used for some larger structures such as bridges and towers. The soil below shallow foundation is usually not excavated or reinforced in any way.

Shallow foundations are usually less expensive to construct than deep foundations because they require less excavation and less material. However, shallow foundations are not always appropriate. The soil must be able to support loads of the structure without settlement or failure. In some cases, the soil may be too weak or too compressible to support a shallow foundation, and a deep foundation may be necessary.

A foundation is shallow if its depth is less than or equal to the width.

$$\mathbf{Df \leq Bf}$$

DESIGN STEPS

The design of footings may be accomplished by carrying out the steps outlined in the following approach:

- Determine how much weight is being supported by the footing.
- Acquire a soil sample or profiles that display the soil divisions at the location
- Determine the highest level that the water can reach.
- Collect the relevant measures from the field as well as the laboratory tests.
- Find out the dimensions of the footing as well as its position.
- Find out how much weight the supporting stratum can sustain.
- Adjust the sizes of the footings as necessary.
- Be careful to check the contact pressure of the footing.
- Verify that the footing is stable when subjected to forces of sliding, lifting, and overturning.
- Create an estimate for both the total and the difference between the settlements.
- Develop the framework of the footing
- Determine whether or not foundation drains, insulation, or damp proofing are necessary.

ADVANTAGES

- Because less excavation is required, the labor costs associated with excavation operations may be reduced.
- The development of shallow foundations is made easier by the reduced amount of depth that is required when putting the foundation.
- The tools and machinery needed for the building of a shallow foundation are not only straightforward but also quite inexpensive.
- It is possible to create shallow foundations in a short amount of time, which not only helps save money but also helps reduce the cost of renting equipment and people.

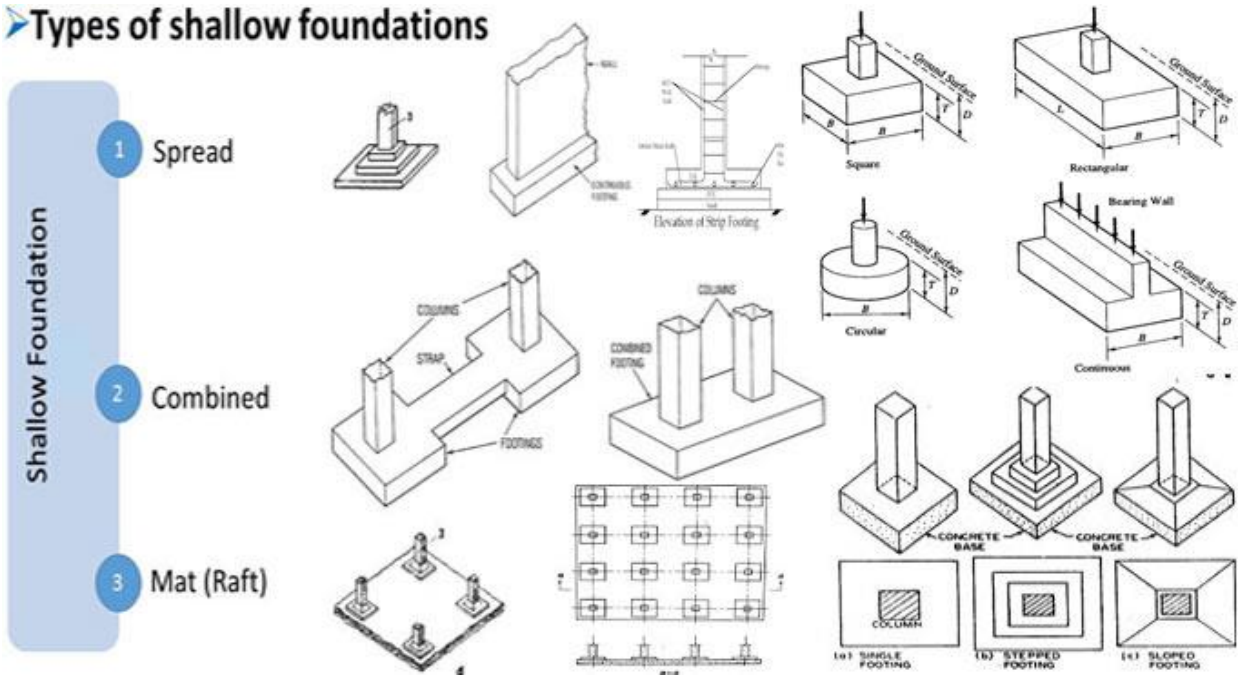


Fig 11.1: Different types of Shallow foundation

Fig 11.2: Isolated Footing used at Science City

DEEP FOUNDATION

Deep foundation is required to carry loads from a structure through weak compressible soils or fills on to stronger and less compressible soils or rocks at depth, or for functional reasons. Deep foundations are founded too deeply below the finished ground surface for their base bearing capacity to be affected by surface conditions, this is usually at depths >3 m below finished ground level. Deep foundation can be used to transfer the loading to a deeper, more competent strata at depth if unsuitable soils are present near the surface.

When the depth of the foundation is greater than the width of the foundation, it is called a deep foundation.

Df >Bf

NEED OF DEEP FOUNDATION

- It is used when the soil has a low bearing capacity. •
- It is suitable when the self-weight of the structure is very high. •
- To sustain the high-rise structure from the sudden impact, a deep foundation is the most preferable. •
- Mostly used where the soil is very loose and low dense. 7.4.3.

TYPES OF DEEP FOUNDATION

The deep foundations are of the following types:

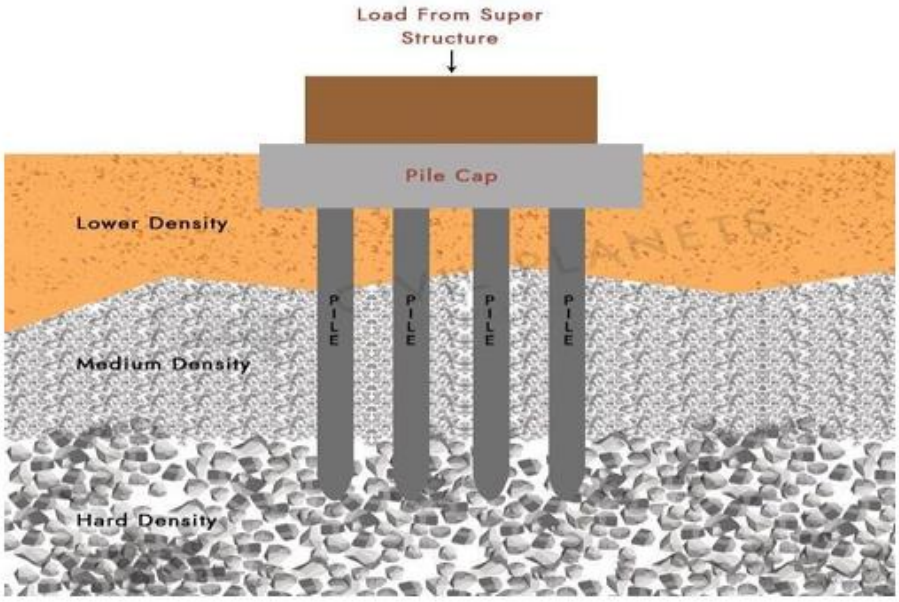


Fig 11.3: Pile Foundation

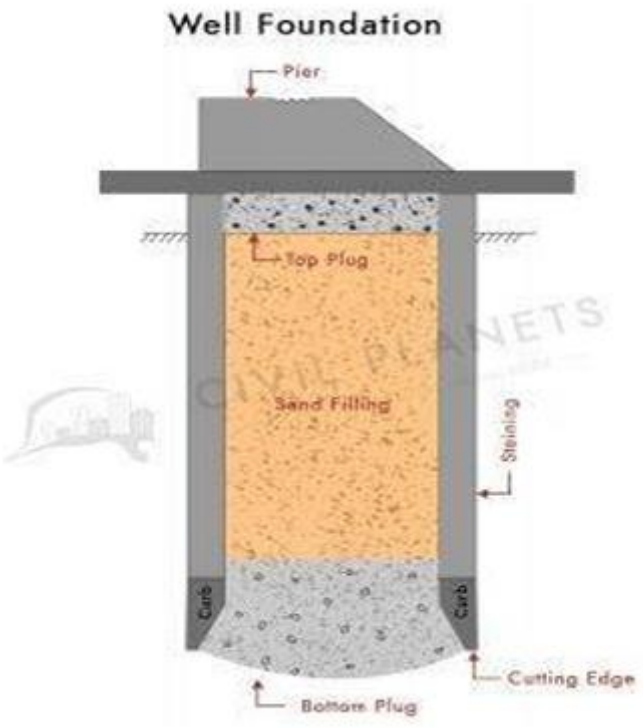


Fig 11.4: Well Foundation

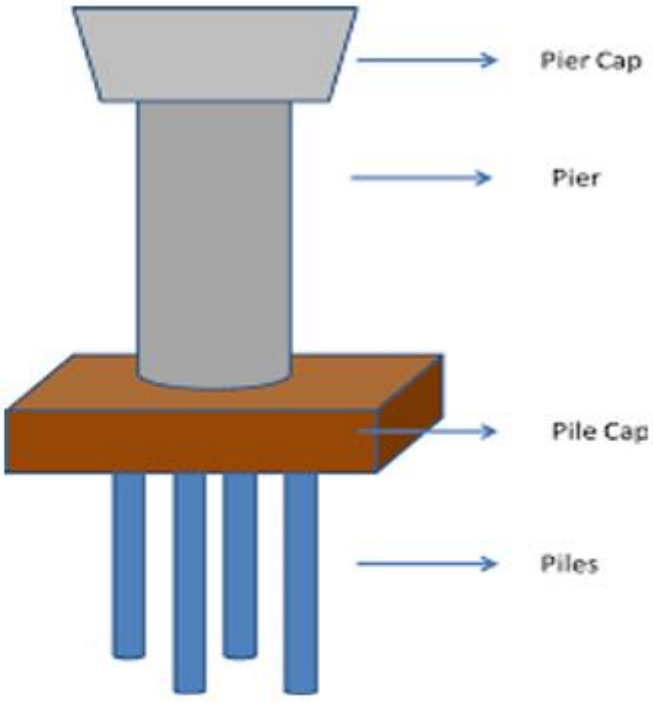


Fig 11.5: Pier Foundation

12. FOUNDATION USED AT SCIENCE CITY

INTRODUCTION TO RAFT FOUNDATION

Raft foundation is actually a thick concrete slab resting on a large area of soil reinforced with steel, supporting columns or walls and transfer loads from the structure to the soil. Usually, mat foundation is spread over the entire area of the structure it is supporting.

Raft foundation is generally used to support structures like residential or commercial buildings where soil condition is poor, storage tanks, silos, foundations for heavy industrial equipment etc.

WORKING PRINCIPLE

To get a better idea about when to use raft foundation, it is important to understand how raft foundation works. Let's get a quick review of its working principle.

Raft foundation transmits the total load from the building to the entire ground floor area. Stress distribution mechanism of raft foundation is very simple. Total weight of the structure and self-weight of the mat is calculated and is divided by the total area of the foundation it is covering to calculate the stress on the soil.

As in case of raft foundation the contact area of the foundation with soil is much more than any other type of foundation, so the load is distributed over a larger area and thus the stress on soil is lesser and the possibility of shear failure of soil is also reduced.

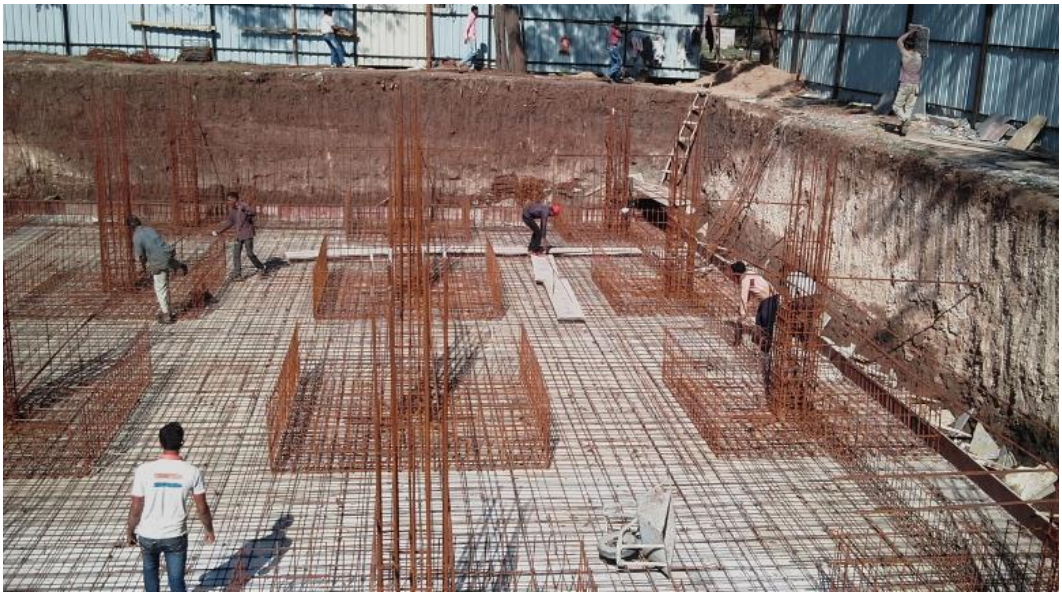


Fig 12.1: Raft Foundation

WHEN TO CHOOSE A RAFT FOUNDATION?

For foundation design, one of the most important aspects is choosing the right type of foundation. Raft foundation is preferred when:

- The soil has a high bearing capacity.
- Load of the structure has to be distributed over a large area.
- Individual or any other foundation area would approximately cover 50% of the total ground area beneath the structure.
- The columns and walls are placed so closely that the individual footings would overlap.
- Stress on soil needs to be reduced.
- There is a possibility of differential settlement in case individual footing is used.
- When soil strata are unpredictable and contain pockets of compressible soil.
- Basement is to be constructed.
- Any other type of footing cannot be used advantageously.

TYPES OF RAFT FOUNDATION

Several types of Raft foundation may be used depending on the condition of soil and the load imposed on the foundation. Followings are the different types of raft foundation used in construction:

1. Flat plate mat
2. Plate thickened under the column
3. Two-way beam and slab Raft
4. Plate raft with pedestals
5. Plied raft
6. Rigid Frame Mat or Cellular Raft Foundation

CONSTRUCTION PROCESS

Key steps of Raft foundation construction are noted below:

1. Identify the desired depth at which foundation is to be provided.
2. Excavate soil up to the required depth.
3. Compact the soil.
4. Provide a waterproofing membrane.
5. Pour 3” of plane cement-sand paste.
6. Lay reinforcement maintaining the required spacing using spacers.
7. Pour concrete to the desired depth.
8. Curing.

13. STAIRCASE

Stairs are a structure designed to bridge a large vertical distance between lower and higher levels by dividing it into smaller vertical distances. This is achieved as a diagonal series of horizontal platforms called steps which enable passage to the other level by stepping from one to another step in turn. Steps are very typically rectangular. Stairs may be straight, round, or may consist of two or more straight pieces connected at angles.

Stairs consist of several key components, each playing a specific role in their construction and functionality. Here are the main components:

1. **Treads**: The horizontal part of the step where you place your foot. It is the surface that you walk on.
2. **Risers**: The vertical part between each tread. Risers support the treads and determine the height of each step.
3. **Stringers**: The inclined structural supports that run along the sides of the stairs. They bear the weight of the treads and risers. There are typically two stringers (one on each side) in most staircases, but some designs may use a central stringer.
4. **Handrails**: The horizontal or inclined bar you hold onto while using the stairs. Handrails provide support and safety, helping to prevent falls.
5. **Balusters**: Vertical posts or spindles that support the handrail and prevent people from falling through the open spaces between the treads. They are also known as spindles.
6. **Newel Posts**: The large, vertical posts at the top and bottom of the staircase and at landings. They provide structural support for the handrail and balusters.
7. **Landing**: A flat platform at the top, bottom, or between flights of stairs. Landings provide a resting place and allow for changes in direction.
8. **Nosing**: The protruding edge of the tread, which can help to prevent slipping and improve visibility of the step.
9. **Bullnose**: The rounded or curved edge of the first step in a staircase, often used for aesthetic purposes and to ease the transition from the floor to the stairs.
10. **Railing Posts**: Posts that support the handrail, particularly where it changes direction or at intervals along the length of the handrail.
11. **Cap**: The covering or finish applied to the top of the newel post or the top of the stair tread. It can be decorative or protective.

TYPES OF STAIR

1. Straight Stairs
2. L Shaped Stairs
3. U Shaped Stairs
4. Winder Stairs
5. Spiral Stairs
6. Curved Stairs
7. Cantilever Stairs
8. Split Staircase (Bifurcated)
9. Ladders

In our project Split Staircase (Bifurcated) is use

Fig.13.1: Bifurcated stair

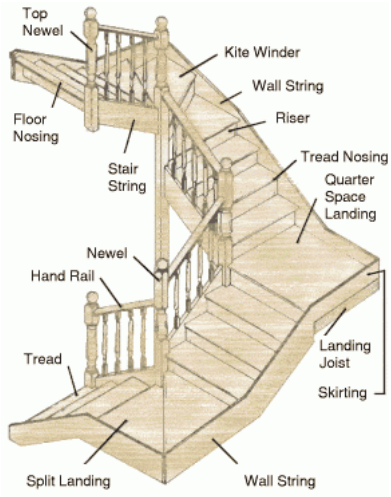


Fig.:13.2: Components of Stairs

Bifurcated stairs are a type of staircase that splits into two separate flights, usually after reaching a landing midway. These two flights then lead in opposite directions, creating a "Y" shape or a mirrored "L" shape. This design is often used in large buildings, such as hotels, theaters, or palaces, where the staircase serves as a grand architectural feature.

Key characteristics of bifurcated stairs include:

- Central landing
- Symmetrical layout
- Wide lower flight

Bifurcated stairs are not only functional but also add a dramatic and visually appealing element to the interior design of a building.

14.AUDITORIUM

The fully air-conditioned multipurpose auditorium is ideal for conventions, seminars, and annual general meetings, theatrical & musical performances, ballet, opera, symphony etc. It is equipped with variable reverberation time and sophisticated sound reinforcement system; large stage (suitable for 100 performers at a time) with cyclorama, stage craft and modern stage light control and projection facilities and sufficient greenroom spaces etc.

FEATURES:

- Seating capacity 600
- Fully air-conditioned
- Stage size of 27 x 16 m suitable for 100 performers
- Orchestra pit for ballet/opera programme
- Vertical stage movement for special effects
- Fully controlled stage light
- Green room for 50 men & 50 women
- 18-bar stage craft for drop scenes, light etc.
- Registration counter, toilets & dinning space.

Fig.14.1: Auditorium

Material used on Auditorium Stage

MDF Sheets : MDF (Medium Density Fiberboard) sheets are commonly used in the construction of auditorium stages due to their versatility, smooth finish, and cost-effectiveness

Uses of MDF Sheets in Auditorium Stage Construction

1. Stage Flooring
2. Stage Backdrops and Set Design
3. Acoustic Panels
4. Stage Framing and Structures
5. Decorative Elements

Benefits of Using MDF Sheets in Auditorium Stage Construction

- Smooth Surface
- Good Acoustic Properties
- Easy to Work With
- Stability
- Cost-Effective

Fig.14.2: MDF Sheets

Material used on stairs of Auditorium

Timber: Timber is a popular choice for constructing stairs in auditoriums due to its aesthetic appeal, durability, and versatility. The selection of the right type of timber is crucial to ensure safety, longevity, and the overall design requirements of the auditorium. Here are the common types of timber used for constructing stairs in an auditorium

Types of Timber Used for Stair Construction

1. Oak (Red Oak or White Oak)
2. Maple
3. Walnut
4. Ash
5. Beech
6. Pine

The choice of timber for constructing stairs in an auditorium depends on factors such as durability, aesthetics, cost, and maintenance requirements. roper finishing and maintenance are essential to ensure the longevity and safety of timber stairs in high-traffic areas like auditoriums.

Fig.; 14.3 Audience Sitting Area

15. CONSTRUCTION PROJECT EQUIPMENT

Machines are a vital resource to the accomplishment of a construction project One of the most obvious problems in construction is how to transport heavy building materials. Machines provide the solution to that problem. And there are also many problems like for excavation weneed JCB, for preparing the concrete we need batching plant etc. The proof of how well the planner understands the work that must be accomplished and selects appropriate machines for that purpose. And the selection of machines also decides that company made a profit or sustaina loss.

The list of construction project equipment is given below:

1. Backhoe & Excavators

Backhoe is another widely used equipment which suitable for multiple purposes. The name itself indicating that the hoe arrangement is provided on the back side of vehicle while loading bucket is provided in the front. This is well useful for excavating trenches below the machine level and using front bucket loading, unloading and lifting of materials can be done.

Fig. 15.1: Backhoe

2. Bulldozers

Bulldozers are another type of soil excavating equipment which are used to remove the topsoil layer up to particular depth. The removal of soil is done by the sharp-edged widemetal plate provided at its front. This plate can be lowered and raised using hydraulic pistons. These are widely used for the removal of weak soil or rock strata, lifting of soil,etc.

Fig. 15.2: Bulldozers

3. Steel Bar Bender

It is a machine that is used to bend bars made of steel and other heavy metals. These machines enable you to bend heavy steel bars at accurate angles. This is used as it saves time, can bend bars with accuracy, and provides a uniform bending due to which bars don't develop cracks**.**

It is capable of bending steel bars from 0 to 180degrees.

Fig. 15.3: Steel Bar Bender Compactor

4. **Compactors or Rollers**

Compactors or Rollers are used to compact the material or earth surface. Different types of compactors are available for different compacting purposes. Smooth wheel rollers are used for compacting shallow layers of soil or asphalt etc. sheep-foot rollers are used for deep compaction purposes.

Pneumatic-tyred rollers are used for compacting fine grain soils, asphalt layers etc.

Fig. 15.4: Compactor

5. **Transit Mixture**

It is used to transport concrete mortar from aconcrete batching plant.

As per code agitation speed should be 2-3 RPM & mixing speed in range of 10-20 RPM.CAPACITY: **7 Cubic Meter**

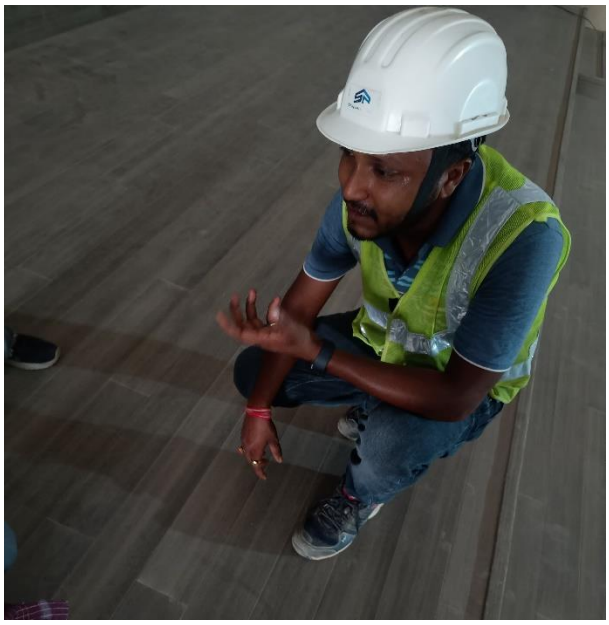
Fig 15.5: Transit Mixture

6. Cranes

Cranes are generally found on vehicles, but cranes used for construction work are adapted to move on the tractor, and several cranes may be attached to barges when usedfor construction work on waterway bridges. The lifting arm is usually articulated to allow lifting and reduction as required. Generally, this is achieved through a system of cables or hydraulic mechanisms, and the whole structure may be coupled to a support to provide more stability during its operation.

Fig. 15.6: Crane

16. Glimpse from Training



17. CONCLUSION

As an undergraduate I would like to say that this training program is an excellent opportunity for me to get to the ground level and experience the things that I would have never gained through going straight into a job.

I am grateful to Shapoorji Pallonji Constructions for giving me this wonderful opportunity to undergraduates to identify, observe and practice how engineering is applicable in the real industry.

The only chance that an undergraduate has to have this experience is the industrial training period. I feel I got the maximum out of that experience. Also, I learn the way of work in an organization of being punctual, the importance of maximum commitment, and important of team spirit.

In my opinion, I have got a lot of knowledge and experience needed to be successful in a great engineering challenge, as in my opinion, engineering is after all a challenge

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