IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

Construction of Medical College Building

Samuel Fernandes
Government Medical College in Jangaon, Telangana, India

Abstract: *BPR Infrastructure Limited is significantly involved in the construction of the new Government Medical College in Jangaon, Telangana. The project has been approved by the National Medical Commission and will accommodate 100 students annually for the MBBS program under the Kaloji Narayana Rao University of Health Sciences.*
BPR Infrastructure Private Limited, with over 40 years of experience in civil construction, is handling the project. The company's operational scope includes civil, structural, infrastructural, and electrical engineering services. The college's construction is part of BPRIL's broader portfolio, which includes a mix of ongoing and completed projects predominantly in Andhra Pradesh and Telangana.

Keywords: *BPR Infrastructure Limited*

I. INTRODUCTION

1.1 ABOUT COMPANY

BPR Infrastructure Limited is significantly involved in the construction of the new Government Medical College in Jangaon, Telangana. The project has been approved by the National Medical Commission and will accommodate 100 students annually for the MBBS program under the Kaloji Narayana Rao University of Health Sciences.
BPR Infrastructure Private Limited, with over 40 years of experience in civil construction, is handling the project. The company's operational scope includes civil, structural, infrastructural, and electrical engineering services. The college's construction is part of BPRIL's broader portfolio, which includes a mix of ongoing and completed projects predominantly in Andhra Pradesh and Telangana.

1.2 PROJECT DETAILS

NAME OF THE PROJECT	: Construction of Jangaon Medical College
PROJECT COST	: 130 crore
PROJECT PERIOD	: 18 Months
DATE OF COMMENCEMENT	: 3-2-2024
DUE DATE OF COMPLETION	: 1-1-2026
TOTAL BUILTUP AREA	: 7.04 acres
NUMBER OF FLOORS	: G+3
TYPE OF STRUCTURE	: RCC

DOI: 10.48175/568

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

1.3 LOCATION OF THE PROJECT

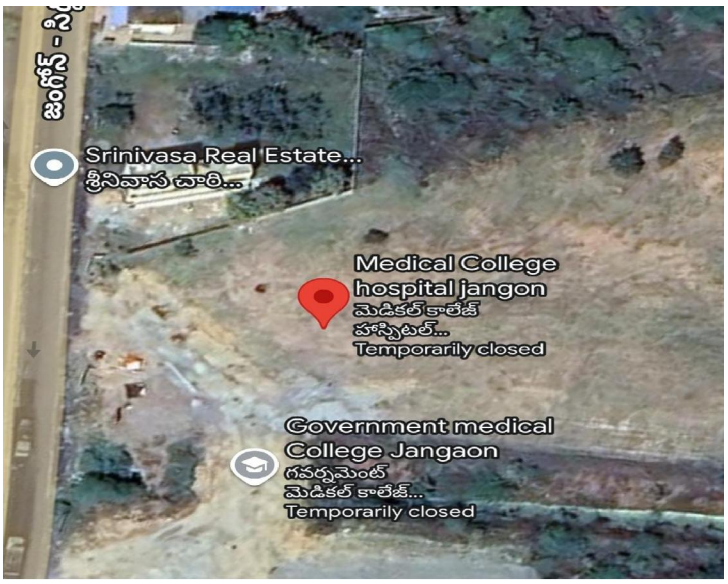


Fig:2 Location of the Project

II. MATERIALS USED

2.1 CEMENT

Cement is a fine powder made from a mixture of minerals, most commonly limestone, clay, shells, and silica. When mixed with water, it undergoes a chemical reaction known as hydration, which causes it to harden and bind other materials together. Cement is a key ingredient in concrete and mortar, which are widely used in construction.

There are different types of cement, including:

1. Portland Cement: The most common type used in construction.
2. Blended Cements: Made by combining Portland cement with supplementary materials like slag or fly ash.
3. High-Strength Cement: Used for projects requiring superior strength.
4. White Cement: Used for decorative purposes, such as in sculptures or high-end architectural work.

In this project they used ACC 53 Grade Cement

Fig:3 Cement

2.2 FINE AGGREGATE

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

Fine aggregate refers to small particles of material, typically sand, that are used in the production of concrete and mortar. These particles are generally less than 5 millimeters in diameter. Fine aggregates are crucial in creating a strong and durable mixture for construction. They help fill the voids between coarse aggregates (larger particles like gravel or crushed stone) and contribute to the overall workability and strength of the concrete.

Common Types of Fine Aggregates:

1. Natural Sand: This is the most common form of fine aggregate, derived from riverbeds, beaches, or quarries. It consists of finely granulated particles of rock and minerals, primarily silica.
2. Manufactured Sand: This type of sand is produced by crushing rocks, typically granite or limestone, to produce finer particles. It is often used as a substitute for natural sand, especially in regions where natural sand is scarce or expensive.
3. Crushed Stone Dust: In some cases, fine aggregates may include dust produced during the crushing of stone aggregates.

Fig:4 River Sand

Fig:5 Manufactured Sand

2.3 COARSE AGGREGATE

Coarse aggregate refers to the larger particles used in the production of concrete, typically ranging in size from 5 millimeters to 40 millimeters (or more). Coarse aggregates are a key component in the formulation of concrete and help provide structural strength, durability, and volume to the mix.

Types of Coarse Aggregates:

1. Gravel: Rounded stones usually sourced from riverbeds or quarries. Gravel is commonly used in construction due to its excellent workability and strength characteristics.
2. Crushed Stone: Made by crushing larger rocks like limestone, granite, or basalt. Crushed stone tends to have angular shapes, which provides better interlocking and bonding properties in concrete.
3. Recycled Aggregates: These are derived from demolition debris, like old concrete or asphalt. Recycled aggregates are increasingly used in construction to promote sustainability and reduce waste.
4. Dolomite and Limestone: These are common types of stone used as coarse aggregates. They are favored for their strength and workability.

Common Sizes of Coarse Aggregate:
Small Coarse Aggregates: 5 mm to 10 mm
Medium Coarse Aggregates: 10 mm to 20 mm
Large Coarse Aggregates: 20 mm to 40 mm or more

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

Fig:6 Coarse Aggregate

Size Of Coarse Aggregate

Coarse aggregate	Size
Fine gravel	4.75mm – 8mm
Medium gravel	8mm – 16mm
Coarse gravel	16mm – 64mm
Cobbles	80mm – 300mm
Boulders	>300mm

Table:1 Coarse Aggregate Sizes

2.4 WATER

Water used for concrete is an essential component in the concrete mix, as it reacts chemically with the cement to form a bond through a process known as hydration. The quality and quantity of water directly affect the workability, strength, and durability of the concrete.

Quality of Water:

The water used for mixing concrete must meet certain requirements to ensure the final product is of good quality:

Free from Impurities: Water should be clean and free of salts, oils, acids, alkalis, or other impurities that can interfere with cement hydration and the development of concrete's strength.

Low in Chlorides: Chlorides can promote corrosion of reinforcing steel within concrete, leading to deterioration over time.

pH Value: Ideal water should have a neutral pH (around 7), as highly acidic or alkaline water can harm the hydration process.

Water-Cement Ratio:

The amount of water used in the mix is critical for the final strength of the concrete. This is typically referred to as the water-cement (w/c) ratio. The ratio is the mass of water to the mass of cement used in the mix.

Lower Water-Cement Ratio: Results in stronger concrete but can make the mix more difficult to work with.

Higher Water-Cement Ratio: Increases workability but reduces concrete strength, making it more prone to cracking and shrinkage.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

Role of Water in Concre

1. Hydration of Cement: ` vhich is responsible for the hardening of the concr
2. Workability: Water pro e. It makes the mixture more workable and easier
3. Curing: Water is also designed strength and durability. Proper curing k

2.5 ADMIXTURES

Admixtures are chemical substances or additives that are introduced into the concrete mix to modify its properties, enhance its performance, or facilitate certain aspects of its handling during mixing, transportation, or curing.

These admixtures can significantly improve the workability, strength, durability, and other characteristics of concrete. Admixtures are usually added in small quantities, often measured by weight or volume, relative to the total amount of cement.

Types of Admixtures and Their Functions:

Super plasticizers (High-Range Water Reducers):

Function: Dramatically reduce the water content of the concrete mix while maintaining or improving its workability.

Use: These are used when high-strength concrete with low water-cement ratios is needed, especially in precast concrete, high-rise construction, and when producing self-compacting concrete (SCC).

Example: Polycarboxylate ethers, melamine-based admixtures.

Fig:7 Fosroc Admixture

2.6 STEEL

Steel is a crucial material used in construction due to its strength, versatility, and durability. It is used in various forms and applications in the construction of buildings, bridges, and infrastructure. Steel provides the structural support needed for buildings to withstand loads, stresses, and environmental factors. It is commonly used in **reinforced concrete**, **structural frameworks**, **roofs**, and **foundations**, among other components.

In this project Fe 550 grade of steel is used.

Fe 550 is one of the variants of TMT Steel Bars, which is ideal for high-rise buildings and other structures that require bearing a lot of weight.

Here, 'Fe' refers to the iron content present in the bar, and 550 refers to the minimum yield strength of the bar.Sizes of steel bars which are used in this project are 8 mm to 32 mm diameter.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

Fig:8 Steel

Advantages of Steel:

Strength and Durability: Steel offers superior strength compared to other materials like wood or concrete. It can support heavy loads and withstand extreme weather conditions.

Flexibility and Versatility: Steel can be molded into various shapes and sizes, making it versatile for different construction applications.

High Strength-to-Weight Ratio: Steel is strong yet relatively lightweight, making it easier to transport and install, especially in large-scale projects.

Fire Resistance: Steel does not burn, although it can lose strength at high temperatures. However, fireproof coatings are often applied to steel to enhance its fire resistance.

Sustainability: Steel is recyclable, making it an environmentally friendly choice for construction.

III. EQUIPMENT USED

There are several equipments used in construction of project some are listed below

Total Station

Auto level

Concrete Mixer

Compaction Roller

3.1 TOTAL STATION

A **Total station** is a **modern surveying instrument** that combines the functions of an **electronic theodolite** (used for measuring angles), a **distance measuring device** (typically using EDM - electronic distance measurement), and a **microprocessor** for data processing. it is used in construction, civil engineering, and land surveying to measure angles, distances, and elevations, enabling precise positioning and mapping of construction sites or land areas.

Total stations are commonly employed in tasks such as **site layout**, **topographical surveys, boundary surveys, road construction, building construction,** and **geodetic measurements**.

Working Method of Total Station:

1. Angle Measurement: The theodolite part of the total station measures both the horizontal and vertical angles between the instrument and the target point.

2. Distance Measurement: Using EDM, the total station sends an electromagnetic signal to a reflector placed at the point of interest. The time taken for the signal to travel to the reflector and return is measured, allowing the instrument to calculate the distance.

3. Data Processing: The total station's microprocessor processes the angle and distance information, converting it into coordinates (e.g., X, Y, Z) based on the instrument's position. This data can be stored and transferred to a computer or a field data collector for further analysis.

4. Surveying Applications: Data from multiple points can be used to create topographic maps, site plans, and contour maps. The instrument can also be used for staking out points for construction, checking alignments, or determining boundaries.

Applications of Total Station in Construction:

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

1. **Site Surveying**: Total stations are used for topographic surveys to collect data on the land's features, such as elevation, slopes, boundaries, and natural features.
2. **Building Layout**: In construction, total stations are used to stake out construction projects, ensuring that the building's layout matches the architectural plans.
3. **Structural Monitoring**: Total stations can monitor the movement or settlement of structures by taking measurements over time, ensuring the integrity of foundations or supporting structures.
4. **Road and Highway Construction**: Total stations are used to measure the elevation and alignment of roads, ensuring proper grading and drainage.
5. **Land and Boundary Surveys**: They are frequently used for land boundary determination and boundary disputes, as well as mapping land features.
6. **Tunnel and Underground Construction**: Total stations are also used in tunnel construction and underground works to ensure precise alignment of tunnels, shafts, and other subterranean structures.
7. **Site Control and Staking**: Total stations are used to establish control points on construction sites, which are then used to align and position components like walls, columns, and other elements.

g:14 Total Station

3.2 AUTO LEVEL

An **Auto Level**, also known as a **Self-Leveling Level**, is an optical instrument used for leveling, particularly in surveying, construction, and engineering projects. It allows surveyors and construction professionals to measure the elevation difference between points on a site and ensures that structures are built level, facilitating accurate grading, drainage, and alignment.

Unlike traditional spirit levels, which require manual adjustment, an **Auto Level** automatically compensates for slight tilts to give accurate readings, making it a crucial tool in both field and site work.

Working principle of Auto Level:

1. Setup:

The auto level is mounted securely on a tripod and roughly aligned with the area to be leveled.

The operator adjusts the instrument for a line of sight to the target point, ensuring it is positioned in the general area of the leveling rod.

2. Self-Leveling:

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

The auto level has a built-in compensator that automatically levels the instrument horizontally. This means that as the instrument is set up, the internal pendulum or compensator ensures that the line of sight is perfectly horizontal.

3. Reading the Staff:
The operator looks through the eyepiece of the auto level and aligns the crosshairs with the measurement on the leveling rod, which is placed at the point to be measured.
The difference in the reading on the rod, when compared to the reference point or benchmark, gives the elevation difference between the two points.

4. Taking Multiple Measurements:
For accurate leveling, measurements are often taken at multiple points on the site and compared against a reference point to ensure uniformity and consistency.

Applications of Auto Level in Construction:
1. Land Surveying:
Auto levels are commonly used in topographical surveys to measure ground elevation and create accurate maps of terrain and landscapes.

2. Setting Out Foundations:
In building construction, auto levels are used to ensure that foundations and structural elements are placed at the correct elevation relative to the surrounding area.

3. Road Construction:
Auto levels help ensure proper road grading and the maintenance of consistent slopes for drainage, preventing water pooling and erosion.

4. Floor Leveling:
In building construction, auto levels are used to verify that floors are level during the construction process and throughout subsequent stages.

Fig:15 Auto Level

3.3 CONCRETE MIXER
A **concrete mixer** is a construction equipment used to **mix** ingredients like **cement, sand**, **aggregates,** and **water** to form **concrete**. It ensures that the concrete mix is consistent, homogeneous, and ready for use in various construction tasks, such as building foundations, floors, roads, and other structural elements.
Concrete mixers come in different types, sizes, and configurations, but their primary function is to thoroughly mix the ingredients to achieve the desired workability and strength for the concrete. They are essential for large-scale construction projects, as they allow for the efficient production of concrete on-site.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

Working Method Concrete Mixers :

Loading the Ingredients:

First, the dry ingredients (cement, aggregates, and sand) are loaded into the mixer drum. Water is then added to form the concrete mix.

The materials should be added in the right proportions, depending on the desired mix ratio (e.g., 1:2:4 for cement:sand:aggregate).

Mixing:

The motor turns the drum, and the blades or paddles inside the drum rotate, ensuring that the ingredients are thoroughly mixed.

As the drum rotates, the material is lifted and then falls, which helps in the uniform distribution of water, cement, and aggregates.

Discharging:

Once the concrete is mixed properly, it is discharged from the drum. Depending on the type of mixer, this may involve tilting the drum, reversing the drum's rotation, or using a discharge chute.

Transporting (for mobile mixers):

If the mixer is truck-mounted, the concrete is transported to the desired location. The rotating drum keeps the concrete mixed during transport to prevent it from setting prematurely.

Advantages of Concrete Mixers:

Uniform Mixing: Concrete mixers ensure a uniform blend of materials, providing consistent quality and workability for construction.

Time Efficiency: Mixing concrete manually can be time-consuming, but a concrete mixer speeds up the process, enabling faster construction timelines.

Labor Saving: Concrete mixers reduce the need for manual labor in mixing the concrete, allowing workers to focus on other aspects of the project.

Versatility: Concrete mixers can be used to mix a variety of concrete types, including regular concrete, high-strength concrete, or specialty mixes.

Portability: Many concrete mixers, especially truck-mounted and portable mixers, can be moved around the site or between different project locations.

Cost-Effective: While large-scale construction projects might require specialized equipment, smaller-scale projects benefit from the cost-effectiveness of concrete mixers, reducing labor costs and ensuring high-quality concrete.

3.4 COMPACTION ROLLER

A **compaction roller**, also known as a type of construction equipment used to compact soil, gravel, asphalt, or concrete during the construction process. The primary purpose of a compaction roller is

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

to increase the **density** of materials, ens to provide a stable foundation for buildings, roads, and other structures.

Compaction is essential in construction to ity of the base material. By using a compaction roller, engineers and construc or the surface is solid and level, reducing the potential for settling or shiftin

Working Method of Compaction Rollers

Load the Material:

Before starting, the material to be compac spread evenly on the ground using earth-moving equipment like bulldozers or

Compaction Process:

The compaction roller then moves across the material, applying pressure to it through the drum (for static rollers) or vibration (for vibratory rollers). This compresses the particles together, removing air voids and increasing density.

Rollers may make multiple passes over the area to achieve the desired level of compaction.

Adjusting the Pressure and Vibration:

The operator can adjust the compaction settings, such as vibration frequency and amplitude (the intensity of vibration), depending on the material being compacted.

The roller's weight and pressure may also be adjusted to suit different material types and compaction needs.

Uniform Compaction:

The operator ensures that the roller covers the entire surface evenly to achieve uniform compaction. Uneven compaction can lead to weak spots in the material, potentially affecting the structure built on top.

Advantages of Using Compaction Rollers:

Improved Strength:

Proper compaction enhances the strength and stability of the material, which is essential for the integrity of the construction, such as roads, foundations, and other structural elements.

Time Efficiency:

Rollers can quickly compact large areas, reducing the time required compared to manual methods. This allows projects to proceed faster and more efficiently.

Consistent Results:

The use of compaction rollers ensures uniform compaction, which helps in maintaining the quality of the finished product, whether it's road asphalt or foundation soil.

Cost-Effective:

By improving the quality and durability of the material, compaction rollers reduce the need for repairs and maintenance, making them a cost-effective investment in the long run.

Versatility:

Different types of rollers can be used for a variety of tasks, from compacting soil to working with asphalt, gravel, and other construction materials.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

Fig:17 Compaction Roller

IV. COMPONENTS OF BUILDING

4.1 PLAIN CEMENT CONCRETE

Plain Cement Concrete (PCC), also known as **Non-Reinforced Concrete**, is a mixture of **cement**, **fine aggregate** (sand), and **coarse aggregate** (gravel or crushed stone) with **water**. It is the simplest form of concrete, typically used for construction elements that do not require reinforcement, such as floors, pavements, foundations, and temporary structures.

Proportion of Ingredients in Plain Cement Concrete:

The mix ratio of PCC varies depending on the project requirements, but a common mix is the **1:2:4** ratio (1 part cement, 2 parts fine aggregate, and 4 parts coarse aggregate). The water-to-cement ratio typically ranges between **0.4 to 0.6.**

Uses of Plain Cement Concrete (PCC):

Foundation:

PCC is commonly used for foundation works. It serves as a base layer for more heavily reinforced structures. It's placed to provide a stable base on the ground before constructing the actual reinforced foundation.

Flooring:

In residential and industrial buildings, PCC is used to create floors, particularly in areas that do not require reinforcement, such as driveways or walkways.

Pavement:

PCC is used for paving roads, pathways, and sidewalks in low-traffic areas or places where the load is minimal.

4.2 FOOTING

A foundation is the lowest part of a building or structure, designed to support and anchor the entire weight of the structure to the underlying ground or soil. Its primary function is to safely transfer the load of the building to the earth, ensuring the structure remains stable and does not settle unevenly or shift. A foundation is the element of any structure which connects it to the ground and transfer loads from the structure to the ground. Foundations are generally considered either shallow or deep. Foundation is a load bearing structure which bears all the loads coming on the building or any structure.

Functions of a footing

1. Support: The foundation bears the weight of the entire structure and distributes it evenly to the ground beneath.
2. Stability: It prevents the building from shifting or tilting, ensuring that the structure remains upright and stable over time.
3. Prevention of Settlement: A well-designed foundation prevents uneven settling of the structure, which can cause cracks and other structural damage.
4. Protection from Environmental Forces: The foundation helps protect the building from the effects of soil movement, water, and temperature fluctuations.

Types of Foundations

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

Foundations are typically categ  the depth at which they are constructed and the conditions of

1. Shallow Foundations:
   - Used when the surface soil ha
   - Types include:

Spread Footing: A wide base that
Slab-on-Grade: A flat concrete sl
Strip Foundation: A continuous s

2. Deep Foundations:
   - Used when the surface soil is weak or when the building is large or tall.
   - Types include:

Pile Foundation: Long columns of concrete or steel driven deep into the ground.
Pier Foundation: Large vertical columns, often used in areas with poor soil.
Caisson Foundation: Hollow, cylindrical structures used to support bridges or piers, often in waterlogged or deep soil.

Construction Process of a Foundation

1. Site Preparation: The land is cleared and excavated to the required depth.
2. Footing or Pile Installation: For shallow foundations, concrete footings are poured. For deep foundations, piles or piers are driven or drilled into the ground.
3. Reinforcement: Steel rebar is often added for strength.
4. Concrete Pouring: Concrete is poured around the reinforcement to form the foundation structure.

4.3 PEDESTAL

A **Pedestal** in construction refers to a **supporting base or platform** that provides a stable foundation for a structure or component, such as a column, statue, or machine. It acts as an intermediary between the primary structure (like a column) and the foundation, distributing the load from the upper structure to the foundation below.

Advantages of Using Pedestals:

1. **Load Distribution**: Pedestals help in evenly distributing the weight of the structure or object to the foundation.
2. **Elevated Placement**: Pedestals raise structures or decorative elements, improving visibility or functionality.
3. **Increased Stability**: Pedestals help ensure the stability of the supported structure, especially in cases of columns or heavy equipment.
4. **Aesthetic Appeal**: Pedestals, particularly for statues or sculptures, add to the aesthetic value of the surroundings.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

4.4 PLINTH BEAM

A **Plinth beam** is a **horizont** y placed just above the ground level, at the top of **uting loads** from the superstructure (the walls, col The plinth beam helps in providing **stability and strength** to the building, ensuring that the foundation remains intact and functional.

Design Considerations:

Reinforcement: Proper reinforcement design is crucial to ensure that the plinth beam can bear the load of the superstructure. The reinforcement is usually placed in the form of **longitudinal bars** and stirrups to resist both bending and shear forces.

Size and Dimensions: The size of the plinth beam is designed based on the building's load, size of the walls, and soil conditions. Typically, the dimensions of a plinth beam range from 300 mm to 450 mm in depth and 300 mm to 600 mm in width.

Load Considerations: The plinth beam must be strong enough to support not only the walls but also any additional load from the floor slabs, columns, and any external forces

4.5 COLUMN

A **column** is **a vertical str** erstructure (like beams, floors, roofs) down to the founda **ads** (forces that push down on them), but they also resist bending and lateral forces. Columns are fundamental components in most buildings and structures, as they provide the necessary support for the entire structure.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

Fig:11 Column

Design Considerations for Columns:

1. **Load-Bearing Capacity**: The column must be designed to support the maximum axial load it will carry without failure. The load is a function of the weight of the structure above, live loads (like people, furniture, etc.), and environmental loads (wind, seismic).
2. **Column Size**: The dimensions of a column are chosen based on the magnitude of the loads it needs to carry and the materials used. The cross-sectional area must be large enough to bear the compressive loads without buckling or collapsing.
3. **Reinforcement (for Concrete Columns)**: Concrete columns are usually reinforced with steel bars (rebars) to resist tensile stresses and prevent cracking. The amount of reinforcement is based on the load requirements and local building codes.
4. **Column Length and Height**: A column's height to width ratio is important because long columns are prone to buckling. For long columns, additional strengthening measures or braces are often required.
5. **Slenderness Ratio**: The slenderness ratio is the ratio of the column's height to its radius of gyration. A higher slenderness ratio indicates a greater tendency for the column to buckle under load, so columns must be designed with care to account for this.

4.6 BEAM

A **beam** is a **horizontal structural element** that primarily resists loads applied perpendicular to its length. Beams are crucial in construction as they help support the weight of floors, roofs, walls, and other structural components, transferring those loads to columns, walls, or other supporting structures. Beams resist **bending**, **shear**, and **torsion** forces.

Design Considerations for Beams:

1. **Load Analysis**: Beams are designed based on the magnitude of the loads they will bear, including dead loads (weight of the structure), live loads (furniture, people, etc.), and environmental loads (wind, snow, seismic forces).
2. **Bending Moment and Shear Forces**: Beams must be designed to resist both bending moments (the tendency to bend under load) and shear forces (forces that act to slide one part of the beam relative to the other).
3. **Reinforcement**: Reinforced concrete beams incorporate steel bars (rebars) that resist tensile forces, as concrete alone is weak in tension.
4. **Beam Size**: The cross-sectional size of the beam is chosen to be strong enough to carry the loads. The depth of the beam is particularly important for resisting bending.
5. **Deflection Control**: Beams are designed to minimize excessive deflection (bending or sagging under load), which can lead to structural issues or aesthetic concerns.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

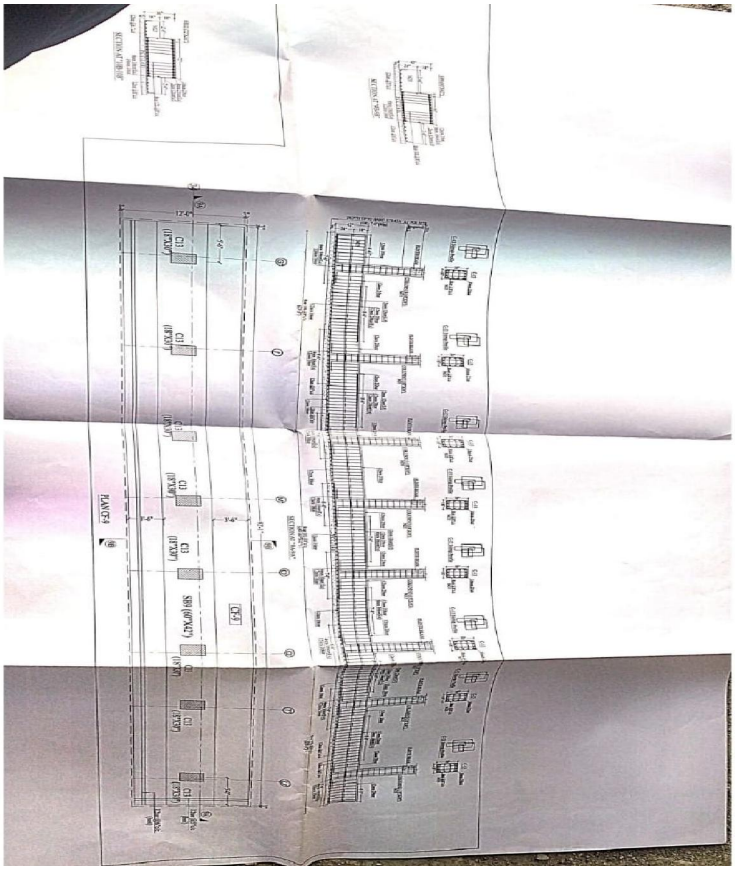


Fig: Reinforcement Details Of Beams

4.7 SLAB

An **RCC slab** is a versatile, durable, and strong component in building construction. By combining **concrete** and **steel reinforcement**, it offers the necessary strength to support the structural load of a building while providing **durability**, **fire resistance**, and **flexibility**. Whether for floors, roofs, or foundations, RCC slabs are essential in most modern construction projects, especially for their ability to span large distances with minimal support.

Design Considerations for RCC Slabs:

1. **Load-Bearing Capacity**: RCC slabs should be designed to handle the expected load (both dead and live loads), which includes the weight of the building materials, people, furniture, and other loads.
2. **Thickness**: The thickness of the slab should be adequate to handle the span and the loads. For example, thinner slabs are typically used for smaller spans, while thicker slabs are used for larger spans or heavier load-bearing applications.
3. **Reinforcement**: Proper reinforcement is crucial for RCC slabs to resist bending**,** shear, and tensile forces. The amount, placement, and type of reinforcement (usually rebar) will depend on the slab's design and expected load.
4. **Deflection Control**: The slab should be designed to avoid excessive deflection or sagging under load. Excessive deflection can affect the performance and aesthetic of the structure.
5. **Shrinkage and Creep**: The design of RCC slabs must take into account the effects of shrinkage (reduction in volume as concrete cures) and creep (gradual deformation under constant load over time).

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

Steps in RCC Slab Construction:

Preparation and Formwork:

The first step in constructing an RCC slab is preparing the site and creating the formwork (molds) that will shape the slab.

The formwork is typically made of timber or steel and is carefully placed to ensure the slab's correct thickness and dimensions.

Reinforcement Placement:

Steel bars (rebars) are placed in the formwork according to the slab's design to provide strength. The reinforcement is typically arranged in two layers: one at the top and one at the bottom, depending on the expected forces.

Concrete Pouring:

Once the reinforcement is in place, concrete is poured into the formwork. The concrete is mixed, transported, and poured into the formwork, ensuring that it fills all spaces around the reinforcement.

Compaction and Curing:

After pouring, the concrete is compacted (using vibrators) to remove air pockets and ensure uniform distribution.

Curing is the final step, which involves keeping the concrete moist for a certain period (usually 7-28 days) to ensure proper hydration, strength development, and prevent cracks.

Removal of Formwork:

After the slab has cured sufficiently, the formwork is removed, leaving behind the hardened RCC slab.

Description of item work	Grade of concrete
PCC	M5 or M10
Footing	M25
Pedestal	M35
Plinth beam	M25
Column	M35
Slab	M30

Table:2 Mix Proportions For Different Works

V. ADVANTAGES AND DISADVANTAGES

5.1 ADVANTAGES

Educational Advantages

1. Enhanced Learning Environment

State-of-the-Art Facilities: Modern classrooms, laboratories, and simulation centers equipped with the latest technology enhance the quality of medical education.

Interdisciplinary Collaboration: A well-designed medical college can facilitate collaboration between different healthcare disciplines, fostering a comprehensive educational approach.

2. Increased Enrollment Capacity

More Students: New facilities can accommodate a larger number of students, addressing the growing demand for medical education.

Diverse Programs: Expanded infrastructure allows for a broader range of medical and healthcare programs, including specializations and continuing education courses.

3. Research Opportunities

Advanced Research Facilities: Access to cutting-edge research labs promotes innovative medical research.

Attracting Talent: High-quality facilities attract top faculty and researchers, enhancing the institution's reputation and research output.

Economic Advantages

1. Job Creation

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

Construction Phase: The building project itself generates employment opportunities in construction, engineering, and architecture.

Operational Phase: Once completed, the college creates jobs for academic staff, administrative personnel, and support services.

2. Local Economic Boost

Increased Spending: Students, staff, and visitors contribute to the local economy through housing, dining, and other expenditures.

Business Opportunities: New businesses may emerge to cater to the needs of the college community, such as bookstores, cafes, and healthcare services.

Healthcare Advantages

1. Improved Healthcare Services

Teaching Hospitals: Many medical colleges are affiliated with teaching hospitals, providing high-quality healthcare services to the community.

Access to Care: Increased healthcare professionals in the area improve access to medical services for local residents.

2. Advancement in Medical Research

Innovative Treatments: Research conducted at the medical college can lead to the development of new treatments and medical technologies.

Healthcare Improvements: Ongoing research contributes to advancements in medical knowledge and practices, improving overall healthcare quality.

5.2 DISADVANTAGES

Financial Disadvantages

1. High Initial Costs

Construction Costs: Building a medical college involves significant financial investment in terms of land acquisition, construction materials, labor, and technology.

Equipment and Furnishings: Equipping the facility with state-of-the-art technology and furnishings adds to the initial expenditure.

2. Ongoing Operational Costs

Maintenance: Regular maintenance and repairs of the building and its infrastructure can be costly. Utilities and Services: Operating a large facility requires substantial spending on utilities (electricity, water, heating/cooling) and services (cleaning, security, landscaping).

3. Financial Risk

Funding Challenges: Securing adequate funding can be difficult, and reliance on loans or investments may introduce financial risk.

ICS

Contd

Lr No: JNTUHUCESTH/CIVIL/MTL/MIX/8531/2/2023
Date: 17.01.2024
Receipt No. 19557
Mix Design Service for M 25 Grade Concrete
Reference: Your Lr.No. DB//D1/EE/REIB/JNG/2023-24/143, Dated: 16.11.2023
Name of Organisation: Government of Telangana Roads & Buildings Department
Jangaon District.

Mix Proportions

Replied to the Materials supplied and based on the client requirements and specifications as listed above the following mix is recommended:

Design grade of concrete	M 25
Assigned grade of quality control	Good
Maximum nominal size of aggregate as per IS code	4
Target mean strength	31.60 N/mm^2
Max W/C ratio for environment exposure	0.50
Required workability (Slump)	Medium
Obtained workability (Slump)	110 mm
Selected water /cement Ratio	0.46
Compressive Strength of concrete at 28 days (Accelerated curing method)	40.55 N/mm^2
Compressive Strength of concrete at 7 days (Accelerated curing method)	31.28 N/mm^2
Recommended mix proportion quantities per cum	
Cement (kg)	380
Water (liters) + Extra Water Absorption for M. Sand @ 2.5%	174.8+8.5
River Sand (kg)	342
Manufactured sand	341
Coarse Aggregate (kg) (20 mm)	694
(12 mm)	463
Admixture Fosroc Conplast SP 430 (ml)	2280

Chief Co-ordinator, ICS
CHIEF CO-ORDINATOR, ICS
JNTUHUCEST HYDERABAD
KUKATPALLY, HYDERABAD-500 085

www.jntuhceh.ac.in
e-mail: principal.ceh@jntuh.ac.in

VI. MIX DESIGN FOR M25 GRADE CONCRETE (FOOTING)

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

ICS

Contd

Lr No: JNTUHUCESTH/CIVIL/MTL/MIX/8531/3/2023
Date: 17.01.2024
Receipt No. 19557
Mix Design Report for M 35Grade Concrete
Reference: Your Lr.No. DB//D1/EE/REIB/JNG/2023-24/143, Dated: 16.11.2023
Name of Organisation: Government of Telangana Roads & Buildings Department
Jangaon District.

Mix Proportions

Based on the Materials supplied and based on the client requirements and specifications as listed above the following mix is recommended:

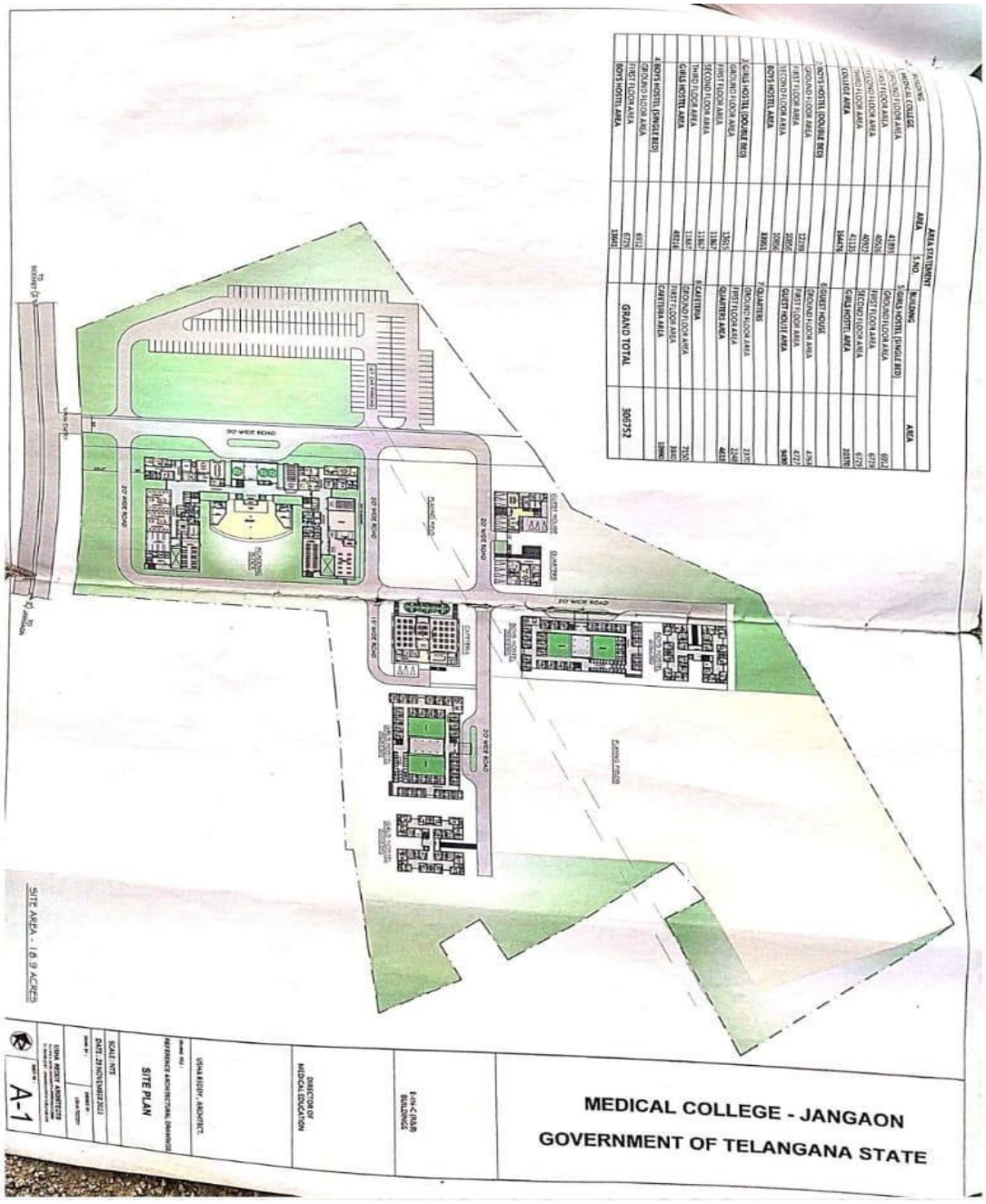
Design grade of concrete	M 35
Asserted Degree of quality control	Good
Standard deviation as per IS code	5
Target Strength σck+1.65* SD	43.25 N/mm^2
Max W/C ratio for environment exposure	0.45
Required workability (Slump)	Pumpable
Obtained workability (Slump)	100 mm
Selected water /cement Ratio	0.40
Compressive Strength of concrete at 28 days (Accelerated curing method) Compressive Strength of concrete at 7 days (Accelerated curing method)	45.60 N/mm^2 35.45 N/mm^2
Recommended mix proportion quantities per cum	
Cement (kg)	420
Water (liters) + Extra Water Absorption for M. Sand @ 2.5 %	168 + 8.45
River Sand (kg) Manufactured sand	338 338
Coarse Aggregate (kg) (20 mm) (12 mm)	688 459
Admixture Fosroc Conplast SP 430 (ml)	2520

Chief Co-ordinator, ICS.
CHIEF CO-ORDINATOR, ICS
JNTUHUCEST HYDERABAD
KUKATPALLY, HYDERABAD-500 085.

www.jntuhceh.ac.in
e-mail: principal.ceh@jntuh.ac.in

VII. MIX DESIGN FOR M35 GRADE CONCRETE(COLUMN)

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

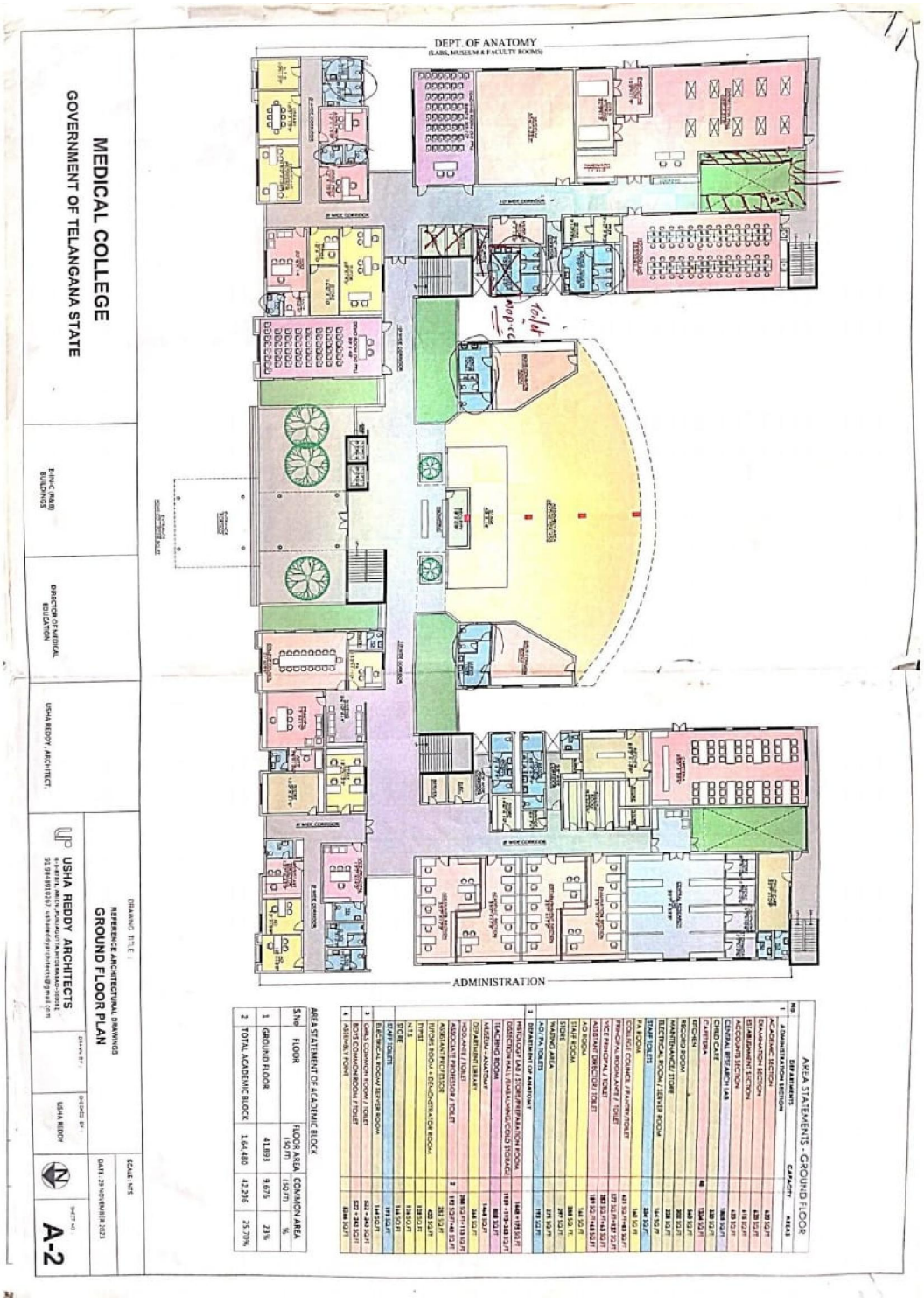


VIII. ARCHITECTURAL DRAWINGS OF THE PROJECT

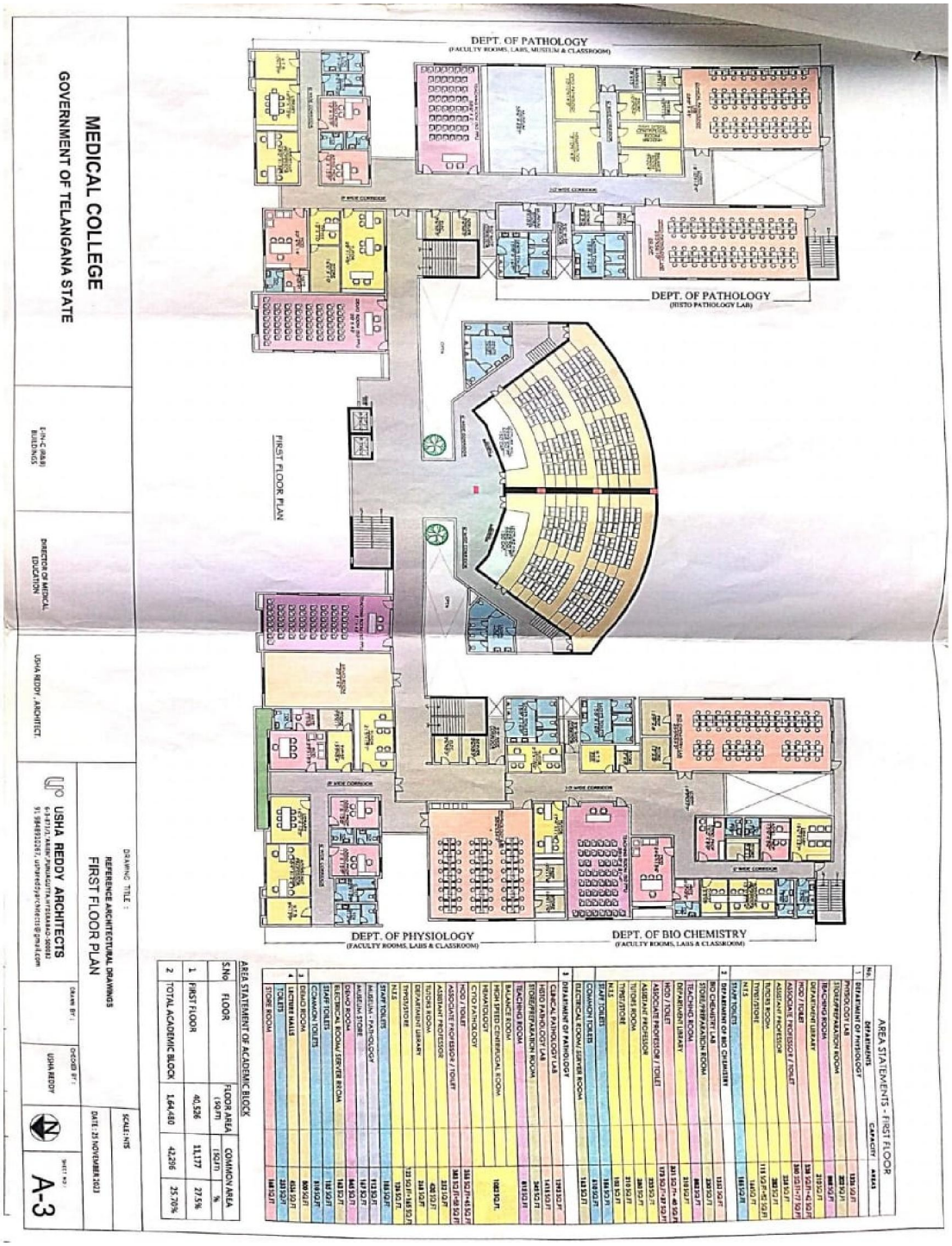
8.1 Ground Floor Plan

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

8.2 I



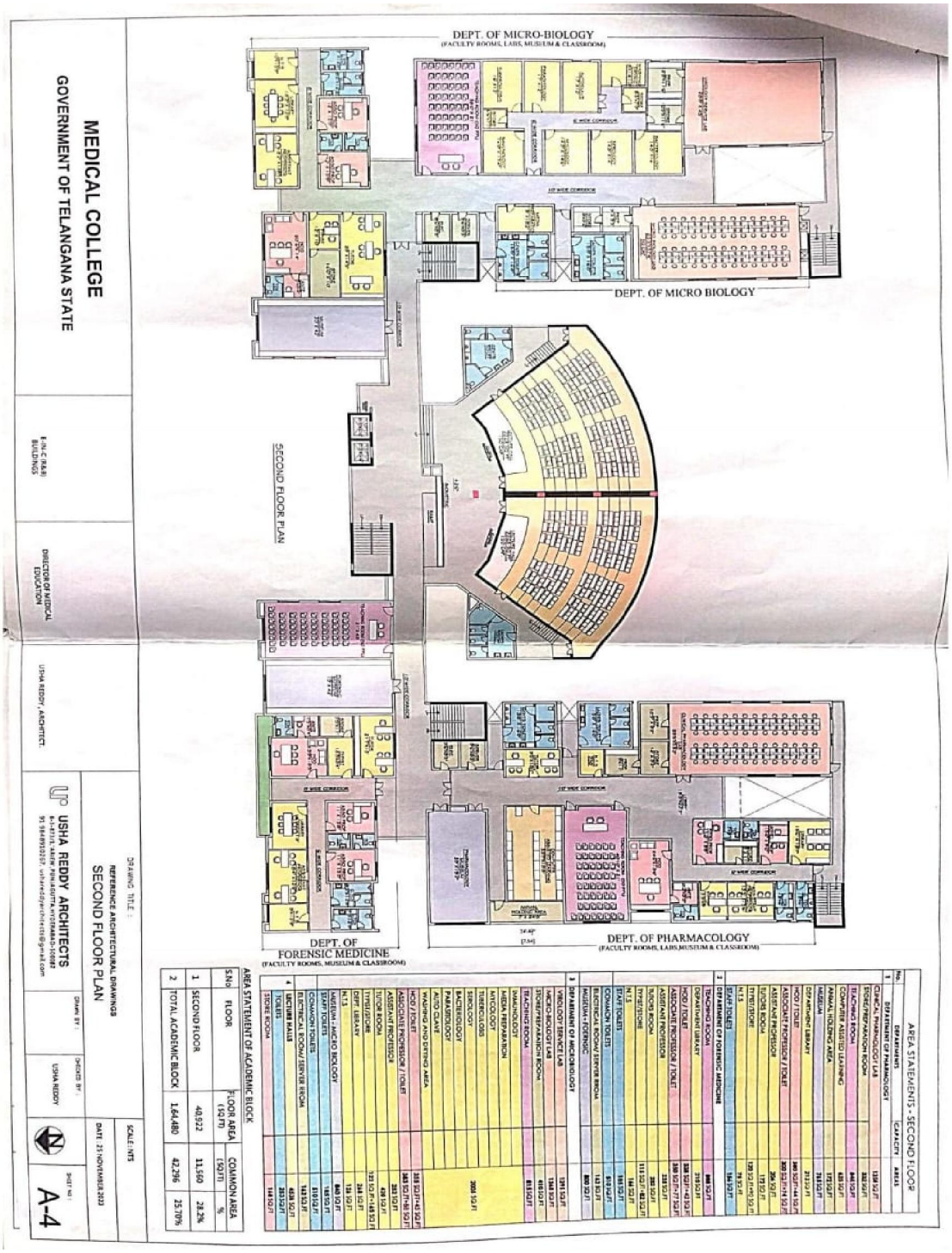
IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025



8.3 S

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

8.4 T



IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

ICS

Contd

Lr No: JNTUHUCESTH/CIVIL/MTL/MIX/8531/2/2023
Date: 17.01.2024
Receipt No. 19557
Mix Design Report for M 25 Grade Concrete
Reference: Your Lr.No. DB//D1/EE/REIB/JNG/2023-24/143, Dated: 16.11.2023
Name of Organisation: Government of Telangana Roads & Buildings Department Jangaon District.

Recommended Mix Proportions

Ratio (by Weight)

Cement	River Sand	Manufactured sand	Coarse Aggregate		W/C
			20 mm	12 mm	
1	0.895	0.895	1.83	1.22	0.46

Properties of cement as obtained from tests		
Normal consistency %	30	
Initial Setting Time(minutes)	140	
Final Setting Time(minutes)	420	
Fineness of cement(On 90Micron) (by sieve) %	3	
Soundness of cement by Le - Chatelier (mm)	2	
Compressive strength of cement(7 days)	34.35 N/mm^2	
Specific Gravity of Cement	3.12	
Properties of Fine Aggregate as obtained from tests	**River Sand**	**Manufactured sand**
Compacted Bulk Density (kg/m^3)	1693	1830
Loose Bulk Density (kg/m^3)	1570	1653
Specific Gravity of Fine Aggregate	2.62	2.61
Fineness Modulus	2.62	2.84
Properties of Coarse Aggregate as obtained From tests	**20mm**	**12 mm**
Compacted Bulk Density/Unit Weight of Dry rodded Aggregate (kg/m^3)	1542	1513
Loose Bulk Density (kg/m^3)	1400	1362
Specific Gravity of Coarse Aggregate	2.61	2.61
Flakiness Index %	11	--
Elongation Index %	9	--
Fineness Modulus	7.17	6.34

Chief Co-ordinator, ICS.

CHIEF CO-ORDINATOR, ICS
JNTUHUCEST HYDERABAD
KUKATPALLY, HYDERABAD-500 085

www.jntuhceh.ac.in
e-mail: principal.ceh@jntuh.ac.in

IX. TEST RESULTS

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

ICS

Contd

Lr No: JNTUHUCESTH/CIVIL/MTL/MIX/8531/2/2023
Date: 17.01.2024
Receipt No. 19557
Mix Design Report for M 25 Grade Concrete
Reference: Your Lr.No. DB//D1/EE/REIB/JNG/2023-24/143, Dated: 16.11.2023
Name of Organisation: Government of Telangana Roads & Buildings Department
Jangaon District.

TEST RESULTS

FINENESS MODULUS OF AGGREGATE **River Sand** WEIGHT OF SPECIMEN *1000 grams*.

S.NO	*I.S.Sieve No.*	*Weight Retained grams*	*% Weight retained*	*Cumulative % retained*	*% passing*
1	*40 mm*	--	--	--	100
2	*20 mm*	--	--	--	100
3	*10 mm*	--	--	--	100
4	*4.75 mm*	30	3.0	3.0	97
5	*2.36 mm*	40	4.0	7.0	93
6	*1.18 mm*	180	18.0	25.0	75
7	*600 mic*	235	23.5	48.5	51.5
8	*300 mic*	300	30.0	78.5	21.5
9	*150 mic*	215	21.5	100	0

Fineness Modulus: 2.62

Chief Co-ordinator, ICS.

CHIEF CO-ORDINATOR, ICS
JNTUHUCEST HYDERABAD
KUKATPALLY, HYDERABAD-500 085

9.1 Fi

www.jntuhceh.ac.in
e-mail: principal.ceh@jntuh.ac.in

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

ICS

Contd

Lr No: JNTUHUCESTII/CIVIL/MTL/MIX/8531/2/2023
Date: 17.01.2024
Receipt No. 19557
Mix Design Report for M 25 Grade Concrete
Reference: Your Lr.No. DB//D1/EE/REIB/JNG/2023-24/143, Dated: 16.11.2023
Name of Organisation: Government of Telangana Roads & Buildings Department
Jangaon District.

TEST RESULTS

FINENESS MODULUS OF AGGREGATE **Manufactured Sand** WEIGHT OF SPECIMEN *1000 grams*.

S.NO	*I.S.Sieve No.*	*Weight Retained grams*	*% Weight retained*	*Cumulative % retained*	*% passing*
1	*40 mm*	--	--	--	100
2	*20 mm*	--	--	--	100
3	*10 mm*	--	--	--	100
4	*4.75 mm*	25	2.5	2.5	97.5
5	*2.36 mm*	170	17.0	19.5	80.5
6	*1.18 mm*	260	26.0	45.5	54.5
7	*600 mic*	120	12.0	57.5	42.5
8	*300 mic*	140	14.0	71.5	28.5
9	*150 mic*	155	15.5	87	13

Fineness Modulus: 2.84

Chief Co-ordinator, ICS.

CHIEF CO-ORDINATOR,ICS
JNTUHUCEST HYDERABAD
KUKATPALLY, HYDERABAD-500 085

9.2 Fine

www.jntuhceh.ac.in e-mail: principal.ceh@jntuh.ac.in

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

9.3 Fineness Modulus Of Aggregate "20mm"

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

ICS

Contd

Lr No: JNTUHUCESTH/CIVIL/MTL/MIX/8531/2/2023
Date: 17.01.2024
Receipt No. 19557
Mix Design Report for M 25 Grade Concrete
Reference: Your Lr.No. DB//D1/EE/REIB/JNG/2023-24/143, Dated: 16.11.2023
Name of Organisation: Government of Telangana Roads & Buildings Department
Jangaon District.

TEST RESULTS

FINENESS MODULUS OF AGGREGATE 20 mm WEIGHT OF SPECIMEN 5000 *grams*.

S.NO	*I.S.Sieve No.*	*Weight retained grams*	*% weight retained*	*Cumulative % retained*	*% Passing*
1	*40 mm*	--	--	--	100
2	*20 mm*	850	17	17	83
3	*10 mm*	4150	83	100	0
4	*4.75 mm*	0	0	100	0
5	*2.36 mm*	0	0	100	0
6	*1.18 mm*	0	0	100	0
7	*600 mic*	0	0	100	0
8	*300 mic*	0	0	100	0
9	*150 mic*	0	0	100	0

Fineness Modulus: 7.17

Chief Co-ordinator, ICS

CHIEF CO-ORDINATOR,ICS
JNTUHUCEST HYDERABAD
KUKATPALLY, HYDERABAD-500 085

9.4 Fineness Modulus Of Aggregate "12mm"

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

ICS

Contd

Lr No: JNTUHUCESTH/CIVIL/MTL/MIX/8531/2/2023
Date: 17.01.2024
Receipt No. 19557
Mix Design Report for M 25 Grade Concrete
Reference: Your Lr.No. DB//D1/EE/REIB/JNG/2023-24/143, Dated: 16.11.2023
Name of Organisation: Government of Telangana Roads & Buildings Department
Jangaon District.

TEST RESULTS

FINENESS MODULUS OF AGGREGATE 12 mm WEIGHT OF SPECIMEN 5000 grams.

S.NO	I.S.Sieve No.	Weight retained grams	% weight retained	Cumulative % retained	% Passing
1	20 mm	--	--	--	100
2	16 mm	--	--	--	100
3	12.5 mm	350	7.0	7.0	93
4	10 mm	100	20	27	73
5	4.75 mm	3650	73	100	0
6	2.36 mm	0	0	100	0
7	1.18 mm	0	0	100	0
8	600 mic	0	0	100	0
9	300 mic	0	0	100	0
10	150 mic	0	0	100	0

Fineness Modulus: 6.34

Chief Co-ordinator, ICS.

CHIEF CO-ORDINATOR, ICS
JNTUHUCEST HYDERABAD
KUKATPALLY, HYDERABAD-500 085

X. CONCLUSION

The construction of the medical college in Jangaon is progressing towards completion, with significant developments in infrastructure. As part of the Telangana government's initiative, nine new medical colleges have been inaugurated, including the one in Jangaon. This development aims to enhance medical education and healthcare services in the district. The new college is utilizing the existing district hospital and Mother and Child Hospital facilities until the new buildings are fully completed.

However, the Jangaon Government Hospital, which has been converted into a teaching hospital for the medical college, faces challenges such as inadequate facilities, staff shortages, and outdated equipment. Despite these issues, efforts are underway to secure additional funding and resources to improve the hospital's infrastructure and capabilities.These measures are expected to improve the quality of medical education and patient care in Jangaon once the college and

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

associated facilities are fully operational.

REFERENCES

[1]. Brown, T. (2020). Quality control in construction projects. Journal of Construction Management, 15(2), 112-125.

[2]. Chen, Y., & Lee, K. (2020). Automation and robotics in construction: Trends and future outlook. Construction Technology Journal, 23(4), 235-247.

[3]. Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (2018). BIM handbook: A guide to building information modeling. John Wiley & Sons.

[4]. EPA. (2019). Environmental regulations and compliance. Environmental Protection Agency. Retrieved from EPA website.

[5]. International Code Council. (2018). International Building Code. International Code Council.

[6]. Johnson, P., et al. (2020). Case study: The University of California, San Francisco Medical School. Journal of Medical Education, 34(3), 210-225.

[7]. Kumar, R., & Kapur, M. (2021). Architectural planning for medical college buildings. Journal of Architectural Design, 22(3), 167-183.

[8]. Kumar, S., et al. (2021). Advances in construction technology: Impact on the construction industry. Journal of Construction Technology, 28(2), 125-139.

[9]. Lee, H., & Chen, P. (2018). Sustainable construction practices. Journal of Green Building, 13(1), 32-49.