

Introduction of Reinforced Concrete

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ABSTRACT:

A common building material that combines the tensile qualities of steel reinforcement with the strength of concrete is reinforced concrete. This abstract gives a concise overview of reinforced concrete's main characteristics. During the casting process, steel reinforcement bars or mesh are inserted into the concrete matrix to create reinforced concrete. The concrete is given more strength and ductility by the steel reinforcement, which enables it to withstand tensile pressures and enhance overall structural performance. There are various benefits of using concrete with steel reinforcement. Because concrete has a high compression resistance, it can support vertical loads, and steel reinforcement increases the tensile strength of the concrete part while also improving its structural integrity. Reinforced concrete is the perfect material for a variety of structural applications because of this combination's ability to effectively withstand both compression and tension. Buildings, bridges, dams, and other types of infrastructure can all be built with reinforced concrete structures. Engineers and architects favor it because of its adaptability, toughness, and affordability. Several aspects need to be carefully taken into account during the design and construction of reinforced concrete structures. This entails choosing the right concrete mix design, figuring out how much reinforcement is needed and where it should go, and observing the right building and curing procedures.

KEYWORDS:

Building, Concrete, Construction, Design Steel, Structural.

I. INTRODUCTION

A common building material that combines the compressive strength of concrete with the tensile strength of steel reinforcement is reinforced concrete. It is an adaptable and strong material with several benefits for the building sector. There are many uses for reinforced concrete constructions, including foundations, buildings, bridges, dams, and roadways. The use of iron bars placed in concrete to increase its strength was invented by French engineer François Coignet in the middle of the 19th century, giving rise to the idea of reinforced concrete. However, the development of steel reinforcement, in particular Joseph Monier's innovation of reinforced concrete, did not completely transform the construction business until the late 19th century. Using reinforced concrete has several benefits. First and foremost, it combines steel reinforcement's high tensile strength with concrete's high compressive strength to create a material that can endure heavy loads and resist failure or cracking. Because of this, reinforced concrete constructions are strong, able to bear enormous weights, and survive bad weather [1], [2].

The adaptability of reinforced concrete in buildings is also well-known. It may be shaped into a variety of sizes and shapes to satisfy design specifications, enabling the fabrication of intricate architectural components and challenging structural arrangements. Reinforced concrete is excellent for both straightforward and complex construction projects because of its flexibility. The durability of reinforced concrete is another benefit. Structures' lifespans are increased by the steel reinforcement, which protects against cracking and lowers the risk of corrosion. The durability and resistance of reinforced concrete structures to environmental elements including fire, moisture, and chemical exposure are well recognized [3], [4].

Structures made with reinforced concrete also have high fire resistance. Concrete is a favored material for fire-resistant construction due to its inherent qualities, including its high thermal mass, slow rate of heat transfer, and resistance to fire. Additionally strengthening and stabilizing the concrete during fire incidents is the steel reinforcement that is incorporated into the concrete [5], [6].

Widespread use of reinforced concrete construction is encouraged by established design guidelines and standards. To ensure the structural integrity and safety of the finished structure, structural engineers employ a variety of design methodologies and calculations to establish the proper amount and placement of steel reinforcement within the concrete. reinforced concrete combines the benefits of both concrete and steel reinforcement to create a versatile and long-lasting building material. It is the best option for a variety of building applications because of

its capacity to withstand both compressive and tensile pressures. Reinforced concrete has become a standard in the building industry due to its adaptability, toughness, and fire resistance, producing sturdy, long-lasting structures that improve the built environment. A common building material that combines the tensile qualities of steel reinforcement with the strength of concrete is reinforced concrete. This abstract gives a concise overview of reinforced concrete's main characteristics [7], [8].

During the casting process, steel reinforcement bars or mesh are inserted into the concrete matrix to create reinforced concrete. The concrete is given more strength and ductility by the steel reinforcement, which enables it to withstand tensile pressures and enhance overall structural performance. There are various benefits of using concrete with steel reinforcement. Because concrete has a high compression resistance, it can support vertical loads, and steel reinforcement increases the tensile strength of the concrete part while also improving its structural integrity. Reinforced concrete is the perfect material for a variety of structural applications because of this combination's ability to effectively withstand both compression and tension [9], [10].

Buildings, bridges, dams, and other types of infrastructure can all be built with reinforced concrete structures. Engineers and architects favor it because of its adaptability, toughness, and affordability. Several aspects need to be carefully taken into account during the design and construction of reinforced concrete structures. This entails choosing the right concrete mix design, figuring out how much reinforcement is needed and where it should go, and observing the right building and curing procedures.

Structures made of reinforced concrete can be made to withstand certain loads as well as adverse climatic conditions like earthquakes, fire, and corrosion. To maintain the structural integrity and safety of reinforced concrete elements, design rules, and standards provide recommendations for selecting the proper dimensions, reinforcing details, and building methods. In the life cycle of reinforced concrete structures, maintenance, and durability are crucial factors. The service life of reinforced concrete elements can be increased through proper maintenance procedures, such as routine inspections, the repair of any damaged sections, and protection from the elements. Reinforced concrete is a flexible and frequently used building material that combines the tensile qualities of steel reinforcement with the strength and durability of concrete. It is excellent for a variety of structural applications because of its capacity to resist both compression and tension. Reinforced concrete buildings can offer long-lasting, safe, and sustainable solutions for diverse construction projects through careful design, construction, and maintenance procedures.

II. DISCUSSION

Reinforced Concrete Structure

Due to its adaptability, toughness, and strength, reinforced concrete structures are frequently employed in the construction sector. These structures provide a material that can bear heavy loads and provide long-term performance by combining the compressive strength of concrete with the tensile strength of steel reinforcement. The main characteristics of reinforced concrete structures will be covered in this article, including their composition, design concepts, construction techniques, and benefits.

Structures made of reinforced concrete are composed of:

Concrete and steel reinforcement are the two main components of reinforced concrete construction. Cement, aggregates (such as sand and gravel), water, and occasionally admixtures are the main ingredients of concrete. It gives the steel reinforcement its compressive strength and serves as a cover to keep it safe. To increase the concrete's tensile strength, steel reinforcement typically in the form of bars or mesh is incorporated into the mixture.

Reinforced concrete structure design principles

To ensure their functionality and safety, reinforced concrete structures are designed according to a set of guidelines. Structural engineers establish the ideal dimensions, reinforcement needs, and general design of the structure by taking into account variables including applied loads, environmental conditions, and planned service life. Design principles, including minimum strength requirements, size requirements, and reinforcement ratios, are provided by design codes and standards.

Construction Techniques for Structures Made of Reinforced Concrete:

There are various phases involved in building reinforced concrete structures. First, formwork is built to specify the structure's shape and measurements. Following that, reinforcement bars are installed in the formwork following the design requirements to provide adequate spacing and cover. Concrete is poured into the formwork

once the formwork has been secured, encasing the reinforcement. After the concrete has been cured and given time to harden a sturdy and long-lasting building is produced.

Reinforced concrete structures have several benefits.

Numerous benefits of reinforced concrete constructions include:

Concrete and steel reinforcement work together to create a structure with great strength and durability. Structures made of reinforced concrete have a long service life, can sustain enormous loads, and are resistant to cracking.

Versatility: Reinforced concrete can be shaped into many different sizes and shapes, enabling a variety of architectural and structural ideas. When building intricate and beautiful structures, this flexibility is especially useful.

Fire Resistance: Because of the inherent fire resistance of concrete, reinforced concrete constructions are highly fire resistant. During fire situations, the concrete coating shields the steel reinforcement from damage caused by high temperatures.

Cost-Effectiveness: Reinforced concrete buildings are an affordable option for building projects. They are cost-effective because raw materials are readily available, the building is simple, and maintenance requirements are minimal.

Concrete is a sustainable material since it can be made with readily available materials in the area. Additionally, because of its lengthy lifespan, fewer replacements are required. Concrete can also be recycled, pulverized, and repurposed in new construction projects.

Reinforced concrete constructions have good resilience to environmental elements such as deterioration from weather, moisture, and chemical exposure. Their durability is ensured by this resilience, which also reduces the need for maintenance.

reinforced concrete buildings are frequently employed in the building sector because of their adaptability, toughness, and durability. Compressive strength in the concrete and tensile strength in the steel reinforcement provided by these structures create a material that can bear enormous loads and provide long-term performance. Reinforced concrete buildings are a favored option for a variety of construction applications due to their composition, design principles, construction techniques, and advantages, which help to develop reliable and long-lasting infrastructure.

machines of reinforced concrete

To handle and process the materials involved in reinforced concrete construction properly and efficiently, numerous machines and pieces of equipment are used. These tools are made to do specific jobs and make sure that reinforced concrete constructions are placed, mixed, dried, and finished properly. We'll look at a few of the most important tools for reinforced concrete building in this article.

Masonry Mixers:

To create the proper concrete mix, concrete mixers combine cement, water, aggregates (such as sand and gravel), and additives. They are available in a variety of shapes and sizes, such as drum mixers, batch mixers, and truck-mounted mixers. Concrete mixers make sure that the elements are mixed consistently and uniformly, producing a homogenous product for construction needs.

Cement Pump:

The liquid concrete is moved from the mixer to the construction site using a concrete pump. A pump and pipelines are used to move the concrete to the required place. Concrete pumps are especially helpful in large-scale projects and high-rise buildings when human concrete transfer may be difficult or time-consuming.

Machines for cutting and Bending Rebar

Rebar's, commonly referred to as reinforcement bars, are a crucial element in reinforced concrete construction. Rebar's are shaped and cut using rebar bending and cutting machines following the necessary criteria. By removing the necessity for hand cutting and bending, these devices increase the effectiveness and precision of reinforcing concrete structures.

Vibratory Concrete:

Air voids in freshly poured concrete are consolidated and removed with concrete vibrators. They come in a variety of varieties, including surface vibrators, external vibrators, and internal vibrators. Concrete vibrators make ensuring that the concrete is compacted properly, increasing its tensile strength and longevity.

Equipment for leveling and placing concrete:

Machines like concrete pumps, concrete screeds, and laser-guided leveling systems are examples of placing and leveling equipment. To ensure a smooth and even surface, these devices are utilized to distribute and level the freshly poured concrete. They aid in getting the concrete to the desired thickness and elevation, raising the overall standard of the finished product.

Tools for finishing concrete:

To give the cured concrete the desired surface roughness and appearance, finishing tools are utilized. Trowels, floats, edges, and brooms are some of them. These tools aid in leveling and smoothing the concrete surface, eradicating flaws, and producing a variety of finishes, including a smooth finish, exposed aggregate, or textured patterns.

Equipment for drilling and cutting concrete:

Hardened concrete can be cut, penetrated, and shaped using machinery for drilling and cutting concrete. They consist of tools like wall saws, core drills, and concrete saws. These tools are necessary for modifying or adapting pre-existing concrete structures as well as for making exact apertures for plumbing, electrical, or HVAC systems.

Equipment for curing concrete:

The development of reinforced concrete's strength and endurance depends on proper curing. During the curing process, moisture and temperature conditions are maintained using curing equipment such as curing blankets, moisture-retaining covers, and curing chemicals. These tools guarantee that the concrete reaches its maximum strength and stops it from cracking or shrinking.

Shotcrete Equipment:

Sprayed concrete is applied using shotcrete machines, commonly referred to as concrete spraying equipment. To create a high-velocity stream of concrete that sticks to the appropriate surface, they combine compressed air with concrete mix. Shotcrete machines are frequently employed in slope stabilization, tunnel building, and maintenance projects.

Equipment for recycling concrete:

Crushed or extra concrete from building sites is recycled using concrete recycling machinery. These tools lessen trash generation and the negative environmental effects of disposing of concrete. In many applications, recycled concrete can be used as fill material or as aggregate in fresh concrete mixtures.

Reinforced concrete members

Concrete and steel reinforcement is used to create reinforced concrete members, which are structural components. Because of their power, toughness, and adaptability, these materials are frequently utilized in construction. We will look at the many kinds of reinforced concrete members, design factors to take into account, and applications in this topic.

Beams Reinforced concrete beams are horizontal structural components that can support loads and resist bending. To support floor slabs, roofs, and bridges, they are frequently utilized in the construction of buildings. Determine the necessary depth, width, reinforcing pattern, and concrete strength when designing reinforced concrete beams to make sure they can support the projected loads and span lengths.

Columns are vertical structural pieces made of reinforced concrete that are used to support the weight of beams, slabs, and other structural components. In addition to transferring loads to the foundation, they offer stability. To achieve suitable strength and stability, reinforced concrete columns are designed taking into account variables like axial load, moment, and slenderness ratio.

Slabs Reinforced concrete slabs are the flat, horizontal sections that make up a building's floors and roofing. One-way or two-way spanning elements are both acceptable. When designing reinforced concrete slabs, considerations including span length, live load, and support conditions are taken into account to establish the necessary thickness and reinforcing configuration.

Reinforced concrete walls serve as vertical structural elements that support buildings from the side and resist horizontal loads like wind and seismic pressures. They can be solid or hollow, and while designing them, it is important to consider the necessary thickness, the details of the reinforcement, and the shear strength to guarantee structural integrity.

Reinforced concrete footings are structural components that distribute the weight of columns, walls, and other vertical members to the subsurface soil or foundation. To prevent excessive settling, they spread the weight over a broader region. The size of the load, the soil bearing capacity, and settling criteria are all taken into account while designing reinforced concrete footings. To support structures or transfer loads to deeper, more stable soil layers, reinforced concrete piles are deep foundation components that are pushed into the earth. They can be precast or cast in place, and they are utilized when shallow foundations are impractical or don't offer enough support. Soil conditions, load requirements, and pile driving issues are all taken into account in the construction of reinforced concrete piles.

Reinforced concrete retaining walls are constructions used to hold soil in place and resist lateral earth pressure. In applications like highway embankments, cellar walls, and seaside constructions, they are frequently used. Designing reinforced concrete retaining walls requires taking into account various aspects, including soil characteristics, surcharge loads, water pressure, and stability requirements. Engineers take into account the loads acting on the member, the characteristics of the material(s) employed, and the design norms and standards while designing reinforced concrete members. Concrete provides compressive strength, and the reinforcement is carefully positioned in those locations where tensile pressures are anticipated. By combining these materials, a composite member is produced that has ductility, durability, and resistance to a variety of loads.

Residential, commercial, industrial, and infrastructural projects are just a few of the many industries in which reinforced concrete components are used. In addition to several other structures, they are utilized in buildings, bridges, tunnels, dams, and water treatment facilities. The strength, durability, and capacity to survive harsh weather conditions make reinforced concrete members a popular choice in construction due to their adaptability and versatility. In contemporary buildings, reinforced concrete members are essential. The enormous variety of reinforced concrete members utilized in the business includes beams, columns, slabs, walls, footings, piles, and retaining walls, to name just a few. The loads, materials, and design standards must be carefully taken into account throughout the design and construction.

Factors affecting the choice of reinforced concrete for a structure

The choice of whether reinforced concrete, steel, masonry, or wood should be used to construct a structure depends on the availability of the materials as well as a variety of value judgments.

Economical

The overall cost of the project is frequently the most important factor structure. Of course, this depends on the price of the building materials as well as the amount of labor and time required to erect the structure. Because the girders, beams, or joists all fit within the same depth, as shown on the second floor, or because the floors are flat plates or flat slabs, concrete floor systems tend to be thinner than structural steel systems. As a result, a building's overall height is decreased as compared to steel construction, which results in (a) lower wind loads because there is less exposed surface area to the wind and (b) cost savings on cladding, mechanical risers, and electrical risers.

However, as the contractor and the owner must set aside funds to complete the construction and won't receive a return on their investment until the structure is ready for occupation, the overall construction duration frequently has an equal or greater impact on the cost. As a result, cost savings brought on by quick production can more than make up for higher material and forming costs. Contrary to structural steel, which must be bought and partially paid for in advance to schedule the job at a steel-fabricating yard, reinforced concrete structure materials are generally available and can be made as they are needed in the construction. Generally speaking, any steps the designer may take to standardize the design and forming will result in lower overall costs. For instance, to reduce form costs, it may be possible to maintain the same column sizes for several floors while yet allowing for variations in column loads by altering the concrete's strength or the amount of reinforcing.

Suitability

For use as a structural and architectural material. The architect can regularly blend the structural and architectural purposes in a reinforced concrete structure. Concrete has the benefit of being applied in a plastic state and being given the desired shape and texture using forms and finishing methods. As a result, materials like flat plates or other kinds of slabs can provide the finished floor and ceiling surfaces while also acting as load-bearing elements. Similar to reinforced concrete floors, reinforced concrete walls can offer aesthetically pleasing surfaces in

addition to being able to withstand seismic, wind, and gravity loads. Finally, the designer determines the size or shape, not whether or not there are readily available standard-made members.

Resistance to fire

A building's structure must survive the impacts of a fire and continue to stand while the occupants are evacuated and the fire is put out. A concrete structure has a 1- to 3-hour fire rating by default, without the need for further fireproofing or other elements. To get comparable fire ratings, structural steel or timber buildings must be fireproofed.

Reinforced concrete and concrete's historical development

Stability.

If a building vibrates when people pass by or oscillates in response to the wind, the residents may become uneasy. Vibrations are generally not a concern with concrete structures because of their increased stiffness and bulk.

Easy to maintain.

Maintenance is naturally less of a concern for concrete members than it is for structural steel or timber elements. This is especially true if dense, air-entrained concrete was chosen for exterior areas exposed to the elements and if appropriate drainage from the structure was considered during design.

Materials are accessible.

Reinforcing steel can be transported to most building sites more simply than structural steel, and there are very many facilities available to mix cement, concrete, water, sand, and crushed rock. Reinforced concrete is therefore usually used as the construction material in isolated places. The decision to employ a different material than reinforced concrete, however, may be influenced by several reasons.

III. CONCLUSION

An essential component of construction, reinforced concrete has many benefits in terms of strength, durability, adaptability, and variety. The tensile strength of steel reinforcement and the compressive strength of concrete combine to create a composite material that can endure a range of loads and environmental conditions. In the construction business, reinforced concrete elements such as beams, columns, slabs, walls, footings, piles, and retaining walls are frequently utilized for a variety of purposes. Buildings, bridges, dams, and other infrastructure projects benefit from the structural integrity, support, and stability provided by these members. Considerations for the design of reinforced concrete members include loads, materials, dimensions, reinforcing detailing, design codes, and standards. Engineers make an effort to guarantee that the members can successfully withstand applied forces, retain structural integrity, and adhere to safety regulations. Architects and designers favor reinforced concrete because of its adaptability, which enables the construction of intricate architectural forms and shapes. The substance can be shaped, cast, and formed to satisfy particular project specifications, enabling the creation of distinctive structures with appealing aesthetics.

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