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Partial Replacement of Fine Aggregate Using Mersey Silt

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ABSTRACT- Numerous researchers are doing experimental experiments with the goal of identifying potential eco-friendly, cost-efficient, and efficient cement substitute materials. The alternatives include recycling, reusing, and renewing techniques for industrial & agricultural debris, whereby the advantages might be acknowledged. By using these wastes as additional and substitute resources, you may save a lot of energy and use less cement, which both assist to reduce the amount of carbon dioxide released into the environment.Any construction sector needs cement, sand, and aggregate at a minimum. Sand, a material used in the creation of concrete and mortar, is crucial in the blend's design. Due to river erosion and environmental issues, river sand is currently in limited supply. The structural sector would be affected by the shortage or absence of sand, thus the most cutting-edge alternative material must be explored for replacing river sand so as to prevent excessive river erosion & environmental harm.Mersey silt is among the most significant components that many scientists take into account while discussing other sand-related materials. Various ratios of this silt combined with sand may be used to create the necessary concrete mixture. In order to partially replace natural sand in the manufacturing of concrete, this work examines the different quantities of Mersey silt. This research focuses on the compression & split tensile strength properties of concrete utilising M20 grade concrete combined with Mersey silt as a partial substitute for natural sand (10%, 15%, and 20%).

KEYWORDS- Mersey Silt, Fine Aggregate, Concrete.

I. INTRODUCTION

One of the versatile building materials that have been utilised for various applications in construction work throughout centuries is concrete. Concrete has been used for thousands of years and it remains a popular choice for construction projects of all sizes due to its resilience, toughness, & versatility. Using concrete may be attributed to the ancient times, with evidences in ancient Egypt and Rome. The Romans were particularly skilled in the use of concrete in their buildings and structures and most of their structures and buildings still stand today, thousands of years later. They used a mix of lime, sand and volcanic ash to make the building material durable. The Pantheon in Rome; built in 125 AD is one of the famous examples of Roman concrete construction. It is the largest unreinforced concrete cupola in the world. Later, in the 20th century, the development of reinforced concrete; which uses steel rods to boost the durability of concrete, revolutionized the construction industry. This allowed the construction of taller and stronger buildings, bridges, roads and dams which led to the widespread use of concrete in modern construction projects. Concrete is composite material that is composed of aggregates (like sand, gravel, or crushed stone), cement, & water. and sometimes admixtures in required proportion. When water is added to the cement, The outcome of the chemical reaction is the hardening of combo, hence a rock-like mass is formed called the concrete. Cement is basically made up of finely ground powder of limestone and clay which is burnt at high temperature in an exceedingly rotating kiln. Cement is very expensive of the components in the mix. Generally, the concrete mix for load bearing structures is in the ratio of 1:2:4 that is; one part of cement is mixed with fine aggregate in two portions & coarse aggregate in four distinct portions. The amount of cement required for culvert bed and foundation concrete is smaller than for structural concrete. The density & resilience of the final concrete are also determined by the particle sizes. It is feasible to secure a thick and powerful concrete by combining the accurate amounts of different sizes of gravel and sand. As it provides the concrete with its compressive strength, the gravel, which is a component of the mixture, serves as its frame. The paste of cement coats the massive particles, fills the empty spaces between them, and glues them together, thereby giving the concrete its high density and impermeability. The proportion of the mix's components and the quality of the materials employed determine the concrete's qualities[1].

- **Strength:** Among concrete's main characteristics is strength. The quantity and grade of cement incorporated in the mix, the calibre of the aggregates, or the water: cement ratio all affect how strong the concrete will be. Concrete may be made to have a broad variety of strengths that depend on the project's needs.
- **Durability:** Concrete can withstand a wide range of environmental conditions as well as exposure of chemicals.

Properly designed and maintained concrete structure can last for decades or even centuries.

- **Workability:** The efficiency with which concrete may be mixed and poured is referred to as its workability. The water-to-cement ratio, aggregate size, and aggregate shape all affect this property.
- **Shrinkage:** Shrinkage is property of hardened concrete. This can lead to the cracks in concrete and other issues if not managed properly. Shrinkage cracks can be prevented with the help of control joints.
- **Versatility:** Concrete serves as a adaptable material, as it can be moulded into various sizes and forms, depending upon the need. It can be reinforced with steel to further increase the strength and durability.

Concrete is one amongst the materials utilised by the building industry the most often nowadays. Its durability and versatility make it an essential component of modern infrastructure. Yet there has been an increase in worry in recent years over the sustainability and environmental impact of concrete and efforts have been made to bring down its negative effect. One of the primary elements that influence the sustainability of the concrete is its carbon footprint, land use, water use, air pollution, waste generation, etc. To address these issues, efforts are undertaken to lessen the effect of concrete on the environment via the use of substitute materials, recycling, and fuels. As sustainability and environmental awareness continue to grow, it is likely that advance efforts will be made to make concrete more sustainable and environment friendly material.

A. Cement

Cement is a fundamental building material that has been a part of human civilization for centuries. Cement is used to bind materials such as sand, gravel, and stone together to form concrete, which is then used to construct buildings, bridges, roads, and other infrastructure.

The use of cement dates back to ancient civilizations when people used mud and straws to build structures. The Egyptians were the first to use a form of cement, made by mixing mud and straw to make bricks for building structures such as the pyramids. Similar form of cement was used in ancient Greece and Rome to construct buildings and bridges. Later in the 14th century, a form of cement called hydraulic lime was developed in Europe. This type of cement was made by heating limestone and then adding water to form a powder. It was widely used to construct buildings and other structures during the Renaissance. In the 19th century, a British engineer named Joseph Aspdin developed a new type of cement called Portland cement. This cement powder was made by heating a clay-limestone combination in a kiln until it became a fine powder. The powder so formed was then mixed with water to make a paste, which was then used to bind together building materials such as sand and gravel.

In the mid-20th century, various other types of cement were developed that were designed to meet specific construction needs. For example, high-strength cement was developed to support heavy loads, while self levelling cement was developed to create smooth surfaces for flooring and other applications. In recent years, advanced cement types have been developed that are more environment friendly than traditional Portland cement. These types of cement use less energy to produce and emit less greenhouse gases, making them a more feasible option for construction. The advanced technology has made the process more efficient and environmentally friendly. For example, some cement plants use alternative fuels such as biomass and waste materials instead of fossil fuels to reduce their carbon footprint.

The manufacturing process of cement is complex and energy intensive process that involves several stages. Cement manufacture begins with the quarrying of basic components like limestone, clay, & sand. Following that these raw materials are crushed into smaller pieces using crushers or hammer mills. The crushed materials are then transported to the cement plant using belts or trucks. The raw materials are then mixed together in a prehomogenization yard to ensure that a uniform mixture is obtained. The mixture is subsequently heated to a temperature of about 1450°C in a rotary kiln. The rotary type of kiln is massive spiralling furnace where these basic materials are subjected for the series of chemical reactions that lead to the formation of clinker as a result of tremendous heat applied to them. After cooling, the clinker is pulverised into a fine powdered form in a cement mill which is a horizontal cylinder that contains steel balls. The ground cement is next stored in silos until it is ready to be transported to customers. During the manufacturing process, small quantities of various types of additives like gypsum, fly ash, & slag are added to clinker to give cement specific properties such as setting time, strength, and durability.

As per IS: 1343 – 1980 (clause 4.1), the types of cement permitted for pressurized applications are subsequent. The data is revised as per the latest amendment (2021) of IS 456-2000, plain & reinforced concrete-code of practice.

- Ordinary Portland cement (OPC) conforming to IS 269 – 33 grade specifications.
- Ordinary Portland cement (OPC) conforming to IS: 8112 – 43 grade specification.
- Ordinary Portland cement (OPC) conforming to IS: 12269– 53 grade specification.
- Rapid hardening Portland cement conforming to IS: 455.
- Portland pozzolana cement:
  a) fly ash based conforming to IS 1489 (part 1) b) calcined clay based conforming to IS 1489 (part2)
- Hydrophobic cement conforming to IS: 8043.
- Low heat Portland cement conforming to IS: 12600.
- Sulphate resisting Portland cement conforming to IS: 12330.

B. Aggregate

Aggregate is a critical material that has wide range of applications within the construction sector. One uses aggregates in concrete, asphalt, as well as road base. In other words, an aggregate is a granular material that is used as a base or filler in construction projects. They are typically sourced from natural deposits, quarries, or produced artificially through the crushing of rocks, gravel, or recycled materials. The primary goal of using an aggregate that is to give strength and stability to construction materials. Upon mixing the aggregate with cement and water, a strong and durable material known as concrete is formed. There are several kinds of aggregates which can be used for structural purposes, each with unique properties and characteristics. The properties of the final product are influenced by the size, form and texture of aggregate particles. For example, rounded aggregates are better suited for making concrete, while angular aggregates are better suited for making road base. Some common types of aggregates used for construction projects include sand, gravel, crushed stone, slag, and recycled materials. Generally, concrete uses sand as a fine aggregate and mortar, while gravel is commonly used as a coarse aggregate in concrete and asphalt. Crushed stone provide excellent stability and drainage property therefore, making it a popular choice for road base and drainage systems. Natural aggregates are often substituted by recycled materials, such as crushed concrete and asphalt.[2] Slag is a steel byproduct & is often used as a alternate for natural aggregates. As the construction industry continues to grow, it is important to prioritize sustainable sourcing and processing practices to minimize the environmental impact of aggregate use since sourcing and processing of aggregate can have significant environmental impacts, particularly if it involves mining and quarrying. Therefore, it is important to procure aggregate from sustainable and responsible sources whenever possible.

i) Classification of aggregate

The classification of aggregate is essential within the construction sector as it helps to determine the properties of construction items and their suitability for specific applications. Aggregates can be classified on the basis of their properties including particle size, shape, texture, and source.

- **Particle Size**

The particulate size of aggregate is a critical factor that influences concrete's ease of use, sturdiness, and longevity and other construction materials. Particle size classification of aggregate is generally done by sieving or screening. The ASTM classifies aggregates based on their particle size as follows:

- **Coarse Aggregates -** The 4.75 mm IS sieve retains materials that are classified as coarse aggregates. The stated size of these aggregates can be 40mm, 20mm, 16mm and 12.5mm. These include crushed stones obtained from grinding of rocks or gravel and non crushed stones obtained from a natural breakdown or weathering of stones. They are generally used in concrete for the construction of structural components including slabs, columns, & beams.
- **Fine Aggregates-** These are aggregates that pass through 4.75mm sieve during sieve analysis, that means the aggregates with particle size smaller than 4.75 mm are classified as fine aggregates. In concrete, they are used for the construction of components such as walls and pavements. Some of fine aggregates used for construction purposes include sand, silt, and clay. The grain size of fine sand varies between 0.125mm and 0.25mm. Material with grain size varying from 0.0625mm to 0.0156mm are silt, & that less in size than silt (<0.0039mm) are know as clay. Loam is the name used to describe the gentle deposit comprising almost equal amounts of sand, silt, and clay. According to size, coarse, medium, & fine sands are also used to characterise fine material. The fine aggregate has been separated into four grading zones by IS: 383-1970, and each zone's fineness increases from zone I to zone IV.

i) Classification on the basis of shape:

Flakiness and elongation index test is used determine the shape of aggregates. The apparatus required for the purpose are flakiness gauge and elongation gauge. Aggregates are classified as angular aggregates, rounded aggregates on the basis mentioned above.

- **Angular Aggregates** – Sharp edged and irregular aggregates are termed as angular aggregates. They are used in the construction of road bases as they provide good interlocking between particles.
- **Round Aggregates -**Aggregates that have smooth edges and are round in shape are called round aggregates. They improve the workability and are commonly used in the construction of concrete and asphalt.
- **Flaky Aggregates** – These aggregates have a flat and elongated shape. They are not suitable for the construction as they reduce the workability of concrete and weaken the resulting concrete.

ii) Texture Classification

How long it requires to finish a task is determined by the amount of time it takes to finish the task.The texture of aggregates is classified as follows:

- **Porous Aggregates -** These are aggregates that have voids in their structure. Since, these provide good drainage, hence drainage systems and road foundation are commonly constructed using them.
- **Non-Porous Aggregates** – These aggregates do not have pores or voids in their structure. They provide concrete and asphalt with better strength.

C. Water

Water is a vital resource in construction. It is used for various activities, including mixing concrete, curing concrete, and dust suppression. The amount of water required in construction projects can vary depending on the project's size, complexity, and location. The most popular building material globally is concrete, and for the hydration process, a large amount of water is needed. The hydration process is the chemical reaction that occurs between water and cement, by virtue of which a strong bond is formed between the aggregates and the cement. A critical element that determines the strength and longevity of the concrete is the water-cement ratio. A greater ratio of water to cement leads to weaker and less lasting concrete, whereas a lower water-cement ratio produces stronger and more resilient concrete.

Water is also used for curing concrete to keep the concrete moist and at a specific temperature to ensure proper hydration. Curing helps to prevent cracking due to shrinkage which can occur when the concrete dries too quickly. The amount of water used in curing depends on the weather conditions and the type of concrete used. Water is also used to suppress the dust and prevent it from spreading particularly in demolition activities as it generates large amounts of dust, which can be harmful to workers' health and the environment.

Concrete should be mixed and dried in water free of harmful chemicals and other contaminants. Due to inappropriate water quality, an unpleasant situation causing concrete suffering is discovered. Concrete mixing using portable water is often regarded as good. If there is any question as to whether water is suitable, especially in a distant place water should be tested and the solid content should be determined as per IS: 3025. The chart should be followed for limiting the quantity of solid contaminants in the water used for mixing. Water that is acceptable for pouring concrete typically has a PH of 6 to 8. Water that is suitable for drinking is thought to be suitable for concrete building.

In addition, water conservation is critical in construction as it helps to minimize the negative impact on the environment and reduce the project cost.

D. Mersey Silt

Sand, cement, and aggregates are necessities for every building sector. Sand is a crucial component of the mix-production process and is used to prepare mortar and concrete. Natural sand is often used extensively due to the significant usage of concrete and mortar.As a result of the fast expansion of infrastructure, there is an extreme need for natural sand in emerging nations. Natural sand reserves, notably in India, have been utilised and are posing severe risks to our planet and community. Developing nations like India are struggling to find excellent quality natural sand. Researchers and engineers have used new inventions like Mersey silt, sand (made from sand), robot silica or sand, crushed rock dust, reused sand, processed and managed silt, and dams from other water bodies in addition to sand to reduce or eliminate the use of river sand. On the contrary, a major restriction is the absence of necessary quality in certain of the aforementioned materials. The alternative material must fulfil the technical specifications of fine aggregates and be locally accessible in significant amounts in order for infrastructure to expand sustainably today. According to the author's research, Mersey Silt is a waste product with the potential to be used as a fine concrete aggregate and may, in theory, make a major contribution to the supply of aggregations. This essay details many real-world tests of the substance in concrete.

i) Shortage : Construction Impact

The current shortage of river sand has significantly impacted the construction sector, leading to various challenges and implications. River sand has traditionally been a crucial component in construction due to its unique properties, such as uniform grain size, good workability, and high compressive strength. However, several factors have contributed to the shortage of river sand and its effect on industry.

Firstly, there has been an increase in the demand for sand due to rapid urbanization and infrastructure development worldwide. As construction activities escalate, the extraction of river sand has become unsustainable, resulting in depletion and erosion of riverbeds. Environmental regulations and concerns about the ecological damage caused by excessive sand mining have also limited the availability of natural sand.

Scarcity of river sand has led to rising costs, making it economically challenging for construction projects. Contractors and builders face difficulties in sourcing sufficient sand for their projects, resulting in delays and increased construction costs. This shortage has particularly affected regions dependent on river sand as the primary source, creating an imbalance in supply and demand. In response to the shortage, alternative sources and substitute materials have been explored. These include manufactured sand, quarry dust, crushed rock fines, and industrial by-products. However, these alternatives often possess different properties and may require modifications to the concrete mix design or additional processing, impacting construction practices and potentially affecting the quality of concrete structures. Concerns regarding the long term viability of the construction sector have also been sparked by a scarcity of river sand.

It has prompted researchers, engineers, and policymakers to explore innovative solutions and promote sustainable practices, such as using recycled materials, implementing efficient construction techniques, and adopting alternative construction materials. To address the shortage, governments and regulatory bodies have implemented measures to regulate sand mining, promote responsible extraction practices, and encourage the use of alternative materials. Additionally, research and development efforts are ongoing to explore more sustainable and environmentally friendly options for construction.

In conclusion, the current shortage of river sand has significantly impacted the construction sector, leading to increased costs, delays, and the need to explore alternative materials. It has necessitated a shift towards sustainable practices & the creation of creative solutions to meet growing demand for construction materials while minimizing environmental impact.

iii) Environmental Sand replacement needed

The need for alternative materials to replace river sand in construction arises primarily from the desire to mitigate environmental damage caused by excessive sand mining. The extraction of river sand has significant environmental implications, including:

- **Erosion of Riverbeds:** Large-scale mining of river sand disrupts the natural flow of rivers, leading to erosion of riverbeds and the loss of important ecosystems. It can result in the alteration of river channels, loss of aquatic habitats, and degradation of riparian vegetation.
- **Habitat Destruction:** Sand mining activities often involve the removal of topsoil and vegetation, leading to the destruction of habitats for various plant and animal species. This disruption can have long-lasting ecological

consequences, including the loss of biodiversity and disruption of food chains.

- **Groundwater Depletion:** Excessive sand mining from riverbeds can lower the water table and deplete groundwater resources. It affects the availability of water for both human consumption and agricultural needs, leading to water scarcity and ecological imbalances.
- **Sedimentation and Water Quality Issues:** Unregulated sand mining can cause increased sedimentation in rivers and other water bodies. This sedimentation reduces water storage capacity, affects water quality, and impacts the functioning of aquatic ecosystems. Given these environmental challenges, the search for alternative materials to replace river sand has become imperative. The exploration of alternative materials serves several purposes.
- **Resource Conservation:** Using alternative materials reduces the dependence on river sand, conserving this finite natural resource. By utilizing alternative materials, the demand for river sand can be minimized, easing the pressure on river ecosystems.
- **Sustainable Construction Practices:** Adopting alternative materials aligns with the principles of sustainable development by promoting responsible resource management and reducing the ecological footprint of the construction industry.
- **Environmental Preservation:** By reducing the need for excessive sand mining, the adverse impacts on riverbeds, habitats, and water bodies can be minimized, preserving natural ecosystems and maintaining the ecological balance.
- **Long-term Viability:** Finding and implementing alternative materials ensures the long-term viability of the construction industry by addressing the challenges posed by the scarcity of river sand and potential future regulatory restrictions.

  Prominent alternatives to river sand include manufactured sand, crushed rock fines, quarry dust, and industrial by-products. These materials offer potential advantages such as consistent quality, reduced environmental impact, and improved resource management.

In conclusion, the need for alternative materials to replace river sand in construction arises from the urgent need to mitigate environmental damage caused by excessive sand mining. By adopting sustainable practices and alternative materials, the construction industry can minimize its impact on ecosystems, preserve natural resources, and promote long-term environmental stewardship.

iv) Mersey Silt as a Substitute For Natural Sand

The selection of Mersey silt as a possible replacement substance for river sand in construction is based on several factors, including its availability, suitability for concrete, and previous studies supporting its use. Let's explore these aspects:

- **Availability:** Mersey silt is readily available in the Mersey Estuary region, making it a locally accessible resource for construction projects in the area. This reduces the need for long-distance transportation of materials, leading to cost savings and minimizing carbon emissions associated with transportation. The local availability of Mersey silt also ensures a stable supply chain, reducing dependency on river sand, which may be subject to scarcity or environmental regulations.
- **Suitability for Concrete Preparation:** Mersey silt possesses characteristics that adapt it to be used as fine aggregate for concrete construction. Its fine-grained nature allows for effective blending with other ingredients, such as cement and coarse aggregates, to produce concrete with desirable properties. Mersey silt's particle size dispersion may be adjusted & controlled to meet specific requirements, ensuring compatibility with concrete mix designs. This adaptability makes it a potential substitute for river sand in concrete applications.
- **Previous Studies and Research:** Several research projects have been carried out to evaluate use of Mersey silt as substitute for river sand in construction. These studies have provided valuable insights into the feasibility and performance of Mersey silt in various concrete applications. Some key findings from previous research include:
  - **Mechanical Properties:** Research has shown that the incorporating of Mersey silt as partial replacement of sand can yield concrete with acceptable mechanical properties. Studies have investigated parameters like split tensile strength, compressive strength, and flexural strength, demonstrating that concrete mixtures containing Mersey silt can meet or even exceed the performance requirements of conventional concrete.
  - **Durability:** The durability aspects of concrete with Mersey silt have also been examined. Studies have focused on properties like absorption of water, permeability to chloride ions, and defence against sulphate assault. The findings suggest that incorporating Mersey silt as a substitute material does not significantly compromise the durability of concrete.
  - **Workability and Fresh Properties:** Workability is an important consideration in concrete production. Previous studies have assessed the workability of concrete mixtures containing Mersey silt, examining factors such as slump, compacting factor, and flowability. Results indicate that the inclusion of Mersey silt can maintain or enhance workability, facilitating proper handling and placement of concrete.
- **Sustainable Construction:** Some studies have highlighted the advantages to the environment from the usage of Mersey silt as a substitute for river sand. By reducing reliance on river sand, the environmental impacts of sand extraction, such as habitat destruction and erosion, can be mitigated. The local availability of Mersey silt also promotes resource conservation and supports sustainable construction practices.

In conclusion, the selection of Mersey silt as an alternative to river sand while making concrete is supported by its availability, suitability for concrete preparation, and previous studies demonstrating its feasibility and performance. The local accessibility of Mersey silt reduces transportation costs and environmental impacts, while its fine-grained nature and adjustability make it compatible with concrete mix designs. Previous research has indicated that concrete mixtures incorporating Mersey silt can achieve satisfactory mechanical properties, durability, and workability. Using Mersey silt as a substitute aligns with sustainable construction practices and offers a potential solution to address the challenges associated with river sand scarcity and environmental concerns.

v) Properties of Mersey Silt

The various Properties of Mersey Silt including Bulk Density, Specific Gravity, Particle size & Texture are provided below, however these can vary depending on specific sampling locations and conditions.

- **Bulk Density:** The bulk density of Mersey silt typically ranges from 1.1 to 1.4 g/cm³ or 1100 to 1400 kg/m³.These can vary based on factors such as moisture content and compaction.
- **Specific Gravity:** The specific gravity of Mersey silt generally falls within the range of 2.65 to 2.80. Specific gravity refers to evaluate how dense a thing is in comparison to water, and it provides an indication of the relative heaviness or lightness of the material.
- **Particle Size:** The particle size distribution of Mersey silt is typically characterized by fine particles. Silt particles fall within the size range between sand and clay, with diameters ranging from 0.002 to 0.05 millimeters (mm). While bigger than clay particles, silt particles typically are smaller than sand particles. Mersey silt may contain a mix of different particle sizes within this range, and the exact distribution can vary depending on the specific location.
- **Texture:** Mersey silt is characterized by its fine texture. While bigger than clay particles, silt particles typically are smaller than sand particles, typically falling within the size range of 0.002 to 0.05 millimeters (mm) in diameter. The texture of Mersey silt can be described as smooth and silky to the touch, with individual particles being too small to be felt individually. When dry, it can feel powdery, and when wet, it has a cohesive nature that allows it to retain its shape but also easily be molded. The fine texture of Mersey silt is a result of its composition and the processes involved in its formation, transportation, and deposition in water bodies such as the River Mersey.

II. OBJECTIVES

- **A.** To know the influence of Mersey silt on the workability of concrete.
- **B.** To examine the impact of Mersey silt on compressive, split tensile, and flexural strength of concrete.
- **C.** To determine the ideal proportion of Mersey silt that can substitute some of the fine aggregate in concrete.
- **D.** To make the concrete economical.
- **E.** To conclude the research in a graciousness.

III. LITERATURE REVIEW

A. M. E. Mathews, T. Kiran, A. Nammalvar, M. Anbarasu, B. Kanagaraj, and D. Andrushia [3]

Self-Compacting Concrete is unique kind of concrete which can readily flow over crowded reinforcing bars. Additionally, it does not segregate and is simple to deal with. With the use of commercial waste products such Fly Ash , ground-granulated slag from blast furnaces and Expandable Perlite Aggregate (EPA), the current inquiry intends to design and construct a sustainable SCC. To achieve the goal strength of 30 MPa, four SCC mixtures were created. To guarantee the qualities of new SCC, workability tests were carried out in accordance with the EFNARC criteria. Extensive tests were performed to assess the created SCC's resistance to acid assaults (sulphuric, nitric, sulphate, and chloride), water absorption, sorptivity, the Rapid Chloride Penetration Test (RCPT), & lastly the increased temperature test. Observations of the impact of SCC mixtures on weight, strength, and temperature were assessed. The research also contrasts SCC mixes with OPC mixes in terms of cost and sustainability index. The created SCC demonstrated outstanding physical and mechanical qualities with a significant decrease in cement content, according to the analysis of experimental data. Remarkable acid & temperature resistance is shown by SCC samples with FA and EPA. Following the sustainable study, it was shown that SCC mixes cut carbon emissions by between 15.2% and 17.2% when compared to OPC mixes[3].

B. Shih-Wei Cho[4]

Fine particles of aggregate less than the 75 m (No. 200) screen are referred to as silt fines. They are often clayey silts or silts, and they are challenging to get away from the top layer of aggregate. This study examines the effect of the substance on the characteristics of concrete in light of the large percentage of silt particles found in Taiwan's river sands. In this investigation, concrete samples with water content ratios of 0.48 & fine aggregate silt contents ranging from 0% to 9% were cast and examined. Additionally, experiments on the transport of chloride were performed to look into the characteristics of concrete. According to test findings, durability decreases when the proportion of silt amount within the fine aggregate approaches 5%. However, if the silt fine concentration is less than 5%, the compressive strength only improves by 1 MPa. However, as the silt concentration goes from 7% to 9%, the pressure drops between 3 MPa to 5 MPa. These findings might be used as a guide for making concrete and for quality assurance of fine aggregate that contains a lot of silt particles[4].

C. Ayodele F O and Ayeni I S[5]

This research study examined the effects of silt/clay contaminants found in fine aggregates upon the durability of concrete. In Ado-Ekiti, Ekiti State, Nigeria, five specimens of fine aggregates were gathered from five distinct places. By performing the sieve test in the lab, it was possible to calculate the proportion of silt/clay in every sample. The five samples of fine aggregates were used to create concrete cubes with a mix ratio of 1:2:4 and a ratio of water to cement of 0.65. At ages 7, 14, 21, and 28 days, the cubes were smashed to assess the compressive strength. These fine aggregate specimens were combined with the same cement, water, and coarse aggregates to create masonry cubes. These fine aggregate specimens were found to not all have the same amount of silt/clay. Additionally, the compressive property of concrete diminishes as silt/clay concentration rises. The slump of the concrete made using these fine aggregate specimens varies, decreasing as the proportion of silt/clay content rises. [5]

D. Sanaz Ramzi & Hamzeh Hajiloo[6]

Despite substantial advancements in the building sector, fire incidents continue to pose a serious risk. The characteristics of the components have a significant impact on how well concrete constructions withstand high temperatures. The current paper offers a critical analysis of the experimental experiments that have been done so far to determine how extreme temperatures affect the lingering mechanical properties of concrete, such as its compressive & tensile strengths and its modulus of elasticity. The effects of supplemental cementing materials, like silica fume, fly ash, & ground granulated blast furnace slag, along with various aggregate kinds, are the main topics of this study. The results of the literature indicate that heat-induced changes in concrete produce a significant degradation of its mechanical properties. Additionally, the kinds of aggregate & the quantity of additional cementing ingredients significantly affect the mechanical characteristics of concrete both at low and high temperatures. The addition of FA & GGBFS enhances concrete's resilience to high temperatures. High levels of FA and GGBFS, however, have a negative impact on the characteristics of concrete. This assessment will serve as a foundation for further research and advance understanding of how reinforced concrete buildings respond to high temperatures [6].

E. Isha Khedikar[7]

Plastic garbage, which is often utilised in everyday life for a variety of purposes, is a major source of waste in the modern era. The plastic used in pipes, pumps, and other agricultural equipment used in India adds to the nation's overall solid plastic waste. To prevent pollution of the environment, water, and land, this waste plastic may be cut down on, recycled, and repurposed. Resources for natural riverbank sand are being depleted from a variety of sources, and the Indian government imposes strict restrictions on their usage. Artificial sand is a substitute for natural sand, although it is also made from crushed rocks. Our natural resources also include these rocks. Consequently, using recyclable plastic as a substitute. Fine aggregates are one significant way that plastic may be recycled. Crushed and ground waste plastic might be utilised to partly replace fine aggregates in construction projects. The objective of the present research is to properly use waste polypropylene as a partial substitute for fine aggregate for concrete mixtures that include more than 20% of it. The current investigation examines replacing fine aggregate by 20%, 25%, and 30% with plastic trash. Our goal is to research how recycled waste plastic behaves in concrete when it is used to cast cubes, cylinders, and beams. Therefore, experimental research is used to demonstrate the qualities of concrete made from recycled plastic waste[7].

F. Martins Pilegis Diane Gardner & Robert Lark

The physical & mineralogical characteristics of manufactured sand are different from those of natural sea & river dredged sand. The effects on the characteristics of freshly-poured and cured concrete might be both favourable and unfavourable. The manufactured sand generated in an industrial-sized crushing facility was examined in a laboratory research to determine its physical as well as mineralogical characteristics. The findings are presented in this article. Artificial neural networks (ANN) were used to research and estimate the effects of such properties on the strength & workability of concrete incase synthetic sand totally replaced natural sand in the mix. Because of increased granule angularity of the synthetic sand, the findings demonstrate sand-based artificial concrete produced in research typically needs a greater water-cement percentage for workability equivalent when compared to ordinary sand concrete. If the produced sand doesn't include clay particles, water-decreasing additives may be applied to make up for this. The flexural and compressive strengths of produced sand concrete are greater than those found in organic sand concrete at the exact same w/c ratio. Considering the characteristics of fine aggregate and the composition of the mix, ANN has shown to be a useful and dependable strategy of forecasting concrete strength & workability.[8]

G. Akmal et al[9]

The requirement for both coarse and fine aggregates is increasing along with the daily growth in building activities. However, reliance on a small number of sources would soon exhaust the aggregates' natural sources. Since the regional riverside sands (Ravi & Chenab) are extremely fine and do not match ASTM criteria for fine aggregates, Lahore, Punjab, Pakistan uses expensive coarse pit sand via northern regions for concrete. It is required to use quarry dust produced when rock is broken down to create fragments in order to increase the grading of river sand that comes from nature in order to reduce the strain on one source. This research carried out extensive empirical effort to improve natural river sand gradation by adding normalised quarry dust. In order to create concrete mixes having a range of strengths of 21 MPa, 28 MPa, and 35 MPa, quarry sand was substituted for some of the natural river sand. For all mixtures, workability & hardened concrete qualities were assessed. For 28 MPa concrete, a cost analysis was done. The outcomes were contrasted with concrete built using coarse pit sand as a control. River sand that had been improved by blending 40% of river sand & 60% normalised quarry dust according to ASTM standards. Additionally, river sand that had some particles removed and been mixed with 50% normalised quarry dust was able to meet ASTM grading standards. When compared to control concrete, the flexural as well as compressive strengths of concrete prepared with higher sand gradation rose by 10–25% & 9–17%, accordingly, for 28 MPa concrete. Using increased river sand's natural gradation resulted in 8.6% more cost-effective 28 MPa concrete than using coarse pit sand, according to cost analysis[9].

H. H. E. Yücel, M. Dutkiewicz, and F. Yıldızhan[10]

Waste products are seen as a viable solution to this critical issue since the acquisition & shipping of aggregate intensify the detrimental effects for concrete on the environment. Waste ballast (WB), which is required for construction of fresh infrastructure along with improving rail track technology, is one of these waste products. This research looked at how basalt-based WB aggregate affected the durability and mechanical properties of regular concrete. WB aggregate was used in lieu of coarse aggregate at replacement rates of 50%, 75%, and 100%. The mixes were put through tests for slump, capillary water, compressive strength, flexural strength, absorption, fast chloride permeability, and water penetration. The use of WB increased the combinations' compressive strength & flexural strength by around 15% and 7%, respectively, according to the study's findings. Additionally, all of the concrete mixes containing WB had lower capillary water absorption, fast chloride permeability, & penetration of water values than the control mixture. The correlation relationships among the mechanical & durability parameters also showed a substantial association between them. All of the study's findings showed that using WB in place of coarse aggregate enhanced both the durability and mechanical properties of concrete. By reducing the detrimental environmental consequences of concrete manufacturing, WB may also offer a more sustainable method of material manufacture[10].

I. P. F. G. Banfill [11]

Mersey silt has been looked at as a potential fine aggregate in concrete. It is possible to create sound concrete with a compressive strength of up to 45 N mm2. However, there is minimal overall cost savings since the cement content needed for normal mixtures is larger than with ordinary sands. It is recommended that the criterion for material finer above 75 m be reduced at 5% of the overall aggregate weight after a rigorous analysis of current British Standard limitations for silt content in aggregates with light of the information that is available[11].

J. C. P. Gour, P. Dhurvey, and N. Shaik [12]

In a world that is increasingly industrialising, In order to protect natural resources and improve individual well-being, recycled building materials are crucial. Using demolition debris in concrete sector has received widespread recognition from governments throughout the world as a way to cut down on manufacturing expenses and reduce the amount of virgin aggregate. However, as they have worse mechanical characteristics than conventional aggregates, precautions should be taken. Pozzolanic materials, such as bone chine, may be used to provide more CSH gel, that boosts mechanical toughness, to solve such issue. Therefore, the goal of this study is to create eco-friendly concrete that can be utilised for medium-grade durability by utilising bone china fine aggregate (BCA) for the fine aggregate and reused construction waste (RCA) as the coarse aggregate. The qualities of the concrete, both while it is new and after it has hardened, are compared using workability, density, compressive, split tensile, & flexural strength. The present study makes use of practical & statistical research to assess the effects of RCA & BCA on actual performance. RSM (response surface methodology) was used to model every measurable response, including workability, density, compressive, flexural, and split strength. A mix experiment was conducted using Central Composite Design technique in RSM. The analysis on the variance (ANOVA) was used to create mathematical models based on the outcomes of the experiment. The results of the examination of variance showed that each model that was built was statistically significant. To look into the interactions between the various factors and to find the best mixing ratio, known regression models were used to construct three-dimensional response surface plots. The findings show that the best replacement rates for coarse and fine aggregates in concrete for RCA and BCA are up to 40% and 60%, respectively. This not merely benefits to save costs but also gives sustainability. Finally, it was determined that the created models might be used to ensure a speedy mix design method by acquiring the most tested aspects of concrete. Thin section methods were implemented to take note of robust interaction between the aggregate and matrix for the microstructure analysis[12].

K. B. R. K. Chunchu and P. Jagadeesh [13]

Self-compacting concrete, also known as SCC, may use additional cementitious ingredients in addition to small amounts of cement. SCC is a practical method that uses less energy and produces greater strength compared to traditional concrete. This study focuses on the qualities of Self-compacting Concrete (SCC), which replaces cementitious material by weight with fly ash in the best possible proportions. In all combinations, self-compacting concrete is designed with a water-binder ratio that is 0.36 and a binder amount of 497 kg/m3 with fly ash serving as a partial substitute for cement (30% by weight). Plastic electronic trash is used as an alternative form of fine aggregate up to 40% for determining the compressive & split tensile strengths between ages 7 and 28 days. Workability of self-compacting concrete mixes, which is a new property, is assessed using slump flow diameter, V-funnel flow duration, and L-box height ratio. The strength measurements show a drop while still meeting the design mix criterion for sand replacement up to 30%. Hence For high workability and robustness, SCC may readily replace plastic electronic waste up to 30% of the time. High Effect Concrete made using polystyrene aggregate is a viable cheap alternative to sand for waste disposal*[13]*.

L. J. Ahmad, Z. Zhou, R. Martínez-García, N. I. Vatin, J. de-Prado-Gil, and M. A. El-Shorbagy [14]

Waste foundry sand (WFS) is an outcome of the foundry sector. While ensuring enduring construction, the usage of WFS in construction supplies will protect the environment and its resources. The utilisation of waste from industry in concrete compensates for a lack of environmental resources, resolves the problem of trash disposal, and offers another form of environmental protection. In the past few decades, a number of scholars have looked at whether WFS may be used to produce concrete rather than natural river sand within an effort to solve the problem of WFS within the foundry area and achieve its recycling. However, it is noted that there is a dearth of understanding about the development of WFS in the manufacturing of concrete, necessitating a compressive study. The chemical & physical makeup of WFS, its fresh qualities, and the durability and mechanical properties of concrete with WFS used in part are all examined in the present research. The results of several research indicate that replacing WFS up to 30% boosted the concrete's endurance & rigidity to some amount, but that as the level of replacement of WFS grew, the workability of new concrete decreased. Future study should combine WFS with pozzolanic substrate or fibre reinforcement, according to this review [14].

IV. METHODOLOGY

Figure 1 shows the Methodology followed:

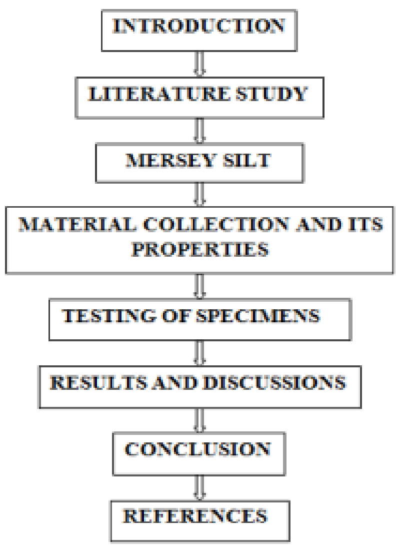

Figure 1: Methodology

A. Dredging

Dredging is a wide word that is defined under numerous rules that encompasses taking away of sand, ballast, clay, gravel, and other substances from the beds or banks of rivers. It also includes the extraction of sediment from culverts, with an exception that permits the removal of sand and silt alone that have built up on the river banks. Purpose of dredging is to eliminate sand and debris from lakes, rivers, harbors, and other bodies of water. Across the globe, sedimentation, which is the process of sand & slush naturally settling, gradually saturates river passages & harbors, necessitating regular dredging efforts.

One of the primary reasons for undertaking dredging projects is to reduce the exposure of fish, animals, and humans to pollutants and prevent the spread of pollution to other parts of the water body. This need for dredging arises from the fact that sediments often become contaminated with various pollutants all around urban & regions with industries. Pollutants can enter water via point sources like sewage flows, municipal or industrial emissions, other sources, and accidental spills, as well as non-point sources like Runoff from surfaces and soil encroachment. In such cases, the preservation and restoration of aquatic natural resources become crucial, and the Significant role is played by NOAA Response and Recovery Office in addressing environmental harm.

The disposal and management of dredged materials are typically handled by industries, local governments, and private sector entities like port management. The U.S. Army Corps of Engineers is responsible for issuing authorizations related to dredged content, while in the US, the Environmental Protection Agency is in charge of monitoring and approving the disposal of dredged debris.

Overall, dredging serves as an essential practice to maintain waterways' navigability, safeguard ecosystems, and mitigate pollution risks. By removing sediment and pollutants, dredging plays a vital role in ensuring the health and sustainability of aquatic environments.

B. Benefits of Reusing Dredging Material

Dredging plays a crucial role in maintaining navigable waterways by removing sediments such as mud and silt from lakes, both public and private, as well as waterway reservoirs. Primary advantages of dredging is ensuring boats and vessels will traverse ports & trading paths safely without scrubbing the floor, which could lead to damage or accidents.

What many people may not be aware of is the potential for reusing the leftover dredged material, which can contribute to reducing the amount of sediment sent to Confined Disposal Facilities (CDFs). While it's crucial to note that not every one of material extracted are appropriate for reuse due to potential contamination, there are cases where dredged sediment can be repurposed, offering environmental benefits and minimizing the overall impact of dredging activities.

The reuse of dredged sediment presents an opportunity to decrease reliance on CDFs for disposal. CDFs are designated areas where dredged materials are stored or contained. However, the availability of suitable CDFs is often limited, and establishing and maintaining these facilities can be costly and environmentally disruptive. By finding alternative uses for the dredged material, the strain on existing CDFs can be reduced, and the necessity for constructing new disposal facilities can be mitigated.

It is important to conduct careful assessment and testing to determine the suitability of dredged sediment for reuse. Some sediments may contain contaminants or possess undesirable characteristics that make them unsuitable for certain applications. However, when viable, the reuse of dredged sediment offers significant environmental advantages. By reducing the amount of waste generated through dredging and minimizing the need for extracting additional natural resources, the environmental impact of dredging operations can be minimized.

Recognizing the potential for reusing dredged sediment promotes a more sustainable approach to dredging. By actively seeking opportunities to repurpose the material, we can contribute to a circular economy where resources are efficiently managed and waste is minimized. This approach aligns with environmental goals by reducing the overall impact of dredging and conserving natural resources.

In conclusion, while dredging serves the primary purpose of maintaining navigable waterways, the reuse of dredged sediment presents an opportunity to further minimize the environmental impact. By reducing the amount of sediment sent to CDFs and exploring alternative applications for dredged material, we can make significant strides towards more sustainable and environmentally friendly dredging practices.

V. MATERIAL COLLECTION & ITS PROPERTIES

A. Cement

Material in this report is held together by cement. For casting beams, cubes, and cylinders, ordinary Portland cement is utilised. OPC 43 grade is widely used type of cement known for its high strength and durability, hence makes it suitable for various construction purposes. Several elements, including clinker, gypsum, and others, are ground to create it & materials like fly ash, slag or silica fumes are added to increase the performance. The compressive strength of OPC 43 grade cement is typically around 43MPa after 28 days of curing. The cement employed for the study received an OPC 43 from the brand Khyber Cement, Purchased from the local dealer. The quantity of the cement in each bag is 50kg. Normal consistency, Bulk Density cement fineness, and specific gravity were the qualities of cement which were investigated and testing was completed. These properties of cement are given in Table.1 & is shown in Figure 2.

Table 1: Properties of OPC

S No.	Properties	Observations
1	Bulk Density	1440 kg/m3
2	Specific Gravity	3.15
3	Initial Setting Time	30 minutes (min)
4	Final Setting Time	240 minutes (max)
5	Fineness	8%
6	Normal Consistency	32%

Figure 2: Cement

B. Fine Aggregate

The naturally available sand acted as a fine aggregate. It was properly washed and classified by passing it through 4.75mm sieve, before using in concrete. The bottom size limit for sand is often thought to be 0.07mm. Pycnometer and sieve analysis were used to determine the specific gravity for fine aggregate, which is shown in Table . The sand used is fine sand conforming to Zone 3 of IS : 383- 1970 and has the fineness modulus of 2.7. Table 2 shows the properties of fine aggregates & the Figure 3 shows the Fine aggregate used.

Table 2: Properties of Fine Aggregate

S. No	Property	Result
1	Specific gravity	2.66
2	Fineness modulus	3

Figure 3: Fine Aggregate

C. Coarse Aggregate

The phrase "coarse aggregate" refers to aggregate that has particles of the same size as those retained on a 4.75mm sieve. Locally available crushed stones; angular in shape obtained from a quarry was used as coarse aggregate, complying to IS 383-1970, having an upper limit size of 20 mm and a minimum value of 12.5 mm. Figure 4 shows the coarse Aggregate used & the Table 3 gives the Specific gravity and water absorption values for coarse aggregate.

Table 3: Specific gravity & water absorption values for coarse aggregate

S.No.	Details	Results
1	Weight of aggregate + container in water (A)	2354
2	Weight of basket in water (B)	745
3	Weight of Aggregate in water (W1) = A – B	1566g
4	Weight of aggregate in air (W2)	2441g
5	Weight of oven dried aggregate (W3)	2429.5g
6	Specific Gravity [W3/(W2 –W1)]	2.77
7	Apparent Specific Gravity [W3/(W3 – W1)]	2.81
8	Water Absorption [{(W2-W1)/W3}*100]	0.47 %

Figure 4: Coarse Aggregate

D. Water

Acidic, alkaline, toxic soils, and other inorganic as well as organic contaminants should not be present in the water. According to IS 456:2000, which is utilised in the experiment, it must be devoid of iron, vegetables, and any other impurities that might negatively affect concrete or reinforcement. The water utilised has a pH of 6.6. Concrete preparation and mixing should be done using water that is safe to consume from the area. Figure 5 shows the water used.

Figure 5: Water

E. Mersey Silt

In our project, Mersey silt will partly substitute natural sand. The Mersey estuary silt's geology & sedimentology are described here. Particle dimension ranges vary by region, although fewer than 25% of the bed's particles are finer rather than 63 m. The majority of the sand portion is quartz, with trace amounts of other heavy minerals. Quartz and numerous clay minerals, including illite and chlorite, may be found within the thinner silt and mud portions. Figure 6 shows Mersey Silt.

Figure 6: Mersey silt

VI. TESTING OF SPECIMENS

A. Compression Strength Test

The capacity of concrete to withstand or sustain certain compressive stresses is known as its compressive strength. Concrete's compressive strength is influenced by a number of elements, including;

- Water - cement ratio
- Cement strength
- Quality of concrete material
- Throughout the manufacture of concrete, quality control, etc.

According to IS 516-1959, specimens with cube & cylinder shapes are utilised to evaluate the compressive strength about concrete. A cylindrical sample is 150mm in diameter & 300mm in length, whereas a cubic specimen has conventional dimensions of 150mm by 150mm by 150mm.

Procedure:

- The requisite grades and appropriate mix proportions are used to produce the new concrete.
- The inside surface of the mould is lubricated after the new concrete has been made to prevent concrete from adhering.
- Then, 4 layers of the freshly made concrete are poured into the mould. A normal tamping rod is used to tamp the cube 35 times after each layer has been filled.
- After the mould has been filled, a trowel is used to level the top surface.
- The specimens are placed in a curing tank at a normal temperature of 27 2°C once the mould has been removed after 24 hours.
- The specimen is removed from the curing tank after seven days and allowed to dry for a bit before being put on the compression testing equipment and having the necessary modifications made.
- The load is then progressively delivered to the test subject at a rate of 140 kg/cm2/min.
- The specimen's failure load is recorded.
- Compressive strength of the concrete = load / area.
- The total of 36 cubical specimens with replacement of cement by Mersey Silt 10%, 15%, 20% were prepared and tested over the course of 7 days, 14days and 28 days. Compression test on cube is shown in Figure 7

Figure 7: Compression Test

B. Split Tensile Strength Test

By exerting a compression force throughout the entire length of the concrete cylinder, the compressive strength of the material is obtained. The utilised specimen is cylindrical with diameter of 150mm and the length of 300mm.The instrument used for the experiment is the universal testing machine (UTM). The specimens after being cured for 7 days, 14 days and 28 days, the cylinders (specimen) were tested. Until the cylinder fails the diametric compressive load is supplied along its length, As shown in Figure 8 At a certain compressive force, the cylinder fails by developing cracks. This is because the concrete is weaker in tension than in compression.

The split tensile strength (fct) in $N/mm^2 = 2P/\pi DL$

Where, P is load applied in Newton.

D = diameter of cylindrical specimen in mm (150) and

L = length of cylindrical specimen in mm (300 mm)

Figure 8: Split Tensile Strength Test Setup

VII. TEST RESULTS

A. Compressive Strength

Compressive strength test was carried on the cubes according to IS 516(1959). The result of compressive test of cubes and the comparison for 7 days , 14 days and 28 days are given in the Table 4.

Table 4: The results of Compressive Test

S. No.	Percentage replacement	Compression Strength (N/mm^2)								
		7 days			14 days			28 days		
		S-1	S-2	S-3	S-1	S-2	S-3	S-1	S-2	S-3
1	0%	17.8	17.4	18	22	21.5	21.9	26.2	26.5	26.9
2	10%	17.4	17.7	17.3	21.3	21.8	21.5	26.6	27.3	27.5
3	15%	17.5	17.2	17.7	14.2	21.2	20.8	26.9	26.6	27.1
4	20%	17.9	17.5	18	21.4	21.6	21.3	27.2	27	**27.6**

The Table 4 above demonstrates that Mersey silt provides better results regarding the compression strength of concrete cubes than natural sand does for conventional concrete, as we can also see from figure 9.

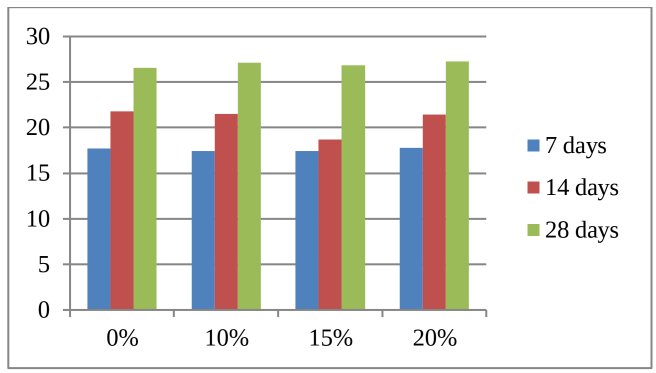

Figure 9: Compressive Strength Of The Cubes At 7 Days,14 Days And 28 Days

B. Split Tensile Strength

The cylindrical specimens of 300 mm length and 150 mm diameter were casted and tested in accordance to IS:5816(1999). The split tensile strength values are plotted below in Table 5 and graphically in figure 10.

Table 5: The Split tensile strength values

S. No.	Percentage of replacement	Split tensile strength (N/mm^2)								
		7 days			14 days			28 days		
		S-1	S-2	S-3	S-1	S-2	S-3	S-1	S-2	S-3
1	0%	1.66	1.89	1.92	2.58	2.63	2.62	3.14	3.17	3.13
2	10%	1.85	1.96	1.97	2.65	2.69	2.68	3.16	3.19	3.22
3	15%	1.96	1.94	1.98	2.67	2.65	2.69	3.19	3.22	3.20
4	20%	1.97	1.98	2.03	2.73	2.77	2.72	3.17	3.20	**3.23**

When contrasted with ordinary concrete, Mersey silt concrete exhibits significant improvements in split tensile strength.

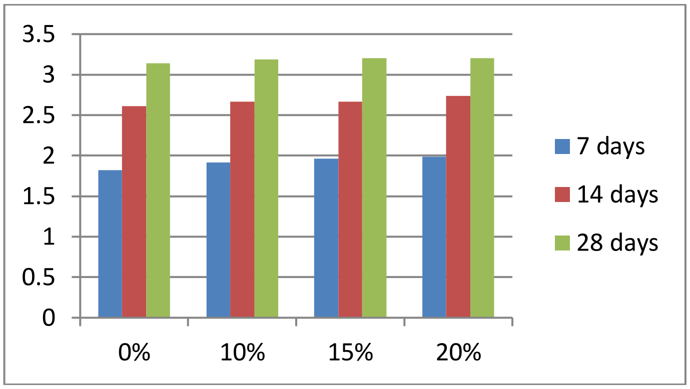

Figure 10: Split tensile strength at 7 days,14 days and 28 days

VIII. CONCLUSION

Mersey Silt could make a big difference in concrete's ability to partially substitute natural river sand. The durability point of perspective varies greatly, which is crucial for managing all processes involved in producing aggregates. It is possible to draw the following conclusions from the experimental work:

- When contrasted with Mersey silt concrete mix, ordinary concrete has a lower 28-day compression strength.
- Greater split tensile strength of as much as 20% replacement was obtained by the Mersey silt concrete.
- In order to achieve better strength than the traditional mix, Mersey silt may be used for natural sand in concrete to a maximum of 20%.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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