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The Strength Characteristics of Usual Concrete Mixed With GGGBs and Dolomite

***Mr. K. Ashif*[*1], Mr. V. Pavankumar Reddy*[*2]**

[*1]Post Graduate Student, Department of Civil Engineering, ALTS, Anantapuramu, A.P, India

[*2]Assistant professor, Department of Civil Engineering, ALTS, Anantapuramu, A.P, India.

ABSTRACT

The concrete industry is on the lookout for industrial by-products or additional cementitious materials in an effort to cut down on carbon dioxide emissions, which are bad for the environment. The mineral dolostone may be ground into a fine powder, which is known as dolomite powder, which is an additive to cement. The efficient use of dolomite powder as a cement substitute in concrete production is the focus of this research. The mechanical properties of M30 grade concrete are studied with partial replacement of cement by Dolomite powder in the percentages of 5%, 10%, and 15%. Finding the sweet spot for dolomite content in concrete that yields the most strength is the first step. Keeping that sweet spot constant, you may then substitute some of the cement with 5%, 10%, or 15% Ground Granulated Blast Furnace Slag (GGBS). The combination of 10% dolomite and 10% GGBS showed the highest strength in the tests. A partial cement substitution with dolomite powder and granulated blast furnace slag is the subject of this paper's investigation into the behavior of M30 concrete.

Keywords: Dolomite, GGBS, Compressive strength, Flexural strength, Split tensile strength, M30 grade concrete.

INTRODUCTION

General:

One of the most extensively used construction materials, concrete is poured at a rate of two billion tons annually around the world. It offers a lot of bang for the buck, which makes it suitable for many settings. Concrete may usually be made using resources that are easily available in the region. Because of its malleability, it may be cast into a wide variety of forms. Additionally, it requires less maintenance and has a long lifespan. The Portland cement industry is responsible for around 7% of global carbon dioxide emissions. By partly replacing one or more additives for Portland cement, blended cements provide long-lasting cementitious systems for the construction industry while lowering energy consumption and carbon dioxide emissions in cement manufacture.

HISTORY OF CONCRETE:

Evidence suggests that the Romans began employing a mixture of lime, crushed stones, and sand as early as the third century B.C. to construct temples and other structures. It all began with leaving the concrete's surface rough and then adding a stucco-like finish. Later on, as a decorative finish, the practice of inserting small stones into the top layer of concrete emerged. Lastly, they created an integrated surface by inserting broken terra cotta roof tiles into the concrete's façade. This led to the manufacturing of bricks made of clay. As the Roman Empire collapsed, concrete technology went into oblivion until the Renaissance. The works of the Roman civil engineer and architect Marcus Vitruvius Pollio, collected in the 'De architecture' series, rose to prominence as a 15th-century standard in the discipline. However, the discovery of the fundamental material in contemporary concrete, "Portland cement," did not occur until the late 18th century, when concrete research was resurrected in 1824.

LIMITATIONS OF CONCRETE:

The United States Department of Army (1999) states that concrete has its limits in some contexts, such as those where it cracks and causes structural components to bend excessively, reducing the structure's serviceability, usable life, and aesthetic appeal.

Low tensile strength:
Construction cracking and failure may be prevented by reinforcing concrete members that are exposed to tensile stress with steel bars.

Deterioration due to drying and motions of moisture:
The loss of water vapor in dry, hardened concrete causes it to shrink. Cracks could develop as a result of this kind of moisture migration. Control joints should be installed to prevent cracks. Surface concrete that has just been placed must be kept constantly wet as it cures in order to avoid drying shrinkage.

FRESH CONCRETE:

Although it is easy to shape new concrete while it is still in its relatively fluid form, the shape of the concrete would gradually alter if the mold were removed right away. The newly mixed concrete would be homogenous if it included and retained all of the sand and gravel grains. The amount of plasticity and notable changes in the mix properties of the freshly mixed concrete often impact the quality and characteristics of the finished product.

Workability:
How easy or difficult it is to pour and compact the concrete in the molds is called its workability. Slump testing allows one to gauge the mixture's consistency and adjust it as needed to achieve the workability needed for a given setting and application technique. A highly stiff mix is necessary to get a low slump, which is advantageous for several applications.

Non segregation:
For a certain volume of paste, the workability may be adjusted by adjusting the quantities and proportions of fine and coarse aggregate. Careful mixing and compacting of freshly mixed concrete is required to keep the mixture homogenous and minimize segregation. In addition, it needs special handling to avoid bleeding the concrete. For instance, in order to avoid segregation, freshly mixed concrete shouldn't be allowed to fall from heights more than three to five feet, and it also can't be carried over great distances without the right agitation.

Uniformity:
How well the materials are measured and combined in accordance with the instructions determines the level of uniformity. To make sure the overall mass of the structure has consistent structural qualities, every batch of concrete must be mixed and proportioned precisely the same. The consistency of the new concrete is also critical as it impacts the cost-effectiveness and durability factors.

HARDENED CONCRETE:

At the very conclusion of the concrete design process, you will have hardened concrete. The strength, stress-strain characteristic, permeability, creep deformation, shrinkage, and durability of hardened concrete are its most essential features. Given its relationship to the structure of the hardened cement paste and its ability to provide an overall image of the concrete's quality, the strength of the concrete is of higher relevance. At a certain age and curing state, the hardened concrete's strength is primarily determined by the water-cement ratio and the degree of compaction.

Strength of Concrete:
The capacity of concrete to withstand loads in compression, flexure, and shear is what makes concrete strong, according to a book by T.W. Love and the United States Department of Army (1999). The ratio of water to cement is the primary factor in determining the concrete's strength. You may thin the paste and coat more particles by adding more water to the mixing process. However, the strength of the concrete would be diminished as a result of the paste's dilution if the water content was excessive.

Compressive Strength:
Concrete comes in a variety of strengths, but the most crucial one is figuring out its compressive strength. since the concrete's main purpose is to endure compressive forces. The specimen size and shape, the pore creation process, the water content, the properties of the components used, the loading orientation, and the curing procedure all affect the concrete's strength.

Creep of Concrete:
The phenomenon of creep occurs due to the gradual increase in strain within the concrete over time when subjected to continuous stress. Creep and shrinkage occurred simultaneously, and it is assumed to be additive for the sake of simplicity. The relaxation of creep occurs when a loaded concrete specimen is subjected to a constant strain, resulting in a progressive decrease in stress over time, with the rate of creep diminishing as time progresses. Numerous factors influence creep, including the types of aggregate, admixtures, cement, mix proportions, time and consolidation, age of the concrete, level of sustained stress, temperature, and the size of the specimen.

Durability of Concrete:
When we talk about a material's "durability," we're referring to its ability to withstand things like wind, snow, frost, and ice; soil, which may cause chemical reactions; salts, which can cause abrasion; and other similar natural and artificial influences. Designing concrete structures with a lifetime of five years or longer requires careful consideration of the material's durability. Increasing the water/cement ratio would shorten the material's lifespan. One property of the concrete that might impact its longevity is its propensity to let water, oxygen, carbon dioxide, chloride, and sulphate in.

SUPPLEMENTARY CEMENTITIOUS MATERIALS:

Substituting solid, finely powdered substances called supplemental cementitious materials (SCMs) for part of the cement in concrete production is standard procedure. When these ingredients react with the hydrated cement, it changes the paste's microstructure. As an added bonus to their eco-friendly effects, SCMs may improve concrete's workability, mechanical properties, and durability. It is possible that SCMs possess either the pozzolanic reactivity or the latent hydraulic reactivity. A process called pozzolaning occurs when finely powdered silica combines chemically with calcium hydroxide to create cementitious chemicals. Other cementitious substances (SCMs) have recently been used to solve these issues. These SCMs may be natural Pozzolans or man-made Pozzolans created from industrial waste materials like as fly ash, slag, or silica fume. Adding SCMs to concrete mixes increases the material's strength and durability with age, and using SCMs to partially replace Pozzalonic Cement (PC) in mixes lowers CO_2 emissions. Pozzolans are a relatively new and popular way to increase the longevity of concrete structures. The major way pozzolans affect concrete is by adjusting the pore structure, which makes the material stronger and less porous. The five most common pozzolans used in industrial projects are metakaolin (MK), silica fume (SF), ground glass beads (GGBS), fly ash (FA), and dolomite powder. Numerous studies have shown that the compressive strength of concrete may be greatly improved by using certain pozzolans at the appropriate replacement level.

Uses of supplementary cementitious materials:

Whether the concrete is still wet or has hardened, it may be enhanced in performance by adding more cementitious elements. Workability, durability, and strength are the main benefits of using them. With these ingredients, the concrete manufacturer may tailor the finished product to any need. High-Portland cement concrete mixes are more prone to cracking and produce more heat. Using additional cementitious materials allows for some control over these effects. Fly ash, slag, and silica fume are supplementary cementitious materials that the concrete industry can use instead of throwing away hundreds of millions of tons of waste. Another benefit is that they lower the consumption of Portland cement, which is associated with high emissions and energy consumption during its manufacture. By using less Portland cement, we can conserve or reduce these emissions.

Effects of pozzolonas on concrete properties:

Workability: Because they contribute more particles to the mixture, supplemental cementitious ingredients usually make freshly mixed concrete more consistent and easier to work with. Mixtures of low-water-content concrete with high-range water-reducing additives, such as silica fume, are often more cohesive and sticky than plain concrete. In order to achieve the necessary slump in concrete, fly ash and slag often lower the water consumption. Increasing the quantity of some extra cementitious elements in concrete might delay its setting time. In warmer climates, this may be useful. By decreasing the amount of additional cementitious material in the concrete during winter, the retardation is counteracted. More fines mean less bleeding and slower bleeding rate for these concretes. This becomes very important when silica fume is used. Plastic shrinkage cracking may occur when bleeding is reduced and the setting time is delayed; extra care should be used while inserting and finishing the material.

Strength: It is possible to tailor concrete mixes to specific applications by adjusting the proportions that provide the desired strength and rate of strength growth. While the rate of strength development may be slower when using cementitious ingredients other than silica fume, the strength gain is more sustained and, in many cases, results in greater ultimate strengths than when using solely Portland cement. Compressive strengths of concrete above 700 MPa are often achieved by using silica fume. Curing the test specimens and the structure of concrete with extra cementitious material often requires more time to achieve the desired qualities.

Durability: To lessen the possibility of thermal cracking in large structural components, supplementary cementitious materials may lower the heat generated during cement hydration. By altering the microstructure of the material, these additives make concrete less permeable to water and salts in the water. Concrete that is impermeable to water will last longer and be less susceptible to chemical attacks and reinforcing steel corrosion, among other types of concrete degradation. Chemical processes, such the alkali aggregate reaction and sulfate attack, cause concrete to expand internally. However, most extra cementitious ingredients may mitigate this effect. For optimal performance in environments During a series of freeze-thaw cycles, it is recommended to use an air void system.

ADMIXTURES:

Based on their purpose, admixtures may be categorized into many sorts, such as plasticizers, superplasticizers, retarders, accelerators, agents that entrain air, and corrosion inhibitors. To increase strength and decrease permeability, plasticizers and superplasticizers make concrete easier to work with without raising the water-cement ratio. Accelerators are best used in cold weather for rapid setting, whereas retarders are better for hot weather for slowing the setting time and preventing premature hardening. The use of air-entraining chemicals improves the concrete's resilience to freeze-thaw cycles by creating tiny air bubbles that water may expand when it freezes. Concrete constructions exposed to saltwater or deicing salts may last longer with the use of corrosion inhibitors, which prevent the reinforcing steel from rusting due to chloride. Admixtures can help mass concrete pours avoid thermal cracking by lowering the hydration heat. In order to lower material costs, increase the lifetime of concrete buildings, and satisfy specified performance criteria, admixtures must be carefully selected and dosed.

Mineral Admixtures:

It is common practice to increase the quantity of mineral admixtures used to concrete in order to enhance its fresh and hardened qualities. The fly ash, silica fume, slag, and natural pozzolans are among these components. When combined with the calcium hydroxide that is generated when cement hydrates, they create more calcium silicate hydrate (C-S-H) gel, which in turn makes concrete stronger and lasts longer. For big concrete pours, fly ash is the way to go since it enhances workability and lowers heat of hydration. By decreasing pore size, silica fume greatly boosts concrete's density and compressive strength while simultaneously improving its resistance to chemical attack and permeability. By decreasing the heat of hydration, ground granulated blast furnace slag (GGBS) increases the resilience of concrete to sulfates and chlorides and makes it less susceptible to thermal cracking.

Chemical Admixtures:

Small quantities of chemical admixtures are often added to concrete in order to manage the setting time, plasticize newly mixed concrete, reduce the water or cement content, or entrained air. Based on their function in PCC, seven distinct chemical admixtures are defined in the American Society for Testing Materials (ASTMC 494) and AASHTOM 194. Standards such as ASTM C 260 and AASHTOM 154 outline the requirements for air entraining admixtures. The specs encompass both the general and physical requirements for every admixture type.

- Air-entrainment agents.
- Water-Reducers.
- Set-Retarders.
- Accelerators.
- Super plasticizers.

Air-Entraining Admixtures : By adding tiny air bubbles to concrete, these make the material more resistant to freeze-thaw cycles, which shortens its lifespan. Two primary categories of air-entraining admixtures are defined by ACI 212.3 and are required to adhere to ASTM C 260 recommendations. To create water-soluble air-entraining admixtures, a wide range of organic chemicals are used. These include, but are not limited to, salts of wood resin, synthetic detergents, and salts of petroleum acids. You may make it seem like there are air gaps by adding solid materials with large pores and a high internal porosity, such diatomaceous earth spheres, broken brick, expanded clay or shale, or hollow plastic spheres.

Accelerating Admixtures: Accelerating An additive that speeds up the hydration process and early strength development of concrete. The most popular and inexpensive soluble inorganic salt is calcium chloride, although other salts such as bromides, fluorides, carbonates, and others will also function. To counteract the slowing effects of water-reducing additives and provide noncorrosive acceleration, soluble organic substances like tri-ethanolamine and calcium formate are used. The use of ferric salts, sodium fluoride, and tricalcium aluminate in quick-setting admixtures helps shot Crete flash set and prevents leaks caused by hydrostatic pressure. Accelerating strength increase or hydration may be achieved with the use of several solid admixtures, including calcium-aluminate cements, finely split silica gels, soluble quaternary ammonium silicates, and even silica fume.

Water-Reducing and Set-Controlling Admixtures: The majority of the goods on the market are admixtures, which have far-reaching impacts on both wet and dry concrete. Strength and finishing qualities may be enhanced by water reduction. These additives have other uses, such as reducing shrinkage, delaying setting, and lowering hydration temperatures. In all likelihood, a water-reducing admixture and a set-controlling admixture are both manufactured by the same business.

Admixtures for Flowing Concrete: These developed as a result of the increasing use of admixtures in concrete for managing the set time and lowering water content. The use of super plasticizers, which are water reducers with a wide variety of applications, results in high-slump concrete that is cohesive and free of segregation, excessive bleeding, and anomalous retardation. Their special properties make them ideal for vibration-free, strongly strengthened applications. Although sulfonated naphthalene and melamine condensates are common super plasticizers, a new class of polycarboxylates has emerged in the recent decade and is increasing the usage of self-consolidating concrete. Both flowing and self-consolidating concrete often make use of admixtures that vary viscosity.

Functions of Admixtures:

- Raise workability without adding water, or lower water content without sacrificing workability
- Delay or speed up the first setting time
- Minimize or eliminate shrinkage or generate modest expansion
- Reduce or prevent shrinkage or create slight expansion
- Modify the rate or capacity for bleeding
- Reduce segregation
- Improve pumping ability
- Reduce rate of slump loss
- Retard or reduce heat evolution during early hardening
- Accelerate the rate of strength development at early ages
- Increase strength(compressive, tensile, or flexural)
- Increase durability or resistance to severe conditions of exposure
- Decrease permeability of concrete.

MATERIALS AND METHODOLOGY

GENERAL:

Cement, pozzolonas (GGBS and Dolomite powder), fine aggregate (river sand), coarse aggregate (crushed granite metal), and water are all components of concrete, and this chapter covers their acquisition and testing for physical properties such as specific gravity, surface texture, fineness modulus, color, chemical composition, bulk density in both loose and compacted states, consistency, and initial setting time of cement.

MATERIALS USED FOR CONCRETE:

Cement:

Cement utilized was Ordinary Portland Cement 53 (OPC 53). All cement parameters were established using IS 12269 - 1987. Cement has a specific gravity of 3.15, an initial setting time of 55 minutes, and a final setting time of 258 minutes. The standard consistency of the cement was 32%.

Physical Properties of Ultratech Brand 53 grade (OPC) cement

S.no	Physical tests	Obtained results	Standards as per IS codes
1	Fineness	5%	Not greater than10% as per IS 4031 part 1
2	Standard Consistency	32%	IS 4031 part 4
3	Initial Setting time	55 min	Not less than 30 minutes as per IS 4031 part 5
4	Final setting time	230 min	Not more than 600 minutes as per IS 4031 part 5
5	Soundness	3mm	Not>10mm as per IS 4031 part 3
6	Specific gravity	3.12	IS 2720 part 3 (3.15)
7	Compressive strength	53 MPa	IS 4031 (Part 6)

Coarse Aggregate:

The coarse aggregate was composed of 60% passing through a 20mm filter and 40% going through a 12.5mm sieve and 40% remaining on a 10mm screen. Grain size was 2.88 and modulus of fineness 3.11.

Physical Properties of Coarse aggregate

S.No	Property	Results
1	Fineness modulus	4.6
2	Bulk density (kg/m^3)	1560
3	Specific gravity	2.85

Fine Aggregate:

It makes use of river sand that has been passed through an IS sieve with a pore size of 4.75 mm. The fine aggregate had a specific gravity of 2.66 and a fineness modulus of 3.22.

Physical Properties of Fine Aggregates

S.no	Properties	Results
1	Bulk density, kg/m^3	1603
2	Specific gravity	2.65
3	Fineness modulus	3.21

Water:

For the mixing and curing of the concrete, we used portable fresh water, which is devoid of acid concentration and organic particles.

Dolomite:

One possible application for dolomite powder, a mineral found in sedimentary rocks, is to substitute a small amount of cement in concrete mixes. There are a few similarities between cement and dolomite powder. Incorporating dolomite powder into concrete has the potential to boost its strength while also lowering its cost. The carbonate mineral dolomite is made up of the chemical formula CaMg (CO3)2. Particularly for its exceptional wettability and dispersibility, the rock-forming mineral dolomite stands out. Dolomite is resistant to weathering. Because of its superior density and surface hardness, dolomite is the material of choice for building projects. Because of its superior hardness and strength, dolomite is the material of choice for asphalt and concrete. The goal of lowering building costs may be achieved via the efficient use of dolomite powder.

Chemical composition of Dolomite powder

Chemical composition	Percent by weight
Silicon dioxide	0.60
Aluminium oxide	0.19
Ferric oxide	0.44
Calcium oxide	55.19
Magnesium oxide	37.71

Sodium oxide	0.39
Potassium oxide	0.01

Ground granulated blast furnace slag (GGBS):

The reduction of iron ore to pig iron in a blast furnace produces GGBS, a non-metallic byproduct. Granules made of the quickly cooled liquid slag are pulverized to a fineness comparable to that of Portland cement. The standard specification states that ground granulated blast furnace slag used as a cementitious material must adhere to a range of 80, 100, and 120 grades, with the higher grades exhibiting a greater contribution to the strength potential. When used with Portland cement, GGBS's cementitious characteristics are amplified. The cementitious materials employ slag at a rate of 20% to 70% by mass.

Chemical composition of GGBS

Chemical constituent	**Percent by weight**
CaO	40%
SiO_2	35%
AI_2O_3	10%
MgO	8%

RESULTS AND DISCUSSION

GENERAL:

This chapter examines the compressive, split tensile, and flexural strengths of concrete mixes that use dolomite instead of cement, as well as mixtures that include both dolomite and GGBS. Multiple strengths, including compressive, split tensile, and flexural, were included in the analysis. To make analysis easier, the findings of this study are provided in both tabular and graphical formats; interpretation of the data is performed at each stage of the experimental process.

Dolomite as a Cement Alternative in Concrete:

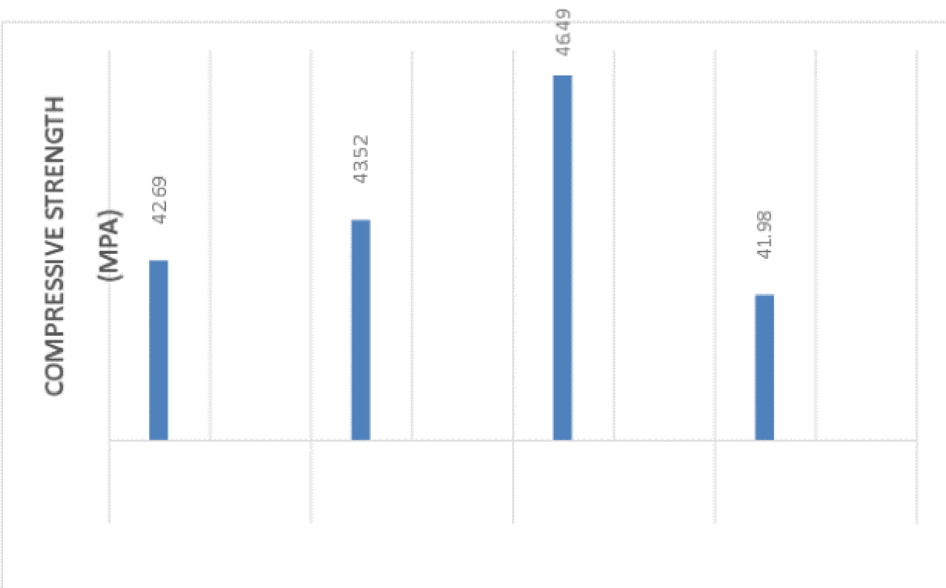
In the first stage, M30 grade concrete is made using dolomite in lieu of some of the cement. See Table.32 for the concrete mixtures' proportions. Refer to Table.45 for the reference materials' compressive, split tensile, and flexural strengths. All of the mixes that use dolomite as a partial cement substitute, including Mix A.

Mix Proportions of Dolomite as partial replacement of cement in concrete

Mix Designation	**Cement (Kg/m^3)**	**Dolomite (Kg/m^3)**	**GGBS (Kg/m^3)**	**Fine Aggregate (Kg/m^3)**	**Coarse Aggregate (Kg/m^3)**	**Water (Kg/m^3)**
Mix A(Control Mix)	425.5	___	___	662	1210	191.5
Mix B(5% Dolomite)	403.75	21.25	___	662	1210	191.5
Mix C(10% Dolomite)	382.5	42.5	___	662	1210	191.5
Mix D(15% Dolomite)	361.25	63.75	___	662	1210	191.5

When used as a cement substitute in concrete, dolomite yields strong results after 90 days

Mix No.	**Replacement Details**	**Compressive Strength (MPa)**	**Split Tensile Strength (MPa)**	**Flexural Strength (MPa)**
Mix A	0% Dolomite	42.69	4.84	5.63
Mix B	5% Dolomite	43.52	5.88	5.83
Mix C	10% Dolomite	46.49	6.46	6.19
Mix D	15% Dolomite	41.98	5.81	5.48

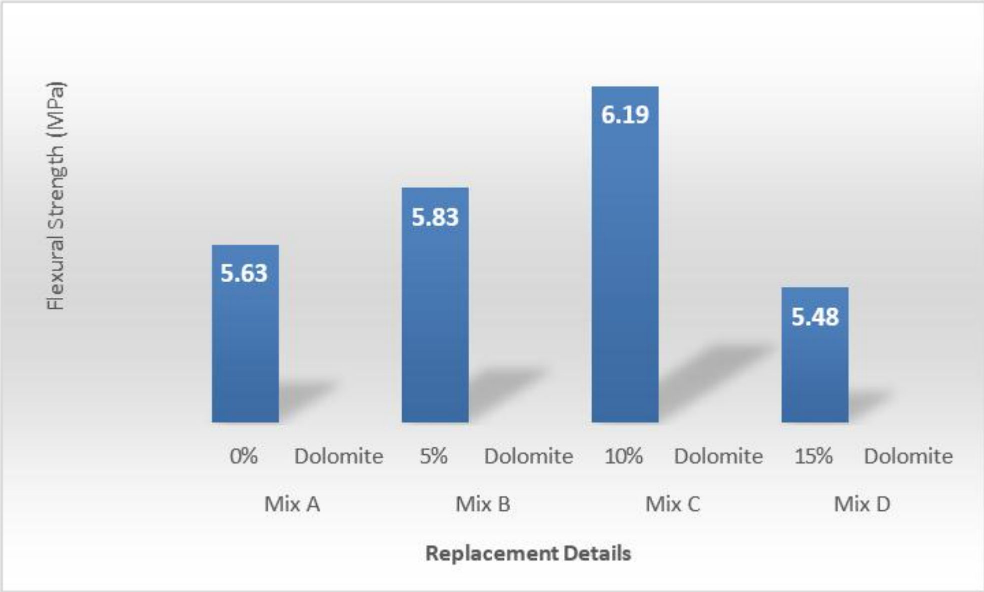


Compressive strength at 90 days for Mixes A to D

The compressive strength of M30 grade varies with varying percentages of dolomite replaced by cement, as seen in the figure. After a slow but steady rise up to a 10% dolomite cement substitution, the compressive strength started to drop. Maximum compressive strength was 46.49 N/mm2 when 10% dolomite was used in the concrete; this was 8.90% more than 42.69 N/mm2 in reference Mix A.

Split Tensile Strength at 90 days for Mixes A to D

Split tensile strength increased progressively up to a 10% cement substitution with dolomite, after which it declined. Using 10% dolomite in the concrete resulted in a maximum split tensile strength of 5.81 N/mm2. In comparison to reference Mix A, which had a split tensile strength of 2.78 N/mm2, Mix C achieved a maximum of 4.84 N/mm2 when 10% dolomite was used in the concrete. Figure shows the variation in split tensile strength of M30 grade when various percentages of cement are replaced with dolomite.



Flexural tensile Strength at 90 days for Mixes A to D.

The flexural strength of M30 grade varies with varying amounts of cement employing dolomite, as shown in Figure 10. Up to a 10% dolomite substitution of cement, the strength improved progressively; beyond that, it dropped. With 10% dolomite, the highest flexural strength reached 6.19 N/mm2, 9.9 percentage points more than that of reference Mix A, which measured 5.63 N/mm2.

CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT BY USING COMBINATION OF DOLOMITE AND GGBS:

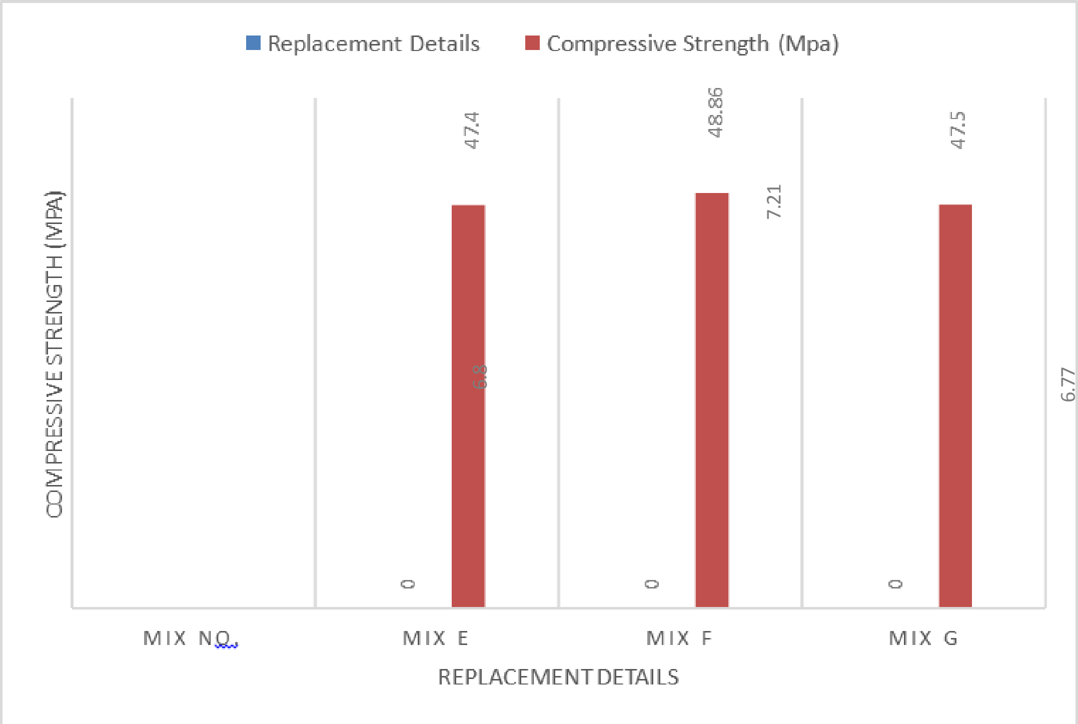
Phase 2 involves mixing dolomite and GGBS to produce M30 grade concrete. Maintaining a consistent amount of dolomite and substituting 5%, 10%, or 15% GGBS for cement is considered optimal. There are specific quantities for each combination in phase 2 that may be found in Table 34. The reference material's compressive, split-tensile, and flexural strengths Table 35 displays Mix A and all other mixes that were made utilizing a mixture of Dolomite and GGBS as a partial cement substitute.

Mix proportions for combination of Dolomite and GGBS as replacement of cement in concrete:

Mix Designation	Replacement Details	Cement kg/m^3	Dolomite (D) kg/m^3	GGBS (kg/m^3)	Coarse aggregate (Kg/m^3)	Fine aggregate (kg/m^3)	Water kg/m^3
Mix E	10% D + 5%GGBS	361.25	42.5	21.25	662	1210	191.5
Mix F	10% D + 10% GGBS	340	42.5	42.5	662	1210	191.5
Mix G	10% D + 15% GGBS	318.75	42.5	63.75	662	1210	191.5

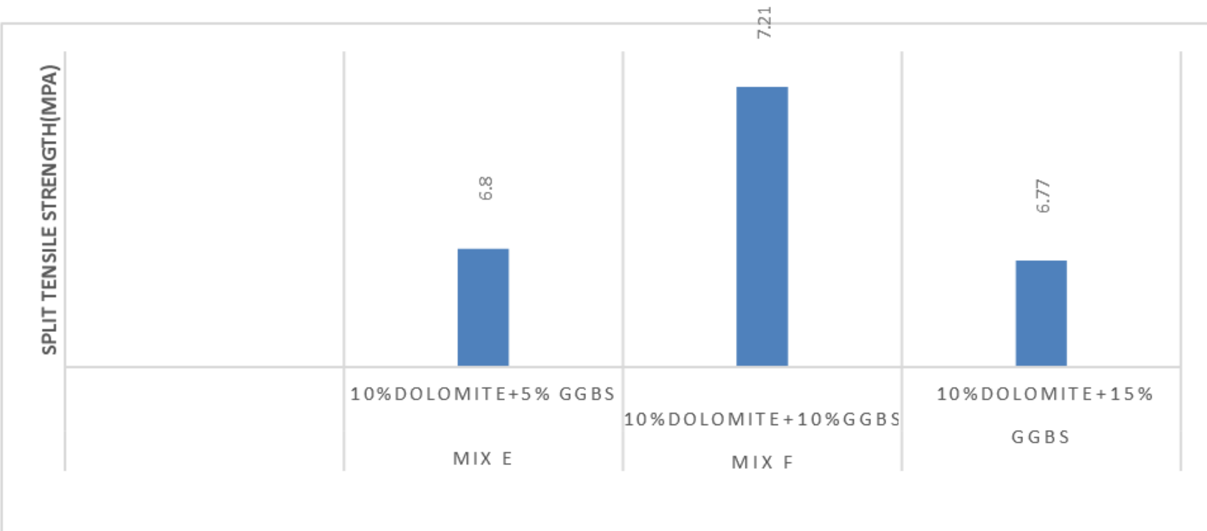
Strength results at 90 days for combination of Dolomite and GGBS as replacement of cement

Mix Designation	Replacement Details	Compressive Strength (MPa)	Split Tensile Strength (MPa)	Flexural Strength (MPa)
Mix E	10%D+5%GGBS	47.40	6.80	6.37
Mix F	10%D+10%GGBS	48.86	7.21	6.79
Mix G	10%D+15%GGBS	47.5	6.77	6.28



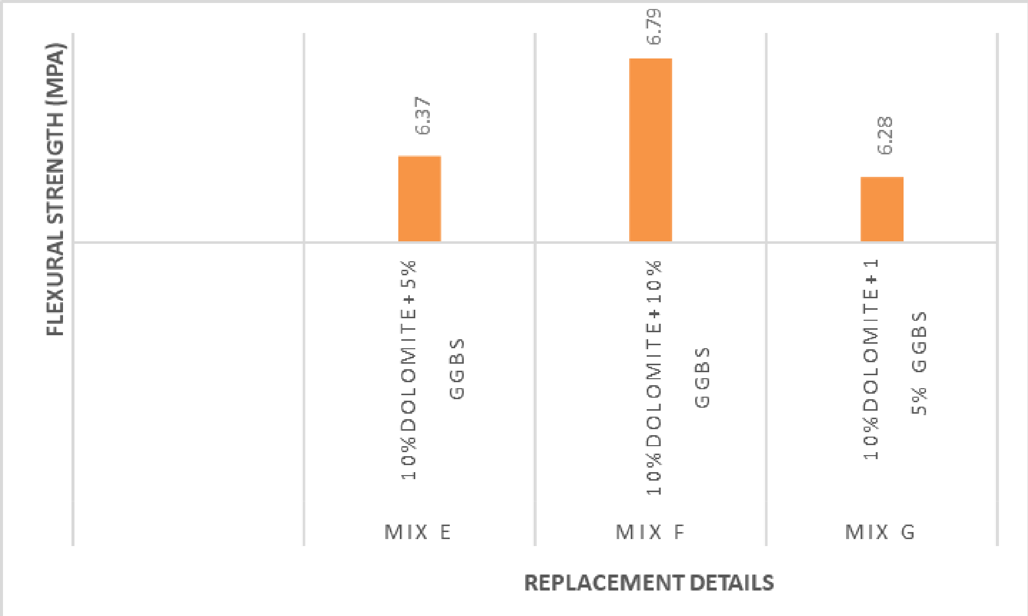
Cube Compressive Strength at 90 days for mixes E to G

Compressive strength increased up to Mix F, beyond which it declined. The highest compressive strength of 48.86 N/mm2 was achieved using a mixture of 10% Dolomite and 10% GGBS. Combine 10% dolomite with 10% GGBS to get Mix F, which has the highest compressive strength. When compared to reference mix A, which contains 42.69 N/mm2, the use of GGBS in conjunction with dolomite increases the strength of the concrete to 48.34 N/mm2. This is an increase of 13.23%. Figure.11 shows the variation in the compressive strength of M30 grade with varying percentages of cement substitution using a mix of dolomite and GGBS.



Split Tensile Strength at 90 days for Mixes E to G

The results showed that the split tensile strength increased up to Mix F (10% Dolomite+10% GGBS) when cement was replaced, and subsequently it declined. Ten percent dolomite and ten percent GGBS produced the highest split tensile strength (7.21 N/mm2). Mix F, which consisted of 10% dolomite and 10% GGBS, produced the highest split tensile strength (7.21 N/mm2) in the concrete, an increase of 48.05% above the reference mix (4.84 N/mm2). As demonstrated in Figure.12, the compressive strength of M30 grade varies when the cement is replaced with varying percentages of dolomite and GGBS.



Flexural Strength at 90 days for Mixes E to G.

Mix F, which served as a cement replacement, had its flexural strength enhanced by adding 10% dolomite and 10% GGBS; nevertheless, this strength subsequently decreased. The flexural strength was 6.79 N/mm2 when 10% dolomite and 10% GGBS were used. An increase of 20.60% above reference Mix A's value of 5.63 N/mm2 was achieved by using Mix F, a blend of 10% dolomite and 10% GGBS, to make concrete with a maximum flexural strength of 6.79 N/mm2. Figure.13 shows the changes in M30 grade compressive strength as a result of replacing 10% of the cement with a dolomite and GGBS mixture.

RESULTS AND DISCUSSION

Conclusions

What follows are the outcomes of the physical tests and experimental investigations conducted on the blended concrete mix consisting of cement, Dolomite powder, and GGBS, as well as on the standard conventional concrete (control mix).

1) In lieu of up to 10% of the cement in concrete mixes, pozzolonic ingredients such as dolomite powder and GGBS may be utilized. Strength at 90 days may be improved by using dolomite powder in conjunction with GGBS.
2) It is possible to use dolomite and GGBS as a filler ingredient to decrease the porosity of concrete by creating a volume matrix.
3) Dolomite and GGBS admixtured concrete has workability properties comparable to regular conventional concrete.
4) Dolomite powder and GGBS will be used in a concrete mix to study its plastic and shrinkage properties.
5) Fifthly, the mix may be more cost-effective than regular concrete because to the addition of dolomite and GGBS, which improve the mix's strength.
6) Experiments have shown that adding dolomite powder and GGBS to concrete mixes greatly improves the material's strength characteristics.
7) In the future, researchers will look at using dolomite powder and GGBS as pozzolonas to make self-compacting concrete mixtures, partially replacing cement.
8) The purpose of this study is to examine the effects of dolomite powder and GGBS on the bond strength properties of both regular conventional concrete and self-compacting concrete mixes.

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