EXPERIMENTAL STUDY ON STRENGTH AND DURABILITY OF CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT WITH GRANITE SLURRY AND AGGREGATES WITH QUARTZ STONE

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ABSTRACT

The ability of concrete to withstand repeated usage, chemical erosion, scratches, and other cycles of crumbling without losing its unique structure, quality, or suitability under the circumstances is a key indicator of its durability. Robust concrete is the outcome of proper planning, sizing, placement, process completion, testing, evaluation, and relieving. India is the second-largest consumer of cement after China. In any event, 10% of global outflows today are carbon dioxide produced by concrete organisations, which affects the environment and modifies the natural framework. India's phenomenal economic development has made its citizens the perfect market for construction materials, where strength is less important than endurance. Massive quantities of quartz and slurry are collected as a result of the massive quantities of rock and quartz stone being assembled. There are many detrimental consequences on the ecosystem from the negligent disposal of this generated waste. Making use of these wastes might aid in addressing the issues of resource depletion and waste creation.

The cement employed in this first assessment of M40 grade concrete's durability was granite slurry. The coarse particles in this case were quartz. For 56 and multiday blocks, the following cement aftereffects are examined separately: functionality, compressive strength, corrosive, soluble, chloride, and sulphate assaults, as well as the results of the Quick Chloride Test and Permeability Test.

KEY WORDS: Granite slurry, quartz, quick chloride test, acid attack test, permeability, chemical attack, durability, and compressive strength.

I. INTRODUCTION

The presence of concrete extends back a very long time; the Minoan civilization involved a substance that was like concrete interestingly around 2000 BC. In the early years of the Roman Empire, around 300 BC, the Romans discovered that the hard water obstruction material we know as concrete was made by mixing lime mortar and a volcanic slag that looked like sand. The most widely used bond in contemporary concrete is Portland concrete. Other readily available types of bonds include; Blended concrete may contain elements such as wood powder, silica smoke, and fly-flaming slag, despite its similarity to Portland concrete; High-quality early-stage concretes that, as their name implies, improve significantly more quickly than Portland or mixed bonds; Low-heat cements are utilized when the substantial's hydration temperature is confined; bonds in sulfate that are antagonistic and have shrinkage restrictions; Concrete for brick work; coloring the bond.

The advancement of the development industry is being seen all around the world. Both private and public constructions are being produced in great numbers. Due to the rising costs of construction materials, notably cement, pulverised stone (coarse aggregate), and fine sand (fine aggregate), it is necessary to investigate the use of interchangeable building materials that are readily available in the area. Because concrete work makes up the majority of building development projects, a drop in the cost of producing concrete will reduce the cost of building development. The main focus of this topic is to consider the fractional replacement of glass powder and wooden powder residue in concrete at various rates, as well as to compare concrete's qualities to that of regular cement.

There is experimental research that can be found in the literature regarding the efficient utilization of granite slurry waste. Waste granite slurry was used at a variety of F.A. and cement replacement levels, according to these studies. Additionally, it has been demonstrated that the characteristics of freshly poured and cured concrete are altered when leftover granite slurry is used. Quartz has a tremendous

economic value. There are many different kinds of gems, including amethyst, citrine, smoky quartz, and rose quartz. Sandstone, which primarily consists of quartz, is an essential building material. Quartz sand, also known as silica sand, is extensively utilized in the manufacturing of ceramics, glass, and foundry molds for metal casting.

1.1 Durability of concrete

The capacity to get through a surprisingly long time without liberal corruption is implied as strength. A getting through substance helps the environment by saving resources, restricting waste, and cutting down the natural effect of help and substitution. The assembly of new construction materials uses up existing resources and may possibly pollute the air and water. Concrete retains its unique properties despite enduring, synthetic attack, and scratched spots. Different concretes require varying degrees of strength, depending on the openness climate and planned attributes. The parts, their proportions, how they work together, how they are placed and restored, the help climate, and how long the concrete lasts are all factors that influence its durability and lifespan.

1. 2 Importance of the present study

Concrete has emerged as a prominent building material across all modern construction fields for the following reasons:

1. Using the right gradients and original processing methods, such as mechanical, chemical, and physical, it is possible to control the properties of cement concrete across a wide range. It is possible to fully automate the process of preparation and placement. It has sufficient versatility to be utilized for mechanical undertakings.
2. It's challenging to envision any structure material that is essentially as adaptable as concrete. When strength, durability, permanence, permeability, and fire resistance are required, concrete is by far the best material to use.
3. Inflation is one of the most pressing problems that any nation must address in the modern world. It is now essential to keep structural integrity and lifespan while lowering building expenses.
4. Cost reduction may be done in a number of different ways. The most effective alternative available to us is the use of waste material as a substitute. All humans have a basic need for shelter. As a result, the building of a structure, which requires cement concrete, serves as the foundation for the shelter. A well-known building material that has been crucial in construction projects is cement concrete.
5. The effect of the rapidly degrading environment is the growing demand in offering robust materials. Effective cementitious materials ultimately succeed in satisfying the bulk of the requirements of the tough concrete. It has been shown that quartz dust and granite slurry are more valuable than fly debris and silica fume.
6. A thorough understanding of the interactions between the many components that go into the creation of concrete, both in the flexible and harden states, is required to make concrete of certain qualities from materials of different characteristics. Total, concrete quality, water-concrete proportion, functionality, blend % consistency, and substantial age are a portion of the factors that influence substantial strength. New building materials are used to speed up construction, and the mix has a big effect on the properties of the concrete. The production of a number of different kinds of industrial waste, such as rice husk ash, foundry sand, blast furnace slag, fly ash, steel slag, scrap tires, waste plastic, broken glass, and so on, has risen significantly as a result of the expansion of various industries and the population.

II. MATERIALS AND METHODS

Utilizing various percentages of quartz and granite sulfate, the current study investigates the strength and durability of M40 grade concrete. Cement, coarse and fine aggregates, granite sulfate, quartz, Super Plasticizers, and water were all used in this study.

2.1 Cement

In the testing, Portland Pozzolana Cement conforming to IS: 1489 (Part1)- 1991 was used. The trial used conventional Portland cement (53 evaluations) from the neighborhood market. To hold the cement back from being presented to dampness, it was kept up in an impenetrable holder and put away in a moistness controlled climate.

2.2 Coarse aggregates

Smashed stone with a maximum size of 20 mm was used as coarse aggregate. The consolidated aggregates' strainer examination uncovers that they meet the prerequisites of IS 383: 1970 for evaluated

aggregates. The coarse aggregates are squashed precise 20 mm stones with a particular gravity of 4.17.

2.3 Fine aggregates

Fine aggregate was procured that met the imperative characteristics of fine aggregate for exploratory work, and the sand follows IS 383: 1970 zone III models. Fine aggregates are produced using waterway sand, which has a particular gravity of 3.22.

2.4 Granite Slurry

Granite is well-known for its extensive use as a building stone around the world due to its extreme hardness and durability as well as its ease of availability. Granite, a material that has historically been mined, is extremely abundant in India and contributes significantly to the country's foreign exchange profits. Prior to Brazil and South Africa, India is the world's second-largest supplier of unprocessed granite after China. In India, granite mines are dispersed throughout the country's several States with output shares of 25% in Karnataka, 24% in Jharkhand, 23% in Rajasthan, 6% in Andhra Pradesh, 5% in Madhya Pradesh, and 5% in Orissa. Karnataka's granite sector contributes a sizeable portion of domestic and worldwide output, which accounts for 20% of the global market.

Figure 1: Granite Slurry

2.5 Super Plasticizer

The decision-making substance is Conplast SP430. A polymer made from sulphonated naphthalene is what it is. It lacks chloride and is shaded an earthy colour. It is used to increase the practicality of the concrete. The range of measurement is between 0.6 and 1.5 litres per 100 kg of cement.

2.6 Quartz stone

Granite and other felsic igneous rocks are characterised by the presence of quartz. Sandstone and shale are examples of sedimentary rocks that frequently contain it. It is a typical component of metamorphic rocks including schist, gneiss, quartzite, and others. The crucibles and other tools used in the semiconductor industry for developing silicon wafers require naturally occurring quartz crystals of exceptionally high purity, which are pricy and scarce.

Figure 2: Quartz stone

2.7 Water

Clean consumable water was gotten from the Department of Civil Engineering for blending and relieving concrete in this venture. Water is a significant part of concrete since it assumes a functioning part in the chemical communication among cement and water. The amount and nature of water should be painstakingly observed since it helps in the development of the strength-giving cement gel. Exorbitant measures of undesirable natural or inorganic components ought to be stayed away from in blending water.

2.8 Chemicals used

To study the durability properties of concrete the chemicals like HCL, Na2SO4 are utilized with suitable quantity.

III. EXPERIMENTAL PROGRAM

3.1 Mix Proportions

In this study, the IS approach is used to calculate the mix proportions for concrete of the M40 grade. The mix ratios in this project were 1:1.63:2.54 with a w/c of 0.45.

3.2 Casting of Specimens

150 X 150 X 150 mm concrete cubes were provided. The samples were demolded and relieved in fresh water after 24 hours using various solutions such HCL, Na2SO4, MgSO4, NaOH, and Nacl for 28, 56, and 90 days.

Figure 3: Casting of specimens

3.3Testing of Specimens

The cast samples are quickly analyzed in CTM machine, according to standard strategies, in the wake of being removed from the relieving tubs and cleaned dry, agreeing per IS 516-1959.

Figure 4: Compression testing machine (CTM)

3.4 Workability of concrete

With differing measures of rock sulfate and quartz stone for concrete in M40 grade, the usefulness of substantial downturn cone test is assessed.

3.5 Acid attack test

Subsequent to relieving the shape examples in a HCL restoring tank for 56 and 84 days, the rate loss of compressive strength is estimated to compute the corrosive assault test.

3.6 Alakaline attack

A NaOH solution curing tank and curing specimens at 56 and 84 days of curing time are used to calculate the percentage loss of compressive strength for M40 grade concrete.

3.7 Sulphate attack

The sulphate attack test is performed using solutions of chemicals like Na2SO4 and MgSO4 with varying percentages of RHA over curing times of 56 and 84 days, respectively.

3.8 Chloride attack test

After curing the cube specimens in a NaCl curing tank for the 56- and 84-day curing periods, the percentage loss of compressive strength is measured to calculate the chloride attack test.

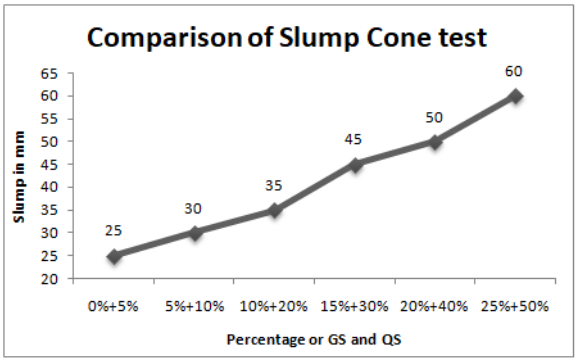
3.9 Rapid Chloride Permeability Test

The investigation was led as per the ASTMC C 1202-97 attributes. The chloride particles should penetrate the straightforward cover adjusted for the concrete designs to arrive at reinforcements to deliver consumption movement. Chloride particles follow these courses, expecting to break in and do mischief to the reinforcement. This test reproduces that event to decide the degree of opposition given by a concrete blend.

Figure 5:RCPT apparatus

IV. RESULTS AND ANALYSIS

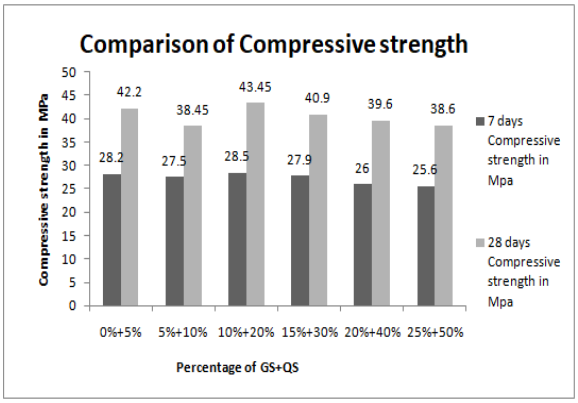
4.1 Workability (Slump cone test)



Graph 1: Comparison of Slump cone test values

The graph above illustrates how different percentages of granite sulrry and quartz stone are used to determine the workability of M40 grade. It can be seen from the graph that as the percentage of different percentages of granite sulrry and quartz stone increases, from 0%GS+0%QS to 25%GS+50%QS, the value of slump increases from 25mm to 60mm.

4.2 Compressive strength



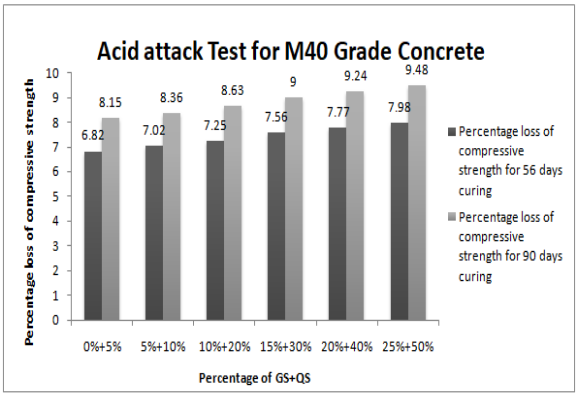
Graph 2: Comparison of 7 days and 28 days compressive strength

The graph above depicts the compressive strength

results. The test specimens' compressive strength was found to be optimal at 10% granite slurry and 20% quartz stone for both the 7-day and 28-day curing times. As the proportion of granite slurry and quartz stone increases after this point, the strength decreases.

4.3 Durability of concrete

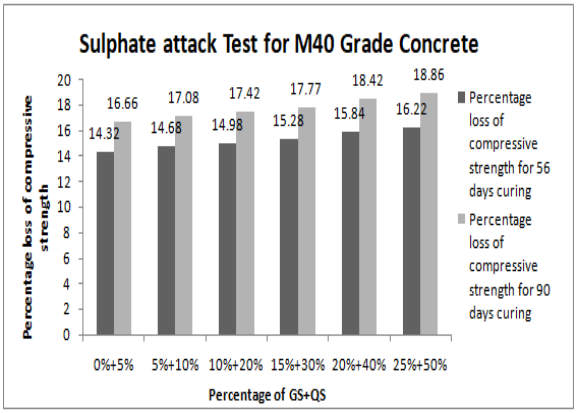
4.3.1 Acid attack test



Graph 3: Comparison of Acid attack test results

The test results for the M40 grade concrete mix are displayed in the graph above. Based on these findings, it was shown that during both 56 and 90 days of curing in an HCL water tank, the percentage loss of compressive strength increases as granite sulphate and quartz stone percentages rise.

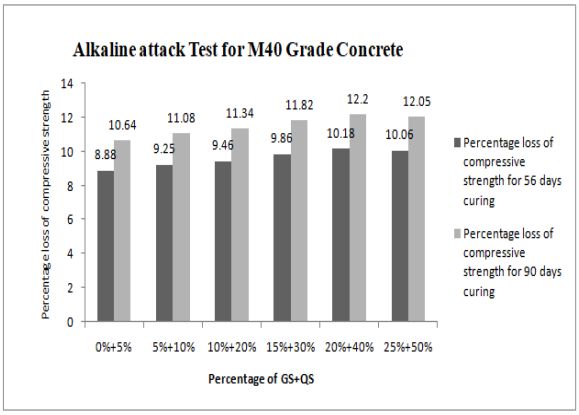
4.3.2 Sulphate attack test



Graph 4: Comparison of sulphate attack test results

The sulphate attack test results are shown in the above graph from this results it was concluded that by increasing the percentage of granite sulrry and quartz stone the percentage loss of compressive strength increases by curing the specimens sulphate solution tank for 56 days and 84 days curing periods.

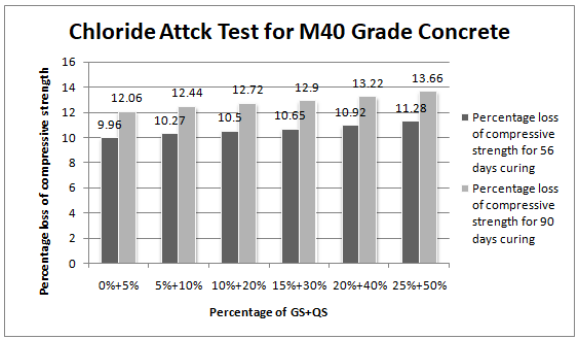
4.3.3 Alkaline attack test



Graph 5: Comparison of alkaline attack test results

The durability of concrete by curing the specimens in alkaline NaOH curing tank is shown in the above graph from this graph it was observed that by using alkaline curing the percentage loss of strength increases forgranite sulrry and quartz stonein both 56 days and 84 days curing methods.

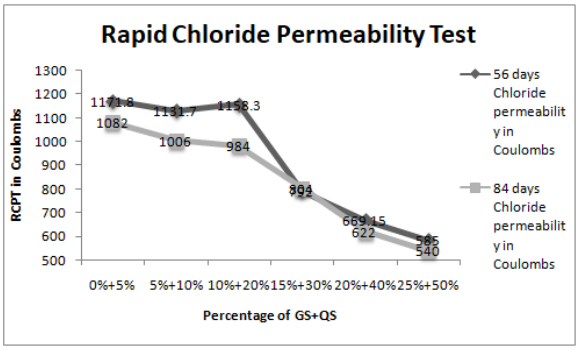
4.3.4 Chloride attack test



Graph 6: Comparison of Chloride attack test results

By curing the test sample in Nacl curing tank the percentage loss of compressive strength increases for both 56 days and 84 days curing period.

4.3.5 Rapid Chloride Permeability Test



Graph 7: Comparison of Rapid Chloride Permeability Test

Granite, sulphate of potash, and quartz stone are used in varying proportions to establish the Rapid chloride permeability test.With more granite, quartz, and sulphate in the mix, the value of the RCPT value drops.

V. CONCLUSIONS

In order to investigate the strength and durability of concrete, different proportions of quartz stone and granite slurry (from 0% to 25% and 0% to 50%, respectively) were added to M40 grade concrete. The findings that follow are the result of this inquiry.

1. When the quantity of quartz stone and granite slurry is raised from 0% to 25% and from 0% to 50%, respectively, the slump cone test results for M40 grade concrete increase.
2. After 7 and 28 days of relaxing, the 10%GS+20%QS case produced the highest compressive strength for the M40 grade when compared to other mixes.
3. Because of the high ingestion quality of GS, the measurement of super plasticizer has to rise in step with the fineness of GS in order to maintain optimum workability.
4. For the M40 grade significant mix, the rate of compressive strength loss for the destructive, fundamental, sulphate, chloride, and alkalinity course of action is determined by increasing the amount of quartz stone and rock slurry by 0% to 25% and 0% to half, respectively.
5. Different amounts of quartz stone and granite slurry, ranging from 0% to 25% and 0% to 50%, respectively, are used to perform the quick chloride porousness test. The more granite, quartz, and other stones are utilised, the lower the RCPT value becomes.
6. As the quantity of quartz and granite sulrry in the water penetrability rises, so does the entry depth for the M40 grade.

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