ENHANCING STRENGTH AND DURABILITY OF CONCRETE THROUGH PARTIAL REPLACEMENT OF CEMENT WITH GRANITE SLURRY AND AGGREGATES WITH QUARTZ STONE

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Abstract: The durability of concrete is crucial for its ability to withstand various forms of deterioration, including weathering, chemical attack, abrasion, and other processes, while maintaining its structural integrity, strength, and functionality in its intended environment. Concrete's strength is the result of meticulous planning, proportioning, placement, curing, testing, inspection, and curing processes. India ranks as the second-largest consumer of cement globally, following China. However, the cement industry's operations contribute to approximately 10% of the world's carbon dioxide emissions, impacting the climate and ecosystem equilibrium. The substantial infrastructure development in India has propelled the nation to become a significant consumer of building materials, emphasizing the importance of durability over strength. The manufacturing processes of granite and quartz stones generate substantial amounts of slurry and waste, posing environmental challenges due to their haphazard disposal practices. Repurposing this waste material offers a solution to address both waste generation and natural resource depletion concerns. This study undertakes an exploratory assessment to evaluate the durability of M40 grade concrete by utilizing granite slurry as a cement substitute and quartz as coarse aggregates. Various aspects including workability, compressive strength, resistance to acid, alkaline, chloride, and sulfate attacks, as well as the results of the Rapid Chloride Test and porosity tests, are examined separately for concrete samples cured for 56 and 84 days.

Key words: Durability, chemical attack, Rice husk ash, compressive strength, Permeability test, Rapid chloride test, acid attack test, chloride attack test.

INTRODUCTION

Concrete has been available from here onward, indefinitely quite a while; the Minoan human civilization around 2000 BC is the primary reported utilization of a material in view of concrete. Around 300 BC, during the beginning of the Roman Empire, the Romans found that joining a sandy volcanic slag with lime mortar created a hard water boundary material that we currently know as concrete. The most generally involved sort of bond in current cement is Portland concrete. Different sorts of bond incorporate mixed concrete, which is like Portland concrete yet may contain materials, for example, fly debris, slag, silica smoke, and wood powder; high early quality cements, which, as the name suggests, gain quality a lot quicker than Portland or blended securities; and low warmth cements, which are utilized when the hotness of hydration of the substantial is restricted. Portland concrete is fabricated by consolidating calcium carbonate, which might be found in limestone or chalk, with silica, alumina, and iron oxide, which can be found in the ground or shale. Contingent upon the nature of the stones utilized, the two fixes are ground and participated in a dry or wet condition.

The blend is then warmed to temperatures as high as 1400 degrees Celsius in a heater, where the two rocks entwine to frame clinker. The clinker is permitted to cool before gypsum is added at a pace of 1-5%. The combination is then finely squashed and sprinkled among Concrete cluster plants. Due to the nearby likeness of the completed concrete to the Portland limestone, the Portland bond is named after it. Concrete is quite possibly the most broadly utilized development material since it very well may be tossed into practically any structure, has fantastic compressive properties, is promptly accessible anyplace, and is regularly more affordable than other development materials like steel or fiber composites. Concrete is made by blending bond powder coarse and fine totals, typically sand and beat shake, with water. It is normally joined with a hand blender or by an enormous bundle plant. Since made sands contrast from typical sands, it is invaluable to have the option to foresee the characteristics of the subsequent concrete without broad exploration community testing.

LITERATURE REVIEW

Dr. G. Prince Arul raj et al They found that the restored examples were passed on to dry in the air in their examination on "Rock POWDER CONCRETE." A pressure testing gear with a limit of 2000 KN was utilized to focus the dry examples. At a steady pace of 14 KN/mm2/min, the heap was applied. Substantial's parted rigidity not entirely settled by testing plain substantial chambers. The split elasticity was estimated utilizing 150mm x 300mm chambers. The examples were assessed for split elasticity subsequent to restoring on an aligned pressure testing hardware with a limit of 2000kN.

A ARIVUMANGAI and T FELIXKALA " Fire Resistance Test on Granite Powder Concrete" turned into the issue in their research. The compressive strength concrete mixes are proven at diverse trying out ages. The compressive strength of all granite powder concretes thermally dealt with at 70o, 140o, 210o, and 280oC for 1 hour and a couple of hours is proven withinside the data. The compressive the 140o, 210o, and 280oC for 1 hour and a couple of hours turned into recorded. The compressive strength of granite powder specimens rose with temperature as much as 70 ranges Celsius, then reduced to 280 ranges Celsius. The compressive strength of control concrete is 6% extra than that of granite powder concrete at 2 hour strength, at the same time as the compressive strength of granite powder concrete varies from 8% to 34%. As a result, granite powder concrete with admixtures significantly improves the compressive strength of concrete, growing it through 1.23 instances over conventional concrete.

S. Vishnu Shankar and K. Saravana Raja Mohan The study "Durability Studies on Cement Mortar with Granite Powder as a Partial Replacement of Cement" concluded that the granite content of 30% in the cement mortar samples took 72 hours for excessive corrosion to occur, which is on average 24 percent longer than the other mixes, based on a visual examination of corroded specimens. As a consequence, it can be inferred that replacing 30% of the cement with granite powder improved corrosion resistance when compared to other combinations. The residual compressive strength of the cement mortar with 30% granite component is higher than other mixes, according to fire resistance tests. 35 replacement performed well in comparison to this degree of replacement.

OBJECTIVES AND SCOPE OF INVESTIGATION

Scope of the investigation

Because of the following factors, concrete has become a prominent building material in all disciplines of modern construction.

1. Using suitable gradients and unique processing techniques, such as mechanical, chemical, and physical, it is feasible to regulate the characteristics of cement concrete across a large range. It is possible to totally automate the process of preparation and placement. It has sufficient plasticity for mechanical work.
2. It's tough to think of another construction material that is as adaptable as concrete. When strength, durability, permanence, permeability, and fire resistance are necessary, concrete is by far the best material to use.
3. In today's world, inflation is one of the most serious issues that any country must deal with. It has become critical to reduce building costs while maintaining structural strength and longevity.
4. Cost reduction may be accomplished in a variety of ways. The utilisation of waste material as a replacement is the most efficient of all the options accessible to us. Shelter is a basic necessity of all humans. As a result, the shelter is based on the construction of a structure, in which cement concrete is a need. Cement concrete is a well-known building material that has come to play an important role in construction projects.
5. The expanding interest for delivering sturdy materials is the result of quick dirtying climate. Beneficial cementitious materials end up being successful to meet the vast majority of the necessities of the tough concrete. Granite slurry and quartz dust are observed to be more noteworthy to other valuable materials like silica fume and fly debris.
6. To produce concrete of specified qualities from materials of varied characteristics, extensive understanding of the interaction of numerous elements that go into the formation of concrete is necessary, both in the pliable and harden conditions. The strength of concrete is determined by factors such as aggregate, cement quality,

water- cement ratio, workability, mix percentage consistency, and concrete age. New building materials are used to accelerate the construction work, in which the mixture plays an important role in characteristics of concrete. The growth in various types of industries together with population growth has resulted in enormous increase in the production of various types of industrial waste materials such as rice husk ash, foundry sand, blast furnace slag, fly ash, steel slag, scrap tires, waste plastic, broken glass, etc

Objectives of the study

Most of the published research studied on the concrete properties with granite slurry and quartz stone. The present study deals with the replacement of cement is made for M40 grade with the use of granite slurry as cement and quartz stone as coarse aggregates.

7. To make a concrete by using granite slurry as cement and quartz stone as coarse aggregates.
8. To investigate the strength properties (Compressive, split, flexural strength) of concrete using granite slurry as cement and quartz stone as coarse aggregates.
9. To study the properties of concrete by using granite slurry as cement and quartz stone as coarse aggregates. like 0%+0%, 5%+10%, 10%+20%, 15%+30%, 20%+40% and 25%+50%.
10. To study the durability properties of M40 grade concrete.

EXPERIMENTAL INVESTIGATION

Mix design of concrete

Concrete blend configuration is a system of choosing the right cement substances and their respective proportions with the purpose of manufacturing cement with a minimal strength, preferred functionality, and solidity as economically (esteem intended) as possible. Gather the previous data earlier than hand, because few define prerequisites are frozen relying in this data, as I favor to pass for a strong blend arrangement.

In this study, mix proportioning for M40 grade concrete is done utilising the IS technique.
Final trial mix for M40 grade concrete is 1:1.63:2.54 at w/c of 0.45

Table 5. 1 Final trial mix for M40 grade concrete

MATERIAL	CEMENT	FINE AGGREGATES	COARSE AGGREGATES	WATER
Density	438 kg/m3	717.12 kg/m3	1115 kg/m3	197 kg/m3
Proportions	1	1.63	2.54	0.45

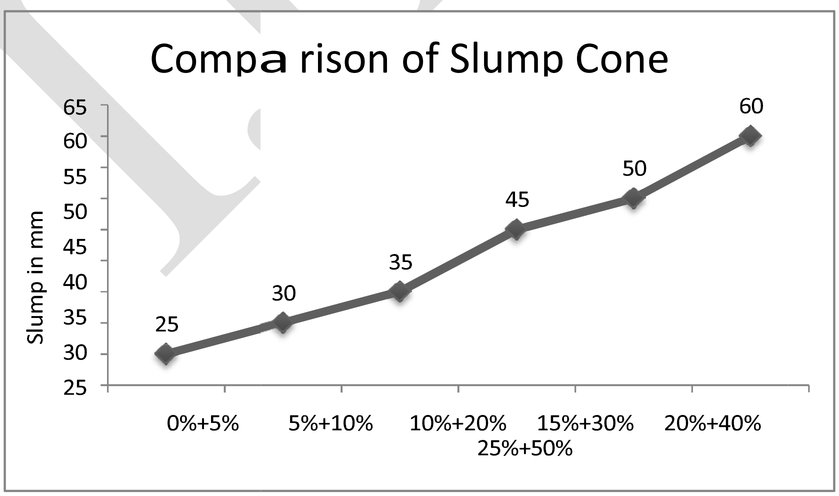
RESULST AND ANALYSIS

Slump cone test

Table Slump Cone Results for M40 Grade concrete

S. No	Percentage of GS+QS	Slump in mm
1	0%+5%	25
2	5%+10%	30
3	10%+20%	35
4	15%+30%	45
5	20%+40%	50
6	25%+50%	60

Fig Slump Cone Test for M40 Grade concrete

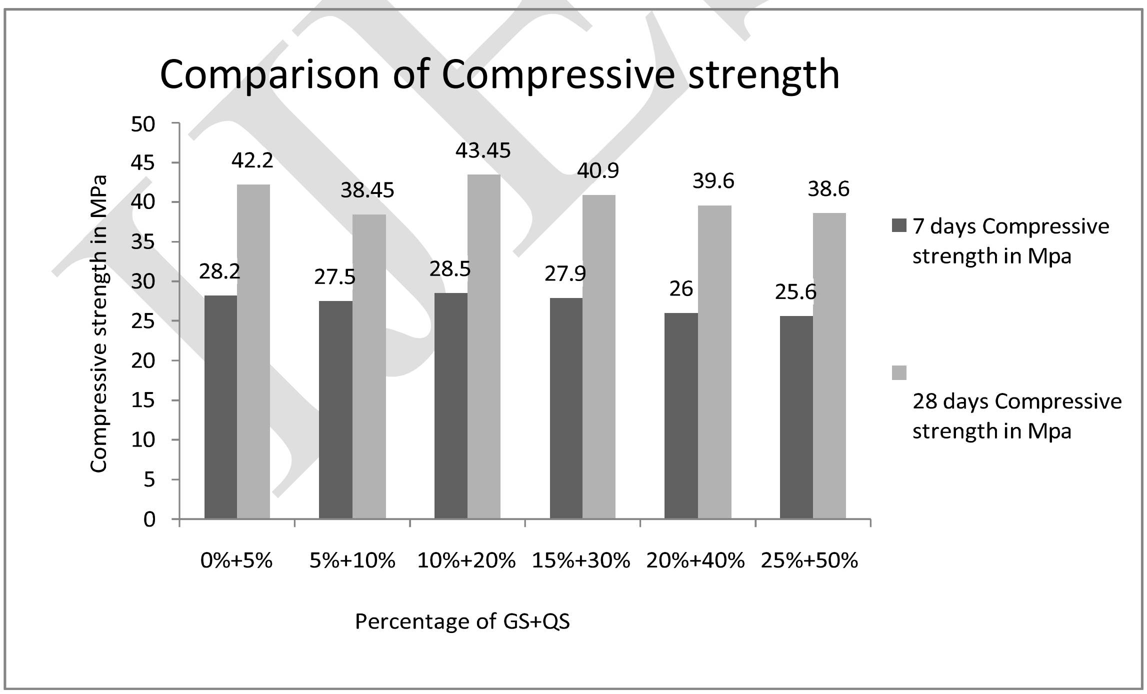


Compressive strength of concrete

Table Compressive Strength for M40Grade concrete

S. No	Percentage of GS+QS	7 days Compressive strength in Mpa	28 days Compressive strength in Mpa
1	0%+5%	28.2	42.2
2	5%+10%	27.5	38.45
3	10%+20%	28.5	43.45
4	15%+30%	27.9	40.9
5	20%+40%	26	39.6
6	25%+50%	25.6	38.6

Table Compressive Strength for M40 Grade concrete



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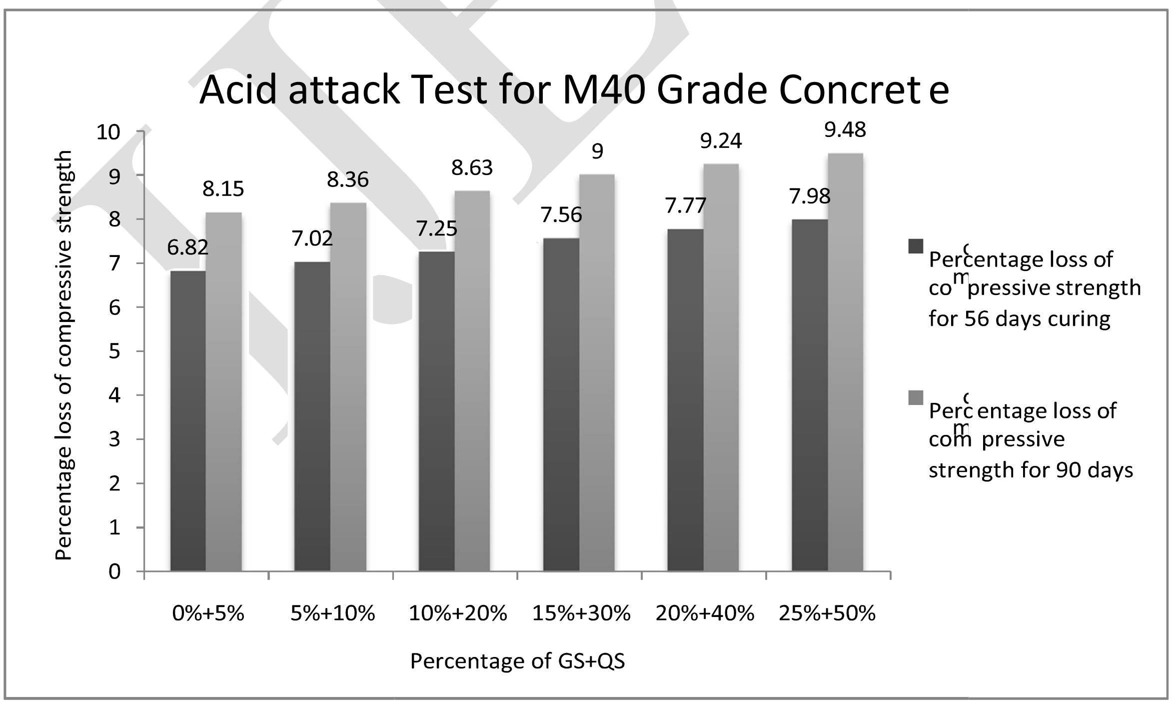
Durability of concrete

Acid attack test

Table Acid Attack Test for M40 Grade Concrete

S. No	Percentage of GS+QS	28 days Compressive strength in Mpa	56 days Compressive strength in Mpa after curing in acid HCL	84 days Compressive strength in Mpa after curing in acid HCL	Percentage loss of compressive strength for 56 days curing	Percentage loss of compressive strength for 90 days curing
1	0%+5%	42.2	39.32	38.76	6.82	8.15
2	5%+10%	38.45	35.75	35.24	7.02	8.36
3	10%+20%	43.45	40.3	39.7	7.25	8.63
4	15%+30%	40.9	37.8	37.22	7.56	9
5	20%+40%	39.6	36.52	35.94	7.77	9.24
6	25%+50%	38.6	35.52	34.94	7.98	9.48

Fig Acid Attack for M40 Grade Concrete

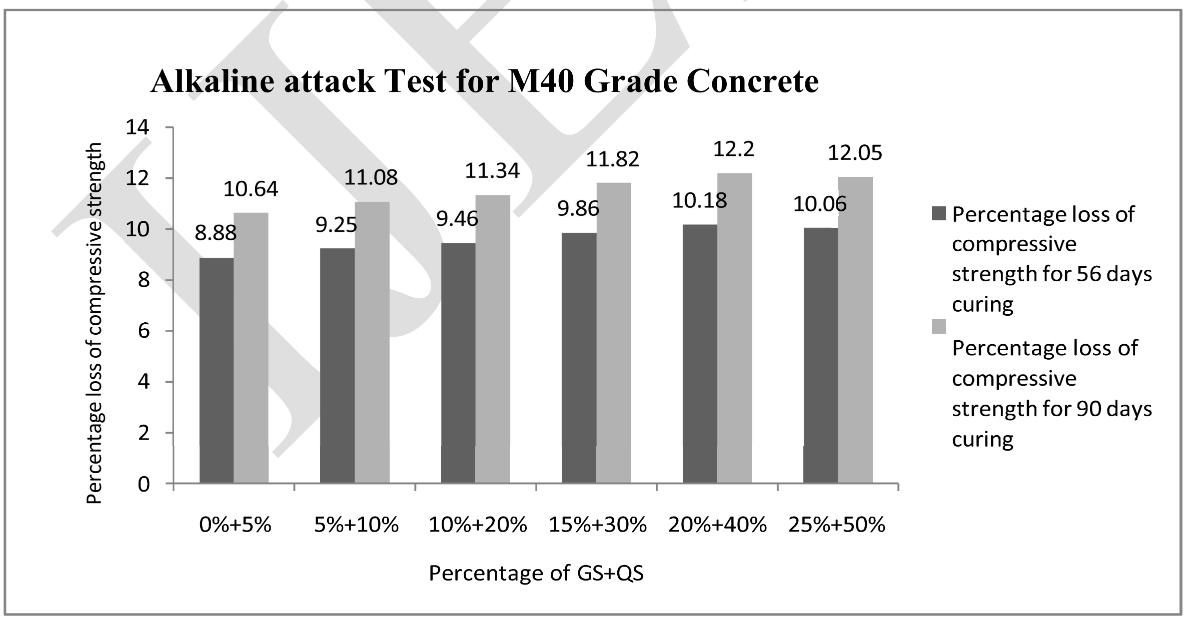


Alkaline attack test

Table Alkaline attack test for M40Grade concrete

S. No	Percentage of GS+QS	28 days Compressive strength in Mpa	56 days Compressive strength in Mpa after curing in NaOH Solution	84 days Compressive strength in Mpa after curing in in NaOH Solution	Percentage loss of compressive strength for 56 days curing	Percentage loss of compressive strength for 90 days curing
1	0%+5%	42.2	38.45	37.7	8.88	10.64
2	5%+10%	38.45	34.9	34.19	9.25	11.08
3	10%+20%	43.45	39.33	38.52	9.46	11.34
4	15%+30%	40.9	36.87	36.06	9.86	11.82
5	20%+40%	39.6	35.57	34.77	10.18	12.2
6	25%+50%	38.6	34.71	33.95	10.06	12.05

Fig Alkaline attack for M40 Grade Concrete

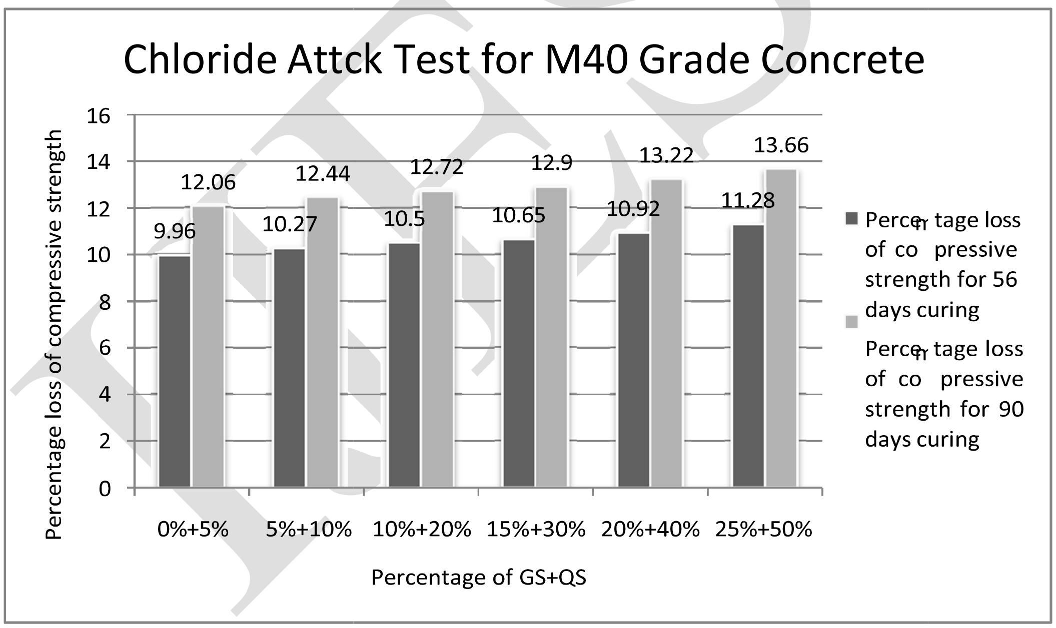


Chloride attack test

Table Chloride attack test for M40 grade Concrete

S. No	Percentage of GS+QS	28 days Compressive strength in Mpa	56 days Compressive strength in Mpa after curing in Chloride NaCl	84 days Compressive strength in Mpa after curing in Chloride NaCl	Percentage loss of compressive strength for 56 days curing	Percentage loss of compressive strength for 90 days curing
1	0%+5%	42.2	39.32	38.76	9.96	12.06
2	5%+10%	38.45	35.75	35.24	10.27	12.44
3	10%+20%	43.45	40.3	39.7	10.5	12.72
4	15%+30%	40.9	37.8	37.22	10.65	12.9
5	20%+40%	39.6	36.52	35.94	10.92	13.22
6	25%+50%	38.6	35.52	34.94	11.28	13.66

Table Chloride attack for M40 Grade Concrete



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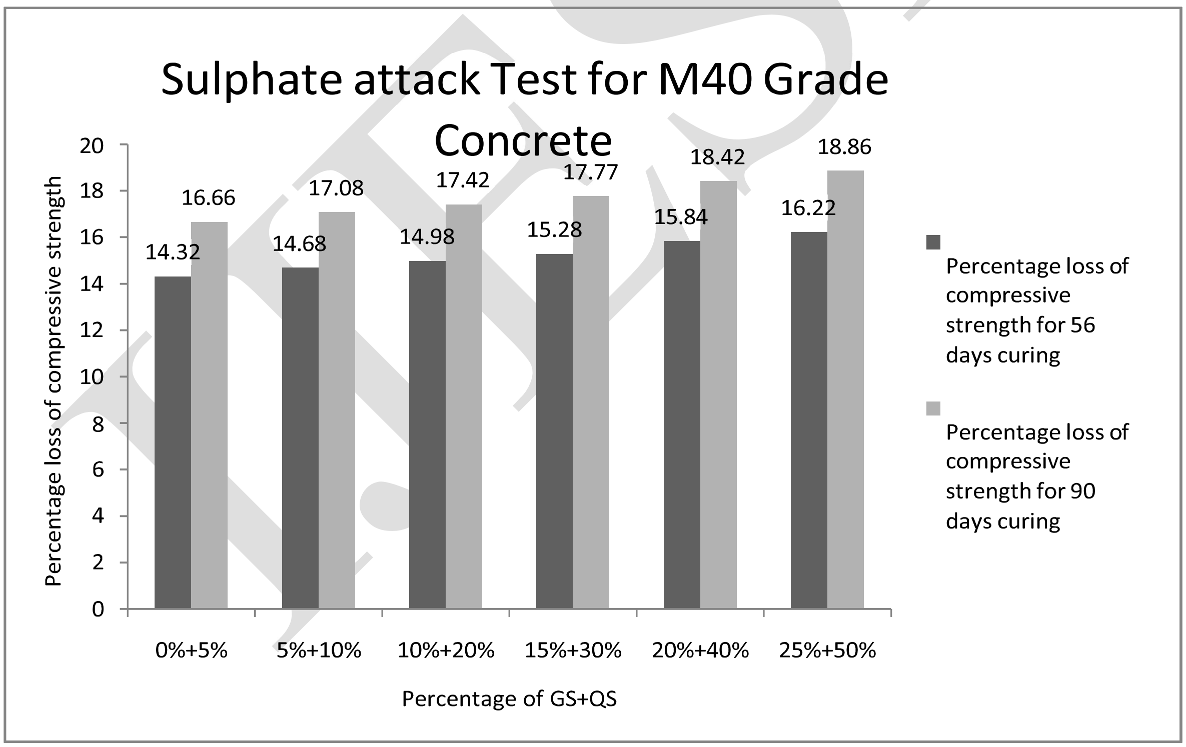
Sulphate attack test

Table Sulphate attack test for M40 grade Concrete

S. No	Percentage of GS+QS	28 days Compressive strength in Mpa	56 days Compressive strength in Mpa after curing in sulphate Na2SO4+MgSO4	84 days Compressive strength in Mpa after curing in sulphate Na2SO4+MgSO4	Percentage loss of compressive strength for 56 days curing	Percentage loss of compressive strength for 90 days curing
1	0%+5%	42.2	39.32	38.76	14.32	16.66
2	5%+10%	38.45	35.75	35.24	14.68	17.08
3	10%+20%	43.45	40.3	39.7	14.98	17.42
4	15%+30%	40.9	37.8	37.22	15.28	17.77
5	20%+40%	39.6	36.52	35.94	15.84	18.42
6	25%+50%	38.6	35.52	34.94	16.22	18.86

Fig Sulphate attack for M40 Grade Concrete

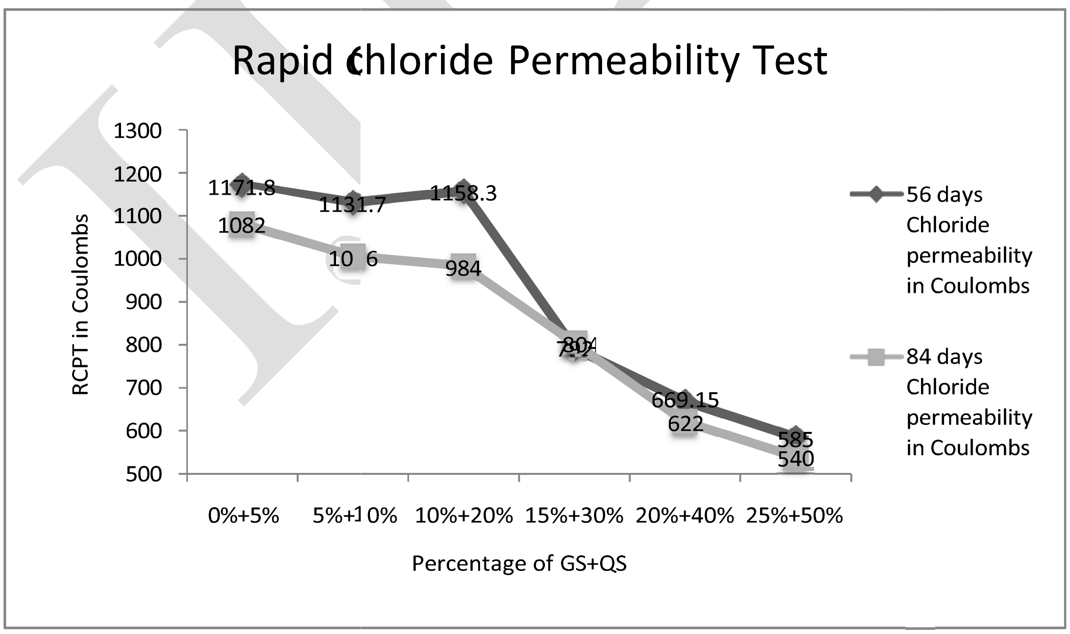


Rapid chloride permeability test

Table Rapid Chloride permeability test for M40 grade Concrete

S. No	Percentage of GS+QS	56 days Chloride permeability		84days Chloride permeability	
		Coulombs	Remark	Coulombs	Remark
1	0%+5%	1171.8	low	1082	low
2	5%+10%	1131.7	low	1006	low
3	10%+20%	1158.3	low	984	Very low
4	15%+30%	792	Very low	804	Very low
5	20%+40%	669.15	Very low	622	Very low
6	25%+50%	585	Very low	540	Very low

Table Rapid Chloride permeability for M40 Grade Concrete



CONCLUSIONS

The goal of this study is to investigate the strength and durability of concrete utilising varying amounts of granite slurry and quartz stone in M40 grade concrete, ranging from 0% to 25% and 0% to 50%, respectively. The following findings were made as a result of this investigation.

1. For M40 grade concrete, the slump cone test esteems increment when the extent of granite slurry and quartz stone from 0% to 25% and 0% to 50%
2. The 10%GS+20%QS case yielded the most elevated compressive strength for the M40 grade following 7 days and 28 days of relieving, contrasted with different blends.
3. To keep up the ideal workability, the measurement of super plasticizer must be brought up pair with the GS fineness because of the GS high ingestion quality.
4. For M40 grade concrete blend, the rate loss of compressive strength for corrosive, basic, sulfate, chloride, and alkalinity arrangement increments as the extent of granite slurry and quartz stone from 0% to 25% and 0% to 50%
5. The quick chloride porousness test is performed with fluctuating groupings of granite slurry and quartz stone from 0% to 25% and 0% to 50%. As the extent of rice husk ash is expanded, the RCPT esteem brings down.
6. As the measure of rice husk ash in the water penetrability rises, the profundity of entrance for the M40 grade increments.

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