International Journal of Engineering Research and Science & Technology

www.ijerst.org

ISSN : 2319-5991

Vol. 21 No. 2 (2025)



ijerst.editor@gmail.com

editor@ijerst.com

International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com
Vol. 21, No. 2, 2025
© 2025 IJERST. All Rights Reserved
Peer Reviewed, Referred & Indexed Journal

Research Paper

Experimental Study on Strength and Durability of Concrete by Partial Replacement of Cement with Granite Slurry and Aggregates with Quartz Stone

Pachha chakravarthi[1]

[1]Teaching assistant, ACE Engineering Academy, Hyderabad, 500001, Telangana, India

Abstract *Durability of concrete is controlled by its capacity to oppose enduring activity, chemical attack, scraped spot, or some other cycle of crumbling, and will hold its unique structure, quality, and serviceability when presented to its current circumstance. Solid concrete is a consequence of appropriate plan, proportioning, placement, completing the process of, testing, review, and relieving. India is second biggest shopper of cement after china. However, these days Cement enterprises produce about 10% of the world's carbon dioxide which influences the climate and cause irregularity in the biological system. The surprising expansion in foundation in India has made Indians the best customers of building materials, where the issue of durability over strength is basic. Huge quantity of granite and quartz stone production leads to the collection of enormous quantity of slurry and quartz. Random disposal of this generated waste degrades the environment in numerous ways. Utilization of this waste may solve the problem of waste generation and also the problem of scarcity of natural resources.*

An exploratory assessment was attempted in this work to examine the durability of M40 grade concrete using granite slurry as cement and quartz as coarse aggregates. Workability, compressive strength, acid attack, alkaline attack, chloride attack, sulfate attack, Rapid chloride test, and porousness test discoveries of concrete are surveyed for 56 and 84 day cubes separately.

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

I INTRODUCTION

Concrete has been around for a long time, the primary known utilization of a material taking after cement was by the Minoan human advancement around 2000 BC. Amid the beginning times of the Roman Empire around 300 BC the Romans found that blending a sandy volcanic slag with lime mortar made a hard water obstruction substance which we currently know as concrete. The dominating sort of bond utilized in present day concrete is Portland concrete, different kinds of bond accessible incorporate; Blended concrete, which is like Portland concrete however may contain materials, for example, fly fiery remains slag, silica smoke and wood powder ; High early quality concretes, which as the name recommends gains quality much faster then Portland or mixed bonds; Low warmth concretes, utilized when limits are put on the warmth of hydration of the Concrete; Shrinkage restricted bonds; Sulfate opposing bonds; Colored bonds; Masonry concrete.

Portland bond is made by blending calcium carbonate generally found in limestone or chalk and silica, alumina and iron oxide found in earth or shale. The two fixings are ground and combined in either a dry or wet state contingent upon the qualities of the stones being utilized. The blend is then put in a furnace at temperatures as high as 1400 degrees

Celsius, at this temperature the two rocks intertwine to frame clinker. The clinker is permitted to cool and gypsum is included at around 1 – 5 percent. The blend is then ground to the required fineness and dispersed to Concrete clump plants. Portland bond gets its name from the Portland limestone in light of the nearby likeness of the completed cement to the Portland Limestone.

Concrete is a standout amongst the most prevalent materials for development attributable to the way that it very well may be thrown into pretty much any shape, it has great compressive qualities, is promptly accessible pretty much anyplace and is generally shoddy in contrast with different materials accessible for development, for example, steel or fiber composites. Concrete is produced using a blend of bond powder coarse and fine aggregates, ordinarily sand and pounded shake and water. It tends to be either blended in a hand blender or by an extensive bunch plant.

Since produced sands have distinctive properties to common sands it is useful to have the capacity to anticipate the properties of the resultant cement without broad research center testing. There have been various endeavors to demonstrate the impact of the physical and concoction attributes of aggregates on the new and solidified properties of cement and give Concrete blend plan techniques. These, to some degree, consider some of the aggregate qualities: the molecule estimate circulation, most extreme total aggregate size and aggregate compose (characteristic or squashed). Notwithstanding, as these techniques depend on measurable information from many cement blends, the outcomes are summed up and on account of a particular kind of aggregate, similar to crusher dust or produced aggregates, probably won't yield the normal last Concrete properties. Moreover, the Concrete compressive quality evaluations depend on the w/c proportion, which for average aggregates may be right, yet for extremely precise or fine aggregates may turn out to be a wrong portrayal of the quality. Comparable impacts may be experienced in consistency estimations.

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.

1. To make a concrete by using granite slurry as cement and quartz stone as coarse aggregates.

2. To investigate the strength properties (Compressive, split, flexural strength) of concrete using granite slurry as cement and quartz stone as coarse aggregates.

3. 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%.

4. To study the durability properties of M40 grade concrete.

II LITERATURE STUDIES

Divakar et al studied on “Experimental Investigation on behavior of concrete with the use of Granite fines” in this study they founded on The compressive strength has increased by 22% with the use of 35% replacement of fine aggregates with granite fines. With increase of granite fines up to 50% increasing compressive strength will limit to 4% only. The split tense strength remains same for 0%,25% and 35%. For 5% replacement there is an increase of 2.4% of strength and for 15% replacement there is a reduction of tensile strength by 8%. However we can conclude that with the replacement of 35% granite fines the test results shows no decrease in strength compared with the conventional mix usingfully sand as fine aggregates. \

J. Thivya and M. Arivukkarasi studied on “ Comparative Analysis on Partial Replacement of Cement by Metakaolin and Fine Aggregate by Granite Powder” in this study they founded on the The addition of Metakaolin along with cement has increased the compressive strength of the concrete when compared to the conventional concrete. The

more effective percentage of replacement with Metakaolin seems to be between 10% and 15%. The mechanical properties of concrete are increased with partial replacement of Metakaolin and Granite powder. The compressive strength of concrete increased with 15%MK and 20%GP replacement in concrete.

P. L.Chowdhery et al. Studies on "Strength Properties of Effect of Waste Granite Powder on the Compressive Strength of Concrete" in this study they analyzed on the compressive strength of concrete is found to increases with increase in Granite powder content. It is found that the strength is increasing from 0 to 7.5% and decreases 7.5% to 10% for 7 and 28 days. The split tensile strength of blended concrete is found to be with the replacement of cement by Granite powder from 0 to7.5 percent. However the split tensile strength of concrete is seen to increase with the Granite powder content and reaches an optimum value at 7.5% and afterwards gets decreased for 10%for 7 and 28 days.

M.Manikandan andDr.T.Felixkala studies on "EXPERIMENTAL STUDY ON PROPERTIES OF GRANITE WASTE IN SELF COMPACTING HIGH PERFORMANCE REINFORCED CONCRETE BEAM" in this study they analyzed on the basis of experiments conducted on six beam specimens the following observation and conclusions are drawn. The load at failure of GP was high that controlled beam when test at 28days its increase. The deflection under the concrete beams with 25% GP were same as the controlled beams at 28 days testing and it was quite less than controlled beams. The structural behavior of self compacting high performance reinforced concrete beams with GP resembled the typical behavior of high performance reinforced concrete beams and there increase in load carrying capacity of GP beams with age. Hence result of this investigation suggest that concrete with 25% GP replacement for fine aggregate could be used for Self compacting high performance reinforced concrete beams.

Raghavendra R et al. studies on "Flexural strength of High Performance Concrete using Granite powder as fine aggregate" in this study they founded on the flexural strength shows increasing trend at early stages of curing even after replacing natural sand by granite powder. The later stage of curing that is 28 and 56 days let to a new increment in strength with the increase in GP% but not as much as conventional concrete. The workability is as good as conventional concrete. Hence the granite aggregates can be considered as an alternative for fine aggregates (river sand).

N . Kiran Kumar et al. studies on "An Experimental Investigation on strength of Granite-fines concrete" in this study they founded from the test results it is clearly evident that granite powder as a partial replacement of sand proves to be beneficial when mechanical properties of strength is considered. Concrete mix with 30 % addition of granite fines proves to be better when compared with other proportions. Compressive Strength, particularly in all the ages higher than reference mix (GF0), there was an increase in strength as the days of curing increases. The compressive strength with 30 % addition of granite fines yielded higher value compared with other values.

III MATERIALS AND MIX DESIGN USED

Cement

Portland cement is produced using calcareous substances which incorporate limestone and chalk, notwithstanding argillaceous minerals which incorporate shale and earth. Wet and dry cycles are the 2 sorts of cycles. The best variation is if the uncooked substances are blended and floor soggy or dry. Lime, silica, alumina, and iron oxide are the most extreme well known fundamental added substances utilized in cement fabricate. In this examination Ordinary Portland concrete of 53 grade (ACC concrete) has been acquired and has been utilized.



OPC 53 Grade cement

Aggregates

Aggregates are an important part of concrete. They offer a strong base for concrete, decrease shrinkage, and save money. Aggregates are non-essential granular elements that are provided by themselves, such as sand, rock, or crushed stone. They're also the raw ingredients that go into making concrete. Clean, hard, and solid aggregates should be devoid of absorbed synthetic chemicals, dirt, and other small particles that might cause cement to disintegrate.

Coarse aggregates

Coarse aggregates are debris with a width extra than 4.75mm however a steady variety of 9.5mm to 37.5mm. They can be created out of a huge variety of substances which can be both essential, auxiliary, and reused. Essential or virgin aggregates may be located on land or withinside the ocean. Rock is a coarse, land-gained general produced via way of means of the ocean. Rock and beaten stone are examples of coarse aggregates. Rock makes up the bulk of the coarse fabric in concrete, with beaten stone accounting for the rest.In this study coarse aggregate of nominal sizes of 20mm, 12mm are used.

Fine aggregates

Sands from both the land and the ocean are used to make pleasant mixture. The maximum not unusual place pleasant aggregates are herbal sand or beaten stone, with the bulk of debris passing thru a 4.75mm screen. The pleasant mixture on this observe became river sand, which became received from a nearby producer and illustrated with inside the figure.

Granite Slurry

Granites being hard and tough and its easy availability make it a household name for widespread use as a construction stone throughout the world. India is highly rich in granite which has been considered as miner mineral but it is a major contributor in foreign exchange earnings. India is the second largest exporter of unprocessed granite after China while ahead of Brazil and South Africa. In India, Granite mines are spread in its different States having production shares as Karnataka (25%), Jharkhand (24%), Rajasthan (23%), Andhra Pradesh (6%), Madhya Pradesh (5%) and Orissa (5%). The granite industry of Karnataka gives a significant percentage of the national and international production leading to approximately 20 % of world's market.



Granite slurry

Quartz stone

Granite and other felsic igneous rocks have quartz as a distinguishing element. Sandstone and shale are examples of sedimentary rocks where it is quite frequent. Schist, gneiss, quartzite, and other metamorphic rocks all contain this mineral. Because quartz has the lowest weathering potential of the Goldich dissolution family, it is abundant as a residual mineral in stream sediments and residual soils. Quartz is commonly found in abundance in "mature" rocks, indicating that the rock has been severely reworked and that quartz was the dominant material that withstood severe weathering.



Quartz stone

Mix Design for M40 Grade Concrete

Mix design is calculated as per IS 10262 and IS 456 2000 code standards

Concrete Mix proportions for Trial Number 1

1. Cement = 438 kg/m^3
2. Water = 197 kg/m^3
3. Fine aggregates = 717.12 kg/m^3
4. Coarse aggregate = 1115 kg/m^3
5. Water-cement ratio = 0.45

Final trial mix for M40 grade concrete is 1:1.63:2.54 at w/c of 0.45

Experimental tests to be conducted on concrete

Workability of concrete

1. Slump cone test

Strength of concrete

1. Compressive strength

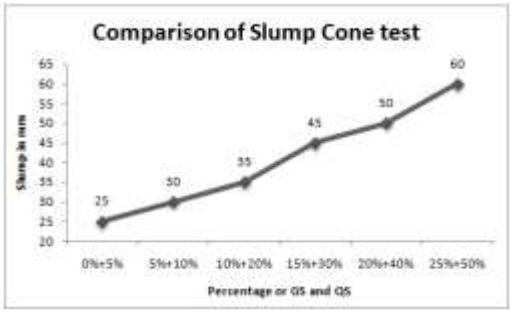
Durability of concrete

1. Acid attack test
2. Alkaline attack test
3. Sulphate attack test

IV RESULTS AND ANALYSIS

Workability of concrete

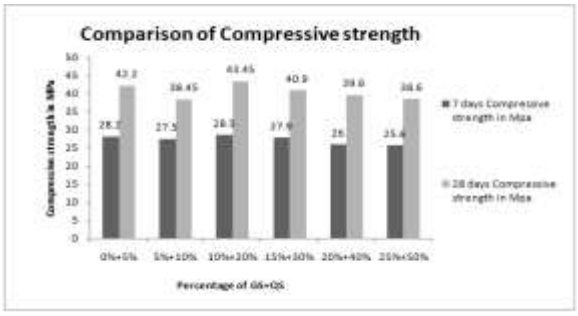
Slump cone test results



Comparison of slump cone values

Strength of concrete

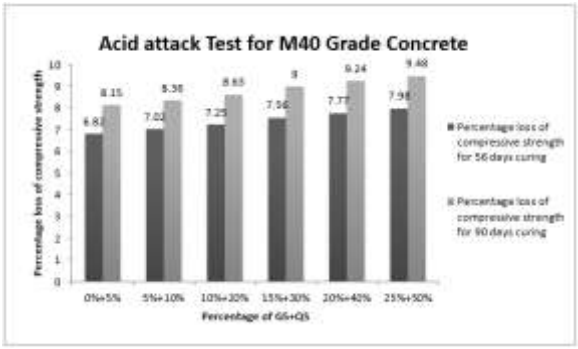
Compressive strength



Comparison of compressive strength of concrete

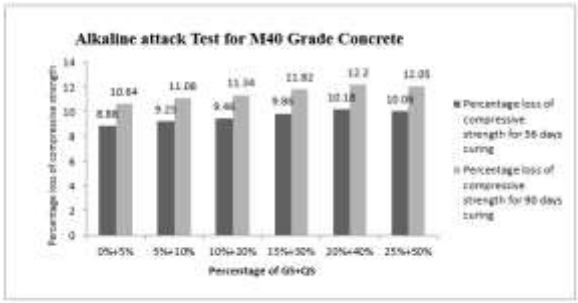
Durability of concrete

Acid attack test



Percentage loss of strength due to acid attack

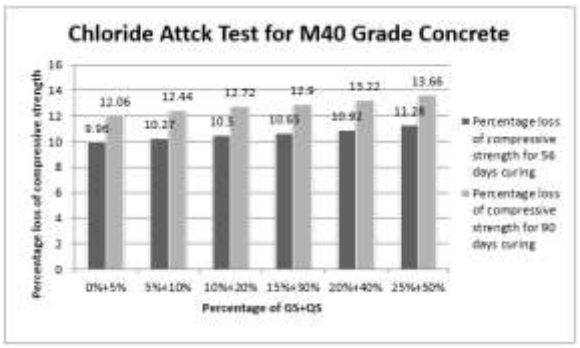
Alkaline attack test



Percentage loss of strength due to alkaline attack

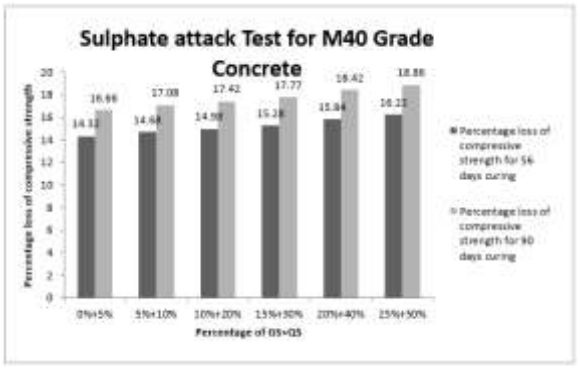
Chloride attack test

International Journal of Engineering Research and Science & Technology



Percentage loss of strength due to chloride attack

Sulphate attack test



Percentage loss of strength due to sulphate attack

V CONCLUSIONS

The motivation behind this examination is to explore the strength and durability of concrete using fluctuating rates of granite slurry and quartz stone in M40 grade concrete, going from 0% to 25% and 0% to 50%. The accompanying discoveries were drawn from this exploration.

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.

REFERENCES

[1]. Almeida N, Branco F, Santos JR. Recycling of stone slurry in industrial activities: Application to concrete mixtures. Building and Environment. 2007 Feb; 42(2):810–9. https://doi.org/10.1016/j.buildenv.2005.09.018

[2]. Hudson BP. Manufactured sand for concrete: Talks of the many properties that good manufactured sand can offer to enhance the performance of concrete. Indian Concrete Journal. 1997; 71:237–41.

[3]. Safiuddin M, Raman SN, Zain MF. Utilization of quarry waste fine aggregate in concrete mixtures. Journal of Applied Sciences Research. 2007; 3(3):202–8.

[4]. World Business Council for Sustainable Development (WBCSD)/International Energy Agency (IEA). Cement Technology Roadmap 2009- Carbon emissions reductions up to 2050. 2009. Available from: www.iea.org/papers/2009/Cement_Roadmap.pdf

[5]. World Business Council for Sustainable Development (WBCSD)/International Energy Agency (IEA). Cement roadmap targets; 2009b. Available from: www.iea.org/ papers/2009/Cement_Roadmap_targets_viewing Pdf

[6]. Rego G, Martínez C, Quero A, Blanco TP, Borquea JM. The effects of dust inhalation in slate industry workers. Medicinaclinica. 2001 Mar; 116(8):290–1.https://doi.org/10.1016/S0025-7753(01)71802-7.

[7]. Barbosa MS, Carneiro AP, Maciel JG, Moronte EA, La Rocca PD, Santos ARM. Silicosis among quartzite production workers of São Thomé das Letras-Minas Gerais region: Initial data indicate serious public health issue. Revista Brasileira de Saúde Ocupacional. 2011 Jun; 36(123):177–84.https://doi.org/10.1590/S0303-76572011000100018

[8]. Menezes RR, Neves GA, Ferreira HC, Santana LNL. Recycling of mine wastes as ceramic raw materials: An alternative to avoid environmental contamination. INTECH Open Access Publisher; 2012.

[9]. Pappu A, Saxena M, Asolekar SR. Solid wastes generation in India and their recycling potential in building materials. Building and Environment. 2007 Jun; 42(6):2311–20. https://doi.org/10.1016/j.buildenv.2006.04.015.

[10]. Ribeiroa SV, Holandaa JNF. Soil-cement bricks incorporated with granite cutting sludge. IJESIT. 2014 Mar; 3(2).

[11]. Ramos T, Matos AM, Schmidt B, Rio J, Sousa-Coutinho J. Granitic quarry sludge waste in mortar: Effect on strength and durability. Construction and Building Materials. 2013 Oct; 47:1001–9. https://doi.org/10.1016/j.conbuildmat.2013.05.098'

[12]. Mármol I, Ballester P, Cerro S, Monrós G, Morales J, Sánchez L. Use of granite sludge wastes for the production of coloured cement-based mortars. Cement and Concrete Composites. 2010 Sep; 32(8):617–22. https://doi.org/10.1016/j.cemconcomp.2010.06.003

[13]. Binici H, Shah T, Aksogan O, Kaplan H. Durability of concrete made with granite and marble as recycle aggregates. Journal of Materials Processing Technology. 2008 Nov; 208(1):299–308. https://doi.org/10.1016/j.jmatprotec.2007.12.120

[14]. Divakar Y, Manjunath S, Aswath MU. Experimental investigation on behaviour of concrete with the use of granite fines. International Journal of Advanced Engineering Research and Studies. 2012; 1(4):84–7.

[15]. Vijayalakshmi M, Sekar AS. Strength and durability properties of concrete made with granite industry waste. Construction and Building Materials. 2013 Sep; 46:1–7. https://doi.org/10.1016/j.conbuildmat.2013.04.018

[16]. Williams CK, Partheeban P, Kala TF. Mechanical properties of high performance concrete incorporating granite powder as fine aggregate. India International Journal on Design and Manufacturing Technologies. 2008 Jul; 2(1):67–73. https://doi.org/10.18000/ijodam.70029

[17]. Manasseh JO. Use of crushed granite fine as replacement to river sand in concrete production. Leonardo electronics journal of practice and technologies. 2010 Jul; (17):85–96.

[18]. Kala DT. Effect of granite strength powder on properties of concrete. International Journal of Engineering and Science. 2013 May; 2(12):36–50.