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# An Experimental Study on Partial Replacement of Fine Aggregate by Quarry Dust and Granite Powder in M25 Grade Concrete

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***Abstract*: Concrete is the most widely used construction material in civil engineering industry because of its high structural strength and stability. For low- and middle-income people very difficult to construct the buildings. Now-a-days, in the market the fine aggregate rates are increasing rapidly due to the depletion of River sands. Quarry Dust and Granite Powder are among the powder wastes generated by the industry. To overcome from this crisis, partial replacement of fine aggregate by quarry dust and granite powder in concrete. This research is carried out in two phases. In the first phase, the mix of M25 cubes is made by normal convectional concrete to determine the maximum compressive strength. In the second phase, Fine aggregates is partially replaced by Quarry Dust and Granite Powder by 50%, 60% and 50%,40% as fine aggregates as constant to determine the compressive strength as 3,7 and 28 days. This research evaluates the strength and strength efficiency factors of hardened concrete by partially replacing of fine aggregates by various percentages of Quarry Dust and Granite Powder for M25 grade of concrete at different ages.**

***Keywords*: Quarry, granite**

## 1. Introduction

*1) Concrete*

Concrete is one of the most commonly used building materials. Concrete is a composite material made from several readily available constituents such as Cement, Fine and Coarse aggregates with suitable proportion of water content according to mis design as per code IS 10262:2019. Concrete is versatile material that can easily be mixed to meet a variety of special needs and formed to virtually any shape. The properties of Concrete are such as versatility, durability, sustainability, and economy have made it as the world’s most widely used construction material. About four tons of concrete are produced per person per year worldwide and about 1.7 tons per person in the United States. The term concrete refers to a mixture of aggregates usually river sand and either gravel or crushed stones, held together by a binder of cementitious pastes.

*2) Cement*

In this modern world, the construction of various structures is increasing day by day and usage of concrete also getting very high. Cement is major part of any construction. Cement is extracted from crushing of lime stone to form fine powder and then blended in the correct proportions.

*3) Aggregates*

After cement, Aggregates are major part of any construction. River sand is the one which can be used as fine aggregate in concrete. Now-a-days the cost of river sand is becoming very high, low and middle income can’t able to construct the buildings as per their requirements. Natural Resources like River Sand is depleting at a faster rate and on the other hand the industrial wastes are increasing at a faster rate. A best approach to solve these two consequences as a replacement of natural resources by industrial wastes. Crusher quarry dust can be economical alternative and freely available material to the river sand. Use of quarry dust in concrete not only improves the quality of concrete but also conserves the natural river sand for future generations. Granite Powder is a hydro product in granite factories while using into desired shapes. Granite Powder belongs to igneous rock family which is having compressive strength more than the 200Mpa. The Physical Properties of Quarry Dust and Granite Powder are more similar to the natural river sand and hence it can be used as a partial replacement to the fine aggregates. We are making of Cubes & Cylinders of different proportions and testing of compressive strength and spilt tensile strength tests at different ages such as 3,7 and 28 days. According to mix design code M25 grade of project done by 2 proportions such as 50% of fine aggregates and remaining 50% as 25% of quarry dust and 25% of granite powder, 40% of fine aggregates and remaining 60% as 30% of quarry dust and 30% of granite powder. We are not using any admixtures because of cist of admixtures is high. Coarse Aggregates are produced from crushing of stones. The stones retaining on 4.75 mm is called the coarse aggregate. For concrete normally 20 mm aggregates are used.

*4) Water*

Water is an important ingredient of concrete as it actively participates in the chemical reactions with the cement. Since it

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helps to form the strength giving cement gel, the quantity and quality of water is required to be looked into very carefully. Water cement ratio is used as 0.45 for M25. It should be free from organic matter like impurities and salt and pH value should be between 6 and 7 is used for casting and curing the concrete blocks as per IS- 456:2000.

## 2. Literature Review

The partial replacement of fine aggregates by quarry dust and granite powder. Quarry Dust is formed by crushing of stones in quarries. Granite Powder is a hydro product in granite factories generated while using into the desired shapes.

*1) Quarry dust*

Abbas S.Y., Srivastava V. and Agarwal V.C., (2019) conducted their research on the mix design of M25 concrete. They carried out their work using PPC cement of grade 43. Quarry dust was obtained from local stone crusher mill of Mirzapur, India. Cube sample of size was prepared and compressive strength at 7 and 28 days were obtained. From their research, they have concluded that optimum percent of replacement of fine aggregate by quarry dust gave better strength at 7 days as well as 28 days. They also specified that increase in strength might be due to change in the composition of matrix of concrete. Yogesh Aggarwal & Rafat Siddique (2019) in paper on „microstructure and properties of concrete using bottom ash and waste foundry sand as partial replacement of fine aggregates"[9] has given the study report. This paper presents the experimental investigations carried out to study the effect of use of bottom ash as replacement of fine aggregates. Compressive strength of fine aggregates replaced bottom ash concrete specimens were lower than control concrete specimens at all the ages. Mix containing 35% and 45% bottom ash, at 90 days, attains the compressive strength almost equivalent to of compressive strength of normal concrete at 28 days. Furthermore, it was observed that the greatest increase in compressive, splitting tensile and flexural strength were achieved by substituting 30% of the natural fine aggregate with bottom ash as fine aggregate.

*2) Granite powder*

Divakar. Y , Manjunath. S & Dr. M.U Aswanth (2017) used granite powder as partial replacement for the fine aggregate. By using these materials cement mortar and concrete were prepared. After that the relative workability test, compressive strength test and flexural strength test were conducted. From that test results, they conclude that when the percentage of granite powder added in concrete increases then the compressive strength and flexural strength of concrete is also increasing. Granite fines which are the side–effect delivered in stone plants while slicing enormous stone rocks to the coveted shapes. After dissipation of water the rock dust remained is transported and arranged on the terrains. Chandra Rathor (2018) Self- compacting concrete is one of the most progressive improvements in solid research, this solid can stream and to fill the most restacked spots of the frame work without vibration. There are a few strategies for testing its properties in the express. This work presents the properties of self-compacting concrete, blended with various kinds' added substances: fly powder, miniatured scale silica, metakaolin. So, we included admixtures air conditioning hypercritic around 0.5% and 0.2% of aggregate cementitious content in each blend from that point. The compressive strength quality conveyed in the CTM. The increments of fly slag were 20%, 25%, 30%, and 35% of cement. It was seen that expansion the level of fly powder brought about the decline of compressive strength.

*3) Replacement of materials*

Now a days the cost of construction is high due to lack of building materials. As per our research the cost of cement and natural river sand is very high. So, we replaced the natural river sand by quarry dust and granite powder in M25 grade concrete.

*4) Quarry dust*

Quarry Dust is a by-product of the crushing process which is a concentrated material use as aggregates for concreting purposes, especially as a fine aggregate. In quarrying activities, the rock has been crushed into various sizes; during the process the dust generated is called quarry dust and it is formed as wastes. Quarry Dust powder is the waste generated from Manufactured Sand (M-Sand) and constituents to 30-40% of the total quarry dust produced. The present study reports the suitability of quarry dust powder in the development of concrete buildings blocks by evaluating its strength, durability, acoustic and thermal properties. In the backdrop of Rapid growth, Construction industries are facing acute shortage of the convectional building materials. For the past some years, Due to the environmental concerns and administrative restrictions in the India cost of sand rises higher and higher. Comparatively, cost of sand is three to four times higher than the quarry dust, even in river banks and places where the natural sand is locally and easily available. It is proposed to ascertain the possibility of replacing the sand with the locally available alternatives such as quarry dust without compromising quality, strength and workability of concrete. As per India Mart, the cost of quarry dust is 500 rupees per one ton for construction sectors. It satisfies the reasons behind the alternative material as a substitute for sand at very low cost.

*5) Advantages of quarry dust*

1. Cost effective, easily available, consumption reduces the pollution in the environment and effectively used as a replacement material for river sand.
2. Water is required for the cement to hydrate and solidify.

*6) Disadvantages of quarry dust*

1. Requires proper proportioning and lab test which may increase the budget of the project.
2. Concrete which is partially replaced may not have longer life span as estimated by standard IS codes.
3. If good results are visible then maybe it is difficult to implementation in mass project which requires standard acceptance.

*7) Granite powder*

Granite Powder is a by-product produced in granite factories while cutting into desired shapes. It belongs to igneous rock family which is having compressive strength more than the 200 Mpa. The physical properties of granite powder is more similar to the natural river sand and hence it can be used as a replacement to the natural river sand. Granite industry produces around 18 million tons waste per annum. Granite Powder is locally available waste material hence it is possible to make economical concrete. According to the journals, the physical properties of granite powder are as follows as below

Table 1
Physical Properties of Granite Powder

| Specification | Value |
|---|---|
| Colour | White |
| Specific Gravity | 2.83 |
| Bulk Density | 2.68 g/cm$^3$ |
| Surface Area | 0.1311 m$^2$/g |
| Moisture Content | 10% |
| Fineness Modulus | 2.43 |

*8) Advantages of granite powder*

1. Granite Powder is a promising material for use in concrete similar to those of pozzolanic materials such as silica fume, fly ash, slag etc…,
2. It acts as a filler material to reduce the void content in concrete.
3. It is a great product to use as it binds together beautifully when slightly damps.

*9) Disadvantages of granite powder*

1. Open sky mining as in the granite quarries leads to the environmental problems such as obstruction of drains in the rainy seasons.
2. Slurry affects the productivity of the land as a result of decreasing porosity, water absorption and percolation.
3. If good results are visible then maybe it is difficult to implementation in mass project which requires standard acceptance.

## 3. Methodology

All the works which are necessary for our project had been executed in Concrete Technology Laboratory in Kuppam Engineering College. Mix Design is very important to make the cubes & cylinders for good results. Mix design for M25 grade concrete is done by using IS 10262:2019 and concrete design code IS 456:2000. In this project, we had done in 3 stages.

- First stage is testing of materials.
- Second stage is making of cubes & cylinders as normal concrete.
- Third stage is replacing of material with cubes & cylinders. After casting of cubes & cylinders, we have to check the compressive strength and spilt tensile strength at 3,7 and 28 days.

*1) Stipulations for proportioning*

i. Grade designation: M25
ii. Type of cement ( BHARATHI:OPC 43 grade
iii. Maximum nominal size of coarse aggregate:20 mm
iv. Maximum water-cement ratio: 0.45
v. Workability: 100 mm (slump)
vi. Exposure condition: Severe
vii. Method of concrete placing: Chute(not pumping)
viii. Degree of supervision: Good
ix. Type of aggregate: Crushed angular aggregate
x. Chemical admixtures: No
xi. Specific gravity of cement: 3.15
xii. Specific gravity of quarry dust: 2.70
xiii. Specific gravity of granite powder: 2.56
xiv. Specific gravity of fine aggregate: 2.62
xv. Specific gravity of coarse aggregate: 2.65
xvi. Sieve analysis of fine aggregate : Zone-2

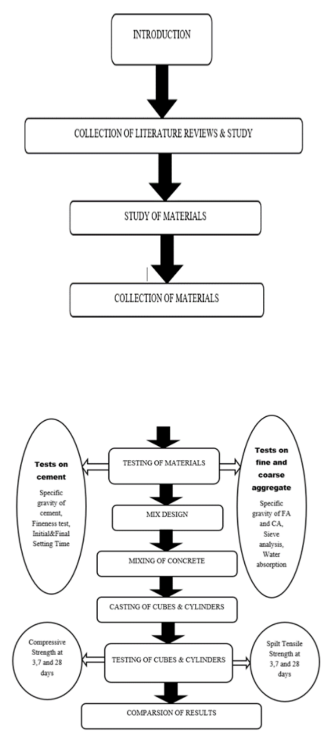
*2) Test data for materials*

a) Cement: OPC 43 grade
b) Specific gravity of cement: 3.15
c) Specific gravity of Quarry dust: 2.70
d) Specific gravity of Granite powder: 2.56
e) Specific gravity of
   1. Coarse aggregate: 2.65
   2. Fine aggregate: 2.62

f) Water absorption
   1) Coarse aggregate: 0.56 %
   2) Fine aggregate: 1.62 %

The coarse and fine aggregates are wet and their total moisture content is 2 % and 5 % respectively. Therefore, the free moisture content in coarse and fine aggregate shall be as shown in

1. Coarse aggregate : Free moisture = Total moisture content – Water absorption = 2.0 – 0.56 = 1.44 %
2. Fine aggregate : Free moisture = Total moisture content – Water absorption = 5.0 – 1.62 = 3.38 %




*3) Target strength for mix proportioning*

$f'_{ck} = f_{ck} + 1.65\,S$ Or $f'ck = f_{ck} + X$

which ever is higher. From Table 2, (IS 10262-2019) Standard deviation, S = 4 N/mm$^2$

From Table 1, (IS 10262-2019) X = 5.5

a) $f'_{ck} = f_{ck} + 1.65$ S b) $f'_{ck} = f_{ck}$ + X
= 25 + 1.65 × 4 0r = 25 + 5.5
= 31.6 $N/mm^2$ = 30.5 $N/mm^2$

Therefore, The Target strength will be 31.6 $N/mm^2$

*4) Approximate air content*

From Table 3, (IS 10262-2019)

The approximate amount of entrapped air to be expected in normal (non-air-entrained) concrete is 1.0 % for 20 mm nominal maximum size of aggregate.

*5) Selection of water-cement ratio*

From Fig. 1, (IS 10262-2019)

The free water-cement ratio required for the target strength of 31.6 N/mm2 is 0.45 for OPC 43 grade curve. This is lower than the maximum value of 0.45 prescribed for 'severe' exposure for reinforced concrete as per Table 5 of IS 456

0.45 < 0.50

Hence OK

*6) Selection of water content*

From Table 4, (IS 10262-2019)

Water content= 186 kg (for 50 mm slump) for 20 mm aggregate. Estimated water content for 100 mm slump (increasing at the rate of 3 % for every 25 mm slump = 186+6/100*186 = 197.16 kg

Hence the arrived water content = 197.16 ≈ 200 kg.

*7) Calculation of cement content*

Water-cement ratio = 0.45

Cement content = 200/0.45

= 444.4 $kg/m^3$ ≈ 450 $kg/m^3$

Note: This illustrative example is with increase of 10 cementitious material content. Cementitious material content = 450 × 1.10 = 495 $kg/m^3$

Water content = 200 $kg/m^3$

Water-cementitious ratio = 200/495 = 0.45

*8) Proportion of volume of coarse aggregate and fine aggregate content*

From Table 5, (IS 10262-2019)

Volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate (Zone II) for water-cement ratio of 0.5 = 0.62. The corrected proportion of volume of coarse aggregate for the water-cement ratio of 0.45 = 0.62 + 0.0 = 0.63 Therefore, volume of coarse aggregate = 0.63$m^3$ . Volume of fine aggregate = 1 – 0.63 = 0.37 $m^3$.

*9) Mix calculations*

The mix calculations per unit volume of concrete shall be as follows:

Total volume = 1 $m^3$

Volume of entrapped air in wet concrete = 0.01 $m^3$

Volume of cement= Mass of cement /Specific gravity of cement*1/ 1000 = 450/3.15*1/1000= 0.14 $m^3$

Volume of water= Mass of cement /Specific gravity of water*1/ 1000

= 200/1*1/1000 = 0.20 $m^3$

Volume of all aggregates = [(a-b)-(c+d)]= 0.65 $m^3$

Mass of coarse aggregate = e × volume of coarse aggregate × Specific gravity of coarse aggregate × 1000

= 0.65 × 0.63 × 2.65 × 1000

= 1085.18 = 1090 kg

Mass of fine aggregate

= e × Vol of fine aggregate × Specific gravity of fine aggregate × 1000

= 0.65 × 0.37 × 2.62 × 1000

= 630.11 kg

= 635 kg

Mass of quarry dust = 25% of (mass of fine aggregate) = 0.25 x 635= 158.75 kg

Mass of granite powder = 25% of (mass of fine aggregate) = 0.25 x 635 = 158.75 kg

Mass of quarry dust = 30% of (mass of fine aggregate) = 0.30 x 635 = 190.25 kg

Mass of granite powder = 30% of (mass of fine aggregate) = 0.30 x 635= 190.25 kg

*10) Mix proportions: For Trial Number 0(Convectional Concrete)*

For 1m3

- Cement = 450.00 $kg/m^3$
- Water (Net mixing)= 200.00 $kg/m^3$
- Fine aggregate = 635.00 $kg/m^3$
- Coarse aggregate = 1090.00 $kg/m^3$
- Quarry dust = 0 $kg/m^3$
- Granite powder = 0 $kg/m^3$
- Free water- cementitious materials ratio = 0.45

*For Trial Number 1(50% 0f partial replacement of fine aggregate) for 1m3*

- Cement = 450.00 $kg/m^3$
- Water (Net mixing)= 200.00 $kg/m^3$
- Fine aggregate = 317.50 $kg/m^3$
- Coarse aggregate = 1090.00 $kg/m^3$
- Quarry dust = 158.75 $kg/m^3$
- Granite powder = 158.75 $kg/m^3$
- Free water-cementitious materials ratio = 0.45

*For Trial Number 2(60% 0f partial replacement of fine aggregate) For 1m3*

- Cement = 450.00 $kg/m^3$
- Water (Net mixing) = 200.00 $kg/m^3$
- Fine aggregate = 254.00 $kg/m^3$
- Coarse aggregate = 1090.00 $kg/m^3$
- Quarry dust = 190.25 $kg/m^3$
- Granite powder = 190.25 $kg/m^3$
- Free water- cementitious materials ratio = 0.45

## 4. Preparation and Testing of Concrete

*1) Mixing and casting*

Spread the sheet on the floor and weigh the materials such as cement, fine aggregate, coarse aggregate and water as per mix design. Mix the cement and fine aggregate on a water tight none-absorbent platform until the mixture is thoroughly blended and it is in uniform colour. Add the coarse aggregate and mix with cement and fine aggregate until the coarse aggregate is uniformly distributed throughout the batch. Add water and mix until the concrete appears to be homogenous and of the desired consistency. Before casting of concrete in cubes and cylinders, apply the lubricant inside the moulds because of easy removal and smooth surface finishing.

Sizes of cubes = 150 X 150 X 150 mm.

Sizes of cylinder = Diameter – 150 mm,

= Height – 300 mm.

*2) Compaction*

There are various problems may arise if compaction of concrete is not carried out properly as honeycomb and trapped inside concrete paste. Poor compaction of concrete leads to permeability problems and decreasing ultimate capacity of hardened concrete. Manual compaction is done in 3 layers using tamping rod. For each layer 25 blows for proper compaction. For proper results, we were used both manual and mechanical equipment.

*3) Removal of casting and curing*

The test specimens are stored in moist air for 24 hours and after this period the specimens are marked and removed from the moulds and kept submerged in clear fresh water until taken out prior to test. Curing of concrete is defined as the process of maintaining the moisture and temperature condition of concrete for hydration reaction to normally so that concrete develops hardened properties over time. The main component is needed to be taken care of moisture, heat and time during curing process. Curing can be done by using sump with water.

*4) Tests on concrete*

Quality test on concrete is performed as a part of quality control of concrete structure. Different quality tests on concrete such as compressive strength tests, slump test, permeability tests etc. are used to assume the quality of the concrete.

*5) Fresh concrete: Slump cone test*

Slump test is a laboratory or at site test used to measure the consistency of concrete. Slump test shows an indication of the uniformity of concrete in different batches. The shape of the concrete slumps shows the information on the workability and quality of concrete. After mixing the concrete, the slump cone was cleaned and was placed in cone mould in 4 layers. Each layer approximately ¼ of the height of the mould and then tamped each layer 25 times with tamping rod distributing the stokes in a uniform manner over the cross – section of the underlying layer. The top was strike off with a trowel or tamping rod so that the mould is exactly filled. The cone was removed immediately, raising is slowly and carefully in the vertical direction. As soon as the concrete settlement came to a stop, the subsidence of concrete in mm which will give the slump was measured.

*6) Hardened concrete*

Standard steel mould was used for casting of cube size 150X150X150 mm and casting of cylinders of 150mm diameter and 300mm height. Concrete was placed uniformly over the length of the mould in three layers and compacted satisfactorily. After, compacting the entire concrete, the excess concrete at the top of the mould was stuck off with a wooden straight edge and the top finished by a trowel. Demoulding was done after 24 hours and the specimens were cured under water. After 3, 7 & 28days, the cubes specimen was removed from curing tank and taken for testing. After 28days, the cylinder specimens were removed from tank and taken for testing.

*7) Compressive strength test*

Compressive strength is the ability of material or structure to carry the loads on its surface without any crack or deflection. A material under compression tends to reduce the size, while in tension, size elongates. The cubes at 3, 7 &28 days of curing were taken for test. Remove the specimen from water after specified curing time and wipe out excess water from the surface. Clean the bearing surface of the testing machine. Place the specimen in the machine in such a manner that the load shall be applied to the opposite of the cubes cast. Rotate the movable portion gently by hand so that it touches the top surface of the specimen. Apply the load gradually till the specimen fails. Record the maximum load.

$$\text{Compressive strength} = \frac{ultimate\ load}{cross\ section\ area}$$

*8) Spilt tensile strength test*

The concrete is very weak in tension due to its brittle nature. Hence, it is not expected to resist the direct tension. Concrete develops cracks when tensile forces exceed its tensile strength. It is necessary to determine the tensile strength of concrete to determine the load at which the concrete member may crack. Taken out the wet specimen from water after 3, 7 &28 of curing or any desired age at which tensile strength to be estimated. Then, wipe out water from the surface of specimen. Specimen should be placed such a manner load shall be applied uniformly. Rotate the movable portion gently by hand so that it touches the top surface of the specimen. Apply the load continuously without shock at a rate within the range 0.7 to 1.4 Mpa/min (1.2 to 2.4 Mpa/min based on IS 5816 - 1999. Finally, note down the breaking load (P).

$$\text{Split tensile strength} = \frac{2p}{\pi DL}$$

## 5. Test Results and Comparison

*1) Comparison test results for 3-, 7- and 28-days curing*

Table 1

| S.No | Description | 3 Days Curing ($N/mm^2$) | 7 Days Curing ($N/mm^2$) | 28 Days Curing ($N/mm^2$) |
|---|---|---|---|---|
| 1 | Convectional Concrete | 1.69 | 2.33 | 3.46 |
| 2 | 50% of FA & 50% of QD and GP | 1.90 | 2.54 | 3.74 |
| 3 | 40% of FA & 60% of QD and GP | 2.05 | 2.75 | 3.96 |

*2) Compressive strength*

The cubes at 3, 7 and 28 days of curing were taken for test. The compressive strength of convectional concrete and new proportions such as 50% of fine aggregate and remaining 50% as 25% of quarry dust and 25% of granite powder, 40% of fine aggregate and remaining 60% as 30% of quarry dust and 30% of granite powder.

## 6. Costing and Comparison

The quantity of materials such as cement, sand, coarse aggregate required for 1m3 of M25 grade concrete is first

| S. No | Materials | Quantity of materials required for 1m$^3$ | Rate | Per | Total Cost (Rupees) |
|---|---|---|---|---|---|
| 1 | Cement | 8.880 | 370 | Bag | 3285.60 |
| 2 | Fine Aggregates | 0.630 | 550 | M$^3$ | 346.50 |
| 3 | Coarse Aggregates | 1.085 | 630 | M$^3$ | 683.55 |
| 4 | Mixing Charges | 1.000 | 200 | M$^3$ | 200.00 |

Total cost = ₹ 4515.65

Total cost required for 1 m$^3$ of conventional concrete = ₹ 4520.00

COST OF 1 m$^3$ Concrete (QD – 25% & GP – 25% )

| S. No | Quantity of materials required for 1 m$^3$ | Material | Rate | Per | Total Cost (Rupees) |
|---|---|---|---|---|---|
| 1 | 8.880 | Cement | 370 | Bag | 3285.60 |
| 2 | 0.630 | Fine Aggregate - 50% | 550 | M$^3$ | 173.25 |
| | | Quarry Dust - 25% | 450 | M$^3$ | 70.90 |
| | | Granite Powder – 25% | 200 | M$^3$ | 31.50 |
| 3 | 1.085 | Coarse Aggregates | 630 | M$^3$ | 683.55 |
| 4 | 1.000 | Mixing Charges | 200 | M$^3$ | 200.00 |

Total cost = ₹ 4444.80

Total cost required for 1 m$^3$ of conventional concrete = ₹ 4450.00

COST OF 1 m$^3$ Concrete (QD – 30% & GP – 30% )

Cost of 1m$^3$ Concrete

| S.No | Quantity of materials required for 1 m$^3$ | Materials | Rate | Per | Total Cost (Rupees) |
|---|---|---|---|---|---|
| 1 | 8.880 | Cement | 370 | Bag | 3285.60 |
| 2 | 0.630 | Fine Aggregate - 40% | 550 | M$^3$ | 138.60 |
| | | Quarry Dust - 30% | 450 | M$^3$ | 85.05 |
| | | Granite Powder 30% | 200 | M$^3$ | 37.80 |
| 3 | 1.085 | Coarse Aggregates | 630 | M$^3$ | 683.55 |
| 4 | 1.000 | Mixing Charges | 200 | M$^3$ | 200.00 |

Total cost = ₹ 4430.6

Total cost required for 1 m$^3$ of conventional concrete = ₹ 4435.00

calculated. And the cost of materials for their corresponding quantities is multiplied with them.

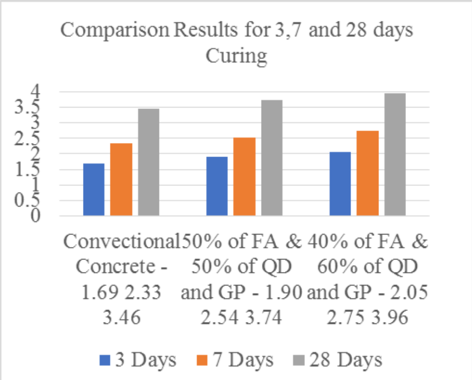



Fig. 1. Graph No: 8.8 Test Results for 3,7- and 28-Days Curing

Mix proportion of M25 grade concrete 1: 1: 2

*1) Cost of convectional concrete for 1 m$^3$*

It is defined as mixture of cement, fine aggregate, coarse aggregate and suitable proportion of water. As per mix design (IS 10262:2019), the following result are obtained for 1 m3 of concrete.

*2) Cement*

Quantity of cement required for 1 m$^3$ of concrete
= 444.40 kgs

No of bags required for 1m$^3$ of concrete
= 444.40/50 = 8.88 bags

*3) Fine aggregate*

Quantity of fine aggregate required for 1 m$^3$ of concrete = 630.11 kgs

In term of fine aggregate as m$^3$ = 630.11/1000
= 0.63 m$^3$

*4) Coarse aggregate*

Quantity of coarse aggregate required for 1 m3 of concrete
= 1085.18 kgs

In term of coarse aggregate as m$^3$
= 1085.18/1000 = 1.085 m$^3$

*5) Water*

Quantity of water required for 1 m3 of concrete
= 200 litres

In term of water as m$^3$ = 200/1000 = 0.200 m$^3$

*6) Current market rate of materials without transportation charges*

- Cement = ₹ 370 per bag
- Quarry Dust= ₹ 450 per m$^3$
- Granite Powder = ₹ 200 per m$^3$
- Fine aggregate= ₹ 550 per m$^3$
- Coarse aggregate = ₹ 630 per m$^3$

Cost of 1m$^3$ Conventional Concrete

## 7. Conclusion

Based on above results the following conclusion can be drawn

- In order to increase Compressive strength and Split tensile strength, Fine aggregate (Natural River Sand) is replaced by quarry dust & granite powder in m25 grade concrete.
- The usage of quarry dust & granite powder is reducing the usage of river sand and to avoid the depletion of natural river sand to the manufacture of concrete of very high strength at early age.
- The usage of quarry dust & granite POWDER in concrete is highly improves the strength, the results carried out the strength in 28 days.

Compressive strength in 28 days = 27.78 $N/mm^2$

Split tensile strength at 28 days = 3.96 $N/mm^2$

## 8. Future Scope

- We can continue this test, replacement of fine aggregates by quarry dust and granite powder with admixtures.
- When we use admixtures, we can reach more results but cost is very high.
- We got more strength up to 35%, 40% replacement of quarry dust and granite powder and got less strength up to 70% replacement. So we can check between 41%-69% replacement of quarry dust and granite powder.

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