# "Testing and Analyzing the Properties of Concrete Prepared with Steel Slag & Marble Powders as Partial Replacement of Cement"

**Prachi Dixit[1]**
*PG Student*
*Dept. of Civil Engineering,*
*I.C.E. College of Engineering & Technology*

**Deependra Kumar Varshney[2]**
*Assistant Professor*
*Dept. of Civil Engineering,*
*I.C.E. College of Engineering & Technology*

---

**ABSTRACT:** The current work includes researching the mechanical properties, for example, compression quality, parting elasticity, and flexural quality of traditional solid which are contrasted and the consequences of M30 grade acquired by the halfway substitution of a mix of steel slag powder and marble powder with concrete. On supplanting of concrete with steel slag powder and marble powder at 5%, 10%, 15%, 20%, 25% and 30% by weight of concrete. Quickened restoring is received which by and large invigorates early when contrasted with ordinary relieving.

Concrete is the most adaptable utilized material which requires the enormous amount of port land concrete. Be that as it may, the creation of Normal Portland Concrete (OPC) produces a lot of which is contaminating the environment. Henceforth it is unavoidable to locate an elective material. The blend of marble powder and stone powder concrete is an imaginative development material which will be delivered by the substance activity of inorganic atoms.

For every substitution functionality and quality tests was directed. All quality tests following 3 days, 14 days, and 28 days restoring was acquired. The marble dust powder and rock dust powder are liberated from cost. Consequently, it is by all accounts prudent.

***KEYWORDS:***

Quality and normal for concrete, rigidity, compression quality, and steel slag powder, marble powder, concrete, and so forth.

## 1. INTRODUCTION

Concrete is the single most broadly utilized construction material on the planet today. It is utilized in structures, spans, walkways, expressway asphalts, house development, dams, and numerous different applications. The way in to solid and strong cement is the blend extents between the different parts. Less concrete glue can prompt more voids, in this way less quality and solidness while greater concrete glue can prompt more shrinkage and less sturdiness. The degree and the proportion of fine totals to coarse totals can influence quality and porosity. The blend configuration ought to likewise accomplish the ideal functionality of cement in order to forestall isolation and allow for simplicity of arrangement. Normally, a solid blend is about 10% to 15% concrete, 25% to 30% sand, 40% to 45% percent total and 15% to 20% water. Entrained air (5% to 7%) is additionally added to cement to improve solidness. Cement should have enough compressive quality and flexural solidarity to help applied burdens. Simultaneously it ought to have great toughness to expand its structure life and lessen upkeep costs. As a rule, solid will have great protection from freeze and defrost scraped spot, sulfate responses, bright radiation, seawater, soluble base silica response, and chlorides. The degree and maximum size of totals are significant parameters in any concrete mix. They influence relative extents in blend, usefulness, economy, porosity and shrinkage of cement. Stone powder, a waste material from the rock cleaning industry, is promising materials for use in concrete like those of pozzolanic materials, for example, silica see the, fly debris, slag, and others. These items can be utilized as a filler material (subbing sand) to diminish the void substance in concrete. Rock powder is a modern result got from pounding of stone and stone cleaning industry in a powder structure. It is additionally created from reusing marble tops, terrazzo, rock pavers, and stone pieces and disposes of. Whenever left all alone and isn't appropriately gathered and put away, the fine rock powder can be effectively be airborne and will mess wellbeing up and natural contamination.

Inward breath of stone powder fine particles is a wellbeing peril and is a reason for lung sicknesses particularly for individuals living close to rock plants. In this current work, rock powder is utilized as fractional substitution of sand in concrete in various rate and the related compressive quality, flexural, and parting rigidities of cement have been assessed. Thusly, characteristic assets of sand can be saved and the wellbeing perils of these modern squanders are limited. Reusing of rock residue will keep these losses from winding up in landfills and gives moderate, eco-accommodating, strong stone for different employments. Reused tiles produced using reused glass or squanders from mines or manufacturing plants have been utilized for floors, ledges, and dividers. Earthenware tiles may be made from factory waste (known as post-industrial waste) created by the creation of regular tiles. Flotsam and jetsam arrangement from fireclay tiles consolidates post-modern and post-purchaser reused squanders. The Flotsam and jetsam arrangement tile comprises of 26% reused stone residue (post-industrial waste) from a rock cutting activity. It likewise contains 26% reused glass (post-buyer squander).

## 2. LITERATURE REVIEW

This area of Composing Outline at long last reveals a couple of real factors of cement arranged with steel slag &marble powders subject to the assessment of various authors work as follows:

Shehdeh Ghannama1, HusamNajmb2, Rosa Vasconez3 (2016), concentrated on "Trial investigation of cement made with stone and iron powders as Halfway substitution of sand" get the This study was restricted to the assessment of the mechanical properties of concrete with rock powder and iron powder also its workability and smoothness. The more drawn out term execution of concrete with rock powder and iron powder was not some portion of this study. Durability is significant for the correct utilization of this material in structural as well as non-basic applications and will be explored in a future study. [1].

RochakPandey1, Prof. M.C.Paliwal2, Jatin Mehta3, Jeet N Tiwari4 (2016), chipped away at "ideal fractional supplanting of concrete in concrete with squander Marble dust related to super plasticizers", It was finished up from this examination that Droop estimation of cement will in general increment with increment in substitution level of concrete. An augmentation of 44 % in droop esteem was found at 15% substitution of concrete when contrasted with ordinary cement was watched. In spite of the fact that droop estimation of cement further increments with increment in rate substitution of concrete in concrete. At 20 % substitution 50 % augmentation was watched. [2].

Gurcharan Singh1, Dr. S. K. Madan2 (2018), performed on "Toughness of Cement made with Marble Residue as halfway substitution of Concrete exposed to Sulfate assault", emplacement of marble dust with the concrete doesn't create any unfriendly impact on the exhibition of cement as far as compressive quality, water retention and strength. [3].

K.Sathish Kumar1, B.kaviya2 (2018), concentrated on "exploratory examination on fractional supplanting of concrete with marble powder" In this trial study the 3D shape and chambers were casted with various rates of OPC + marble powder (0% , 5% , 10% ,15%), and To limit the expenses for development with use of marble powder which is inexpensively accessible. [4].

Md Mahboob Ali1, Prof. S.M.Hashmi 2 (2014), performed on "An Exploratory Examination on Qualities Attributes of Cement with the Fractional Substitution of Concrete by Marble Powder Residue and Sand by Stone Residue", The Compressive quality of Blocks are expanded with expansion of waste marble powder up to 10% supplant by weight of concrete and further any expansion of waste marble powder the compressive quality abatements. [5].

Shereen K. Amin1, Mostafa E. Allam2, Gihan L. Garas3 and Hisham Ezz4 (2020), took a shot at "An investigation of the substance impact of marble and rock slurry on green mortar compressive quality", This outcome is proving with the concoction sythesis examination led by Bruna et al. (2018), which uncovered that the principle segments of the stone waste were silica (42.80%), calcium oxide (19.00%), and aluminum trioxide (8.07%) along with modest quantities of different oxides. [6].

## 3. MATERIALS AND METHODOLOGY

### 3.1. MATERIALS

3.1.1. Cement

Cement is a fastener, a substance utilized for development that sets, solidifies, and clings to different materials to tie them together. Concrete is rarely utilized all alone, yet rather tie sand and rock (total) together. Concrete blended in with fine total produces mortar for stone work, or with sand and rock, produces concrete. Concrete is the most generally utilized material in presence and is just behind water as the planet\'s most-expended asset. Concretes utilized in development are normally inorganic, frequently lime or calcium silicate based, which can be described as non-pressure driven or pressure driven separately, contingent upon the capacity of the concrete to set within the sight of water (see pressure-driven and non-water-driven lime mortar).

### 3.1.2. Components of Cement:

**Table 3.1: Physical Properties of cement**

| Sl.No. | Characteristics | Values Obtained Experimentally | Values Specified By IS 12269:1987 |
|---|---|---|---|
| 1. | Specific Gravity | 3.15 | - |
| 2. | Standard Consistency, percent | 34 | - |
| 3. | Initial Setting Time, minutes | 65min | 30 (minimum) |
| 4. | Final Setting Time, minutes | 525min | 600 (maximum) |

**Table 3.2 Chemical Properties of cement**

| Chemical content | Amount(%) |
|---|---|
| Calcium oxide (CaO) | 60-67 |
| Silicon dioxide($SiO_2$) | 17-25 |
| Aluminum Oxide($Al_2O_3$) | 3-8 |
| Iron Oxide ($Fe_2O_3$) | 0.5-6 |
| Magnesium oxide(Mgo) | 0.1-4 |
| Sodium Oxide ($Na_2O$) | 0.2-1.3 |
| Potassium Oxide ($K_2O$) | 0.2-1.3 |
| Potassium Oxide ($K_2O$) | 1-3 |

### 3.1.3. Concrete

Concrete is a composite material made out of fine and coarse total reinforced along with a liquid (concrete glue) that solidifies (fixes) after some time. In the past lime based concrete covers were regularly utilized, for example, lime clay, however at times with other water driven concretes, for example, a calcium aluminate concrete or with Portland concrete to shape Portland concrete cement (for its visual similarity to Portland stone). Numerous other non-cementitious sorts of solid exist with different strategies for restricting total together, incorporating black-top cement with a bitumen cover, which is much of the time utilized for street surfaces, and polymer cements that utilization polymers as a folio.

**Table: 3.3. Components of Cement**

| Oxide compounds (mass %) | CEM I 42.5 | Marble Dust (Cherry) |
|---|---|---|
| $SiO_2$ | 21.12 | 28.35 |
| $Al_2O_3$ | 5.62 | 0.42 |
| $Fe_2O_3$ | 3.24 | 9.70 |
| CaO | 62.94 | 40.45 |
| MgO | 2.73 | 16.25 |
| Density ($g/cm^3$) | 3.10 | 2.80 |

### 3.1.4. Concrete mixture (coarse aggregate)

A solid blender (regularly informally called a concrete blender) is a gadget that homogeneously joins concrete, total, for example, sand or rock, and water to shape concrete. A regular solid blender utilizes a spinning drum to blend the parts. For littler volume works, compact solid blenders are regularly utilized with the goal that the solid can be made at the building site, giving the laborers sufficient opportunity to utilize the solid before it solidifies. An option in contrast to a machine is blending concrete by hand. This is normally done in a push cart; notwithstanding, a few organizations have as of late sold changed coverings for this reason. The solid blender was imagined by Columbus, Ohio industrialist Gebhardt Jaeger.

### 3.1.5. Steel slag

Steel slag, a result of steel making, is created during the detachment of the liquid steel from polluting influences in steel-production heaters. The slag happens as a liquid fluid soften and is a mind boggling arrangement of silicates and oxides that cements after cooling. For all intents and purposes all steel is currently made in incorporated steel plants utilizing a rendition of the essential oxygen process or in forte steel plants (smaller than usual factories) utilize an electric circular segment heater process. The open hearth heater process is not, at this point utilized. In the essential oxygen process, hot fluid impact heater metal, piece, and motions, which comprise of lime (CaO) and dolomitic lime (CaO.MgO or \"dolime\"), are charged to a converter (heater). A spear is brought down into the converter and high-pressure oxygen is infused. The oxygen joins with and evacuates the polluting influences in the charge. These contaminations comprise of carbon as vaporous carbon monoxide, and silicon, manganese, phosphorus and some iron as fluid oxides, which join with lime and dolime to frame the steel slag. Toward the finish of the refining activity, the fluid steel is tapped (poured) into a scoop while the steel slag is held in the vessel and hence took advantage of a different slag pot. There are numerous evaluations of steel that can be delivered, and the properties of the steel slag can change altogether with each evaluation. Evaluations of steel can be named high, medium, and low, contingent upon the carbon substance of the steel. High-grade prepares have high carbon content. To diminish the measure of carbon in the steel, more noteworthy oxygen levels are required in the steel-production process. This additionally requires the option of expanded degrees of lime and do lime (transition) for the expulsion of debasements from the steel and expanded slag development. There are a few distinct kinds of steel slag created during the steel-production process. These various sorts are alluded to as heater or tap slag, raker slag, engineered or spoon slags, and pit or cleanout slag. Figure 18-1 presents a graph of the general stream and creation of various slags in a cutting edge steel plant.

**Table: 3.4. Steel slag chemical composition**

| Constituent | Composition (%) |
|---|---|
| CaO | 40 - 52 |
| $SiO_2$ | 10 - 19 |
| FeO | 10 - 40 (70 - 80% FeO, 20 - 30% Fe2O3) |
| MnO | 5 - 8 |
| MgO | 5 - 10 |
| $Al_2O_3$ | 1 - 3 |
| $P_2O_5$ | 0.5 - 1 |
| S | < 0.1 |
| Metallic Fe | 0.5 - 10 |

The steel slag delivered during the essential phase of steel creation is alluded to as heater slag or tap slag. This is the significant wellspring of steel slag total. Subsequent to being tapped from the heater, the liquid steel is moved in a scoop for additional refining to evacuate extra contaminations despite everything contained inside the steel. This activity is called spoon refining since it is finished inside the exchange scoop. During scoop refining, extra steel slags are created by again adding transitions to the spoon to dissolve. These slags are joined with any remainder of heater slag and help with engrossing deoxidation items (incorporations), heat protection, and security of spoon refractories. The steel slags created at this phase of steel making are for the most part alluded to as raker and spoon slags.

### 3.1.6. Marble dust

Marble dust is squashed or ground marble particles that can even now be framed to make a strong item. Squander marble powder is created as a result during cutting of marble. The waste is roughly in the scope of 20% of the all out marble dealt with. The measure of waste marble powder produced at the examination site each year is considerable being in the scope of 250-400 tons. The residue is utilized in a lot a larger number of occasions than marble itself as a result of its lower cost and flexibility. Marble dust is ordinarily blended in with concrete or saps to make refined marble, which seems to be like genuine marble. At the point when total is blended in with dry Portland concrete and water, the blend frames a liquid slurry that is effectively emptied and formed into shape. The concrete responds with the water and different fixings to shape a hard framework that ties the materials together into a solid stone-like material that has numerous employments.

The marble cutting plants are dumping the powder in any close by pit or empty spaces, close to their unit despite the fact that informed regions have been set apart for dumping. This prompts genuine natural and residue contamination and control of huge territory of land particularly after the powder evaporates. This likewise may prompt tainting of the underground water saves.

**Table: 3.5. Typical Marble dust chemical composition**

| Oxide compounds | Marble dust (mass %) |
|---|---|
| Sio2 | 28.35 |
| Al2o3 | 0.42 |
| Fe2O3 | 9.70 |
| Cao | 40.45 |
| Mgo | 16.25 |
| Density (g/cm$^3$) | 2.80 |

### 3.2. Methodology

Concrete is the significant crude material utilized in any development. In this way nature of concrete must be checked before utilizing it as a structure material. Following tests can be performed on concrete in research center to check its quality.

### 3.2.1. Test procedure.

Slick concrete glue is set up by measuring concrete with 0.85 occasions the water required to give a glue of standard consistency. The stop watch is begun at the moment water is added to the concrete. The form laying on a nonporous plate is filled totally with concrete glue and the outside of filled glue is leveled smooth with the highest point of the shape. The test is led at room temperature of 27± 2°C. The shape with the concrete glue is put in the Vicat's mechanical assembly and the needle is brought down tenderly in contact with the test square and is then immediately discharged. The needle in this way infiltrates the test square and the perusing on the Vicat's device graduated scale is recorded. The method is rehashed until the needle neglects to puncture the square by around 5 mm estimated from the base of the shape. The stop watch is pushed off and the time is recorded which gives the underlying setting time. The concrete is viewed as at last set when after applying the needle tenderly to the outside of test hinder, the needle establishes a connection, however the connection neglects to do as such.

The accompanying philosophy was led on the distinctive material to know their physical and building properties.

- Normal consistency and fineness of concrete
- Initial and last setting occasions of concrete
- Specific gravity of concrete
- Soundness of concrete

- Compressive quality of concrete
- Specific gravity of sand
- Bulking of sand
- Fineness modulus of fine total
- Fineness modulus of coarse total
- Flakiness file
- Elongation file
- Specific gravity of coarse total
- Usefulness of cement

### 3.2.2. TESTS ON CEMENT

Cement is the major raw material used in any construction. Therefore quality of cement must be checked before using it as a building material. Following tests can be performed on cement in laboratory to check its quality.

**Fig: 3.1. (a). Compressive strength of cube.**


**Fig: 3.1. (b). Flexural strength of beam.**

**Fig: 3.1. (c). Split tensile strength of cylinder.**

**Fig: 3.1. Different testing stages of concrete prepared by marble powder & steel slag**

### 3.2.3. NORMAL CONSISTENCY

To decide typical consistency of concrete by utilizing vicat‟s device the ordinary consistency of concrete past is characterized as level of water which allows the vicat unclogger to enter to a point 5 to 7mm from the base or 33-35mm from the highest point of the shape when the given concrete past is tried. Take around 500 Gms of concrete and set up a glue with a gauged amount of water (say 24 percent by weight of concrete) for the main path. The blending ought to be done in the middle of 3-5 min; the time is checked from the hour of adding water to dry concrete until the beginning of filling mold. After totally filling the shape, shake the form to remove air. Fill the vicat form with the glue, the shape is opposing on a non-permeable plate and then smooth off the outside of the glue making it level with the highest point of the form.

**Fig: 3.2. Vicat apparatus for Normal consistency**

Paste the test block in the mould together with non-porous resisting place under the load bearing the plunger; lower the plunger of 50mm long and 10mm dia gently to

Mixture design

Test results for mix design

Characteristic compressive strength required

In the field at 28 days = 30 Mpa

Maximum size of aggregate = 20mm

Degree of workability (specified or not) = 25-50 mm

Type of exposure = moderate

Minimum cement (if specified) = 350 kg/m$^3$

Minimum cement (if specified) = opc 35 grade

Test data for materials = 2.62

Cement used specified gravity of, 1. Fine aggregate, 2. Coarse aggregates (20mm) = 2.69

Specific gravity of cement = 3.15

Sand corresponds of zone = Zone II

The target mean strength is determined using following relation

Ft = 30 + (1.65*5) = 38.25 Mpa

Ft = Fck + (t*s)

Target mean stength of concrete = 38.25 Mpa

Where Ft = target mean strength = 28 days

Fck = characteristics compressive strength = 28 days.

Assuming not more than 5% results are expected to fall below to characteristic compressive strength. In which cases the value of „t" is 1.65 standard deviation for M30 grade of concrete is 5 (from table 8 of IS 456). Selection of w/c ratio corresponding to the target mean strength of 38.25 MPa = 0.4 (from table 5 of IS 456, maximum water-cement ratio = 0.45) From Table. IS: 10262-2009 for nominal maximum size of aggregate 20 mm, the maximum water content is 186 liters per cubic meter. For change in value of w/c ratio the following adjustments are required according to IS: 10262-2009 in water content and percentage of sand in total aggregate. Selection of water and sand content water per cubic meter for 20 mm maximum size of aggregate and sand of zone II water content per cubic meter of concrete is 186 Kg and sand content (as % of total aggregate) = 35% This cement is adequate for moderate exposure condition.

**3.2.4. Determination of Cement content:**

Water / Cement ratio = 0.4

Required water content = 186 Lts/m3

Cement content = 186/0.4 = 465

Kg/m3 Volume of concrete = 1 m3

Volume of cement = [465/3.15] x [1/1000] = 0.147 m3

Volume of water = [186/1] x [1/1000] = 0.186 m3

Volume of all in aggregates € = a – (b + c) = 1– (0.147 + 0.186) = 0.667 m$^3$

Volume of coarse aggregates = e x Volume of CA x specific gravity of CA = 0.667 x 0.65 x 2.69 x 1000 = 1166.24 kg

Volume of fine aggregates = e x Volume of FA x specific gravity of FA = 0.667 x 0.35 x 2.62 x 1000 = 611.64 kg

### 4. RESULTS AND DISCUSSION

#### 4.1. Compressive strength

Total no of cubes casted for 3 days = 7

Total no of cubes casted for 14 days = 7

Total no of cubes casted for 28 days = 7

Total no of cubes casted for compressive test = 21

**Table: 4.1. Compressive strength of concrete with marble dust and steel slag**

| % of replacement of cement with marble dust and steel slag | Compressive strength of the concrete at different ages (N/mm²) | | |
|---|---|---|---|
| % of replacement | 3 days | 14 days | 28 days |
| 0 | 32.39 | 46.41 | 51 |
| 5 | 30.89 | 41.51 | 46.83 |
| 10 | 19.08 | 34.01 | 31.99 |
| 15 | 19.80 | 25.46 | 24.67 |
| 20 | 16.42 | 18.25 | 21.90 |
| 25 | 8.20 | 8.52 | 13.61 |
| 30 | 3.89 | 2.57 | 4.95 |

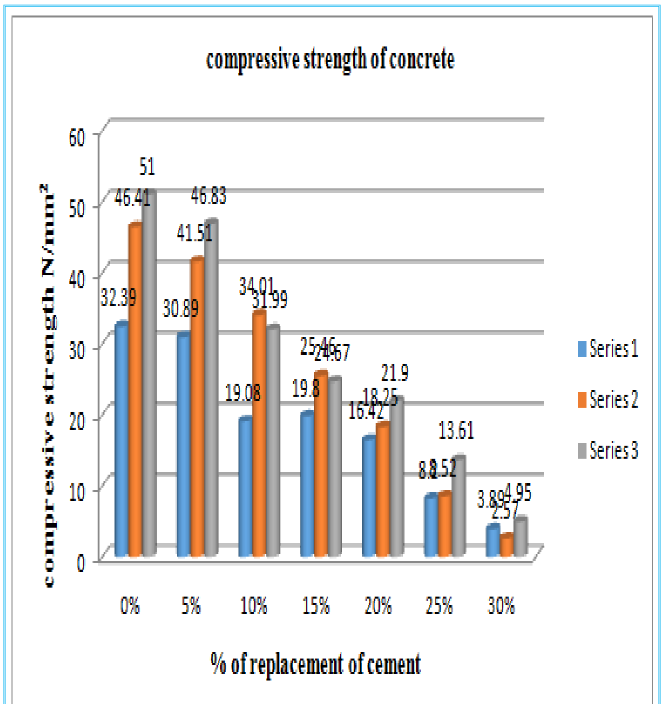


**Fig: 4.1. Compressive strength of concrete with marble dust and steel sla**

#### 4.2. FLEXURAL STRENGTH

Total No of beams casted for 3 days = 7

Total No of beams casted for 14 days = 7

Total No of beams casted for 28 days = 7

Total No of beams casted for Flexural test = 21

**Table: 4.2. Flexural strength of concrete with marble dust with steel slag**

| % of replacement cement with marble dust and steel slag | Flexural strength of concrete at different ages (Nmm²) | | |
|---|---|---|---|
| % of replacement | 3 days | 14 days | 28 days |
| 0 | 15.20 | 21.82 | 24.91 |
| 5 | 14.92 | 20.21 | 20.94 |
| 10 | 8.42 | 12.82 | 13.72 |
| 15 | 7.82 | 8.62 | 10.01 |
| 20 | 6.9 | 8.71 | 9.85 |
| 25 | 3.9 | 4.21 | 7.31 |
| 30 | 1.65 | 2.19 | 2.34 |

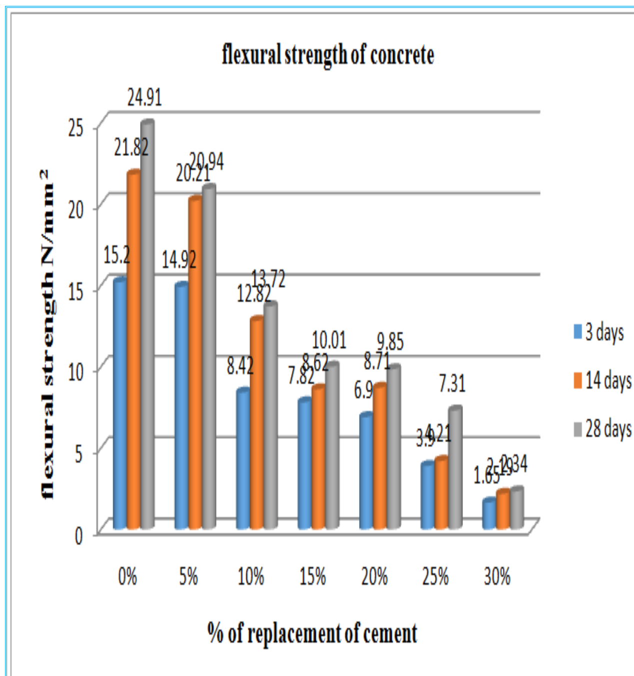


**Fig: 4.2. Flexural strength of concrete with marble dust with steel slag**

### 4.3. SPLIT TENSILE STRENGTH

Total No of cylinders casted for 14 days =7

Total No of cylinders casted for 3 days = 7

Total No of cylinders casted for 28 days =7

Total No of cylinders casted for split tensile test = 21

**Table: 4.3. Split tensile strength of concrete with marble dust and steel slag**

| % of replacement cement with marble dust and steel slag | Split tensile strength of concrete at different ages (Nmm²) | | |
|---|---|---|---|
| % of replacement | 3 days | 14 days | 28 days |
| 0 | 3.20 | 4.57 | 5.23 |
| 5 | 3.51 | 4.96 | 4.99 |
| 10 | 1.84 | 3.85 | 3.92 |
| 15 | 1.52 | 2.15 | 2.89 |
| 20 | 1.42 | 1.23 | 2.43 |
| 25 | 0.93 | 0.67 | 0.74 |
| 30 | 0.65 | 0.62 | 0.65 |

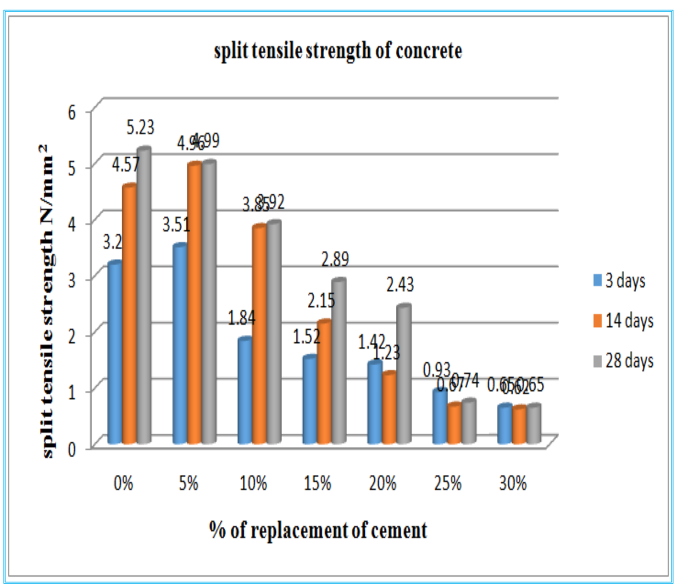


**Fig: 4.3. Split tensile strength of concrete with marble dust and steel slag**

### 4.4. CONCLUSION AND FUTURE WORK.

In this project, the performance of the combination of marble and granite dust concrete with different replacement levels of cement at 0%, 5%, 10%, 15%, 20%, 25%, 30% were studied. In this study totally 63 specimens were tested. The Compressive strengths, split tensile strength and flexural strength of the concrete mixes test results are compared with 9 specimens tested under conventional concrete method at 3,14 and 28 days. Based on the experimental study, the following observations are made. After 10% replacement the all mechanical strengths are gradually decreased.

1. In previous experimental investigation the compressive strength, flexural strength, split tensile strength are increased up to 10% replacement of cement with granite dust. After 10% replacement the all mechanical strengths are gradually decreased.

2. In this investigation for each replacement of cement with combination of marble and granite dust, the all mechanical strengths are gradually decreased from 5% to 30%.

3. The replacement of cement is suitable for only for single replacement of either marble dust or granite dust. The combinations this two ingredients are not suitable for replacement of cement. The workability of concrete mix is decreased with increase percentage of marble and granite dust.

### ACKNOWLEDGMENTS

Prachi dixit is a final year M.Tech student from Civil Department at I.E.C.College of engineering & technology. by her research work performance she has optimize all parameters of work with guide Deependra Kumar varshney. The authors are thankful to the guide for his coordination and support to complete research work.

### REFERENCES

[1]. Shehdeh Ghannama[1], HusamNajmb[2], Rosa Vasconez[3] (2016), "Experimental study of concrete made with granite and iron powders as Partial replacement of sand", Department of Civil Engineering, California Polytechnic and State University, Pomona, CA, USA, http://dx.doi.org/10.1016/j.susmat.2016.06.001, 2214-9937/© 2016 Elsevier B.V. All rights reserved.

[2]. International journal of engineering sciences & research Technology, m .tech scholar (civil), department of civil and environment engineering, nitttr, bhopal, india, doi: 10.5281/zenodo.60769, [pandey**et al.,* 5(8):august, 2016] issn: 2277-9655, Ic™ value: 3.00 impact factor: 4.116.

[3]. Gurcharan Singh[1], Dr. S. K. Madan[2] (2018), "Durability of Concrete made with Marble Dust as partial replacement of Cement subjected to Sulphate attack", World, Vol. 23, No. 11, pp. 151-160, 2018.

[4]. K.Sathish Kumar[1], B.kaviya[2] (2018), "experimental study on partial replacement of cement with marble powder", International Journal of Pure and Applied Mathematics Volume 119 No. 12 2018, 9591 9600, ISSN: 1314-3395 (on-line version), url: http://www.ijpam.eu.

[5]. Md Mahboob Ali[1], Prof. S.M.Hashmi [2] (2014), "An Experimental Investigation on Strengths Characteristics of Concrete with the Partial Replacement of Cement by Marble Powder Dust and Sand by Stone Dust", Journal of Engineering Research and Applications www.ijera.com ISSN : 2248-9622, Vol. 4, Issue 9( Version 1), September 2014, pp.203-209.

[6]. DR. K. R. DESAI (2017)' "facial feature extraction uses lbp with gabor filter", novateur publications, international journal of innovations in engineering research and technology [ijiert], issn: 2394-3696, volume 4, issue 4, apr.-2017.

[7]. Shereen K. Amin[1], Mostafa E. Allam[2], Gihan L. Garas[3] and Hisham Ezz[4] (2020), worked on "A study of the chemical effect of marble and granite slurry on green mortar compressive strength", Bulletin of the National Research Centre.

[8]. Jayant sharma[1], Basantkumar Bansal[2], Rupal Sankhla[3], Dr. Anju Sharma[4] (2017), "Analysis of Mechanical and Durability Characteristics of Concrete using Granite slurry waste and Metakaolin as a partial replacement of Cement", Scientific Journal of Impact Factor (SJIF): 4.72, International Journal of Advance Engineering and Research Development, Volume 4, Issue 11, November - 2017, e-ISSN (O): 2348-4470, p-ISSN (P): 2348-6406.

[9]. G.Anjaneyulu[1] and M. Srinivasa Rao[2] (2017), "An experimental analysis of strength characteristics of concrete using partial replacement of cement by granite dust and marble dust", aijreas volume 2, issue 5 (2017, may) (issn-2455-6300) online anveshana's international journal of research in engineering and applied sciences.

[10]. Revati P. Sawant[1], Sudhanshu Pathak[2], and Sachin Mane[3] (2019), "Partial Replacement of Cement with Combination of Alccofine and Marble Dust for Development of Sustainable Concrete", International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue-4, November 2019.

[11]. PS Naufal Rizwan[1], M Franchis David[2], S Jansi Sheela[3] and S Daniel Raj[4] (2017), "Effect of Industrial Waste as Partial Replacement of Ingredients in Ultra High Strength Concrete: A Review", Journal of Chemical and Pharmaceutical Research, 2017, 9(12):191-194, ISSN: 0975-7384 CODEN (USA): JCPRC5, *Available online www.jocpr.com.*

[12]. Irem Zeynep Yildirim[1] and Monica Prezzi[2] (2011), "Chemical, Mineralogical, and Morphological Properties of Steel Slag" Hindawi Publishing Corporation, Advances in Civil Engineering, Volume 2011, Article ID 463638, 13 pages, doi:10.1155/2011/463638.

## BIOGRAPHIES

**Prachi Dixit**, M.Tech student from Civil Department, at I.E.C. College of Engineering & Technology.