# UTILIZATION OF WASTE MARBLE POWDER IN CEMENT-BASED PRODUCTS BY INCORPORATING NANO SILICA

A PROJECT REPORT

*Submitted in partial fulfilment of requirements for award of degree*

*of*

**BACHELOR OF TECHNOLOGY**

**IN**

**CIVIL ENGINEERING**

*Under Supervision*

*Of*

**Dr. Ashok Kumar Gupta**

**(PROFESSOR AND HEAD OF CIVIL DEPARTMENT)**

*By*

**Ritanjay (161601)**

**Shubang Malgotra (161661)**

**Saksham Mahajan (161675)**

**JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY**

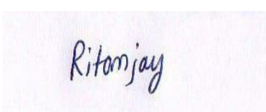
**WAKNAGHAT, SOLAN-173234**

**HIMACHAL PRADESH,INDIA**

**May, 2020**

# STUDENTS DECLARATION

We hereby declare that work presented in Project report entitled **"UTILIZATION OFWASTE MARBLE POWDER IN CEMENT-BASED PRODUCTS BY INCORPORATING NANO SILICA**" submitted for partial fulfilment of requirements for degree of Bachelor of Technology in Civil Engineering at **Jaypee University OfInformation Technology**is an authentic record of our work carried out under supervision of **Dr. Ashok Kumar Gupta, (Professor and Head of Department, Civil Engineering).**This work has not been submitted elsewhere for reward of any or degree/diploma. We are fully responsible for the contents of our project report.



| | | |
|---|---|---|
| Ritanjay | ShubangMalgotra | SakshamMahajan |
| 161601 | 161661 | 161675 |

Department of Civil Engineering

Jaypee University Of Information Technology Waknaghat, India

DATE :-2nd JUNE, 2020

# CERTIFICATE

This is to certify that the work which is being presented in the project report titled "**UTILIZATION OF WASTE MARBLE POWDER INCEMENT-BASED PRODUCTS BY INCORPORATING NANO SILICA**" in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering submitted to the department of Civil Engineering , **Jaypee University of Information Technology, Waknaghat** is an authentic record of work carried out by **Ritanjay (161601), ShubangMalgotra(161661) & Saksham Mahajan(161675)** during a period from August, 2019 to November 2019 under the supervision of **Dr. Ashok Kumar Gupta**, **Professor and Head of the Department of Civil Engineering**, Jaypee University of Information Technology,Waknaghat.

The above statement made is correct to the best of our knowledge

Date: 2nd June, 2020

Signature of Supervisor
Dr. Ashok Kumar Gupta
Professor and Head
Department of Civil Engineering
JUIT, Waknaghat

Signature of HOD
Dr. Ashok Kumar Gupta
Professor and Head
Department of Civil Engineering
JUIT, Waknaghat

Signature of External Examiner

# ACKNOWLEDGEMENT

We take this opportunity to acknowledge all who has been great sense of support and inspiration throughout the project work successful. There are lots of people who inspired us and worked for us in every possible way to provide detail about various related topics .Thus, making our report work a success. Our first gratitude goes to our Head of department, **Dr. Ashok Kumar Gupta** for his guidance, encouragement and support.

We are grateful to **Dr. Ashok Kumar Gupta** , **Professor and Head** of Civil department and assistant professor **Mr. Abhilash Shukla** for their diligence, guidance, encouragement and helped throughout the period of project, which has enabled us to complete project work in time. Their insight and creative ideas are always the inspiration for us during the dissertation work.

We would also like to thank **Mr. Itesh Singh**(Lab Technician) of the department of Civil Engineering at Jaypee University of Information Technology Waknaghat, Solan (H.P.). His presence and guidelines regarding the experimental work helped us to achieve our results. Without his involvement it won't be easy to get the accurate results.

Finally, we must express our very proud found gratitude to our parents for providing us with unfailing support and continuous encouragement throughout our period of study and through the process of researching and writing this report. This accomplishment would not have been possible without them.
Thank you.

# ABSTRACT

Currently, Cement is in demand construction material because it possesses high compressive strength and sturdiness tons of studies are done on cement to improvise its properties for economical and 1environmental point of view. The study on waste materials as partial replacement of cement have shown positive results for an equivalent. With the utilization of waste materials, the quantity of cement required for construction certainly reduces thus making construction economical and also safeguards the environment. during this study , an effort was made to enhance the mechanical properties of cement by utilizing Waste Marble Powder and incorporation Nano Silica. Results demonstrated that the replacement of cement by WMP increases the setting time and fluidity but on the opposite hand decreases the compressive strength of cement specimen. While use of NS, increases the compressive strength and reduces the setting time and fluidity of cement. This was because Nano Silica promotes the hydration process in cement. Different proportions of WMP(0%, 10%, 20%, 30%) and NS(0%, 0.5%, 1%, 1.5%, 2%, 2.5%, 3%) were taken to seek out the simplest suitable mix proportion. Cement mortar and concrete was utilized in this study. The specimen was tested at 7 , 14 and 28 days of curing period for the determination of compressive strength. The discoveries were relied upon to advertise the utilization of WMP in Cement based materials.



**Keywords:-** Nano silica, Waste marble powder, Microstructure, Compressive strength.

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# LIST OF ABBREVIATIONS

| | |
|---|---|
| **WMP** | **Waste Marble Powder** |
| **NS** | **Nano Silica** |
| **XRD** | **X-Ray Diffraction** |
| **XRF** | **X-Ray Fluorescence** |
| **PSD** | **Particle Size Distribution** |
| **SEM** | **Scanning Electron Microscope** |
| **MP** | **Marble Powder** |
| **WMD** | **Waste Marble Dust** |
| **WMDC** | **Waste Marble Dust Cement** |
| **MPC** | **Magnesium Phosphate Cement** |
| **FA** | **Fly Ash** |
| **SCC** | **Self Compacting Concrete** |
| **RA** | **Recycled Aggregates** |
| **OPC** | **Ordinary Portland Cement** |

# CHAPTER-I

# 1.2 INTRODUCTION

## 1.1 General

In this study, most aim of this is often to partially replace cement by Squander materials like Squander marble powder as an additive. within cement and concrete based industries interest of supplementary materials is expanding as of late, refore it had been suggested to use cement and waste products as a replacement. this is often done considering saving of natural resources consumption and chance of extinction of those minerals. Using waste marble powder because replacement not only lowers cement content within mixture but also helps in decreasing environmental pollution caused by WMP. refore, maximum utilization of marble waste within various in powderial sectors, especially construction, agricultural and paper would help to guard environment. Marble are often wont to enhance properties of cement based materials. Utilization of waste marble powder as cementitious material in preparation of concrete also will induce a relief on waste disposal issues.

Marble referred to as metamorphic rocks, changed from unadulterated limestone, are progressively used in building construction process in India. Squander marble is customarily used as untreated .Marble powder is that waste which is generated from marble finishing industries in construction which has similar physical and chemical actions of sand and utilized with cement.

## 1.2MORTAR:-

Mortar is a material utilized instone work improvement to fill openings between blocks and squares utilized in development. Mortar is a blend of sand, a folio, for example, concreteor lime, and water and is applied as a glue which at that point sets hard.

**Fig1.1** Cement mortar mix

**1.1.1 CementMortar :**

Cement mortar is a kind of mortar where cement is utilized as restricting material and sand is utilized as fine total. Contingent on ideal quality, concrete to sand extent of concrete mortar differs from 1:2 to 1:6.

**Types Of Cement Mortar:-**

**a) Type N concrete mortar-**

Type N mortar mix has a medium compressive quality and it is made out of 1 area Portland solid, 1 segment lime, and 6 segments sand. It is seen as a generally helpful mix, important for above assessment, outside, and inside weight bearing foundations. It is similarly supported mortar mix for fragile stone workmanship. It ordinarily achieves 28-day quality in extent of 750 pounds for each square inch (psi).

**b) Type M concrete mortar-**

Type M mortar mix has most essential proportion of Portland concrete and is recommended for considerable weights and underneath grade applications, including foundations, holding dividers, and carports. While type M mortar gives at any rate 2,500 psi of compressive quality, it offers commonly poor security and fixing properties.

**c) Type S concrete mortar-**

Offering a high compressive nature of in excess of 1,800 psi and a high-pliable bond quality, type S mortar is sensible for certain exercises at or underneath grade. It performs inconceivably well to withstand soil weight and wind and seismic weights. Despite way that type S mortar must have a base compressive nature of 1,800 psi, it is every now and again mixed for characteristics some place in scope of 2,300 and 3,000 psi.

**1.2.2 Lime Mortar:-**

Lime mortar is a sort of mortar where lime (fat lime or water powered lime) is utilized as restricting material and sand is utilized as fine total. lime to sand extent of concrete mortar is kept 1:2. pyramids at Giza are put with lime mortar.

**1.2.3 Gauged Mortar:-**

Measured mortar is a sort of mortar where concrete and lime both are utilized as restricting material and sand is utilized as fine total. Fundamentally, it is a lime mortar where concrete is added to increase higher quality. procedure is known as checking. concrete to lime extent changes from 1:6 to 1:9. Checked mortar is conservative than concrete cement and furthermore have higher quality than lime mortar.

**1.2.4 Surkhi Mortar:-**

This kind of mortar is set up by using totally surkhi instead of sand or by replacing half of sand in case of fat lime mortar. powder of surkhi should be adequately fine to pass BIS No. 9 sifter and development should not be over 10% by weight. surkhi mortar is used for stand ard workmanship work of different kinds in foundation and superstructure. In any case, it can't be used for putting or pointing since surkhi is likely going to disintegrate after some time".

**1.2.5 Mud Mortar:-**

Mud mortar is a sort of mortar where mud is used as limiting material and sawdust, rice husk or dairy creatures Squander is used as fine aggregate. Mud mortar is useful where lime or cement isn't available.

**1.3 Marble Powder:-**

"Marble is a changeable stone because of change of unadulterated lime stone. stone is additionally among basic substances used in constructional errands since old events, especially for decorative employments. It may be clearly obvious waste synthetic concoctions of vegetation arrive at thousands and a huge number of stores. Loading of those waste synthetic compounds is outlandish. Re-cycling conveys with a couple of advantages for instance protecting every common asset, vitality preserving, causative to advertise, curtailing waste materials alongside procuring a speculation to future years.

### 1.4 Nano Silica:-

Nano Silica (NS) can add to productive 'Molecule Packing' in cements by densifying smaller scale and nanostructure prompting improved mechanical and toughness properties. NS can control corruption (through obstructing of water section by virtue of pore refinement) of crucial fastener arrangement of hydrated concrete i.e., CSH gel caused as a rule because of calcium filtering out when inundated in water. NS improves conduct of newly blended concrete cements by bestowing isolation obstruction and by upgrading both functionality/mouldability and union of lattice. NS solids could fill voids between concrete grains, bringing about immobilization of "free" water ("filler" impact) and in this manner expanding cohesivity of new nix. Utilization of colloidal nano silica particles in watery medium guides better scattering of nanoparticles in solid network and diminishes agglomeration of nanoparticles which improves nanoparticles execution in concrete. NS improves cohesiveness of blend or than diminishing isolation and dying.

# CHAPTER-2

# LITERATURE REVIEW

## 2.1 GENERAL

The objective to study this chapter was to have handful of information about general studies done so far in the specified field. Focus was given on different methodologies and procedures performed so that a suitable approach for investigating this study is achieved.

## 2.2 LITERATUREREVIEW

**(Ma, B., Wang, J., Tan, H., Li, X., et al.) (2019),** directed an examination In request to advance use of waste marble powder (WMP) in concrete based materials, an endeavor to improve mechanical properties of concrete WMP framework by consolidating nano silica (NS) was made in this investigation. 16 mortar blends consolidating NS (0%, 1%, 2% and 3%) and WMP (0%,10%, 20% and 30%) as halfway substitution of Portland concrete were planned. Mechanical properties, standard water necessity, setting time and smoothness were examined, and hydration and microstructure attributes were additionally investigated with hydration heat, X-beam diffraction (XRD), atomic attractive reverberation (NMR) and checking electron magnifying lens (SEM). Results showed that substitution of concrete by WMP clearly diminished compressive quality, regardless of that calcite in WMP incompletely responded with aluminum stage to create carbonate AFm stage rather than monosulphate. Besides, NS indicated beneficial outcome on quality improvement of concrete WMP framework, and explanation was because of nucleation impact, filler impact . NS could in part balance antagonistic impact on compressive quality of mortar brought about by WMP, and 10% WMP and 3%NS demonstrated an ideal extent. Such discoveries were relied upon to speed up utilization of WMP incement-based materials.

**(Singh,L.P, 2013),** led an examination on Beneficial job of Nano silica in concrete based materials . Nanomaterials are increasing across board regard for be utilized in development area in order to display improved execution of materials as far as keen capacities and economical highlights. During most recent multi decade various nanomaterials, for example, nano silica, nano Titania, nano alumina, nano silica has been utilized most broadly. Various distributions showed up towards utilization of Nano silica in cementitious framework is basically because of way that solid remains most mind boggling material and its hydration instrument is as yet not totally comprehended. Thusly, scientists are concentrating on essential study of this material at nano/nuclear level. Further, analysts are proceeding to improve solidness and maintainability of cement, and They have acknowledged critical augmentation in mechanical properties of cementitious materials by fusing nano silica.

**(Land & Stephan, 2012),** directed an exploration to consider impact of nano-silica on hydration of common Portland concrete. Nucleation seeding is another way to deal with control energy of concrete hydration . It is expected that outside of se particles go about as a nucleation site for CSHseeds which at that point quicken concrete hydration. For this situation speeding up ought to rely upon particles surface zone.

**(Khodabakhshian*et al.*, 2018),** discovered quality & toughness of cement containing marble squander powder will in general decay for substitution proportions over 10% yet good outcomes were gotten beneath that degree of substitution. Concerning utilization of silica smolder, it was seen that it improves the quality and strength of cement with marble squander powder by balancing the decrease of its properties comparative with regular cement. Notwithstanding acquiring around indistinguishable outcomes from the first solid blend, utilizing 20% marble squander powder and 10% silica rage as fractional substitution of concrete brought about a 30% concrete decrease which diminishes the unsafe impacts of concrete industry on nature.

**(Vardhan *et al.*, 2015),** conducted a study on Mechanical properties and microstructural investigation of concrete mortar consolidating marble powder as fractional substitution of concretesetting conduct, sufficiency and stream capacity qualities of concrete glues made by halfway supplanting concrete with marble powder are contemplated. Alongside this, quality turn of events and small scale basic properties of concrete altered consequences of investigation demonstrate that up to 10% of marble powder can be utilized as supplanting of concrete with no trade off on specialized attributes of blend. enormous variety in compound synsis of marble powder when contrasted with that of concrete doesn't influence development and setting attributes of concrete.

**(Ergün, 2011),** conducted a study on utilization of diatomite and waste marble powder as halfway substitution of concrete . Diatomite is a pozzolanic material Undefined silica, cristobalite and minor measures of lingering minerals. Squander marble powder (WMP) is a dormant material which is gotten as a mechanical side-effect, forming& cleaning causes a genuine ecological issue. This paper portrays techniques and aftereffects of a research facility examination of mechanical properties did on solid examples containing diatomite and WMP as fractional substitution of concrete in concrete. research center work basically comprises of portrayal of crude and waste materials,preparation of solid examples with diatomite and WPM in various proportions by weight as trade for concrete and a super plasticizing admixture to decrease water request and pressure and flexural trial of examples.. Besides, utilization of a superplasticizing admixture in creation of cement diminished water request. Almost certainly, mix of responsive silica, high surface zone (Blaine) (contingent upon diatomite substitution) and low water request (contingent upon superplasticizing admixture in solid examples) improved mechanical properties.

**(Uygunoǵlu, Topçu&Çelik, 2014)**,conducted a study on Use of waste marble and reused totals in self-compacting concrete for ecological supportabilitybecause of an expansion in marble and solid creation, rose squanders are arranged into void fields. marble squanders and reused totals can be utilized in creation of self-solidifying concrete as total, and in this manner a bit of leeway can be given as far as manageability of structures and earth.

**(Singh *et al.*, 2017),** conducted a study on ecological and monetary effects of utilizing waste marble powder in concrete. Productive usage of waste marble powder in different development rehearses has become a subject of enthusiasm for examine regions. A diagram of works announced viewing utilization as fractional substitution of sand and concrete by marble powder in concrete is introduced in paper. Holes in investigations to date have been called attention to. A natural effect correlation of ordinary cement with utilization of marble powder as incomplete substitution of concrete and sand is completed utilizing UMBERTO NXT life cycle investigation programming with ReCipe midpoint and endpoint strategies. At last, a point by point cost examination study has been performed to legitimize utilization of marble powder in solid which has shown empowering brings about terms of solidarity and quality. It has additionally been discovered that utilization of marble slurry in concrete decreases its ecological effect and is financially valuable. utilization of marble powder in concrete in scope of 10-15% expands compressive quality and split rigidity of cement in scope of 15-20%. utilization of plasticizers improves quality because of w/c decrease. sand replacement with marble powder in proportion of 35-half shows great outcomes for compressive and split elastic qualities. Strength properties like porosity, scraped spot obstruction, carbonation, sorptivity, sulfate opposition, and water infiltration have improved. This can be ascribed to better compaction of blends as a result of filler impact of marble powder. 15% concrete substitution by marble powder shows reserve funds in cost by 9.077%. For concrete with 25 % sand substitution lost 3.27% is seen which is insignificant if utilization of marble lessens effect of utilizing regular totals. Natural effect examination of typical cement with marble powder consolidated cements gives positive indications of decreased effect of cement due to enormous investment funds in ecological effect of concrete decrease and sand extraction. carbon impression of one ton of auxiliary cement is decreased to 350 kg/m3 (with 15% marble powder substitution of concrete) when contrasted with 410 kg/m3 for customary cement. Removal of solid influences fossil consumption, ozone exhaustion and agrarian land use. vitality required in concrete creation is as high as 70% which is around 1.18 GJ/ton. Hence, a 15% concrete substitution by squander marble powder prompts practically 1.05% less vitality utilization.

**(Ulubeyli&Artir, 2015),** conducted a study on Properties of Hardened Concrete Produced by Waste Marble Powder. Marble is modernly prepared by being cut, cleaned, and utilized for improving purposes, and in this manner, financially important. In marble quarries, stones are sliced as squares through various techniques. During cutting procedure, 20-30% of a marble square becomes squander marble powder. Marble powder is a waste material produced in significant sums on planet. Marble squander prompts a genuine ecological issue also. Thusly, utilization of waste marble in solid creation as an admixture material or total has progressively become a significant issue. In current examination, impact of various utilization territories of waste marble on solidified solid properties was researched dependent on past investigations. Looking at all outcomes, recommendation " marble waste can be utilized in creation of cement" was talked about in a point by point way. refore, utilization of waste marble powder in (1)conventional solid blend, (2) self-compacting solid blend, and (3) polymer solid blend, was uncovered. Thus, it was discovered that utilization of waste marble in ordinary solid blend as an admixture material or total is appropriate as it can improve a few properties of solidified cement. Be that as it may, utilization of waste marble in oneself compacting and polymer concrete blends as an admixture material or total isn't influenced decidedly regarding solidified properties of cement. Subsequently, it was presumed that supplanting of waste marble with concrete or total in ordinary cement was improved properties of solidified cement. Yet, utilizing of waste marble in self-compacting or polymer concrete was not influenced decidedly on properties of solidified cement.

**(Berra *et al.*, 2012**), led an examination on Effects of Nano silica expansion on functionality and compressive quality of Portland concrete glues. Smaller than usual droop and rheometric tests were done on concrete glues made with three portion levels of Nano silica at various water/fastener proportions. Concrete glue functionality came about to be altogether lower than anticipated for received water/fastener proportions, as a result of prompt communications between nano silica sol and fluid period of concrete glues, which prove development of gels portrayed by a noteworthy water maintenance limit. subsequent decrease of blend functionality was maintained a strategic distance from by appropriate expansion systems of superplasticizers. No considerable improvement in compressive quality advancement of cementitious blends by nanosilica expansion was watched, conversely with certain outcomes from writing. This affirms clashing experience on issue, however a few parameters influencing quality improvement were recognized and talked about.  postponed option of blending water aliquots ends up being a compelling method of diminishing unfriendly impact of nanosilica on blend functionality, without changing water/fastener proportion and additionally including superplasticizer. Interestingly, no functionality improvement related with deferred water expansion is watched for Portland concrete blends. For situation utilizing superplasticizer to improve blend usefulness, method of adding superplasticizer to blending water containing nanosilica before concrete option (prompt superplasticizer option) has all earmarks of being wrong, because of momentary communication among superplasticizer and nanosilica that decreases nanosilica reactivity. Despite what might be expected, a postponed expansion of superplasticizer, combined with utilization of a fitting blender for separate of gels shaped from nanosilica sol destabilization, ends up being best system to consistently scatter blend fixings, without essentially punishing nanosilica reactivity. outcomes from mechanical tests recommend that, as a result of water maintenance in NS containing blends and ensuing need of expanding w/b proportion to get a legitimate functionality, it isn't right to contrast Rc information and ordinary OPC at a similar w/b proportion. best possible examination must be done between blends in with a similar functionality and a similar w/b proportion, got by including superplasticizers. correlation for this situation shows a restricted increment of Rc for tests containing nanosilica, to be ascribed generally to quickening impact of superplasticizer on concrete solidifying.

( **KumarRanjan,KumarShyamKishor),** conducted a study on Five solid blends containing 0%, 5%, 10%, and 20% MDP as concrete substitution by weight premise has been readied. Water/concrete proportion (0.43) was kept consistent, in all solid blends. Compressive quality, split elasticity of solid blends acquired.Consequences of research facility work indicated that supplanting of concrete with MDP increment, up to 10% for compressive quality, and up to 15% for split elasticity and flexural quality of cement.

**(Talah, A Kharchi, F Chaid, R )** conducted ana test investigation of impact of marble powder utilized as fractional substitute for Portland concrete (PC) on mechanical properties and sturdiness of elite cements. investigation of trial results on concrete at 15% substance of marble powder with a fineness modulus of 11500 cm2/g, in a chloride domain, indicated that it contributes emphatically to flawlessness of its mechanical attributes, its strength regarding relocation of chloride particles and oxygen penetrability. Based on analyses performed, it very well may be inferred that marble powder is appropriate for detailing of superior cements (HPC) and ir properties are fundamentally better contrasted with reference concrete (RC). accompanying ends are drawn from test outcomes and examination: Marble powder could be utilized as halfway substitution of Portland concrete up to 15% in composite concrete. Furrmore to this, an improvement in toughness attributes is watched; without diminishing compressive quality of cement. sturdiness test on solid containing MP comprised of inundation in running water, chloride arrangement, in all cases, auxiliary changes to examples were noted. In all cases expansion had improved physical attributes of cement generally to reference solid example.

# CHAPTER-3
# MEHTODOLOGY

## 3.1 GENERAL

The type of materials used in our project are discussed here and different type of testing to know about properties. Also we study certain methods so as to apply WMP in binding materialwithout hindering properties of mix design. We will be focus on to replace cement with waste marble powder so that certain improvements will be attained in mix design properties.

## 3.2 Material used:

Various types of materials used in the study are given below

### 3.2.1 CEMENT

Grade of cement used was OPC 43 (Ordinary Portland cement) which has 28days minimum compressive strength of 43Mpa.

**Fig. 3.1 Cement**

### 3.2.2 FINE AGGREGATES

We used standard sand available in our university. Firstly sand was sieved using sieve analysis and one which passes 4.75 mm IS sieve is taken . n sand is oven dried to ensure no additional moisture in it.

**Fig 3.2 Sand**

### 3.2.3 COARSE AGGREGATES

We used coarse aggregates already available in university. maximum size of aggregates was 20mm. It was ensured that aggregates was dry upon addition in mixture.

**Fig 3.3 Aggregates**

### 3.2.4 WASTE MARBLE POWDER

Waste Marble Powder was procured from a marble industry located in Jammu, J&K. WMP was being used as a partial replacement of cement.

**Fig 3.4 Waste Marble Powder**

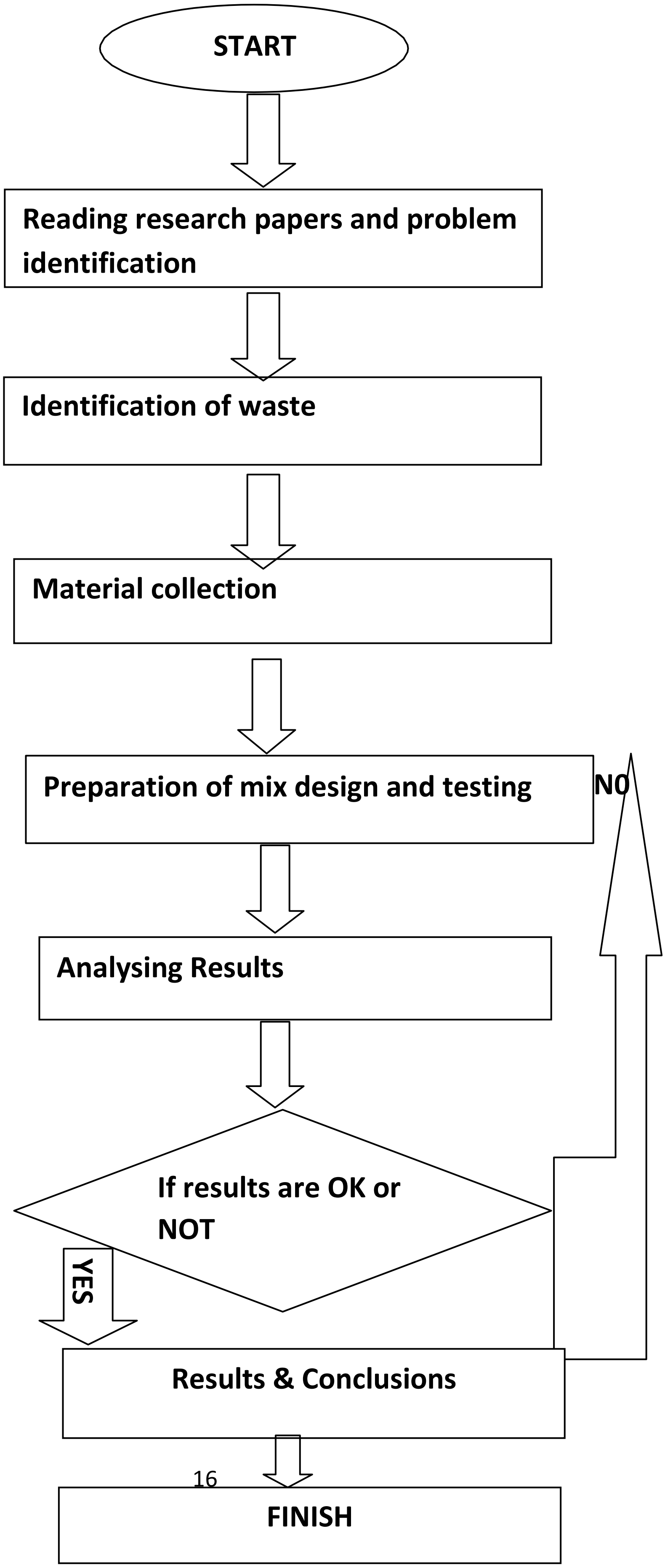
### 3.2.5 NANO SILICA

Nano Silica used in our project was taken from Fibre Zone ,Ahemdabad and its particle size is 17nm.

**Table 3.1 Specifications of Nano Silica**

| **Test item** | **Requirements** |
|---|---|
| Specific surface area | 202 |
| PH value | 4.12 |
| Sieve residue | 0.02 |
| Tamped density | 44 |
| SiO2 Content % | 99.88 |
| Carbon Content % | 0.06 |
| Specific gravity | 2.2 |
| Particle size | 17 nano |

### 3.3 WORK PLAN


START
Reading research papers and problem identification
Identification of waste
Material collection
Preparation of mix design and testing
N0
Analysing Results
If results are OK or NOT
YES
Results & Conclusions
FINISH

## 3.4 EQUIPMENTS USED

Various equipments were used to prepare cement and concrete samples which are represented in Table below.

**Table 3.2 TOOLS Used**

| S.No. | TOOLS | USE |
|---|---|---|
| 1. | Sieve | For Gradation of material according to particle size. |
| 2 | Trowel | Gauging purpose |
| 3 | Tamping Rod | For removing voids |
| 4 | Measuring cylinder | To Measure water |
| 5 | Weighing balance | For Measuring the weight |
| 6 | Stop watch | For Time Note down |
| 7 | Vibration machine | For Compaction of concrete |
| 8 | Moulds | Mortar ( 70*70*70)mm Concrete (150*150*150)mm |

## 3.5 SUITABLE TESTING

various test to be performed on cement, WMP and NS are listed below:

- Specific Gravity of Cement
- Setting time
- Compressive strength test
- Xray diffraction(X–RD)
- Scanning electron microscope(SEM)

### 3.6 TESTING OF CEMENT

To check properties of cement to be used in mix and also to verify cement grade following tests were done:

#### 3.6.1 SPECIFIC GRAVITY

Specific gravity test was done using Specific Gravity Bottle and kerosene. generalized formulae to find specific gravity is

**Specific gravity = weight 5 x (weight3–weight1)/ (weight5 + weight3- weight4) x (weight 2 – weight 1)**

Where, w1 = empty bottle weight

w2 = ( empty bottle weight + weight of water).

w3 = ( empty bottleweight + weight of kerosene).

w4 = (empty bottleweight + weight of water + weight of kerosene).

w5 = weight of cement.

#### 3.6.2 CONSISTENCY TEST

consistency test is done to find out amount of water required to form a paste with cement of normal consistency. test is done using VicatAppartus and penetration of plunger is checked.

**Procedure**:

1. Weight cement approx. 400g and place it in a a bowl.
2. It is assumed that standard consistency of water is 28% and n same amount of water is added in concrete.
3. Blend glue completely inside 3-5 minutes. time taken to get concrete glue in wake of including water is called measuring time.
4. Presently fill glue in vicat form accurately.
5. At that point, place vicat form on glass plate and see that unclogger should

contactoutside of vicat shape delicately.

6. Discharge unclogger and permit it to sink into test form.

7. Note down entrance of unclogger from base of form showed on scale.

8. Rehash same analysis by including various rates of water until perusing is in middle of 5-7mm.

### 3.6.3 SETTING TIME

**Apparatus Required:**

- Vicat apparatus
- Measuring Cylinder
- Stop watch
- Glass plate
- Enamel tray
- Trowel

**Test Procedure**

1. To find out water requirement for paste, consistency test is done prioir to this to get standard consistency (P).

2. 400 g cement is weighted and set up a slick concrete glue with (0.85P) of water by weight of concrete.

3. Measure time is kept between 3 to 5 minutes. time is noted at moment water is added to concrete. Record this time as (T1).

4. Fill Vicat shape, laying on a glass plate, with concrete glue measured as above. Fill shape totally and smooth off outside of glue making it level with highest point of form. concrete square in this manner arranged is called test square.

**Fig 3.5 VicatAppartus**

**Procedure for Initial Setting Time**

1. Spot test square kept in form and laying on non- permeable plate under bar bearing needle.

2. Lower needle delicately until it interacts with outside of test square and snappy discharge, permitting it to infiltrate into test square.

3. To start with needle totally punctures test square. Rehash this system for example rapidly discharging needle after at regular intervals till needle neglects to puncture square for around 5 mm estimated from base of form. Note this time (T2).

**Test for Final Setting Time**

1. For deciding last setting time, supplant needle of Vicat's mechanical assembly by needle with an annular connection.

2. concrete is viewed as at last set when after applying last setting needle delicately to outside of test hinder; needle establishes a connection consequently, while connection neglects to do as such. Record this time (T3).

**CALCULATIONS:**

**IST = (T2-T1)**

**FST = (T3-T1)**

Here,

T1 =Time when water is first added to cement

T2 =Time when needle fails to penetrate 5 mm to 7 mm from bottom of mould

T3 =Time taken by needle to make an impression but attachment fails to do so.

### 3.6.4 X-RAY DIFFRACTION TEST:

To get detailed information about mineral composition of materials, X-Ray Diffraction method was used. Due to complexity of usage, test was done at advanced laboratories at PEC, Chandigarh.

### 3.6.5 SCANNING ELECTRON MICROSCOPE (SEM):

Scanning Electron Microscope (SEM) is an advanced method to briefly study microstructure of materials. sample of Cement ,NS and WMP for XRF test has been tested in IIT Mandi.

### 3.6.6 X-RAY FLUORESCENCE:

XRF is a non-destructive systematic procedure used to decide natural creation of materials. XRF analyzers decide science of an example by estimating fluorescent X-beam transmitted from an example when it is energized by an essential X-beam source. Every component present in an example creates a lot of trademark fluorescent X-beams that is interesting for that particular component, which is reason XRF spectroscopy is a magnificent innovation for quantitative and subjective investigation of material piece. samples for XRF test has been tested in SAIF, Punjab.

### 3.6.6 DYNAMIC LIGHT SCATTERING:

DLS is a method that can be utilized to decide size appropriation profile of little particles in suspension or polymers in arrangement. DLS is utilized to describe size of different particles. It requires particles roughly not exactly a micron in size to be homogeneously suspended in a liquid. This strategy is especially valuable to examine conduct of nanoparticles in suspensions.

### 3.7 Testing Of Fine Aggregates:

**1) Fineness Modulus :**

Fineness modulus of total is resolved utilizing strainer investigation.This test gives degree of sand zone. Fineness modulus is a factor acquired by including total rates of total held on every one of standard strainers running from 10 mm to 150 µ and partitioning this total by 100.

**2) Specific Gravity :**

Specific gravity test was performed using Pycnometer Bottle with conical cap and opening.

### 3.8 Testing Of Coarse Aggregates:

**1) Specific Gravity:**

test is done to gauge quality of material. totals with low explicit gravity are typically answered to be more fragile when contrasted with ones having higher explicit gravity esteem.

### 3.9 Testing Of Cubes Samples:

**1) Compressive Strength Test:**

Compressive quality is capacity of material to convey heaps on its surface with no split and avoidance. pressure test was performed on solid 3D squares of measurement

(150*150*150) mm. samples are tested under CTM following . heap was applied bit by bit at pace of 140 kg/cm2/minute (0.22 MPa/s) till sample falls flat.

**Fig 3.6 Compression Testing Machine**

Formulae to calculate Compressive Strength is:

**Compressive Strength = P/*A***

Here, P - Failure load (N).

A - Area of specimen (mm2).

**2) Split Tensile Strength Test:**

solid is powerless in pressure because of its weak nature, in this way, it creates breaks when pliable powers surpass its rigidity. In this way, it is fundamental to decide elasticity of cement to decide heap at which solid individuals may break. test is performed under CTM on solid chamber of 100 mm breadth and 200 mm tallness. heap is applied at a consistent pace of (1.2 to 2.4) MPa/min until example comes up short. split tensile strength is calculated using below mentioned formula:

**Split Tensile Strength = 2 P π L D**

Here, P-Failure load (N)

L- length of cyclinder (mm)

D- Diameter of cyclinder (mm)

## 3.10Preparation Of Mortar Specimen:

### 3.10.1 Mix Proportion and Mixing

Instruments used for mixing shall be properly cleaned and water should be at normal room temperature. Generally, portable water is used for cubes preparation.

Quantity of material to be used for each cube is:

Cement - 200g

Sand - 600g

Water - ( P/4 + 3.0) % of combined mass (cement + sand)

Here, P is % of water required to produce a paste of standard consistency.

On a non-porous plate, place mixture of sand and cement and mix it with dry trowel and n add water in it. mixing should be done for minimum time of 3 mins and if time taken to obtain uniform colour exceed 4 min n mixture will be rejected.

### 3.10.2 Moulding Specimen:

- Before garing molds apply a layer of oil jam to joints and contact surface of base of form and base plate. Apply slim covering of shape oil in inward faces
- Assemble shape and spot it on stand and tight it solidly.
- Fill mortar in solid shape and utilizing an altering pole conservative it . This procedure is rehashed till shape is appropriately filled .
- Place form alongside remain on vibration stand. term of vibration will be 2 minutes at indicated speed of 12000 (+-400).
- After vibration is finished, expel shape from remain alongside base plate and

utilizing a trowel finish top surface of Cube.

**Fig 3.7 Mortar Moulds**

### 3.10.3 Curing Of Specimen:

moulds filled with paste are removed after 24 hrs and n placed in a water tank with clean water. cubes are to be completely submerged in water.

**Fig 3.8 Curing Of Cubes**

**Fig 3.9 Demoulded Cubes**

### 3.10.4 Testing Of Mortar Cubes:

After removing cubes from curing tank , they are allowed to dry before testing. testing is done using compression testing machine.

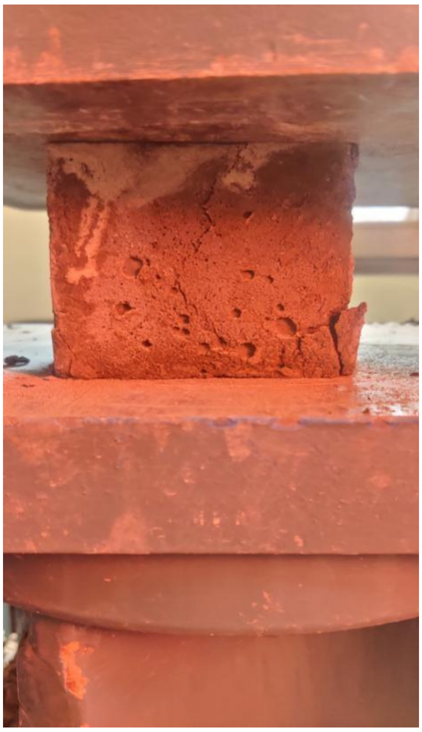


**Fig 3.10 Testing of cube**

**Fig 3.11 Cracking Pattern of Cub**

**3.11 Mix Design Of Concrete Specimen:**

**CONDITIONS AND TARGETS FOR M40:**

1. Exposure: Mild
2. Aggregate size : 20mm
3. Aggregate shape : Angular
4. Target slump : 50mm
5. Water to binder :0.50
6. Volume of voids for 20mm aggregate size = 2%

**MIX DESIGN FOR CONCRETE MIX M40**

**1. Target mean strength**

Fm = fck + 1.65*s

=40 + 1.65*5(for m40 s=5 from table-1 of IS-10262-2009)

=48.25

**2. Selection of water-binder ratio**

From table 5 of is 456, maximum water binder ratio=0.60 for mild exposure

Taking w/b=0.50

**3. Selection of water content**

Maximum water content for 20mm aggregate=186kg

Targeting 50mm slump

We can take water content=186kg

**4. Calculation of binder content**

W/b=0.50

Binder=372kg (this also satisfies minimum binder content as per table 5 of IS-456)

6. **<u>Proportion of volume of coarse and fine Aggregate content</u>**

From table 3 of 10262-2009,volume of coarse aggregate corresponding to 20mm size and fine aggregate(zone-i) per unit volume of total aggregate =0.60

7. **<u>Mix calculations</u>**

i) Volume of concrete = $1m^3$

ii) Volume of voids = $.02m^3$(2%)

So,

$0.98 = MASS_W/DENSITY_W + MASS_C/DENSITY_C + VOLUME_T$

$VOLUME_{TA} = 0.6759\ m^3$

FROM (5)

$V_{CA} = 0.6*V_{TA}$

SO,

$V_{CA} = 0.4055\ m^3$

$V_{FA} = 0.2763\ m^3$

$V_{WATER} = 0.186\ m_3$

FOR 15*15*15 $cm^3$ MOULD

$VOLUME_{CA} = 1368.56$ cc

$MASS_{CA} = 3749.86$ g

$VOLUME_{FA} = 916.26$ cc

$MASS_{FA} = 2428.089$ g

$VOLUME_{WATER} = 627.75$ cc

$MASS_{WATER} = 627.75$ g

$VOLUME_{CEMENT} = 3954.6$ cc

$MASS_{CEMENT}$ =1255.44 g

**Table 3.3 Mix Design Results**

| S.NO. | Material | Quantity (g) |
|---|---|---|
| 1 | Cement | 1256 |
| 2 | Fine Aggregates | 2454 |
| 3 | Water | 628 |
| 4 | Coarse Aggregates | 3801 |

## 3.12 Concrete Cube Preparation:

The quantity of materials required to cast cubes were calculated from mix design and n were collected to start casting process.

### 3.12.1 Mould Size:

Moulds used for casting concrete cubes have fixed size of 15*15*15 cm as per IS Codes. cubes are casted for 7 days, 14 days and 28days. Each cube sample consists of 3 cubes specimens from which average strength value is taken.

### 3.12.2 Mixing of Concrete:

At first, all material collected is placed on a tray and material is mixed using a dry trowel and gauging is done to attain uniformity in mix. n will gradual addition of water, concrete is mixed so that no portion of mix remains dry. When it appears that mix is prepared , gauging is stopped.

**Fig 3.12 Mixing Of Concrete**

### 3.12.3 Cube Casting:

Before filling concrete in moulds, y are first tightened properly using nut bolts. n a layer of lubricant is applied on inner side, joints and base plate of moulds. After that, concrete is poured in layers and each layer is tampered using a tampering rod so that concrete spreads uniformly in mould. When mould is filled to top, it in n placed on vibrating table to remove voids. After that mould is kept untouched for 24 hours in moist room. After 24 hours, mould is demoulded using key .

**Fig 3.13 Tightening Of Moulds**

**Fig 3.14 Tampering of cube**

### 3.12.4 Curing Of Concrete Cubes:

After concrete cubes are demoulded , y are n taken to a curing tank having clean water. cubes should be completely submerged in water. temperature of tank should be at 27°C. cubes are taken out from tank after specified day of testing. After testing demolished cube is immersed in ethyl alcohol to stop its reaction.

**Fig 3.15 Demoulded cubes**

## 3.13 <u>MIX DESIGN FOR MORTAR</u>

### 3.13.1 MIX DESIGN CALCULATION

1. CEMENT : SAND = 1:3
2. WATER/CEMENT = .5
3. APPLYING EQUATION

$C/3.15 + 3*C/2.65 + .5*C/1 = 1m^3$

C = .5129kg

WATER = .256kg

SAND =1.5388kg

FOR 7*7*7 $cm^3$

CEMENT = 175.9 gm

$VOLUME_{CEMENT}$ = 55.84cc

WATER = 87.96 gm

$VOUME_{WATER}$ =87.97cc

SAND = 527.73 gm ,$VOLUME_{SAND}$ =199.19cc

## 3.14 Mix Proportions:

Mix proportions that are to be casted are mentioned in table below.For each proportions 6 cubes are to be casted to check 7, 14& 28 days of strength.

- **MIX FOR WMP0 NS 0**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 175.9 | 87.96 | 527.73 | 0 | 0 |

- **MIX FOR WMP0 NS 0.5**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 175 | 87.96 | 527.73 | 0 | .8795 |

- **MIX FOR WMP0 NS1**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 174.14 | 87.96 | 527.73 | 0 | 1.759 |

- **MIX FOR WMP0 NS1.5**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 173.26 | 87.96 | 527.73 | 0 | 2.63 |

- **MIX FOR WMP0 NS2**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 172.38 | 87.96 | 527.73 | 0 | 3.52 |

- **MIX FOR WMP0 NS2.5**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 171.5 | 87.96 | 527.73 | 0 | 4.4 |

- **MIX FOR WMP0 NS3**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 170.62 | 87.96 | 527.73 | 0 | 5.28 |

- **MIX FOR WMP10 NS0**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 158.31 | 87.96 | 527.73 | 17.59 | 0 |

- **MIX FOR WMP10 NS.5**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 157.43 | 87.96 | 527.73 | 17.59 | .8795 |

- **MIX FOR WMP10 NS1**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 156.55 | 87.96 | 527.73 | 17.59 | 1.759 |

- **MIX FOR WMP10 NS1.5**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 155.67 | 87.96 | 527.73 | 17.59 | 2.63 |

- **MIX FOR WMP10 NS2**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 154.8 | 87.96 | 527.73 | 17.59 | 3.52 |

- **MIX FOR WMP10 NS2.5**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 153.92 | 87.96 | 527.73 | 17.59 | 4.4 |

- **MIX FOR WMP10 NS3**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 153.04 | 87.96 | 527.73 | 17.59 | 5.28 |

- **MIX FOR WMP20 NS0**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 140.72 | 87.96 | 527.73 | 35.18 | 0 |

- **MIX FOR WMP20 NS0.5**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 139.84 | 87.96 | 527.73 | 35.18 | .8795 |

- **MIX FOR WMP20 NS1**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 138.96 | 87.96 | 527.73 | 35.18 | 1.759 |

- **MIX FOR WMP20 NS1.5**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 138 | 87.96 | 527.73 | 35.18 | 2.63 |

- **MIX FOR WMP20 NS2**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 137.12 | 87.96 | 527.73 | 35.18 | 3.52 |

- **MIX FOR WMP20 NS2.5**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 136.24 | 87.96 | 527.73 | 35.18 | 4.4 |

- **MIX FOR WMP20 NS3**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 135.36 | 87.96 | 527.73 | 35.18 | 5.28 |

- **MIX FOR WMP30 NS0**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 123.13 | 87.96 | 527.73 | 52.77 | 0 |

- **MIX FOR WMP30 NS0.5**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 122.25 | 87.96 | 527.73 | 52.77 | 0.8795 |

- **MIX FOR WMP30 NS1**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 121.37 | 87.96 | 527.73 | 52.77 | 1.759 |

- **MIX FOR WMP30 NS1.5**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 120.49 | 87.96 | 527.73 | 52.77 | 2.63 |

- **MIX FOR WMP30 NS2**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 119.61 | 87.96 | 527.73 | 52.77 | 3.52 |

- **MIX FOR WMP30 NS2.5**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 118.731 | 87.96 | 527.73 | 52.77 | 4.4 |

- **MIX FOR WMP30 NS3**

| CONSTITUENT | CEMENT | WATER | SAND | WMP | NS |
|---|---|---|---|---|---|
| AMOUNT(gms) | 117.85 | 87.96 | 527.73 | 52.77 | 5.28 |

## Mix Proportions Of Concrete

### 4.1.1 MIX FOR WMP0 NS0

SUFFIX TO WMP AND NS SHOWS PERCENTAGE OF CEMENT (EXAMPLE :WMP0 SIGNIFIES 0% OF CEMENT CONTENT)

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1255.44 | 627.75 | 2453.27 | 1387 | 0 | 0 |

- **MIX FOR WMP0 NS.5**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1249.16 | 627.75 | 2453.27 | 1387 | 6.27 | 0 |

- **MIX FOR WMP0 NS1**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1242.88 | 627.75 | 2453.27 | 1387 | 12.55 | 0 |

- **MIX FOR WMP0 NS1.5**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1236.60 | 627.75 | 2453.27 | 1387 | 18.83 | 0 |

- **MIX FOR WMP0 NS2**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1230.33 | 627.75 | 2453.27 | 1387 | 25.10 | 0 |

- **MIX FOR WMP0 NS2.5**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | W |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1224.05 | 627.75 | 2453.27 | 1387 | 31.37 | 0 |

- **MIX FOR WMP0 NS3**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WM P |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1217.77 | 627.75 | 2453.27 | 1387 | 37.66 | 0 |

- **MIX FOR WMP10 NS0**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1129.89 | 627.75 | 2453.27 | 1387 | 0 | 125.5 |

- **MIX FOR WMP10 NS 0.5**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1123.61 | 627.75 | 2453.27 | 1387 | 6.27 | 125.5 |

- **MIX FOR WMP10 NS1**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1116.95 | 627.75 | 2453.27 | 1387 | 12.55 | 125.5 |

- **MIX FOR WMP10 NS1.5**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1110.67 | 627.75 | 2453.27 | 1387 | 18.82 | 125.5 |

- **MIX FOR WMP10 NS2**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1104.4 | 627.75 | 2453.27 | 1387 | 25.10 | 125.5 |

- **MIX FOR WMP10 NS2.5**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1098.51 | 627.75 | 2453.27 | 1387 | 31.37 | 125.5 |

- **MIX FOR WMP10 NS3**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1092.24 | 627.75 | 2453.27 | 1387 | 37.66 | 125.5 |

- **MIX FOR WMP20 NS0**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 1004 | 627.75 | 2453.27 | 1387 | 0 | 251 |

- **MIX FOR WMP20 NS 0.5**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 997.72 | 627.75 | 2453.27 | 1387 | 6.27 | 251 |

- **MIX FOR WMP20 NS1**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 991.79 | 627.75 | 2453.27 | 1387 | 12.55 | 251 |

- **MIX FOR WMP20 NS1.5**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 985.52 | 627.75 | 2453.27 | 1387 | 18.82 | 251 |

- **MIX FOR WMP20 NS2**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 979.24 | 627.75 | 2453.27 | 1387 | 25.10 | 251 |

- **MIX FOR WMP20 NS2.5**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 972.96 | 627.75 | 2453.27 | 1387 | 31.37 | 251 |

- **MIX FOR WMP20 NS3**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 966.68 | 627.75 | 2453.27 | 1387 | 37.65 | 251 |

- **MIX FOR WMP30 NS0**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 878.80 | 627.75 | 2453.27 | 1387 | 0 | 376.63 |

- **MIX FOR WMP30 NS0.5**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 872.53 | 627.75 | 2453.27 | 1387 | 6.27 | 376.63 |

- **MIX FOR WMP30 NS1**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 866.25 | 627.75 | 2453.27 | 1387 | 12.55 | 376.63 |

- **MIX FOR WMP30 NS1.5**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 859.97 | 627.75 | 2453.27 | 1387 | 18.82 | 376.63 |

- **MIX FOR WMP30 NS2**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 853.69 | 627.75 | 2453.27 | 1387 | 25.1 | 376.63 |

- **MIX FOR WMP30 NS2.5**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 847.42 | 627.75 | 2453.27 | 1387 | 31.37 | 376.63 |

- **MIX FOR WMP30 NS3**

| CONSTITUENTS | CEMENT | WATER | FA | CA | NS | WMP |
|---|---|---|---|---|---|---|
| AMOUNT(gms) | 841.14 | 627.75 | 2453.27 | 1387 | 37.65 | 376.63 |

# CHAPTER-4

# RESULTS

## 4.1 GENERAL:

Various tests were performed on binder, WMP , Nano silicaand supplanting of concrete with WMP and NS and results were looked at.

## 4.2 RESULT:

outcomes which were acquired from various testing are considered in this section. outcome part comprises of result from testing of mortar like basic testing of cement and compressive strength.

### 4.2.1 XRF Testing results:

**Result of 43 OPC Cement**

Eval2 V2.5.500 Admin 02-12-2019 12:53:31
Sample: CEM-01
Measured on 26-11-2019 19:04:20
Sample measured by Admin
Measurement method: Best Detection-Vac34mm

| CaO | SiO2 | Al2O3 | SO3 | Fe2O3 | MgO |
|---|---|---|---|---|---|
| 1619.4 KCps | 195.7 KCps | 43.2 KCps | 81.4 KCps | 217.9 KCps | 34.8 KCps |
| 64.49 % | 18.34 % | 4.48 % | 3.79 % | 3.19 % | 2.99 % |

| K2O | TiO2 | Na2O | MnO | P2O5 | Cr2O3 | SrO |
|---|---|---|---|---|---|---|
| 65.6 KCps | 3.8 KCps | 0.7 KCps | 5.0 KCps | 1.2 KCps | 1.0 KCps | 14.9 KCps |
| 1.95 % | 0.32 % | 0.14 % | 0.10 % | 0.10 % | 0.04 % | 0.02 % |

| Cl | ZnO | ZrO2 | NiO | Rb2O | CuO | Intensity Scal |
|---|---|---|---|---|---|---|
| 0.6 KCps | 2.6 KCps | 8.8 KCps | 1.0 KCps | 3.7 KCps | 0.8 KCps | |
| 0.02 % | 0.01 % | 81 PPM | 76 PPM | 54 PPM | 47 PPM | 1.048 |

- **Results of Nano Silica**

Eval2 V2.5.500 Admin 02-12-2019 12:52:17
Sample: NS-01
Measured on 26-11-2019 19:54:24
Sample measured by Admin
Measurement method: Best Detection-Vac34mm

| SiO2 | Al2O3 | K2O | MgO | CaO | Cl | Fe2O3 |
|---|---|---|---|---|---|---|
| 828.6 KCps | 5.3 KCps | 7.4 KCps | 2.3 KCps | 2.3 KCps | 1.7 KCps | 14.2 KCps |
| 98.04 % | 0.65 % | 0.44 % | 0.22 % | 0.14 % | 0.12 % | 0.12 % |

| Na2O | Cr2O3 | SO3 | P2O5 | NiO | TiO2 | CuO |
|---|---|---|---|---|---|---|
| 0.3 KCps | 2.9 KCps | 0.4 KCps | 0.2 KCps | 4.6 KCps | 0.2 KCps | 1.5 KCps |
| 0.08 % | 0.06 % | 0.05 % | 0.04 % | 0.02 % | 83 PPM | 45 PPM |

| Rb2O | SrO | Intensity Scal |
|---|---|---|
| 5.2 KCps | 1.2 KCps | |
| 37 PPM | 8 PPM | 1.513 |

- **Results of Marble Powder**

Eval2 V2.5.500 Admin 02-12-2019 12:53:13
Sample: WMP-01
Measured on 26-11-2019 19:25:34
Sample measured by Admin
Measurement method: Best Detection-Vac34mm

| CaO | SO3 | MgO | SiO2 | Al2O3 | Fe2O3 |
|---|---|---|---|---|---|
| 1091.4 KCps | 533.0 KCps | 120.5 KCps | 46.4 KCps | 18.2 KCps | 66.2 KCps |
| 51.83 % | 27.35 % | 11.45 % | 5.18 % | 2.31 % | 0.99 % |

| K2O | TiO2 | P2O5 | Na2O | SrO | MnO | Cl |
|---|---|---|---|---|---|---|
| 8.9 KCps | 2.2 KCps | 1.6 KCps | 0.2 KCps | 34.3 KCps | 2.2 KCps | 0.5 KCps |
| 0.35 % | 0.19 % | 0.14 % | 0.05 % | 0.05 % | 0.04 % | 0.02 % |

| ZrO2 | V2O5 | Cr2O3 | ZnO | NiO | CuO | Rb2O |
|---|---|---|---|---|---|---|
| 3.2 KCps | 0.2 KCps | 0.3 KCps | 1.5 KCps | 0.8 KCps | 1.0 KCps | 1.4 KCps |
| 0.02 % | 0.01 % | 83 PPM | 66 PPM | 56 PPM | 54 PPM | 18 PPM |

### 4.2.2 Particle Size Distribution Testing results :

- **PSD Testing Results for cement**

**Size Distribution Report by Intensity**
*v2.2*

Malvern

**Sample Details**

| | |
|---|---|
| **Sample Name:** | Cement 3 |
| **SOP Name:** | mansettings.nano |
| **General Notes:** | |

| | | | |
|---|---|---|---|
| **File Name:** | Trial Demo.dts | **Dispersant Name:** | ETHANOL |
| **Record Number:** | 1888 | **Dispersant RI:** | 1.361 |
| **Material RI:** | 1.59 | **Viscosity (cP):** | 1.0950 |
| **Material Absorbtion:** | 0.010 | **Measurement Date and Time:** | Monday, November 18, 2019 ... |

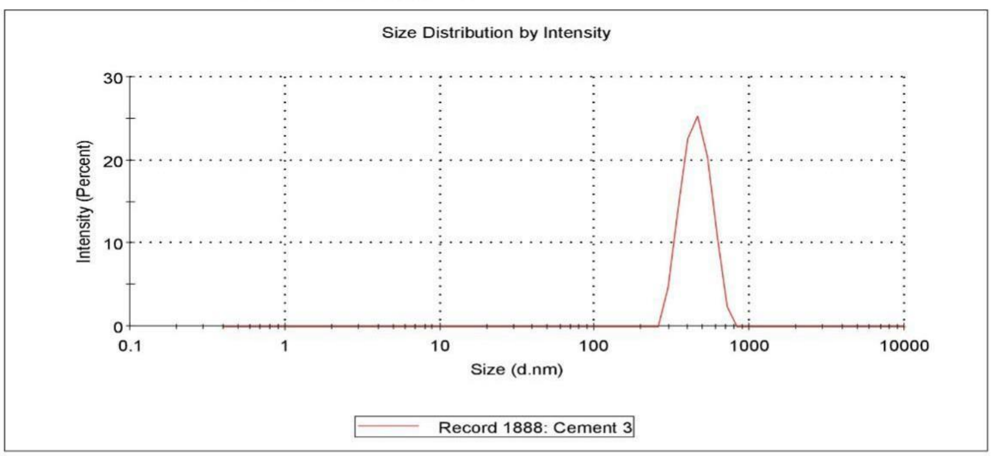
**System**

| | | | |
|---|---|---|---|
| **Temperature (°C):** | 25.0 | **Duration Used (s):** | 20 |
| **Count Rate (kcps):** | 225.5 | **Measurement Position (mm):** | 4.65 |
| **Cell Description:** | Disposable sizing cuvette | **Attenuator:** | 11 |

**Results**

| | | | Size (d.nm): | % Intensity: | St Dev (d.n... |
|---|---|---|---|---|---|
| **Z-Average (d.nm):** | 854.1 | **Peak 1:** | 458.4 | 100.0 | 96.43 |
| **PdI:** | 0.595 | **Peak 2:** | 0.000 | 0.0 | 0.000 |
| **Intercept:** | 0.582 | **Peak 3:** | 0.000 | 0.0 | 0.000 |

**Result quality :** **Refer to quality report**




Malvern Instruments Ltd
www.malvern.com

Zetasizer Ver. 7.11
Serial Number : MAL1118272

File name: Trial Demo
Record Number: 1888
05 Dec 2019 3:52:42 PM

- **PSD testing results for Nano Silica:**

## Size Distribution Report by Intensity

*v2.2*

Malvern

**Sample Details**

| | |
|---|---|
| **Sample Name:** | Nano Silica 3 |
| **SOP Name:** | mansettings.nano |
| **General Notes:** | |

| | | | |
|---|---|---|---|
| **File Name:** | Trial Demo.dts | **Dispersant Name:** | Water |
| **Record Number:** | 1885 | **Dispersant RI:** | 1.330 |
| **Material RI:** | 1.59 | **Viscosity (cP):** | 0.8872 |
| **Material Absorbtion:** | 0.010 | **Measurement Date and Time:** | Monday, November 18, 2019 ... |

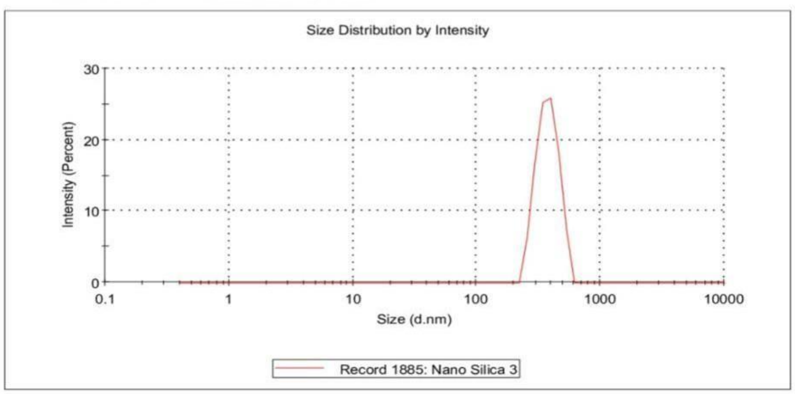
**System**

| | | | |
|---|---|---|---|
| **Temperature (°C):** | 25.0 | **Duration Used (s):** | 70 |
| **Count Rate (kcps):** | 221.1 | **Measurement Position (mm):** | 4.65 |
| **Cell Description:** | Disposable sizing cuvette | **Attenuator:** | 11 |

**Results**

| | | | Size (d.nm): | % Intensity: | St Dev (d.n... |
|---|---|---|---|---|---|
| **Z-Average (d.nm):** | 721.6 | **Peak 1:** | 378.0 | 100.0 | 73.89 |
| **PdI:** | 0.475 | **Peak 2:** | 0.000 | 0.0 | 0.000 |
| **Intercept:** | 0.418 | **Peak 3:** | 0.000 | 0.0 | 0.000 |

**Result quality :** **Refer to quality report**



- **PSD testing results for WMP:**

## Size Distribution Report by Intensity
*v2.2*

Malvern

**Sample Details**

**Sample Name:** Waste Marble 3
**SOP Name:** mansettings.nano
**General Notes:**

| | | | |
|---|---|---|---|
| **File Name:** | Trial Demo.dts | **Dispersant Name:** | Water |
| **Record Number:** | 1881 | **Dispersant RI:** | 1.330 |
| **Material RI:** | 1.59 | **Viscosity (cP):** | 0.8872 |
| **Material Absorbtion:** | 0.010 | **Measurement Date and Time:** | Monday, November 18, 2019 ... |

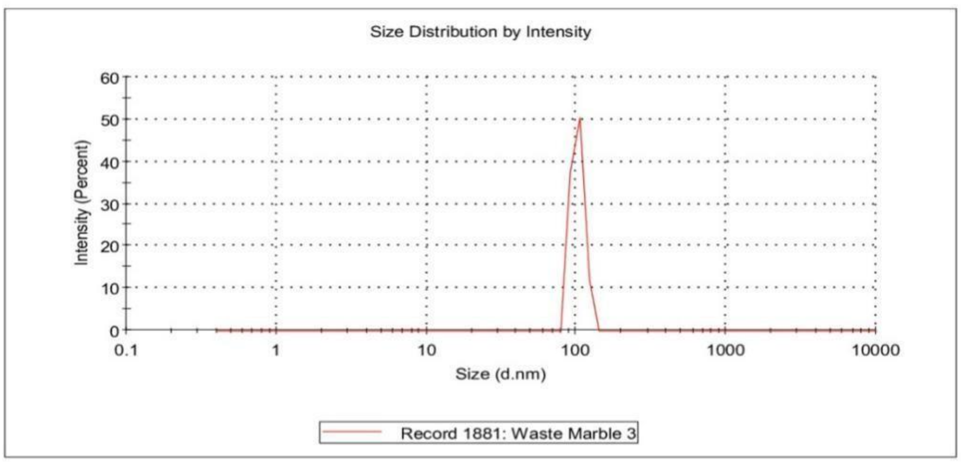
**System**

| | | | |
|---|---|---|---|
| **Temperature (°C):** | 25.0 | **Duration Used (s):** | 10 |
| **Count Rate (kcps):** | 215.0 | **Measurement Position (mm):** | 4.65 |
| **Cell Description:** | Disposable sizing cuvette | **Attenuator:** | 10 |

**Results**

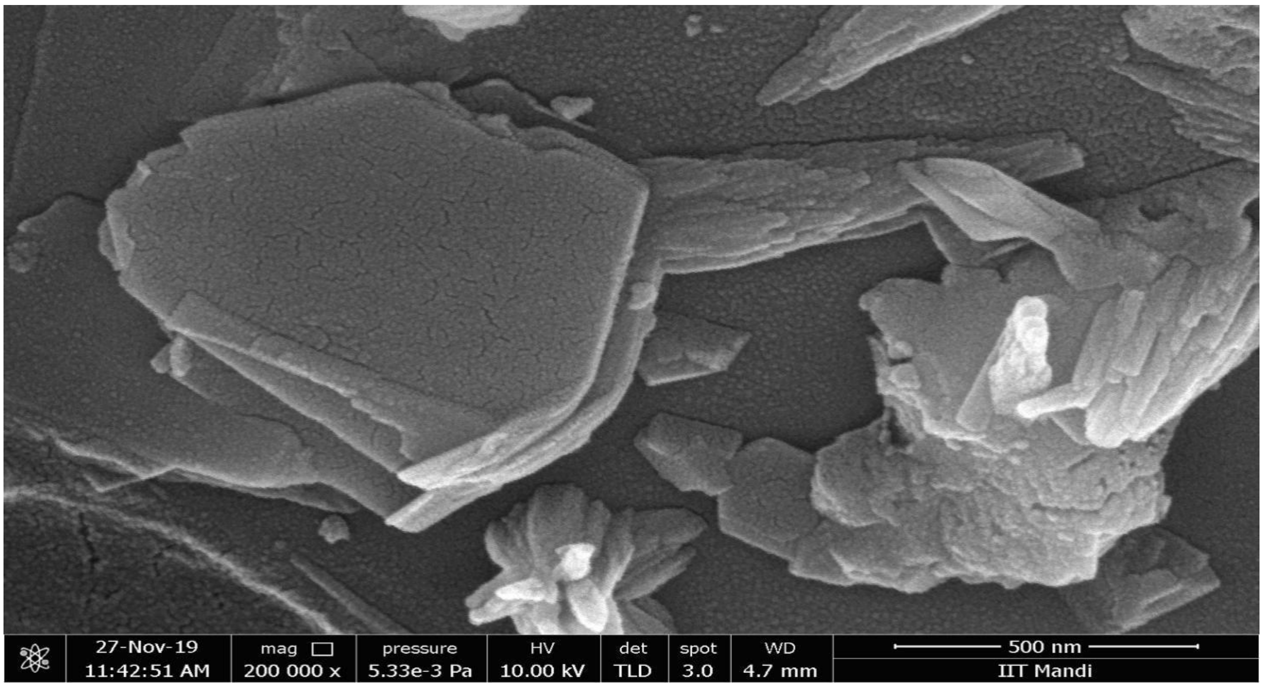
| | | | Size (d.nm): | % Intensity: | St Dev (d.n... |
|---|---|---|---|---|---|
| **Z-Average (d.nm):** | 2678 | **Peak 1:** | 102.3 | 100.0 | 10.02 |
| **PdI:** | 1.000 | **Peak 2:** | 0.000 | 0.0 | 0.000 |
| **Intercept:** | 0.463 | **Peak 3:** | 0.000 | 0.0 | 0.000 |

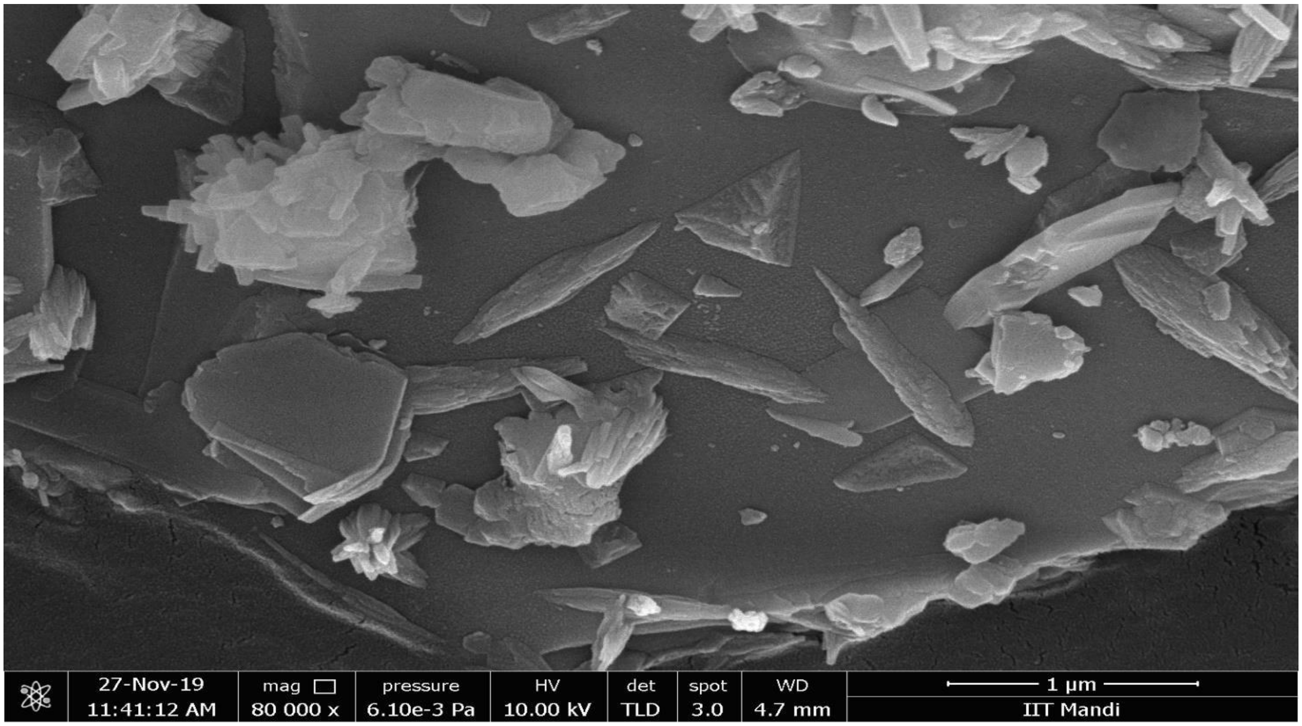
**Result quality :** **Refer to quality report**

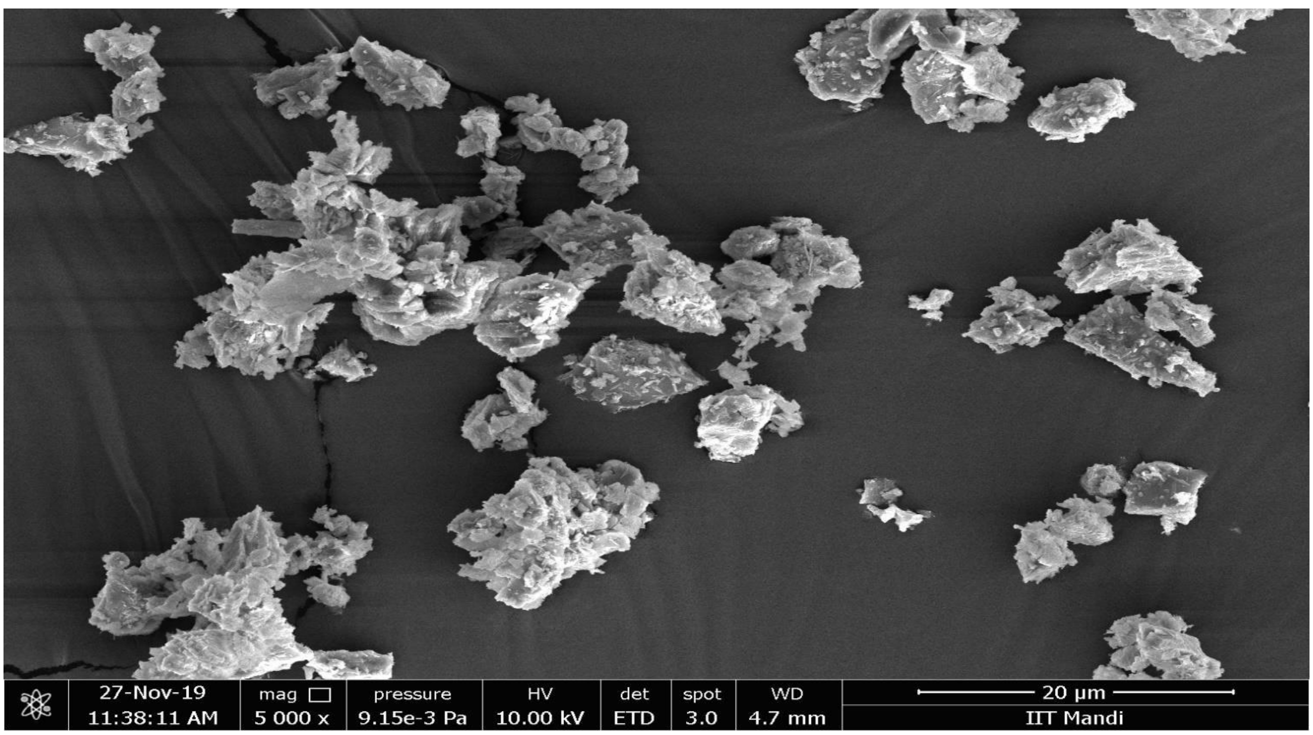


### 4.2.3 SEM Testing results :

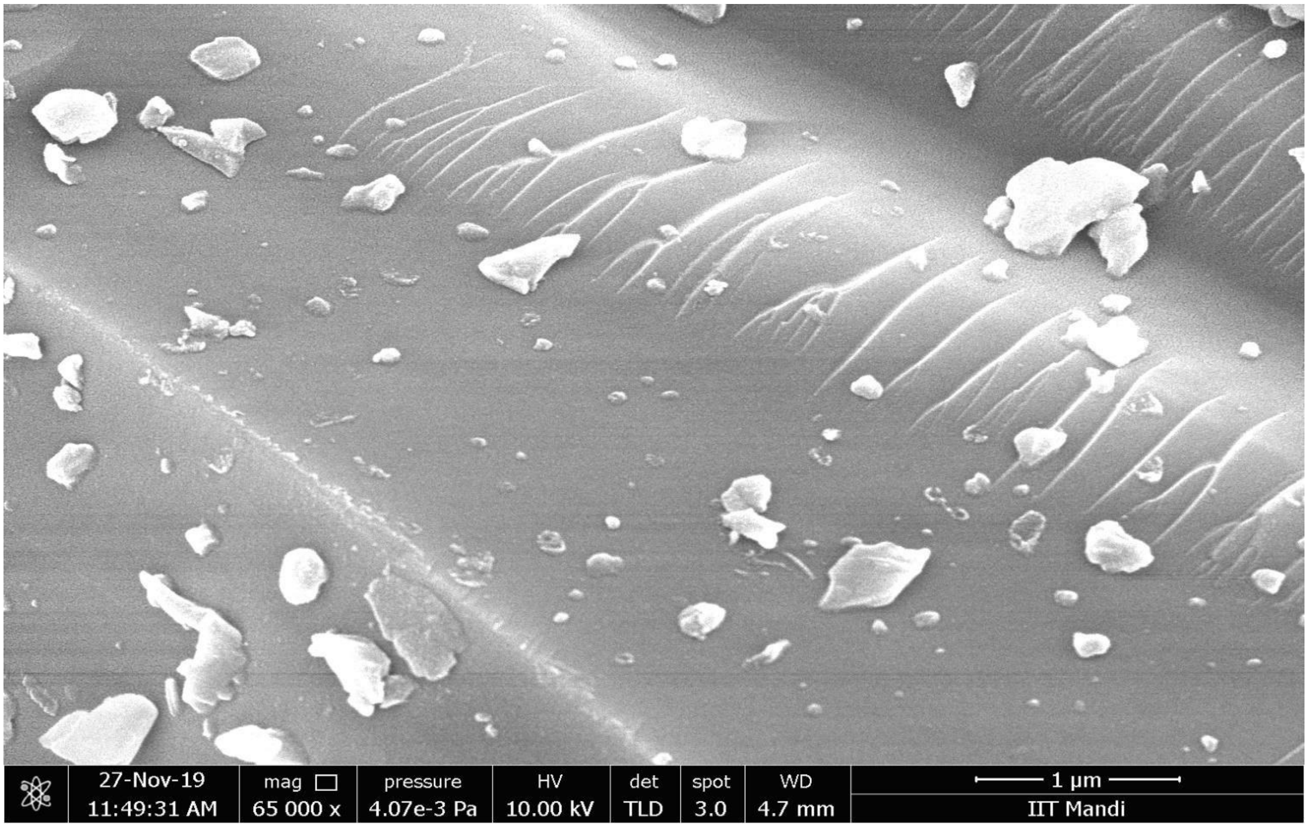
- **<u>SEM of Cement</u>**

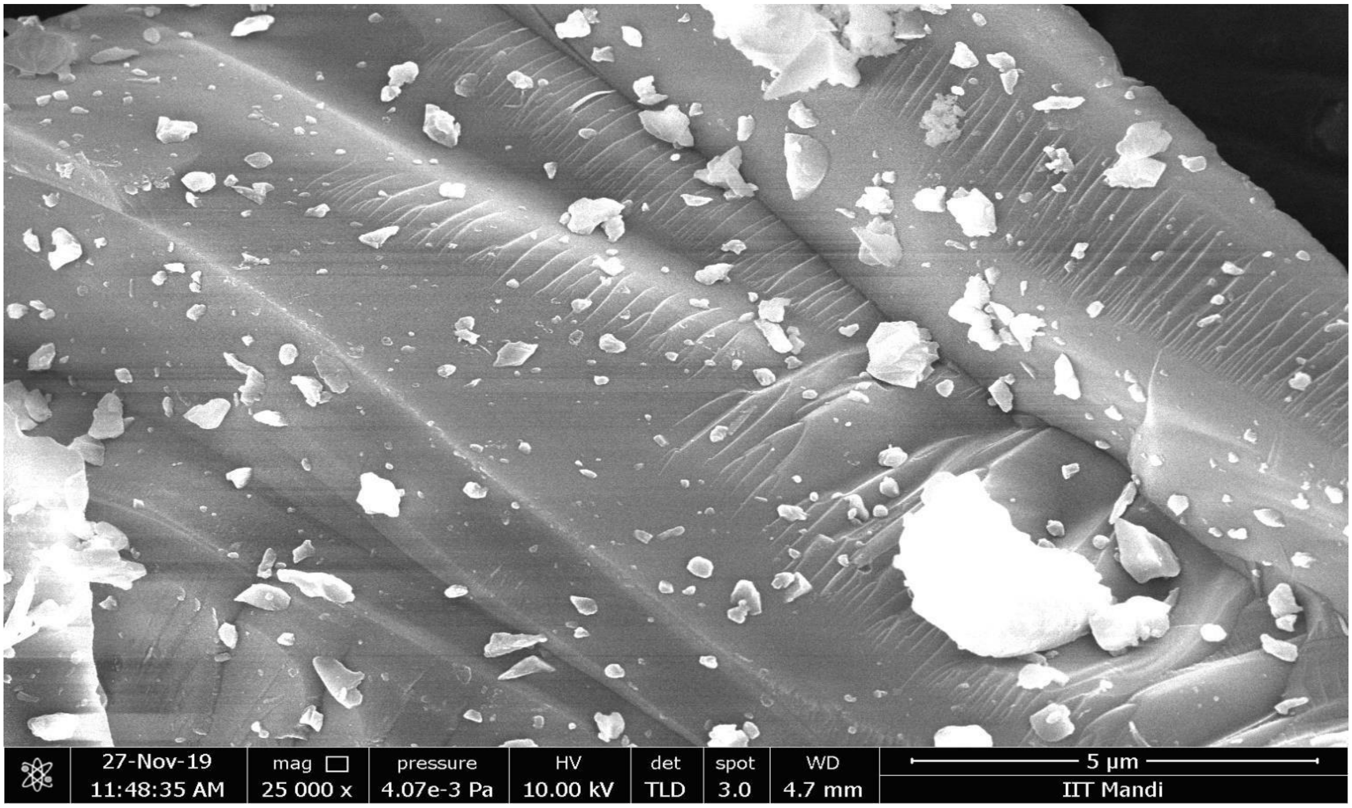


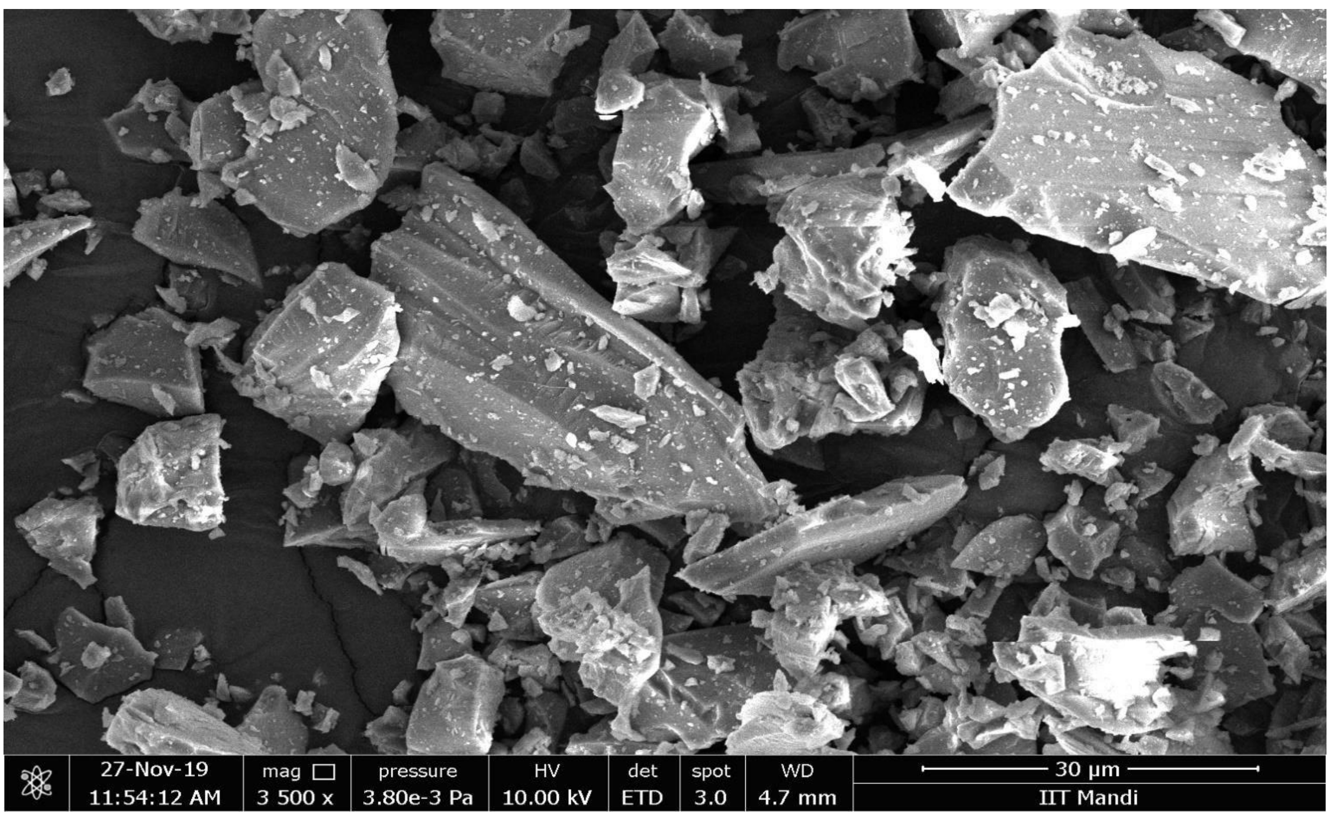

27-Nov-19
11:41:12 AM
mag
80 000 x
pressure
6.10e-3 Pa
HV
10.00 kV
det
TLD
spot
3.0
WD
4.7 mm
1 μm
IIT Mandi


27-Nov-19
11:38:11 AM
mag
5 000 x
pressure
9.15e-3 Pa
HV
10.00 kV
det
ETD
spot
3.0
WD
4.7 mm
20 μm
IIT Mandi

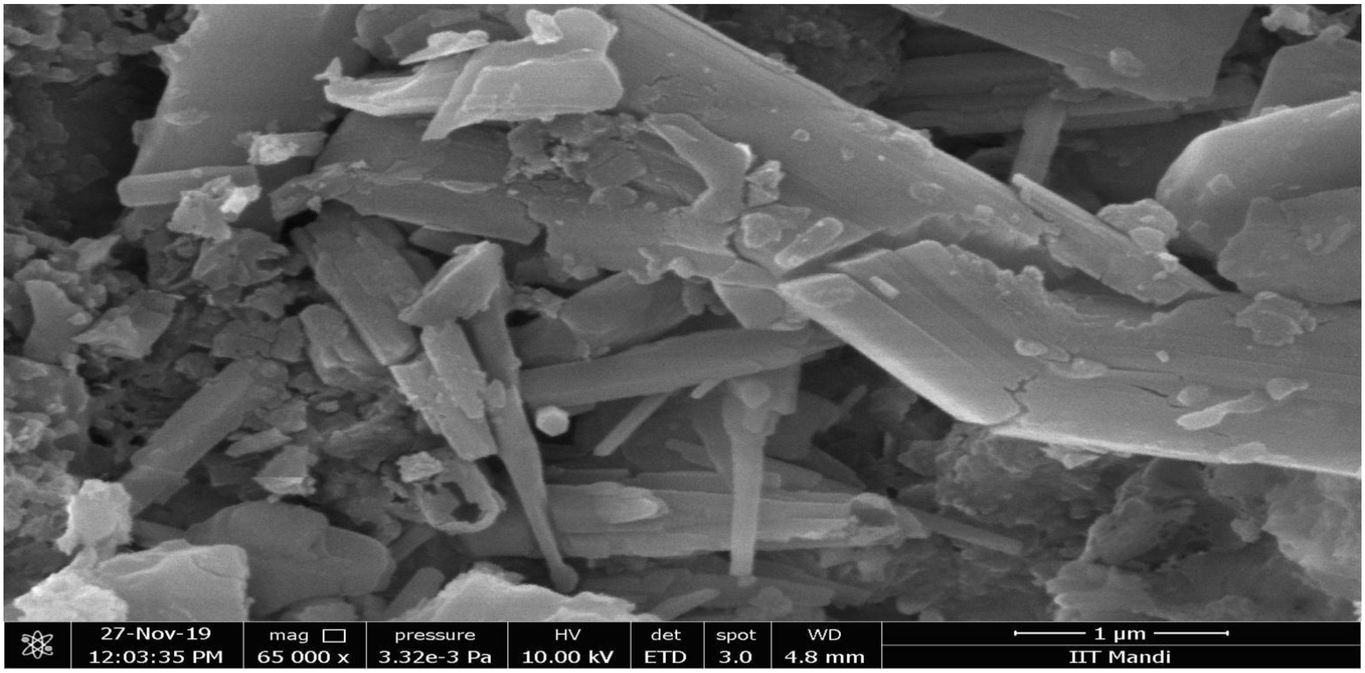
- **SEM of Nano Silica**




27-Nov-19
11:48:35 AM
mag
25 000 x
pressure
4.07e-3 Pa
HV
10.00 kV
det
TLD
spot
3.0
WD
4.7 mm
5 µm
IIT Mandi


27-Nov-19
11:54:12 AM
mag
3 500 x
pressure
3.80e-3 Pa
HV
10.00 kV
det
ETD
spot
3.0
WD
4.7 mm
30 µm
IIT Mandi

- **SEM of Waste Marble Powder**




To examine impact of NS and WMP on microstructure of concrete paste, morphology of hydration items is described by SEM, and SEM pictures of 28 days tests present in Fig .As appeared in Fig, bunches of free stringy like CSH gel is seen in W0N0 and some monstrous hexagonal platy calcium hydroxide (CH) precious stone implant in CSH gel is additionally being seen. It displayed free microstructure of lot of voids. In W30N0 test (Fig), hydration items developed along outside of WMP particles; CSH gel mixed around in a group shape. Substitution of concrete by WMP prompted a decrease in measure of compelling cementitious material and brought about reduction of hydration items. As per Fig, an a lot denser microstructure including a lot of wipe like CSH gel coming in voids is distinguished contrasted with Fig, because of beneficial outcome of NS. In view of above outcomes, it can be assumed that expansion by NS surprisingly improved microstructure of concrete and concrete WMP tests, which could be utilized to clarify previously mentioned higher compressive quality of 2 of m concrete NS and concrete WMP-NS framework.

### 4.2.4 Materials testing results

The tests related to basic properties of cement were performed and ir results are evaluated in table below.

**Table4.1 Tests results of cement**

| S.no. | Test performed | values |
|---|---|---|
| 1 | Specific Gravity | 3.10 |
| 2 | Normal Consistency | 29% |
| 3 | Setting Time | Initial- 35 minutes<br>Final- 190 minutes |

### 4.2.5 Mortar testing results:

Utilizing pressure testing machine after 7,14 and 28days, compressive quality of mortar at different extents of NS and WMP samples was calculated. Results at 7 , 14 and 28 days have been shown in tablebelow

**Table 4.2 Compressive Strength Results Of Mortar**

| MORTAR SAMPLE CODE | 7 DAYS | 14 DAYS | 28 DAYS |
|---|---|---|---|
| | | | |
| WMP& NS- 0% | 8.94 | 15 | 22.85 |
| WMP-0 & NS-0.5% | 13.6703 | 17.6092 | 23.17 |
| NS-1% | 13.8827 | 17.8828 | 23.53 |

| | | | |
|---|---|---|---|
| NS-1.5% | 14.1954 | 18.2856 | 24.06 |
| NS-2.0% | 14.809 | 19.076 | 25.1 |
| NS-2.5% | 15.1984 | 19.5776 | 25.76 |
| NS-3.0% | 15.6527 | 20.1628 | 26.53 |
| | | | |
| WMP-10& NS-0% | 12.1127 | 15.6028 | 20.53 |
| NS-0.5% | 12.3015 | 15.846 | 20.85 |
| NS-1.0% | 12.921 | 16.644 | 21.9 |
| NS-1.5% | 13.3635 | 17.214 | 22.65 |
| NS-2.0% | 13.393 | 17.252 | 22.7 |
| NS-2.5% | 13.6762 | 17.6168 | 23.18 |
| NS-3.0% | 13.924 | 17.936 | 23.6 |
| | | | |
| WMP-20%& NS-0% | 10.8678 | 13.9992 | 18.42 |
| NS-0.5% | 11.092 | 14.288 | 18.8 |
| NS-1.0% | 11.2749 | 14.5236 | 19.11 |
| NS-1.5% | 11.7233 | 15.1012 | 19.87 |
| NS-2.0% | 11.8472 | 15.2608 | 20.08 |
| NS-2.5% | 12.3487 | 15.9068 | 20.93 |
| NS-3.0% | 12.5434 | 16.1576 | 21.26 |
| | | | |
| WMP-30& NS-0% | 9.7704 | 12.5856 | 16.56 |

| | | | |
|---|---|---|---|
| NS-0.5% | 10.0182 | 12.9048 | 16.98 |
| NS-1.0% | 10.2011 | 13.1404 | 17.29 |
| NS-1.5% | 10.502 | 13.528 | 17.8 |
| NS2.0% | 10.7203 | 13.8092 | 18.17 |
| NS-2.5% | 11.1097 | 14.3108 | 18.83 |
| NS-3.0% | 11.269 | 14.516 | 19.1 |

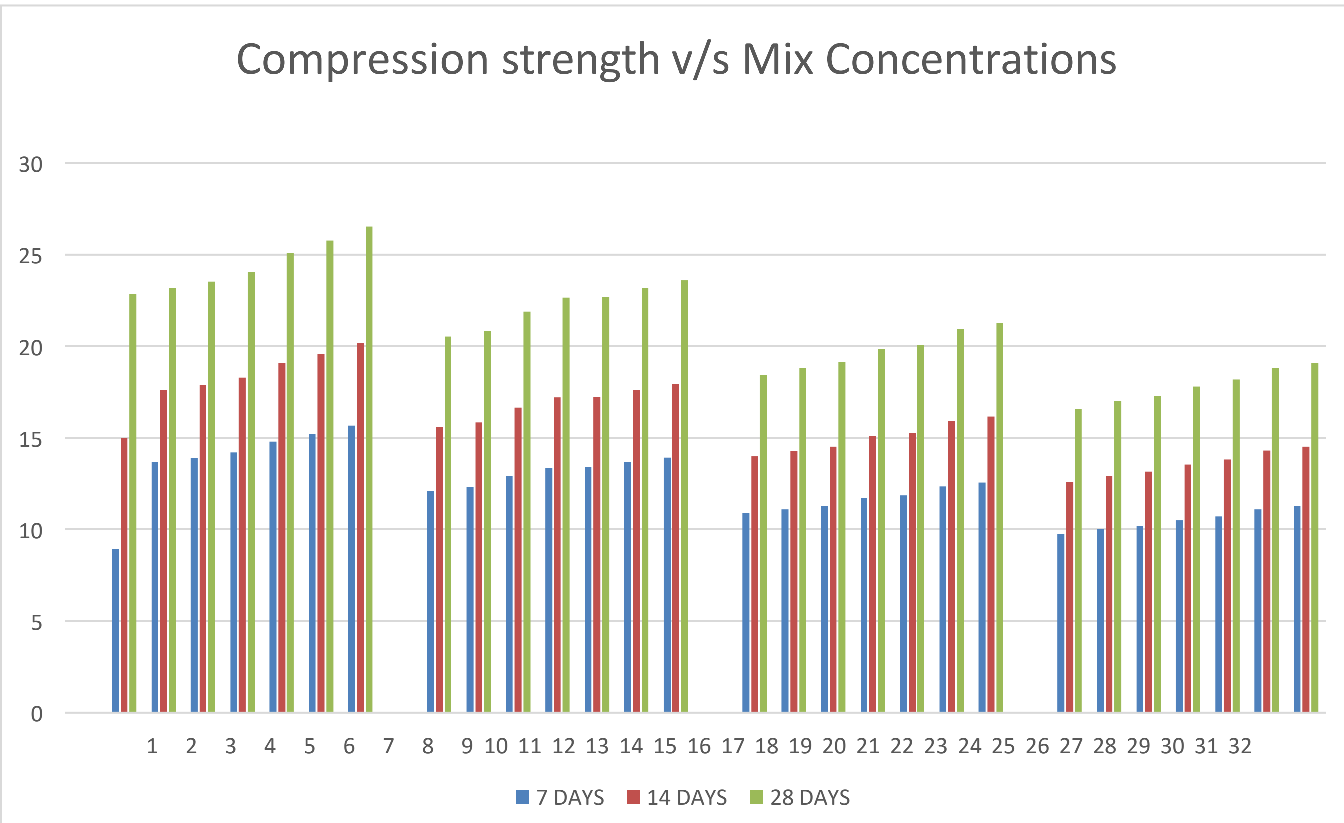



**Fig 4.1 Comparison Of Compressive Strength Of Mortar**

### 4.2.6 Concrete testing results :

Utilizing compression testing machine after 7,14 and 28days, compressive quality of concrete at different extents of NS and WMP samples is calculated. Results at 7 , 14 and 28 days have been shown in tablebelow.

**Table 4.3 Compressive Strength Results Of Concrete**

| SAMPLE CODE | 7 DAYS | 14 DAYS | 28 DAYS |
|---|---|---|---|
| WMP& NS- 0% | 30.8 | 41.8 | 55 |
| WMP-0 & NS-0.5% | 31.4 | 42.6 | 56.1 |
| NS-1% | 31.8 | 43.2 | 56.8 |
| NS-1.5% | 32.1 | 43.6 | 57.4 |
| NS-2.0% | 32.5 | 44.2 | 58.1 |
| NS-2.5% | 32.9 | 44.6 | 58.7 |
| NS-3.0% | 33.2 | 45.1 | 59.3 |
| | | | |
| WMP-10& NS-0% | 28.1 | 38.1 | 50.1 |
| NS-0.5% | 28.4 | 38.5 | 50.7 |
| NS-1.0% | 28.7 | 39.0 | 51.3 |
| NS-1.5% | 29.2 | 39.7 | 52.2 |
| NS-2.0% | 30.0 | 40.7 | 53.5 |
| NS-2.5% | 30.5 | 41.3 | 54.4 |

| | | | |
|---|---|---|---|
| NS-3.0% | 31.0 | 42.0 | 55.3 |
| | | | |
| WMP-20%& NS-0% | 24.5 | 33.3 | 43.8 |
| NS-0.5% | 24.9 | 33.7 | 44.4 |
| NS-1.0% | 25.3 | 34.4 | 45.2 |
| NS-1.5% | 25.8 | 35.0 | 46.1 |
| NS-2.0% | 26.3 | 35.7 | 47 |
| NS-2.5% | 26.8 | 36.3 | 47.8 |
| NS-3.0% | 27.4 | 37.2 | 48.9 |
| | | | |
| WMP-30& NS-0% | 22.3 | 30.3 | 39.9 |
| NS-0.5% | 22.8 | 31.0 | 40.8 |
| NS-1.0% | 23.1 | 31.4 | 41.3 |
| NS-1.5% | 23.6 | 32.1 | 42.2 |
| NS2.0% | 24.1 | 32.7 | 43 |
| NS-2.5% | 24.5 | 33.3 | 43.8 |
| NS-3.0% | 24.9 | 33.8 | 44.5 |

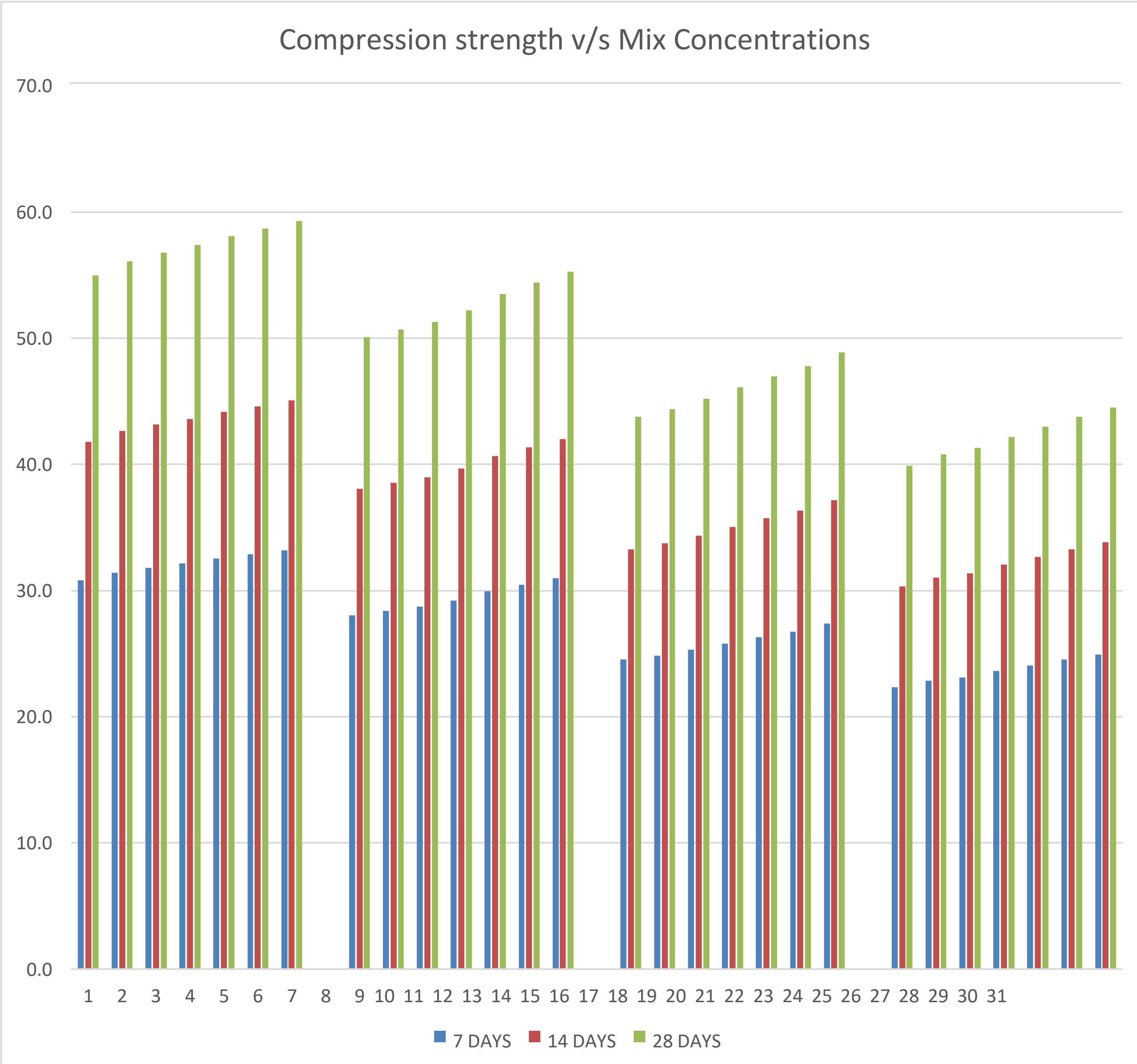



**Fig 4.2 Comparison Of Compressive Strength Of Concrete**

### 4.2.7 Split Tensile Strength testing results:

split tensile strength of concrete specimen was obtained using cyclindricalmoulds in a compression testing machine for 7, 14 and 28.

**Table 4.4 Split Tensile Strength Of Concrete**

| MORTAR SAMPLE CODE | 7 DAYS | 14 DAYS | 28 DAYS |
|---|---|---|---|
| | | | |
| WMP& NS- 0% | 2.71 | 3.14 | 4.6 |
| WMP-0 & NS-0.5% | 2.74 | 3.16 | 4.67 |
| NS-1% | 2.77 | 3.19 | 4.72 |
| NS-1.5% | 2.79 | 3.22 | 4.75 |
| NS-2.0% | 2.81 | 3.25 | 4.78 |
| NS-2.5% | 2.9 | 3.33 | 4.84 |
| NS-3.0% | 2.96 | 3.39 | 4.91 |
| | | | |
| WMP-10& NS-0% | 2.51 | 2.94 | 4.33 |
| NS-0.5% | 2.56 | 3.00 | 4.41 |
| NS-1.0% | 2.58 | 3.02 | 4.44 |
| NS-1.5% | 2.61 | 3.06 | 4.5 |
| NS-2.0% | 2.66 | 3.11 | 4.58 |
| NS-2.5% | 2.69 | 3.15 | 4.63 |
| NS-3.0% | 2.71 | 3.18 | 4.68 |
| | | | |
| WMP-20%& NS-0% | 2.31 | 2.71 | 3.98 |
| NS-0.5% | 2.40 | 2.81 | 4.13 |

| | | | |
|---|---|---|---|
| NS-1.0% | 2.44 | 2.86 | 4.21 |
| NS-1.5% | 2.48 | 2.91 | 4.28 |
| NS-2.0% | 2.51 | 2.94 | 4.33 |
| NS-2.5% | 2.53 | 2.97 | 4.37 |
| NS-3.0% | 2.55 | 2.99 | 4.4 |
| | | | |
| WMP-30& NS-0% | 2.17 | 2.54 | 3.74 |
| NS-0.5% | 2.19 | 2.56 | 3.77 |
| NS-1.0% | 2.22 | 2.60 | 3.82 |
| NS-1.5% | 2.24 | 2.62 | 3.86 |
| NS2.0% | 2.27 | 2.67 | 3.92 |
| NS-2.5% | 2.30 | 2.69 | 3.96 |
| NS-3.0% | 2.33 | 2.73 | 4.02 |

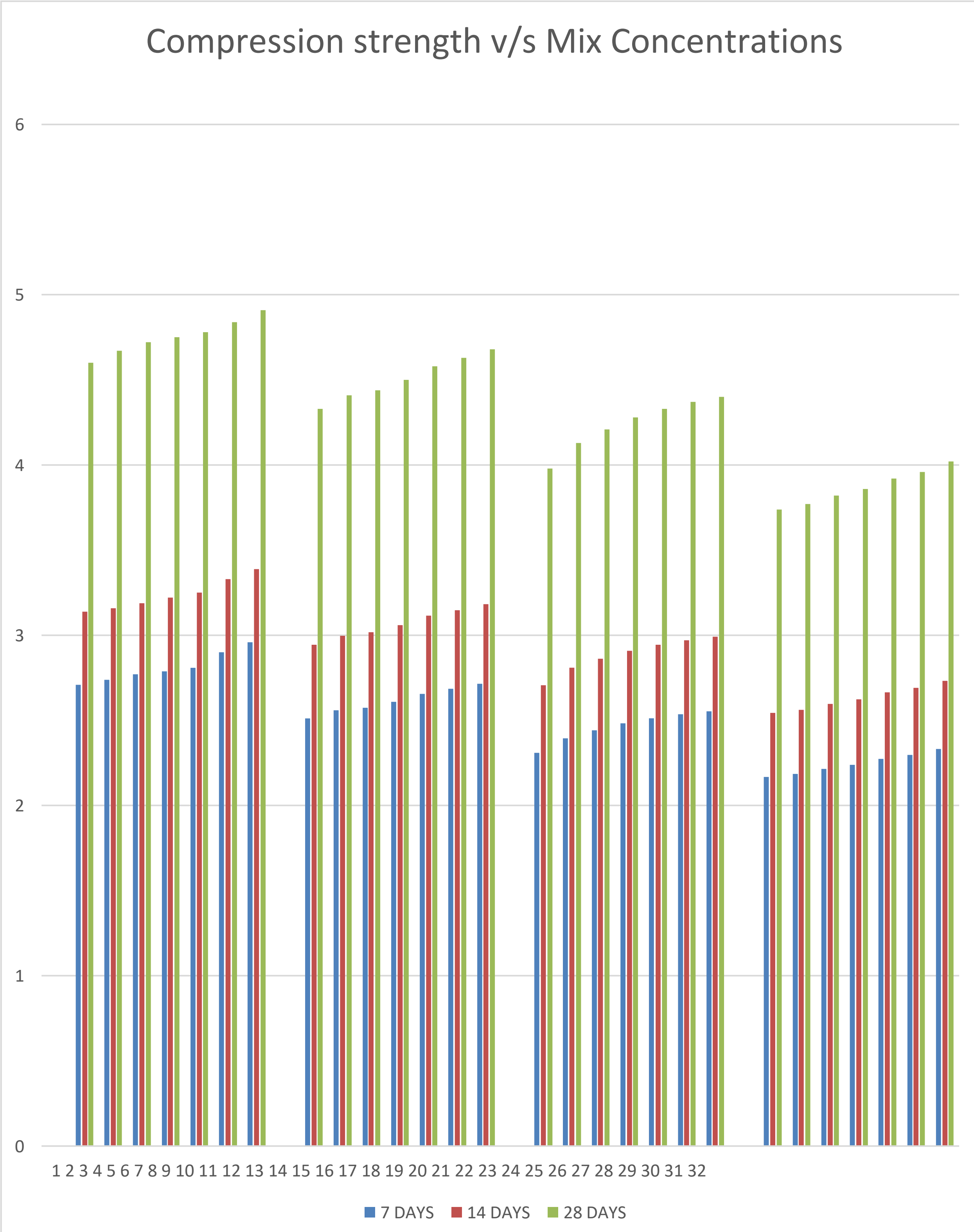



**Fig 4.3 Comparison Of Split Tensile Strength Of Concrete**

# CHAPTER-5

# CONCLUSION

## 5.1 DISCUSSION

Use of commercial Squander and by products as an aggregate or staple is of extraordinary down to earth criticalness creating artifact parts alternative for materials and giving an alternate or supplementary materials to construction industry during cost effective manner and therefore preservation of normal assets. due to environmental threats related to WMP (Squander marble powder), ir appropriate removal has pulled intons of consideration of hippieswithin most recent years. so as to appropriately discard those hundreds to thousands of huge amounts of powder, utilization of creative procedures to reuse m is crucial. Without right removal of this powder material, subsequent reserves would cause significant wellbeing dangers for general public and refore environment. refore, target is to review likelihood to incorporate marble sawing powder Squander s as a filler in concrete and reby reducing ill effects of Marble dust.

## 5.2 CONCLUSION

In light of examination above, ends were drawn from this work as follows:

1. WMP improved perfection and expand ed setting time of glues anyway altogether lessened compressive quality with replacement extent over 10%, regardless of way that calcite in WMP to some degree reacted with aluminum stage to convey carbonate AFm stage. reduced quality could be credited to diminish of C2S and C3S.

2. NS diminished perfection and setting time of cement WMP structure because of its ultra-high express surface district. Notwithstanding, NS basically expand ed compressive nature of cement WMP system. This was a direct result of nucleation sway, filler sway and ultra-high pozzolanic reactivity of NS, which basically propelled hydration system of cement at introductory period and preferred position plan of a denser microstructure.

3. On expansion of WMP inside blend, compressive quality is diminished while expansion of NS allegedly improves compressive quality.

4. Combine utilization of WMP and NS could incompletely balance negative impact brought about by each and gain satisfactory solidified properties.

## 5.3- FUTURE SCOPE

India is on verge of becoming a developed nation. event process directly relates infrastructural modernity process. The demand of cement is increasingly which involves an alternate resource , keeping in mind economical and environmental benefits. Squander marble powder may be a burden on environment because it is non degradable. So as to have prudent and traditional methodology, use of items like WMP and NS is recommended. Ideal utilization of 10%WMP and three NS as a substitution of concrete improves properties of blend.

# REFERENCES


- (Ma *et al.*, 2019)Ahmad, M.R. & Chen, B. (2018) Effect of silica fume and basalt fiber on mechanical properties and microstructure of magnesium phosphate cement (MPC) mortar. *Construction and Building Materials*. [Online] 190, 466–478. Available from: doi:10.1016/j.conbuildmat.2018.09.143.

- Akbar, F. (2016) *Marble Powder ' s Effect on Permeability and Mechanical Properties of ConcretKhaliq, Shams Ul Shahzada, Khan Alam, Bashir Bilal, Fawad Zeb, Mushtaqe*. 10 (4),522–527.`

- Aruntaş, H.Y., Gürü, M., Dayi, M. &Tekin, I. (2010) Utilization of waste marble dust as an additive in cement production. *Materials and Design*. [Online] Available from:doi:10.1016/j.matdes.2010.03.036.

- Belaidi, A.S.E., Azzouz, L., Kadri, E. & Kenai, S. (2012) Effect of natural pozzolana and marble powder on properties of self- compacting concrete. *Construction and Building Materials*. [Online] Available from:doi:10.1016/j.conbuildmat.2011.12.109.

- Berra, M., Carassiti, F., Mangialardi, T., Paolini, A.E., et al. (2012) Effects of nanosilica addition on workability and compressive strength of Portland cement pastes. *Construction and Building Materials*. [Online] Available from:doi:10.1016/j.conbuildmat.2012.04.132.

- Ergün, A. (2011) Effects of usage of diatomite and waste marble powder as partial replacement of cement on mechanical properties of concrete. *Construction and Building Materials*. [Online] Available from: doi:10.1016/j.conbuildmat.2010.07.00

- Gencel, O., Ozel, C., Koksal, F., Erdogmus, E., et al. (2012) Properties of concrete paving blocks made with waste marble. *Journal of Cleaner Production*. [Online] Available from:doi:10.1016/j.jclepro.2011.08.023.

- Khodabakhshian, A., Ghalehnovi, M., de Brito, J. &AsadiShamsabadi, E. (2018) Durability performance of structural concrete containing silica fume and marble industry waste powder. *Journal of Cleaner Production*. [Online] Available from: doi:10.1016/j.jclepro.2017.09.116.

- Land, G. & Stephan, D. (2012) influence of nano-silica on hydration of ordinary Portland cement. *Journal of Materials Science*. [Online] Available from:doi:10.1007/s10853-011-5881-1.

- Ma, B., Wang, J., Tan, H., Li, X., et al. (2019) Utilization of waste marble powder in cement-based materials by incorporating nano silica. *Construction and Building Materials*. [Online] 211, 139–149. Available from:doi:10.1016/j.conbuildmat.2019.03.248.

- Singh, L.P., Karade, S.R., Bhattacharyya, S.K., Yousuf, M.M., et al. (2013) Beneficial role of nanosilica in cement based materials - A review. *Construction and Building Materials*. [Online]. Available from: doi:10.1016/j.conbuildmat.2013.05.052.

- Singh, M., Choudhary, K., Srivastava, A., Singh Sangwan, K., et al. (2017) A study on environmental and economic impacts of using waste marble powder in concrete. *Journal of Building Engineering*. [Online]. Available from:doi:10.1016/j.jobe.2017.07.009.

- Topçu, I.B., Bilir, T. &Uygunoğlu, T. (2009) Effect of waste marble dust content as filler on properties of self-compacting concrete. *Construction and Building Materials*. [Online] Available from: doi:10.1016/j.conbuildmat.2008.09.007.

- Ulubeyli, G.C. &Artir, R. (2015) Properties of HardenedConcrete Produced by Waste Marble Powder. *Procedia - Social and Behavioral Sciences*. [Online] Available from: doi:10.1016/j.sbspro.2015.06.294.

- Uygunoɫlu, T., Topçu, I.B. &Çelik, A.G. (2014) Use of waste marble and recycled aggregates in self-compacting concrete for environmental sustainability. *Journal of Cleaner Production*. [Online] Available from: doi:10.1016/j.jclepro.2014.06.019.

- Vardhan, K., Goyal, S., Siddique, R. & Singh, M. (2015) Mechanical properties and microstructural analysis of cement mortar incorporating marble powder as partial replacement of cement. *Construction and Building Materials*. [Online] Available from: doi:10.1016/j.conbuildmat.2015.08.071.

- IS CODE-4031,1981 (Part-6). Indian Standard Code for determination of Compressive Strength of Hydraulic Cement or Masonry Cement.

## JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

## PLAGIARISM VERIFICATION REPORT

**Date:** 2/06/2020

**Type of Document (Tick):** PhD Thesis | M.Tech Dissertation/ Report | B.Tech Project Report ✔ | Paper

**Name:** Ritanjay , Shubang Malgotra Saksham Mahajan **Department:** Civil **Enrolment No** 161601,161661 161675

**Contact No.** 7018675701,9149518057,8492907770 **E-mail.** ritanminhas55@gmail.com, malgotrashubang@gmail.com sakshammahajan9876@gmail.com

**Name of the Supervisor:** Dr. Ashok Kumar Gupta & Mr. Abhilash Shukla

**Title of the Thesis/Dissertation/Project Report/Paper (In Capital letters):** UTILIZATION OF WASTE MARBLE POWDER IN CEMENT - BASED PRODUCTS BY INCORPORATING NANO SILICA

### UNDERTAKING

I undertake that I am aware of the plagiarism related norms/ regulations, if I found guilty of any plagiarism and copyright violations in the above thesis/report even after award of degree, the University reserves the rights to withdraw/revoke my degree/report. Kindly allow me to avail Plagiarism verification report for the document mentioned above.

**Complete Thesis/Report Pages Detail:**

- Total No. of Pages = 80
- Total No. of Preliminary pages = 10
- Total No. of pages accommodate bibliography/references = 4

Ritanjay
Saksham Mahajan

**(Signature of Student)**

### FOR DEPARTMENT USE

We have checked the thesis/report as per norms and found **Similarity Index** at ..20............(%). Therefore, we are forwarding the complete thesis/report for final plagiarism check. The plagiarism verification report may be handed over to the candidate.

15/7/2020 HOD CE DEPT

**(Signature of Guide/Supervisor)**

15/7/2020 HOD CE DEPT

**Signature of HOD**

### FOR LRC USE

The above document was scanned for plagiarism check. The outcome of the same is reported below:

| Copy Received on | Excluded | Similarity Index (%) | Generated Plagiarism Report Details (Title, Abstract & Chapters) | |
|---|---|---|---|---|
| | • All Preliminary Pages<br>• Bibliography/Images/Quotes<br>• 14 Words String | | Word Counts | |
| **Report Generated on** | | | Character Counts | |
| | | **Submission ID** | Total Pages Scanned | |
| | | | File Size | |

**Checked by**
**Name & Signature** **Librarian**

..............................................................................................................................................

**Please send your complete thesis/report in (PDF) with Title Page, Abstract and Chapters in (Word File) through the supervisor at plagcheck.juit@gmail.com**