AN INVESTIGATION ON PROPERTIES OF S.C.C BY PARTIAL REPLACEMENT OF COARSE AGGREGATE WITH WASTE MARBLE CHIPS

SACHIN PURANDARE[1], DR.UJJAVAL SHAH[2]
[1]Postgraduate Student, Civil Engineering, Parul Institute of Engineering and Technology, Limda - Vadodara
[2]Associate Professor, Civil Engineering, Parul Institute of Engineering and Technology, Limda - Vadodara

ABSTRACT:-

Now a days a marble industry produces large amount of waste in forms of marble chips & dust. This waste is dumped on to open land which creates a lot of environmental problems. This study is to investigate the properties of self-compacting concrete using waste marble as a partial replacement of conventional natural coarse aggregate. An experimental investigation is carried out to study behavior of M50 concrete using waste marble chips as a partial replacement of coarse aggregate with partially replace 0%, 10%, 20%, 30% & 40%. Polycarboxylate based super plasticizer is added to concrete. Concrete cube, cylinders will be cast and test on it. Main aim is to determine the effect of waste marble as partial substitute of coarse aggregate on the properties of self-compacting concrete in fresh state and hardened state. Fresh concrete test like compaction factor test will be undertaken as well as hardened concrete test like compressive strength at the age of 7 days, 28 days will be obtain and also durability aspect of concrete for sulphate attack will test.

KEY WORDS:- Waste Marble Chips, Sulphate Attack On Concrete Cubes, self-compacting concrete, Compressive Strength, Fresh property

Introduction:-

Today we are faced with an important consumption and a growing need for aggregates because of the growth in industrial production, this situation has led to a fast decrease of available resources. On the other hand, a high volume of marble production has generated a considerable amount of waste materials; almost 70% of this mineral gets wasted in the mining, processing and polishing stages which have a serious impact on the environment. The processing waste is dumped and threatening the aquifer. Therefore, it has become necessary to reuse these **waste marble chips** particularly in the manufacture of concrete products for construction purposes. Because of continual depletion of quarries aggregates, construction materials are more and more judged by their ecological characteristics. The lack of technology and unscientific methods of quarrying marble in Algeria has generated a huge quantity of waste of this valuable mineral; leaving the waste materials to the nature directly can cause serious environmental problems. In addition, the marble cutting industry generates a high volume of wastes. Recent studies showed that marble waste can be used as aggregates for assorted construction materials. Self-compacting concrete is an exceedingly stream capable kind of solid that spreads into the shape without the requirement for mechanical vibration. Self-compacting concrete is non-isolating solid that is set by methods for its very own weight. The exceptionally liquid nature of S.C.C makes it reasonable for putting in troublesome conditions and in segments with congested fortification. It was initially created in Japan, to defeat the issues caused by absence of finish and uniform compaction through vibrations. It has since turned out to be monetarily gainful on account of various components. It enhanced toughness and compressive quality, less demanding putting and subsequently decrease in labour at the season of setting, better surface completions, more noteworthy opportunity in outline which can prompt more slender solid segments, diminished clamour levels as a result of nonattendance of vibrations. S.C.C can be utilized

even within the sight of thick fortification because of its streaming, passing and filling capacities.

Experimental Investigation:-

[1]Material Used:

Cement- Ordinary Portland cement of 53 grade from a single batch was used for the entire work and care has been taken that it has to been stored in airtight containers to prevent it from being affected by the atmospheric and monsoon moisture and humidity. The cement procured was tested for physical requirements in accordance with IS:12269-1987 and for chemical requirements in accordance with IS: 4032-1977.

Waste Marble Chips – Waste marble has true density 2.736 (g/cm3), Bulk density 2.684 (kg/cm3), Porosity 1.96 (%), Absorption (by weight) 0.39 (%), Saturation 0.87 (%).

Fig.1 Waste Marble Chips

Marble chips is a modern waste delivered from cutting of marble stone for use in different development applications in India. The utilization of marble chips as coarse total in cement diminishes the measure of characteristic total.

Fine Aggregate- The river sand, passing through 4.75 mm sieve and retained on 600 µm sieve, conforming to Zone II as per IS 383-1970 was used as fine aggregate in the present study. The sand is free from clay, silt and organic impurities. The aggregate was tested for its physical requirements such as gradation, fineness modulus, specific gravity and bulk modulus in accordance with IS: 2386-1963.

Coarse Aggregate- Throughout the investigations, crushed coarse aggregates of 20mm and 10 mm greet procured from the local crushing plants was used. The aggregate was tested for its physical requirements such as gradation, fineness modulus, specific gravity and bulk density etc. in accordance with IS: 2386-1963 and IS: 383-1970.

Silica Fume-

Silica fume is a byproduct of producing silicon metal or ferrosilicon alloys. One of the most beneficial uses for silica fume is in concrete. Because of its chemical and physical properties, it is a very reactive pozzolan. Concrete containing silica fume can have very high strength and can be very durable.

[2] Mixing Proportion:-

Following table showing mix design of SCC with addition of different proportion of Waste Marble Chips. Waste Marble Chips replacement ranges from 0% to 40% in the step by volume. Fine aggregate volume remained constant.

Table-2: Mix Proportion

Cement (kg/m^3)	F.A (kg/m^3)	C.A (kg/m^3)	Water (Ltr/m^3)	SP (Ltr/m^3)
495	917	787	165	8.25

Table-3: Partial Replacement of Waste Marble Chips with Coarse Aggregate

Replacement of Waste marble chips with Coarse aggregate	Cement (Kg)	Waste marble chips (Kg)	Sand (Kg)	Course aggregate (Kg)
0%	495	0	917	787
10%	495	78.7	917	708.7
20%	495	157.4	917	629.6
30%	495	236.1	917	550.9
40%	495	314.8	917	472.2

[3] Preparation of Samples:-

In this study totally 36 cubes were casted by replacing cement with WM replaced by 0%, 10%, 20%, 30% & 40% for three different water cement ratios. For each water cement ratio and replacements 3 cubes were caste and its average compressive strength is tabulated for 7, 14 and 28 days. All the materials used were batched by

weight proportions. Concrete were mixed in drum type mixer in the laboratory. Before starting mixer machine the mixer drum was fully washed using water and allowed to dry for 5 minutes. The coarse aggregate, WM and river sand mixed for 2 minutes. Finally cement and remaining water was added and mixing continued until the concrete gets homogeneous. The same procedure was followed for various mixes. 150 mm cube moulds were used to cast the specimen and a vibrating table was employed to compact the concrete. Immediately after casting the specimens were covered with plastic sheets for 24Hrs to prevent the evaporation of water from the concrete. The cube was taken out from mould after 24hrs and cured in water under ambient temperature until they were tested.

[4] Test on fresh SCC:-

Tests of SCC on fresh properties include slump flow, v-funnel test and L-box test. The result of this test is given in table 3.

Slump Flow: - The maximum flow of concrete in absence of any obstructions was conducted by slump flow test in which the slump cone was filled mixed without any compaction. The value of Slump flow is the average of the two diameters cone in perpendicular directions of the concrete after lifting the cone and until concrete stops flowing.

Fig.2- Slump Flow Test

V-funnel: - This test is used to determine the filling ability properties (flow ability) of the concrete. The funnel is filled up with 12 liter of concrete. Find the time taken for its flow down. V-funnel value is the time of concrete flowing from the opening at the bottom of the funnel. Both the test gives indications of flow ability of concrete.

Fig.3- V-funnel test specimen

L- Box: - This test assesses the flow of concrete and also the extended to which the concrete is subjected to blocking by reinforcement. About 14 liter of concrete is required for the test and let it rest for 1 minute before the test.

Fig.4- L-Box test

Table 3:- Result of fresh concrete

Test	Properties	Time	Flow
Slump Flow	Falling ability	8 sec.	740
V-funnel	Falling ability	12 sec.	-
L-box	Passing ability	1.5,2 sec.	-

Results and Discussion:-

[1]Compressive strength:-

Concrete cubes of size 150×150×150mm were casted and tested for compressive strength in normal water at ages of 7, 28 days for 0%, 10%, 20%, and 30% & 40% replacement of waste marble chips for M50 grade of concrete.

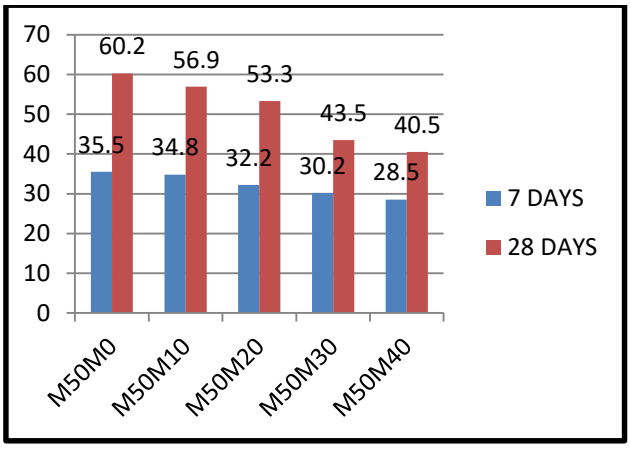

Fig.5- Compressive strength of concrete at ages of 7 days and 28 days

[2]Flexural strength:-

Fig.6 shows flexural strength results for mix with different percentage of waste marble.

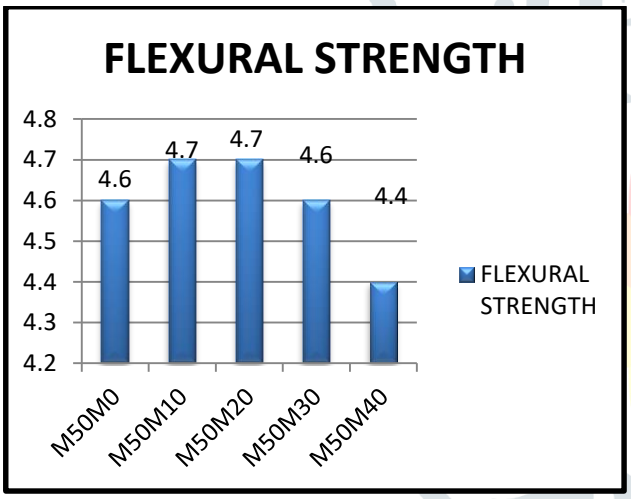

Fig.6- Flexural strength of concrete at ages of 28 days

CONCLUSION:-

1. The compressive strength of concrete with waste marble in the lowest water to binder ratio was lower.

2. Replacing coarse aggregate up to 40% WM was found that relatively decrease in compressive strength of concrete.
3. Partial replacement of coarse aggregate with WM improved the performance & durability of concrete more than the other concrete.

References:-

1. TayfunUygunoglu, IlkerBekirTopçu, AtilaGürhanÇelik"Use of waste marble and recycled aggregates in self-compacting concrete for environmental sustainability" Science Direct**(2014)**
2. Mohsen Tennicha, Mongi Ben Ouezdoua, AbderrazekKallela "Thermal effect of marble and tile fillers on self-compacting concrete behavior in the fresh state and at early age" Science Direct **(2018)**
3. Mohsen Tennich, Mongi Ben Ouezdou, AbderrazekKallel "Behavior of self-compacting concrete made with marble and tile wastes exposed to external sulfate attack" Science Direct **(2018)**
4. Sudarshan D. Kore, A.K. Vyas "Impact of marble waste as coarse aggregate on properties of lean cement concrete" Science Direct **(2016)**
5. Hasan S¸ ahanArel"Recyclability of waste marble in concrete production" Science Direct **(2016)**
6. Mohsen Tennich, AbderrazekKallel, Mongi Ben Ouezdou "Incorporation of fillers from marble and tile wastes in the composition of self-compacting concretes" Science Direct **(2015)**