Impact of Partial Replacement of Fine Aggregate & Coarse Aggregate with Marble Waste in High Strength Concrete

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Abstract- *Concrete is the most widely used construction material in civil engineering industry because of its high structural strength and stability. Concrete has become really expensive. Marble is industrially processed & being cut, polished, and utilized for decorative purposes, and thus, economically valuable. In marble quarries, stones are cut as blocks through different methods. During the cutting process, 20-30% of a marble block becomes marble waste. Marble stone industry generates both solid waste and stone slurry. All these wastes are thrown out in the areas near the factories and cause severe environmental problems. In this study, tried to make eco-friendly concrete, marble waste is used in various percentages in the fine and coarse aggregate replacement and carry out optimum percentages of them. After getting optimum percentages of fine and coarse aggregate replacement carry out Mechanical properties of M60, M70 & M80 grade of concrete. Then we used optimum percentage of marble F.A. and marble C.A. prepares binary mix from both and determine properties of conversional concrete & High performance concrete. By using that binary mix proportion produce high performance concrete. And at the end we compare economical parameter of both conventional as well as marble waste concrete.*

Keywords- Marble Waste Coarse Aggregate, Marble Waste Fine Aggregate, Concrete, High Strength Concrete.

I. INTRODUCTION

In construction industry concrete is the most versatile material. Nowadays the demand of concrete is increasing. The need for concrete affects natural resources as concrete is made from natural resources. Due to depletion of natural resources the architect and engineers has growing interest in sustainable development. So a new material is used in place of concrete. For selecting this type of material we can use many types of waste. Industrial waste is one of them. This industrial waste is left directly in the environment which leads to environmental problems. The collection and disposal of industrial waste have to be done properly. So the use of industrial waste instead of concrete will help us not only to save natural resources, but also to create a new type of construction material which boosts sustainable development. Application of these materials in concrete is environmentally friendly and economically beneficial.

Industrial waste is used in many types of concrete like conventional concrete, self compacting concrete, light weight concrete, high performance concrete and green concrete with different proportion. In concrete production variety of Industrial waste materials such as marble waste, glass waste, copper slag, silica fume, blast furnace slag, fly ash, and limestone are being used.

Recent research shows that it is possible to utilize industrial byproducts as well as other waste material in the production of normal concrete when it is used as partial replacement of fine aggregate or/and coarse aggregate. Also, it has been demonstrated that many of the produced concrete (ordinary concrete) made with wastes and industrial resources possesses superior assets as compared to the conventional concrete in terms of strength, performance and durability.

II. LITERATURE REVIEW

- **Bhupendra singh kalchuri et al. (2015).** When the percentage of marble powder waste has increased up to 20% the compressive strength of concrete is also increased and by further increasing the percentage of marble powder waste the compressive strength is decreased. In concrete production the compressive test also shows that the waste marble powder can be successfully utilized as partial replacement of fine aggregate

- **Kür at EsatAlyamaç. et. al. (2015)** The marble powder content negatively correlates with the workability of concrete, but highly important result is that, it is possible to produce required concrete workability with and without chemical additives. In the range of optimal values when the amount of marble powder used the compressive strength of marble powder concrete is higher than the

compressive strength of reference concrete. The durability properties of concrete such as water absorption and abrasion resistance have a positive effect on the optimum rate of marble powder. In accordance with the requirements using up to 40% marble powder in concrete is suitable. Thus, environmentally friendly, economic and durable concrete is obtained.

- **R. Rodrigues et al. (2015).** To maintain the same levels, there was no need change the w/c ratio of the various mixes significantly in terms of workability. With higher replacement ratios the bulk density slightly decreases. As the replacement ratio increases the compressive strength decreases, but this decrease is not significant up to replacement ratios of 10%. The test that showed most variability was the splitting tensile strength. Nevertheless, it was concluded that as there was an increase of the replacement ratio the parameter decreases. For higher incorporation ratios of SME (Sludge from the marble extraction industry) as cement replacement the modulus of elasticity showed a slight decrease. Due to an increase of the mixes compactness the Plasticizers increased the modulus of elasticity. With the incorporation of SME (Sludge from the marble extraction industry) the ultrasonic pulse velocity decreases since this has a much lower hydraulicity than cement, therefore does not contribute as much as improving compactness. However, almost this decrease is insignificant. Abrasion resistance decreases with the incorporation of SME but this decrease is not significant for replacement ratios of up to 10%.

- **Aalok D. Sakalkale et al. (2014).** Addition of waste marble powder up to 50% by weight in place of sand than the compressive strength of concrete is increased, but further any addition of waste marble powder the compressive strength is decreased. At 25% replacement of sand in concrete is given nearly equal to control mix tensile strength. We can get better tensile strength at 25% sand replacement in concrete by using waste marble powder. Addition of waste marble powder up to 50% by weight in place of sand than the flexural strength of concrete is increased, but further any addition of waste marble powder the flexural strength is decreased. For replacement of sand with marble powder we found out that the optimum percentage in concrete is almost 50%.

- **Diogo Silva et al. (2014)** The workability of concrete is negatively influenced by incorporation of secondary marble fine aggregates. The incorporation of secondary aggregates is affected by the compressive strength of concrete and as the ratio of replacement has increased the compressive strength of all the concrete family studies decreases. For the granite concrete and river sand concrete families have similar losses in split tensile and compressive strength of concrete as the incorporation ratio increases.

- **Rishi et al. (2014).** The fine aggregate and cement is partially feasible to be replaced by waste marble powder for improving the strength characteristics of concrete. By replacing the fine aggregate and cement combine by waste marble powder the strength of concrete is decreased. It is found that 10% marble waste powder is replaced against flexural and split tensile strength at 28days.

- **F. Gameiro et al. (2013)** As the replacement ratio increase the workability of fresh concrete tends to decrease, except for the river sand specimens. The incorporation of marble aggregates proved to be positive, especially at a replacement ratio of 20% in terms of water absorption by capillary action. Regarding water absorption by immersion, it can be concluded that the permeability of the granite and basalt concrete specimens is improved by incorporating with marble, which is beneficial for durability. In concerning carbonation resistance, with the incorporation of marble sand, granite sand mixes improves whereas river sand concrete mixes did not, in terms of carbonation resistance sand concrete mixes had imperceptible changes, in concrete permeability the changes in this property were mainly caused by variations. There is a solid relationship between the chloride penetration results and the rates of water absorption by immersion; the replacement ratio of the granite and basalt concrete mixes as the fine marble waste aggregates is increased. When the chloride migration coefficient decreased, but in the river sand concrete mixes did not do it.

- **Antonio Andre et al. (2013).** Mixes made with basalt coarse aggregates and limestone coarse aggregates Workability are increased by the 20% and decrease by 50% incorporation ratio. Mixes made with granite coarse aggregates are unchanged in its workability. The ratio of primary aggregates with coarse marble aggregate is increased when the compressive strength is decreased. The behavior of concrete made with coarse marble aggregate in water absorption by immersion, it is similar to that of the reference concrete. Water absorption by capillary action is lower in the incorporation of coarse marble aggregate in the mixes made with limestone coarse aggregate and granite coarse aggregate. Coarse marble aggregate concrete has a similar carbonation depth to that of the reference concrete

- **CONCLUTION: -**

As per above all the research paper all the researcher had done work on Partial replacement of Marble waste. Marble waste will be good for economy and environment. It helps in saving natural resources. Optimum percentage for replacement is varies up to 20% to 50% for fine aggregate and up to 20% coarse aggregate. Marble waste is good for some durability-related characteristics. Compressive strength of concrete decreased with increasing ratio of primary aggregate with coarse marble aggregate.

III. METHODOLOGY

Tests Done on Ingredients

1) Natural Coarse Aggregates & Marble Waste Coarse Aggregates

- Impact value
- Crushing value
- Specific gravity
- Water Absorption
- Bulk density
- Abrasion value

2) Fine Aggregate & Marble waste F.A.

- Fineness Modulus
- Water absorption
- Specific gravity
- Bulk density

3) Cement

- Consistency
- Initial Setting Time
- Final Setting Time
- Soundness
- Compressive strength after 3days
- Compressive strength after 7days
- Compressive strength after 28days

IV. PROPERTIES OF MATERIAL

1) Cement - Physical properties of cement.

Table 1.

Sr. No.	Test	Result
1	Consistency	32%
2	Initial setting time	110 min
3	Final setting time	245 min
4	Soundness	2.45
5	Compressive strength after 3-days	17.60 N/mm^2
6	Compressive strength after 7-days	24.30 N/mm^2
7	Compressive strength after 28-days	35.10 N/mm^2

2) Coarse Aggregates & Marble Waste C.A

Physical properties of C.A.

Table 2.

Sr. No.	Properties	N.C.A	M.W.C.A
1	Impact value	9.56 %	29.65 %
2	Crushing value	12.23 %	24.52 %
3	Specific gravity	2.88 kg/m^3	2.77 kg/m^3
4	Water absorption	0.92 %	1.50 %
6	Bulk Density	1494 kg/m^3	1425.33 kg/m^3
7	Abrasion Value	16.50 %	24.55

3) Fine Aggregates & Marble Waste F.A

Physical Properties of F.A.

Table 3.

Sr. No.	Properties	N.F.A	M.W.F.A
1	Fineness Modulus	3.56 %	2.90 %
2	Water absorption	1.45 %	2.70 %
3	Specific Gravity	2.55 %	2.63 %
4	Bulk Density (kg/m^3)	1540	1586.67

V. CASTING SCHEDULE FOR M-60

Table 4.

Sr. No.	% Replacement with F.A.	% Replacement with C.A.	No. of Cubes	No. of Cylinder	No. of Beams
1	0	0	6	3	3
2	20	0	6	3	3
3	30	0	6	3	3
4	40	0	6	3	3
5	0	20	6	3	3
6	0	30	6	3	3
Total			**36**	**18**	**18**

VI. RESULTS

Workability Test

Table 5.

Sr. No.	% Replacement with F.A.	% Replacement with C.A.	Slump Value	Compaction Factor Value
1	0	0	36	0.81
2	20	0	34	0.805
3	30	0	34	0.80
4	40	0	32	0.78
5	0	20	30	0.80
6	0	30	27	0.77

Compressive strength results

M-60 Grade concrete compressive strength results

Table 6.

Sr. No.	% Replacement with F.A.	% Replacement with C.A.	7 days Strength (N/mm^2)	28 days Strength (N/mm^2)
1	0	0	50.50	69.16
2	20	0	45.20	69.28
3	30	0	44.50	70.30
4	40	0	46.30	66.30
5	0	20	43.56	67.30
6	0	30	41.70	69.23

M-60 Grade concrete Split Tensile strength results

Table 7.

Sr. No.	% Replacement with F.A.	% Replacement with C.A.	7 days Strength (N/mm^2)	28 days Strength (N/mm^2)
1	0	0	50.50	69.16
2	20	0	45.20	69.28
3	30	0	44.50	70.30
4	40	0	46.30	66.30
5	0	20	43.56	67.30
6	0	30	41.70	69.23

M-60 Grade concrete Flexural strength results

Table 8

Sr. No.	% Replacement with F.A.	% Replacement with C.A.	7 days Strength (N/mm^2)	28 days Strength (N/mm^2)
1	0	0	3.28	5.85
2	20	0	3.10	5.65
3	30	0	3.40	5.90
4	40	0	2.90	5.35
5	0	20	3.71	6.10
6	0	30	3.70	6.11

M-60 Grade concrete Flexural strength results

Table 9

Sr. No.	% Replacement with F.A.	% Replacement with C.A.	7 days Strength (N/mm2)	28 days Strength (N/mm2)
1	0	0	4.1	7.29

2	20	0	3.80	7.34
3	30	0	4.25	7.40
4	40	0	4.0	7.30
5	0	20	4.55	7.60
6	0	30	4.75	7.70

VII. CONCLUSION

As of now we can conclude from the study & experimental work that natural fine aggregate can be replaced by marble waste fine aggregate up to 30% after replacing more than 30% the compressive strength of concrete reduces in abnormal way & coarse aggregate can also be replace with marble waste coarse aggregate up to 30%. After replacing more than 30% of coarse aggregate the compressive strength is decreasing. By replacing 30% marble waste we get good enough result.

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