Effect of Marble Slurry and Recycled Aggregate in Different Grade of Concrete

Dr. Rambha Thakur[1], Balram[2]

[1]Assistant Professor, Department of Civil Engineering, Rattan Institute of Technology and Management, Haryana, India
[2]Research Scholar, Department of Civil Engineering, Rattan Institute of Technology and Management, Haryana, India

ABSTRACT

In this world of rapid urbanization the demand for natural construction materials is increasing day by day which has created a necessity for alternative construction materials. The reduction in the sources of natural sand and aggregate and the requirement in the cost of concrete production has resulted in the increased need to identify substitute material to sand as fine aggregates and recycled aggregate as course aggregate in the production of concretes. Quarry dust and recycled aggregate are waste products which are released directly into the environmental and can cause environment pollution. Quarry dust a waste from the stone crushing unit accounts 25% of the final product from stone crushing unit. Recycled aggregate is a waste from demolition of concrete from buildings or structures consisting of concrete.

INTRODUCTION

Concrete is the most regularly used construction material in the world. It is estimated that the present utilization of concrete in the world is of the order of 1O billion tones every year. The word "concrete" makes from the Latin verb "concretus" which means to develop together. It is a composite material. Concrete is artificial stone made of Portland cement, coarse aggregates and fine aggregates and water. Aggregates are 65% -80% of the volume of the concrete.

Sand, gravel & crushed stone are the primary aggregates used. A11 aggregates must be essentially free of silt or organic matter. [1] The ingredients can be categorized into two sets namely active and inactive. The active set consists of cement and water and the inactive set consists of fine and coarse aggregates. Sometime admixtures are added to improve the properties of the concrete.

It can be fabricated in all categories of possible geometries, it has outstanding hardened and durability properties, it's important materials are mostly available everywhere in the world and additional importantly its realization is comparatively cheap specially related to steel.

Concrete finds applications in foundations and swimming pools, homes, streets, slabs-on-ground, walls, beams, columns, floors, roofs, bridges, dams, yards, basements, barriers, plain cement tiles, pavement blocks, kerbs, drain covers, benches pavements and other infrastructure. On the other hand, there are certain disadvantages of using concrete since it is brittle material and also it has low tensile stress.

The researchers were trying to decrease the brittleness and making concrete more effective by using mineral additions to improve its characteristics for several years [2]. The mineral accompaniments are well-defined as very fine or powder materials that can be used as ingredients in concrete or mortar. Broadly using of mineral additions in concrete increase it's, setting time, strength gain, workability, durability to deterioration processes [3].

First of all the production of concrete needs enormous quantities of natural resources every year. Then, the production of Portland cement discharges nearly one ton of CO2 into the atmosphere [4].

It is expectable that the cement manufacturing alone is liable for about 7% of worldwide CO2 secretions. In the construction industry concrete is the largely used material, which consumes natural recourses like aggregate & water.

The production cost of cement is high and causes high secretion of CO2 [5]. Excess quantity of CO2 damages the natural climatic condition.

Also, the manufacture of concrete involves bulk volumes of water. The water availability is a matter of worry these days.

The concrete manufacturing uses over one trillion gallons masses of water each year worldwide, not including washing and curing water [6]. Lastly, the waste and disposal of concrete structures create another major environmental problem [7].

This can be achieved by the use of high-performance materials available at a lower cost. In order to make concrete more eco-friendly, cement has been replaced by some raw materials like marble slurry, fly ash, stone dust, sugar cane ash, rice husk ash, bottom ash, silica fume, granite dust, etc.

Calcium oxide	37.30
Magnesium oxide	4.13
Sodium oxide	1.21
Potssium oxide	0.40
Aluminium Trioxide	1.37
Ferrous oxide	0.86
Titenium oxide	0.05
Silica	24.90
LOI	31.94

Figure 1 Chemical composition of Kota marble slurry in percentage

LITERATURE REVIEW

Aliabdo et al (2014) investigated experimentally the effect of marble slurry on properties of concrete. In that work both cement and sand were replaced by the marble slurry from 0.0% to 15% at an interval of .25% by weight of cement. No effect was reported on setting time and soundness. Max compressive strength was observed at the replacement of cement by 10% marble slurry. 3 day compressive strength of mortar with 5%, 7.5% & 10% replacement by marble slurry was reported as 1%, 10% & 12% respectively.

Celik et al (2014) made an attempt to use natural waste like high volume natural volcanic pozzolana ash and limestone powder. The mechanical properties of concrete studied by substituting 50% cement with finely ground natural volcanic pozzolana ash with or without lime stone powder.

Lakhani et al (2014) have studied the effect of stone waste as a mixture in pozzolana or nonpozzolana material. In the work fresh and hardened properties of concrete were investigated. In SCC with limestone as a protective material with marble powder without fly ash showed the high performance at 20 % replacement.

Torkaman et al (2014) carried out a study on lightweight concrete with the replacement of cement by wood fiber waste, rice husk ash and limestone powder. Replacement of cement by wood fiber decreased the compressive strength. W/c ratio also increased with increase of wood fiber and decreased with rice husk ash and limestone powder.

]Krishnamoorthi and Kumar (2013) experimentally studied the workability and harden properties of concrete with the use of quarry dust as a sand replacement and fly ash as cement replacement. The quarry dust replaced by 10% to 20% at an interval of 5 % and cement was also replaced by the same amount by weight. Workability

Pandya and Kant (1988) presented a finite element formulation for flexure of a symmetrically laminated plate based on a higher-order displacement model and a three-dimensional state of stress and strain. They incorporated linear variation of transverse normal strains and parabolic variation of transverse shear strains in higher order.

Zinno and Barbero (1995) developed a three-dimensional element with two-dimensional kinematic constraints for the geometric nonlinear analysis of laminated composite plates using a total Lagrangian description and the principle of virtual displacements.

Experimental Programme

Different mix proportions by replacing cement with MS and coarse aggregate by recycled aggregate have been used for studying the fresh and hardened properties of concrete. In this research work the cement was replaced by 0%, 5%, 7.5%, 10% and 15% with MS and 50% natural aggregates were replaced by recycled aggregate. The grade of concrete chosen in this work was M25 and M40.

An experimental programmed was setup to investigate the fresh and hardened properties of concrete by using MS and RA. The effect of MS on mortar properties was also studied. The main aim was to investigate the compressive strength, split tensile strength, flexural strength and workability of two mix proportions M25 and M40.

Flow Chart of Work

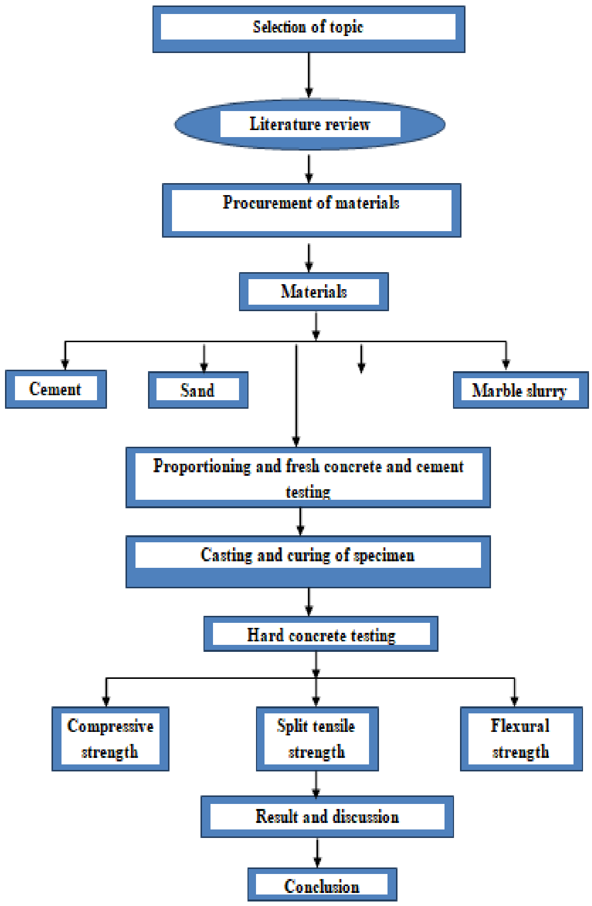

Figure 1: Flow chart of work

RESULTS

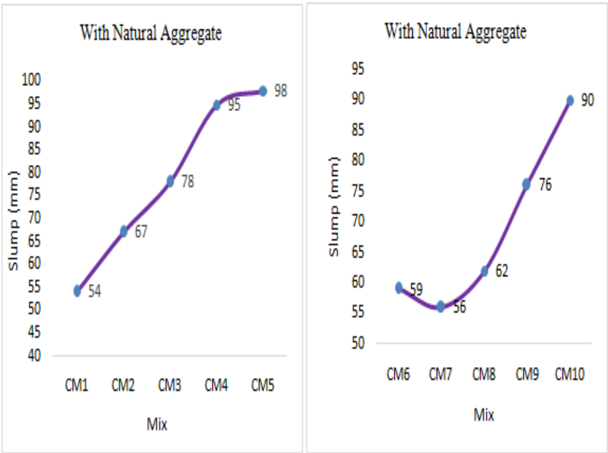

Figure 2 workability of M25 & M40 grade with natural aggregate

It has been observed from Figure 2 w.r.t. M25 & M40 that maximum workability was obtained for CM5 with reference to CM1 (Control mix).

The maximum slump was increased by 81.48% and 52.53% for CM5 and CM10 respectively.

The minimum slump was obtained at CM7.

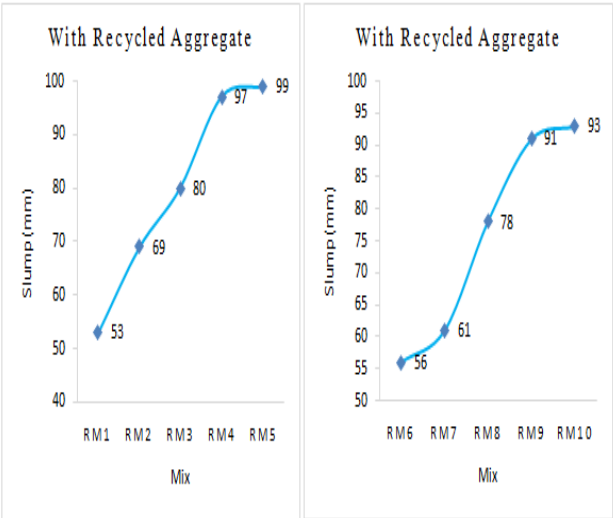

Figure 3: workability of M25 & M40 grade with recycled aggregate

It has been observed from Figure 3 w.r.t. M25 & M40 that maximum workability was obtained for RM5 with reference to RM1 (Control mix).

The maximum slump was increased by 86.79% and 66.07% for RM5 and RM10 respectively.

The Minimum slump was obtained at CM7.

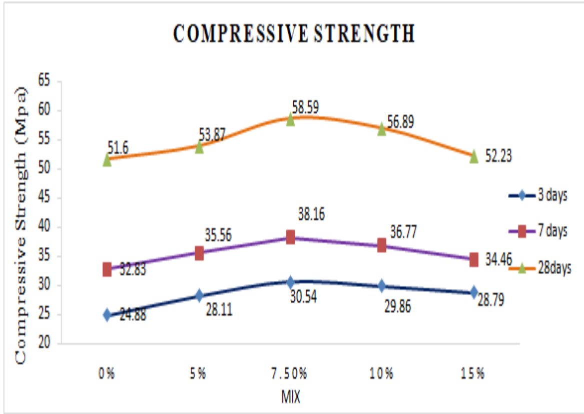

Figure 4: Compressive Strength of mortar

It has been observed from Figure 4 maximum compressive strength of cement increased at 7.5 % replacement of cement by MS. In comparison of all mix proportion maximum compressive strength was increased by 22.74 %, 16.23 % and 13.54 % at 3, 7 and 28 days respectively with 7.5% replacement of cement by MS.

CONCLUSION

Cement

- Normal consistency increases from 27.5% to 29.5% with replacement of MS at 7.5%.
- Maximum compressive strength of mortar increased at 7.5 % replacement of cement by MS. In comparisons of all mixes maximum compressive strength was increased by 22.74 %, 16.23 % and 13.54 % at 3, 7 and 28 days respectively.

Concrete

- Slump of concrete mix proportions increased with addition of recycled aggregate.
- Maximum compressive strength increased by 11.29% and 14.41% for CM3 at 7 and 28 days respectively.
- Maximum compressive strength increased by 9.13% and 11.66% for CM9 at 7 and 28 days respectively.
- Maximum compressive strength increased by 12.78% and 16.71% for RM3 at 7 and 28 days respectively.
- Maximum Compressive Strength increased by 16.48% and 12.98% for CM9 at 7 and 28 days respectively.

REFERENCES

[1]. Mehta P, Monteiro P. (2006), Concrete microstructure, properties and materials, 3rd edition McGraw-Hill Company.

[2]. Safiuddin M, Raman S N, Zain (2007), Utilization of quarry waste fine aggregate in concrete

mixtures. Applied Science Res; 3:202–8.
[3]. Binici H, Shahb T, Aksoganc O, Kapland H., (2008), Durability of concrete made with granite and stone as recycle aggregates. Journal of Mater Process Technology; 208:229–308.
[4]. Tangchirapat W, Jaturapitakkul C, Chindaprasirt P. (2009), Use of palm oil fuel ash as a supplementary cementitious material for producing high-strength concrete, Construction Building Materials; 23(7):2641–6.
[5]. Aliabdo Ali A., Abd Elmoaty, M.Abd Elmoaty, Esraa M. Auda, (2014), Re-use of waste stone dust in the production of cement and concrete, in Construction and Building Materials 50, 28-41.
[6]. Mehta P K (1999), Concrete technology for sustainable development. Concrete Institute; 21:47–53.
[7]. Mehta P K (2002), Greening of the concrete industry for sustainable development. Concrete Institute; 24:23–8.