Assessment of Workability and Different Strengths of Lime Stone Aggregate Concrete

Md Umar Khan
Assoc Professor
Chaitanya Bharathi Institute of Technology
Proddatur, Kadapa(dt)

AVS Sai Kumar
Asst. Professor
Nalanda Institute of Technology
Sattanapalli, Guntur(dt)

***Abstract*—Since concrete is the most important part in structural construction, the aggregate content should be in a form of good strength for structural purposes. Concrete is made up of aggregate, cement and water. Through this combination of Materials, three – quarter of the mix is governed by aggregate. The aggregate itself is categorized as fine and course aggregate. Here we propose coarse aggregate using lime stone material. We can use this lime stone aggregate (LA) for all structural elements in civil engineering**

Keywords—Concrete, Lime stones, compression testing machine, split tensile machine and Flexural strength testing

I. INTRODUCTION

In general granite aggregate is commonly used in industrial construction. Though IS 383-1970 code specifies the use of limestone and other aggregate for construction works, but it was very meager in reality. In this regard a ray of light was focused on use of lime stone aggregate for slabs elements. At present the generation of lime stone aggregate is discussed in detail. Tadpatri is town in Anantapur (Dist), this area is much potential for low limestone layered stone. The local people these layered stone is extracting and the same converting in to finished products, which are useful for flooring in dowelling houses.

These are made in required shape according the requirement of consumer. During the generation of required shape, a waste is generating and this is dumping in around the factories and besides of roads, this is due to lack of dumping area. In this town around 500 stone polishing machines are working per day. During working time of machine a waste is coming from each machine [2] and these is dumping in around town. This disposal is also a big problem for polishing machine owners and for municipality authorities. After having a look over this scenario a thought came up and it leads to utilize the waste material in the concrete industry. In this connection it was decided that to utilize the waste as coarse aggregate after making the waste in 20 and 12 mm aggregate[3]. For this crusher was used to obtain single graded material of 20 and 12 mm aggregate.

In construction industries, the use of aggregates is the most importance material in composition of concrete. Places having granite aggregate should have no problem in construction projects, but for places where the other type of aggregate is also available on par with granite, to curb the use of excessive granite material,[4] in other words, to preserve the natural good material (granite) for future generation, it is necessary to use other available material in to some extent

II. EASE OF USE

A. General Information of Aggregate

Since three-quarters of volume of concrete is governed by aggregate, it is not surprising that its quality is of considerable importance. Not only may the aggregate affects the strength of the concrete, aggregate with undesirable material would not get a good and strong concrete but also its can produce low durability and performance of the concrete.

Aggregate was originally a composition of a concrete mix with the proportion to the cement content and also as an inert material dispersed throughout the cement paste largely for economic purposes. It is possible to take into account that aggregate is a building material connected into a cohesive whole by means of the cement paste, as a comparison similar to masonry work in building [5] construction. In fact, the aggregate can absorb heat, water, chemicals and also its physical properties will influence the performance of concrete.

Aggregate cheaper compare to cement, therefore it is possible an economic value to put into consideration. But economy not the only reason [1] why to select aggregate , it is also have engineering advantages on concrete, so that it can bring higher volume stability , produce better durability than the hydrated cement paste alone

B. Particle shape and texture

Aggregate, whether crushed or naturally reduced in size, it can be divided into many groups of rocks having common characteristics. According to BS 812: Part 1: 1975 the rocks are classified as given in Table 1.0 in the early page.

The aggregate to be used in the concrete shall have good shape and surface texture. In the case of crushed rocks, the particle shape depends not only on the nature of the parent material but on the type of crusher and its reduction ratio, for example the ratio of the size fed into crusher and the size of finished product.

C. Scope of present work

Based on the availability of equipment in the laboratory experimental work was conducted on cube, cylinders and beams so that it leads to evaluate compression, split and flexural strengths. There is a need to study the microstructure of concrete by conducting the X-ray diffraction and SEM analysis. Due limitation of the equipments, it was confined to finding of above said strengths only

III. EXPERIMENTAL WORK

A. Cube Compressive Strength Test

The test set up for conducting cube compressive strength test is depicted in Figure: 3.1. Compression test on cubes is conducted with 2000kN capacity compression testing machine. The machine has a least count of 1kN. The cube was placed in the compression-testing machine and the load on the cube is applied at a constant rate till to failure of the specimen and the corresponding load is noted as ultimate load. Then cube compressive strength [6] of the concrete mix is then computed by using stand formula. (This test has been carried out on cube specimens at 28 days) and the obtained values are presented in next chapter.


Figure 3.1: Compression Testing Machine (CTM)

B. Split tensile strength

This test is conducted with compression testing machine and it can be viewed in figure: 3.2. The cylinder is placed on the bottom compression plate of the testing machine and is aligned such that the center lines marked on the ends of the specimen are vertical. Then the top compression plate is brought into contact at the top [7] of the cylinder. The load is applied at uniform rate, until the cylinder fails and same load is taken in to account as ultimate load. From this load, the splitting tensile strength is calculated for each specimen by stand formula. The results are presented in next chapter.


Figure 3.2: Split tensile strength test setup

C. Flexural Strength Test

The loading arrangement to test the beam specimens for flexure is shown in Figure: 3.3. The test is conducted on a loading frame. The beam element is simply supported on two rollers of 4.5 cm diameter over a span of 450 mm. The element is checked for its alignment longitudinally and adjusted if necessary. Required packing is provided using rubber material. Care was taken to ensure that the two loading points were at the same level. The loading was applied on the specimen through hydraulic jacks and was measured using a 15 tones [8] pre-calibrated proving ring. The load is transmitted to the beam element through the I-section and two 16mm diameter rods spaced at a distance of 150mm. For each increment of loading, the deflections at the center of span are recorded using dial gauges. Continuous observations were made and the cracks were identified with the help of magnifying glass. Well before the ultimate stage, the deflect meters were removed and the process of load application was continued till to continued total failure and at this stage the load is recorded as ultimate load.


Figure 3.3: Flexural Strength test setup

IV. TEST RESULTS

A. *Influence of Lime Stone Aggregate on Workability*

The workability of mixes have been measured by Compaction factor test. The values of compaction factors results are presented in Table 4.1 and figure 4.1.From this it is observed that the compaction factor increase with increase in the % of lime stone [9] aggregate in the concrete mix. Hankfi Binci et.al (2008) has been also reported same type of result for marble concrete. The increase of workability may be due to lower water absorption and smooth texture surface of lime stone aggregate than the granite aggregate.

Table 4.1: Workability of concrete.

S.No	Nomenclature	Compaction Factor(CF)
1	NC	0.768
2	LC 25	0.792
3	LC 50	0.832
4	LC 75	0.874
5	LC 100	0.921

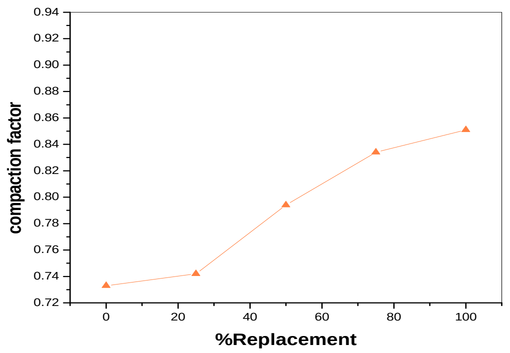

Figure 4.2 Compaction Factor vs. % Replacement

B. *Influence of Lime Stone Aggregate on Compressive Strength*

The compressive strengths for all mixes are presented in table4.2 and Figures 4.2. From this, it can be observed that the 28 days compressive strength decrease with the increase in the percentage of lime stone up to 100%. For 25% replacement of lime stone aggregate there is decrease in cube compressive strength by 9.94% over granite aggregate concrete. For 75% replacement level, the compressive strength has decrease by 28.44% when compared with reference concrete. At 100% replacement of lime stone, the compressive strength has decreased by 42.42% over granite aggregate concrete. This type of observation [10] was observed by Hanfi Binici et.al (2008) for marble concrete. But Hebhoub et.al (2011) reported in different way for marble concrete. They reported that, at 75% replacement level the strength was enhanced when compared with other replacements and at 100% replacement level there was decrease in compressive strength. Whereas from present experimental work it is observed that there is continuously decrease in compressive strengths as percentage of lime stone aggregate increases in concrete mix. This may be due to different surface texture of aggregates.

Table 4.2: Compressive Strength for lime stone aggregate concrete

S.NO	NOMENCLATURE	ULTIMATE LOAD(KN)	ULTIMATE STRESS(N/MM^2)	AVERAGE STRESS(N/MM^2)	% OF DECREASE IN COMPRESSIVE STRENGTH
1	NC1	721	33.04	32.69	--
	NC2	648	29.80		
	NC3	793	35.24		
2	LC 1-25	641	28.48	29.44	9.94
	LC 2-25	602	27.75		
	LC 3-25	679	31.17		
3	LC 1-50	506	22.48	24.20	25.97
	LC 2-50	583	23.91		
	LC 3-50	545	24.22		
4	LC 1-75	504	22.40	22.39	28.44
	LC 2-75	483	21.46		
	LC 3-75	524	23.28		
5	LC1-100	390	17.37	18.82	42.42
	LC2-100	424	18.84		
	LC3-100	457	20.31		

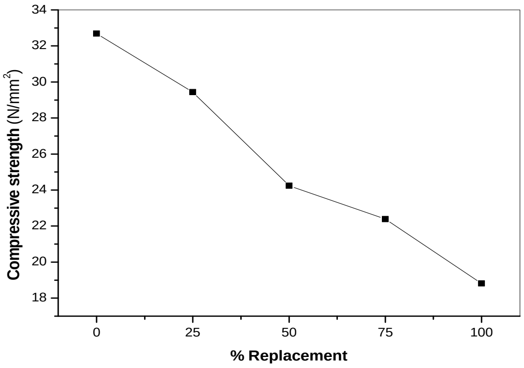

Figure 5.2: Compressive Strength vs. % Lime stone aggregate

C. *Influence of Lime Stone Aggregate on Split Tensile Strength*

The variation of 28 days Split tensile strength of lime stone mixes is presented in table 4.3 and Figures 4.3. From these it is observed that the split tensile strength decrease with the increase in the percentage of lime stone up to 100%. For 25% of lime stone there is decease in split tensile strength by 21.64% over the granite aggregate concrete. For 75% and 100%, the split tensile strength has decreased by 50.6% and 61.98% respectively over granite aggregate concrete (reference mix). Hebhoub et.al (2011) reported in different way for marble concrete. They reported that, at 75% replacement level the strength [11] was enhanced when compared with other replacements. Hanfi Binici et.al (2008) reported the split tensile strengths for marble concrete. They observed that there is a marginal increase in split tensile strengths as percentage of marble aggregate increases in concrete mix. But the present experimental results showed reverse trend i.e., there is decrease trend as lime stone aggregate content increases in concrete.

Table 4.3: Compressive Strength for lime stone aggregate concrete

S. NO	NOMENCLATURE	ULTIMATE LOAD(KN)	ULTIMATE STRESS(N/MM^2)	AVERAGE STRESS(N/MM^2)	% OF DECREASE IN SPLIT TEN. STRENGTH
1	NC1	541	7.63	7.76	--
	NC2	547	7.84		
	NC3	551	7.79		
2	LC 1-25	409	5.78	6.08	21.64
	LC 2-25	445	6.29		
	LC 3-25	436	6.17		
3	LC 1-50	396	5.60	5.32	31.44
	LC 2-50	362	5.12		
	LC 3-50	372	5.26		
4	LC 1-75	271	3.83	3.83	50.60
	LC 2-75	202	3.70		
	LC 3-75	279	3.97		
5	LC1-100	198	2.80	2.98	61.98
	LC2-100	222	3.14		
	LC3-100	211	2.98		

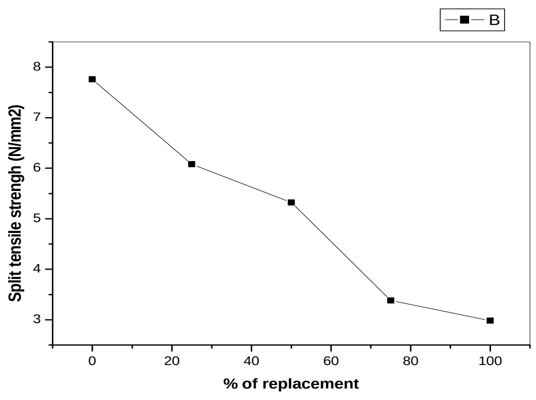

Figure 4.3: Split Tensile Strength vs % Lime stone aggregate

D. Influence of Lime Stone Aggregate on Flexural Strength

The flexural strength of lime stone aggregate concrete results are presented in table 4.4 and Figures 4.4. From this it is observed that the 28 days flexural strength decrease with the increase in the percentage of lime stone aggregate up to 100%. For 25% replacement there is decease in flexural strength by 12.5% w.r.t. reference mix. At 75% and 100%, the flexural strength has decrease by 30.21% and 42.53% respectively with respect reference mix (granite aggregate concrete). Hanfi Binici et.al (2008) reported the flexural strengths for marble concrete. Their observation in flexural strength is very low [12] significance over control specimens. The granite aggregate showed a lesser value compared with marble concrete. But form the present investigation it is observed that as lime stone aggregate increases there is decrease in flexural strength when compared with granite aggregate. This simple test does not measure the bond strength at aggregate interface but it is possible to compare the effect of the aggregate substitution.

Table 4.4: Compressive Strength for lime stone aggregate in Flexural Strength

S. NO	NOMENCLATURE	ULTIMATE LOAD(KN)	ULTIMATE STRESS(N/MM^2)	AVERAGE STRESS(N/MM^2)	% OF DECREASE IN SPLIT TEN. STRENGTH
1	NC1	29.40	5.42	5.36	--
	NC2	26.32	4.25		
	NC3	30.54	5.42		
2	LC 1-25	26.49	4.67	4.69	12.50
	LC 2-25	25.69	4.56		
	LC 3-25	27.28	4.84		
3	LC 1-50	26.89	4.78	4.60	14.17
	LC 2-50	23.01	4.44		
	LC 3-50	28.77	4.60		
4	LC 1-75	22.31	3.69	3.63	30.70
	LC 2-75	20.12	3.57		
	LC 3-75	18.91	3.36		
5	LC1-100	17.41	3.09	3.08	42.53
	LC2-100	16.92	3.01		
	LC3-100	17.83	3.16		

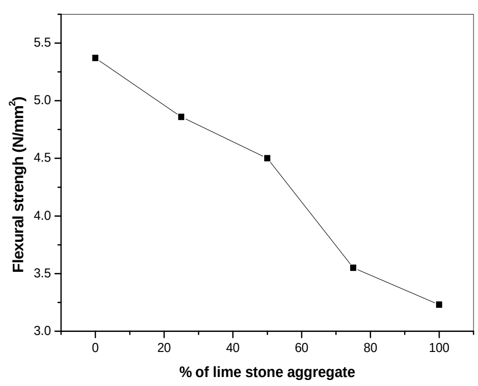

Figure 4.4: Flexural strength vs. % of lime stone aggregate.

CONCLUSIONS AND FUTURE WORK

In this paper we identified that the workability for limestone aggregate is increases with compared with granite aggregate concrete. The compressive strengths were decreased with increase the lime stone aggregate in the concrete mix. The split tensile strengths were decreased for lime stone aggregate concrete compared with granite aggregate concrete. The flexural strength was marginally affected for lime stone aggregate concrete. The incorporation of lime stone upto 75% is beneficial for the concrete works. The failure modes are similar for both lime stone and granite aggregate concrete. The use of lime stone aggregate for concrete works is demonstrated in compression, split and flexural strengths. This study could enlighten the local peoples to use of limestone aggregate for concrete works (minor works at initial stages).

The future work is the studies can be conducted to know the performance under impact and torsion loading. Studies can be conducted by incorporation of steel fibres Mathematical / Empirical models can be developed for the lime stone reinforced concrete. Durability studies such as resistance to Sulphate attack, Acid resistance etc., can be carried out on lime stone reinforced concrete.

REFERENCES

[1] P. Torres,"Incorporated the granite cutting sludge in industrial porcelain tile formuations". A journal of the European ceramic society 24 (2004) 3117-3185.

[2] Mustafa karasahin and SerdaTerzi, "Evaluation of marble dust in the mixture of asphaltic concrete",Construction and Building Materials, Vol-21, 2007, pp. 616-620

[3] Almeida,N.,Recycling of stone slurry in industrial activities: Application to concrete mixtures. Building and Environment vol-42, 2007,pp. 810-819.

[4] HanifiBinici, "Durability of concrete made with granite and marble as recycle aggregates",Ajournal of material processing technology.vol-208, 2008,pp. 299-308.

[5] HuseyinAkbulut and CahitGurer, "use of aggregate produced from marble quarry waste in asphalt pavements",Building and Environment vol-42,2007,pp.1921-1930.

[6] Karaca and Elci , "using dimension stone quarry wastes as concrete aggregate",ICCBT 2008 – A – (03)- pp.45 – 56.

[7] BaharDemirel,"The effect of the using waste marble dust as fine sand on the mechanical properties of the concrete", Internal journal of physical sciences 2010-vol.5(9),pp.1372-1380.

[8] Marmol, "The use of granite sludge wastes for the production of colored cement-based mortars", Cement and concrete composites vol.32-2010. pp-617-622.

[9] Hebhoud, "use of waste marble aggregates in concrete", Construction and Building materials, vol 25-2011 pp.1167-1171.

[10] Baboo Rai, "influence of marble powder/granular in concrete mix", International journal of civil and structural engineering. Vol.1, No-4, 2011, pp-827-834.

[11] Shirule, "partial replacement of cement with marble dust powder", International journal of advanced engineering research and studies.vol.1/issue III/april-june, 2012/175-177.

[12] ElhamKhalizadehShirazi, "reusing artificial stone waste in concrete as a filler of fine aggregates", A journal of food, agriculture & environment, vol.10(1),January 2012.

[13] Dewanshu Ahlawat, L.G.Kalurkar "Coconut Shell as Partial Replacement of Coarse Aggregate in Concrete", An IOSR Journal of Mechanical and Civil Engineering, ICAET-2014, pp:61-64.

[14] Mohd Monish , Vikas Srivastava , V.C. Agarwal , P.K. Mehta and Rakesh Kumar "Demolished waste as coarse aggregate in concrete" J. Acad. Indus. Res. Vol. 1(9) February 2013, Youth Education and Research Trust (YERT).

[15] B. Jaivignesh, R. S. Gandhimathi, EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF FINE AGGREGATE BY COPPER SLAG Integrated Journal of Engineering Research and Technology April 2015.