Design of Compressive &Flexural Strength of Concrete by Using Laterite Aggregate

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Abstract— Integration of new material as a partial course aggregate and fine aggregates replacement in local concrete production would be able to reduce the high dependency of concrete manufacturer on current aggregate supply that may lead to ecological imbalance when natural material is used excessively. This project presents the assessment on the characteristic of laterite aggregate obtained from Konkan region before discussing further on the influences of this local material towards engineering properties of normal concrete. Concrete mixes containing 0%, 10%, 20% and 30% laterite aggregate and 25% and 50% of laterite sand replacement level were cast before subjected to water curing for 7 and 28 days. Compressive strength test and flexural strength will be conducted in accordance to the existing standard. The present experimental investigation examines the effect of laterite aggregate, as partial replacement to cement and aggregate various properties of concrete block.
Investigation is done on M30 grade mix using laterite aggregate as partial replacement by weight of cement. Experimentation is carried out to find the compressive strength, flexural strength of the concrete blocks. Experimentation is also carried out analysis the production cost of concrete blocks by using laterite aggregate.
Key words: Konkan laterite, Laterite Coarse Aggregate (L.C.A), Laterite Fine Aggregate (L.F.A)

I. INTRODUCTION

The need to utilize other types of material as a partial aggregate replacement in concrete stems from the escalating demand of construction industry for concrete material leading to increasing use of conventional aggregate exploited from the environment.

This creates a unique problem where the supply of raw materials required for construction (cement, sand, steel etc.) is falling short of demand. This problem has been foreseen and exhaustive research exists on use of waste materials and industrial by-products in construction to make small scale construction more sustainable. This research attempts to focus on providing a local solution to small scale construction firms by utilizing an indigenous material for local works that will be well known to local builders and masons and will not create logistical and technical problems that are usually associated with integrating a new material into the construction process.

Research has been done on use of laterite in concrete in tropical countries like Nigeria and Malaysia which has established laterite as a sustainable material for use in construction. The main obstacle to utilizing this research in India has been the great variation in regional properties of laterite in India, even this paper has narrowed its scope to Konkan laterite but previous research has been referred to establish a scientific process as well as to predict performance of laterised concrete. laterite stone scrap creates problem in quarries and needs removal for further excavation. Hence there is ample quantity of waste laterite available for use in local works.

II. OBJECTIVE

The primary goal of this research is to:-

- To carry out testing on cylinder and cube cast using laterite concrete
- Investigate if laterite is a suitable replacement for river sand and conventional aggregate in production of concrete.
- Perform testing on laterite coarse aggregate and laterite fine aggregate according to IS method
- Perform testing on Konkan laterite and research its properties
- Find an optimal percentage for replacement of conventional aggregates by laterite such that it maintains the engineering properties of concrete while improving sustainability.

III. PROPERTIES LATERITE AGGREGATE

operties	Laterite coarse aggregate	Laterite fine aggregate
Water absorption	8.4%	14%
Specific gravity	2.74 (E.g method)	2.6
	2.4 IS method	2.24
Compressive strength	2.35 N/mm2 For whole block	
elongation	11.96%	-
flakiness	1.3%	-
Crushing value	34.8%	-
Fineness modulus		3.2

Table 1:

IV. METHODOLOGY

we obtained the scrap blocks from Dapoli region of Maharashtra where they had been locally mined., most blocks was 390x19x19mm of deformed shape with fractures and cracks.the blocks were broken by hand into aggregates passing through 20mm IS sieve and retained on 12 mm IS sieve,the left over scrap was converted into fine aggregate passing through 2.36mm IS sieve and retained on 1.44mm IS sieve and silt was passed through 90 micron sieve and removed.

Standard tests for Aggregates as recommended by IS codes were performed on LCA and LFA
The following process was chosen.

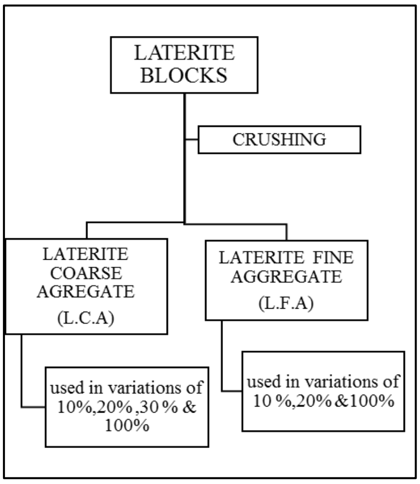

Fig. 1: Process Flowchart

Replacement % of L.F.A	Replacement % of L. C.A	Symbol	cubes	cylinders
0%	0%	control	6	6
0%	100%	LCA 100	6	0
100%	0%	LFA 100	6	0
100%	100%	LCA100,LFA100	6	0
10%	10%	LCA10,LFA10	6	6
10%	20%	LCA20,LFA 10	6	6
10%	30%	LCA30,LFA10	6	6
20%	10%	LCA10,LFA20	6	6
20%	20%	LCA20,LFA20	6	6
20%	30%	LCA30,LFA20	6	6

Table 1: Properties of aggregates

V. Mix Design

The mix design was prepared as per IS 10262-2009 with Target strength equivalent to M20 grade concrete.

– Grade designation-M20
– Type of Cement-OPC (53 grade)
– Max nominal size of aggregate-20mm
– Exposure conditions-severe
– W/C ratio : 0.5

A. *Mix Proportion*

Cement	Fine aggregate	Coarse Aggregate
1	1.9	2.9

Table 2: mix proportions

B. *For One Cubic Metre*

Cement	384 kg
Water	192
Fine Aggregate	725 Kg
Coarse Aggregate	1112 Kg

Table 3: summary of quantities

Fig. 2: 20mm laterite coarse aggregate.

Fig. 3: color variation in LFA 100,LCA100 and LCA100,LFA100 cubes.

VI. Result

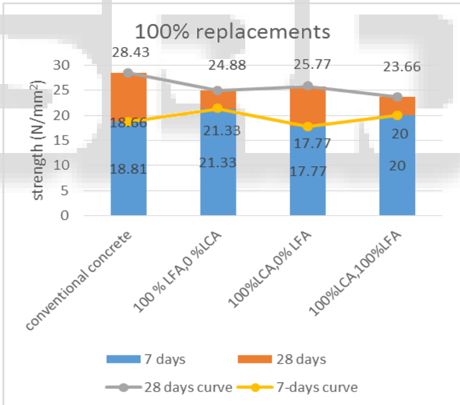

Fig. 4: 100 %replacement results

A. *Observations*

1) All values fall below the value of conventional concrete but are above 20N/mm2
2) In variations where L.F.A was used the gain is higher for 7-days of strength For LFA 100-85.7 % of strenght was gained by 7th day,for conventional concrete 66 % was gained by 7th day.
3) Seventh day strength were higher for both LFA variations though overall 28th day strength was lower than conventional
4) The addition of 100 % LCA reduces strength by almost 10 % compared to conventional concrete
5) On addition of 100 % LFA to 100 % LCA cube the 7 days strength increases but 28 day strenght decrease

VII. COMPRESSION TESTING OF CUBES

A. *Results of LFA 10 with LCA10, LCA20, LCA 30*

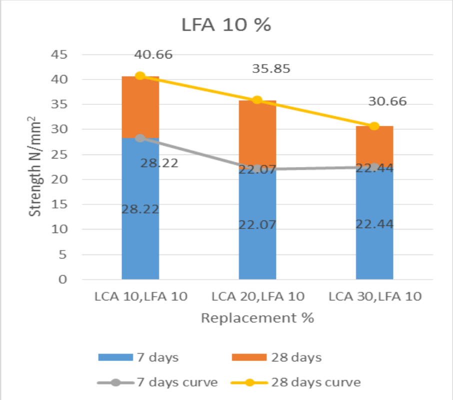

Fig. 5:

1) Overall strength decreases as percentage of laterite coarse aggregate increases in 28 days testing for every 10 % increase in LCA there is roughly 5 N/mm2 loss of strength
2) No recognisable pattern for affect on seven day strength

B. *Results for LFA20 and LCA10, LCA20, LCA30*

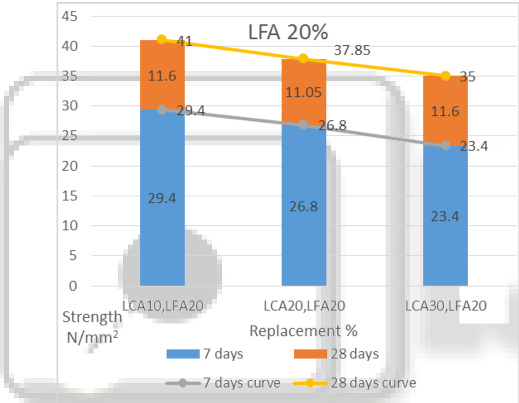

Fig. 6:

1) Clear and proportional decrease (28 days and 7 days) with increase in LCA %as observed for 28 days in LFA 10 as well,
2) As seen above the values of strength decreases over time as concentration of LCA increases however values of compressive strength are clearly higher for cubes where 20 % of LFA was used.
3) With increase in concentration of LFA the loss of strength is also slower as concentration of LCA increases

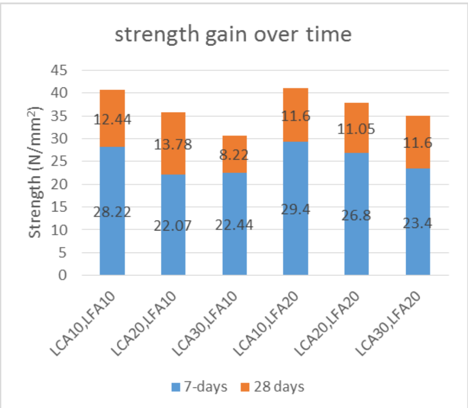

Fig. 7:

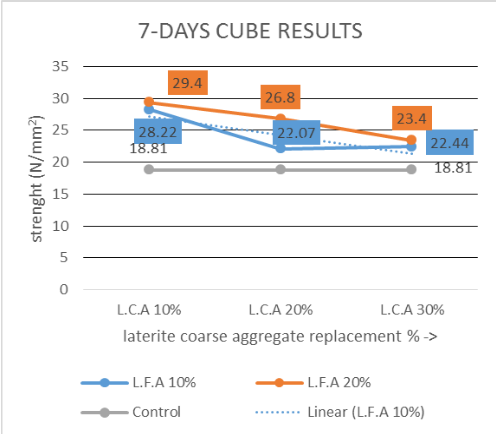

Fig. 8:

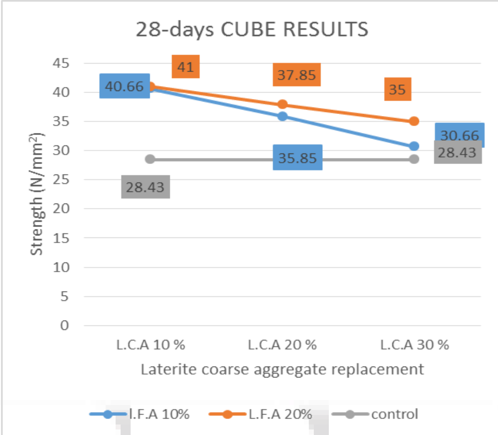

Fig. 9:

VIII. CYLINDER RESULT

L.C.A %	L.F.A %	7 days (KN)	Avg	N/mm2	28 days(KN)	Avg	N/mm2	type
10	10	110	115.33	1.63	248	240	3.39	cylinder
		120			238			
		116			234			
20	10	182	177.33	2.51	234	253.33	3.58	cylinder
		172			268			
		178			258			
30	10	142	148	2.1	216	205.33	2.9	cylinder
		152			220			
		150			180			
10	20	140	130.66	1.84	204	210	2.97	cylinder
		120			218			
		132			208			

20	20	180	185.33	2.62	284	269.33	3.81	cylinder
		192			250			
		186			274			
30	20	136	135.33	1.91	232	226.66	3.21	cylinder
		134			228			
		136			220			

Table 4:

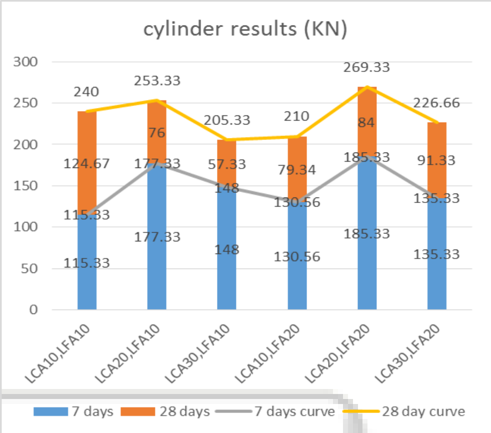

Fig. 10:

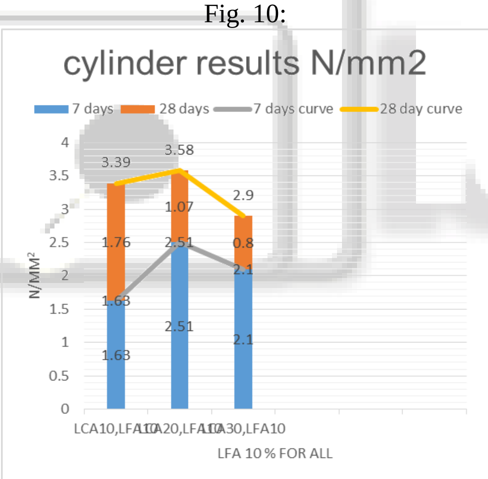

Fig. 11:

IX. Conclusions of Results

1) The addition of LCA affects strength and reduces it
2) The addition of LFA increases seven days strength in a shorter time
3) Therefore LFA has advantageous properties that make concrete gain strength faster

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