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A Comparison between Compressive Strengths of Natural Aggregate Concrete and Recycled Aggregate Concrete

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Abstract- Recycled aggregates utilizes materials from concrete and masonry constructions. Reuse of demolition waste avoids the problem of waste disposal and is also helpful in reducing the gap between demand and supply of fresh aggregate. For improving the quality of recycled coarse aggregate, various surface treatment methods such as washing the recycled aggregates with water and diluted acid were investigated. Strength properties of the treated and untreated coarse aggregate were compared in this work. The results indicated that the compressive strength of recycle aggregate is found to be less than the natural aggregate. Mix designs can be made using recycled aggregate for structural concrete elements instead of disposing off the recycled concrete to achieve economy.

Key word -demolished concrete, coarse aggregate (NA and RCA), cement, aggregate, comparison, strength

1. INTRODUCTION

On this earth, there is very fast development now a days. So, the use of all natural resources used in this development are getting scarce in next few years. So, it is necessary to find the options to preserve the natural resources. Other problem is that, the all waste of the demolished buildings are deposited on some sights which reserves the lots of area of land. Main aim of this project is to recycle the construction and demolition waste aggregates to control the scarcity of the natural resources. From this project we can define which type of recycled aggregate can take place of natural aggregate in which type of condition.

2. LITERATURE REVIEW

A study has been conducted by **M C Limbachiya, A Koulouris, J J Roberts and A N Fried** in Kingston University, UK on "Performance of Recycled Aggregate Concrete". The effects of up to 100% coarse recycled concrete aggregate on arrange of fresh, engineering and durability properties have been established and assessed its suitability for use in a series of designated applications. Compressive strength tests on standard 100mm concrete cubes were carried outages up to one year after initial curing in water at 20° Cat 28days. Overall, the results show that up to 30% coarse RCA has no effect ton concrete strength, but there after a gradual reduction with increasing RCA content occurs.

The research has been conducted by **Song GU et al.** on "Properties of Recycled Aggregate Concrete" concluded that, Because of old mortars adhered on the surface of the aggregate the water absorption rate of recycled aggregate is far more than natural aggregates, the slump and strength will decrease while the replacement rate of RCA increased and Fly ash can enhance the workability of recycled concrete effectively. While the replacement rate of FA to cement is no more than 30%, the strength of concrete will not decrease obviously.

R. Sri Ravindrajah, Y. H. Loo, C. T. Tam conducted an experiment on "Strength evaluation of recycled-aggregate concrete by in-situ tests". The compressive strength of concrete was determined at various ages up to 90 days using 100mm cubes. Based on the results, they concluded that for a given water cement ratio, the recycled-aggregate concrete showed a lower strength than that for the natural aggregate concrete. The results also showed that the relationship between the strength and water-cement ratio at both ages follows a similar trend for the recycled-aggregate concrete as well as the natural aggregate concrete.

3. PLAN OF WORK

On this world, NA is going to be scares in next few years and another problem is there is lot of

construction waste disposed on land. In short construction waste uses lot of useful land.

We have seen lot of construction waste in our city so, we want to find out solution of that situation. We studied on Existing Studies on Recycled Aggregate Concrete and Identification of Problem.

In this project, we find the solution of

Fig. 1. Crushing wastage and demolished concrete by hammering and jaw crusher and get 20mm down aggregate

construction waste by using recycle aggregate in place of natural aggregate.

Then material is divided into small pieces by hammering and then in jaw crusher.

Then we decide the Mix design methodology to obtain M25 grade recycled aggregate concrete

Stipulations for Proportioning		
1.	Mix Proportion	1:1:2
2.	Grade Designation	M25
3.	Type of Cement	OPC 53 grade
4.	Maximum Nominal Aggregate Size	20 mm
5.	Minimum Cement Content	400 kg/m 3
6.	Maximum Water Cement Ratio	0.45
7.	Degree of Supervision	Good
8.	Type of Aggregate	Crushed Angular
Target Strength for Mix Proportioning		
1.	Target Mean Strength	36 N/mm2
2.	Characteristic Strength @ 28 days	25 N/mm2

After that we check the compressive strengths of both cubes after curing of 7 days, 14 days and 28 days.

We get the res**u**lts of compressive strength test and compared with each other.

4. TESTS AND RESULTS

4.1 Impact value test

Natural aggregate

Sr. no.	Description	Sample 1	Sample 2
1	Weight of sample(W1)gm	311	273
2	Weight of aggregate passing through 2.36mm sieve(W2)gm	40	39
3	Aggregate impact in % I.V=(w2/w1)*100	12.86	14.28
4	Average impact value in %	13.57	

Untreated recycle aggregate

Sr. no.	Description	Sample 1	Sample 2
1	Weight of sample(W1)gm	256	283
2	Weight of aggregate passing through 2.36mm sieve(W2)gm	72	81
3	Aggregate impact in % I.V=(w2/w1)*100	28.12	28.62
4	Average impact value in %	28.37	

Treated recycled aggregate

Sr. no.	Description	Sample 1	Sample 2
1	Weight of sample(W1)gm	259	307
2	Weight of aggregate passing through 2.36mm sieve(W2)gm	52	47
3	Aggregate impact in % I.V=(w2/w1)*100	20.07	15.30
4	Average impact value in %	17.68	

4.2 Abrasion Test

Observation table

1. Grading = B
2. Number of sphere used = 11
3. Weight of charge = 500 gm
4. No. of revolution = 500

Natural aggregate

Sr. no.	Description	Sample
1	Weight of sample (w1)gm	5000
2	Weight of sample retained on 1.70mm I.S sieve(W2)gm	4358
3	Percentage wear(W1-W2/W1)*100	12.84

Untreated Recycled Aggregate

Sr. no.	Description	Sample
1	Weight of sample (w1)gm	5000
2	Weight of sample retained on 1.70mm I.S sieve(W2)gm	3684
3	Percentage wear(W1-W2/W1)*100	26.32

Treated Recycled Aggregate

Sr. no.	Description	Sample
1	Weight of sample (w1)gm	5000
2	Weight of sample retained on 1.70mm I.S sieve(W2)gm	4000
3	Percentage wear(W1-W2/W1)*100	20

4.3 Flakiness Index test

Observation table:
Natural Aggregate

Total weight of sample = 546 gm

Sr. no.	Size of aggregate (IS sieve)	Individual weight retained between sieve(gm)	Weight of aggregate passing through respective slot of the gauge(gm)
1.	20mm-16mm	W1=217	w 1=42
2.	16mm-12.5mm	W2=183	w 2=61
3.	12.5mm-10mm	W3=83	w 3=16
4.	10mm-6.3mm	W4=59	w 4=27

Calculation:

Flakiness index = (w 1+w 2+ w 3+ w 4)*100/total weight of sample
= 26.7 %

Untreated Recycled Aggregate

Total weight of sample = 707 gm

Sr. no.	Size of aggregate (IS sieve)	Individual weight retained between sieve(gm)	Weight of aggregate passing through respective slot of the gauge(gm)
1.	20mm-16mm	W1=376	w 1=81
2.	16mm-12.5mm	W2=192	w 2=44
3.	12.5mm-10mm	W3=93	w 3=21
4.	10mm-6.3mm	W4=47	w 4=6

Calculation:

Flakiness index = (w 1+w 2+ w 3+ w 4)*100/total weight of sample
= 21.4 %

Treated Recycled Aggregate

Total weight of sample = 513 gm

Sr. no.	Size of aggregate (IS sieve)	Individual weight retained between sieve(gm)	Weight of aggregate passing through respective slot of the gauge(gm)
1.	20mm-16mm	W1=86	w 1=48
2.	16mm-12.5mm	W2=228	w 2=39
3.	12.5mm-10mm	W3=148	w 3=21
4.	10mm-6.3mm	W4=44	w 4=7

Calculation:

Flakiness index = (w 1+w 2+ w 3+ w 4)*100/total weight of sample

= 22.4 %

4.4 Elongation Index test

Observation table:

Natural Aggregate

Total weight of sample = 546 gm

Sr. no.	Size of aggregate (IS sieve)	Individual weight retained between sieve(gm)	Weight of aggregate retained on the respective slot of the gauge(gm)
1.	20mm-16mm	W1=217	w 1=59
2.	16mm-12.5mm	W2=183	w 2=94
3.	12.5mm-10mm	W3=83	w 3=33
4.	10mm-6.3mm	W4=59	w 4=25

Calculation:

Elongation index = (w 1+w 2+ w 3+ w 4)*100/total weight of sample

= 38.6 %

Untreated Recycled Aggregate

Total weight of sample = 707 gm

Sr. no.	Size of aggregate (IS sieve)	Individual weight retained between sieve(gm)	Weight of aggregate retained on the respective slot of the gauge(gm)
1.	20mm-16mm	W1=376	w 1=69
2.	16mm-12.5mm	W2=192	w 2=61
3.	12.5mm-10mm	W3=93	w 3=27
4.	10mm-6.3mm	W4=47	w 4=16

Calculation:

Elongation index = (w 1+w 2+ w 3+ w 4)*100/total weight of sample

= 24.4 %

Treated Recycled Aggregate

Total weight of sample = 513 gm

Sr. no.	Size of aggregate (IS sieve)	Individual weight retained between sieve(gm)	Weight of aggregate retained on the respective slot of the gauge(gm)
1.	20mm-16mm	W1=86	w 1=11
2.	16mm-12.5mm	W2=228	w 2=36
3.	12.5mm-10mm	W3=148	w 3=40
4.	10mm-6.3mm	W4=44	w 4=22

Calculation:

Elongation index = (w 1+w 2+ w 3+ w 4)*100/total weight of sample

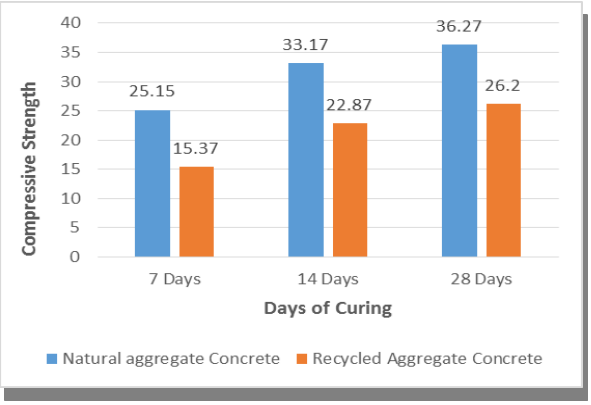
= 21.6 %

4.5 Compressive Strength test

Natural Aggregate

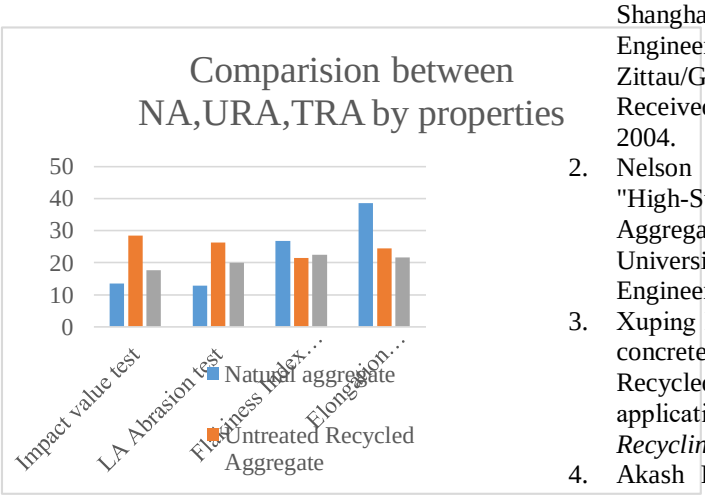
Sr. no.	Description	Compressive Strength (N/mm^2)		
		7 Days	14 Days	28 Days
1	Natural Aggregate Concrete	25.15	33.17	36.27

2	Recycled Aggregate Concrete	15.37	22.87	26.20



4. SUMMARY OF RESULTS

4.1 Comparison between NA, treated RA and untreated RA



4.2 Comparison between Compressive strengths of NA concrete and RA concrete

5. CONCLUSION

Untreated RA has 28.37 Impact value, so we can say that it prefer for concrete used for both wearing and non-wearing surfaces. Treated RA has 17.68 Impact value, so we can say that it prefer for concrete used for both wearing and non-wearing surfaces. Untreated RA has 26.32 Abrasion value, so we can say that it prefer for concrete used for both wearing and non-wearing surfaces. Treated RA has 20 Abrasion value, so we can say that it prefer for concrete used for both wearing and non-wearing surfaces.

So, RA aggregates can be used in concrete on level of laboratory experiments. So, it cannot be used in large quantity production because the treatment is not possible for large quantity production. The 28-day target compressive strength was achieved to 25 MPa even though the RAC strength is lower than NAC. The compressive strength for RAC is within the same range compared to NAC and reaching up to 25MPa at day 28 of curing.

So, RA aggregates can be used in concrete on level of laboratory experiments. So, it cannot be used in large quantity production because the treatment is not possible for large quantity production.

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