International Journal of Scientific Research and Engineering Development-– Volume3 Issue 1, Jan-Feb 2020

Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

Experimental Study on Strength and Quality of Concrete with Partial Replacement of Crushed Rocks, Surkhi and Bloated Clay Aggregates in M25 and M30 Grade Concrete

Kapa Avanti[1] , B.Anjana Devi [2]

1.(M.Tech scholar) 2. (GUIDE & ASSISTANT PROFESSOR)

CHEBROLU ENGINEERING COLLEGE, CHEBROLU-522212, GUNTUR-A.P

ABSTRACT:

The present study deals with the impacts of bloated clay nothing but expansive clay aggregates, waste brick powder i.e surkhi & crushed rocks are the partial supplements in traditional concretes. In this construction era the replacements are very common with mixing of fine aggregates and sometimes coarse aggregates too, why because of natural resources scarcity at some places that means it varies from place to place availability. In this investigation we have to obtain the impacts regarding the blended mixes in concrete. The main objective of this study was to compare the structural performance of NCC and LWC beams of grade M25 and M30. The experimental investigation has been carried out by blending of quarry fines , surkhi and LECA together in place of conventional aggregates for LWC beams. The proportions of quarry fines and LECA were 60% and 40% which kept constant for all LWC beams. The cement was partially replaced by 20% bloated clay in both NCC and LWC beams in order to make concrete durable. A total 12 beams were cast in which six of M25 grade and six of M30 grade for NCC and LWC. The cross section maintained for all the beams were 150mm × 300mm and the length was 2000mm. The experimental study was conducted to know the behaviour of these beams under simply supported two points loading and comparison was drawn between beams made out of Normal Conventional Concrete (NCC) and Light weight Concrete (LWC). The results indicated that the light weight concrete beams can be obtained by blending of different light weight aggregates. The ultimate load for LWC beams are more than that of NCC beams of M25 and M30 grades. The deflections for LWC beams were smaller than that of NCC beams of grade M25 where as the ultimate deflections of LWC beams are slightly higher than that of NCC beams of M30 grade concrete.

I. LITERATURE REVIEW:

Concrete having low density (1800 to 2000 kg/m3) are termed as lightweight concrete which can be apparently achieved either by using low density aggregates or with the complete elimination of coarser aggregates. However, aggregates occupy major volume of concrete and provide volumetric stability to the concrete. Hence, the presence of aggregate is vital in concrete. Different types of concrete namely lightweight aggregate, no fines concrete, aerated/cellular concrete, and foamed concrete were widely investigated over decades (Narayana and Ramamurthy, 2000). However, the light weight concrete produced from light weight aggregates has received wider acceptance for many special applications. It is well known fact that 50 to 60% of the concrete volume is occupied by the aggregates. This contributes for the overall economy in concrete production as well as improves the composite elastic modulus (Bekir and Tayfun, 2007). It is also evident that concrete occupied with optimum coarse and fine aggregate fraction can provide satisfactory mechanical performance.

Hence, to provide a volumetric stability of concrete it is vital to have optimum aggregate fillers in which the mortar fills the pore spaces to provide a solid structure (Bekir and Tayfun, 2010). Thus, the presence of aggregates in bulk volume can provide stability to fresh concrete when placed in the formwork; as well as improve the post hardened concrete performance. Lightweight concrete finds potential applications in many pre-fabricated lightweight concrete structural construction for easy handling and faster erection. Apart from the above, reducing self-weight of the structure makes it a versatile construction material on earth for special applications (Bijen, 1986). Lightweight aggregate derivatives can be of natural origin (lightweight rock) or can be artificially produced from industrial waste material (Ahmaruzzaman, 2010).

II. NEED FOR ARTIFICIAL LIGHTWEIGHT AGGREGATE

The tremendous growth in the infrastructural sector around the world and the large demand for aggregates in construction makes it a versatile alternative construction material. Production of artificial aggregates without exploiting the natural resources is another promising solution and provides thrust areas for identifying artificial aggregates. Also, the beneficial utilization of industrial waste materials to produce artificial aggregates can be a viable choice for concrete production (Chi et al., 2003). This subsequently result in large scale consumption of industrial waste materials in concrete and can reduce the environmental pollution hazard. The substitution of mass filler materials such as artificial aggregates in concrete can significantly reduce the dead weight and cost of concrete production (Kim et al., 2012).

Petavratzi (2006) investigated that the large amount of dust fraction below 75 m generated from various ores and found that the different types of rock produced different amounts of fines with different physical properties. Mitchell and Benn (2007) replaced a HSI with a cone crusher. For 20mm aggregate size, the production increased from 250 to 300 tonnes per hour for the same feed rate i.e. 20% increase in production and the proportion of fines have been decreased from 38 to 30% i.e. 21% decrease in fines. Mitchell (2007a) suggested that the quarrying sector would consider using new technologies, which reduce the fines production and that further research work is required in identifying the capital and operational costs associated with quarry fines.

The University of Leeds (2007c) explored that the quarry fines are produced from various activities, but the stages of blasting are considered as the most liable in generating such fines. The amount of dust produced during blasting is estimated to be as high as 20%. Chris Hartwiger and Patrick O'Brien (2008) found that the manufactured sand is extremely angular and has a wide particle distribution curve. These are characteristics of sand that sets up quickly and this is what happens with the manufactured sand. Companies that manufacture sand should screen out fine and very fine particles. Seven factors need to be evaluated in the sand selection process. They are particle size, shape, crushing potential, chemical reaction, hardness, infiltration rate, color, and overall playing quality. Sven-Henrik Norman (2008) discussed the merits of manufactured sand from crushed rock. He emphasized that the crusher selection is based on the abrasiveness of the source rock, feed fraction to the circuit and the nature of the sand required and also concluded that the VSI crushing is the preferred.

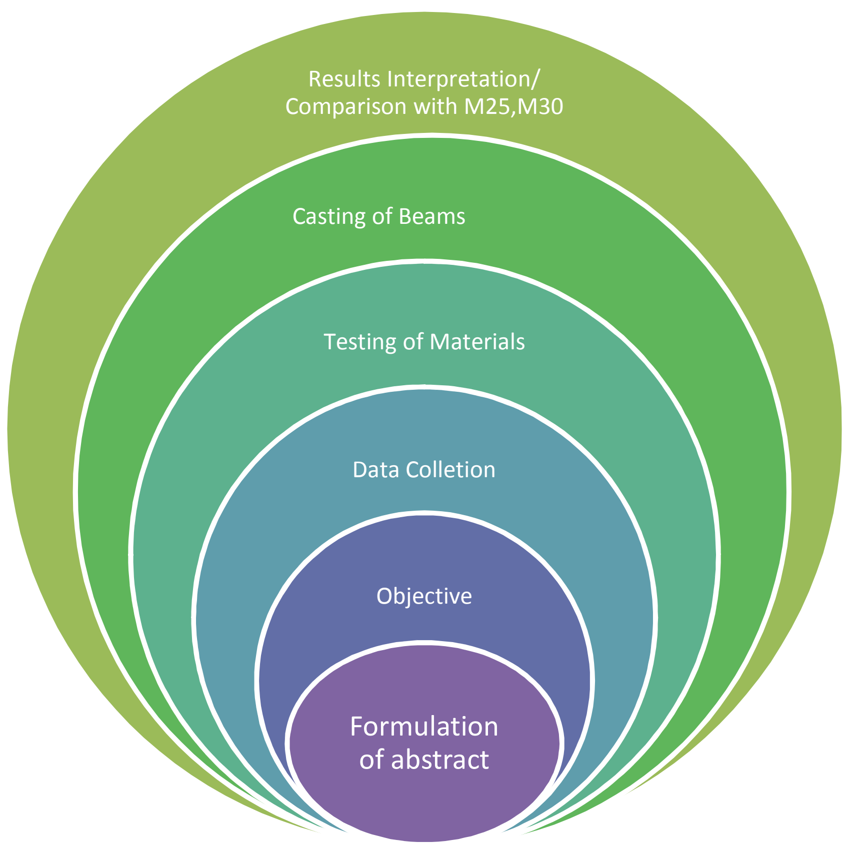
III. MATERIALS USED:

The materials used in the present investigation are

- Cement
- Fine Aggregate
- Coarse Aggregate
- Light Weight Aggregate
- Surkhi
- Quarry Fines or Crushed Rock Powder

IV .Data Collection

Methodology or Frame Work



LOADING ARRANGEMENT

TEST : I Flexural Strength of the Beam

The flexural strength of concrete is determined from the beam specimen of size 150mm×300mm2000mm. The beam specimens are casted ass per Indian Standards. The flexural strength of beams is determined after 28 day curing. The results are shown in Table.

Table 1 Flexural Strength of Beams

S.NO	BEAM POINT	LOAD IN KG	RESULT (7 Days)	RESULT (28 Days)	RESULT (56 Days)
1	M25 CVV @1	79000	28.2	31.00	31.06
2	M25 CVV @2	76000	29.01	32.34	32.79
3	M25 CVV @3	73000	30.7	33.41	33.85
4	M25 CVV @1	78000	30.82	35	35.91
5	M25 CVV @2	98000	29.9	34.62	34.93
6	M25 CVV @3	96000	28.6	34.52	34.85
7	M30 DVV@1	70000	33.2	41.23	41.7
8	M30 DVV@2	68000	34.8	39.01	38.0
9	M30 DVV@3	69000	36.2	39.89	39.65
10	M30 DVV@1	81000	36.9	39.89	39.98
11	M30 DVV@2	82000	38.12	40.12	41.22
12	M30 DVV@13	83000	38.39	41.1	41.34

Load Deformation Behaviour of RC Beams

An important aspect in the analysis and design of structures relates to the deformations caused by the loads applied to a structure. Clearly it is important to avoid deformations so large that they may prevent the structure from fulfilling the purpose for which it is intended. But the analysis of deformations may also help us in the determination of stresses. To determine the actual distribution of stresses within a member, it is necessary to analyze the deformations which take place in that member. This project deals with the deformations of simply supported light weight concrete beams and normal conventional concrete beams under two points loading. The combined load-deformation behaviours of beams are shown in below chart.

Fig.2 Load Deflection Curve for M25 Grade Concrete

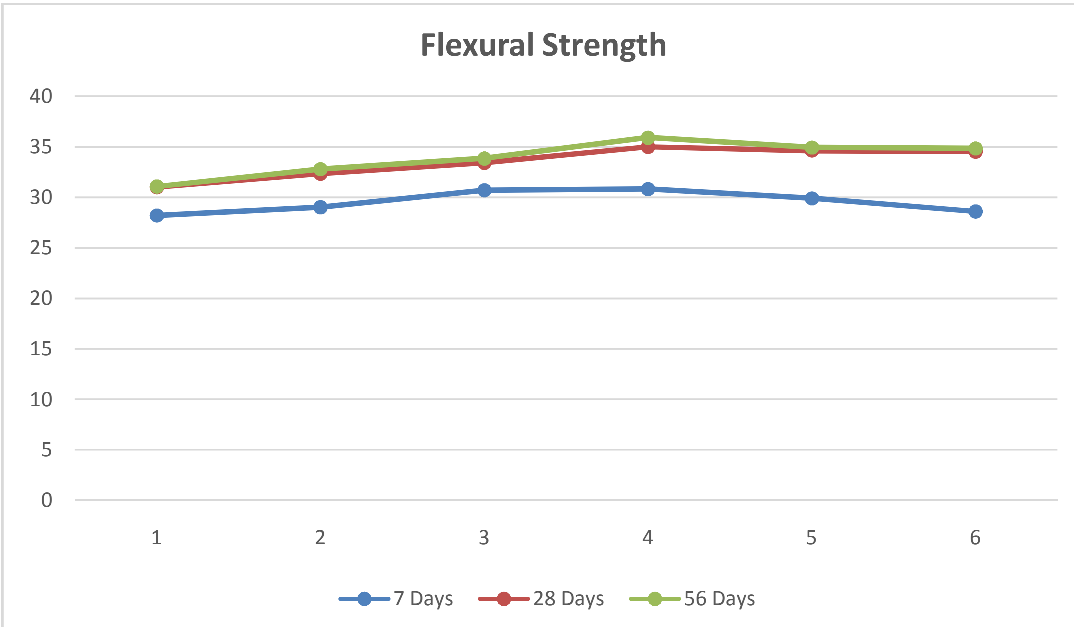


Fig. 3 Load Deflection Curve for M30 Grade Concrete

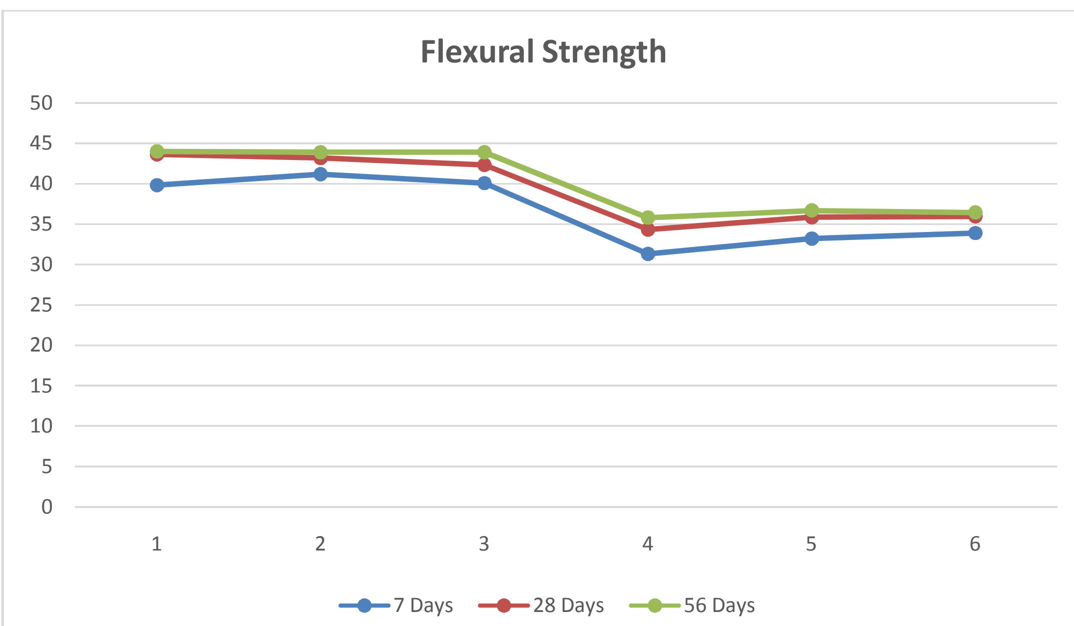


Table 4 Flexural Strength of Beams

S.NO	BEAM	FCK (7 Days)	FCK (28 Days)	FCK (56 Days)
1	M25 NCCB1	28.27	34.52	33.7
2	M25 NCCB-2	30.31	33.12	34.1
3	M25 NCCB-3	31.39	33.12	34.9
4	M30 NCCB-1	39.82	43.65	44.01
5	M30 NCCB-2	41.18	43.19	43.90
6	M30 NCCB-3	40.07	42.34	43.88
7	M25 LWCB-1	28.11	30.23	31.25
8	M25 LWCB-2	28.06	28.09	30.2
9	M25 LWCB-3	29.52	30.00	30.76
10	M30 LWCB-1	31.3	34.34	35.8
11	M30 LWCB-2	33.2	35.87	36.69
12	M30 LWCB-3	33.89	35.98	36.44

Fig. 4 CRACK PATTERN -I

Fig. 5 CRACK PATTERN -II

Fig. 6 CRACK PATTERN -III

TEST : II ULTRASONIC PULSE VELOCITY TEST REPORTS FOR BEAMS:

Table 1. UPV FOR LWC BEAMS : 150mm X300mmX2000mm

S NO	BEAM ID	Obtained average velocity(m/s)	Quality of Concrete
1	LWC-I	3821	Good
2	LWC-II	4245	Good
3	LWC-II	4287	Good
4	LWC-IV	4891	Excellent
5	LWC-V	4896	Excellent

Table.2 UPV FOR NCC BEAMS: 150mm X300mmX 2000mm

S NO	BEAM ID	Obtained average velocity(m/s)	Quality of Concrete
1	NCC-I	3567	Good
2	NCC-II	4123	Good
3	NCC-III	4298	Good
4	NCC-IV	4876	Excellent
5	NCC-V	4878	Good

Table 3 UPV FOR LWC+NCC BEAMS : 150mm X300mmX 2000mm

S NO	BEAM ID	Obtained average velocity(m/s)	Quality of Concrete
1	LWC+NCC-I	3123	Good
2	LWC+NCC-II	4444	Good
3	LWC+NCC-III	4743	Excellent
4	LWC+NCC-IV	4574	Excellent
5	LWC+NCC-V	4134	Good

TEST –III MODULUS OF RUPTURE TEST REPORTS

1.Modulus of Rupture Test Reports (LWC)

S NO	BEAM ID	28 DAYS	56 DAYS
1	LWC-I	25.04	27.8
2	LWC-II	23.11	25.6
3	LWC-II	21.74	24.8
4	LWC-IV	19.74	20.4
5	LWC-V	19.98	20.7

2.Modulus of Rupture Test Reports (NCC)

S NO	BEAM ID	28 DAYS	56 DAYS
1	NCC-I	33.12	36.82
2	NCC-II	30.18	33.12
3	NCC-III	29.87	31.23
4	NCC-IV	29.01	30.7
5	NCC-V	28.78	30.24

3.Modulus of Rupture Test Reports (LWC+NCC)

S NO	BEAM ID	28 DAYS	56 DAYS
1	LWC+NCC-I	38.12	39.6
2	LWC+NCC-II	34.18	37.3
3	LWC+NCC-III	32.70	36.4
4	LWC+NCC-IV	32.19	34.15
5	LWC+NCC-V	31.78	32.13

CONCLUSIONS :

An experimental investigation has been carried out to compare the behaviour of light weight concrete beams by blending of light weight aggregates and the normal conventional concrete beams and concluded that,

- It is possible to obtain the structural LWC by blending of different light weight aggregates.

• For every mix the beams were cast and an average 28 day flexural strength was 34.62 N/mm2 and 41.23 N/mm2, which were more than the target mean strength for both M25 and M30 LWC respectively.

• The ultimate load for LWC beams are more than that of NCC beams of M25 and M30 grades.

• The ultimate deflections of M25 grade LWC beams are less than the ultimate deflections of NCC beams of same grade.

• The ultimate deflections of M30 grade LWC beams are slightly higher than the ultimate deflections of NCC beams of same grade

REFERENCES

1. Mr. Anil Kumar R, Dr. P Prakash "Studies on Structural Light Weight Concrete by Blending Light Weight Aggregates" International Journal of Innovative Research in Engineering & Management, Volume-2, Issue-4, July-2015 pp 48-52.

2. R. Kalpana, P. S. Kothai "Study on Properties of Fibre Reinforced Light Weight Aggregate Concrete" International Journal for Scientific Research & Development Vol. 3, Issue 02, ISSN (online): 2321- 0613, 2015 pp 1876 – 1879

3. Jihad Hamad Mohammed , Ali Jihad Hamad "A classification of lightweight concrete: materials, properties and application review" International Journal of Advanced Engineering Applications, Vol.7, Iss.1, 2014 pp.52-57.

4. Dr. V.Bhaskar Desai, Mr. A. Sathyam "Some Studies on Strength Properties of Light Weight Cinder Aggregate Concrete" International Journal of Scientific and Research Publications, ISSN 2250- 3153, Volume 4, Issue 2, February 2014.

5. Mohamed R. Afify, Noha M. Soliman "Feasibility of Using Lightweight Artificial Course Aggregates in the Manufacture of R. C. Elements" International Journal of Engineering and Advanced Technology, ISSN: 2249 – 8958, Volume-3, Issue-2, December 2013 pp 290 - 306

6. Dr.Muyasser M. Jomaa'h "Using of Local Limestone as Aggregate in Concrete Mixture" Tikrit Journal of Engineering Sciences, Vol.19, No.1, March 2012 pp 35-43.

7. Payam Shafigh, Mahmoud Hassanpour M, S. Vahid Razavi and Mohsen Kobraei "An investigation of the flexural behaviour of reinforced lightweight concrete beams" International Journal of the Physical Sciences Vol. 6(10), 18 May, 2011 pp. 2414-2421.