

A Review on use of Demolition waste in Highway Construction - “A State of Art”

Dr.Jayant Supe, Asso. Prof., Dept of Civil Engg, SSIET, Bhilai C.G

Abstract— This paper deal with the Review report on Demolition waste used in construction of roads along with the various methods employed for strength determination of Concrete for road keeping in mind the concept of 3r's i.e. Reduce, Recycle and Reuse and also with the green building Concept. The sustainability of recycled concrete aggregate used as a base material is currently unknown; Since RCA used in highway construction by comparing the environmental, social, and economic impacts of each product therefore, in order to use the resources efficiently and effectively modern methods and technique are adopted in the field of Construction of roads, Strength of concrete plays a crucial role for the life of road which has to bear uneven static and dynamic circumstances by human or even by environment.

Key Words: RAC, Strength, Reuse.

I. INTRODUCTION

In recent years, the government of India has been relentlessly encouraging sustainable development to achieve both economic growth and a good living environment for future generations in classify to achieve the concept of Green and marvelous environment and infrastructure.

India has second largest road network in the world of around 46,89,842 kms and the in population wise comes first and still growing. On other hand the use of roads becomes an important means of their life and the maintenance of road become a great challenge for country so keeping in mind the roads networks are further been divided so that the superior work out can be done. All these are governed under the National Highway Development Project which connects the major cities of India. According Goldman Sachs 2009 India need to expend around 10, 15,410 crore on infrastructure project before 2020 in order meet the economic needs, for upgrading India's road networks.

The traffic on all national highways is probable to increase enormously in the future. To meet the requirement optimally and thus to ensure swift economic progress of the country, it is crucial to develop and ascertain an efficient highway planning and management system. Effort is also required to incorporate various systems associated to highway management carried out in India and in other countries. Maintenance by Contract for National Highways and expressways should be concealed or it

should be through a part of the construction contract to diminish financial burden on the exchequer we must pursue up strict construction management and rigorous quality control measures and should protect national investment with lowest continuance expenditure.

After carrying out the pavement estimation and appraisal tactical continuation and rehabilitation should be acutely considered, including full depth joint sealing, repairing of all cracks, sub-surface drainage, proper repairing of all spalled joints, Grout jacking of slabs and reconstruction etc. All patches shall preferably be repaired to full depth. Crooked dowel bars can create higher load transmit stresses at joints hence proper care should be taken. 'D' cracking of slabs is caused by poor quality aggregates that absorb water and swell on freezing near joints. This result in cracking of slab resulting severe and rapid loss of pavement serviceability.

Several Methods are adopted in order to determine the strength of concrete of roads such as Equivalent Cube Method, Equivalent Cylindrical Method, Ultra Sound Testing Method, Making and Curing Flexure test, Extensometer test, Electrodynamics method, Maturity Test, Non Distractive testing etc. these are some Indian Standard testing methods but Apart from this some other methods are also developed and still developing the field of concrete technology for measuring the properties of concrete pavement.

Since Non-destructive test methods are preferred to destructive test methods since they can be performed in-situ without resulting in damage to the pavement. Non-destructive tests can also be less labor intensive, require less time to conduct, ultimately cost less, and can be just as accurate as conventional destructive tests. Non-destructive test methods that require less time to conduct and cost less can be used to perform more tests on a given section of pavement. This increase in the number of sampling locations for a given section of pavement statistically provides a greater confidence in the measured pavement property

Nataatmadja performed an experiment to investigate the performance of four recycled concrete aggregates (RCAs). The crushing Concrete undergoes the compressive strength of 15 to 75 Mpa in order to compile the requirement of sub base material. And conclude that ten percent fines test is best FOR evaluating as it does not inflict excessive force on RCA and also revealed that the RCA can utilized as an subbase for an concrete road.

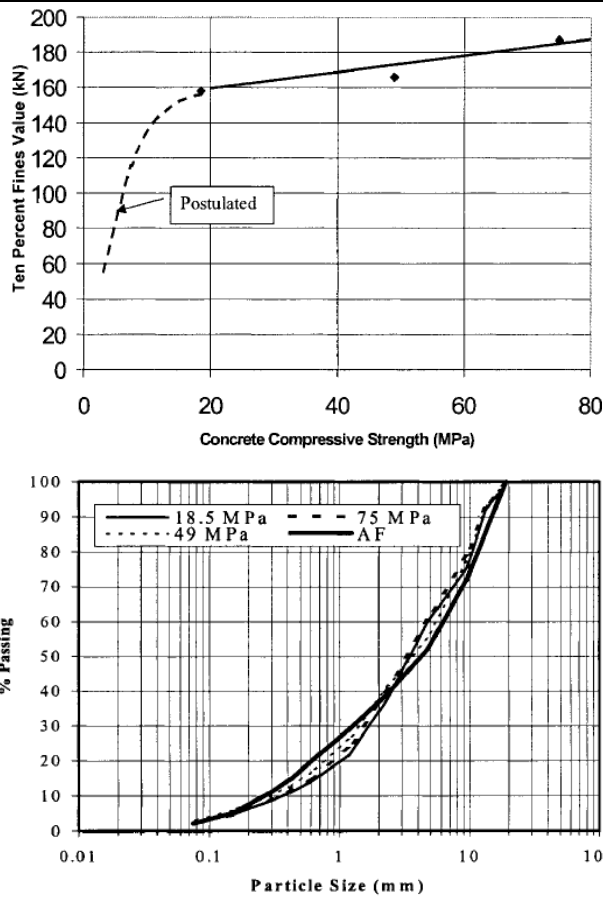


Figure 1 Variation of 10% Values with Concrete Compressive Strength and Particle Size Distribution of RCC Aggregates

From his experiment RCA may even produce a higher resilient modulus under low deviator stresses, as compared with other materials.

Zezhou et. al introduce an a novel computer-based prediction model which use gene expression programming (GEP) help in furcating of construction by the use to demolition waste generation data for effective planning , design and control waste generation. The model is well validated and tested and compared with the multiple linear model and the artificial neural network.



Figure 2 Modeling results of the amount of CDW

At last zezhou conclude that combining the advantages of the time series model and the factor regression model simultaneously; and (2) solving complex prediction problems involving many factors of impact. And can be implement in construction of concrete road.

Keveem discusses a framework for incorporating sustainable design/thinking as a new civil engineering

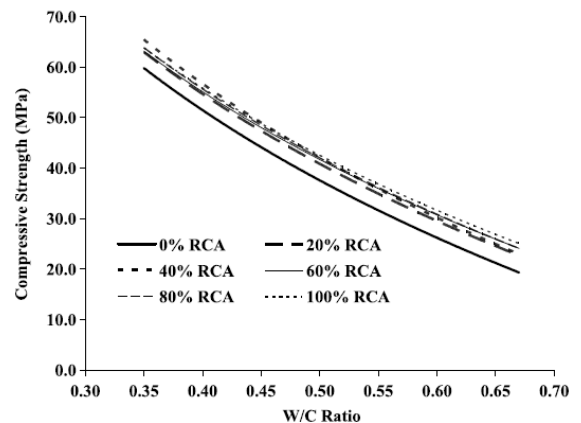
course and experiences from the pilot offering. Important areas are outlined to aid all engineers in understanding sustainability in context with traditional engineering principles. Green-building rating systems were used to introduce the concepts of sustainability in buildings and infrastructure, highlighted by presentations from green-building professionals. By providing a better understanding of sustainability through education, civil engineers can provide proactive solutions to a growing global infrastructure.

Zega and maio use waste material in construction of roads and infrastructure since it is now becoming a global trend in order to utilize the resources more effective and in efficient manner in the all filed specially construction filed. Zega present several inimitability of recycled coarse aggregates obtained by crushing waste ready-mix concrete, as well as the durability and Mechanical properties of recycled concretes made by using .25 .5 and .75 of these aggregates for construction of roads.



Figure 3 Deposit of remains of ready-mix concrete in a concrete-manufacturing company

Yong et. al 2013 Conducts an experiment for evaluating the properties of RCA , so that application of RCA in construction field can more expanded. Rational concrete mix design is used for the evaluation of properties i.e. elasticity, strength drying shrinkage. And at last they revealed that RCA exhibit higher shrinkage as compared to NCA Concrete.



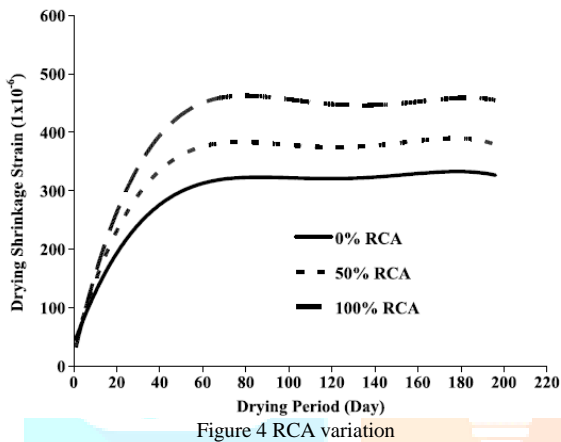
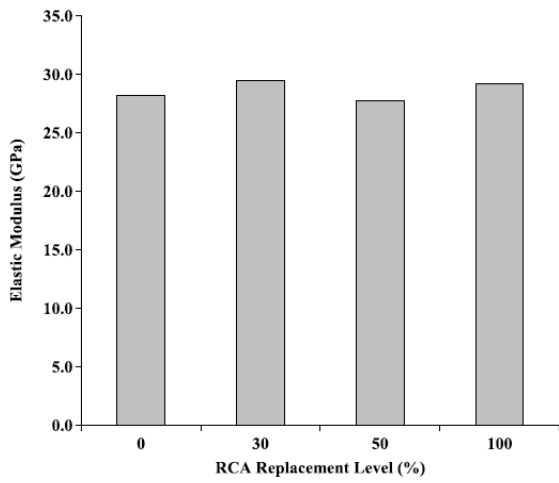


Figure 4 RCA variation

Ahmed presents a report of the properties of RCA and compared the properties of RCA with the RCA additive mix. The mix is in order of ratio from .25 to 1. Fly ash is used as an additive and the evaluation of properties are done after 60 to 90 days and found that the mix contain 40% fly ash have good compressive strength as compared to other mix but the decline in other properties are also been seen i.e. tensile and flexural strength but apart from these an improvement water absorption is seen over there the mix have % fly ash absorb less water as compared to other.

Cantillo, and Guzmán develop an alternative method for testing tensile strength of an concrete. In their method a hollow cylindrical concrete specimen is taken. In hollow region radial internal fluid pressure is applied till the failure of specimen. The developed method is well validated and compared with other method and found that about 17 % superior strength (Tensile) have been achieved.

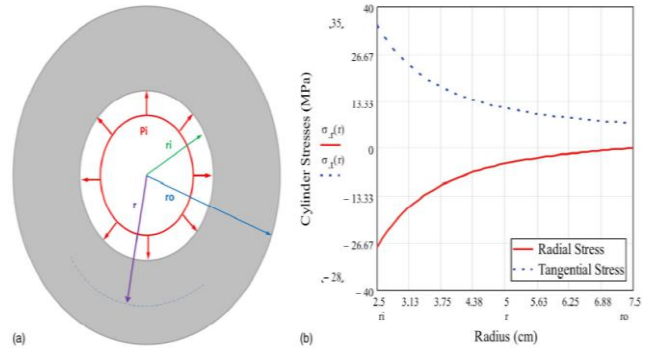


Figure 6 (a) Geometrical parameters for Lamé's equations; (b) stress distribution through a cylinder wall subjected to a $P_i \frac{1}{4} 28 \text{ MPa}$

Herrador et. al elaborate the use of construction and demolition waste (CDW) in order to make environmental friendly sustainable construction work which leads in proper utilization of deposited construction waste. Another benefit of these to prevent the borrowing material from another source which is an fine impact in construction work special in making roads. For this a field study has been carried out for justifying the performance of pavement composed of concrete, ceramic waste aggregate and asphalt mix, and concluded that the load bearing capacity of recycled CDW for road shows good and satisfactory agreement.



Figure 7 Delivery and Watering of CDW aggregate to the jobsite



Figure 8 Spreading and layer CDW aggregate to the jobsite

Herrador et. al 2012 gives a compressive research report on demolished concrete lumps (DCLs) or demolished concrete segments (DCSs) which is integrated with thin walled square steel tubular column subjected to strength testing in order to analyze the cyclic behavior of column during cyclic lateral loading. Apart from his a parametric analysis has also been done.

Masi and Chiauzzi present a brief review report over a

Non destructive testing (NDTs) methods carried out in for determination of strength of Reinforced concrete for making building and roads. The result shows a short inconsistency of rebound number and straight velocity values all along the beam, and a high unevenness for surface velocity values and, particularly, core strengths.

Table 1

Minimum, maximum, mean value and coefficient of variation of the main test results.

Method	Sample	N values	Min-max	Mean	St. Dev.	CV (%)
Rebound test (S)	A	13	26-38	31	4	12
	B	13	28-37	32	3	9
	C	13	34-42	39	2	5
	D	13	34-44	38	3	8
	E	14	24-27	25	1	4
	F	14	29-35	32	2	6
ALL	80	24-44	33	5	15	
Direct Ultrasonic Pulse Velocity (V) (m/s)	A-C	13	3771-4227	3984	136	3
	B-D	13	3553-4290	3996	199	5
	E-F	14	3370-3792	3596	136	4
	ALL	40	3370-4290	3852	245	7
	Surface ultrasonic pulse velocity (Vs) (m/s)	A	13	1337-2588	1837	397
In situ strength (f_c) (MPa)	B	13	1221-3534	2066	776	38
	F	13	2010-3175	2568	373	15
	ALL	39	1221-3534	2385	650	27
	A-C	10	22.0-33.7	25.2	3.5	14
Weight density (SW) (kN/m ³)	B-D	13	19.2-30.7	25.3	3.6	14
	E-F	6	12.8-29.1	19.5	6	31
	G-H	6	14.8-23.2	17.2	3.1	18
	ALL	35	12.8-33.7	23.1	5.0	21
	A-C	10	22.56-23.15	22.83	0.29	1
B-D	13	22.98-23.54	23.23	0.15	1	
E-F	6	22.45-23.43	23.09	0.36	2	
G-H	6	21.77-23.93	22.69	0.70	3	
ALL	35	21.77-23.93	23.00	0.29	1	

Wua et. al 2013 proposed different structural member enclosing demolished concrete of variable size and provide a new tested data of seismic performance along with strength and ductility of thin-walled circular steel tubular column crammed with demolished concrete blocks (DCBs) and fresh concrete (FC).and conclude the DCB,s columns has lower lateral strength as compared to FC even the parametric diametric ratio also affect the deformation capacity.

Bohdana and Tomasz perform an ultra sound test for evaluation of destructive strength of the concrete with time variation and determine d conversion factor. And develop formulae which convert the strength of any model diameter to different one and this is tested in mortar between the bricks and revealed that shape and size affect the strength of the component.

Massod et. al 2002 discusses the recycling process and effective utilization of waste concrete and effort are made for making the construction more sustainable and economical. Along with these Tests are also performed to evaluate the characteristics of recycled concrete. Since Demolition waste is mostly applicable of the bas or sub base for constructing Highway construction such as roads.

Mingming et. al 2013 implement LCSA (life cycle sustainability analysis) in concrete recycling and elaborate step by step in each process in oder to give impact of technological system at the microscopic level and the effect resource management can be possible through this approach especially in construction of Roads. Yilma proposed a new testing method for determining of unconfined compressive strength (UCS) of rock core. The test include core strangle test since this test have some

deficiencies and limitations are well elaborated but the aim of the test is to analyze the strangle type of loading on core axis and develop the empirical relation between UCS and CST and brief explanations is stated in order to implement in road construction

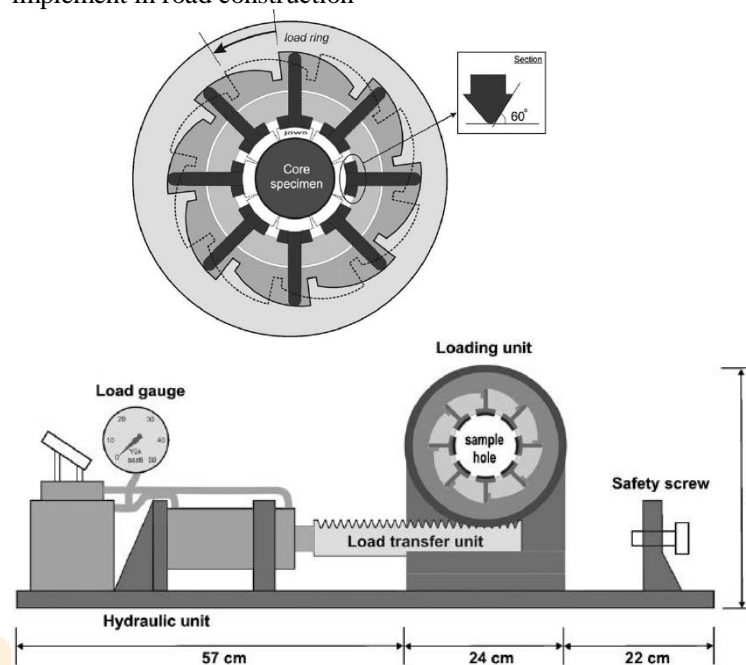


Figure 8. Designed test machine and main units

II. CONCLUSION

Enormous research and various test including destructive as well as non destructive testing are performed the different authors and researcher in the field of use of Demolish waste, Strength Determination, implementation of 3 r's for sustainable development of concrete roads Specially in India. Now a day modern methods and techniques are used for constructing roads and even for their maintenance the age of roads can be enhance up to 200-400 times as compared to past year.

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