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Blending of Recycled Concrete Aggregates for Use in Base Course Construction

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ABSTRACT- This review intends to develop the best financial arrangement by blending of recycled concrete aggregates for use in base coarse development. Hence, the target of this undertaking is to examine the properties of mixed blended Recycled Concrete Aggregate including optimum moisture content, maximum dry density, and bearing strength. For deciding the above properties, the blending of the recycled aggregate has been done in various extents of 100 %, 90%, 80%, 70%, 60%, and half reused total with the differing level of sand. Research center path were led to examine the chance of utilizing level of reused substantial total (100%, 90%, 80%, 70%, 60%, and half) with 3% and 5% of concrete to supplant the piece of sand in blend. The substantial compaction tests were led to decide the ideal dampness content and dry thickness of the reused totals. California bearing proportion tests were led at ideal dampness content. The primary extent of the review is that the development destroyed waste can be utilized in development of streets by mixing the reused substantial totals. In this review, the most noteworthy dry densities are for increases of 5% concrete in reused substantial totals. The investigation of bearing strain uncovered a decent obstruction of the granular combination (reused substantial total + concrete), which brought about high upsides of CBR because of progress of grain size dissemination during the compaction.

KEYWORDS- Recycling, Concrete Aggregate, Demolished concrete, CBR, blended aggregates

I. INTRODUCTION

Aggregate is one of the most vitally important materials in use for concrete production as it profoundly influences concrete properties and performance. Regarding aggregate usage in concrete, a conservative estimate is that at least 4.5 billion tons of concrete aggregates per year are consumed worldwide. This figure is assumed to represent total aggregate production, including usage in concrete and road base.

The above inevitably impacts on the environment due to the great huge quantity of general and construction waste materials or from building demolition sites generated in developed countries. The research conducted for the Industry Commission Report indicated that about 3 million tons of waste aggregate has been created in the Australia alone. The disposal of all this waste has become a harsh social and environmental problem. This is a large burden on the world's natural resources and an increasingly expensive problem for solid waste management[1]. Therefore, a possible alternative aggregate method to overcome this issue may be using recycled concrete aggregates instead of natural aggregate in construction tasks. This solution not only can help to conserve and extend natural resources but also can reduce the cost of waste treatment and the demand on landfill sites for disposing the waste.

The recycling process of concrete involves crushing, removing and separation into various sizes and bulks. Reclaimed aggregate may be designated according to its origin and its quality. In this project, the other most important issue is to determine the best solution to make the recycled concrete aggregate economical for most infrastructure tasks especially in road construction works[2]. in India and large quantities of construction materials for creating these facilities are needed [3]. The planning Commission allocated approximately 50% of capital outlay for infrastructure development in successive 10th & 11th five year plans. Rapid infrastructural development such highways, airports etc. and growing demand for housing has led to scarcity & rise in cost of construction materials. Most of waste materials produced by demolished structures disposed off by dumping them as land fill. Dumping of wastes on land is causing shortage of dumping place in urban areas [4]. Therefore, it is necessary to start recycling and re-use of demolition concrete waste to save environment, cost and energy.

Central Pollution Control Board has estimated current quantum of solid waste generation in India to the tune of 48 million tons per annum out of which, waste from construction industry only accounts for more than 25%. Management of such high quantum of waste puts enormous pressure on solid waste management system[5]. Fig-1 shows the blended aggregates. The total quantum of waste from construction industry is estimated to be 12 to 14.7 million tons per annum out of which 7-8 million tons are concrete and brick waste. According to findings of survey, 70% of the respondent have given the reason for not adopting recycling of waste from Construction Industry is "Not aware of the recycling techniques" while remaining 30% have indicated that they are not even aware of recycling possibilities [7].

Figure 1: Blended Aggregates

II. REVIEW OF LITERATURE

Tavakoli M. (2016) examined the compressive; parting malleable and flexural qualities of 100% reused coarse total concrete and 100% regular sand to contrast them and typical cement made of normal squashed stone. The water-concrete proportion was 0.3 and 0.4 in the substantial blend plan. The test outcome shows the compressive, elastic and flexural qualities of RCA are minimal higher than the regular total at a similar size of 25.4mm at 28-day example.

Dhir et al. (2017) concentrated on the impact of the tidiness and level of the substitution of RCA. They discovered that the level of tidiness of total has fundamentally influenced on the aftereffects of the properties of mutually the plastic and solidified cement. The functionality and compressive qualities both were inferior than the quarried total from seventeen to seventy eight percent contingent upon the level of substitution of RCA. The outcomes additionally showed reused total has extremely high air content.

Limbachiya (2004) concentrated on the properties of reused total contrasted and regular totals and discovered the thickness of RCA is ordinarily four to eight percent inferior and water assimilation two to six times higher. The outcomes showed that a decrease in droop esteem with expanding RCA substantial blends. The outcomes likewise eased back that up to 30% coarse RCA has no impact on the standard substantial 3D square strength however from there on a steady decrease with expanding RCA content happens. This implies that some change is fundamental of the water/concrete proportion to accomplish the same power with high extents of RCA.

BachirMelbouci (2009) concentrated on the mechanical reaction of reused total and decides their mechanical attributes the delegate test; the CBR test and the shearing test have been completed. The outcome acquired showed that their attributes are lower than those of the normal totals.

Hu¨ seyinAkbulut, CahitGu¨rer (2015) examined reused totals created from homogeneous marble and site quarry squanders in Afyonkarahisar–Iscehisar locale were contrasted with two other total examples as of now utilized in Afyonkarahisar city black-top asphalts. Los Angeles scraped area; total effect esteems (AIV), freezing and defrosting, flakiness record and Marshall Stability stream tests were done on the total examples. The test outcomes demonstrate that the actual properties of the totals are inside determined cutoff points and these waste materials might conceivably be utilized as totals in light to medium dealt black-top asphalt folio layers.

Poon etal. (2002) fostered a method to create substantial blocks and clearing blocks from reused totals. The test outcome showed that supplanting normal total by 25% to half have little impact on the compressive potency; however more elevated levels of substitution diminished the compressive strength. The cross over strength expanded as the level of reused total expanded. The substantial clearing blocks with a 28-day compressive power of basically 49MPa can be created without the fuse of fly debris by utilizing around 100% reused total. As indicated by the review, reused total has been utilized in underlying designing. For instance viaduct and marine loch in the Netherlands in 1998 and a place of business in England in 1999. The task in the Netherlands had shown that twenty percent of the coarse total was supplanted by reused total. The task additionally demonstrated even there are some hindrance of reused total, for example, being too frail, more permeable and that it has an extremely higher worth of water assimilation. Notwithstanding, the review showed that these shortcomings could be stayed away from by utilizing motorized formed substantial blocks. The functionality likewise could be enhanced by emptying the blend into the shape. Subsequently, the presentation of the blocks and squares was additionally palatable in the reduction and slide opposition tests.

Fumotoetal. (2002) concentrated on supplanting stream sand with reused total. They found that reused fine total had bigger surface regions, and that the molecule shape was a lot of more terrible contrasted and that of standard waterway sand. The concentrated likewise showed that air content could affect the droop. There was less air content due to the bigger surface spaces of the reused fine total. They additionally originated that reused total has higher water assimilation which strongly affects substantial strength. Notwithstanding, the scientists found that, by adding super plasticizer of 0.6% of concrete substance, the compressive solidarity to a comparative level as regular total.

Taesoon Park (2003) introduced the test consequences of a research center and field study executed to explore the qualities and execution of dry and wet reused substantial total (RCA) as base and sub base materials for substantial asphalt. The actual properties of the RCA were examined as far as the dampness thickness relationship, molecule record, and fine total rakishness. Execution concerns have zeroed in on similarity, security, shear opposition, and molecule rupture of the RCA. These were assessed in the research center utilizing the U.S. Armed force Corps of Engineers Gyratory Testing Machine. The falling weight deflectometer was utilized to quantify the avoidance of asphalt segments built with RCA base and sub base in the sub base material and might be equivalent to squashed stone total.

III. MATERIALS AND METHODS

The test specimens were cast using cement, fine aggregate, recycled concrete aggregates and water. The materials, in general, conformed to the specifications laid down in the relevant Indian Standard Codes. The materials used for making specimens were having their characteristics. Fig-2 shows the Site review of crushing plan In this research, two main commercially material available RCA products, namely RA01 and RA02, collected from a leading concrete recycle plant in Yamuna nagar, Haryana. Sources of materials are demolished building (slabs, floors, columns and foundations), bridges, airport runways and concrete road pavement. The taken sample has been undergone to the specified crushing process to produce RA01 and RA02.As it is shown in table no. 1, the maximum percentage of the constituents that is considered in RA01 and RA02 at plant output. These two materials were blended in different percentage by weight to form another four samples to present various combinations of constituents. Fig-3 shows the Grader Crusher

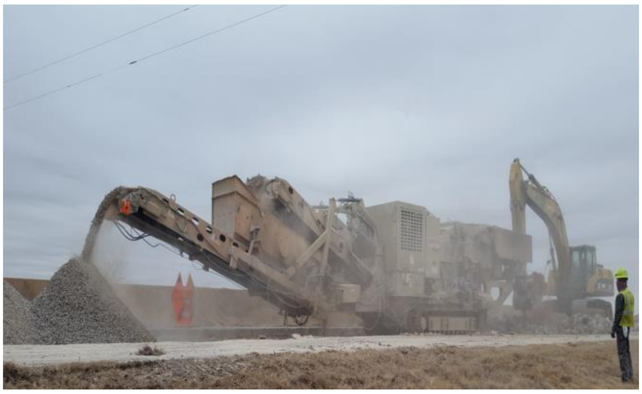

Figure 2: Site review of crushing plan

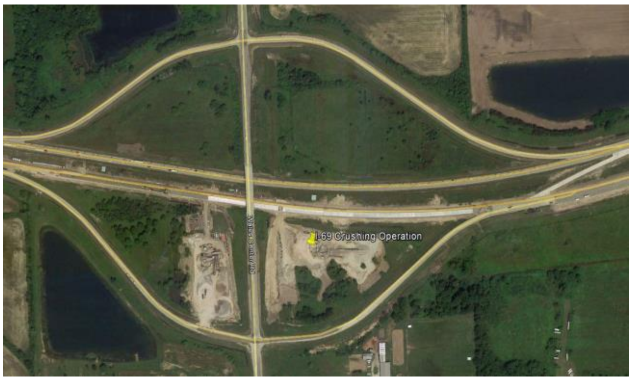

Figure 3: Grader Crusher

A. Materials

1) Plasticity

Cone-penetrometer method was used to deter-mine the liquid limit (LL) as well as plastic limit test was done for plastic limit (PL) for the sample of fines passing IS 0.475 mm sieve. Fines sample of ‘RA01-100/RA02-0’ and ‘RA01-0/RA02100’ were tested since other four samples are blended of these two. The LL values and mean values of plastic limit (PL) test (Atterberg limit test) were shown in Table 7. As per the MORTH, the maximum plasticity index (PI) is 6 and liquid limit 25 percent for material subtype 2.1. ‘RA01-100/RA02-0’ is within that range but ‘RA01-0/RA02-100’having PI of material subtype 2.3 which is given maximum PI as 8. The subtype 2.3 is applied for upper sub base layers by Main Roads.

2) Fine Aggregate

River sand was used as fine aggregate. The particle size distribution and other physical properties of the fine aggregate are listed in Table 2 respectively. Clumps of clay and other foreign matter were separated out from the sand by sieving it through a 150 micron sieve. The particle size distribution curve, also known as a gradation curve, represents the distribution of particles of different sizes in the soil mass. Table 3 shows the Characteristics of sand

3) Coarse Aggregate

Locally available recycled concrete aggregates were used as coarse aggregates. The recycled aggregates produced by the crushing of the concrete blocks resulting from the concrete cube demolition in concrete laboratory. Concrete blocks were crushed by using compressive test machine. Coarse aggregate was sieved through a 150 micron sieve to remove dirt and other foreign material.

4) Water

The water used for both mixing and curing samples was free from injurious amounts of deleterious materials. Potable water is generally considered satisfactory for mixing and curing concrete. In the present investigation, potable tap water was used.

5) Grain Size Distribution

Particle size distribution of a particular pavement aggregate type affects its compressibility, permeability, density...etc. Material subtype is applied for base layers by MORTH and its gradation curves are drawn as their specifications. These demarcating lines are showing that fine content of the six samples are within required range but close to the minimum curve, while the course particles have exceeded the maximum gradation curve at the top. But all the curves show that a greater fraction of their curves are laid within the specified range.

6) Cement

Pozzolana Portland cement from a single lot was used throughout the course of the investigation. The physical properties of the cement as determined from various tests conforming to Indian Standard IS: 1489-1991 are listed in Table 1. Cement was carefully stored in tight silos to prevent deterioration in its properties due to contact with the ambient conditions.

Table 1: Physical properties of Cement

Sr. No.	Properties	Observation
1	Fineness (90 micron IS Sieve)	4 percent
2	Initial setting time	58 minutes
3	Final setting time	280 minutes
4	Standard consistency	31 percent
5	28-days compressive strength	42.65 MPa

Table 2: Seive Analysis of fine Aggregates

IS Sieve designation	Percentage weight retained	Cumulative percentage weight retained	Percent finer by weight (%)
4.75 mm	0.3	0.3	99.7
2 mm	0.5	0.8	99.2
1 mm	0.5	1.3	98.7
425 m	4.0	5.3	94.7
300 m	20	25.3	74.7
150 m	62.5	87.8	12.2
75 m	10.2	98	2
Pan	2.0	100	0

Table 3: Characteristics of sand

Uniformity coefficient, C_u	1.72
Coefficient of curvature, C_c	0.99
Specific Gravity, G	2.66
Optimum moisture content, w_{opt} %	13
Maximum dry density, γ_{dmax}	1.72

7) Mixture preparation

The general expression for the total dry weight W of the sand, recycled concrete aggregates and cement is

W = Wsand + WRCA + WCement

Where, Wsand = weight of sand

WRCA = weight of recycled aggregates

Wcement = weight of cement

B. Tests Performed

1) Modified Procter Test

The Procter test is carried out to determine the optimal water content ''Wopt" and the maximum dry density ''γdmax". The proctor curves are drawn up taking into account of the added brick, cement or sand. The results will be then compared with those obtain on natural aggregates.

The modified Procter test was developed to represent heavier compaction. The test is used to stipulate the field conditions where heavy rollers are used. This test was standardized by the American Association of State Highway Officials and therefore also known as modified AASHO test.

The Indian Standard Code IS: 2720 (Part VIII) gives the specifications for heavy compaction based on this test.

In the modified Procter test, the rammer used is much heavier i.e. mass is 4.89 kg and free drop is 450 mm. The face diameter is 50 mm. The soil is compacted in five equal layers; each layer is being given 25 blows. The compactive energy for the rest is thus increased to 27260 kg cm/ 1000 cm3 that are about 4.5 times that of Standard Proctor Test. The sample taken from proctor test for getting results of optimum moisture content and dry density is being dried in oven for 24 hours.

Bulk density γ (gamma) in g/cc of each compacted specimen should be calculated from the equation:

$$\gamma = (W2-W1)/ V$$

Where, V = volume in cc of the mould.

The dry density Yd in g/cc

$$\gamma d = 100\gamma/ (100+w)$$

The dry densities, γd obtained in a series of determinations should be plotted against the corresponding moisture contents, w. A smooth curve should be drawn through the resulting points and the position of the maximum on the curve as shown in table 4

Table 4: Optimum Moisture Content and Maximum Dry Density for Six Samples

Sample Type	Optimum Moisture Content %	Maximum dry density (g/cm3)
RA01-100/RA0-0	12.11	1.701
RA01-80/RA02-20	13.1	1.778
RA01-60/RA02-40	13.2	1.842
RA01-40/RA0-60	13.6	1.866
RA01-20/RA02-80	14.1	1.816
RA01-0/RA02-100	14.3	1.856

According to MORTH specification, MDD should be more than 1.700gm/cm3 and OMC should be minimum 8 percent. In addition, with the increment of fine aggregate in the samples the curves are more pointed showing the sensitivity of mixture of water. And it is also interesting to note that all the samples are more sensitive to the moisture variation on the dry side of the OMC curves than the wet side of the OMC.

2) California Bearing Ratio Test

California Bearing Ratio (CBR) test is a type of test developed by California Division of Highways in 1929. The test is used for evaluating the suitability of sub grade and the materials used in sub-base and base coarse.

The test is conducted on a prepared specimen in a mould. The laboratory test consists of a mould 150 mm diameter and 175 mm high, having a separate plate and a

Collar. The load is applied by a loading frame through a plunger of 50 mm diameter. Dial gauges are used for measurement of expansion of the specimen on soaking and for measurement of penetration.

It is noted that with the displacer disc inside the mould, effective height of the mould is only 125 mm. The test consists of causing the plunger to penetrate the specimen at the rate of 1.25 mm per minute. The loads required for penetration of 2.5 mm and 5.0 mm are recorded by a proving ring attached to the plunger. The load is expressed as a percentage of the standard load at the respective deformation level, and is known as the CBR value. The CBR value is determined corresponding to both 2.5 mm and 5.0 mm penetration, and the greater value is used for the design of flexible pavement.

$$\text{CBR value} = \frac{\text{Test load}}{\text{Standard load}} \times 100$$

$$\text{CBR (2.5 mm)} = \frac{\text{Corrected load at 2.5 mm}}{13.44} \times 100$$

$$\text{CBR (5.0 mm)} = \frac{\text{Corrected load at 5.0 mm}}{20.16} \times 100$$

CBR characterization is widely used to provide a relative measure of strength, elastic modulus and moisture durability. CBR tests were performed as specified in AS 1289.6.1.1 – 1998 and MORTH on the six samples compacted at their corresponding OMC.

To find OMC homogenization period that is time between material mixing with water and compaction and for this a series of CBR tests were done on RCA samples at different periods 0,3 and 8 hours. The main components of crushed concrete are aggregates; cement mortar, sand need specific time period for uniformly moisture distribution.

Figure 4: Curing of Moulds

CBR was conducted only for two samples to observe the strength gaining pattern. As shown in above table, no moisture homogenization period shows less CBR value in six sample because they did not have enough time for homogenization of moisture.3 hours curing period showed higher CBR values since the materials have taken sufficient time for uniformly moisture distribution which helps for properly compaction of the samples. But RA01 100/RA02-0 showed lower CBR values for 8 hours curing period while RA01-0/RA02-100 had its highest CBR value than previous conditions. RA01-0/RA02-100 consists on more fines, clay bricks, and RAP particles which need more time and 3 hours insufficient for uniformly moisture distribution. In the RA01-100/RA02-0 neither clay bricks nor RAP , but when check at the higher curing time that is 8 hours, mortar with cement shows less strength and poor bonding between RCA and cement along with poor compaction. Therefore 3 hours moisture homogenization compaction was followed for the next CBR test series. Figure-5 shows the California bearing ratio test apparatus

3) CBR test for Unsoaked Samples

Now, next step taken to do CBR test on unsoaked curing periods on compacted six samples and effect on this CRR values. Every sample was prepared following the 3 hours curing period and followed standard compaction procedure. Figure-5 shows the California bearing ratio test apparatus

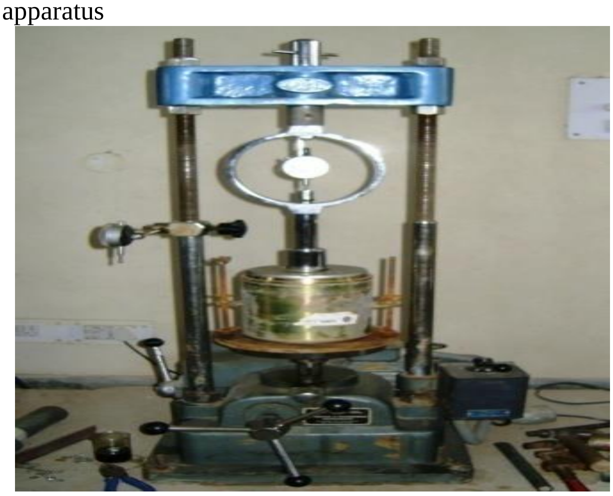

Figure 5: California bearing ratio test apparatus

The sample compacted into the mould was cured (unsoaked) in a sealed container for different periods that is 4 and 8 days along with 4.5kg surcharged load before applying testing. The changing of CBR values in curing periods for each RCA are shown in Table. Four days curing for compacted samples were followed and it is done as per MORTH. Eight days curing period for compacted samples were applied to observe the strength gaining with time.RA01-100/RA02-0 and RA01-80/RA02-20 had little bit lower values of their CBR after eight days curing of the compacted samples. Fine particles of these compacted samples were fixing themselves below 4.5 kg surcharge load for eight days. Due to this cause, they form little voids between irregular shapes recycled aggregates because these 2 samples have low quantity of fines comparatively with other samples. And that cause weak inter connection in the upper part of the compacted samples during load transfer and result for low CBR values.

4) CBR Test for Soaked Samples

To perform the test of CBR values under soaking sample plays an important role for the strength of base course under fully saturated condition. This is recommended for flood areas in material selecting and base course designing. As per MORTH, it has introduced minimum required soaked CBR value as 80 for base layers. The soaked CBR results and the best CBR values which were shown by the mixture cured three hours and compacted samples cured 4 days are shown in Fig. For the soaked test, sample were cured 3 hours prior to compaction and the compacted samples also cured for four days with 4.5kg surcharged load prior to testing. It shows that soaked CBR values not reached the minimum requirement of the Main Road's specifications.

Table 5: Variation of CBR values with different moisture homogenization periods

CBR %			
Sample type	**No moisture homogenization period**	**3hrs moisture homogenization period**	**8hrs moisture homogenization period**
RA01-100/RA02-0	62	75	54
RA01-80/RA02-20	58	64	-
RA01-60/RA02-40	54	67	-
RA01-40/RA02-60	51	62	-
RA01-20/RA02-80	49	61	-
RA01-0/RA02-100	47	52	54

Table 6: CBR values for different curing period of compacted samples.

CBR%		
Sample type	**Mixture-3 hrs curing and compacted sample cured 4 days**	**Mixture 3 hrs curing and compacted sample cured 8 days.**
RA01-100/RA02-0	83	80
RA01-80/RA02-20	78	76
RA01-60/RA02-40	73	76
RA01-40/RA02-60	65	65
RA01-20/RA02-80	62	62
RA01-0/RA02-100	59	43

RA01-60/RA0-40, RA01-40/RA02-60 and RA01-20/RA02-80 are almost equal but slightly higher values .Due to high fine fraction values; it has very increased
Compact ability and increased water absorption for cement mortar strength
Gaining affect on its load bearing strength.
RA01-0/RA02-100 had its lowest CBR values and this is due to the lower intrinsic particle strength of crushed bricks and reclaimed asphalts (RAP) which led to lower overall bearing strength of RCA [13]. Also the poor interlocking system due to the crushed clay brick and sand decrease the load transfer capacity of the compacted samples.

IV. RESULTS

The test data and results on soil with different percentage of recycled concrete aggregate and cement as obtained in this investigation are analyzed and discussed in detail in this chapter. The study of bearing pressure revealed a good resistance of the granular mixture (recycled concrete aggregate + cement), which resulted in high values of CBR due to improvement of grain size distribution during the compaction.
For determining the above properties, the blending of the recycled aggregate has been done in different proportions of 100 %, 80%, , 60%,40 % and 20% in six samples of recycled concrete aggregate name RA01 and RA02 with the varying percentage of sand. Laboratory trails were conducted to investigate the possibility of using percentage of recycled concrete aggregate (100%, , 80%, 60%, 40%and 20%) with 3% and 5% of cement to replace the part of sand in mix.
For this, modified proctor test and California bearing ratio (CBR) test done on RCA. CBR was conducted only for two samples to observe the strength gaining pattern. The proctor tests show that there is great change of the granular structure according to the number of blows and presence of water.
As shown and related it's shown the connection between OMC and MDD and how each other effect each other. The range of the variation of MDD and OMC are relatively small as 1.701-1.856 g/cm3 and 12.11-14.3%, respectively. It can be seen that with the increase in fines contents of a material, both OMC and MDD increase as fines can absorb more water and can reduce the void volume by filling the voids between larger particles.
According to MORTH specification, MDD should be more than 1.700gm/cm3 and OMC should be minimum 8 percent.
When we added RCA in sand, surface area is reduced due to larger particle size, so the less water is required to lubricate them. Figure 13 depicts that 100% sand has highest OMC i.e. 13% because of larger surface area and

smaller particle size. For 100% RCA, OMC is 10.2. As the particle size increases, the surface area reduces and it requires less water to lubricate the particles.

As shown no moisture homogenization period shows less CBR value in six sample because they did not have enough time for homogenization of moisture.3 hours curing period showed higher CBR values since the materials have taken sufficient time for uniformly moisture distribution which helps for properly compaction of the samples. But RA01 100/RA02-0 showed lower CBR values for 8 hours curing period while RA01-0/RA02-100 had its highest CBR value than previous conditions. RA01-0/RA02-100 consists on more fines, clay bricks, and RAP particles which need more time and 3 hours insufficient for uniformly moisture distribution. In the RA01-100/RA02-0 neither clay bricks nor RAP , but when check at the higher curing time that is 8 hours, mortar with cement shows less strength and poor bonding between RCA and cement along with poor compaction. Therefore 3 hours moisture homogenization compaction was followed for the next CBR test series.

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RA01-100/RA03-0'sample has certainly very appreciable results at CBR test at the both soaked and unsoaked. 'RA01-80/RA02-20'sample also has come close to 'RA01-100/RA02-0' with CBR results but lesser values.

V. CONCLUSION

The testing programme as planned has been explained in this chapter to achieve the objectives of the present investigation. . The basic properties of the various constituents of concrete such as cement, fine aggregates, coarse aggregates and water are presented. The procedure adopted for testing soil for optimum moisture content, dry density and bearing strength has been described.

This study aims to develop the best economic solution by blending of recycled concrete aggregates for use in base coarse construction. Therefore, the objective of this project is to investigate the properties of blended Recycled Concrete Aggregate including optimum moisture content, maximum dry density, and bearing strength..

The process of recycled concrete aggregates by blending is done by performing various experiments analysis and etc.

- Various experiments were performed by performing various tests (Modified Procter test, California bearing ratio test etc.) using concrete materials.
- The results obtained were discussed and analyzed by various experts and field professionals.
- Certain websites regarding concrete technology were browsed and studied.
- Literatures of various experts were studied.
- The aggregates resulting from the recycling of the products of demolition lie within the scope of local materials replacement and this study contributes to their valorization in the field of civil engineering, particularly in roads.

Aggregate is one of the most vitally important materials in use for concrete production as it profoundly influences concrete properties and performance. Regarding aggregate usage in concrete, a conservative estimate is that at least 5.0 billion tons of concrete aggregates per year are consumed worldwide. This figure is assumed to represent total aggregate production, including usage in concrete and road base.

The above inevitably impacts on the environment due to the great huge quantity of general and construction waste materials or from building demolition sites generated in developed countries. The research conducted for the Industry Commission Report indicated that about 3 million tons of waste aggregate has been created in the Australia alone. The disposal of all this waste has become a harsh social and environmental problem. This is a large burden on the world's natural resources and an increasingly expensive problem for solid waste management. Therefore, a possible alternative aggregate method to overcome this issue may be using recycled concrete aggregates instead of natural aggregate in construction tasks. This solution not only can help to conserve and extend natural resources but also can reduce the cost of waste treatment and the demand on landfill sites for disposing the waste.

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RCAs have fewer fines but higher percentage of coarse fraction. The six curves are shown minimum required particles size distribution of material subtype.

CBR mould is being cured for 4 days, 7 days, 14 days and 28 days to get proper strength of blended sand and recycled concrete aggregate with addition cement. The detailed analysis and discussion of the test results as obtained from the experimental program as well as their comparison with work done by other researchers, wherever possible, is presented in following sections.

The proctor tests show that there is great change of the granular structure according to the number of blows and presence of water. The addition of the sand, recycled concrete aggregate and cement varies considerably the behavior of the recycled concrete aggregates at compaction. OMC decreases with increasing the percentage of recycled concrete aggregates (RCA)

When we added RCA in sand, surface area is reduced due to larger particle size, so the less water is required to lubricate them. Figure 13 depicts that 100% sand has highest OMC i.e. 13% because of larger surface area and smaller particle size. For 100% RCA, OMC is 10.2.As the particle size increases, the surface area reduces and it requires less water to lubricate the particles.

The proctor compaction test gave relatively higher water absorption for maximum dry density. Cement, rock dust and clay bricks cause for higher compaction with increase the RA0 portion but lower the density. However the density varied in a small range giving the lowest value for ‘RA01-100/RA02-0’ which represents only crushed concrete aggregate.

RA01-100/RA03-0’sample has certainly very appreciable results at CBR test at the both soaked and unsoaked. ‘RA01-80/RA02-20’sample also has come close to ‘RA01-100/RA02-0’ with CBR results but lesser values. The above inevitably impacts on the environment due to the great huge quantity of general and construction waste materials or from building demolition sites generated in developed countries. The research conducted for the Industry Commission the disposal of all this waste has become a harsh social and environmental problem. This is a large burden on the world’s natural resources and an increasingly expensive problem for solid waste management. Therefore, a possible alternative aggregate method to overcome this issue may be using recycled concrete aggregates instead of natural aggregate in construction tasks. This solution not only can help to conserve and extend natural resources but also can reduce the cost of waste treatment and the demand on landfill sites for disposing the waste.

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