International Journal on Emerging Technologies **12**(1): 87-93(2021)

ISSN No. (Print): 0975-8364
ISSN No. (Online): 2249-3255

Stabilization of Road Subgrade Soil Using Recycled Aggregates

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(Received 28 September 2020, Revised 24 December 2020, Accepted 23 January 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The way toward changing the internal properties of soil to improve the bearing capability and strength property of weak soil is known as Stabilization of that weak soil. Road paths or structure situated on weak soil needs adjustment. Adjustment of soil is primarily accomplished for altering designing properties of that feeble soil to improve the bearing capacity and durability property of that soil. Alongside this, the waste material dumping is having a lot of issues for its removal. The purpose of the assessment is to assess the waste material is to evaluate the waste material with an audit on the modification of clayey soil utilizing crushed concrete aggregates. This proposal presents the outcomes of an assessment that explored the utilization of wrecked concrete in the adjustment of extensive clayey soil. In this study, the California bearing ratio (CBR) tests were done on the clay soil mixed with coarse aggregates of similar size and extents. The soil samples were made and analyzed first with no coarse aggregates, then by mixing coarse aggregates in changing percentages by weight, for example, 0%, 30%, half, and 70%. The consequences of CBR tests show that with the expansion in the level of coarse totals, the CBR estimation of the soil rises. It is noted that the ratio of improvements in the CBR values for soil samples stabilized with 70% recycled aggregates (RA) ranges from 7.16% to 13.81% respectively for the unsoaked conditions. When the soil sample is soaked in water, this progress ranges from 9.34% to 14.98% for the same soil sample respectively. This study primarily focuses to improve the bearing capacity and strength of the subgrade soil and also utilizing the RA efficiently. Maximum Dry Density (MDD), Optimum Moisture Content (OMC), and CBR values are obtained from the mixture of soil with RA for different proportions.

Keywords: Bearing Capacity, CBR Value,Maximum Dry Density, Optimum Moisture Content,Recycled Aggregate, Subgrade Soil, Soil Stabilization.

Abbreviations: CBR, California bearing ratio;MDD, maximum dry density; OMC, optimum moisture content; RA, recycled aggregate; CDW, construction and demolition waste; RCA, recycled concrete aggregates; RCM, recycled concrete material.

I. INTRODUCTION

The fabricated environment devours a ton of energy and material. An enormous interest of around 40 billion tons of totals is requested for development reason. The expense of material records for over 60% of the all out undertaking cost. In any case, 10% of development material end up as destruction wastes yearly [1]. This essentially emphasizes the stabilization of extensive soil locally available demolished concrete. This meets the accompanying purposes like utilization of coarse and fines of crushed solid structures to settled soil at various rates for example on 0%, 30%, half, and 70%. The investigation additionally underscores the determination of different parameters of soil like moisture content and Atterberg limit at the various extent of demolished concrete aggregates. The utilization of CDW in structural designing has expanded impressively, and in production, RA are broadly utilized as subgrade materials [2]. Utilizing a wide range of natural materials is generally unavoidable due to specialized, financial, and natural contemplations in the subgrade development of highway works [3].

It has being set up that few tons of materials are required for street development. Aggregate in black-top asphalt regularly utilized in agricultural nations includes up to 95% usual aggregates. The aggregate sum required for an undertaking relies upon the street's subgrade and expected traffic loading and the ventures size. For frail subgrade (< 10% CBR), adjustment utilizing waste should be possible [4, 5]. This would pointedlylessenroadwaywideness and the quantity of ingredientsrequired forbuilding. This provides financial, eco-friendly and social benefits.

Different strategies are accessible for settling clayey soil. These techniques join adjustment with chemical extracts, soil substitution, compaction control, moisture control, and warm strategies. According to previous studies and utilization of annihilated waste issues, fines acquired from crushed waste is a cost-effective and efficient method of soil stabilization [6]. RCA, which contain particles essentially starting from reused demolished concrete [7] and mixed recycled aggregates (MRA), which are made from reused squashed workmanship and incorporate block, mortar, solid, black-top, and gypsum particles are two sorts of RA produced from CDW [8]. However, because of the massive volume of roadways projects, replacement is very costly and impractical inthese projects. For the development and support of countryside highways taking into account low volumes of traffic, nearby soil isn't just the least expensive yet additionally the profoundly adaptable road material.

The locally accessible clay soil isn't reasonable as a subgrade material due to its low CBR value and expanding qualities. Stabilizers like RCA can help to improve the CBR value of the soil sample. Subgrade adjustment of the clayey soil is essential to make the upper slice of road structure become stable and lessening asphalt thickness [9]-[13].

Structural designers need to handle bunches of issues for the development of pavements in weak soil zones as a result of its low CBR value and substitute swell- shrink condition when the soil interacts with water. These results need a high cost for construction as well as requires continuous repairing for cracks of various structures. These days, squashed cement is accessible in huge amounts, which results from the destruction of old structures and waste concrete from new structures. Presently, a significant number of the wastes produced will stay on the earth for hundreds a great many years and the making of non-rotting waste materials joined with a developing buyer populace has brought about a garbage removal emergency. This emergency can be illuminated by reusing and reused squander into helpful items. As a rule, the designing properties of soil subgrade were high pliancy material which can be improved by utilizing reused material as a stabilizer [14].

In recent years, a large number of the wastes produced will stay in the environment for hundreds of millennia and the formation of non-rotting waste materials together with an expanding consumer general population has brought about a garbage removal emergency. This emergency can be settled by reusing waste into valuable items. All in all, the designing properties of soil subgrade were high versatility material which can be upgraded by utilizing reused material as a stabilizer [15].

Over the most recent couple of a very long time in a few nations around the globe, has been carefully considered the reusing of waste materials, for example, C&D waste, plastics, and elastic, and spoon heater slag and procedures have been proposed for how to effectively utilize these materials in highway pavements or subgrades [16]-[17]. Generally, the higher the CBR value, the more suitable the subgrade for highwayconstruction as well as subgrade soil having a CBR value lower than 5 should be considered aspoor material for pavement structures [18].CBR value and upgrade expanding qualities can be improved by the utilization of RCA with weak clay soil. The outside layer thickness of highways additionally decreases with the assistance of these added substances because of which the cost of construction can be diminished generally.

Contingent on the kind of pavement, the subgrade layer is situated in the bottom of the pavement structure basic the base course or surface course. Generally, subgrade comprises different locally accessible soil materials that cannot have enough solidarity to help pavement load. The long- term presentation of the pavement would be better if the strength/firmness nature of the materials would be better. Thus, the structural design of the pavement ought to be encouraged by the proficient, generally prudent, and powerful utilization of existing subgrade materials to improve their implementation. Legitimate treatment may be expected to make the subgrade functional for overlying layers for highway construction if there should be an occurrence of delicate and wet subgrades. Clay sub-grades particularly whensaturated may provide inadequate support [19].

Soils having huge versatility may similarly shrink and swell impressively with changes in humidity conditions. The pavement can move or hurl because of these adjustments in volume with changes in moisture content and may cause a decrease in the thickness and strength of the subgrade, accelerating pavement disintegration [20]. Stabilization may also be used toprovide a working platform for construction operations in wet weather. These types of soil qualityimprovement are referred to as soil modification or soil stabilization. The strength of soils for these applications can be obtained by the use of a familiar indicator test called CBR value [21].

Information got from CBR tests aid the assurance of the requirement for soil adjustment and the assessment of the general asphalt thickness over the subgrade [22]. It is recommended to utilize these solid squares after crushing in the improvement of geotechnical properties of delicate soil through expanding the strength of such soil and lessen its compressibility. The delicate soil is blended in with a few rates of squashed concrete to determine the improvement of the geotechnical properties of weak soil.

The greater part of the past examinations was identified with subgrade change with reused materials, restricted to evaluate prompt advantage through development help. Notwithstanding, there is a need to distinguish the drawn-out advantages and additionally related dangers to utilize reused material for subgrade adjustment. Subsequently, in the current examination, the CBR tests were done on the mud mixed with coarse aggregates of similar sizes and extents.

In this work, we focused on: (1) improving the properties of weak soil, (2) investigating the effective use of recycled and waste material in various construction applications as well as the feasibility of the application of CDW for improving the performance of subgrade and sub-base layers in the roads and highways, (3) evaluating the physical properties, strength parameters, and durability characteristics of RCM relevant to pavement sub-base materials specifications and pavement design, (4) determining the CBR value of treated road sub-base for the various percentage of RA and the soil, (5) determining the bearing capacity of road sub-base by applying RCA.

II. MATERIALS AND METHODS

Several tests are conducted to determine the properties of Godagari soil and RA. The squares of waste total are granulated by factories to get squashed aggregate which passing through sieve no. 4. The weight of these aggregates is lighter than any other natural aggregates which also provides a decent deformation when blended in with soil. The properties of soil such as liquid limit, plastic limit, shrinkagelimit, plasticity index, etc. are obtained from the laboratory tests. OMC and MDD of theGodagari soil are acquired from modified proctor tests.

CBR tests were also carried out to evaluate the bearing capacity of the untreated and treated soil.To determinespecific gravity, water absorption, crushing value, impact value, abrasion value, etc., RA are also tested as per IS 2386:1963.Godagari soil is stabilized by performing a series of modified proctor tests and CBRtests withthe addition of different proportions of RA. The tested soil was mixed with 30%, 50%, and 70% RA by dry weight of the soil. The combinations were then exposed to the accompanying tests:

i) Moisture Content.

ii) Atterberg Limits.
 a) Liquid Limit
 b) Plastic Limit

iii) Compaction
 (a.) Standard proctor test
 (b.) Modify proctor test

iv) CBR.

(v) Unconfined Triaxial Test.

III. RESULTS AND DISCUSSION

A. Soil sample

The subgrade soil used in this study is clay soil, which was collected from Godagari ofRajshahi district. The properties of the Godagari soil were found out as per ASTM andthe results obtained are tabulated in Table 1.

Table 1: Test properties of soil sample.

Soil Properties	Values	
Specific gravity (Gs)	2.68	
Liquid limit	25.52%	
Plastic limit	16.21%	
Plasticity index	9.31%	
Dry density, kN/m^3	18.53	
CBR (%)	Unsoaked	Soaked
	9.34	7.16

B. Recycled concrete aggregates

RCA was collected from variousconstruction and demolition sites in and around the Rajshahi University of Engineering & Technology, Rajshahi, Bangladesh campus. The collected wastematerials were then crushed up to 25.4 mm smaller sizes manually. The properties of recycled wastes used are tabulated in Table 2. It is observed from the table that the aggregates were of sufficiently good quality.

Table 2: Properties of RA.

Soil Properties	Values
Unit weight, loose (kN/m^3)	17.28
Unit weight, dense (kN/m^3)	18.84
Apparent specific gravity	2.42
Loss Angeles Abrasion Value (%)	31.00
Aggregate Impact Value (%)	30.00
Aggregate Crushing Value (%)	46.00

C. Mix Proportions of Soil Sample

The samples are made into 4 possible proportions

Clay 100% and Aggregates 0%, C100 A0

Clay 70% and Aggregates 30%, C70 A30

Clay 50% and Aggregates 50%, C50 A50

Clay 30% and Aggregates 70%, C30 A70

D. Particle Size Distribution Curve

Fig. 1 shows the grain size distribution curve for Godagari soil. The grainsize distributions were analyzed following the Spanish standard UNEEN-933-1. Here, 3.8% is sand, 23.64% is silt and 72.56% is clay which is obtained from Fig. 1. Hence Godagari soil is clay type. From the graph, it is observed that the particle size is distributed over a wide range, hence it is a well-graded soil.

E. Modified Proctor Test

Table 3 shows the MDD values and the OMC got from the modified proctor test for the Godagari soil and reused aggregates. Fig. 2 shows the moisture-density curves.From the modified proctor test results, it was witnessed that, for soil mixed with different quantities of RA, the density improved with the addition of RA.

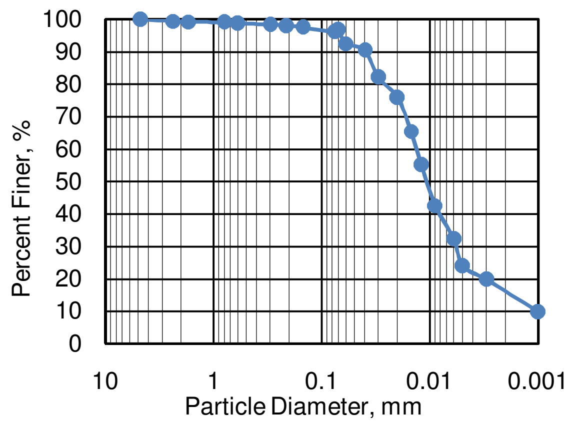

Fig. 1. Grain size distribution curve for Godagari soil.

Table 3: Modified proctor test values of various proportions of Godagari soil and RA.

Proportion of Sample	MDD (kN/m³)	OMC (%)
C100 A0	18.53	10.3
C70 A30	18.90	12
C50 A50	19.10	11.4
C30 A70	19.31	11.9

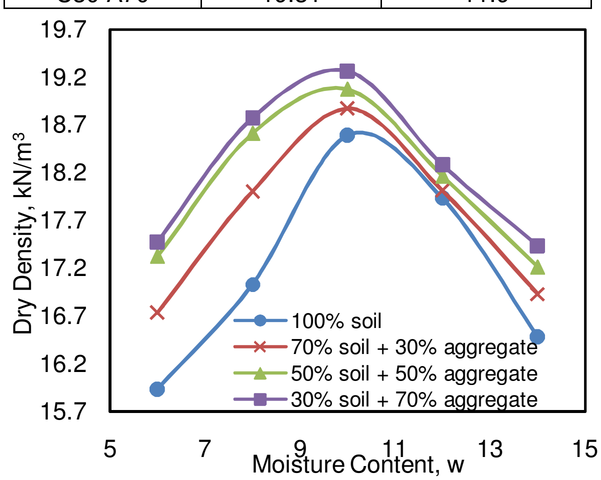

Fig. 2. Compaction curves for all proportions of Godagari soil and RA.

By the addition of 70% of RA with 30% soil, the MDD of the soil sample was increased from 18.53 kN/m^2 to 19.31 kN/m^2 which is observed from Fig. 2. It is known from the different investigations that an expansion of dry density involves a reduction of voids ratio and a more conservative soil.
This variation in MDD could be because of the variation in void ratio when RA was added. Further addition of RA increased in value of the MDD. The percentage as the OMC tends to decrease RA increased. However, the OMC goes on increasing first and then decreases. Furthermore, there are a lot of changes in the OMC of 100% soil without RA and 30% soil with 70% aggregates. On the other hand, the 50% and 30% RA treated soil showed a minimum change of 11.4%, 12% in OMC and 19.10 kN/m^3, 18.90 kN/m^3 in the MDD.

F. Effect of RA on CBR of Soil
Several unsoaked and soaked CBR tests were performed in the laboratory with different amounts of RA at their respective MDD and OMC. The laboratory result of theCBR test conducted on Godagari soil stabilized using the mixing of the various percentage of RA shown in Fig. 3 to Fig. 8 given above for unsoaked and soaked conditions. Generally, from the result, it can be seen the loads increase for stabilized soft soil within the addition of RA compared to unstabilized soil for the soaked and unsoaked conditions.

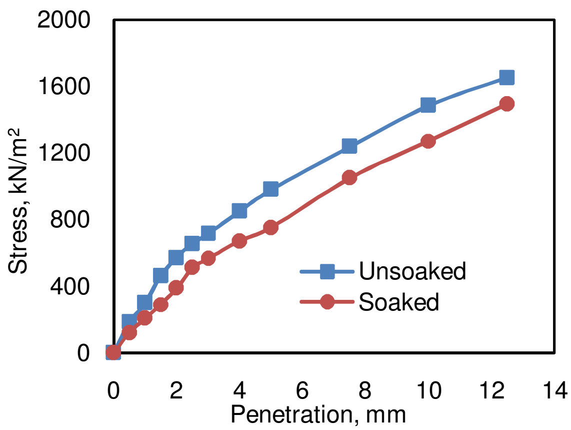

Fig. 3. Stress vs. penetration graph for 100% soil under unsoaked and soaked conditions.

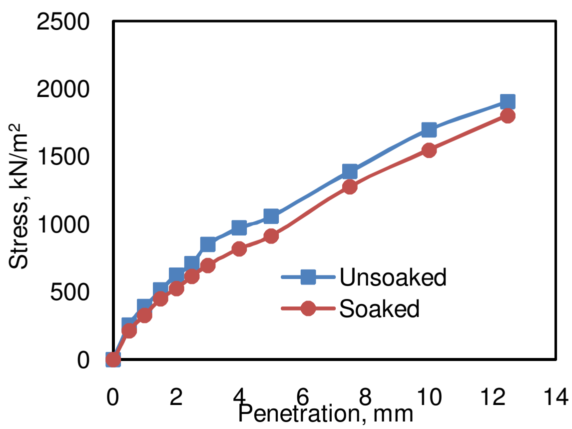

Fig. 4. Stress vs. penetration graph for 70% Godagari soil with 30% aggregates under unsoaked and soaked conditions.

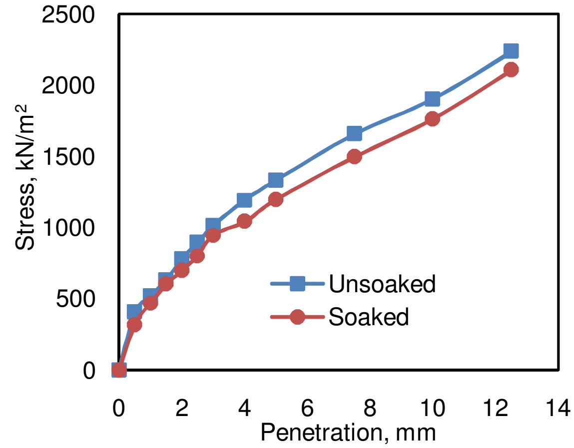

Fig. 5. Stress vs. penetration graph for 50% Godagari soil with 50% aggregates under the unsoaked and soaked condition.

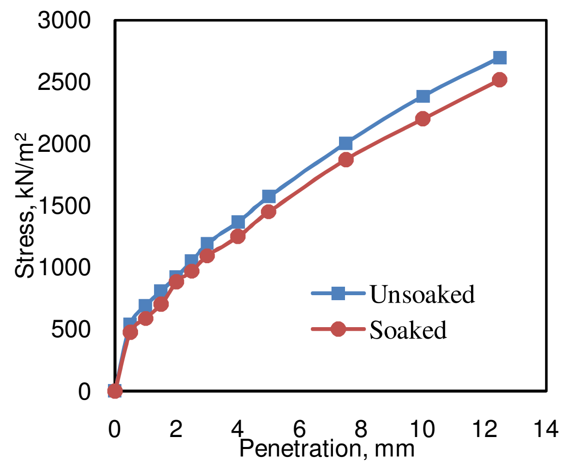

Fig. 6. Stress vs. penetration graph for 30% Godagari soil with 70% aggregates under the unsoaked and soaked condition.

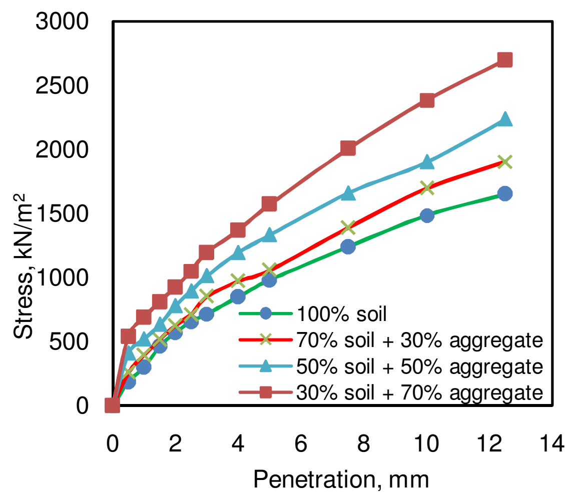

Fig. 7. Stress vs. penetration graph for all proportions of soil and aggregates under the unsoaked condition.

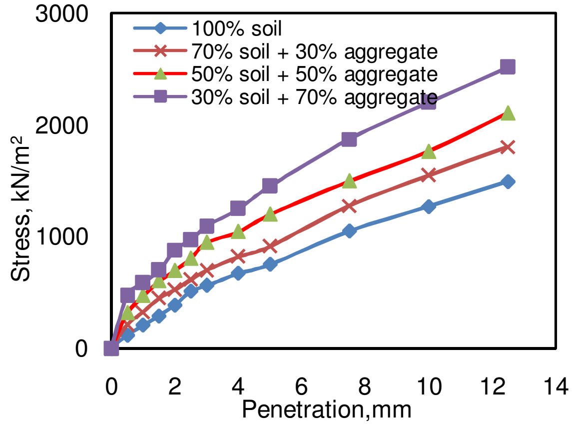

Fig. 8. Stress vs. penetration graph for all proportions of soil and aggregates under the soaked condition.

Fig. 3 indicates that under unsoaked condition stresses at 2.5 mm penetration is 656 kN/m^2 and at 5 mm penetration is 980.7 kN/m^2 for 100% Godagari soil with no RA whereas under the soaked condition at 2.5 mm and 5 mm penetration stresses are 511.4 kN/m^2 and 751.8 kN/m^2 for same proportions of Godagari soil without RA.

Under unsoaked condition stresses at 2.5 mm penetration is 709.1 kN/m^2 and at 5 mm penetration is 1057.4 kN/m^2 for 70% Godagari soil with 30% RA whereas for 70% Godagari soil with 30% RA at 2.5 mm and 5 mm penetration stresses are 614.5 kN/m^2 and 912.5 kN/m^2 under the soaked condition which is obtained from Fig. 4.

From Fig. 5 it is also observed that under unsoaked condition stresses for 50% Godagari soil with 50% RA at 2.5 mm penetration is 894.6 kN/m^2 and at 5 mm penetration is 1332.5 kN/m^2 whereas for the same proportions stresses are 803.7 kN/m^2 and 1198.1 kN/m^2 at 2.5 mm and 5 mm penetration under soaked condition.

Fig. 6 shows that stresses at 2.5 mm penetration under unsoaked condition is 1050.1 kN/m^2 and at 5 mm penetration is 1572.9 kN/m^2 for 30% Godagari soil with 70% RA whereas for 30% Godagari soil with 70% RA at 2.5 mm and 5 mm penetration stresses are 969.5 kN/m^2 and 1450.1 kN/m^2 under soaked condition.

It is observed from Fig. 8 that the range of stresses of soil varies from 980.7 kN/m² to 1572.9 kN/m² (treated with 70% RA) under the unsoaked condition and from Fig. 8 the range of stresses of soil varies from 751.8 kN/m² to 1450.1 kN/m² (treated with 70% RA) under soaked condition.

The variety of CBR values (unsoaked and doused) of Godagari soil with fluctuating rates of demolished concrete aggregate appears in Table 4. Given the CBR test results, it was seen that the CBR esteem initially expanded step by step with the expansion of destroyed concrete aggregates. Anyway, the CBR value increments because of the expansion in the load-bearing limit of soils when reused aggregate was added to the weak soil. With the addition of 70% of recycled concrete aggregate unsoaked CBR value was increased from 9.34% to 14.98% and the soaked CBR value increased from 7.16% to 13.81%.

Table 4: CBR test for Godagari soil.

Type	**CBR for 2.5 mm (%)**		**CBR for 5 mm (%)**	
Condition	Unsoaked	Soaked	Unsoaked	Soaked
C100 A0	9.37	7.31	9.34	7.16
C70 A30	10.13	8.78	10.07	8.69
C50 A50	12.78	11.48	12.69	11.41
C30 A70	15.01	13.85	14.98	13.81

G. Bearing capacity

From Fig. 9 and Fig. 10, it is observed that the bearing capacity of subgrade soil increases with the increase of the percentage of RA, and maximum bearing capacity is obtained under unsoaked conditions.

Table 5: Bearing capacity for Godagari soil.

Conditions	**Unsoaked (kN/m^2)**	**Soaked (kN/m^2)**
C100 A0	653.8	501.2
C70 A30	704.9	608.3
C50 A50	888.3	798.7
C30 A70	1048.6	966.7

The thickness of flexible pavements of different percentages of CBR values decreases with the increase of the different percentages of RA. The cost of pavement is reducing to add this waste material.

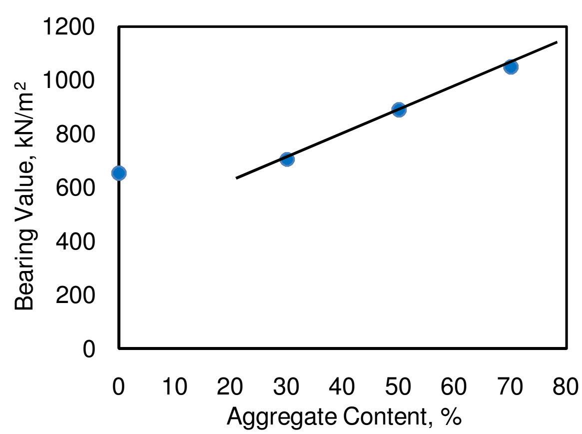

Fig. 9. Bearing capacity graph for Godagari soil under the unsoaked condition.

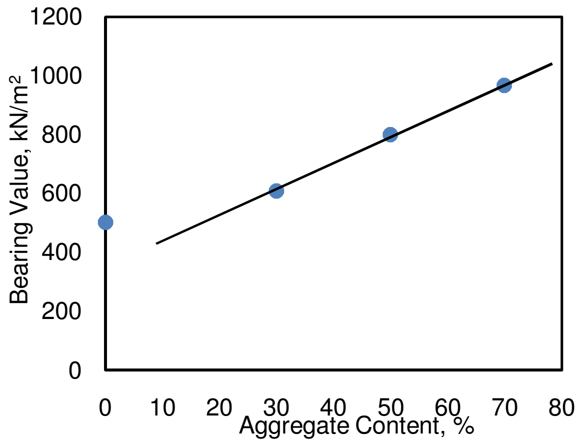

Fig. 10. Bearing capacity graph for Godagari soil under the soaked condition.

IV. CONCLUSION

This paper covers a relative study between untreated soil tests and tests treated with various levels of reused solid aggregates to research their impacts on the properties of chose soil utilizing CBR tests. The CBR estimations of the combinations expand with increasing the reused concrete aggregates in the mixture. Utilizing concrete aggregates waste in soil stabilization assists with diminishing the dangerous natural effects of the waste and improves the designing properties of soil which eventually decreases the expense of development and builds the life of the structure based on stabilized soil. Increment of CBR value implies increment in bearing limit which empowers plan of roadways layers with lower thicknesses without antagonistic impacts on the underlying capacity of the pavement design; this prompts a considerable decrease in expense.

From this research study the obtained conclusions are given below:

1. The expansion of reused aggregates to the Godagari soil prompts the decrease of OMC and expanded of MDD.
2. The ideal measure of aggregate was discovered to be 70%.
3. RA is a waste material that could be utilized in a subgrade for flexible and rigid pavements.
4. The OMC of soil-recycled aggregate mix increases with increasing the percentage of RA.
5. The OMC was decreased from 10.3 % to 11.9% and MDD increased from 18.53 kN/$m^2$to 19.31kN/m^2 with 70% addition of aggregates.
6. The CBR value of the Godagari soil under unsoaked condition was raised from 9.34% to 14.98% and at saturated condition was raised from 7.16% and 13.81%.
7. The CBR estimations of the mixtures increments with expanding the reused concrete content in the combination.
8. Using C&D squander in soil adjustment assists with decreasing the dangerous natural effects of the waste and improves the designing properties of soil which at last lessens the expense of development and builds the existence of the construction based on settled soil.

V. FUTURE SCOPE

The outcome of this project will help to increase the strength of the weak soil by using RA. The proposed approach not only protects the environment but also makes the efficient and effective reuse of those RA that significantly increase the sustainability of the construction projects.

Conflict of Interest: The authors of this paper have no conflict of interest regarding the publication of the paper.

REFERENCES

[1]. Busari, A., Adeyanju, E., Loto, T., &Ademola, D. (2019, December). Recycled aggregate in pavement construction: review of literatures. In *Journal of Physics: Conference Series* (Vol. 1378, No. 2, p. 022026). IOP Publishing.

[2]. Adebanji, O., Ayobami, B., and Emmanuel, A. (2018) Pavement interlayer material improvement using industrial waste: Review of literatures *Int. J. Civ. Eng. Technol. 9*(6), 1114–1122.

[3]. Adeyanju, E. A. and Okeke, C. A. (2019). Clay soil stabilization using cement kiln dust, 1st International Conference on Sustainable Infrastructural Development, 1–10.

[4]. da ConceiçãoLeite, F., dos Santos Motta, R., Vasconcelos, K. L., & Bernucci, L. (2011). Laboratory evaluation of recycled construction and demolition waste for pavements. *Construction and building materials*, *25*(6), 2972-2979.

[5]. Kou, S. C., & Poon, C. S. (2009). Properties of self-compacting concrete prepared with recycled glass aggregate. *Cement and Concrete Composites*, *31*(2), 107-113.

[6]. Nagasaki, S., & Nakayama, S. (Eds.). (2015). *Radioactive waste engineering and management*. Tokyo: Springer Japan.

[7]. Ferber, V., Auriol, J. C., Cui, Y. J., & Magnan, J. P. (2009). On the swelling potential of compacted high plasticity clays. *Engineering Geology*, *104*(3-4), 200-210.

[8]. Barbudo, A., Agrela, F., Ayuso, J., Jiménez, J. R., & Poon, C. S. (2012). Statistical analysis of recycled aggregates derived from different sources for sub-base applications. *Construction and Building Materials*, *28*(1), 129-138.

[9]. Fauzi, A., Nazmi, W. M., & Jauhari, Z. (2013). Experimental study on subgrade stabilization of kuantan clay soil using HDPE mixed with lime. In *Proceeding of the 14th REEEA Conference, Kuala Lumpur, Malaysia*.

[10]. Fauzi, A., Fauzi, U. J., & Nazmi, W. M. (2013). Engineering quality improvement of kuantan clay subgrade using recycling and reused materials as stabilizer. *Procedia Engineering*, *54*, 675-689.

[11]. Fauzi, A., Rahman, W. M. N. W. A., & Jauhari, Z. (2013). Utilization waste material as stabilizer on kuantan clayey soil stabilization. *Procedia engineering*, *53*, 42-47.

[12]. Fauzi, A., Nazmi, W. M., & Fauzi, U. J. (2011). Subgrade Stabilization Assessment Of Kuantan Clay Using Lime, Portland Cement, Fly Ash, And Bottom

Ash. In *Geotechnical Engineering For Disaster Mitigation and Rehabilitation and Highway Engineering 2011: Geotechnical and Highway Engineering—Practical Applications, Challenges and Opportunities (With CD-ROM)* (pp. 500-506).
[13]. Fauzi, A., & Djauhari, Z. (2013). Comparison of the engineering properties and CBR of Kuantan and south sumatera stabilized clayey by using carper fiber mixed with lime. In *Proceeding of the 6th Civil Engineering Conference in Asia Region: Embracing the Future through Sustainability, Jakarta, Indonesia*.
[14]. Chang, F. Y., & Wey, M. Y. (2006). Comparison of the characteristics of bottom and fly ashes generated from various incineration processes. *Journal of hazardous materials*, *138*(3), 594-603.
[15]. Batayneh, M., Marie, I., & Asi, I. (2007). Use of selected waste materials in concrete mixes. *Waste management*, *27*(12), 1870-1876.
[16]. Lai, J., Liu, H., Qiu, J., & Chen, J. (2016). Settlement analysis of saturated tailings dam treated by CFG pile composite foundation. *Advances in Materials Science and Engineering*, *2016*.
[17]. Lai, J., Mao, S., Qiu, J., Fan, H., Zhang, Q., Hu, Z., & Chen, J. (2016). Investigation progresses and applications of fractional derivative model in geotechnical engineering. *Mathematical Problems in Engineering*, *2016*.
[18]. Bowles, J. E. (1992). *Engineering properties of soils and their measurement*. McGraw-Hill, Inc.
[19]. Kerni, V., Sonthwal, V. K., & Jan, U. (2015). Review on stabilization of clayey soil using fines obtained from demolished concrete structures. *International Journal of Innovative Research in Science, Engineering and Technology*, *4*(5), 296-299.
[20]. Poon, C. S., Qiao, X. C., & Chan, D. (2006). The cause and influence of self-cementing properties of fine recycled concrete aggregates on the properties of unbound sub-base. *Waste management*, *26*(10), 1166-1172.
[21]. Edil, T. B., Acosta, H. A., & Benson, C. H. (2006). Stabilizing soft fine-grained soils with fly ash. *Journal of Materials in Civil Engineering*, *18*(2), 283-294.
[22]. Arora, S., & Aydilek, A. H. (2005). Class F fly-ash-amended soils as highway base materials. *Journal of Materials in Civil Engineering*, *17*(6), 640-649.

How to cite this article: Datta,S. and Mofiz, S.A. (2021). Stabilization of Road Subgrade Soil using Recycled Aggregates. *International Journal of Emerging Technologies*, **12**(1): 87–93.