International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 05 | May 2022 www.irjet.net p-ISSN: 2395-0072

Utilization of Red Soil and Lime Powder by partially replacing Fine Aggregate in Conventional Concrete.

Ameer Mohammed Khan[1], Abdullah Mohammed Mahboob Ibrahim[2], Md Abed Ali[3]

[1,2,3]*Student, Department of Civil Engineering, ISL Engineering College, Telangana, India.*

Abstract - *Exploratory research is carried out to study the performance of concrete by substituting the aggregate with locally obtainable red soil. It includes a particular testing to identify the quality enhancement of cementitious materials when red dirt is put to it.*

The substantial sand replacement by red soil has been done according to the precise mix percentage to get high strength in concrete. In earlier research of the journal key concern arising that growth of red soil is to lowered the durability of concrete and it absorb greater quantity of water. So, in this project, lime powder is also used in the concrete to prevent the water absorption and permeability. Under this project, it is preferable to analysis the durability of M20 Concrete and the quantity of red soil is to be put in following proportion such as 15 percent, 30 percent & 45 percent. Material properties such like compressive strength, split tensile strength, compressive and flexural testing was carried out for red soil blended concrete and standard concrete to distinguish the strength and impermeability in it. The tests are performed after 7 days, 14 days & 28 days of curing.

1. INTRODUCTION

Nowadays there is a shortage of soil its very difficult to buy sand in inexpensive method. Overcoming of this challenge is extremely crucial to investigate the alternative materials. In order to meet the need of the fine aggregates, some alternate substance must be identified. Hence, this project it is intended to undertake exploratory activity by preparing concrete blocks having replacement material of fine aggregate by accessible natural red dirt. Sand is a major material used mostly for fabrication of cement mortars and plays a most essential function in concrete mixture. In general, consumption of natural sand is high, owing to the significant usage of concrete and mortar. Hence the need of natural sand is very strong in emerging nations to support the rapid infrastructure expansion. So, we utilized red dirt in this project.

Red soil availability is in every sort of regions and it has unlimited supplies throughout all locations which may be effectively used for mixing of cement in building construction.

Red soil is generated owing to erosion of igneous and metamorphic rocks. It is very impermeable once it is mixed with cement and for its size and its coloration is in red due to the existence of iron in it.

LIITERATURE REVIEW

Mihai Iliescu and Ioan Ratiu: developed a novel design methodology for stabilizing roadway sub-grade utilizing geo-grid reinforcement. In their investigation, they discovered that geogrids may boost the effectiveness of the sub-grade soil. Researchers conducted thorough static and dynamic plate bearing testes under diverse conditions depending on the outcome of trail and the member hypothesis, they created design graphics for multipurpose geo-grid in muddy and impermanent road.

Rakesh Kumar and P. K. Jain: in their research of ground enhancement methodologies demonstrated that the creation of granular piles in expanding soil enhances the ultimate load capability of the soil. They subsequently made an effort to research the enhancement of load carriage of granular pile either with or without geo-grid coring via laboratory simulated tests and determined that the load bearing capability of granular pile rises by enclosing the pile with geo-grid.

Pradeep Singh and K.S. Gill: conducted done scientific investigation to find the ideal site of delivering geo-grid reinforcing in sub-grade soil by performing CBR test and unconfined compressive test. He discovered that by supplying geo-grid strengthening from top offer substantial enhancement in CBR values and tension strain behavior of sub-grade soil.

Karthik G et.al (2020): Conducted research on Modification of Structural Parameters of Red soil by the application of Wood Ash and GGBS. They found that MDD increases while OMC decreases by Wood Ash content at 20 percent and GGBS content at 10 percent.

Dhamotharan R et.al (2018): They had done an experiment on study of Black Cotton Soil Bricks using Fly Ash & Crushers Waste. They determined that there will be rise in Compressive Strength and reduction in Water Absorptivity after introducing Fly Ash and Crusher Waste at varied percentages.

M. Sai Nandan et.al (2020): They have performed an investigation on Normalization of Red Soil By utilizing Coconut Coir Fiber and Rice Husk Ash. They adopted Coconut Coir Fiber and Rice Husk Ash as an addition and they reached the Optimum values by combining 15 percent of Rice Husk Ash and Coconut Coir Fiber.

MATERIALS USED

Lime powder:

A finer lime powder is to be utilized in cement to give a good effect. Therefore, Hydraulic lime is excellent and ideal for concrete.

Objectives of Using Lime Powder:

- To boost the durability of the red soil mixed concrete in comparison to plain concrete mix.
- To minimize the consumption of foundry sand
- To minimize the permeability and moisture penetration of red soil mixed concrete.
- To produce durable concrete mix Inexpensively.

CEMENT

The cement is a connecting substance. It complying to IS456-2000-53 grade. It comprised of milling the raw materials, blending them intently in certain proportion depending on such homogeneity and proportions burning them in a furnace at a temp of around 1350 – 1450 degree centigrade where at temperature, the content cinder and partially binds to construct stackable chapped clinker. The clinker is allowed to cool and crushed to a fine powder and additions of 2 to 3 percent of gypsum is done. Product created by utilizing this technique is Portland cement. Of all the components that impact the behavior of concrete, cement is by far the most essential ingredient, since it is used to bond sand and aggregate so it withstands atmospheric action.

Properties of Cement

S.no	Properties	Values
1	Specific Gravity	3.13
2	Fineness	3.66%
3	Initial Setting Time	28 min
4	Final Setting Time	596 min

Fine Aggregate

The particles less than 4.75 mm size is considered as fine aggregates. River sand is mainly utilized as fine aggregate. In this exploratory research substitution of river sand was used as fine material.

Properties of Fine Aggregate

S.no	Properties	Values
1	Specific Gravity	3.12
2	Void Ratio	0.420
3	Porosity	28.66 %
4	Fineness Modulus	3.08
5	Zone	III

Coarse Aggregate

Naturally obtainable properly graded granite aggregates of normal size larger than 4.75 mm but less than 16mm having fineness value of 2.71 was utilized as coarse aggregates.

Properties of Coarse Aggregate

S.no	Properties	Value
1	Specific Gravity	3.55
2	Fineness Modulus	5.89
3	Water Absorption	0.93 %
4	Impact Strength	15.95 %

Red Soil

Red dust is rich with iron oxide, but low in nitrogen and lime. Its hue is largely due to iron oxides forming a thin film on the sand grains when the oxide exists as hematite the hue is red and when it appears in the hydrated phase as limonite the soil gains are yellow in color. Typically, the topsoil is red while the horizon underneath develops yellowish tone.

Properties of Red Soil

S.no	Properties	Value
1	Specific Gravity	2.69
2	Porosity	1.29
3	Void Ratio	62.33 %
4	Liquid Limit	73 %
5	Plastic Limit	41 %
6	Plasticity Index	32

MIX DESIGN

Fabrication of excellent concrete demands painstaking care exercised at every step of making of concrete. If meticulous attention is not applied, and proper guidelines are not observed, the final concrete is likely to be bad concrete. Thus, it is vital for anyone to understand what are the excellent regulations to be observed in each step of manufacturing of concrete for generating high standard concrete.

1. *Batching*
2. *Blending*
3. *Positioning*
4. *Tamping*
5. *Curing*

Batching

Batching is the right procedure of metering the materials. For critical concrete, always, weigh batching method should be utilized. Use of weighing method in batching, enhances the accuracy, adjustability and convenience. Varieties of weigh batchers are accessible, the precise type to be selected, relies upon the kind of task. When weigh batching is implemented, the assessment of water must be done precisely utilizing measure jars.

Blending

Hand blending is done for relatively small concrete jobs. Manual blending must be done on an impermeable concrete or brick surface of sufficiently big size to accommodate one bag of cement. Spreading out the determined amount of coarse aggregate and fine aggregate in alternating layers. Pour the cement over the top of that though, and blend them thoroughly by shovel, turning the combination over and over until the homogeneity of hue is achieved.

This homogenous combination is laid out in a thickness of around 20 cm. This procedure is performed until such a good time a nice regular, homogeneous concrete is created. It is a special necessity to verify that perhaps the water is not poured but it is merely sprayed. Water in a modest amount should be added towards the finish of the combining to acquire the just required consistency. At that moment, even a tiny amount of water makes difference. Afterwards the red soil is inserted in concrete at the varied proportion of concrete and lime powder is also added to the mix at half of the amount of red soil.

Positioning

It may not be sufficient that perhaps a concrete mix which is correctly designed, batched, blended is of highest significance. The concrete should be laid in organized way to produce optimal outcomes. The measures should be taken and ways adopted when laying concrete in the castings.

Tamping

Manual pounding of concrete is employed in event of minor concrete works. Generally, this approach is also employed in such circumstances, when a big amount of reinforcing is employed, which cannot be usually compressed using conventional tools. Manual compaction comprises of rodding, pounding or hammering. When manual compaction is utilized, the homogeneity of concrete is preserved at a high degree. Tamping has been one of the common strategies utilized in compacting roof or subfloor or roadway pavements when the thickness of concrete is considerably less but the ground to be completed is smooth and flat.

Curing

Concrete gains its capacity through the hydration of cement molecules. The cement hydration is just not an instantaneous activity but a cycle lasting for lengthy time. Curing may alternatively be characterized as maintaining the cement wet and warm enough because the cement hydration can persist. More precisely, it may be stated as the technique of preserving a suitable amount of moisture and an optimum warmth in concrete at the time of placement and shortly upon installation, whereby the hydration of plaster may persist until the required qualities are evolved to a considerable degree to fulfil the criteria of utility. The molded squares and cylinders are submerged in water barrels for seven days, 14 days and 28 days.

EXPERIMENTAL INVESTIGATIONS

Compressive Strength Test:

The typical cast of size 150mm × 150mm x 150mm is adopted for molding. Curing is carried for 7, 14 and 28days for concrete cube specimens and the strength test is performed in CTM (Compression testing machine) according to IS 516:1959 for conventional mix and for the substantial substituted samples.

Split tensile strength test:

The typical casting of dimensions 150mm × 300mm is utilized for auditioning. Curing is performed for 7, 14 and 28 days. Split tensile test was performed in testing

machine (CTM) as per IS 5816:1999 for regular mixture and for the partially supplemented samples.

Flexural strength test:

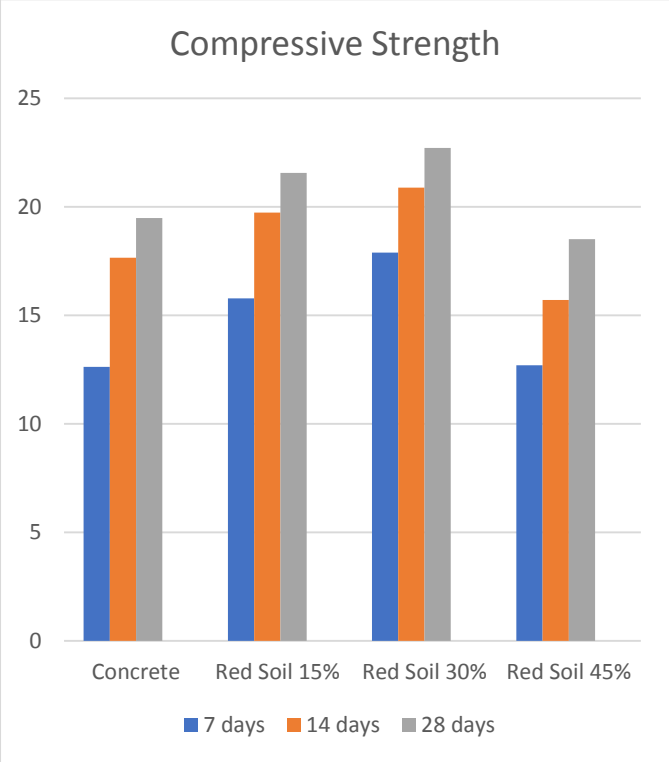
The basic mold of dimensions 500mm × 100mm × 100mm is being used for molding. Curing is conducted for7, 14 and 28 days. flexural strength test is conducted as per IS 516:1959 in universal testing machine (UTM) for usual mix and for the half-substituted samples.

EXPERIMENTAL RESULTS

The outcomes completed in the present study are reported in the style of Graphs and Charts for varied percentage of Red Soil as a replacement to Fine aggregate. The preceding is the percentage replacement of concrete i.e., 15 percent, 30 percent and 45 percent.

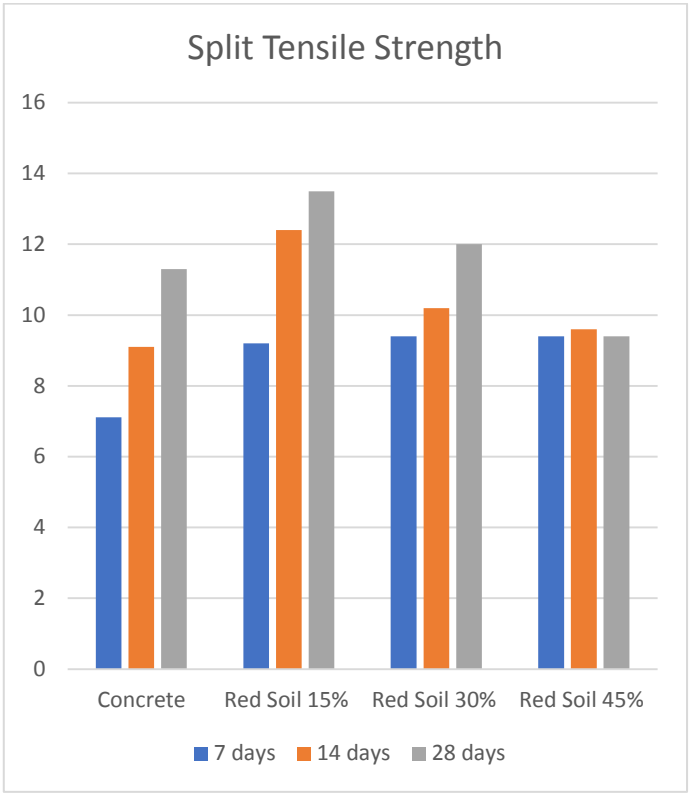
Compressive Strength Test:

Curing (days)	Concrete (n/mm²)	Red Soil 15% (n/mm²)	Red Soil 30% (n/mm²)	Red Soil 45% (n/mm²)
7	12.63	15.78	17.89	12.69
14	17.66	19.74	20.88	15.71
28	19.48	21.56	22.71	18.51



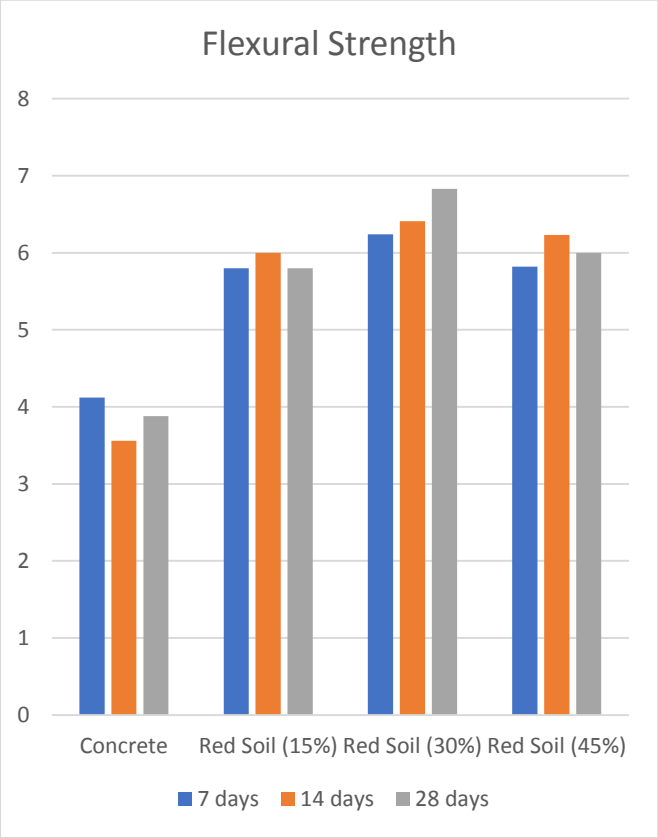
Spit Tensile Strength Test:

Curing (days)	Concrete (n/mm²)	Red Soil 15% (n/mm²)	Red Soil 30% (n/mm²)	Red Soil 45% (n/mm²)
7	7.11	9.2	9.4	9.4
14	9.1	12.4	10.2	9.6
28	11.3	13.5	9.6	9.2



Flexural Strength Test

Curing (days)	Concrete	Red Soil (15%)	Red Soil (30%)	Red Soil (45%)
7	4.12	5.8	6.24	5.82
14	3.56	6.0	6.41	6.23
28	3.88	5.8	6.83	6.0



CONCLUSIONS

- The accompanying study results of several tests explains that the red soil blended cement is comparatively better than normal concrete in toughness and impermeability.
- In flexural strength, for ordinary concrete the value ranges between 3.8 – 4.1 N/mm^2 but in red dirt blended cement it has an excellent considerable development in strength. The properties of red soil combined concretes flexural strength ranges between 5.8 - 6.41 N/mm^2.
- In split tensile strength, for ordinary concrete the real value between 7.11 – 11.3 N/mm^2 but in red dirt mixed concrete it has an excellent considerable development in strength. The values of red dirt mixed concretes in split tensile strength ranges between 9.2 – 13.5 N/mm^2.
- In compressive strength, for basic concrete the readings are 12.6 – 19.48 N/mm^2 but in red soil mixture concrete it has dramatic improvement, the values are 15.78 – 22.71 N/mm^2.

REFERENCES

1) A.K.Choudhary, K.S.Gill and J.N.jha (2011)"improvement in CBR values of expensive soil sub-grades using geosynthetics"IGCJ-233.

2) Akinmusuru and Akinbolade (1981) "Stability of loaded footing on reinforced soil", journal of Geotechnical engineering, 107(GT6),PP.819-827.

3) Dr.P.Senthil kumar & R. Rajkumar (2012)"Effect of Geotextile on CBR Strength of Unpaved Road with Soft Subgrade"EJGEVol.17.

4) Dash, S K et.al,(2007) "Behavior of geocell-reinforced sand beds under strip loading ", 916, 905-916. Doi: 10.1139/T07-035.

5) Evangelin RamaniSujatha and VigneshJayaraman (2012) "Improving the strength of sub-grade using geo grids".

6) Rakesh Kumar and P.K.Jain (20130"Expansive soft soil improvement by geo grid encased granular pile ". IJET

7) Mihai Iliescu and IoanRatiu (2012) "Geo-grid reinforced road sub-grade stabilization design methodology".

8) Pradeep Singh, K.S.Gill (2012) "CBR Improvement of clayey soil with geo-grid Reinforcement " IJETAE Vol.2 (315-318).

9) Karthik G et.al (2020), "Modification of Geotechnical Properties of Red Soil by the application of Wood Ash and GGBS". Int. Research Journal of Engineering and Technology, Vol.07, Issue 07, (July 2020).

10) Dhamotharan R et.al (2018), "Comparative Study on Black Cotton Soil using Fly Ash and Crusher Waste". Int. Research Journal of Engineering and Technology, Vol. 05, Issue 03(Mar 2018).

11) M. Sai Nandan et.al (2020), "Stabilisation of Red Soil By using Coconut Coir Fibre and Rice Husk Ash". Int. Journal of Innovative Technology and Exploring Engineering, Vol. 09, Issue 03(Jan 2020).

12) F.G. Bell, "Lime Stabilization of clay minerals and soils", Engineering Geology, Vol.42, no.4, pp.223237, 1996.

13) Arora K.R. (2004). Soil Mechanics and Foundation Engineering, Standard Publishers Distributors.

14) Ashish Kumar Pathak et.al (2014), "Soil Stabilization using ground granulated blast furnace slag". Int. Journal of Engineering Research and Applications, Vol. 04, Issue 05(May 2014).

15) Experimental study on Stabilization of clay soil using coir fibre" by T. Subramani, D. Udayakumar, International Journal of Application of Innovation in Engineering and management, Vol. 05, Issue 05(May 2016).

16) Ch. Ravi Tej et.al (2017), "An Experimental Study on Stabilization of Red soil by GGBS and Jute Fibre". IJSRT, Vol. 03, Issue 07(2017).

17) Effect of Jute Fibre on Engineering properties of Lime Treated Black Cotton Soil" by Harshitha Bairagi, R.K. Yadav, R. Jain. IRJET, Vol. 03, Issue 02(Feb 2014).