An Experimental Study on Concrete Using Laterite Soil As Partial Replacement To Cement And Sand

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Abstract- *One way to reduce consumption of sand is to optimize the use of existing building material and infrastructure. Recycled building and quarry material can be a substitute for sand. Despite the every high value of minerals found in the sand, it is mostly used for concrete or is buried under highways. Concrete rubble should be recycled to avoid using aggregates, at least for low- quality uses. Recycling glass bottles would also reduce sand consumption.*

Substitutes for cement and sand will be a solution for the cost effective and environment friendly construction. As per the investigation carried out, Laterite soil can be used to replace sand and fines of the laterite soil which is passing 75 micron sieve can be used as replacement for cement. The replacement of sand and cement by laterite soil up to 20% exhibits higher compressive strength than regular concrete. Training of architects and engineers, new laws and regulations, positive incentives are needed to initiate a shift for lowering our dependency on cement and sand. Renewable and recycled materials need to be targeted for building houses and roads

Keywords- Laterite soil, cement, sand

I. INTRODUCTION

Concrete is one of the most commonly used construction material in developing countries like India. Concrete is a composite material consisting of cement, aggregate and water which are added in different proportions. The aggregates generally used are coarse gravel such as limestone or granite along with fine aggregate such as sand. Portland cement is commonly used as binder material and various chemical admixtures such as fly ash, silica fumes and ground granulated blast furnace slag can also be added to produce concrete with improved strength and durability.

The Ordinary Portland Cement (OPC) is one of the main ingredients used for the production of concrete and it has no alternative in civil construction industry. Unfortunately, the production of cement involves emission of large amounts of carbon-dioxide gas into the atmosphere, a major contributor for green house effect and the global warming, hence it is necessary to either search for another material or partly replace it by some other material.

The worldwide consumption of natural sand is very high, due to the extensive use of concrete. In general, the demand of natural sand is quite high in developing countries to satisfy the rapid infrastructural growth. Unfortunately, sand are not readily available in many parts of the country, and regarded as scarce material for concrete-making in those communities. Persons making concrete in such localities usually import sand from relatively distant places at higher costs, and this increases the overall cost of making concrete and of providing housing for the people. Thus, there is an increasing need to source alternative locally-available materials that could serve as suitable replacement to sand as fine aggregate in concrete.

High cost, scarcity and adverse effect on environment due to the use of conventional materials like cement and sand in the manufacturing of concrete has been a major challenge for construction industry in the developing country like India. Thus, there is an increasing need to find alternative locally-available materials that could serve as suitable replacement to cement and sand in concrete. As per the investigations carried out, Laterite soil can be used as a replacement to conventional material in general concrete structures. Laterite has been used in building construction for thousands of years and approximately 30% of the world's present population still lives in laterite. In Kerala –more than 60% of the state is covered by laterite blanket over various crystalline rocks.

II. ENVIRONMENTAL IMPACT DUE TO EXCESS USAGE OF SAND AND CEMENT PRODUCTION:

Sand and cement are crucial resources to economic development activities**.** Mining and dredging activities are often caused due to excessive usage of sand.For each tones of cement, the building industry needs about six to seven times more tones of sand and gravel .Thus the world's use of

aggregates for concrete can be estimated at 25.9 billion to 29.6 billion tons a year. Taking all these estimates into account, a conservative estimate for the world consumption of aggregate exceeds 40 billion tons a year.

Impacts of sand mining and gravel extraction are alteration of channel slope. Water quality impacts are caused by sand mining and dredging activities. Ecological impacts as a result of mining leading to loss of habitats, species disturbance and clearance of vegetation.so by carrying a replacement of these conventional material with laterite soil can reduce environmental impact assessment.

III. OBJECTIVES

The main aim of the project is to develop M25 grade concrete by partial replacement of cement and sand with laterite soil. The main objectives are as follows.

- To development concrete mix by using laterite fines and powder.
- To increasing the strength of concrete by using laterite soil.
- Studying fresh and hardened properties of concrete with laterite soil.
- To prove that, laterite fines and powder can economically replace cement and sand in concrete mix.

IV. METHODOLOGY

Strength is the very important property of the concrete because; the first consideration in structural design is that the structural member should be able of carrying the imposed loads. The mix of concrete used in this study is M25. Mix design is done as per Indian Standards specification IS 10262-2009.

The percentage of replacement are done in three steps initially cement is replaced with laterite dust in the levels of 5%,10%,15%,20%.In the next step sand is replaced with laterite soil in the levels of 5%,10%,15%,20%.In the final step cement and sand replacement is done with laterite dust and laterite soil respectively with percentage of replacement as 2.5%+2.5% ,5%+5%,7.5%+7.5%,10%+10%.Teste were carried out for compressive strength of concrete for all substitution levels at a curing period of 7 days,28 days.

PREPARATION OF RESOURCES

The cement sample, on coming to the lab, would be methodically dry, any by hand over or in a appropriate blender in such a way so as to make sure the maximum probable combination and consistency in the substance, concern is taken to keep away from the interruption of unfamiliar matter. The cement would then be store in an arid space. Trial of aggregates on behalf of each group of concrete would be of the required grade and would be in air-dried circumstance.

PROPORTIONING

All the materials were maintained as per the IS prescription. The proportioning of materials in concrete blend which is used for formative the appropriateness of the resources available would be alike in every respect to those which are engaged in the exertion. Where in the quality of the materials of the concrete which are used on the location will have to be exacting by amount, they would be designed from the quantity by weight which are used in the testing cubes and also the unit weight of the materials. The laterite soil was collected from Kedenje Nitte.

BATCHING

The quantity of aggregate, cement, water and laterite soil for every batch would be taken by mass (weight batching).

MIXING OF CONCRETE

The concrete mix was prepared in a lab batch blender, in a manner so as to avoid the loss of water or any other ingredients. Each batch of concrete would be of such a mass so as to run off about 10% more moulding than the required figure of experimental specimen.

COMPACTION OF CONCRETE

The test specimen would be casted as quickly as subsequent to mixing, and in such a manner so as to make filled compaction of concrete by either segregation or excessive laitance. The concrete would be alive packed onto the cast in layer roughly 5cm deep. In insertion every scoopful of concrete, the shovel would be enthused about the apex rim of the mould so as the concrete glide as of it, in command to make sure a regular sharing of the concrete inside the mould. Each level would be packed together also by hand over or through vibration. Following the peak layer will be packed in; the exterior of the concrete would be leveled with apex of the mould, by means of a trowel.

Meanwhile the fresh property of concrete is studied.

CURING OF THE SPECIMENS

The casted concrete cubes and cylinders were soaked in a curing tank for 7,28 days .Room temperature was maintained throughout the curing process.

TESTS FOR CONCRETE SPECIMEN

After the specimens were taken out from curing tank. Exterior water and gravel were wiped off. Test specimens were dried and kept aside for 24 hours prior to the commencement of test. After which the test like compression test was carried out with great precision.

V. EXPERIMENTAL DATA

5.1 MATERIALS

The strength of the concrete is based on the properties of its materials used. The basic ingredients used in current work are,

- Cement
- Fine aggregate
- Coarse aggregate
- Water
- Laterite soil
- Laterite dust

LATERITE SOIL

The soil name "laterite" was given by Buchanan(1807) in India, from a Latin word "later" meaning brick. Laterite is used extensively in the construction of embankment for roads and earth dams. Lateritic soils are widely used as construction material in under-developed and developing countries of the world. However they argue that laterites have not been extensively used in construction medium to large-size building structures, probably because of lack of adequate data needed in the analysis and design of structure built of lateritic soils.

Figure 5: Laterite soil

5.3 Mix Proportion

The work undertaken here deals with the fresh and hardened property of desired concrete mix with laterite as a partial replacement to cement and sand in the range from 5% to 20% is studied. Based on the literature review M25 grade concrete is selected. Then the amount of all the ingredients like cement, sand, coarse aggregate water content is calculated as per IS 10262.

VI. RESULTS AND DISCUSSION

In the present study the laterite soil is used in the development of M25 grade concrete where cement and sand has been replaced by laterite fines and laterite powder in the level of 0%,5%,10%,15% and 20%. The fresh and hardened properties of developed concrete mix has been studied and discussed below.

FRESH PROPERTY

6.2.1 SLUMP CONE TEST

Table 6.1: Slump check for concrete with partial replacement of cement by laterite dust

SL NO	Type of concrete	Slump
1	0% LD	95
2	5%LD	78
3	10%LD	76
4	15%LD	68
5	20%LD	65

Table 6.2: Slump check for concrete with partial replacement of sand By laterite soil

SL NO	Type of concrete	Slump
1	0% LS	95
2	5%LS	82
3	10%LS	79
4	15%LS	73
5	20%LS	69

Table 6.3: Slump check for concrete with partial replacement of cement and sand By laterite soil

SL NO	Type of concrete	Slump
1	0% LD+0%LS	95
2	2.5%LD+2.5%LS	76
3	5%LD+5%LS	73
4	7.5%LD+7.5%LS	71
5	10%LD+10%LS	67

6.3 HARDENED PROPERTY

COMPRESSIVE STRENGTH TEST

Table 6.4: Compressive strength of cubes with partial replacement of cement by laterite dust at 7, 28 days

SL NO	% of replacement	Average ultimate Compressive Strength at 7 days MPa	Average Ultimate Compressive Strength at 28 days MPa
1	0%	17.7	24
2	5%	32.44	44.44
3	10%	29.77	42.66
4	15%	23.55	42.2
5	20%	21.33	34.12

DENSITY OF CONCRETE CUBE

Table.6.13: Density of cubes with replacement of cement and sand by laterite dust and laterite soil

SL. No	% of replacement	Weight of concrete cube in kg	Density of concrete cube in kg/m^3
1	0%	7.93	2350
2	2.5%LD+2.5%LS	8.02	2376
3	5.0%LD+5.0%LS	7.89	2338
4	7.5%LD+7.5%LS	7.84	2323
5	10%LD+10%LS	7.86	2328

VII. CONCLUSIONS

Compressive strength of the concrete decreased with increase in percentage replacement of cement by laterite dust. Regarding the experiment work conducted the subsequent remarks concerning the performance and characteristic of concrete on fractional substitute of cement and sand by laterite soil are

- Laterite soil can be effectively used as an alternative for cement and sand in developing M-25 grade concrete.
- Compressive strength of concrete increases with the usage of laterite soil as a replacement to cement and sand.
- It is cost effective and environmental friendly compared to conventional concrete.
- The compressive strength of concrete at later ages is more compared to early age because of triggered Pozzolanic reaction at later age.
- The experimental work revealed that 5% replacement is optimum for M-25 grade concrete.
- The ever increasing demand and cost of sand, along with scarcity can be diminished up to certain extent.

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