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A Study on Performance of River Crushed Rocks as Coarse Aggregate in Concrete

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Abstract: ***River stone has high potential as a natural aggregate, yet it is rarely used as a concrete material. This study investigates using river crushed rock as a coarse aggregate to replace natural quarry crushed stone. Concrete mixes with 0%, 25%, 50%, 75% and 100% river crushed rocks replacement were tested .Mix proportion is done as per IS 10262 (2009). Fresh and hardened properties of each mix were evaluated. Result showed an increase in both slump value and strength properties with higher river crushed rock content. River crushed rock is therefore a viable alternative for coarse aggregate in concrete.***
Keywords: Aggregates, River stones, Fresh properties, Hardened properties.

I. INTRODUCTION

Coarse aggregates refer to irregular and granular materials such as sand, gravel, or crushed stone, and are used for making concrete. In most cases, Coarse is naturally occurring and can be obtained by blasting quarries or crushing them by hand or crushers. Their angularity and strength affect the concrete in numerous ways. Needless to say, the selection of these aggregates is a very important process. Materials that are large enough to be retained on the 4.7mm sieve size usually constitute coarse aggregates and can reach a maximum size of 63mm.The size of coarse aggregates affects several aspects of the concrete, mainly strength and workability, and the amount of water needed for the concrete mix. It also helps determine how much fine aggregate is needed to produce a concrete batch. The bigger the size, the smaller is its bondable surface area for cement, sand and water the less water and fine aggregate is needed with concrete mixes. The size of the coarse aggregate determines the cement to water ratio less water means a stronger mix, but it also becomes less workable. One important factor is the space between TMT Bars. The aggregate needs to be smaller than the space between internal reinforcements. This will allow the aggregate to pass between the rebar and settle evenly throughout the structure.

II. LITERATURE REVIEW

The aggregate element in concrete comprises some 60–75% of the total volume. Aggregate inclusion in concrete reduces its drying shrinkage and improves many other properties. Aggregate is also the least expensive per weight unit, put it makes the most amount of the weight. The global consumption of aggregate will be in the range of 8–12 billion tones after 2023. In India, almost all the Civil Engineering constructions are carried out using quarry crushed stone aggregate as it was available in plenty. Due to heavy increase in the construction activities, the quarry crushed stone which are the conventional coarse aggregate is under depletion and also, now–a-days an acute shortage of these materials is experienced. Case Study of Hilly areas concluded that, mining practices have already caused serious social and environmental impacts in some mining areas. These problems include land degradation, harm to livestock. Deposition of stone dust on soil and crops due to wind and runoff leads to degradation of soil quality and crop production. Investigation envisages the potential utilization of river crushed rocks as a coarse aggregate in replacement of quarry crushed stone aggregate in concrete, which are locally available. Crushed river rocks is made by crushing natural stone from riverbeds. They are then screened to remove debris such as dirt and dust, leaving behind desirable sizes and colours. The crushing process can be done manually or mechanically. One of the most significant advantages of using crushed river rocks in landscaping is its natural beauty. The materials come in various colors and sizes, giving designers ample choices for creating bespoke landscapes.

III. MATERIALS AND METHODOLOGY

A. Materials Used

1) Cement: OPC 43 Grades.
2) Fine Aggregate : Natural river sand, Zone II, IS 10262 : 2019
3) Coarse Aggregate: River crushed rocks.
4) Test: 20, 10 mm River crushed rocks.
5) Water : Potable Water, PH 6.5 – 8.5

Tests on Aggregate (IS 2386 Part 4 1986)

Property	Natural quarry crushed stone aggregate.	River Crushed Rock	IS 383 Limit
Specific Gravity	2.68	2.615	2.6-2.9
Water Absorption	0.8 %	1.115%	Max. 2%
Crushing Value	18.2 %	19.66%	Max. 30 %
Impact Value	14.6%	16.625%	Max. 30 %
Flakiness Index	12%	13.8%	Max. 35%
Elongation Index	31 %	32.1%	Max. 40 %

Sieve analysis 10mm nominal size

Test Parameters	Test Method	IS Sieve size	Result passing	IS 383-2016
Sieve Analysis	IS:2386-1963 Part-I (RA 2021)	12.5	100.00	100.0
		10.00	87.21	85-100
		4.75	8.02	0-20
		2.36	0.32	0-5

Sieve analysis 20 mm nominal size

Test Parameters	Test Method	IS Sieve size	Result passing	IS 383-2016
Sieve Analysis	IS:2386-1963 Part-I (RA 2021)	40.0	100.00	100.0
		20.0	86.63	85-100
		10.00	7.10	0-20
		4.750	0.20	0-5

Mix Design M_{25}

20mm,l0mm,sand W/C ratio= 0.4 Admixture@1.10% of Cement Content						
Water in Ltrs.	Admixture in ltrs.	Cement in Kgs	Sand in Kgs	River Crushed Rocks. In Kgs	River Crushed Rocks 20mm nominal Size in Kgs	River Crushed Rocks 10mm nominal Size in Kg
157.6	3.85	350	775	1127	764	435

Mix Design M_{30}

20mm,l0mm,sand W/C ratio= 0.4 Admixture@1.10% of Cement Content						
Water in Ltrs.	Admixture in ltrs.	Cement in Kgs	Sand in Kgs	River Crushed Rocks. In Kgs	River Crushed Rocks 20mm nominal Size in Kgs	River Crushed Rocks 10mm nominal Size in Kg
153.38	4.217	383.45	791	1068	732	409

IV. RESULTS AND DISCUSSION

Workability – Slump Test

Mix	M25 Slump	M30 Slump
R0	95mm	88mm
R50	82mm	76mm
R100	72mm	65mm

Compressive Strength M_{25} in N/mm^2 (Mpa)

Description	Trail No I	Trail No 2	Trail No 3 (Recommended)	Specified Characteristics (Field) compressive strength of 150mm cube at 28days.
At 7 days	18.5	18.9	19.92	
At 28 days	29.8	30.6	31.4	25 Mpa

Compressive Strength M_{30} in N/mm^2 (Mpa)

Description	Trail No I	Trail No 2	Trail No 3 (Recommended)	Specified Characteristics(Field)compressive strength of 150mm cube at 28days.
At 7 days	26.8	28.8	29.8	
At 28 days	30.2	31.6	33.8	30 Mpa

Durability

Test	R0	R100	Limit
Water Absorption	2.10%	2.35%	3%
RCPT	1850 Coulombs	2100 Coulombs	1000-2000

V. CONCLUSION

Workability of concrete mixes increased with the increase in the percentage of river crushed stones. If the workability had kept constant, the water content for some of the concrete mixes could have been reduced thus benefiting the mechanical properties of concrete, thus it can be concluded that the river crushed rocks which is abundantly available locally can be efficiently used as a coarse aggregate in concrete. River crushed rock from Yijung River under Tuensang District satisfies all IS 383 physical requirements, up to 100% Replacement yields greater than 90% control strength acceptable as per IS 456 for structure use .

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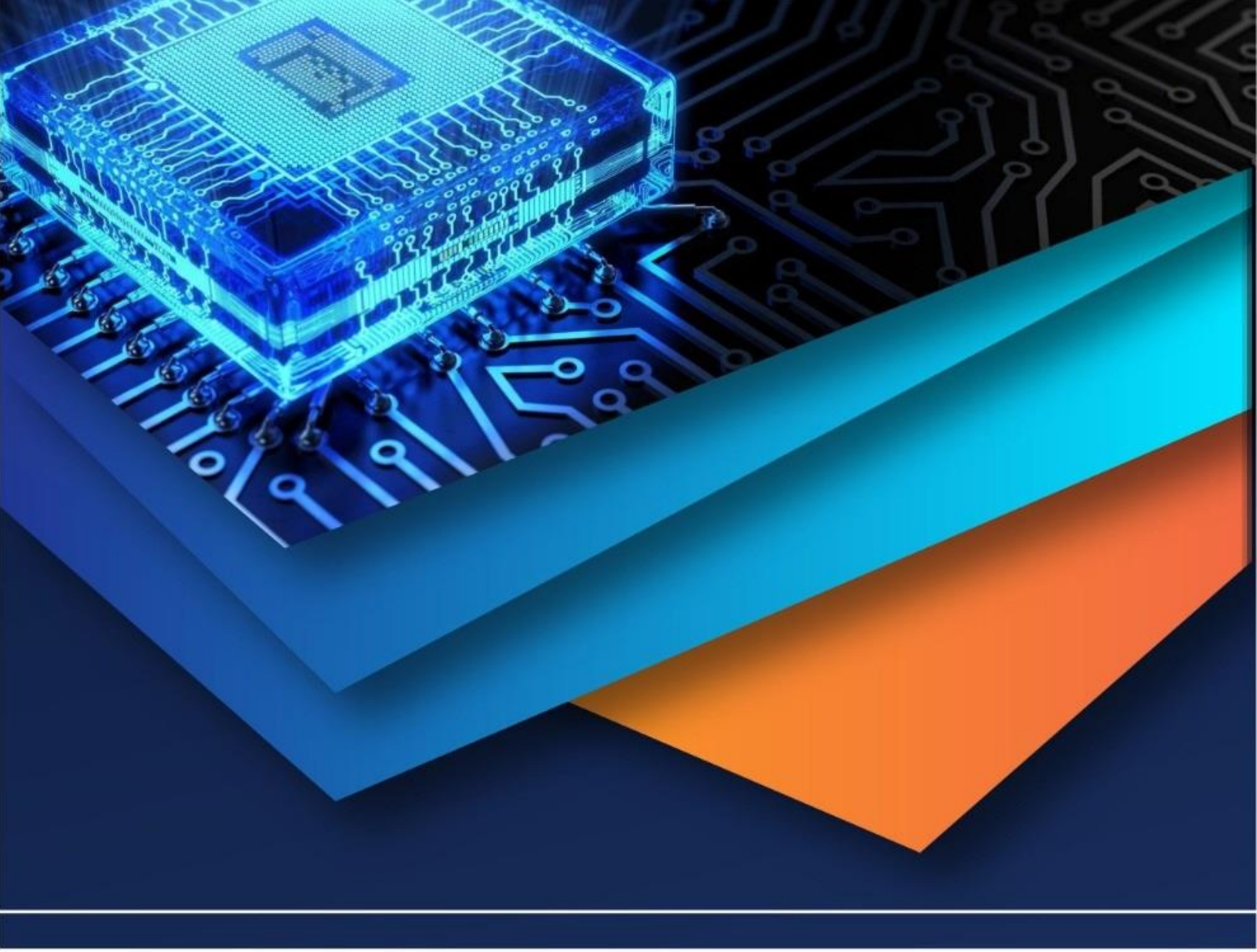

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