COMPARATIVE STUDY ON THE USE OF M-SAND, QUARRY DUST AND QUARRY WASTE AS ALTERNATIVES TO RIVER SAND IN CONCRETE

[1]D. Srinath, [2]P. Neeraja,
[1]M.Tech Student, MGIT, dsrinath_pg24civ2005@mgit.ac.in
[2]Assistant Professor, MGIT, pneeraja_civil@mgit.ac.in

Abstract— Concrete remains the backbone of modern infrastructure owing to its high compressive strength, durability, thermal stability, and availability. However, the excessive exploitation of natural river sand as fine aggregate has created severe environmental problems such as riverbed depletion, lowering of groundwater levels, and ecological disturbances. This research explores sustainable fine aggregate alternatives—Manufactured S and(M-sand), quarry dust, and quarry waste—and evaluates their combined performance in concrete. In this study, river sand is replaced with a blend of 40% M-sand, 30% quarry dust, and 30% quarry waste. Experimental investigation is carried out on M25 grade concrete to determine workability, compressive strength, and split tensile strength. The results demonstrate that the alternative mix offers comparable or superior properties to conventional concrete, therefore supporting sustainable construction practices by reducing dependency on natural river sand.

I. Introduction

Concrete is one of the most widely used construction materials globally, with applications spanning residential, commercial, industrial, and infrastructure projects. The quality of concrete is significantly influenced by the type and properties of aggregates used. River sand has traditionally served as the primary fine aggregate in concrete production. However, extensive extraction of river sand has led to detrimental environmental impacts, including river bank erosion, destruction of natural habitats, reduced groundwater recharge, and disruption of aquatic ecosystems. With increasing environmental regulations and the depletion of natural sand resources, researchers and engineers have turned their attention toward potential substitutes. Among these, Manufactured Sand (M-sand), quarry dust, and quarry waste have gained prominence due to their availability as industrial by-products and their promising physical and mechanical properties. This study aims to analyze the possibility of blending these materials to create a sustainable and high-performance fine aggregate mix.

Design mix

The methodology adopted for this project involves a systematic experimental approach to evaluate the suitability of alternative fine aggregates (M-Sand, Quarry Dust, and Quarry Waste) as full replacements for natural river sand in concrete. The research was carried out through the following sequential steps:

- Material Selection and Collection
- Material Testing
- Concrete Mix Design
- Casting of Specimens
- Curing Process
- Testing of Hardened Concrete

A standard concrete mix design (M25 grade) was prepared in accordance with IS 10262:2019 guidelines. The mix design for the control sample (using 100% river sand) was kept constant, and subsequent mixes were prepared by replacing river sand with M-Sand, Quarry Dust, and Quarry Waste at varying proportions (e.g., 40%, 30%, and 30%).

For 3 cubes – (150x150x150) mm Ratio
of M25 = 1:1:2
Sumofratio=1+1+2=4
Wet volume=0.15x0.15x0.15
$=0.003375m^3$
Including 10% wastage=0.003375+0.0003375
$=0.0037125m^3$
For 3 cubes=0.0037125x3
$=0.0111375m^3$
Dry volume=0.0111375x1.54
$=0.0172m^3$
Materials Quantities**:**

$$\text{Cement}=\frac{0.01715 \text{ x1x } 1440}{4}$$
$=6.17kg$

$$\text{Sand}=\frac{0.01715\text{x } 2\text{x}1600}{4}$$
$=6.86kg$

$$\text{Coarse Aggregate}=\frac{0.01715\text{x2x}1450}{4}$$
$=12.43kg$

II. Methodology

The experimental program consists of selecting materials, preparing mix proportions, casting specimens, and testing mechanical properties. M25 grade concrete is designed according to IS 10262-2019. Fine aggregates arere placed with a blend of 40% M-sand, 30% quarry dust, and 30% Quarry waste. A standard water–cement ratio of 0.45 isused through out the study. Cubes (150×150×150 mm) and cylinders (150 mm × 300 mm) are cast and cured for 7, 14, and 28 days.

III. Results & Discussion

The results indicate that the alternative fine aggregate mix provides comparable strength and durability to conventional concrete. The compressive strength of the blended mix exceeds that of river sand concrete after 28 days of curing. Workability is slightly reduced due to the angular particles present in quarry dust and M-sand, but remains within acceptable limits for M25 grade concrete. The split tensile strength also shows improvement, likely due to enhanced particle packing and reduced voids.

Table 1Compressive Test results

S.NO	Type of Concrete	Compressive Strength N/mm^2		
		Sample1	Sample2	Sample3
1	Normal Concrete	32.52	37.30	30.05
2	Quarry by-products concrete	37.21	39.97	40.71

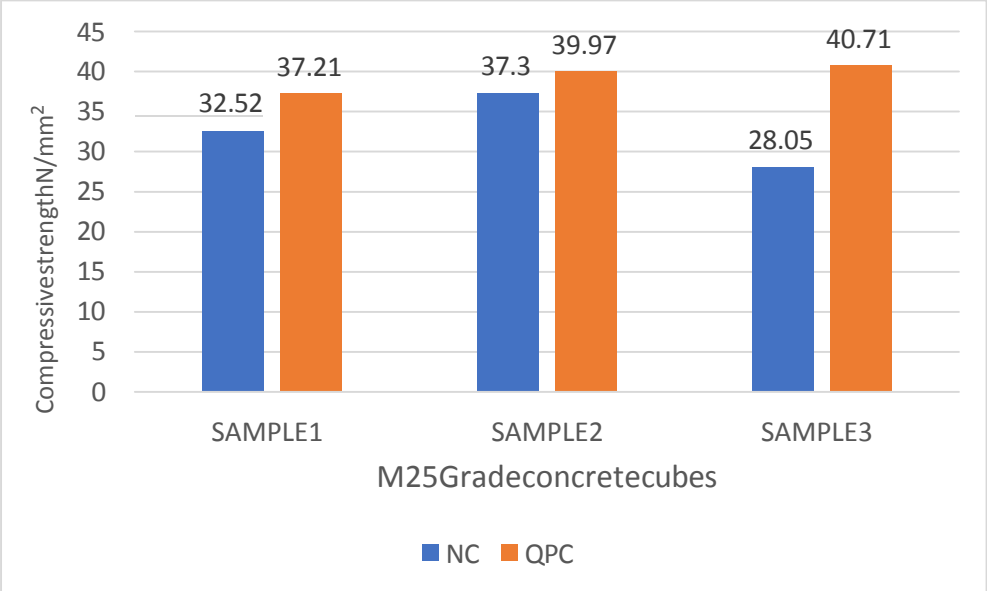
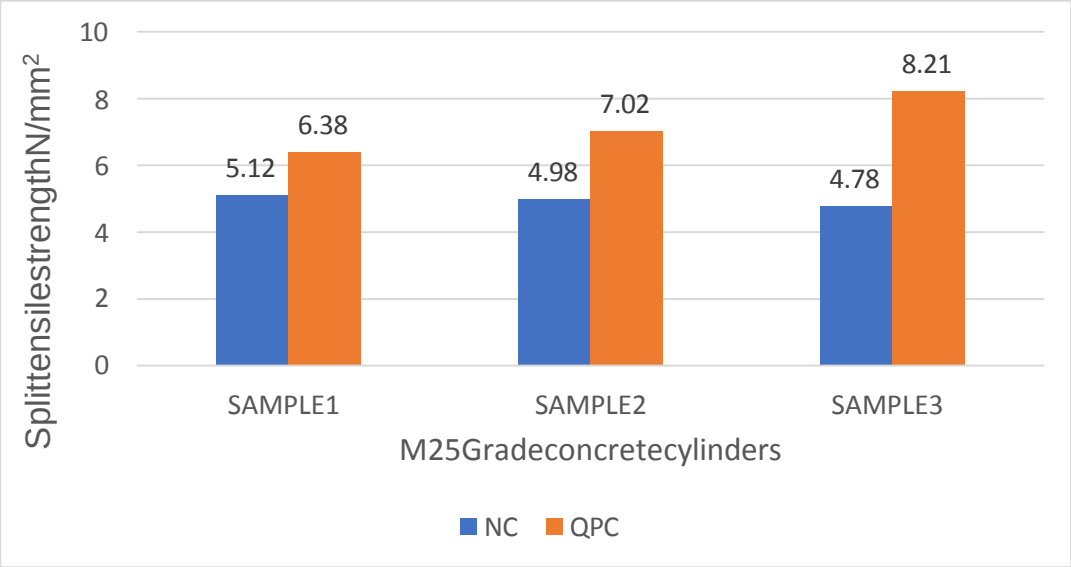


Table 2 Split Tensile Test results

S.NO	Type of Concrete	Split Tensile Strength N/mm^2		
		Sample1	Sample2	Sample3
1	Normal Concrete	5.21	4.98	4.78
2	Quarry by-products concrete	6.38	7.02	8.21



IV. Conclusion

The study concludes that replacing natural river sand with a combined mix of M-sand, quarry dust, and quarry waste is both feasible and beneficial. The alternative mix provides improved mechanical properties, reduces the environmental impact of natural sand mining, and promotes sustainable utilization of industrial by-products. This approach can significantly contribute to greener construction practices.

References

[1] IS 10262: 2019, "Concrete Mix Proportioning—Guidelines."

[2] IS 456: 2000, "Plain and Reinforced Concrete—Code of Practice."

[3] Dr. B.C. Punmia, "Concrete Technology," Laxmi Publications