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Influence of crushed sand on the dynamic modulus of elasticity of sand concrete

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ABSTRACT

This research work deals with study of the dynamic modulus of elasticity of sand concrete containing crushed sand. As the crushed sand was replaced by river sand in three different proportions which are 10%, 20% and 30% respectively. In this paper, the flexural strength, ultrasonic pulse velocity, and the dynamic modulus of elasticity will be examined. The results obtained showed that the sample consisting of 30%crushed sand +70% river sand gave the best result for all the studied experiments.

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1. Introduction

The use of sand type in concrete has been the subject of many studies because of the increasing demand for river sand [1, 2], as the depletion of river sand has caused many environmental issues [3]. Sand concrete does not contain gravel, but if it can be contained, it is with a mass ratio (gravel/sand) of less than 0.7 [4].The sand type effect on sand concrete properties has been the subject of study [5].
The objective of the present study is the properties of sand concrete using crushed sand, the focus of this study was on flexural strength, ultrasonic pulse velocity, and the dynamic modulus of elasticity.

2. Material And Method

2.1. Materials Used

2.1.1 Sands

Crushed sand (CS) and River sand (RS), presents continuous particle size distribution ranging from 0.08 to 5 mm; but the fraction smaller than 0.16 mm remains very small.
The particle size distributions of the various sands used are shown in **Fig. 1.**
Tamis (Sieve):5, 2.5, 1.25, 0.63, 0.315, 0.16, 0.08 and 0.01

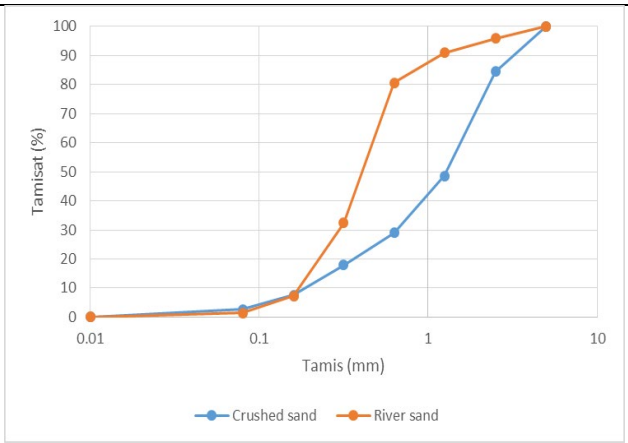

Fig1. Granular size analysis of crushed and river sand

2.1.2. Cement

The cement employed is ordinary Portland cement (type II) of class 42.5, also known as ‘‘CPJ CEM II/A”. The physical characteristics are the following: absolute density of 3.1 g / cm3 and 370 m2/kg fineness.

2.1.3. Water

Water temperature is 20 ± 1 C°. Its quality conforms to the requirements of standard NFP 18-404.

2.2. Methods

2.2.1. Formulation of Sand Concrete

The mix proportions adopted were prepared from a formulation based on an experimental approach derived from previous works on sand concrete [6–8]The mixing proportion approach used here for sand concrete was aimed at optimizing the compactness of the granular structure. Where the **table 1** shows the proportion of the compositions of sand concrete

2.2.2. Experimental methods

Flexural strength is tested at 7and 28days on prismatic specimens (4x4x16) cm3 in according with standard EN 196-1.

Ultrasonic pulse velocity test (UPV) was used following NF EN 12 504-4 standard.

Dynamic modulus of elasticity of sand concrete is calculated according to the ultrasonic propagation velocity and the dry density of the samples.

3. Results and Discussions

3.1. Flexural Strength

The best value for the cement sample was 30% CS. This indicates that the increase in crushed sand gives good results. This is what Figure 2 shows for the results obtained from the flexural strength after 7 and 28 days

Table 1 Compositions of sand concrete

Compositions	CS (Kg/m^3)	RS (Kg/m^3)	W / C
10% CS +90% RS	163.02	1455.75	0.7
20% CS +80% RS	326.04	1294	0.7
30% CS +70% RS	489.06	1132.25	0.7

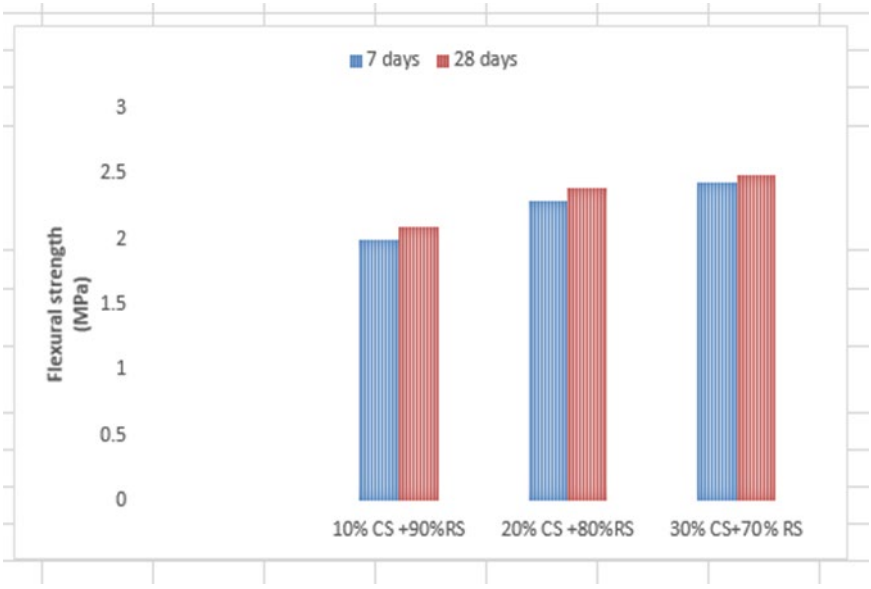

Figure 2 Flexural strength of sand concrete

3.2. Ultrasonic Pulse Velocity Test

The ultrasonic pulse velocity test was performed on concrete at the age of 7 and 28 days. The use of crushed sand contributes to the compactness of the cement matrix which improves the ultrasonic pulse velocity of sand concrete. As shown in Fig. 3

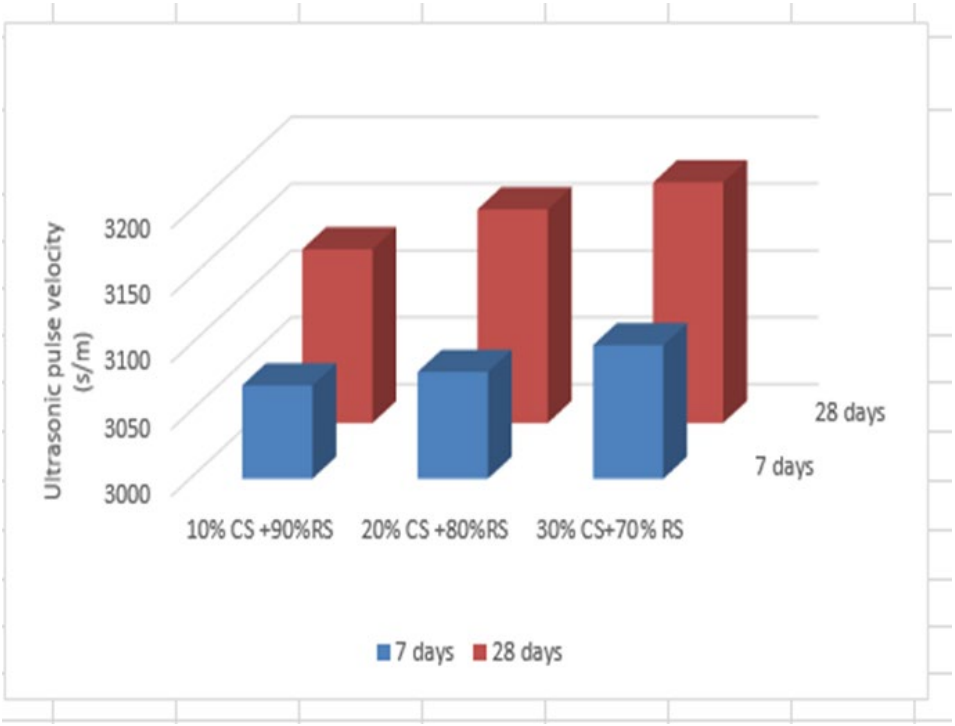

Figure 3 UPV of sand concrete

3.3. Dynamic Modulus of Elasticity

Figure 4 shows that the dynamic modulus of elasticity increases with the increase of crushed sand, and thus adding crushed sand can contribute to improving the dynamic modulus of sand concrete.

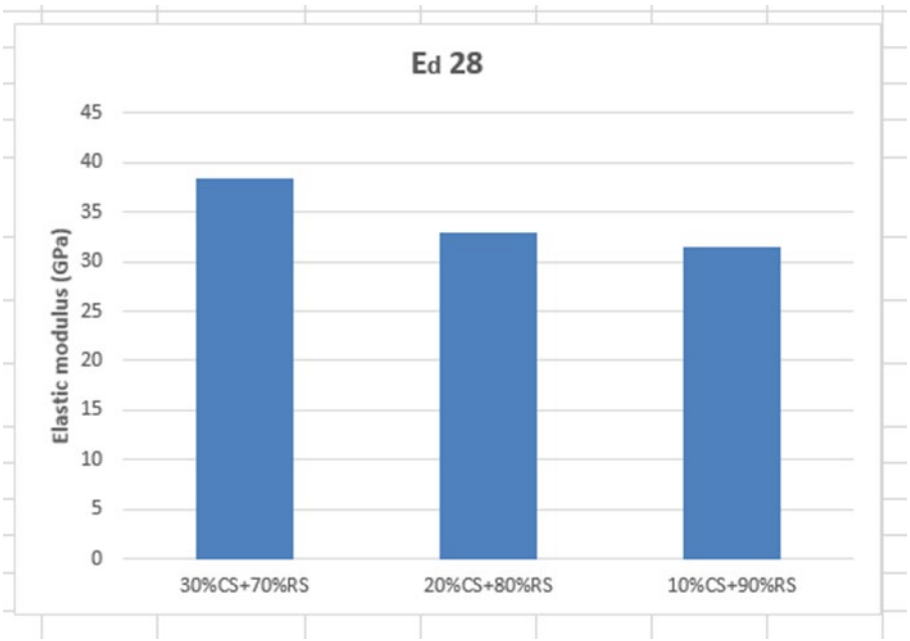

Figure 4 Ed of sand concrete

4. Conclusion

Based on the results obtained to study of the dynamic modulus of elasticity of sand concrete containing crushed sand, the following conclusions are obtained:

Best value of flexural strength obtained for the sample was 30% crushed sand.

Ultrasonic pulse velocity of the samples increased when the percentage of crushed sand increased.

Good improvement in the dynamic modulus of elasticity for the sample was 30% crushed sand + 70% river sand.

Finally, several properties of sand concrete were improved by replacing part of the crushed sand with river sand, and from the obtained results it can be concluded that the effect of crushed sand on concrete properties is positive and contributes to its improvements.

References

[1] K. Gadri and A. Guettala, "Evaluation of bond strength between sand concrete as new repair material and ordinary concrete substrate (The surface roughness effect)," *Constr. Build. Mater.*, vol. 157, no. May, pp. 1133–1144, 2017, doi: 10.1016/j.conbuildmat.2017.09.183.

[2] K. Gadri and A. Guettala, "Study of the adaptation of the sand concrete as repair material associated with an ordinary," vol. 3, pp. 13–20, 2017.

[3] J. Zhang, D. Li, and Y. Wang, "Toward intelligent construction: Prediction of mechanical properties of manufactured-sand concrete using tree-based models," *J. Clean. Prod.*, vol. 258, p. 120665, 2020, doi: 10.1016/j.jclepro.2020.120665.

[4] M. Hadjoudja, M. M. Khenfer, H. A. Mesbah, and A. Yahia, "Statistical Models to Optimize Fiber-Reinforced Dune Sand Concrete," *Arab. J. Sci. Eng.*, vol. 39, no. 4, pp. 2721–2731, 2014, doi: 10.1007/s13369-013-0774-z.

[5] M. R. Wakchaure, A. P. Shaikh, and B. E. Gite, "Effect of types of fine aggregate on mechanical properties of cement concrete," *Int. J. Mod. Eng. Res.*, vol. 2, no. 5, pp. 3723–3726, 2012.

[6] A. Benaissa, A. Kamen, K. Chouicha, and S. Malab, "Panneau 3D au béton de sable," *Mater. Struct.*, vol. 41, no. 8, pp. 1377–1391, 2008.

[7] O. Jaradat, K. Gadrı, and A. Guettala, "Study the mechanical and physical properties of sand concrete using crushed limestone sand," *J. Mater. Electron. DEVICES*, vol. 3, no. 1, pp. 26–29, 2021.

[8] O. Z. Jaradat, K. Gadri, B. A. Tayeh, and A. Guettalaa, "Influence of sisal fibres and rubber latex on the engineering properties of sand concrete," *Struct. Eng. Mech.*, vol. 80, no. 1, pp. 47–62, 2021.