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Enhancement of Cement Mortar Mechanical Properties with Replacement of Seashell Powder

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***Abstract*—**Many synthetic additives have been using for improve cement mortar and concrete characteristics, but natural additive is a friendly environment option. The quantity of (2% and 4%) seashell powder has been replaced in cement mortar, and compared with plain cement mortar in early age of 7 days. The strain gauges have been installed on beams and cube, for monitoring fluctuation of flexural and compressive strength. Main objective of this paper is to study effect of linear static force on flexural and compressive strength of modified cement mortar. The results have been indicated that the replacement of appropriate proportion of seashell powder enhances cement mortar mechanical properties. The replacement of 2% seashell causes improvement of deflection, time to failure and maximum load to failure on concrete beam and cube, the same occurs for compressive modulus elasticity. Increase replacement of seashell to 4% reduces all flexural strength, compressive strength and strain of cement mortar.

***Keyword*—**Compressive strength, flexural strength, compressive modulus elasticity, time to failure, deflection.

I. Introduction

THE nanoparticles of cement paste has been reshaped, it caused improvement of compressive strength of concrete [1], [2]. Incorporation of minerals admixtures in ordinary Portland cement improves workability, mechanical properties, resistance under aggressive environment and setting time of concrete [3]-[6]. The modulus of elasticity of concrete is an important parameter to estimate the strain distributions and displacements [7]. There are many studies that investigate the elastic properties of different concrete types [7]-[9]. It has been reported that the wastes or industrial by-products are used to improve elastic properties of concrete [8], [10] and [11]. In this paper, the compressive strength, flexural strength and compressive modulus elasticity of cement mortar have been modified by replacement of seashell powder, to study the effect of linear static force on deflection and time to the failure of small beam.

II. Experimental setup

The OPC paste has been mixed with 50% of sand to measure accurate mechanical properties of OPC. The mixture design has been indicated in Table I. To study the effect of seashell powder on mechanical properties of OPC, 2% and 4% of seashell powder has been replace in cement mortar, and cubical molds (10cm × 10cm × 10cm) and beam molds of (10cm × 10cm × 50cm) have been used, for measure flexural and compressive strength of specimens.

TABLE I
Mix Designs of the Solidified Wastes

OPC	Sand	Oil palm shell ash	W/C ratio
(50%)	(50%)	(0%)	0.4
(48%)	(50%)	(2%)	0.4
(46%)	(50%)	(4%)	0.4

The curing of specimens has been taken place at water 25 ± 5°C for 7 days. The compressive and flexural strength of specimens have been measured based on ACI standard and the average value of three specimens selected for interpretation. For cubes and beams the appropriate graphs have been depicted for analysis of mechanical properties of cement mortar.

III. Result and discussion

The mechanical properties of cement mortar are important factors in structure stability. The natural additive modify nanoparticle of cement mortar and controls mechanical properties of that. The agriculture waste materials improve sustainable development and minimize environment pollution.

In the cubic specimens, the effect of replacement of 2% and 4% seashell powder on cement mortar has been assessed. The force versus time to failure improves with replacement of 2% seashell in cement mortar, and negative effect of seashell has been observed with replacement of 4% (Figs. 1-3), the deflection of cement mortar has considerably been enhanced with replacement of 2% seashell in cement mortar and reduced with replacement of 4% seashell (Figs. 4-7), Addition of seashell did not substantially effect on static compressive modulus elasticity of cement mortar (Figs. 8-10). According to the [12], the pozzolans increase the mechanical strength of concrete. And [13], has been reported that fly ash did not change modulus elasticity of concrete. And it has been observed that the seashell did not change modulus elasticity of cement mortar. It can be concluded that the natural minerals mainly modify compressive strength, flexural strength, deflection and time to failure. From above observation it is possible to estimate strain and deflection of a cement mortar and concrete section, when natural additive has been used in mix design.

In the small cement mortar beam (Figs. 11-15), have been observed that the replacement of 2% seashell improve deflection, time to failure and maximum load to failure, and replacement of 4% seashell has negative effect on maximum

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load to failure, time to failure and deflection of small cement mortar beam.

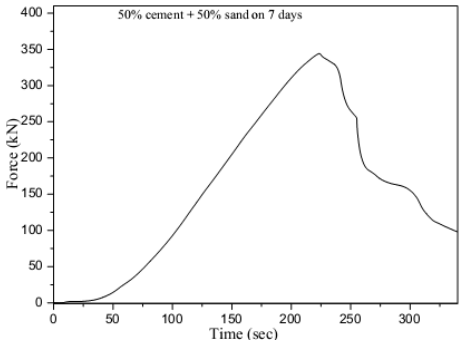

Fig. 1 Force Vs time to failure for cubic specimen [14]

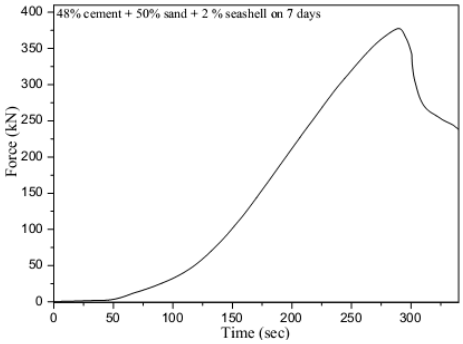

Fig. 2 Force Vs time to failure for cubic specimen

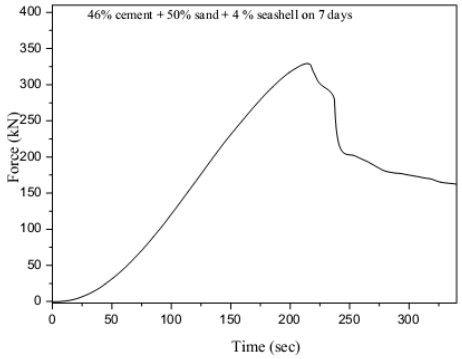

Fig. 3 Force Vs time to failure for cubic specimen

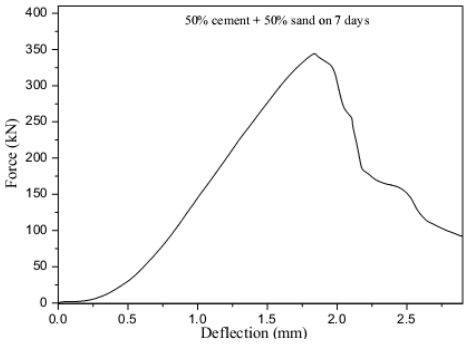

Fig. 4 Force Vs deflection for cubic specimen [14]

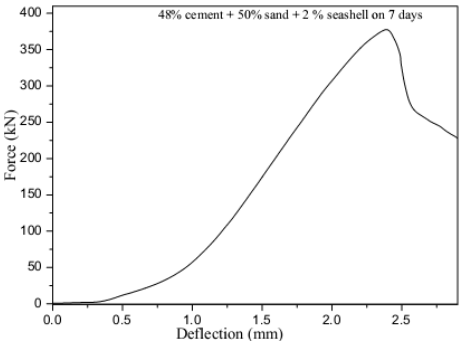

Fig. 5 Force Vs deflection for cubic specimen

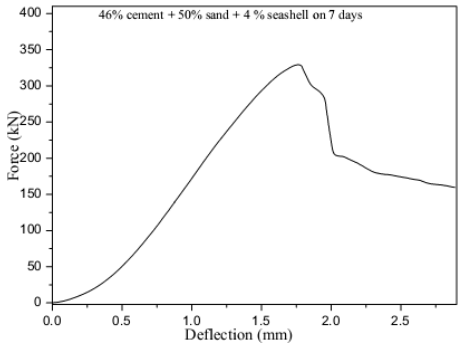

Fig. 6 Force Vs deflection for cubic specimen

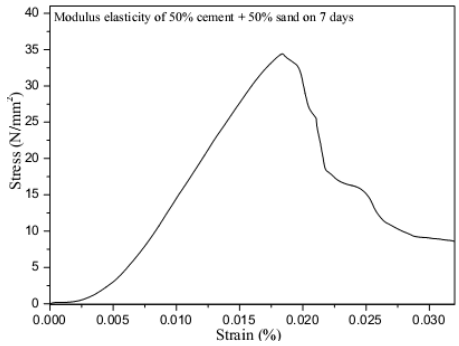

Fig. 7 Stress Vs strain for cubic specimen [14]

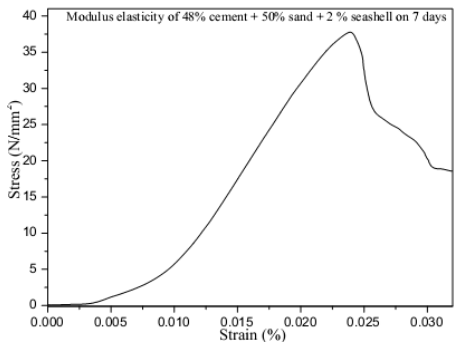

Fig. 8 Stress Vs strain for cubic specimen

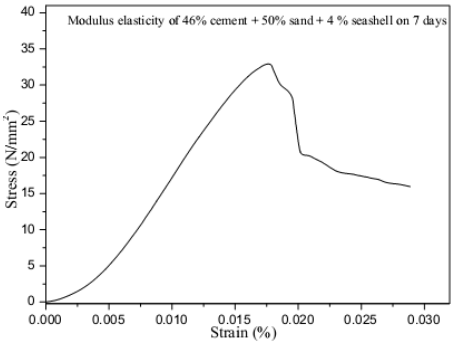

Fig. 9 Stress Vs strain for cubic specimen

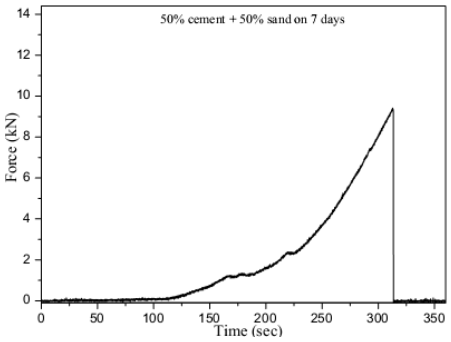

Fig. 10 Force Vs time for beam [14]

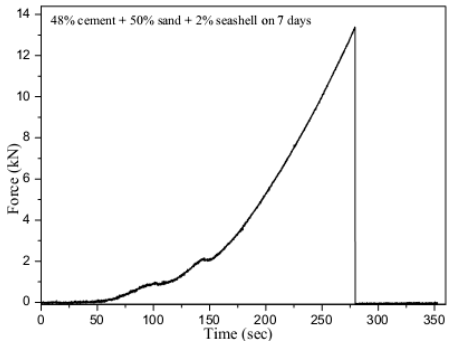

Fig. 11 Force Vs time for beam

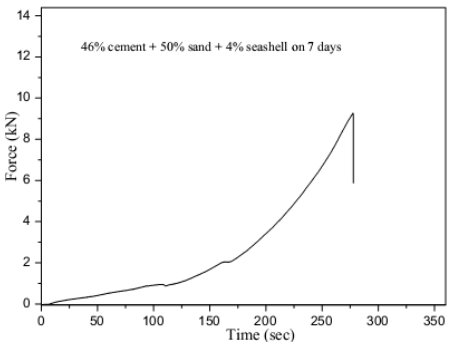

Fig. 12 Force Vs time for beam

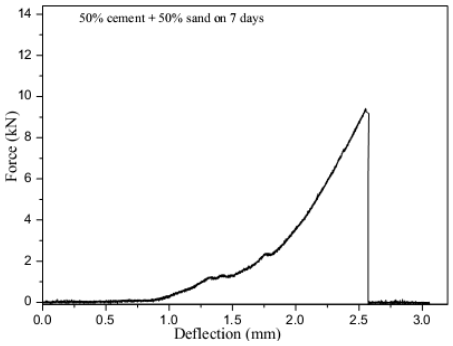

Fig. 13 Force Vs deflection for beam [14]

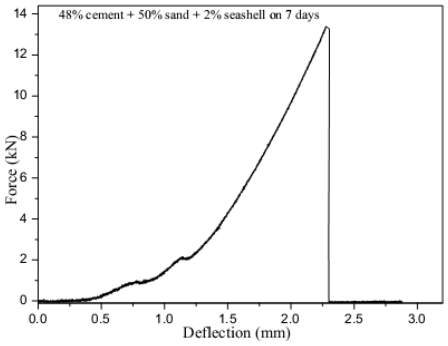

Fig. 14 Force Vs deflection for beam

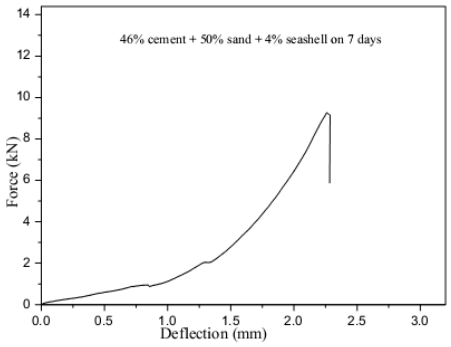

Fig. 15 Force Vs deflection for beam

IV. Conclusions

- The appropriate proportion of a waste agriculture has been used as a natural additive, and showed acceptable effect on mechanical properties of cement mortar.
- In the small cement mortar beam and cubic cement mortar specimens, the deflection, time to failure and maximum load to failure with replacement of 2% seashell has been enhanced.
- Addition of seashell has not been effect on static compressive modulus elasticity of cement mortar.
- Replacement of 4% seashell has negative effect on flexural and compressive strength of cement mortar.
- From above observation it is possible to estimate strain and deflection of a cement mortar and concrete section, when natural additive has been used in mix design.

- The morphology of crack in this work has not been investigated.

REFERENCES

[1] A. Namdar, Thermally Modifying Bentonite for Construction Industry. Int. J. of GEOMATE, 1 (2011) 95-98.
[2] A. Namdar, Natural minerals mixture for enhancing concrete compressive strength. Frattura ed Integrità Strutturale, 22 (2012) 26-30; DOI: 10.3221/IGF-ESIS.22.04.
[3] Uchikawa H. Effect of blending components on hydration and structure formations. In: Proceeding of 8th ICCC, 1, 249, Rio de Janeiro-Brasil; 1986.
[4] Rousekova I, Bajza A, Zivica V. Silica fume-basic blast furnace slag systems activated by an alkali silica fume activator. Cem Concr Res 27(12) (1997) 1825-8.
[5] Khatri RP, sirivivatnanon V, Yang JL. Role of permeability in sulphate attack. Cem Concr Res 27(8) (1997) 1179-89.
[6] Nagla VT, Page CL. Effects of carbonation of pore structure and diffusional properties of hydrated cement pastes. Cem Concr Res 27(7) (1997) 995-1007.
[7] Topçu IB. Alternative estimation of the modulus of elasticity for dam concrete. Cem Concr Res 35(2) (2005) 2199-202.
[8] Mostofinejad D, Nozhati M. Prediction of the modulus of elasticity of high strength concrete. Iran J Sci Technol 29(B3) (2005) 311-21.
[9] Simeonov P, Ahmad S. Effect of Transition zone on the elastic behavior of concrete. Cem Concr Res 25(2) (1995) 304-10.
[10] Topçu IB. Assessment of the brittleness index of rubberized concretes. Cem Concr Res 27(2) (1997)177-83.
[11] Topçu IB, Demir A. Durability of rubberized mortar and concrete. ASCE J Mater Civil Eng 19(2) (2007) 173-8.
[12] G.C. Isaia, A.L.G. Gastaldini, R. Moraes. Physical and pozzolanic action of mineral additions on the mechanical strength of high-performance concrete. Cement & Concrete Composites 25 (2003) 69-76.
[13] Yıldırım H, Sengul O. Modulus of elasticity of substandard and normal concretes. Construction and Building Materials, 25 (4) (2011) 1645-1652.
[14] Namdar A, Yahaya FM, Jie KJ, Ping LY. An Investigation on Effect of Oil Palm Shell Ash on Flexural Strength and Compressive Strength of Cement Mortar. 2014 The 4nd International Conference on Advanced Materials Research (ICAMR 2014). Macau, China, Jaunary 22-23, 2014.