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EXTENDED ABSTRACT

Investigating the Effect of Copper Mine Tailing on the Stress-Strain Behavior of Confined Concrete

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Stress-strain behavior, Copper mine tailing, Confined concrete, Green concrete.

1. Introduction

One of the important factors that affect the concrete behavior is confinement. On the other hand, strength and ductility of concrete depend on the stress–strain characteristics of concrete, which they are also influenced by the confinement of the members (Ahmad and Shah, 1982). Copper mine tailing (CMT) were used to produce environmentally friendly bricks instead of shale and clay by Ahmari and Zhang in 2012. Onuaguluchi and Eren (2016) reported the properties of CMT material used as proper material and a potential additive in mortar and concrete specimens. Huang et al. (2012) studied the application of CMT material to prepare autoclaved aerated concrete. The sum of SiO_2, Al_2O_3 and Fe_2O_3 in CMT material is 81.88%, which exceeds the 70 percent requirement for class N raw and calcined natural pozzolanas (ASTM C618). Therefore, CMT materials are expected the proper potential to produce pozzolanas (Thomas et al. 2013).

2. Methodology

Four concrete mix proportions have been designed to investigate the effects of CMT material on the stress-strain behavior of confined concrete. Ordinary Portland Cement (OPC) was replaced by CMT material at 0%, 10%, 15% and 20% by weight of cement. In this study, the coarse and fine aggregates were used Based on ACI 211 with a maximum size of 12.5 mm 4.75 mm respectively. For testing the stress- strain behavior was used the cylindrical molds of 150 mm diameter and 300 mm height. The CMT-concrete specimens were prepared and kept immersed in water for 56 days after one day of casting. The pitch of the spirals used were 75 mm, 50 mm and 25 mm (volumetric ratios 1.01%, 1.52% and 3.04%).

3. Results and discussion

3.1. Stress-strain behavior of unconfined concrete

The stress- strain curves of CMT-concrete specimens with various percentages of CMT material are shown in Fig. 1. The results show that the strength of unconfined concrete increases with increasing CMT material replacement level (up to 15%).

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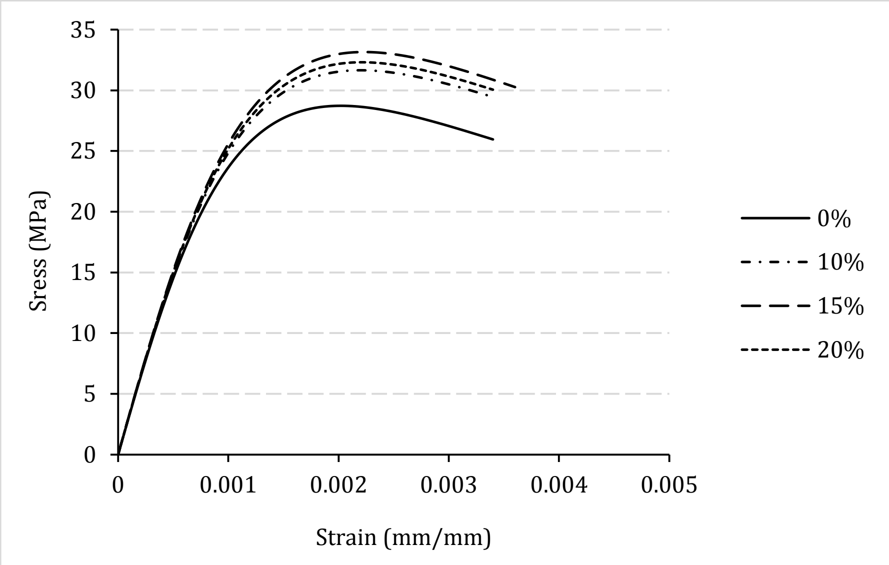

Fig. 1. Relationships between stress and strain of concrete with different CMT material replacement

3.2. Stress-strain behavior of confined concrete

The values of the strength enhancement of confined concrete, which is the ratio of the peak stress of confined CMT-concrete to the peak stress of unconfined concrete are shown in Table 1. Also, the strain enhancement was calculated the ratio of the strain at peak stress of confined concrete to the strain at peak stress of unconfined concrete (see Table 1). The strength and strain enhancement of CMT- concrete increased by 1.8% to 2.8% and 0.9% to 35.9% when the volumetric ratio of confinement was increased from 1.01% to 3.04%, respectively.

Table 1. Effect of confinement on strength and ductility

Specimen ID	Peak stress (MPa)	Strength enhancement	Strain at peak stress	Strain enhancement
C-E-0	28.74	1.00	0.002025	1.00
C-E-75	29.29	1.019	0.002135	1.054
C-E-50	31.38	1.092	0.002825	1.395
C-E-25	38.71	1.347	0.005075	2.506
T-E-0	33.35	1.00	0.002225	1.00
T-E-75	34.58	1.037	0.002365	1.063
T-E-50	37.60	1.127	0.003512	1.578
T-E-25	45.87	1.375	0.006375	2.865

3.2. Stress-strain model

In this study, the available models for the stress–strain behavior of confined CMT-concrete was compared with the model proposed by Mander et al. (1988). The result show that the stress-strain model proposed by Mander et al. (1988) can be used for CMT-concrete with a modification in the curve fitting factor (r).

4. Conclusions

1. The strength of concrete increase with increasing CMT material content (up to 15%). The peak strain also increases with increasing CMT material content.
2. The confined CMT- concrete appears to be suitable for construction activities design since the spiral confinement improves the strength, strain at peak stress.
3. For CMT- concrete confined can be used the stress-strain model proposed by Mander et al. with a modification in the curve fitting factor (r).

5. References

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