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EXTENDED ABSTRACT

An Investigation into the Economical, Environmental and Durability of Structural Fiber Lightweight Concrete

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1. Introduction

In order to reduce dead loads of structures in earthquake prone areas such as Iran, lightweight concretes have several advantages which could be used as a substitution of ordinary concretes. One of the challenges in construction industry is producing an economical and environmental structures which could be able to fulfil requirements of structural and durability properties both. Thus, this industry needs a sustainability evaluation to find sustainable materials in engineering, environmental and economical aspects which this is one of the keys to achieving sustainable development. The main purpose of this research is to investigate economical, environmental and durability properties of lightweight concretes and fiber reinforced lightweight concretes and compare them with ordinary concretes.

2. Methodology

2.1. Materials

In this way, five types of concretes including: 1_ ordinary concrete with the density of 2310 kg/m^3 , 2_ lightweight concrete made by leca and 3,4,5 lightweight concrete made by leca and reinforced by steel, glass and polypropylene fibers with the content of 1 percentage and density of 1810 kg/m^3 were made. The ratio of w/c, fine aggregate and superplasticizer for all specimens were same and their difference was substitution of leca in lightweight concrete instead of gravel.

2.2. Methods

In order to evaluate mechanical and durability properties, compressive (BS EN 12390-3, 2009) and tensile (ASTM C496/C496M, 2011) strength, 4-point electrical resistant (AASHTO, TP 95, 2011), rcpt (ASTM C1202, 2012), depth of hardened concrete penetration test (BS EN 12390-8, 2009) and concrete water absorption test (BS EN 1881-122, 2011) carried out in 28 days of specimens. In the second phase, iso 14040 [ISO 14040, 2006] was applied to investigate environmental impacts. Two main concretes “ordinary and lightweight concrete”, were studied by impact 2002+ methodology (Olivier Jolliet, et al, 2001) in 4 scopes of environment: human health, ecosystem quality, climate change and resources aspects. In the third and economical phase, the

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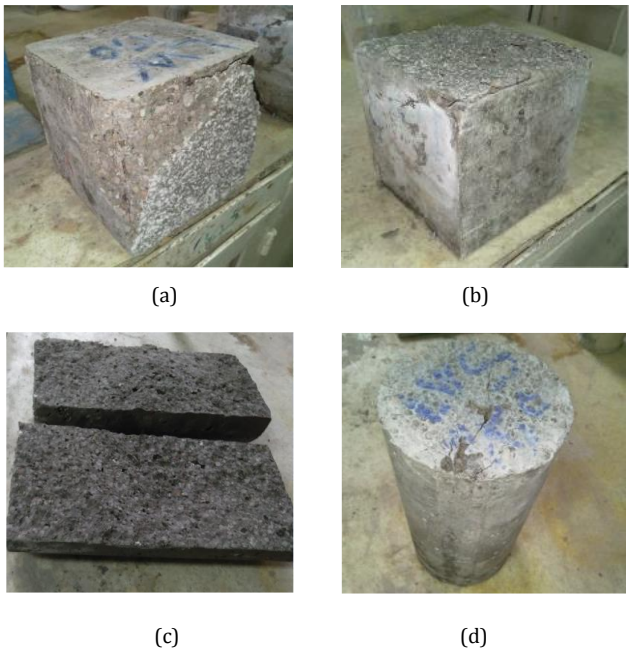
information had gained by modeling a five floor building made by structural lightweight concrete elements and compare it with the same building made by ordinary concrete.

3. Results and discussion

The results in mechanical experiments show that ordinary concretes have more compressive resistance in compare with lightweight and fiber lightweight concretes, but in tensile resistance, steel fiber reinforced lightweight concrete has the most resistance. Fig. 1 shows specimens after mechanical tests. In durability, due to fewer pores in ordinary concrete, they are more durable than light weight concretes.



(a) (b)

(c) (d)

Fig. 1. Mechanical test specimens: a) light weight concrete in compressive test, b) steel fiber reinforced light weight concrete in compressive test, c) light weight concrete in tensile test, d) steel fiber reinforced light weight concrete in tensile test

In environment phase, lightweight concretes have 56% in human health, 17% in ecosystem quality, 19% in climate change, and 45% in resources more damages for environment in compare with ordinary concretes. In economical phase, the decrement of rebar usage by using lightweight concrete instead of ordinary concrete in five floor building was 6.3 percent.

4. Conclusions

Results showed that in the case of equality of concrete matrixes, lightweight concrete made with leca has comparatively fewer durability in compare with ordinary concretes. In the case of environment, due to industrial process and preparation of leca, lightweight concretes have more negative effect for environment. And in economic scope, lightweight concretes can reduce deadload of structure and thus lead to consume less rebar in construction. But due to construction projects are unique, an economical investigation before implementation can lead to an explicit answer.

5. References

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