V -336 INFLUENCE OF MIXTURE PROPORTIONS UPON GREENING NO-FINES CONCRETE PROPERTIES

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1. INTRODUCTION

Recently, there has been for a number of reasons growing interest in the use of No-Fines Concrete as an ecological material. No-Fines Concrete, referred to hereinafter as NFC, consists solely of cement, water and uniform-sized coarse aggregate. The present study evaluates the use of available high water absorption volcanic coarse aggregate efficiency for greening NFC production and the effects of factors such as, void content, aggregate types, gradation upon NFC's mechanical properties. Influence of concrete blocks' thickness and soil thickness on the coexistence of NFC with plants were also investigated.

2. EXPERIMENTAL WORK

Details of mixing procedure, specimens casting and testing methods are reported elsewhere [1]. Briefly, normal portland cement ((C), specific gravity of 3.15 and blaine value of 3290 cm^2/g) was used to produce NFC with available crushed limestone ((CL), 6 different gradations), pumice ((P), 3 gradations) and scoria ((S), 3 gradations). The water absorption of pumice varies between 87~109% and that of scoria between 35~40%. The volume of aggregate was maintained constant to 1 m^3 and the cement factor was changed. The basic aggregate cement ratios (A/C) by volume were 6, 8 and 12.

Compressive, tensile splitting and flexural strength tests were made according to the JIS specifications. During compressive test, the displacement of each specimen was measured by a compressometer and the secant modulus of elasticity was calculated according to JSCE-G502 (1988). Permeability was measured on (specimens of ϕ10x10 cm) constant head permeameter at head loss of 12 cm.

The coexistence of NFC with plants was studied in two steps. The first step investigated the coexistence of commercially available tuff grass with NFC made from several mixes of different crushed limestone gradations and covered with soil of 3 cm of thickness. The blocks had 38 cm of length, 33 cm of width and 5 cm of thickness. On the second step, (only A/C=8), thickness' of planting concrete blocks were varied 5, 10, 15 and 20 cm and covered with soil of different thickness' (3, 6 and 10 cm). The fresh concrete had pH of about 12. To reduce the pH of the surface of NFC, the pores within its body were filled with mixture of peat moss, soil and fertilizer. The mixture had pH of 4.75.

3. RESULTS AND DISCUSSIONS

Fig.1 shows relationships between flexural, tensile strength and compressive strength for concrete made with volcanic aggregates. The ratio of flexural strength to compressive strength varies from 2/3 to 1/4 whereas that of tensile strength to compressive strength varies from 1/4 to 1/5. These ratios are higher than that for NFC with conventional aggregates[1,2].

Fig.2 represents a relationship between compressive strength and secant modulus of elasticity (E) for NFC made with scoria. The secant modulus increases with an increase of compressive strength that decreases with increment of A/C ratios. For higher cement factor its values were less than 7 GPa.

Fig.3 depicts a stress-strain relationship for NFC with crushed limestone. Fig.3 clearly shows that the

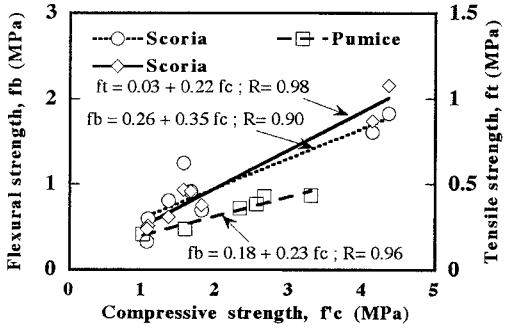

Fig.1 Relationships between flexural, tensile strength and compressive strength

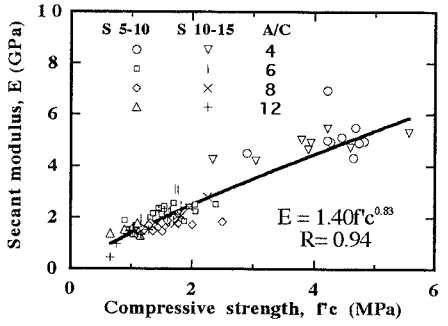

Fig.2 Relationship between compressive strength and secant modulus of elasticity

Key words: greening, no-fines concrete, strength, secant modulus of elasticity, permeability.
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strain quantity decreases with a decease of maximum stress and increment of void content (Vc)[3]. Also the secant modulus of elasticity decrease with void content increment. It is about 4 times bigger than that of NFC with scoria and less than half of that of conventional concrete.

Fig.4 illustrates permeability versus continuous void content (measured by volume method). Permeability increases with an increase of continuous void content and depends on aggregate gradation.

Fig.5 shows tuff grass length versus aggregate cement ratio. After 5 months the growth of grass was almost indistinguishable for all aggregate cement ratios. However after that the grass growth decreased significantly for any gradation in case of A/C=6. This is thought to be related to the higher pH of the surface of NFC made with higher cement factor.

Fig.6 shows tall fescue length versus time for NFC blocks with various thickness' and covered with 6 cm of soil. The thickness of NFC blocks influences the growth of plants. The thinner the blocks were the better the growth of grass was. Similar results are found with other soil thickness and concrete types. Also for NFC blocks of the same thickness, the grass growth was better for blocks covered with thicker layer of soil.

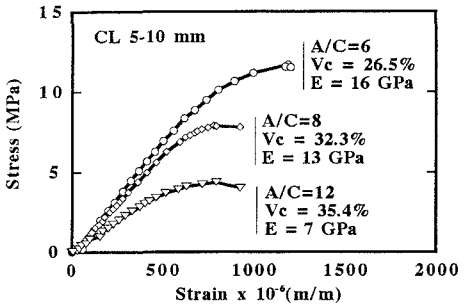

Fig.3 Relationship between stress and strain

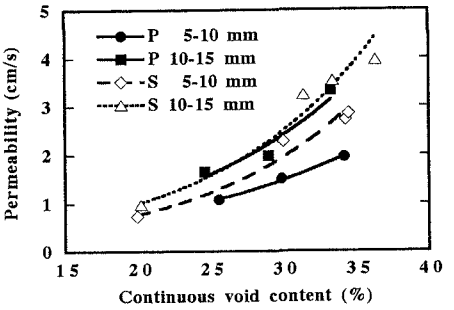

Fig.4 Relationship between permeability and continuous void content

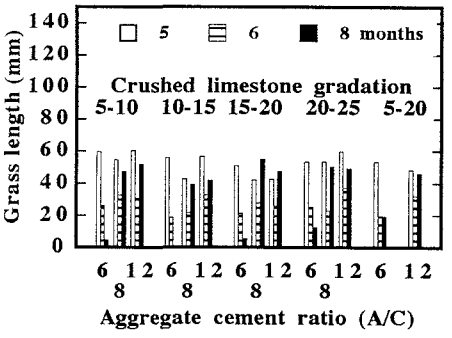

Fig. 5 Grass length Vs aggregate cement ratio

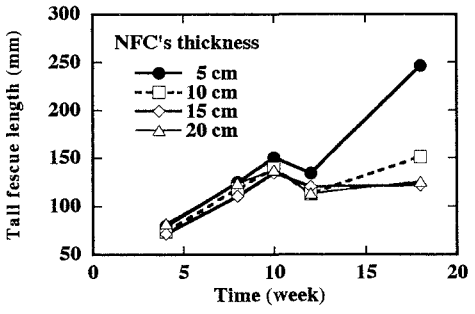

Fig.6 Relationship between grass growth and NFC blocks' thickness

4. CONCLUSIONS

The tests clearly show that:

(1) void content, aggregate gradation and aggregate cement ratios influence the texture of porous concrete and hence its mechanical properties and its coexistence with plants,

(2) within this experiment, ratios of modulus of rupture and tensile splitting to compressive strength are higher than corresponding ratios obtained for NFC with conventional aggregates and conventional concrete,

(3) the secant modulus of elasticity of NFC is less than half of that of conventional concrete. That of NFC with crushed limestone is about 4 times bigger than that with scoria, and

(4) thickness' of NFC blocks and soil influence the plant's growth.

[REFERENCES]

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