STRUCTURAL BEHAVIOUR OF SINGLY REINFORCED OPS BEAMS

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ABSTRACT: Concrete using oil palm shell (OPS) as coarse aggregate has been found useful as lightweight concrete and strengths of up to 28 MPa have been attained. To further investigate its suitability for structural purposes, additional tests are required. Therefore, this paper presents an experimental investigation on the modulus of elasticity and flexural behaviour of three reinforced OPS concrete beams with different effective depths and reinforcement ratios. From the investigation, OPS concrete show promising results for use as structural members, especially for the construction of low cost houses in areas where oil palm is found in abundance.

Keywords: Lightweight concrete, Renewable resources, Flexural behaviour, Modulus of elasticity, Deflection

1. Introduction

Nearly 80% of the resources used today are non-renewable. Due to the scarcity of conventional raw materials, engineers are focusing more on developing construction materials with renewable resources. The appearances of new types of concrete, especially for lightweight concrete production are becoming more common nowadays. In Malaysia, the high availability of oil palm shell (OPS) waste at no cost and the potential pollution caused by these wastes have led to studies into the possible use as aggregates in concrete. Malaysia is currently the largest producer and exporter of palm oil, generating over 4 million tonnes of waste OPS annually.

Concrete using OPS as coarse aggregate has been found useful as lightweight concrete (Mannan and Ganapathy, 2004) and even compressive strengths of up to 28 MPa have been achieved (Teo et al., 2005a). OPS aggregates have bulk densities in the range of about 500 to 600 kg/m^3. When incorporated into concrete as coarse aggregates, the resulting hardened concrete is lightweight with air-dry densities of about 1900 kg/m^3.

The use of lightweight concrete in construction has many benefits. A significant amount of dead load reduction can be observed when lightweight concrete is used. Structures constructed using lightweight concretes can produce a load reduction of approximately 15 to 30 percent as compared to structures built with normal weight concretes.

Recent investigations have also shown that OPS concrete has good potential as structural members (Teo et al., 2005b). Therefore, the purpose of this paper is to investigate further the structural properties of OPS concrete by determining the modulus of elasticity and conducting full-scale prototype singly reinforced concrete beam tests.

2. Materials Used

All materials used in this investigation were locally obtained. These included ASTM Type 1 cement, river sand as fine aggregate and OPS as coarse aggregate. The properties and grading curve of the river sand and OPS aggregates are shown in Table 1 and Fig.1 respectively. A Type-F naphthalene sulphonate formaldehyde condensate based superplasticiser in aqueous form was also incorporated and these properties are presented in Table 2.