



Predictive models for mechanical properties of hybrid fibres reinforced concrete containing bamboo and basalt fibres

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ABSTRACT

The aim of this study was to investigate hybrid fibre reinforced concrete containing natural Bamboo and basalt fibres and forecasting the effect of these fibres on Mechanical properties. The contents of Basalt fibres were (0%, 0.25%, 0.50%, 0.75% and 1.00%). The mechanical performance of the hybrid fibre-reinforced concrete was studied in terms of compressive, splitting tensile and flexural strengths. All the samples were tested at the ages of 7, 14, and 28 days. The results showed that an increase in fibre percentages led to a reduction in the concrete slump. It was also found that 0.75% Basalt fibres with 1% bamboo fibres resulted in the optimum performance of the mechanical properties of the concrete. Based on regression models, it was found that bamboo fibres have negative impact on the compressive and splitting tensile strength while basalt fibres enhanced this strength, however, the negative effect of bamboo fibres reduces with the age of concrete. While the effect of bamboo fibres on flexural strength was positive and basalt fibres have negative impact on it. It was concluded that the bamboo and basalt fibre have good relation in overall improving the mechanical properties of hybrid fibre reinforced concrete.

1. Introduction

Hybrid fibre-reinforced concrete is defined as a combination of more than one type of fibre in concrete. Green and sustainable concrete materials have been the main concern in the construction industry. Concrete is the most widely used man-made construction material in the world [1]. Fibres are usually added in concrete mixes to control cracking due to plastic and drying shrinkage. Fibres used in concrete mixes are available in different materials as well as sizes and shapes [2]. The main factors affecting the characteristics of fibre-reinforced concrete are water-cement ratio, percentages of fibres used, their diameters and lengths [3]. Cracking, earthquakes, high temperatures, and fires are among the issues which may lead to a reduction in the durability [4]. Common fibres added in concrete mixes include steel, polypropylene, glass fibre, polyester, and carbon. Some characteristics may be enhanced, and some would be diminished since each fibre has its different properties [5]. However, fibres can enhance the durability of

concrete [6]. The use of synthetic fibres can be costly, and the production process of the fibres may also consume high energy and may be harmful to the environment and human health [7].

Basalt is a type of igneous rock produced by the rapid cooling of lava. It is a type of mineral fibre present in volcanic rocks [8]. Basalt fibres are available in various forms such as chopped and fibre strands. Many investigations have been conducted on Basalt fibres as an ingredient for improving the properties of concrete [9–12]. Basalt fibres in concrete provide a lot of advantages such as high strength, high elastic modulus, good thermal and chemical stability as well as effective sound insulation and electrical characteristics [13].

Bamboo is available abundantly in Asia Pacific countries. Bamboo fibres are natural and are harvested from Bamboo plants. These plant-based natural fibres have many advantages such as low cost, low density, environment friendly, and are sustainable [14]. The Bamboo achieves its maturity within three to four years and consumes little energy to harvest [15]. Due to its outstanding properties such as low

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