ABSTRACT

This study is aimed at investigating the mathematical model of compressive strength which considers the effect of curing temperature on the mechanical properties of conventional concrete. A model is proposed for estimating compressive strength of concrete under isothermal curing conditions. The key features of the model are the relationships among ages of concrete, curing temperature, water to cement ratio, degree of hydration and the relative strength development.

The mechanical properties obtained were the compressive strengths at 3, 7, 28, and 91 days. Each mix proportion of concrete was divided into 3 sets to cure in water at standard and elevated temperature (50°c and 65°c).

The formulation of the model is proposed in two steps. First, the model is developed to predict the 28-day compressive strength. The concept of 28-day compressive strength model is based on the chemical composition (CaO) in both cement and fly ash, water to binder ratio, and ratio between paste volume and void volume of compacted aggregate. The equation can be applied to conventional and fly ash concrete under a curing temperature of about 30°C and no air entraining agent which is the limitation of this model. Then, it is deliberated that strength development depends on the changing rate of hydration reaction and microstructure due to the effect of temperature, water content and ages of concrete. The higher the curing temperature, the more rapid the strength development particularly at early age. Finally, the model is adjusted to predict compressive strength of conventional concrete at another temperature or fluctuating temperature from 3 days to 1 year using the concept of the relative strength development ratio based on the degree of hydration reaction.

The results of the model coincide well with experimental results, which show that this model can be used to evaluate compressive strength of concrete in real conditions.