CHAPTER 1

INTRODUCTION

1.1 General

The largest source of electricity production in Thailand is from coal. The by-product residue resulting from the combustion process is called fly ash. The amount of this ash annually increases due to the increasing power requirement. It is disposed in landfills, which creates environmental problems. Instead of discarding it, it is more beneficial and economic to utilize fly ash as an effective partial substitute for ordinary Portland cement in concrete construction. Among the materials which possess pozzolanic properties, fly ash appears to be the most attractive and readily available in Thailand.

When a portion of cement in concrete is replaced, the certain application properties of concrete are changed as shown in the chart below.

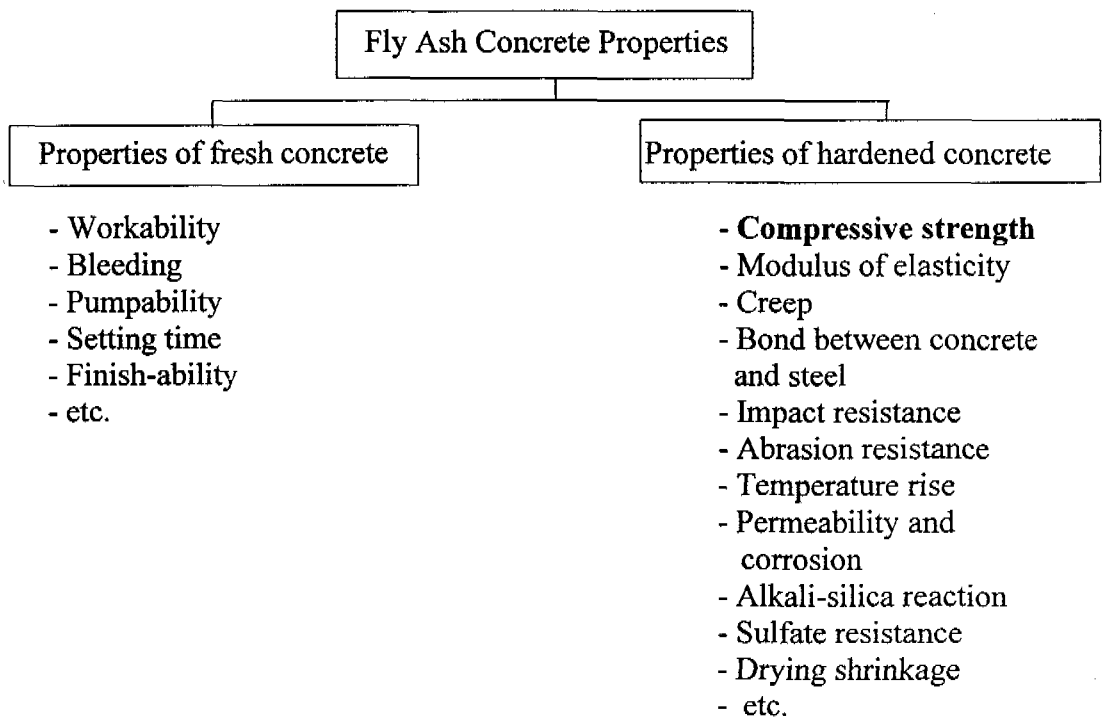

Fig. 1.1 The effects of fly ash on properties of concrete

Strength of concrete is a fundamental property in concrete design. Therefore the strength prediction is developed to take into account a variety use of fly ash. Due to the different types of fly ash in Thailand, the study takes into account various chemical composition of fly ash in order to predict the compressive strength of concrete with all classes of fly ash. To construct the model, this study collects data of various mix proportion, mostly from laboratories in Thailand including those from the universities and industries' laboratories.

1.2 Statement of Problem

Fly ash is an innovative material in Thailand's construction. Nowadays, the strength of fly ash concrete in mix proportion is practically designed by making trial mixes. This has disadvantages of uncertainty, cost and is time consuming. There is only a little research which helps the quantitative prediction of properties of fly ash concrete in Thailand, especially the equation for evaluating contribution of fly ash to the compressive strength of concrete. As a consequence, the design code for fly ash concrete is not available for practical engineers. That is an obstacle to the utilization of fly ash concrete.

Since concrete is used for many purposes and under various conditions of service, it is subjected to cure in different conditions. Accordingly the strength development of concrete will be different for the different conditions of curing adopted. The curing conditions with respect to time, moisture and temperature, thought to have effect on hydration of cement, have an important influence on the strength of concrete.

A compressive strength prediction model for fly ash concrete has been recently proposed by Tangtermsirikul et al. (1999). In the model, concrete is cured in isothermal temperature water at about 30°C. In the practical cases, the curing temperature could not be controlled due to the fluctuating temperature of the environment and temperature is high in mass concrete, which has strong effect on the degree of hydration of cement paste. This is the limitation of the model to have constant curing temperature about 30-60°C. The model still can not be applied to classified fly ash and the low unit calcium oxide content in mix proportion of concrete.

In addition, construction works in Thailand do not only use conventional concrete but also use other special concrete such as roller-compacted concrete and self-compacting concrete to achieve the construction requirement. These special types of concrete also need some understanding before being able to design such kinds of concrete.

1.3 Objective and Scope of Study

The aim of this study is to develop a model for evaluating compressive strength of concrete under various curing temperatures and chemical compositions of cement.

Three steps are involved in applying the model to estimate the compressive strength at elevated curing temperature: (1) establish the average degree of hydration for each mix proportion based on curing temperature history; (2) compute the normalization of strength ratio based on 28-day compressive strength; and (3) estimate compressive strength of concrete by using the normalization of strength ratio that based on the normalized hydration reaction and relative pore structure value.

In addition, the 28-day compressive strength model proposed by Tangtermsirikul et al. (1999) will be modified to predict other special concrete such as

self-compacting concrete and roller-compacted concrete by modifying the ratio between paste volume and void content of total aggregate to the conventional concrete's equation for the reason that the concrete have different methods of compaction.