CHAPTER I

INTRODUCTION

Introduction

In the present day, the application of prestressed concrete has widespread in all of the highrise-building construction and the precast industry. Since the prestressed concrete has the advantage that it can work out simultaneously after the time of prestressing transfer, eventhough the strength of the materials used are not fully developed, the removal of formwork can occur earlier and then gain with the multiple reuse of the same formwork. This reduces the cost of formwork and cycle-time of the construction especially in cast-in-place construction.

But, now the development of the prestressed concrete in the highrise-building construction and the precast industry has come to a point that the cycle-time of the construction, normally 4-5 days and 1-2 days for post-tensioned flat plate construction and precast construction respectively, cannot be reduced anymore. This is because of the waste of time during the initial set of cast-in-place concrete and the time the concrete to be prestressed. This time duration is approximately 1-3 days depending on the type of cement used, the curing condition, and the stressing system, etc..

This restriction of non-reducing time duration can be solved by the ancient technique, developed by the Romans, called the "DEWATERING" process. This process uses the advantage of lowering the water-cement ratio by extracting the excess water from the freshly placed concrete prior to initial set. The more the water reduction, the more earlier the compressive strength of concrete can develop which results in reducing the duration of time after placing to transfer the prestressing force to the concrete. This leads to the most desirable profit, the earlier removal of the formwork and the earlier serviceability of the prestressed concrete.

Objectives & Scope

The objectives of this study are

1. To determine the effect of vacuum dewatering on the rate of strength gain of concrete
2. To determine the effect of vacuum dewatering on the mechanical properties of concrete, namely compressive strength, splitting tensile strength, modulus of rupture and modulus of elasticity.

Experimental program is set up to study the effect of vacuum dewatering that accelerates the rate of strength gain of concrete mixes, having water-cement ratio and cement content as variables.

Literature Review

The vacuum dewatering process in which excess water is extracted from a concrete mix by applying suction has been used for a number of years in various parts of the world. Several research studies were done to find out how the vacuum dewatering process affects the concrete quality.

Lockhardt (1) stated that the vacuum concrete process has several advantages over unprocessed concrete including higher strength, lower shrinkage, less absorption, greater wear-resistance and improved frost-resistance. He also presented some details about the operation and application of the process.

Creskoff (1) had noticed that vacuum concrete, because of its higher strength, makes possible the use of a leaner mix for a specified strength.

Albert (1) also suggested that it is possible to make tests for concrete strength within a few minutes after concerte has been placed using some types of vacuum concrete testing machine.

Gershberg, Dessov and Ittin (2) presented a paper concluding the same as the one by Lockhardt.

Billner and Thorud (3) showed the use of the vacuum process applied to precast concrete houses as another viewpoint that it can reduce both cost and time in precast concrete construction. They also noted that the actual savings on any particular project depends, of course, on the number of typical houses and the number of panels cast from each mould.

Orchard (4) tested vacuum treatment at both sides and top and reported that the results tended to show that the top surface method was more effective than the former, provided a minimum mat size was used.

Garnett (5) reported that the reduction in gross water-cement ratio decreased with increasing depth of concrete, and that there appeared to be no effect at a depth greater than 15 centimeters. A coarse aggregate grading enabled slightly more water to be extracted than did the fine grading.

Buchan and Hawkes (6) studied the variation in the distribution of ingredients resulting from application of vacuum at the sides of specimens. The movement of the sand and cement during their vacuum processing results in a lowering of the aggregate-cement ratio and water-cement ratio in the concrete near the treated face. After vacuum treatment ceases, there is a progressive redistribution of the water content towards uniformity.

A paper in Concrete Construction journal (7) was presented to review the basic concept and profit of the vacuum dewatering process on conventionally non-treated concrete. It also pointed out that the amount of formwork needed for a job can often be reduced by as much as 80 %.

Lewis, Mattison and Smith (8) tested vacuum-dewatered concrete slabs made in the laboratory and compared with those done on non-processed concrete. They concluded that the 28-day compressive strength of vacuum-processed concrete is approximately the same as that obtained from non-processed concrete having an initial water-cement ratio the same as that to which the vacuum-treated concrete is reduced.

Plahn (9) had tested two concrete plates at the National German Institute for Materials Testing. One plate was to be vacuum-treated, the other not. He proposed to find out how the vacuum treatment improves the concrete quality; compressive strength, development of compressive strength in the top part and in the bottom part at various ages, splitting tensile strength, wear-resistance, shrinkage, etc.. After the vacuum treatment ceased, the water-cement ratio was reduced by 12.2% of the initial water cement ratio used. The test results could be summarized as follows: the compressive strength increase is about 50% at 1-day age and decreases to be about 30% at 28-day age, the development of the compressive strength is earlier either in the top part or in the bottom part (up to 94.0 % and 54.3 % at 1-day age, respectively).

Wenander (10,11) presented two papers about the vacuum dewatering process in various viewpoints including how the system works, its effect on concrete quality, popularity of the system, the type and capacity of the equipment used, job procedures, mix design, admixtures and also, the most important one, economy.

There was a paper presented in Concrete Construction journal (12) concluding the vacuum dewatering procedures. It was explained in details about the sequence of steps with the available equipment at that time.

Wenander and Malinowski (13) had presented a paper concluding the answers to the questions that occured after their two papers in 1975. They showed that the total concrete floor of 7,000 to 8,400 square feet per day can be placed and dewatered without overtime using only one set of equipment and the construction team of 4-5 men only.

Danielsson (14) showed in his paper that the owner was able to save about 60,000 dollars in his decision to change the design from a two-course floor, with a 1-inch-thick hard topping slab (installed by the specially contractor) over a 7-inch-thick reinforced base slab, to a single-course floor with 8-inch-thick vacuum-dewatered slab finished with a metallic aggregate dry shake.

There were also another two papers (15,16) about the demonstration of the vacuum dewatering process at New Zealand in 1980 and at Connecticut in 1981, respectively.