CHAPTER III

EXPERIMENTAL STUDY

Experimental Program

As shown in Table 1, the tests are divided into two series :

SERIES I to determine the influence of vacuum dewatering on the rate of strength gain of the concrete being vacuum-dewatered

SERIES II 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.

The specimens for these two series just mentioned above are 10 by 10-cm. beam specimens, 50 cm. long. After the third-point-loading test for modulus of rupture, schematically shown in Fig. 4, has completely ceased, those broken portions of the beam specimens are utilized as the modified-cube specimens for compressive strength tests and splitting tensile strength tests respectively. The schematic

หอสมุดกลาง สถาบันวิทยบริการ จุฬาลงกรณ์มหาวิทยาลัย

diagrams of these two strength tests are shown in Fig. 5 and Fig. 6 sequentially. But the ones for modulus of elasticity are the 10-cm. cube specimens cast seperately.

For SERIES I, tests are made upon several grades of conerete at various ages, varying the cement content and the water-cement ratio as shown in Table 2. For convenience,the tests must be divided into the following two parts :

Part A to determine the effect of water-cement ratio by varying the initial water-cement ratio with the constant cement content and the same final water-cement ratio

Part B to determine the effect of cement content by varying the cement content with both the same initial and final water-cement ratios.

For SERIES II, tests are made upon the same grade of concrete at 28-day age. The effect of curing condition is also included as another variable. Specimens used are the same as those of SERIES I mentioned above.

Preperation of the Specimens

Concrete was mixed in the electrical mixer. All of the aggregates used were commercial grades available in the market at that time. The coarse aggregate was limited to be 3/4 inch in maximum size conforming to the size of the

013047

specimens and the portland cement type I was used. The cement content was varied from 250 to 350 kg./m.^{3} of concrete to have the mix proportion as between 1:3.2:4.8 and 1:2.3:3.4 by weight. The percentage of sand in each mix was 40 percents by weight of the total aggregates. The details of each mix proportion were concluded in Table 3. After the mixing time passed, the fresh concrete was transported to the nearby pan, carefully remixed by hand to insure the uniformity of the concrete, and then was deposited into the prefabricated formwork.

Illustrated in Fig. 7, the formwork was made of plywood segments, being built-up as a row of 25 side-by-side blocks, 10-cm. in square section and 50 cm. long. Each block was divided by the plywood chips, except the middle one which was extra subdivided to perform as four 10-cm cube blocks, shown in Fig. 8. Thus, for each mix, the 24 beam specimens and 4 cube specimens were cast. They all were compacted by hand tamping in the standard manner as directed in AASHTO and British Standards, and screeded afterwards to the desired elevation. The remaining step in specimen preparation for the conventionally non-treated concrete was only the form stripping in the following day, whereas the intermediate one for the vacuum-dewatered concrete was the vacuum dewatering process.

As shown in Fig. 9, the filter pad was laid over the

concrete surface immediately after the screeding had terminated, followed by the top cover that projected beyond the dewatering zone by 10 cm. wide to provide as air-tight seal. Then the vacuum pump was started up to commence the dewatering process and prolonged, with the maintained vacuum at 60% of the atmospheric pressure shown in Fig. 10, until the squeezed-out water was no longer drained. The amount of the water drawn-off, shown in Fig. 11, was collected and utilized to approximate the final water-cement ratios later. As the duration of the vacuum dewatering process passed, the top cover and the filter pad both were taken off, and the sideforms were stripped at once to notify the stiffness of the concrete, which was cast approximately half an hour before. The remainder parts of the formwork were stripped on the following day provided the hardening process of the concrete was undisturbed.

Unfortunately, due to a number of confinements including the size of the available filter pad and top cover, the capacity of the concrete mixer, the strength of the plywood formwork related to the compaction procedure and so on, two mixes of concrete were coincident dewatered on condition that the wet concrete was mixed and deposited into place earlier than do the drier one. The details concerning about the vacuum dewatering process were concisely tabulated in Table 4. The final water-cement ratios of the vacuum

dewatered concrete were computed under the assumption that the average water-cement ratio of those two mixes must be the same eventhough their initial water-cement ratios are quite different. This assumption was proved to be true after the work of Buchan and Hawkes (4) and also confirmed later by the test results of this research.

After the stripping of the formwork, all specimens of each mix were divided into two groups. The first one, consisted of nine beam specimens and four cube specimens, was collected in the water pond to have the moist curing whereas the second one was left in the laboratory as the air-dry-cured specimens.

The Testing Procedures

First, the commencement of the experiments was existed at the Amsler 20-ton testing machine, where each beam specimen was subjected to third-point loading with 45-cm. span, shown in Fig. 12. Next, both of the broken portions were utilized as the modified-cube specimens for the compressive and splitting tensile strength tests at the Amsler 100-ton testing machine. The 10-mm. steel plates, 10 cm. wide, were placed between both the upper and lower sides of the specimen and the machine loading platform to act as the bearing plates in the compression test, shown in Fig. 13. Contrarily, in the spitting tension test these

interposing plates were displaced by some narrow strips of 10-mm. plywood, 10-mm. wide, shown in Fig. 14. All of the specimens were tested in the standard manner as modufied from ASTM C78, C116 and C496 respectively.

Being moist-cured in the water pond by 28 days after casting, the cube specimens for elastic modulus test were left in the room temperature to let the surfaces air-dry. As the appropriate time passed, the preselected surface of each cube specimen was prepared for the attachment of the electrical strain gage. The Amsler 40-ton testing machine was used in testing for the relationship between the compressive stress and the compressive strain, associated with the strain gage indicator and the switching box.

All of the testing conditions in every step of the experimental procedures were carefully maintained, whether that specimen was conventionally non-treated concrete or vacuum-dewatered one, in order to achieve the accurate results of these comparative tests.

In this research the total number of standard tested specimens is 750 pieces.