PANYNJ's Experience with

Airport Concrete Pavement Mixes and Test Results

by Casimir Bognacki

Since 1996, the Port Authority of NY & NJ (PANYNJ) has placed approximately 100,000 cubic yards of portland cement concrete pavements at our airports: LaGuardia (LGA), J. F. Kennedy (JFK), and Newark (EWR). The specified concrete was to have a 28-day flexural strength of 700 psi. Acceptance testing was based on ASTM C-78 third point loading test (beam). The beam size used was 6" x 6" x 20". We also made 6" x 12" "cylinders," ASTM C-39, with every beam.

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Both tests were performed to establish a relationship between cylinders and beams and make the case not to use beams for acceptance testing. After reviewing test data for 100,000 cubic yards, the relationship between the two tests was found to be quite variable, without a clear, defendable relationship except that as compressive strength increased, so did the flexural strength.

The mix design was:

- Minimal maximum coarse aggregate size No. 467 Stone (1.5").
- Minimum combined aggregate 65% by volume.
- Average air - 5.0%.
- Design W/C - .4 - 90% less than .45.
- Pozzolan must be used, minimum 20% of cementitious by weight.

The concrete mixes used at LaGuardia Airport and J.F. Kennedy contained flyash and a high cementitious content. There was little problem meeting the 700 psi flexural strength on any of the projects. In fact, 95% of the lots tested received the full 6% incentive payment. Only one lot of concrete received a 50% payment reduction.

ASTM has established a coefficient of variation of 5.7% for beams tested by a single operator in a laboratory; and a coefficient of variation of 2.9% for cylinders tested by a single operator in the field.

The coefficient of variation for the beams ranged from 5.3 to 6.8%. The in-test coefficient of variation for the cylinders ranged between 1.9 and 4.3%. It should be noted that the cylinders and beams were made and tested by many technicians. However, the testing variability was acceptable and certainly in line with the ASTM precision statements.

The beams had twice the variability of the cylinders. This certainly makes the case for using cylinders because of reliable repeatability. Samples are generally picked at random. However, when the technician on site observes a load that has an excessive slump, that load will also be tested. Such non-random samples are part of the statistics. This will tend to increase the overall variability of the test results. Nevertheless, the cylinders had the higher coefficient of variability.

The total coefficient of variability for beams ranged between 7.4 and 12%. For the cylinders, it ranged between 8.9 and 17.2%.

The data also show that beams are not as sensitive to variations in the percentages of entrained air and of water as are cylinders.

A regression analysis was performed for the LGA and JFK projects to determine the effect of air content changes in the mix on compressive and flexural strength. The results are as follows:

LGA: Percent air-compressive test - regression coefficient – .88
Percent air-flexural test - regression coefficient – .70

JFK: Percent air-compressive test - regression coefficient – .77
Percent air-flexural test - regression coefficient – .66

Thus, the percent of changes in air in a mix had a stronger correlation on the compressive strength than on the flexural strength.

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We attempted to plot the compressive and flexural strength data to establish a correlation between the two tests. It became obvious rather quickly that one equation would not define all four projects. Many of the commonly-used relationships between compressive strength and flexural strength did not hold.

Conclusions and Recommendations

- We could not establish any repeatable and reliable relationship between compressive and flexural strength.
- The overall coefficient of variability was higher for the compressive test data.
- The flexural strength requirements of 700 psi were met without difficulty.
- If pavement design is based on flexural strength, then test for flexural, not compressive, strength.
- We are investigating the benefits of increasing our flexural strength requirements to 800 psi.
- Develop a more "user friendly" test to determine flexural strength. ■

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A Formwork Minute

The temperature and rate of vertical placement of concrete are factors influencing the development of lateral pressures that act on the forms. If temperature drops during construction operations, rate of concreting often has to be slowed down to prevent a buildup of lateral pressure overloading the forms. Failure to regulate properly the rate and order of placing concrete on horizontal surfaces or curved roofs may produce unbalanced loadings and consequent failures of formwork. (From *Formwork for Concrete* by M.K.Hurd)