Research Objective
1. To evaluate core strength relative to in situ strength under different conditions likely to be encountered in the field.
2. To investigate core conditioning practices that provide better estimates of in situ strength.

Research Approach
- A total of sixteen 5-ft x 5-ft x 9-in slabs were cast and tested.
- Each slab accommodated 8 cores and 8 in situ specimens.
- In situ specimens were cast using a method similar to ASTM C 673, Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds
- Slabs were organized in pairs; each pair having the same mix as follows:
  - 3 concrete mix designs
  - 2 methods of core conditioning
  - 2 Absence/presence of rebar in the core
- In total, 8 combinations were studied.

Experimental Slab Features

Mix Design
Three mix designs, differing from each other primarily in terms of strength:
- a high-strength (5,000 psi) concrete typical of precast prestressed IDOT bridge beams,
- a regular-strength (3,500 psi) IDOT paving concrete, and
- a low-strength (≤3,500 psi) concrete, essentially the same mixture as the regular paving mix but with excess water and air.

<table>
<thead>
<tr>
<th>Mix Design</th>
<th>Regular</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Agg.</td>
<td>1400</td>
<td>1400</td>
<td>1400</td>
</tr>
<tr>
<td>Fine Agg.</td>
<td>1227</td>
<td>1108</td>
<td>1227</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>145</td>
<td>145</td>
<td>145</td>
</tr>
<tr>
<td>Cement</td>
<td>705</td>
<td>705</td>
<td>705</td>
</tr>
<tr>
<td>Water</td>
<td>29.2 gal (0.42)</td>
<td>29.6 gal (0.35)</td>
<td>34.8 gal (0.50)</td>
</tr>
<tr>
<td>Air-Entraining Admixture</td>
<td>4.0 oz</td>
<td>4.0 oz</td>
<td>4.0 oz</td>
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</tbody>
</table>

In Situ Strength Specimens
In this research, the cores were cast using ASTM C 673 modified. A side study determined that the specimens shared the same temperature profile as the slabs and could be consolidated in such a way to produce the same density as the hardened concrete in the slab.

In 1-day wet core conditioning, the typical for precast concrete slabs, cores were conditioned for 24 hours (i.e., 1-day wet condition).

Experimental Slab Matrix

Concrete for each slab was provided by a nearby ready-mix plant using Department-approved mix designs. Each truck was batched with 4 yd³ of concrete to help ensure consistency and adequate mixing action.

A total of 16 slabs were cast and tested:
- 8 regular-strength paving concrete slabs wet-cured with burlap and plastic sheeting for 3 days
- 4 slabs without embedded rebar
- 4 slabs with embedded rebar
- 4 high-strength concrete slabs wet-cured for 1 day
- 4 low-strength concrete slabs wet-cured for 3 days

For each set of 4: half of the slabs had their cores conditioned with the 1-day wet treatment, the other half had their cores conditioned with the 1-day dry treatment.

Statistical Analysis of Strength Results
An analysis of variance (ANOVA) was used to statistically evaluate the strength results of each slab and each pair of related slabs.

The null hypothesis for the analysis was: “Population samples for a particular type of core condition (e.g., high-strength) have the same mean value as that from the molded-in-place cylinder samples for a given concrete mixture and condition.”

Thus, the alternative hypothesis was: “Population samples have different mean values.” In which case, correction factors were then applied to the average strength of a slab’s cores such that the null hypothesis would be made true.

That is, if the core strengths and in situ specimen strengths for a slab were determined to be statistically different (i.e., null hypothesis is false), correction factors were applied to the cores’ results to make them statistically similar to in situ results in a 95% confidence level.

For this study, the correction factors providing the most confident strength estimations were determined to be when the cores were subjected to 1-day dry conditioning.

Conclusions
- 1.05 for 22 pavement cores not containing rebar
- 1.06 for 23 pavement cores containing rebar
- 1.05 for 23 pavement cores in which some have, and the others do not have, rebar
- 1.03 for 23 high-strength concrete cores without rebar