Durability Engineers: Low-strength Concrete Strip Footing Evaluation with Rebound Hammers and GPR

Non-destructive testing methods to assess the strength of concrete footings and identify the presence, depth and orientation of steel rebar

Overview

- Durability Engineers needed to assess approximately 180 ft of concrete footings and identify locations for taking core samples
- The Silver Schmidt Rebound Hammer and the Proceq GP8000 Ground Penetrating Radar (GPR) were used for efficient testing
- The team successfully identified variability in the concrete strength and areas of lower compressive strength

Challenge

In a U.S. municipality building construction project located in the Mid-Atlantic United States, delays in the construction schedule were incurred. During the construction, approximately 180 linear feet of cast-in-place concrete footings exhibited compressive strengths below the project specified requirements.

From testing completed by the quality control testing laboratories, concrete cylinders cast during construction and concrete cores extracted from the footings after placement indicated variable and low compressive strengths. Due to the below specified compressive strengths, the concrete footings were scheduled for demolition which would delay the construction schedule and cause additional cost for demolition, repair, and concrete reinstatement.

Solution

To evaluate the relative strength of the concrete footings, the concrete footings were excavated and exposed for assessment. DE performed a visual assessment and nondestructive testing utilizing a Screening Eagle's Silver Schmidt OS8200 rebound hammer. The rebound hammer measurements coupled with the footing placement dates and approximate truck number discharge locations were used to observe trends and identify locations for core sampling and subsequent laboratory testing. DE performed the following analysis:

- Rebound Hammer - Rebound hammer testing was performed in general conformance with ASTM C805, “Standard Test Method for Rebound Number of Hardened Concrete.” The rebound hammer was used to provide indications of relative concrete strength along the length of the exposed concrete footing. Rebound hammer measurements were taken at 2-foot increments along the exposed concrete footing.

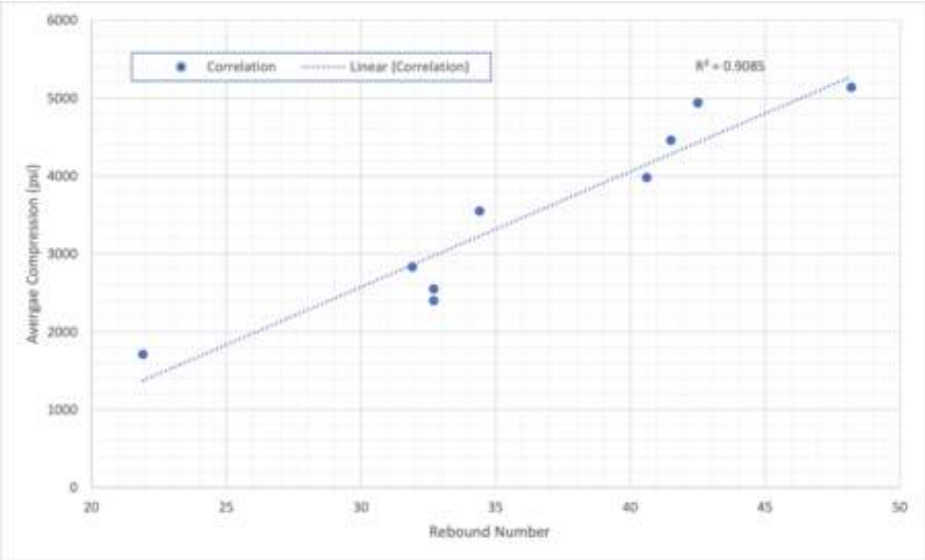
- Ground Penetrating Radar (GPR) – Georadar GP8000, GPR was used to assess the as-built conditions of the footing and identify the presence, orientation, and depth of steel reinforcement and support the core extraction process.

- Laboratory Analysis – To correlate the rebound hammer results and determine the root cause of the below specified compressive strength, concrete core samples were submitted to a laboratory for petrographic analysis, density, compressive strength testing.

Durability Engineers onsite using the Silver Schmidt Hammer

Results

The rebound hammer results provided relative indication of the concrete compressive strength around the strip footing. As shown in the figure below, variability in the various concrete truck placements revealed variability in the concrete compressive strength between each truck.



Correlation of compression and NDT results

Compressive strength testing results correlated with the measurements by Screening Eagle's Silver Schmidt OS8200, see plot above, and allowed for identification of areas with lower compressive strengths. This variability allowed DE to isolate the below-specified strength placements and allowed the engineer to design repairs to minimize interruption to the project schedule and budget.

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