



Case Study: Courtyard by Marriott; Oklahoma City, Oklahoma



Flintco, Inc. completed an eight-story, 225-room Courtyard by Marriott hotel in downtown Oklahoma City. Using the IntelliRock system to optimize post-tensioning and provide reliable temperature profiling during cold-weather concrete operations saved one day per pour during the project.

Project Background

Flintco Inc. completed a 225-room Marriott Courtyard hotel in downtown Oklahoma City. The \$20-million project placed about 7,400 cubic yards of concrete for cast-in-place piers and 16 elevated decks.

The project began in late fall during the time of year that would require Flintco Project Superintendent, Randy Holland, to do much of the cast-in-place concrete work during cooler weather, when concrete gains strength more slowly. Holland gained experience with the IntelliRock system while using it on the \$52 million University of Oklahoma football stadium expansion project. With IntelliRock, Holland could check real-time, in-situ concrete temperature and strength at any time, a great advantage on this post-tensioned, elevated deck job. The IntelliRock system's ability to provide traceable documentation on a structure's temperature also made IntelliRock a valuable quality assurance tool.

Estimating Concrete Strength

The IntelliRock system streamlined and accelerated concrete operations on the project based on ACI and ASTM standards for using the maturity method of estimating concrete strength. The IntelliRock system estimates the strength gain within the structure, not within a companion specimen, a critical difference because the hydration rate of test specimens is typically different than the hydration rate of the placed element. Utilizing a system that measures and records in-situ strength and temperature is an improvement over using traditional test specimens, since they gain strength at different rates.

Normally a testing lab, through destructive testing of cylinder specimens, provides estimates of concrete strength on a project like this. Even though this project's contract called for pulling six to eight extra early break cylinders, Holland implemented the IntelliRock system in order to know the strength of a

placement at any given time, without having to call the lab and have a set of cylinders tested which would not represent the true strength of the placement.



Job site in downtown Oklahoma City, April 2003.

Optimizing Post-tensioning with IntelliRock

Since this job involved placing post-tensioned elevated decks, Holland knew that the ability to check in-place strength in real-time with the IntelliRock system would significantly enhance his critical path as well as his QA efforts – it allowed Holland to know when to stress the post-tension cables. “We would pour concrete and plan on stressing at a minimum of 60% of design strength,” stated Holland. “But you shouldn't wait until it reaches 100%. There is a window where you can stress per specifications. I like to do it as soon as I know and can document that we have reached the required 60% strength.”

If post-tensioning is done too early, there is risk of compressive-strength failure. If post-tensioning is done at the right time, it reduces overall crack formation by counteracting the tensile stresses before they exceed the tensile strength. If done too late, the post-tensioning will still hold the cracks

together and be structurally sound, but with arguably increased exposure to water and salt-intrusion, corrosion, etc. By using the intelliRock system, Holland had timely information and thus, confidence about when the optimal time had arrived to stress the cables.

Concrete Operations

The strength estimates provided by the intelliRock system allowed Holland to accelerate the project workflow. “On a cast-in-place job, the quicker you can cycle the forms, the faster the job is going to go,” said Holland. “The key to cycling the forms is knowing when you reach the required strength. On this job, I was able to cycle forms in 2 to 3 days even in colder weather because we had the in-situ information necessary to know how much the element needed protection or how much supplementary heat was needed. Had I waited for cylinder results from the lab, it would have taken five to seven days.” On this project, cycling forms faster based on intelliRock strength estimates saved Holland on the average one 8-hour day per pour. The total number of man-hours saved for the 16 pours on the project totaled 128 hours.

During a deck pour, which was either 6,500 square feet or 11,000 square feet deck, Holland would place an intelliRock logger in each deck, toward the end of the pour but away from the edge. When these loggers indicated strength was reached, Holland knew the rest of the deck had achieved strength as well. “Having used the intelliRock system before, I know the loggers are giving me a true strength reading,” continued Holland. “I also used intelliRock to validate data from cylinder breaks. There is a lot of human error in the cylinder testing process – how they get taken, stored, handled, and cured, etc. On this particular job, we continued to break validation cylinders for the purpose of confirming the QC batching process. In addition, the cylinder breaks provided a level of comfort to some professionals on the project who weren’t familiar with intelliRock. Based on the intelliRock information, I would make sure to get cylinder breaks as quickly as possible, but it was the sensors I relied on to know that structurally the concrete was okay.”

Cold Weather Quality Assurance

The intelliRock system also proved its QA worth by providing Holland a way to check concrete temperatures and strengths in cold weather. “We began pouring piers in September, and poured elevated decks during December, January, and February, during what turned out to be an unusually cold winter,” Holland said. “I had to make to make sure the concrete didn’t freeze. Keeping it warmer would let it gain strength faster.”

Project specifications required that concrete temperature on placements be at least 50 °F (10 °C) or above. After a pour is completed, concrete begins to generate its own heat; however, in cold weather it is sometimes necessary to heat from underneath as well as with blankets. Holland would routinely connect the intelliRock reader to the embedded sensors within the first 24 hours just to check the temperature of a placement. “This was important, because I was spending money wrapping decks, tenting them underneath and heating them. At one point during the project, I had 3 million BTUs of heat running. As long as I had at least 50 °F (10 °C) concrete temperatures and it didn’t freeze, it was okay. At 25 °F (-3.9 °C) ambient temperature, I was having 70 °F (21.1 °C) concrete.”

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Summary

“intelliRock was a quality assurance and quality control tool that let me know when to stress tendons and continually cycle forms to keep the job moving,” concludes Holland. “Pouring through the winter, just being able to know the concrete’s temperature was a big help. This is my second job using intelliRock – I will not do another cast-in-place concrete job of any size without using intelliRock, because it speeds the project up, saves money and because of the quality assurance data it provides. It lets me know where I am with my strength and temperature. If you are ever going to get into an argument with a testing lab or a structural engineer, you need some data to verify your position, and the intelliRock system provides that.”