

Concrete Pre-qualifications—Case Study

Ritz-Carlton Toronto (Simcoe Centre)

Overview

The Ritz-Carlton development is located on the south side of Wellington Street, between Simcoe and John Streets. The 990,000 square foot facility features a five-star hotel with 266 rooms and 153 condominium residences in a stately, elegant point tower destined to become a city landmark. High strength concrete mixes up to 75 MPa were required for various elements. While historical data was available for most mixes, historical data for the high strength mixes was not available and in order to pre-qualify the mixes, trial batches were done in order to determine the correct w/c ratio for each mix.

General Notes

In the process of pre-qualifying a mix design, three basic steps must be followed: (1) determination of the standard deviation of strength results, (2) determination of the required average or target strength, and (3) selection of mixture proportions required to produce the average strength, either by trial mixture procedures or by appropriate past experience. When a concrete producer has a suitable record of between 15 and 30 consecutive strength tests for a specific mix design, the standard deviation of that mix can be calculated. The required average compressive strength of the mix, f_{cr} , may then be calculated using table 5.3.2.1 (Required Average Compressive Strength When Data Are Available to Establish A sample Standard Deviation) of ACI 318. Once the target strength is established, concrete mixture proportions can be determined by the designer using suitable past field experience or by laboratory trial mixtures.

In the event that a concrete production facility does not have an acceptable record of field test results

to calculate the standard deviation, laboratory trial mixtures having proportions and consistencies required for the proposed work can be made. These mixtures must be prepared using at least three different w/c ratios that will produce a range of strengths encompassing the required average strength, f_{cr} , determined using the table of results. For each w/c ratio, at least three test cylinders must be cast for each test age, including that designated for determination of f_c' . From results of compressive cylinder tests, a curve can be plotted showing the relationship between w/c ratio and compressive strength. An appropriate w/c ratio for the mix can then be found by simple interpolation of the curve.

Site Specifics

75 Mpa– Parking Columns (C-1)

75 Mpa– Parking Columns (SCC)

50 Mpa– Shear walls, columns slabs, beams (SCC)

Historical data was not available for these three mixes. CSA & ACI 318 standards require that if no historical data is available for a mix, then the target strength should be calculated as follows:

For specified 28 day strength > 35MPa

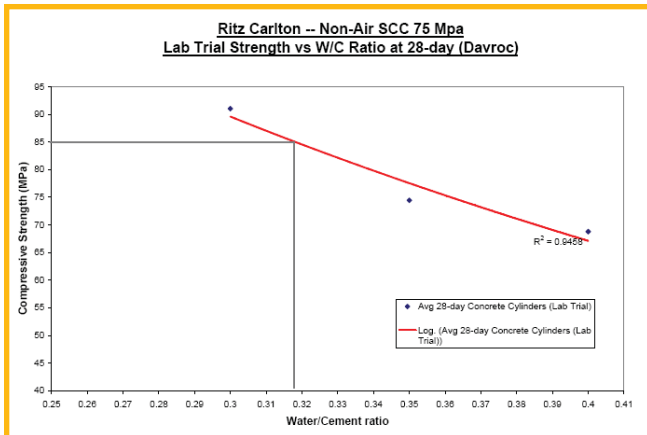
$$f_{cr} = 1.10f_c' + 4.83$$

Ex: For 75 Mpa the f_{cr} was 87.33

f_{cr} being 28 day target strength and f_c' being the 28 day required strength. Three lab trials were conducted using 3 different w/c ratios and the 28 day compressive strength results were plotted. A line of best fit was drawn and the w/c ratio for the mix was determined from interpolating the graph. The w/c ratio chosen was 0.28.

After determining the required w/c ratio, a production trial was performed to verify the results of the lab program. The 28 day compressive strength results were then recorded to assure they met the

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requirements. The average strength of the three cylinders was 99 Mpa. Therefore, the mix was deemed acceptable for use in this application.

Recommendations

At the commencement of a project and once the ready mix contractor is chosen, the pre-qualification process must begin immediately. Specifically, when high performance concrete mixes, such as self-consolidating or high strength concrete are involved. This is because, in the event that historical data is unavailable, the lab and batch trial process will require substantial lead time that may impact the schedule.

Further Reading

For more information check ACI 318-5 & CSA A23.1-04