SmartRock™

How to calibrate and use concrete maturity

SmartRock™

Giatec SmartRock™ is a wireless rugged sensor that can be embedded in the formwork at the time of pouring in order to measure and record concrete temperature during curing and hardening. The temperature data can be downloaded using a free mobile app available on iOS and Android platforms. The temperature information can be used for quality control and assurance purposes. Moreover, the temperature history of concrete can be correlated to its strength based on the maturity concept. This is described below.

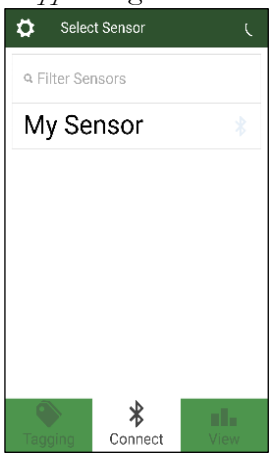
Concrete Maturity

Knowing the temperature history, the strength of concrete can be estimated using a calibration curve based on the concrete maturity concept as per specifications in the ASTM C1074 standard. This method is well-accepted by DOTs, NRMCA, PCA, and ACI in the US, as well as CSA in Canada. The maturity method is described in details here: http://www.giatecscientific.com/knowledge-center/concrete-maturity-in-situ-compressive-strength/

Traditionally, contractors collect the temperature data using wired temperature sensors, calculate the maturity index (or temperature-time factor), and use a calibration curve to estimate the concrete strength. The SmartRock™ sensor and mobile app together offer an easy tool for data collection and analysis on the job site. The user just needs to enter the mix calibration information in the SmartRock™ app and assign it to a particular sensor. Then, the real-time strength values would be automatically calculated and shown in the app once the user connects to the SmartRock™ wireless sensor.

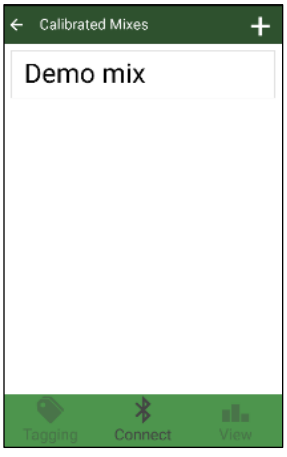
The concrete maturity calibration should be conducted for a particular concrete mixture before the project is started. If this information is provided by the concrete producer or has been previously developed, the user can simply enter the data on the app as following these steps:

1. Click on the gear icon in the Connect tab to go to app settings.



2. Go to the "Calibrated Mixes".

3. Click on the + icon to add a mix.



4. Add the mix name, datum temperature, maturity and strength values.

These steps are fully described in the SmartRock™ user guide:
http://www.smartconcretesensors.com/wp-content/uploads/2016/02/SmartRock-User-Guide-V3.pdf

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Develop Maturity Calibration

Concrete maturity calibration can be easily developed following the instructions in the ASTM C1074 standard. Users can use SmartRock™ sensors to facilitate this process. The main required steps are summarized as follows:

1. Prepare and mix the concrete batch for at least the volume of 17 specimens (10 x 20 cm cylinders).
2. Cast and cure all the 17 cylinders in the laboratory at room temperature (23 °C) in standard curing room.
3. Insert the temperature sensor cable of two SmartRock sensors in the middle of 2 of the above cylinders. NOTE: Tag the SmartRock™ sensors before use, and assign the pouring time after embedding the temperature sensor in the concrete cylinder. Also, assign the "Demo mix" to the sensor.
4. At the ages of 1, 3, 7, 14 and 28 days, perform the following measurements:
    a. Connect to SmartRock™ sensors using the mobile app, record the measured "maturity index" from the app, and calculate the average values of 2 sensors. NOTE: discard the strength value shown in the app. The "Demo mix" is used only to calculate the maturity index.
    b. Using a compression machine, test and record the average value of "concrete strength" of 3 cylindrical specimens.
5. Enter the above 5 pairs of maturity-strength data as well as the datum temperature (see below) in the settings section of the SmartRock™ app.

The mix calibration is now ready to be assigned to a SmartRock™ sensor in a project where the calibrated concrete mix is used.

Datum Temperature

The datum temperature is a temperature below which we are assuming concrete does not develop strength. There is a detailed procedure as described in the ASTM C1074 to calculate the datum temperature for a particular concrete mixture. In most cases this temperature is between -10 °C to 0 °C. For simplicity purposes, the datum temperature can be assumed as 0 °C which is a conservative assumption. If you test and measure the datum temperature for a concrete mixture, please use it for the "Demo mix" in the calibration stage and then in the data entry of the calibrated mix in the SmartRock™ app.

NOTE: This is a simplified guide for your general information. Please refer to detailed instructions in the ASTM C1074 standard specification when conducting the concrete maturity calibration.

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