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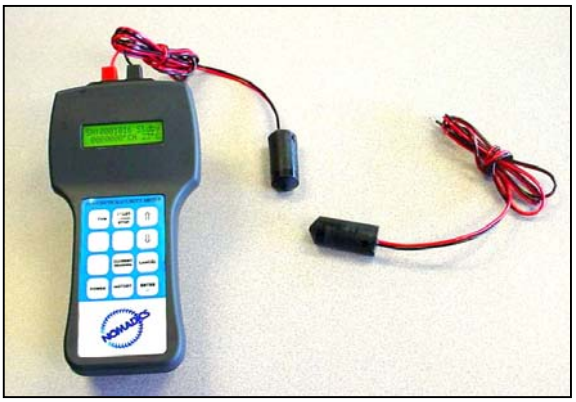

Concrete Maturity Meter Methods

Time-temperature records are playing an increasingly important role in the monitoring and quality control of fresh concrete applications. Construction personnel use these records to verify proper placement and curing processes, prevent concrete defects, ensure structural safety, and to speed construction.

Properly performed, concrete temperature monitoring can produce enormous cost and time savings, particularly since concrete work is often such a critical part of a project's schedule.

Despite the obvious benefits, concrete temperature monitoring is not yet in widespread use. One reason is that acquiring useful data has not always been as easy as it might seem. Monitoring temperature in concrete presents unique challenges that make conventional measuring instruments and methods less than ideal choices.

PROPER APPLICATION

Concrete temperature monitoring involves embedding temperature sensors, typically thermocouples, in concrete to monitor temperature at various points. The sensors are used to track temperature changes during the concrete curing process. This information is meaningful for a variety of reasons. In mass concrete applications, excessive temperature differences within the curing concrete can lead to cracking and structural defects. Temperature profiles are also an important indicator of concrete strength, a determination referred to as "concrete maturity". Concrete maturity is important because an early determination of concrete strength can lead to the next phase of construction, saving significant project costs. The procedures to set up the time temperature curves can be found at http://courses.washington.edu/cm420/lec8/sld001.htm.

SPECIFICATIONS/DETAILS

Construction sites are dirty, dangerous, constantly changing, and subject to widely varying weather conditions, all of which serve to make concrete temperature monitoring difficult. Equipment that is simple to use, rugged, and as durable as possible for long periods of unattended operation is best. The following factors are especially important:

- **Ease of use**. Field temperature monitoring often has to be performed by people unfamiliar with instrumentation, sensing or computerized technology. If the recording system is too complicated, the equipment will not be used properly, if at all.

- **Connectivity and accessibility**. Structural concrete elements to be monitored are frequently hard to access. This affects the placement of temperature probes and how easily the recorded information can be retrieved. Acquiring, displaying and reporting the information can often be

difficult and using a laptop computer in the field is not always practical. There are both direct connect type as well as wireless.

- **Ruggedness and reliability**. Temperature probes are commonly damaged as the concrete is poured into place. Wires can often get in the way of ongoing construction processes. Some recording instruments do not provide enough readings or sufficient battery life to reliably perform for long periods of time. Some are delicate and not well suited for the rugged outdoor conditions. Others are primitive and do not provide enough backup information. Proper selection for the application is required.

- **Accuracy**. Temperature probes are often error-prone and require frequent calibration, particularly with long probe runs and constantly changing outdoor conditions.

- **Security**. A large or expensive instrument on a construction site becomes a target for vandals. If the equipment has buttons or switches, these become a target for tampering. It is important that the unit be low profile and as tamper-proof as possible to ensure collected data is kept secure.

COST INFORMATION

Costs of maturity meters are dropping as its use is beginning to be more widespread. There are also several different model types are being introduced. In 1998 single-channel meters that computed maturity indices based on various maturity functions and have personal computer connections, cost approximately $350. Meters with programmable features such as variable datum temperatures and/or activation energies are preferred over simple models because of the flexibility they offer. The cost of developing a strength-maturity curve has been estimated at $5,000, again at 1998 levels.

FURTHER INFORMATION

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ASTM Standard C1074-98 "Standard Practice for Estimating Concrete Strength by the Maturity Method"
http://www.utexas.edu/research/ctr/pdf_reports/1714_S.pdf Center for Transportation Research, University of Texas at Austin “Match Cure and Maturity – Taking Concrete Strength Testing to a Higher Level”