

## CODE

least the first 3 days after placement, except if accelerated curing is used.

(c) Accelerated curing to accelerate strength gain and reduce time of curing is permitted using high-pressure steam, steam at atmospheric pressure, heat and moisture, or other process acceptable to the licensed design professional. If accelerated curing is used, (1) and (2) shall apply:

- (1) Compressive strength at the load stage considered shall be at least the strength required at that load stage.
- (2) Accelerated curing shall not impair the durability of the concrete.

(d) If required by the building official or licensed design professional, test results for cylinders made and cured in accordance with (1) and (2) shall be provided in addition to test results for standard-cured cylinders.

- (1) At least two 150 x 300 mm or at least three 100 x 200 mm cylinders to be field cured shall be molded at the same time and from the same samples as standard-cured cylinders.
- (2) Field-cured cylinders shall be cured in accordance with the field curing procedure of **ASTM C31** and tested in accordance with **ASTM C39**.

(e) Procedures for protecting and curing concrete shall be considered adequate if (1) or (2) are satisfied:

- (1) Average strength of field-cured cylinders at test age designated for determination of  $f'_c$  is equal to or at least 85 percent of that of companion standard-cured cylinders.
- (2) Average strength of field-cured cylinders at test age exceeds  $f'_c$  by more than 3.5 MPa.

## COMMENTARY

**R26.5.3.2(c)** This section applies whenever an accelerated curing method is used, whether for precast or cast-in-place elements. **EB-001.15**, and **PCI MNL 116**, and **PCI MNL 117** provide general information on accelerated curing. Accelerated curing procedures require careful attention to obtain uniform and satisfactory results. Preventing moisture loss during the curing is essential.

The compressive strength of accelerated-cured concrete is not as high at later ages as that of nominally identical concrete continuously cured under moist conditions at moderate temperatures. Also, the modulus of elasticity,  $E_c$ , of accelerated-cured specimens may vary from that of specimens moist-cured at normal temperatures.

**R26.5.3.2(d)** Strengths of cylinders cured under field conditions may be required to evaluate the adequacy of curing and protection of concrete in the structure.

The Code provides a specific criterion in 26.5.3.2(e) for determining the adequacy of curing and protection afforded to the structure. For a valid comparison, field-cured cylinders and companion standard-cured cylinders need to be made from the same sample. Field-cured cylinders are to be cured, as nearly as possible, under the same conditions as the structure. The field-cured cylinders should not be treated more favorably than the structural members they represent.

In evaluating test results of field-cured cylinders, it should be recognized that even if cylinders are protected in the same manner as the structure, they may not experience the same temperature history as the concrete in the structure. This different temperature history occurs because heat of hydration may be dissipated differently in a cylinder compared with the structural member.

**R26.5.3.2(e)** Research (**Bloem 1968**) has shown that the strength of cylinders protected and cured to simulate good field practice should be at least about 85 percent of standard-cured cylinders if both are tested at the age designated for  $f'_c$ . Thus, a value of 85 percent has been set as a rational basis for determining the adequacy of field curing. The comparison is made between the measured strengths of companion field-cured and standard-cured cylinders, not between the strength of field-cured cylinders and the value of  $f'_c$ . Test results for the field-cured cylinders are considered satisfactory, however, if the strength of field-cured cylinders exceeds  $f'_c$  by more than 3.5 MPa, even though they fail to reach 85 percent of the strength of companion standard-cured cylinders.

The 85 percent criterion is based on the assumption that concrete is maintained above 10°C and in a moist condition for at least the first 7 days after placement, or high-early-strength concrete is maintained above 10°C and in a moist condition for at least the first 3 days after placement.