Concrete Tech Tip
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Curing In-Place Concrete

1. WHAT is Curing?

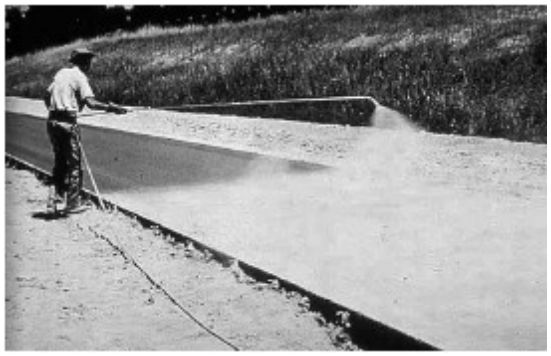
Curing is the maintaining of a satisfactory moisture content and temperature in concrete. Curing begins after placement and finishing so that the concrete may develop the desired strength and durability.
Without an adequate supply of moisture, the Portland (hydraulic) cement in the concrete cannot react to form a high quality product. Drying may remove the water needed for this chemical reaction called "hydration" and the concrete will be of poor quality. Temperature is an important factor in proper curing, since the rate of hydration is temperature dependent. For exposed concrete, relative humidity and wind conditions are also important; they contribute to the rate of moisture loss from the concrete.

2. WHY Cure?

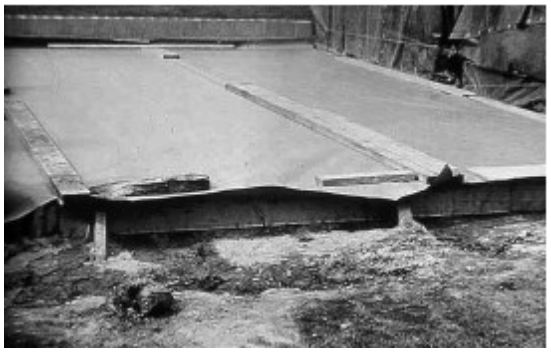
Several important reasons are:

a. **Predictable strength gain.** Laboratory tests show that concrete, in a dry environment, can lose as much as 50 percent of its potential strength compared to similar concrete that is moist cured. Concrete placed under high temperature conditions will gain early strength quickly, but later strengths may be reduced. Concrete placed in cold weather will take longer to gain strength, delaying form removal and subsequent construction.

b. **Improved Durability.** Well-cured concrete has better surface hardness and will better withstand surface wear and abrasion. Curing also makers concrete more water-tight, which prevents moisture and water-borne chemicals from entering the concrete, thereby increasing durability and service life.



Application of liquid-forming compound with hand sprayer



Slab-on-grade covered with waterproof paper

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References

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2. *How to Eliminate Scaling,* Concrete International, February 1980. American Concrete Institute, Farmington Hills, MI.
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4. ASTM C171, *Specification for Sheet Materials for Curing Concrete,* American Society for Testing Materials, West Conshohocken, PA.
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8. CIP 11 *Curing In-Place Concrete,* Concrete in Practice Series, with permission from NRMCA, Silver Spring, MD.

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c. **Better serviceability and appearance**. A concrete slab that has been allowed to dry out too early will have a soft surface with poor resistance to wear and abrasion. Proper curing reduces crazing, dusting, and scaling.

3. HOW to Cure.

Moisture Requirements for Curing: Concrete should be protected from losing moisture until final finishing using suitable methods like wind breaks, fogger sprays or misters, and evaporation retarders to avoid plastic shrinkage cracking. After final finishing, the concrete surface must be kept continuously wet or a membrane curing compound applied. CSA A23.1 Table 19 stipulates a minimum cure period of 3 days at $\geq$ 10°C or for the time necessary to achieve 40% of design strength. This requirement is extended to 7 days at $\geq$ 10°C and/or 70% of design strength when the concrete will be exposed to cycles of freezing and thawing and in the presence of chlorides from sources such as de-icing chemicals. Consult the standard for more details.

Systems to keep concrete wet include:

a. Burlap, cotton mats, non-woven geotextiles and rugs used with a soaker hose or sprinkler. Care must be taken not to let the coverings dry out and absorb water from the concrete. The edges should be lapped and the materials weighted down so that they are not blown away.
b. Sprinkling on a continuous basis is suitable provided the air temperature is well above freezing. The concrete should not be allowed to dry out between soakings, since alternate wetting and drying may damage the concrete.
c. Ponding of water on a slab is an excellent method of curing. The water should not be more than -10°C cooler than the concrete and the dike around the pond must be secure against leaks.
d. Straw that is sprinkled with water regularly. Straw can easily blow away, and if it dries, can catch fire. The layer of straw should be 150mm thick, and should be covered with a tarp.
e. Damp earth, sand, or sawdust will cure flatwork, especially floors. There should be no organic or iron staining contaminants in the materials used.

Moisture Retaining Materials Include:

a. Liquid membrane-forming curing compounds - must conform to ASTM C309 and should be applied at the manufacturer's suggested rate. Do not apply to concrete that is still bleeding or has a visible water sheen on the surface. While a clear liquid may be used, a white pigment will provide reflective properties, and will allow for a visual inspection of coverage. A single coat may be adequate, but where possible a second coat, applied at right angles to the first, is desirable for even coverage. If the concrete will be painted, or covered with vinyl or ceramic tile, then a liquid compound that is non-reactive with the paint or adhesives must be used, or a compound that is easily brushed or washed off. On floors, the surface should be protected from the other trades with scuff-proof paper after the application of the curing compound.
b. Plastic sheets - either clear, white (reflective) or pigmented. Plastic should conform to ASTM C171, be at least 4 mils thick, and preferably reinforced with glass fibers. The plastic should be laid in direct contact with the concrete surface as soon as possible without marring the surface. The edges of the sheets should overlap and be fastened with waterproof tape and then weighted down to prevent the wind from getting under the plastic. Plastic will make dark streaks wherever a wrinkle touches the concrete so plastic should not be used on concretes where appearance is important.
c. Waterproof paper - used like plastic sheeting, but does not mar the surface. Should also conform to ASTM Standards.

d. Although evaporation retarders may be used between finishing operations to prevent plastic shrinkage cracking, they should not be used as finishing aids or curing compounds.

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