

INTRODUCTION

Concrete is cured by ensuring that proper moisture and temperature conditions are maintained while the concrete gains strength, usually for around seven days. Improperly cured concrete will never gain its entire strength and improper curing can affect durability and resistance to wear. Weather extremes are one of the main hazards to making sure concrete cures properly. Hot, windy conditions can cause water to evaporate out of the concrete before it binds chemically with the cement. Concrete that is exposed to temperatures below 40 degrees will take more time to develop its maximum strength. In this unit you will learn proper curing methods and how to protect wet concrete from damage by foot or vehicle traffic.

**FOCUS
ASSIGNMENTS**

FOCUS ASSIGNMENTS

1. Write a short description of any situations you have encountered on jobsites that made proper curing difficult.
2. Participate in a discussion with your classmates about difficult situations they have encountered and what methods they used to ensure that the concrete was cured properly.



Writing



Interpersonal



Employability

**UNIT
OBJECTIVE**

After completing this unit, you will show the following competencies by scoring at least 85% on the Written Test.

**SPECIFIC
OBJECTIVES**

1. State reasons for curing concrete.
2. Match types of curing to their methods of application.
3. Discuss briefly the proper time to cure concrete.
4. Select from a list factors that regulate length of curing time.
5. Select from a list factors that may affect curing.



6. State advantages of using a curing compound.
7. Identify curing equipment.
8. State minimum curing requirements for concrete.
9. Name types of protection needed for concrete.
10. Select from a list temperatures at which protection is needed.
11. Select from a list reasons for protecting concrete in hot weather.
12. State methods used to protect concrete in hot weather.
13. Select from a list precautions to use when protecting concrete during hot weather.
14. Select from a list reasons for protecting concrete in cold weather.
15. State methods used to protect concrete in cold weather.
16. Select from a list precautions to use when protecting concrete during cold weather.
17. Name types of physical protection.
18. Select from a list reasons for using physical protection.
19. State methods used to protect concrete from physical damage.



OBJECTIVE 1

Required Activities/
Resources
– Transparency 1

Optional Activities/
Resources in Instructor's
Guide

State reasons for curing concrete.



Your instructor will show you a transparency that illustrates types of curing.

WORDS YOU SHOULD KNOW

curing	maintaining a satisfactory moisture content and temperature in concrete during its early stages so that desired properties may develop
shrinkage	contraction caused by loss of moisture
creep	slow deformation of concrete due to sustained load
efflorescence	deposit of salts formed on surface of concrete; emerges in solution from within concrete and remains when liquid evaporates
impermeability	resistance to passage of water
abrasion resistance	ability of a surface to resist being worn away by rubbing and friction

- To ensure fully developed strength
- To ensure fully developed durability
- To improve impermeability
- To improve resistance to abrasion
- To reduce efflorescence
- To control plastic shrinkage
- To control cracks
- To minimize creep



OBJECTIVE 2

Optional Activities/
Resources in Instructor's
Guide

Match types of curing to their methods of application.

- Water
 - ❑ By ponding or immersion (Figure 1)

FIGURE 1



- ❑ By sprinkling
- ❑ By fogging
- ❑ By covering with absorptive materials and saturating (Figure 2)

✓ **NOTE:** Make sure concrete is kept moist for a minimum of three days.

FIGURE 2



- Mechanical
 - ❑ By using a hand sprayer, power sprayer, automatic self-powered sprayer, brush, or roller.
 - ✓ **NOTE:** Check to make sure curing compound conforms to your local EPA standards. When using absorptive material, caution must be used to prevent discoloration.
- Membrane compounds
 - ❑ By rolling out or spraying curing material evenly onto concrete slab

EXAMPLES: Liquid membrane and curing compounds



CAUTION: Liquid membrane compounds consist essentially of waxes, natural and synthetic resins, and solvents of high volatility at atmospheric temperatures. Adequate ventilation should be provided and other safety precautions should be taken. Liquid membrane curing compounds are extremely slippery when applied. Be sure compound has dried fully before walking on surface.

✓ **NOTE:** Membrane compounds should not be applied to the base slab of a two course floor since it may prevent a bond from forming between the hardened and fresh concrete.

OBJECTIVE 3

Required Activities/
Resources
– Transparency 2

Optional Activities/
Resources in Instructor's
Guide

Discuss briefly the proper time to cure concrete.



Your instructor will show you a transparency that illustrates the way concrete gains strength with age.

Curing should begin as soon as possible after concrete is placed, finishing procedures are completed, and concrete surface is hard enough so that it will not be damaged.



OBJECTIVE 4

Optional Activities/
Resources in Instructor's
Guide

Select from a list factors that regulate length of curing time.

- Type and content of cement
- Mix proportions
- Required strength of concrete
- Size and shape of concrete mass
- Weather
- Exposure conditions

OBJECTIVE 5

Optional Activities/
Resources in Instructor's
Guide

Select from a list factors that may affect curing.

- Temperature
- Moisture
- Wind
- Placing and finishing time
- Design of the mix

OBJECTIVE 6

Optional Activities/
Resources in Instructor's
Guide

State advantages of using a curing compound.

- Forms good moisture barrier
- Increases concrete strength
- Increases concrete durability
- Improves surface friction properties
- Resists most alkalies
- Resists some oils and fuels
- Easy and quick to apply

✓ **NOTE:** Refer to CFR 1926.103 subpart E in regard to respiratory protection.



OBJECTIVE 7

Optional Activities/
Resources in Instructor's
Guide

Identify curing equipment.

- Hand Sprayer (Figure 3)

FIGURE 3



- Power Sprayer (Figure 4)

FIGURE 4



OBJECTIVE 8

Optional Activities/
Resources in Instructor's
Guide

State minimum curing requirements for concrete.

- At least three days if concrete temperature is 70 degrees Fahrenheit or above
- At least seven days if concrete temperature is between 40 degrees and 70 degrees Fahrenheit
- As given in project specifications

OBJECTIVE 9

Optional Activities/
Resources in Instructor's
Guide

Name types of protection needed for concrete.

- Protection from hot weather
 - ✓ **NOTE:** Rapid dehydration can cause loss of strength and surface failures such as plastic shrinkage cracks.
- Protection from cold weather
 - ✓ **NOTE:** If concrete freezes within the first 2 hours after it is placed, it is almost certain to result in permanent damage to the concrete.
- Protection from physical damage

OBJECTIVE 10

Optional Activities/
Resources in Instructor's
Guide

Select from a list temperatures at which protection is needed.

- ✓ **NOTE:** Temperatures for protection are usually specified by architects.
- 40 degrees Fahrenheit and below or as specified
- 90 degrees Fahrenheit and above or as specified

OBJECTIVE 11

Optional Activities/
Resources in Instructor's
Guide

Select from a list reasons for protecting concrete in hot weather.

- To prevent rapid evaporation of mixing water
- To prevent too-rapid setting caused by high temperatures
- To prevent drying of the surface due to hot, dry winds
- To prevent drying due to high or low relative humidity
- To allow the concrete to develop its full potential strength and durability



OBJECTIVE 12

Optional Activities/
Resources in Instructor's
Guide

State methods used to protect concrete in hot weather.

- Cool aggregate prior to mixing concrete
- Use cold water in the mix
- ✓ **NOTE:** Sometimes it is necessary to use shaved ice in the mix.
- Wet down subgrade and forms just prior to placing concrete
- Apply a monomolecular film to surface of fresh concrete
- Spray water above concrete with a fine mist
- ✓ **NOTE:** This process is often called fogging.
- Set up wind and sun shields
- Design or redesign the mix for hot weather

OBJECTIVE 13

Optional Activities/
Resources in Instructor's
Guide

Select from a list precautions to use when protecting concrete during hot weather.

- Avoid prolonged mixing
- Do not use accelerating admixtures
- Use only specified retarding admixtures
- Keep concrete temperature uniform
- Restrict concrete placement to early morning or late evening
- Schedule work carefully and place concrete promptly after it arrives on the job
- Start curing process as soon as possible

OBJECTIVE 14

Optional Activities/
Resources in Instructor's
Guide

Select from a list reasons for protecting concrete in cold weather.

- To keep it from freezing
- To provide a suitable curing temperature
- To control temperature so that strength gain is not too slow
- To prevent too-slow set which would prolong finishing operations



OBJECTIVE 15

Optional Activities/
Resources in Instructor's
Guide

State methods used to protect concrete in cold weather.

✓ **NOTE:** Deicing chemicals should not be used on concrete surfaces.

- Heat aggregate prior to mixing concrete
- Use heated water in the mix
- Use accelerating admixtures as specified
- Use insulated forms when possible
- House the concrete in weatherproof enclosure
- Use heaters in the enclosures

EXAMPLES: Forced air, oil, natural gas, or bottled gas heaters, steam, oil, or salamanders



CAUTION: Be sure enclosed areas are well ventilated. Refer to CFR 1926.154 and 1926.57 subpart F in regard to heating and ventilating.

- Use protective coverings

EXAMPLES: Insulating blankets, electric blankets, tarpaulins, polystyrene foam sheets, urethane foam sprayed on outside of forms, straw, burlap

OBJECTIVE 16

Optional Activities/
Resources in Instructor's
Guide

Select from a list precautions to use when protecting concrete during cold weather.

✓ **NOTE:** Be sure concrete does not freeze before its strength reaches at least 500 pounds per square inch.

- Be sure heaters and enclosures are properly vented
- ✓ **NOTE:** Carbon monoxide may cause carbonization to surface of concrete.
- Do not drag coverings across newly finished concrete
- Do not walk on fresh concrete when covering
- Be sure all coverings are properly secured
- Be sure enclosures are well braced and are weatherproof
- Be sure all edges are well protected



- Do not remove forms before the required minimum time period of protection
- Take adequate precautions to assure gradual cooling of the concrete at the end of protection period
- Do not leave heaters unattended
- Avoid water cure when using a chemical compound to cure concrete in cold weather

OBJECTIVE 17

Optional Activities/
Resources in Instructor's
Guide

Name types of physical protection.

✓ **NOTE:** Refer to CFR 1926.200 subpart G in regard to barricades.

- Commercial barricades with or without flashers (Figure 5)

FIGURE 5



- Prefabricated concrete barriers (Figure 6)

FIGURE 6



- Barrels (Figure 7)

FIGURE 7



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FIGURE 5



- Prefabricated concrete barriers (Figure 6)

FIGURE 6



- Barrels (Figure 7)

FIGURE 7



- Cones (Figure 8)

FIGURE 8



- Temporary fencing (Figure 9)

FIGURE 9



OBJECTIVE 18

Optional Activities/
Resources in Instructor's
Guide

Select from a list reasons for using physical protection.

✓ **NOTE:** New concrete slabs should be protected from heavy loads and other construction traffic.

- To protect those who are working on concrete
- To protect pedestrians from possible injuries and from splashing concrete
- To prevent possible accidents or damage to vehicles that may be close to work area
- To prevent concrete from damage by vehicles
- To prevent concrete from damage by vandals
- To prevent concrete from damage by animals
- To protect concrete from inclement weather

OBJECTIVE 19

Optional Activities/
Resources in Instructor's
Guide

State methods used to protect concrete from physical damage.

- Set barricades, barriers, barrels, cones, or sawhorses around perimeter of the concrete
- Build lumber barricades around concrete, construct panels and set around concrete, or construct solid wood walls
- Stretch ropes or cables with attached streamers between posts around the perimeter of the concrete
- Cover concrete to protect against rain and inclement weather
- Use plywood or boards to protect concrete from heavy traffic

