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After completing this module, you will show the following competencies by mastering the activities on the Assignment and Job Sheets and by scoring at least 85% on the Module Quizzes.

1. Select statements that describe common mistakes in placing concrete.
2. Distinguish between placing and rodding.
3. Select factors that affect the curing of concrete.
4. Choose the proper action to prevent common concrete failures.
5. Identify equipment used for transporting fresh concrete.
7. Select types of vibrators used to consolidate concrete.
8. Choose factors that determine when to start the concrete finishing job.
9. Use a bull float. (Job Sheet 1)
10. Use a hand float and a finishing trowel. (Job Sheet 2)
11. Use an edger. (Job Sheet 3)
12. Dress edges of a finishing trowel. (Job Sheet 4)
13. Operate a trowel machine. (Job Sheet 5)
14. Operate an electric sprayer. (Job Sheet 6)
15. Choose reasons for using joints in concrete.
16. Select joint types used in concrete construction.
17. Identify types of control (contraction) joints.
18. Identify types of isolation (expansion) joints.
19. Choose variables to consider when deciding joint locations in slabs.
20. Decide location of types of joints. (Assignment Sheet)
21. Identify equipment used to cut joints.
22. Select types of material and sealants used in joints.
23. Identify types of equipment used to apply sealants.
24. Identify types of waterstops.
PLACING AND FINISHING CONCRETE
Carpentry Series

Student Name ________________________________
Start Date: _______ Completion Date: ________

☐ ☐ 1. Study  Information Sheet 1, objective 1.

☐ ☐ 2. Discuss common mistakes in placing concrete.

☐ ☐ Optional Research articles that describe errors made in concrete placement and their consequences.

☐ ☐ 3. Study  Information Sheet 1, objective 2.

☐ ☐ 4. Discuss the difference between placing and rodding.

☐ ☐ 5. Study  Information Sheet 1, objective 3.

☐ ☐ 6. Discuss factors that affect the curing of concrete.

☐ ☐ 7. Discuss the safety issues in using uncured concrete structures and their lack of load bearing capability.

☐ ☐ 8. Take Quiz 1.

☐ ☐ 9. Study Information Sheet 1, objective 4.

☐ ☐ 10. Discuss the proper action to prevent common concrete failures.
11. Discuss  the need for proper planning for concrete pours.

12. Study  Information Sheet 1, objective 5.

13. Discuss  the equipment used for transporting and placing fresh concrete and the safety issues involved in operating the equipment.

14. Study  Information Sheet 1, objective 6.

15. Discuss  the advantages of using vibrators in concrete.

16. Discuss  the relationship between the action of the vibrator to the desirable properties of concrete.

17. Discuss  risks involved with over vibration.

18. Study  Information Sheet 1, objective 7.

19. Discuss  types of vibrators used to consolidate concrete and the safe care and use of each type of vibrator.

Optional Visit  a construction site to observe the use of concrete vibrators in use.

20. Study  Information Sheet 1, objective 8.
21. Discuss factors that determine when to start the concrete finishing job.

22. Take Quiz 2.

23. Read the Introduction to the Job Sheet 1, objective 9.

24. Ask your instructor to demonstrate guidelines and procedures in the Job Sheet. Use the Job Sheet to follow along. Pay careful attention to any guidelines, cautions, and warnings.

25. Practice the procedure demonstrated by your instructor. Use the Job Sheet as a guide. Notify your instructor when you are ready to perform the procedures for evaluation.

26. Stop and have your instructor evaluate your work from the Job Sheet. After your work has been evaluated, follow your instructor’s recommendations.

27. Discuss with your instructor the safety issues involved in using a bull float.

28. Read the Introduction to the Job Sheet 2, objective 10.

29. Ask your instructor to demonstrate guidelines and procedures in the Job Sheet. Use the Job Sheet to follow along. Pay careful attention to any guidelines, cautions, and warnings.
the procedure demonstrated by your instructor. Use the Job Sheet as a guide. Notify your instructor when you are ready to perform the procedures for evaluation.

and have your instructor evaluate your work from the Job Sheet. After your work has been evaluated, follow your instructor’s recommendations.

with your instructor the safety issues involved in using a hand float and a finishing trowel.

the Introduction to the Job Sheet 3, objective 11.

your instructor to demonstrate guidelines and procedures in the Job Sheet. Use the Job Sheet to follow along. Pay careful attention to any guidelines, cautions, and warnings.

the procedure demonstrated by your instructor. Use the Job Sheet as a guide. Notify your instructor when you are ready to perform the procedures for evaluation.

and have your instructor evaluate your work from the Job Sheet. After your work has been evaluated, follow your instructor’s recommendations.

with your instructor the safety issues involved in using an edger.
38. Read the Introduction to the Job Sheet 4, objective 12.

39. Ask your instructor to demonstrate guidelines and procedures in the Job Sheet. Use the Job Sheet to follow along. Pay careful attention to any guidelines, cautions, and warnings.

40. Practice the procedure demonstrated by your instructor. Use the Job Sheet as a guide. Notify your instructor when you are ready to perform the procedures for evaluation.

41. Stop and have your instructor evaluate your work from the Job Sheet. After your work has been evaluated, follow your instructor’s recommendations.

42. Discuss with your instructor the safety issues involved in dressing the edges of a finishing trowel.

43. Read the Introduction to the Job Sheet 5, objective 13.

44. Ask your instructor to demonstrate guidelines and procedures in the Job Sheet. Use the Job Sheet to follow along. Pay careful attention to any guidelines, cautions, and warnings.

45. Practice the procedure demonstrated by your instructor. Use the Job Sheet as a guide. Notify your instructor when you are ready to perform the procedures for evaluation.
and have your instructor evaluate your work from the Job Sheet. After your work has been evaluated, follow your instructor’s recommendations.

with your instructor the safety issues involved in operating a trowel machine.

the Introduction to the Job Sheet 6, objective 14.

your instructor to demonstrate guidelines and procedures in the Job Sheet. Use the Job Sheet to follow along. Pay careful attention to any guidelines, cautions, and warnings.

the procedure demonstrated by your instructor. Use the Job Sheet as a guide. Notify your instructor when you are ready to perform the procedures for evaluation.

and have your instructor evaluate your work from the Job Sheet. After your work has been evaluated, follow your instructor’s recommendations.

with your instructor the safety issues involved in operating an electric sprayer.
Select statements that describe common mistakes in placing concrete.

Some common mistakes in placing concrete are

- Adding excessive water to ready-mix concrete
- Not following safety precautions in working with fresh concrete
- Dropping concrete more than 5': when concrete is allowed to freefall more than 5', the aggregate drops to the bottom of the mixture. This separation creates an uneven distribution of ingredients in the form.
- Poor planning in preparing for changing weather conditions
- Removing forms before the concrete has proper strength
- Placing loads on structures before the concrete has proper strength

Distinguish between placing and rodding.

A. Placing — process of delivering concrete from the supply and placing it at the established area inside the forms

B. Rodding — process of leveling concrete to a specific grade

Select factors that affect the curing of concrete.

**WORDS YOU SHOULD KNOW**

| hydration | the chemical reaction of water with concrete that bonds the molecules together causing the concrete mixture to harden |

The curing of concrete is very important and proper curing can greatly add to the durability and strength of concrete. Study the following factors that affect the curing of
A. Weather

- **Temperature** — The greatest influence on the curing rate of concrete is the temperature. In general, the critical time in the curing process is the first three to seven days. Higher temperatures speed the curing process.

Hydration does best when the temperatures are between 55° to 73° F. When the temperatures are above 73°, the hydration should be slowed to gain the greatest strength of the concrete. Slowing the hydration process can be done by:

- adding admixtures
- wetting the surface with water
- using a curing agent or compound on the concrete surface
- keeping the concrete surface covered (curing blanket)

When concrete temperatures fall below freezing, no hydration takes place, and without heating, concrete could be permanently damaged. Proper hydration of concrete increases its durability and strength. Hydration can be aided when concrete moisture is lost slowly over several days.

- **Humidity** — In arid building sites, special care must be taken to ensure moist curing of the concrete.

B. Water-cement ratio — Too much or too little water can result in poor quality concrete. The proper water-cement ratio aids the hydration process and increases concrete’s strength and resistance to freezing and wear.

**WARNING:** A worker should never add water to ready-mix concrete without consulting his or her supervisor. Severe structural damage can result from the weakened concrete.

**Choose the proper action to prevent common concrete failures.**

Common concrete failures include cracking and wearing.

A. Cracking

- **Weather related cracking** — Concrete that is exposed to weather often cracks due to temperature changes and the forces of the freeze/thaw cycles. When water is allowed to freeze and expand within joints or cavities of concrete, it may cause the concrete to crack.
• **Stress related cracking** — Stress refers to the strength or load bearing capabilities of concrete. Proper structural design can reduce all types of concrete cracking.

**B. Wearing** — Wearing is caused by abrasive action such as that of water, wind, vehicle traffic, and foot traffic.

There are many different steps that can be taken to prevent concrete cracking and wearing. Study the following chart to learn which steps prevent weather related cracking, stress related cracking, and wearing.

<table>
<thead>
<tr>
<th>To Prevent Concrete Failure</th>
<th>Weather Related Cracking</th>
<th>Stress Related Cracking</th>
<th>Wearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adding admixtures</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Using joint control</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Using the correct aggregates</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Using the correct water-cement ratio</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Controlling the curing process</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Using water repellent coatings</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Using smaller joint spacing</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using the correct type of cement</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Using proper finishing procedures</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Adding reinforcement</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**Identify equipment used for transporting and placing fresh concrete.**

There are many different kinds of equipment used to transport and place fresh concrete. Study the following kinds of equipment used to transport and place fresh concrete and discuss in what circumstances you would use each kind.

**FIGURE 1**

*Georgia buggy*
• **Hand buggy**

**FIGURE 3**

• **Wheelbarrow**

**FIGURE 4**

• **Concrete hopper**

**FIGURE 5**

• **Concrete chute**
• Tremie

FIGURE 7

• Elephant trunk

FIGURE 8

• Concrete placing boom (with concrete pump)
FIGURE 9

- **Transit mix concrete truck**

FIGURE 10

Choose advantages of using vibrators in concrete.

**WORDS YOU SHOULD KNOW**

- **puddling or tamping** to vibrate or lightly tamp fresh concrete or mortar to aid in consolidation

✔ **NOTE:** Form small pours, concrete is sometimes consolidated by puddling with a long slim board or spade or by tapping on the outside of the form with a block of wood or hammer.

- Consolidate concrete into a dense mass
- Prevent honeycombing
- Produce a smooth surface along the forms
- Consolidate concrete around reinforcing and inserts
Select types of vibrators used to consolidate concrete.

FIGURE 11

There are many different types of vibrators for use in different situations. Study the following list of concrete vibrators and discuss their uses with your instructor.

✔ NOTE: Immersion-type vibrators are placed into the concrete mix while a form vibrator is attached to the concrete formwork.

- Lightweight electric immersion-type
- Heavy-duty electric immersion-type (high-frequency)
- Air or pneumatic immersion vibrator
- External form vibrator
- Medium-duty gasoline vibrator

Choose factors that determine when to start the concrete finishing job.

The timing in starting the finishing job is most critical in performing a quality finishing job. The concrete curing process must be evaluated before finishing starts. Study the following factors to evaluate when determining when to start the concrete finishing job.

A. The concrete should be hard enough to support the weight of an average size person, leaving only slight footprints on the surface

B. Bleed water should be gone

C. Water sheen or glossy appearance should be gone
PLACING AND FINISHING CONCRETE
Carpentry Series

Use a bull float.

A bull float is a large, flat, rectangular piece of wood, aluminum or magnesium. It is usually 8" wide and 42" to 60" long with a long handle. The handle length ranges from 3.5' to 18' long with a variety of blades and manufacturer’s style. The hand length and blade size makes the bull float difficult to use inside. Blades are usually metal because wood has a tendency to stick on the drying concrete surface.

A bull float differs from a darby primarily because of its size. It is used on outdoor concrete slabs, driveways, sidewalks, and patios and make it possible for the mason/carpenter to float a much larger area than with a darby.

A Bull-float is used:

• to float the surface of the concrete slab immediately after it has been screeded.
• to embed aggregate particles just beneath the surface.
• to remove slight imperfections, waves and voids.
• to compact the concrete at the surface in preparation for other finishing procedures.

General Guidelines

• Before floating adjust the bull-float handle for comfortable use.
• Bull floating is done immediately after the concrete has been straightedged.

WORDS YOU SHOULD KNOW

dishing  concave spots on the finished surface of the concrete
• Do not overwork the concrete.

✓ NOTE: This brings an excess of water and fine aggregate material to the surface causing defects in the finish.

• When possible, always bull float in a direction that is perpendicular to the direction of the straightedging process.

• Bull floating may be done with hand tools or a finishing machine equipped with floating blades. Making smooth passes will save time and improve the appearance of the concrete surface. Learning how to make smooth passes with the bull-float is just a matter of practice.

• Always wear appropriate personal protection equipment for the job being done.

EQUIPMENT AND SUPPLIES

• Bull float
• Personal protection equipment
• Prepared concrete surface or sand pad

PROCEDURE

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>☐</td>
<td>☑</td>
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<td>☑</td>
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</tbody>
</table>

FIGURE 12
4. Begin the forward stroke by pushing and sliding the bull float across the slab while keeping the handle low enough to maintain a slightly raised leading edge of blade.

5. When nearing the end of the forward stroke, jiggle the bull float slightly while raising the bull-float handle to flatten the blade against the concrete surface. See Figure 13.

✔️ NOTE: This procedure helps break the vacuum under the blade and prevents dishing of the concrete surface.

FIGURE 13

6. At the end of the forward stroke, raise the handle slightly and without hesitating start the return stroke while keeping the leading edge of blade raised very slightly (almost flat) to concrete surface. See Point B in Figure 14.

FIGURE 14
7. If it is necessary to make another forward stroke, keep the blade as flat as possible while preventing the blade edges from digging into the concrete surface.

8. Make a second pass with the bull-float blade flat while overlapping the first pass by at least 6". See Figure 15.

FIGURE 15


10. Continue making passes with the bull until the concrete slab is completely covered.

11. If necessary, use a second bull-floating process crosswise from the first.

**NOTE:** To improve the uniformed appearance of the concrete, it is sometimes necessary to bull float crosswise to the first bull-floating process. To do this, begin the second bull-floating process by making crosswise passes over the concrete surface using the same procedure and techniques as found in steps 1 through 8.

**NOTE:** When floating to a coarse-textured finish it may be necessary to allow the concrete to partially harden.

12. Clean up area and put away equipment and supplies.
**SKILL TEST RECORD**

**Evaluator note:** Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed safety procedures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used proper equipment correctly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performed steps in a timely manner</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Followed instructions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provided satisfactory responses to questions asked</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Evaluator note:** To obtain an average rating for the Profile of Training Mastery, total the points in Product Evaluation and divide by the total number of criteria. Circle the rating on the Key.

4 **Skilled** — Can perform job with no additional training  
3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required  
2 **Limited Skill** — Has performed job during training program; additional training is required to develop skill  
1 **Unskilled** — Is familiar with process, but is unable to perform job
Hand floats are usually made from wood, aluminum, and magnesium. Special types of hand floats made of cork, carpet, or molded rubber are used to create textured finishes on rubbed concrete. They range in size from 12” to 18” long and 3 1/2” to 4 1/2” wide. Hand floats are used to prepare the concrete surface for troweling. Metal floats are preferred on some types of toppings and on air-entrained concrete. Metal floats prevent drag and are lighter than wood floats.

✔ **NOTE:** Floats are used to bring the bleed water to the surface. Trowels are used to seal the surface once the bleed water is gone.

A steel hand trowel is the last tool used in the finishing process of a slab of concrete. It is available in many different sizes ranging from 10” to 20” long and 3” to 4 3/4” wide. The first troweling of a slab is generally performed with a wide trowel 16” to 20” long. The last few troweling operations are usually done with a finishing trowel that is 14” to 16” long and 3” to 4” wide.

A trowel must be clean to perform properly. Old mortar should be removed from the blade and shank. Forming a habit of cleaning your tools at the end of each day will insure that they are always in good condition.

The purpose of troweling is to give the surface a smooth, dense finish. Making smooth passes will save time and improve the appearance of the concrete surface. Learning how to make smooth passes with the hand float and the finishing trowel is just a matter of practice.

Always wear appropriate safety equipment and protective clothing for the job being done.
**EQUIPMENT AND SUPPLIES**

- Hand float
- Kneepads
- Large finishing trowel
- Personal protection equipment
- Prepared concrete surface or sand pad

**PROCEDURE**

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Put on personal protection equipment.</td>
</tr>
<tr>
<td></td>
<td>2. While holding the appropriate hand float in your dominant hand and a support trowel in the other hand, position yourself on your knees near the edge of the forms.</td>
</tr>
<tr>
<td></td>
<td>3. Lean out over the edge of the concrete while supporting yourself on the trowel. See Figure 16.</td>
</tr>
</tbody>
</table>

✔ **NOTE:** This position allows you to reach further out.

**FIGURE 16**

![Diagram of a person finishing concrete]
4. Hold the float flat on the concrete surface. See Figure 17.

FIGURE 17

5. Move the float in a wide, semicircular motion.

6. Level high spots or imperfections by using a forward-and-backward sawing motion of the float.

7. Maintain this position and make a second pass with the hand float.

8. Move the float back toward you, while overlapping the first pass. See Figure 18.

FIGURE 18
9. Follow the procedure in steps 4 through 6 for completing the pass.

10. Maintain this position and continue floating following steps 2 through 9.

11. Reposition yourself and float area along edge of forms, moving the float at a right angle to the form. See Figure 19.

✓ NOTE: At this time allow all bleed water to dissipate and clean tools.

FIGURE 19
12. While holding the appropriate trowel in your dominant hand and a support trowel in the other hand make the first pass. See Figure 20.

FIGURE 20

13. Hold trowel flat on concrete surface.


15. Maintain this position and make a second pass with the trowel.
16. Move the trowel back toward you while overlapping the first pass. See Figure 21.

FIGURE 21

17. Follow steps 12 through 16 for completing the pass.

18. Maintain this position and continue troweling, following procedure in steps 12 through 17 until all of the area that you can reach has been troweled except the area along the edge of the form. See Figure 22.

FIGURE 22
19. Reposition yourself and the trowel along the edge of the forms, moving the trowel at right angle to the form. See Figure 23.

**FIGURE 23**

20. Continue to position yourself along the edge of the form following steps 2 through 19 to float and trowel until all edges have been floated and troweled.

✓ **NOTE:** As concrete hardens and moisture evaporates, the concrete may have to be troweled another time or two (sometimes more). On each successive troweling, a smaller trowel should be used and the blade tilted a little more. As the concrete hardens the pressure placed on the trowel should be increased in order to remove imperfections.

21. Clean up area and put away equipment and supplies.
**SKILL TEST RECORD**

**Evaluator note:** Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

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**KEY**

- **4 Skilled** — Can perform job with no additional training
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- **1 Unskilled** — Is familiar with process, but is unable to perform job

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Evaluator's Comments:

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Edgers are produced in several sizes and styles. They are made of steel, stainless steel, bronze, or malleable iron. They are available in many sizes, but the most common sizes are those from 6" to 10" long, from 1 1/2" to 4" wide, and with a lip that is from 1/8" to 5/8" and a radius from 1/8" to 1 1/2". Some edgers have a long handle so that they can be used from a standing position.

Edgers are used to produce a radius on the edge of sidewalks, floor slabs, driveway approaches, and pavement. The radius created by the edger improves the appearance of the slab and reduces the risk of damage to the edge.

Always wear appropriate safety equipment and protective clothing for the job being done.

- Edger
- Edger knee pads
- Margin trowel
- Personal protection equipment
- Prepared concrete surface or sand pad

Yes  No

1. Put on personal protection equipment.

2. Float and trowel the slab edges.

3. Position yourself on your knees near the edge of the forms.

4. Make an arm’s length pass with the margin trowel to cut along inside of form.
✓ NOTE: Making a pass with a margin trowel helps to force the aggregate away from the form and makes it easier to use the edger.

Make an arm's length pass with the edger

Yes ☐ No ☐

5. Hold the edger with the leading edge raised just enough to keep the edger from digging into the concrete and with the rear edge pressed down lightly. See Figure 24.

FIGURE 24

6. Begin the forward stroke by gliding the edger across the top of the concrete until your arm is nearly fully extended. See Figure 25.

✓ NOTE: Do not press too hard on the edger. The edger should make hardly any indentation on the top surface of the concrete.

☐ ☐ 7. At the end of the forward stroke when the arm is fully extended, lift the edger from the concrete while the edger is still in forward motion.

✓ NOTE: If the edger is not in motion when it is removed from the concrete, the concrete surface may be pulled up with the edger.
8. With the arm still extended, begin the return stroke. Draw the edger backward (toward you) with the leading edge (Point B) tilted up slightly. See Figure 25.

**FIGURE 25**

9. At the end of the return stroke, lift the edger from the concrete surface while the edger is still in motion. See Figure 26.

**FIGURE 26**

10. Continue repositioning yourself and edging, repeating steps 4 through 9 until the slab has been completely edged.
Yes  No

11. Clean up area and put away equipment and supplies.

---

**SKILL TEST RECORD**

**Evaluator note:** Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

- Observed safety procedures 4 3 2 1
- Used proper equipment correctly 4 3 2 1
- Performed steps in a timely manner 4 3 2 1
- Followed instructions 4 3 2 1
- Provided satisfactory responses to questions asked 4 3 2 1

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**KEY**

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2 Limited Skill — Has performed job during training program; additional training is required to develop skill
1 Unskilled — Is familiar with process, but is unable to perform job
Dress edges of a finishing trowel.

Words You Should Know

knee board  flat pads used to distribute weight when hand troweling fresh concrete

Keeping the edges of a finishing trowel in the best working condition is just a matter of filing the edges of the trowel. Always handle the trowel carefully. The edges of a trowel are sharp and may cause injury.

Always wear appropriate safety equipment and protective clothing for the job being done.

- 12” to 14” flat mill file
- Finishing trowel
- Flat solid work surface
- Knee board
- Personal protection equipment

Yes  No

1. Put on personal protection equipment.

2. Examine the file to be sure it is in good condition. Discard and replace the file if necessary.

3. Place the kneeboard on flat, solid work surface; lay the flat side of the file on the kneeboard with the blunt end of the file against the cleat on one end of the knee board.
The front end of the kneeboard should butt up against a solid surface, but it is not absolutely essential to the procedure.

4. Holding the trowel handle in your dominant hand and use the other hand to hold the bottom of the blade steady, place the trowel edge perpendicular to the file surface on the end of the file. See Figure 27.

5. Apply downward pressure to the trowel while pushing the trowel forward along the length of the file. See Figures 28 and 29.

Keep the blade of the trowel perpendicular to the file so that the trowel edges will be filed square.

6. Continue procedure until trowel edge is straight and square and has no burrs or ragged edges.

7. Repeat steps 4, 5, and 6 to dress the other side of the trowel edge. See Figure 30.
8. Clean up area and put away equipment and supplies.

---

**SKILL TEST RECORD**

**Evaluator note:** Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

<table>
<thead>
<tr>
<th>Observed safety procedures</th>
<th>4 3 2 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used proper equipment correctly</td>
<td>4 3 2 1</td>
</tr>
<tr>
<td>Performed steps in a timely manner</td>
<td>4 3 2 1</td>
</tr>
<tr>
<td>Followed instructions</td>
<td>4 3 2 1</td>
</tr>
<tr>
<td>Provided satisfactory responses to questions asked</td>
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</tr>
</tbody>
</table>

**Evaluator note:** To obtain an average rating for the Profile of Training Mastery, total the points in Product Evaluation and divide by the total number of criteria. Circle the rating on the Key.
<table>
<thead>
<tr>
<th>KEY</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
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<td>Can perform job with no additional training</td>
</tr>
<tr>
<td>3 <strong>Moderately Skilled</strong></td>
<td>Has performed job during training program; limited additional training may be required</td>
</tr>
<tr>
<td>2 <strong>Limited Skill</strong></td>
<td>Has performed job during training program; additional training is required to develop skill</td>
</tr>
<tr>
<td>1 <strong>Unskilled</strong></td>
<td>Is familiar with process, but is unable to perform job</td>
</tr>
</tbody>
</table>

**Evaluator’s Comments**

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
PLACING AND FINISHING CONCRETE
Carpentry Series

Student name _____________________________Score _________

Operate a trowel machine.

Power trowel machines are used to consolidate and finish concrete surfaces. They are generally used on large concrete slabs for floors, sidewalks, driveways, and pavements. Always wear appropriate safety equipment and protective clothing for the job being done.

✔ NOTE: There may be regional differences in accepted trowel machine procedures.

- Can of oil with spout
- Fire extinguisher
- Gasoline in gas can with funnel or spout
- Personal protection equipment
- Trowel machine with float shoes attached

A. Power Floating

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Put on personal protection equipment.</td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Make all checks of the trowel machine before putting it on the slab.</td>
<td></td>
</tr>
</tbody>
</table>

✔ NOTE: Visually check the machine to be sure all guards, safety devices, and belts are in place and that blades are in good condition; notify instructor if repairs are necessary. Check the gasoline and oil levels, filling if necessary. Never fill machine with gasoline or oil while machine is on the slab.

✔ NOTE: Make sure the area is properly ventilated.
3. Check the slab to be sure it is firm enough for the floating and troweling procedures.

**NOTE:** The slab is ready when an average-sized person leaves only a slight footprint impression on the surface of the concrete.

4. Attach float blades and position the trowel machine on the slab at the hardest point on the slab.

**NOTE:** Usually the hardest point on the slab will be at the location where the concrete was first placed - at one corner of the slab and close to the edge of the form.

5. Adjust the float blades for floating process so that the blades are almost flat.

6. Start the trowel machine.

7. Make the first floating pass by moving the machine across the slab at a right angle to the direction of the bull-floating process. See Figure 31.

**NOTE:** Move the machine right by gently pushing down on the machine handle. Move the machine left by gently lifting up the machine handle.

**NOTE:** Do not operate the machine in one spot for any length of time as this tends to dish out a low place in the concrete.
8. Continue across the slab as shown in Figure 31 until the opposite edge is reached.

**FIGURE 31**

9. Immediately step back and maneuver the trowel machine into the position to make the second floating pass.

**NOTE:** Remember not to operate machine in one spot for any length of time.

10. Maneuver the machine so that it will overlap the first pass by about one-half the blade width. See Figure 32.

**FIGURE 32**

11. Move the machine across the slab while working out the footprints and other imperfections.
Occasionally it is necessary to fill a hole by hand rather than by filling it with the trowel machine. Have a hand trowel ready for this purpose.

12. Using the procedure in step 10, continue making the floating passes until the slab is completely floated. See Figure 33.

FIGURE 33

13. Move the trowel back to the starting position on the slab.

14. Remove the float blades.

**B. Power troweling**

1. Attach and adjust the trowel blades and position the trowel machine on the slab at the hardest point on the slab.

**NOTE:** Adjust the trowel blades so that the blades are relatively flat. As concrete hardens, the blades should be tilted a little more with each successive troweling.

2. Start the trowel machine.
3. Make the first troweling pass, moving the machine across the slab at a right angle to the direction of the floating process. See Figure 34.

**FIGURE 34**

✔ **NOTE:** Move the machine right by gently pushing down on the machine handle. Move the machine left by gently lifting up the machine handle. Do not operate the machine in one spot for any length of time as this tends to dish out a low place in the concrete.

4. Continue across the slab until the opposite edge is reached.

5. Immediately step back and maneuver the trowel machine into position to make the second troweling pass.

6. Maneuver the machine so that it will overlap the first pass by about one-half the blade width.

7. Move the machine across the slab at a right angle to the direction of the floating process as in the first troweling pass, but use a sweeping motion that follows a consistent pattern.

8. Move the machine across the slab while working out footprints and other imperfections.

✔ **NOTE:** Occasionally it is necessary to fill a hole by hand rather than by filling it with the trowel machine. Have a hand trowel ready for this purpose.
9. Continue across slab until the opposite edge is reached.

10. Continue making the troweling passes until the slab is completely troweled one time, using the procedure as described in steps 5 through 9.

11. Continue the troweling process until desired finish is accomplished.

**NOTE:** The number of trowelings required and the waiting period between trowelings depends on the way the concrete sets and on the type of finish desired.

12. Remove trowel machine from slab.

13. Clean up area and put away equipment and supplies.

---

**SKILL TEST RECORD**

**Evaluator note:** Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

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<td>2</td>
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<tr>
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Evaluator note: To obtain an average rating for the Profile of Training Mastery, total the points in Product Evaluation and divide by the total number of criteria. Circle the rating on the Key.

4 Skilled — Can perform job with no additional training
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1 Unskilled — Is familiar with process, but is unable to perform job

______________________________________________________________

______________________________________________________________

______________________________________________________________

Evaluator’s Comments
Sprayers are used to apply form oil to concrete forms, to spray curing compounds, and to mist or fog water over finished concrete to reduce rapid evaporation.

Curing the concrete slab is one of the most important steps to produce quality work. Even if the concrete is mixed, placed and finished properly, poor quality work will result if proper curing procedures are not followed. The most frequently used method of curing concrete is the application of a membrane curing compound sprayed on the surfaces of the concrete with an electric sprayer. Uniform coverage is required and often two coats are suggested to provide adequate protection.

Always wear appropriate safety equipment and protective clothing for the job being done.

- Container of clean water
- Container of curing compound with manufacturer’s instructions
- Electric sprayer unit and operation manual
- Extension cord of sufficient size
- Heavy-duty spray nozzle
- Inlet hose
- Outlet hose
- Personal protection equipment
- Prepared concrete surface
1. Put on personal protection equipment.

2. Check electric sprayer unit and related equipment.
   A. Visually check the sprayer unit to be sure all the guards and safety devices are in place; notify the instructor if repairs are necessary.
   B. Check the condition of extension cord and connections; replace if necessary.
   C. Check the hoses and connections to make sure they are in good condition; replace if necessary.

3. Set sprayer unit near slab at location where it will be convenient to use. Set container of curing compound and container of water beside the sprayer unit.
   ✓ NOTE: If at all possible do not stand on the slab while spraying. Spray the slab while standing near the edge of the slab with the container of curing compound and container of water close to the sprayer unit.

4. Plug the sprayer unit into a proper extension cord.

5. Place the end of the inlet hose in the container of curing compound.
   ✓ NOTE: The inlet hose should be only long enough to reach from the sprayer unit into the curing-compound container. The outlet hose should be long enough to cover the area that is to be sprayed.

6. Pick up the outlet hose and point the nozzle toward the slab.

7. Turn on sprayer unit and adjust the nozzle so that the curing compound will be distributed properly.
   ✓ NOTE: Adjusting the nozzle properly is just a matter of practice. Check with your instructor before proceeding with the spraying procedure to ensure the proper adjustment.
8. Make the first pass with the sprayer by beginning at one end of the slab and working your way across the slab in back and forth motion.

9. Continue making the passes until the slab is covered with curing compound.

✔ NOTE: Sometimes it is necessary to cover the slab with a second coat of curing compound. The second coat is applied by making passes at a right angle to the passes in the first spray pattern.

10. Just before the slab has been completely covered, remove the inlet hose from the curing-compound container to begin clearing compound from the hose and sprayer unit.

11. Place the inlet hose in the container of water, point the nozzle away from slab and continue running the pump until the water coming from the inlet hose is free of curing compound.

✔ NOTE: Some curing compounds have dyes mixed into the compound to allow for visual inspection when determining the sprayer is free of compound.

12. Turn off the sprayer unit.

13. Clean up area and put away equipment and supplies.

---

**SKILL TEST RECORD**

**Evaluator note:** Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.
Criteria:

Observed safety procedures 4 3 2 1

Used proper equipment correctly 4 3 2 1

Performed steps in a timely manner 4 3 2 1

Followed instructions 4 3 2 1

Provided satisfactory responses to questions asked 4 3 2 1

Evaluator note: To obtain an average rating for the Profile of Training Mastery, total the points in Product Evaluation and divide by the total number of criteria. Circle the rating on the Key.

Average Rating

Key

4 Skilled — Can perform job with no additional training

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Evaluator’s Comments

________________________________________________________________________

________________________________________________________________________
Information Sheet 2, objective 15.

the reasons and importance of using joints in concrete.

Information Sheet 2, objective 16.

Discuss the different joint types used in concrete.

a construction site to view as many different types of joints as possible.

Information Sheet 2, objective 17.

the different types of control joints.

Information Sheet 2, objective 18.

the different types of isolation joints.

Information Sheet 2, objective 19.

variable to consider when deciding joint location in slabs.
Quiz 3.

11. Take

12. Complete

13. Study

14. Discuss

Optional Visit

15. Study

16. Discuss

17. View

18. Discuss

19. Discuss

20. Study

the Assignment Sheet, objective 20.

Information Sheet 2, objective 21.

the equipment used to cut joints and the safety issues involved in operating each piece of equipment.

a construction site to view equipment for cutting joints in use.

Information Sheet 2, objective 22.

types of material and sealants used in joints.

sample material and sealants used in joints.

how the different types of materials are installed and what equipment is used to install and finish the joints.

the use of various sealants and the safety precautions that may be necessary, especially for those that may produce fumes and those that must be heated before use.

Information Sheet 2, objective 23.
types of equipment used to apply sealants and the safety issues involved with the operation of each piece of equipment.

a construction site to view joint materials and sealants used.

Information Sheet 2, objective 24.

types of waterstops, their uses, and how and where they are important in concrete construction.

Quiz 4.

a construction site to view joint materials and sealants used.
PLACING AND FINISHING CONCRETE
Carpentry Series

Choose reasons for using joints in concrete.
Study the following reasons for using joints in concrete.

- To eliminate random cracks
- To allow expansion and contraction
- To separate adjoining parts at designed locations
- To temporarily separate two successive placements of concrete
- To allow stress relief
- To control transverse and longitudinal cracking
- To divide slabs into suitable spacing

Select joint types used in concrete construction.
Study the different types of joints and their uses listed below.

A. Construction joints — joint between two successive placements where a placement is temporarily suspended

B. Control (contraction) joints — joint location cut to induce cracking at a designed point rather than at random

C. Decorative joints — a joint placed into the surface of concrete for decorative purposes

D. Isolation (expansion) joints — separation between adjoining sections of concrete that allows for the movement of sections
Identify types of control (contraction) joints.

Study the following control joints.

FIGURE 35

• Tooled control joint

FIGURE 36

• Sawed control joint

FIGURE 37

• Tooled control joint with wood divider strip

FIGURE 38

• Control joint with crack inducer anchored in the subgrade

✓ NOTE: This type is sometimes used in thick slabs.
• Sawed contraction joint with steel dowel

✓ NOTE: The lubricated half is the second pour.

• Longitudinal joint

✓ NOTE: Longitudinal joints are control joints placed lengthwise in highway construction; they may be sawed, tooled, or keyed.

• Skewed joint

✓ NOTE: Skewed joints are control joints placed at an angle across highway slabs.
Identify types of isolation (expansion) joints.

Study the following isolation joints.

FIGURE 42

- Tooled-isolation joint with premolded expansion material

FIGURE 43

- Tooled-isolation joint with premolded expansion material held down by sealant

FIGURE 44

- Tooled isolation joint with premolded expansion material and a capped steel rod

FIGURE 45

- Finger expansion joint

✓ NOTE: A finger joint is a steel interlocking type of expansion used on bridges.
FIGURE 46

![Diagram of Sliding plate expansion joint]

- **Sliding plate expansion joint**

✓ **NOTE:** A sliding plate joint consists of a steel plate anchored to one section of concrete with another plate anchored to the adjoining section of concrete placed so that one will overlap and slide over the other.

**Choose variables to consider when deciding joint locations in slabs.**

Consider the following variables when deciding joint locations in slabs.

- Horizontal movement
- Locations of rigid objects
- Slab size
- Tensile stress
- Variations in slab thickness
- Vertical movement
Decide location of types of joints.

It is necessary for the concrete worker to know proper jointing procedures in order to prevent cracks in the slabs.

Practice identifying the locations of various types of joints by reviewing the Information Sheet and the Student Supplement which directly follows the Assignment Sheet, then complete the following exercise.

For letters A through J on the floor plan on the next page, decide which type of joint should be used, then write the number corresponding to that type in the correct blank. Some blanks may contain more than one number.

A. ________  F. ________  
B. ________  G. ________  
C. ________  H. ________  
D. ________  I. ________  
E. ________  J. ________
Identify equipment used to cut joints.

Study the following kinds of equipment used to cut joints and discuss the use of each. Discuss the safety issues involved in operating each type of equipment.

A. **Jointers** — Jointers are used to help provide concrete crack control and improve the appearance of joints. They are used to make joints in sidewalks, pavement, patios, and floor slabs. Jointers are made of stainless steel, bronze, or malleable iron. Common jointers are 6" long, vary in width from 2" to 4 1/2", and have shallow, medium, or deep bite (cutting edges) ranging from 3/16" to 1" depth. Some jointers also have a long handle so that they can be used from a standing position. Jointers are sometimes called groovers.

![Jointer](image1)

B. **Power concrete saws** — Power concrete saws are used to cut control and decorative joints, cut out concrete sections, and to aid in the demolition of structures.

![Power concrete saw](image2)

- **Heavy-duty floor-type power saw**
Select types of material and sealants used in joints.

**WORDS YOU SHOULD KNOW**

- **elastomeric**: various polymers having the elastic properties of natural rubber
- **polymeric**: used to describe a material that is made from polymers
- **polymers**: natural or synthetic compounds made from many different parts
Study the following types of materials and sealants used in joints and discuss the advantages and disadvantages of each. Discuss the safety issues involved in using the various materials and sealants, especially those that produce fumes and those that must be heated before use.

A. Materials
   - Compressible
   - Metal
   - Plastic
   - Wood

B. Sealants
   - **Acrylic** — synthetic resin used for formulation of caulks and sealants with very good adhesion and weather resistant properties
   - **Elastomer** — elastic substance resembling rubber
   - **Lead** — a soft metal
   - **Mastic** — a pasty material composed of asphalts and nondrying oils
   - **Polyurethane** — nonstaining, durable, flexible, elastomeric polymer compound
   - **Silicone** — polymeric organic compound used as a water resistant sealant
   - **Thermoplastic** — sealant material that becomes plastic upon heating
Identify types of equipment used to apply sealants.

Study the following types of equipment used to apply sealants and discuss the use of each. Discuss the safety issues involved in operating each type of equipment.

FIGURE 51

- **Spouted bucket for hot pour**

FIGURE 52

- **Cartridge-type caulking gun**

FIGURE 53

- **Bulk-type caulking gun**
Identify types of waterstops.

WORDS YOU SHOULD KNOW

serrated  

a jagged or zigzag pattern

Waterstops are made of flexible material and cast in place across joints in concrete to prevent passage of water. See Figure 55 as an example of a waterstop cast in place.
Study the following types of waterstops and discuss the use of each.

- **Serrated**

- **Serrated dumbbell**

- **Serrated "V"**

- **Dumbbell**
FIGURE 61

• On-grade

FIGURE 62

• Cellular

FIGURE 63

• Center-bulb dumbbell

FIGURE 64

• Labyrinth
Placing Concrete on Frozen Subbase

Follow the link below to learn about placing concrete and to answer the following questions.

- Go to http://www.worldofconcrete.com
- Click on the topic "Browse Problem Clinic" in the menu area on the left side of the page
- Click on "Placing" in the "Choose a Problem Clinic category to browse:" box in the middle of the page.
- Click on the article titled "Placing Concrete on Frozen Subbase."
- Read the "Question" and "Answer" sections of the article and answer the following questions.

1. What is the question being asked?
   ____________________________________________________________

2. What can happen if you place concrete on a frozen surface?
   ____________________________________________________________
   ____________________________________________________________

3. What do the authors suggest be done to prepare the surface?
   ____________________________________________________________

4. Where can you find the information for the required subbase temperatures or depth of subbase thawing need for your job?
   ____________________________________________________________
Slab Curling: Causes and Prevention

Follow the link below to learn about placing concrete and to answer the following questions.

- Go to http://www.worldofconcrete.com
- Click on the topic "Browse Problem Clinic" in the menu area on the left side of the page
- Click on "Placing" in the "Choose a Problem Clinic category to browse:" box in the middle of the page.
- Click on the article titled "Slab Curling: Causes and Prevention."
- Read the "Question" and "Answer" sections of the article and answer the following questions.

5. What is slab curling and what causes it?
________________________________________________________________________

6. Which method usually requires you to use low-slump concrete?
________________________________________________________________________
________________________________________________________________________

7. In some areas of the country, large differences in drying shrinkage have been traced to what?
________________________________________________________________________
________________________________________________________________________

8. What can you use at construction or contraction joints also help restrain curling?
________________________________________________________________________

9. List an example of an admixture that may increase shrinkage?
________________________________________________________________________
10. What can be placed near the top surface of the slab to restrain curling?

______________________________________________________________
Finishing Low-Slump Concrete

Follow the link below to learn about finishing concrete and to answer the following questions.

- Go to http://www.worldofconcrete.com
- Click on the topic "Browse Problem Clinic" in the menu area on the left side of the page
- Click on "Finishing" in the "Choose a Problem Clinic category to browse:" box in the middle of the page.
- Click on the article titled "Finishing Low-Slump Concrete."
- Read the "Question" and "Answer" sections of the article and answer the following questions.

1. What type of concrete is being used in the question?
   ________________________________________________________________

2. What tool are they using to close the surface?
   ________________________________________________________________

3. What is the first solution give to close the surface?
   ________________________________________________________________
   ________________________________________________________________

4. Why must you be careful when putting concrete blocks or heavy bagged products on the blade to increase pressure?
   ________________________________________________________________
Craze Cracking

Follow the link below to learn about finishing concrete and to answer the following questions.

- Go to http://www.worldofconcrete.com
- Click on the topic "Browse Problem Clinic" in the menu area on the left side of the page
- Click on "Finishing" in the "Choose a Problem Clinic category to browse:" box in the middle of the page.
- Click on the article titled "Is Craze Cracking a Terminal Illness."
- Read the "Question" and "Answer" sections of the article and answer the following questions.

5. What is the question in the article?
______________________________________________________________

6. What is the general thought about crazing?
______________________________________________________________
______________________________________________________________

7. According to the comments in the reader response section, what might affect the structural integrity of the concrete?
______________________________________________________________
______________________________________________________________