UNIT IV - CONCRETE

Lesson 4: Pouring a Concrete Slab

Competency/Objectives: Describe the procedure for preparing to pour a concrete slab.

Study Questions

1. What tools are needed for pouring concrete?
2. What are forms for concrete pouring?
3. How are forms constructed for slabs?
4. What is the purpose of reinforcement in concrete?
5. What are the types of reinforcement for concrete?
6. How should reinforcement be installed?
7. What are expansion and control joints, and when are they needed?

References

1. *Agricultural Structures (Student Reference).* University of Missouri-Columbia: Instructional Materials Laboratory, Unit IV, 1999.
2. Activity Sheet
    a) AS 4.1: Reinforcing Concrete

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TEACHING PROCEDURES

B. ***Review***

Lesson 3 discussed the various factors that influence site selection and preparation. One of the most common tasks involving concrete is pouring a slab, like that found in sidewalks and driveways. This lesson will explore the equipment, procedures, and materials used in pouring a concrete slab.

C. ***Motivation***

1. Ask students if any of them have poured concrete. If so, what was the concrete used for? Ask the class if concrete poured in a slab will always be formed and constructed in the same manner.

2. Examine the concrete in the floor of the agricultural facility and the sidewalks outside the facility. Look for any cracks or breaks. Ask the students to determine what may have caused the faults in the concrete.

D. ***Assignment***

E. ***Supervised Study***

F. ***Discussion***

1. Ask the students to list the tools and equipment needed to pour concrete.

What tools are needed for pouring concrete?

a) Sledge and claw hammers
b) Carpenter's level
c) Shovel
d) Hose and water source
e) Tape measure
f) Transit or surveyor's level with surveying tripod and surveyor's rod
g) Calculator
h) Circular saw
i) Carpenter's or framing square
j) Lumber
k) 16d duplex-head nails

2. Once the equipment has been obtained, construction of the forms can begin. Ask the students to explain what forms are in relation to concrete. What is the purpose of concrete forms? Discuss the different types of forms used.

What are forms for concrete pouring?

a) Forms are structures designed to hold the concrete in proper shape and location until it sets and hardens.
b) Forms can be constructed of different materials.
    1) Wood forms
        (a) Wood forms for pouring a sidewalk or slab are usually made of 2" × 4" or 2" × 6" boards.

        (b) If plywood is used, SP plywood, or plyform, should be utilized; it is a special plywood made with a waterproof glue that repels the moisture in the concrete so the concrete will not be dried out by the forms.
        (c) Hardboard is sometimes used when forming curves because of its strength and flexibility.
        (d) Wood forms are typically less expensive and easier to construct.
    2) Aluminum or metal alloy forms
        (a) Aluminum or metal alloy forms will give a smoother, more uniform finish to the concrete.
        (b) They are structurally stronger than wood forms.
        (c) They will yield extremely straight, square concrete, since the forms do not bend or sway like wood forms will.
        (d) Aluminum or metal alloy forms are easy to construct and relatively inexpensive
    3) Earthen forms
        (a) Earthen forms can be constructed by shoveling soil in a pile in the desired location.
        (b) The earth is covered with a plastic lining to prevent soil from mixing with the concrete and to keep moisture from bleeding out of the concrete into the soil.
        (c) Earthen forms are rarely used and result in a poor quality slab.

3. Ask students how they would construct wooden forms. How are the forms braced?

How are forms constructed for slabs?

a) Determine the desired height of the forms.
    1) If a 4-inch slab is to be poured, 2" × 4" boards are used, but if the board has been planed or smoothed, the end product is only 1½" × 3½".
    2) This board size can be used for forming a 4-inch slab if soil has been placed on the outside of the form to strengthen it and close the opening at the bottom.

3) If thicker slabs are desirable, wider boards, such as 6-inch or 8-inch boards, are required.

b) Using the strings placed in laying out the corner stakes of the slab, put the edge of the boards directly underneath the string.
   1) Small stakes should be driven at least 6 inches into the ground with a hammer every 4 feet along the outside of the boards.
   2) The top of the stakes must be below the edge of the form to allow the slab to be worked as the concrete dries.
   3) The stakes are nailed to the boards using duplex-head nails attached on the outside of the forms.

c) Double check the forms to see if they are square by measuring the diagonals with a tape measure; if they are not, the forms should be adjusted.

d) Once the forms are square, determine if the forms are level by using the transit or level, tripod, and rod.
   1) If they are not level, the hammer can be used on the higher spots of the form to decrease its height.
   2) At this point, whether the slab should slope or be level should be considered.
      (a) If water or manure drainage is a concern, the slab should have at least a 4 percent slope in the direction that the excess water or manure should run off.
      (b) This slope should be figured into the final placement of the forms.

e) If the slab is to curve, plywood can be used in place of boards to make the forms.
   1) The plywood should be cut so the grain of the plywood runs vertically, because the stress from the concrete would crack or break the form if the grain ran horizontally.
   2) The stakes should be placed only 1 to 2 feet apart on curves instead of every 4 feet.

f) Forms should be secured tightly at the corners to prevent them from separating; sometimes they are attached using bolts or screws.

4. Often concrete by itself is not strong enough to handle the stress of the forces acting on it. Discuss the purposes of reinforcement. Ask students to list examples of concrete slabs that would be under great stress.

What is the purpose of reinforcement in concrete?

a) Reinforcement can strengthen the concrete and help it to resist the forces acting on it.
   1) Concrete has great compressive strength, which is the strength to resist forces pressing downward on the concrete.
   2) Concrete does not have good tensile strength, which is the ability to withstand tension or pull.

3) Reinforcing the concrete will increase its tensile strength, especially at the edge of the slab.

b) Reinforcement will also reduce the tendency of the concrete to crack due to changes in temperature.

5. Have students list materials they think would work as reinforcement in concrete. Discuss the methods of reinforcing concrete.

What are the types of reinforcement for concrete?

a) The most common types of reinforcement are made of steel.
b) Steel has high tensile strength, which helps resist the forces acting on the concrete.
c) The steel used in concrete for reinforcement must be clean and free of rust and organic debris like leaves.
d) In some cases, specially manufactured fibers can be added to the concrete as reinforcement in place of structural steel.
e) Steel rods are also commonly known as reinforcing bars, or rebar.
    1) Can be purchased in a variety of sizes, from ¼ inch up to 2 inches in diameter
    2) Typically sold in lengths of 20 feet and cut to fit
    3) Identified by a number, like 2, 3, 4, 5, or 6, that refer to the diameter of the rod, expressed in eighths of an inch
f) The other common type of reinforcement is steel wire mesh.
    1) Consists of rods of steel wire joined in a criss-cross pattern to form a mesh
    2) Comes in a number of different diameters, ranging from 0000 (small) up to 16 gauge
    3) Differ in the spacing between the wire rods in the mesh; common spacings are 2, 3, 4, 6, 8, 10, 12, and 16 inches
    4) Sold in rolls with common widths of 36, 42, 48, and 60 inches and in common lengths of 150, 200, and 300 feet

6. Ask students how they would install the different types of reinforcement.

How should reinforcement be installed?

a) Steel reinforcement
    1) Steel reinforcement should be placed in the bottom half of the slab, where the tensile forces on the concrete are the greatest; the reinforcement is placed approximately 1 inch above the soil or fill by wiring it to 12-inch rebar stakes that have been driven into the ground.
    2) Both rods and wire mesh need to be joined where they meet.
        (a) Rebar should overlap by a length that is equal to 24 times the diameter of the rod and not less than 12 inches, while mesh should be overlapped one full square spacing plus 2 inches.

(b) The reinforcement should be tied with thin wire where the bars or wire mesh meet.

3) When installing steel reinforcement, be sure to place the rebar or mesh around the outside edges of the slab.

4) The ends of the reinforcement should be placed at least 3 inches from the very edge of the slab, so that it does not eventually stick out of the edge of the concrete and pose a hazard.

b) Thickened edges

1) Thickened edges involve placing a thicker, deeper layer of concrete at the edges of a concrete slab as a type of footing.

(a) The edge should be 4 to 6 inches thicker than the slab itself.

(b) The base of the thickened area should be 12 inches wide, with a 45-degree slope from the bottom of the main slab to the bottom of the thickened edge.

2) This type of reinforcement is used on the perimeter of feeding floors and driveway edges where livestock or vehicles enter the paved area.

7. When placing larger slabs of concrete like a concrete pad or sidewalk, the slab will sometimes move. Ask students to examine the sidewalks outside the agricultural facility or school. What is the purpose of the lines in the concrete? Have students complete AS 4.1.

What are expansion and control joints, and when are they needed?

a) Expansion and control joints may either be grooves made in the concrete or material placed in the concrete to prevent breaks or control where the concrete breaks.

1) Joints can often prevent breakage, but if the concrete does break, these devices will also limit the location and force the break to form a straight line.

2) The straight grooves commonly seen across sidewalks and driveways are expansion and control joints.

b) Expansion and control joints can be made using several different methods.

1) For joints consisting of grooves in the concrete, a piece of angle iron or a v-shaped piece of wood can be pushed in a straight line through the drying concrete.

2) A mason's trowel can also be used to inscribe a groove into the drying concrete.

3) Another method is to saw grooves in the concrete, cutting the joints into the dried concrete with a masonry saw 4 to 12 hours after the concrete is poured.

4) An alternative method of installing expansion and control joints is to place small strips of IKO board on edge in the form before the concrete is poured.

(a) Expansion and control joints should always be placed in straight lines perpendicular to each other.
(b) For slabs 4 inches thick or less, joints should be made in the concrete every 10 feet; for slabs 6 inches thick, joints should be included every 15 feet.

G. ***Other Activities***

Have the students form and pour a sidewalk or small concrete slab at the agricultural facility or school. Be sure to include reinforcement and control joints.

H. ***Conclusion***

One of the most common tasks when working with concrete is pouring a slab. This lesson outlined the tools used in pouring a concrete slab, the procedure for laying out and forming concrete slabs, the methods of reinforcing concrete, and the use of expansion and control joints. Through careful attention to the procedures described, a concrete slab can be placed with minimal concrete defects.

I. ***Answers to Activity Sheets***

AS 4.1

1. Answers will vary.
2. Answers will vary.
3. Sidewalks and edges of driveways, etc.

J. ***Answers to Evaluation***

1. b
2. d
3. a
4. b

5. Rods and wire mesh

6. Rebar should overlap by a length that is equal to 24 times the diameter of the rod and not less than 12 inches, while mesh should be overlapped one full square spacing plus 2 inches. Both should be tied together with thin wire.

7. Expansion and control joints may either be grooves made in the concrete or material placed in the concrete to prevent or control where the concrete breaks.

8. Answers may include any three of the following: sledge and claw hammers, carpenter's level, shovel, hose and water source, tape measure, transit or surveyor's level with a surveying tripod and surveyor's rod, calculator, circular saw, carpenter's or framing square, lumber, and 16d duplex-head nails.

9. Reinforcement can increase the tensile strength of concrete and help it to resist the forces acting on it; it will also reduce the tendency of the concrete to crack due to changes in temperature.

10. Determining the desired height of the forms

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EVALUATION

Circle the letter that corresponds to the best answer.

1. The plywood used for concrete forms should:

    a. Be a special color.
    b. Be made with waterproof glue.
    c. Have lots of knots.
    d. Have a special type of grain.

2. Aluminum or alloy forms are _____ than wood.

    a. Easier to build
    b. Poorer in quality
    c. Weaker
    d. More expensive

3. Earthen forms should be lined with:

    a. Plastic.
    b. Clay.
    c. Organic material.
    d. Oil.

4. What is the minimal amount of slope on a slab for drainage?

    a. 3 percent
    b. 4 percent
    c. 8 percent
    d. 15 percent

Complete the following short answer questions.

5. What are the two most common steel reinforcement materials used in concrete?

    a.

    b.

6. How should reinforcement materials be overlapped during installation?

7. What are expansion and control joints?

8. What are three tools needed for pouring concrete?

   a.

   b.

   c.

9. What are two purposes of reinforcement?

   a.

   b.

10. What is the first step in constructing wooden forms?

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Reinforcing Concrete

Objective: Compare the strength of reinforced and non-reinforced concrete.

Materials and Equipment:

1 8-foot 1" × 6" board
20 16d duplex-head nails
_" welding wire
Wax paper or plastic wrap
Latex gloves
Eye protection
Concrete mix

Procedure:

NOTE: Safety glasses and gloves should be worn whenever working with concrete to protect your eyes from splashing concrete and your skin from chemical burns from the reaction of the cement and water.

1. Construct two forms from the materials provided. The forms should have inside measurements of 2" × 3" × 24". The forms will basically be open-topped boxes into which the concrete will be poured.

2. Line the forms with wax paper or plastic wrap to prevent the concrete from sticking to the wood in the forms.

3. In one of the forms, place two pieces of rebar 3/4 of an inch from the bottom. Do not place rebar in the second box. Support the rebar with small supports made from welding or other stiff wire. These supports are made in the shape of a capital letter M, with the rebar resting in the valley on top of the M.

4. Pour concrete into both of the boxes. Be sure to not displace the rebar.

5. As the concrete is drying, write your name in the concrete in both forms. This will identify your samples and indicate which side of the concrete was up when it was poured.

6. Allow the concrete to cure for seven days.

7. After seven days, remove the forms and place the concrete on top of two sturdy supports with your name facing upwards.

8. Using a large hammer, strike both beams of concrete as close to the middle as possible.

Key Questions:

1. What happened to each of the samples when they were struck with a hammer?

2. What effect did the rebar have on the strength of the concrete?

3. What are two examples of locations where additional strength would be needed for concrete?

   a.

   b.