Lesson 4: Pouring a Concrete Slab

One of the most common activities in pouring concrete is pouring a concrete slab. Concrete slabs are used in foundations, garage floors, sidewalks, and many other places. This lesson will examine the procedures used in pouring concrete slabs.

Tools for Pouring Concrete

As with any construction task, specific tools and equipment are needed to pour a concrete slab. The tools required include sledge and claw hammers, a carpenter's level, a shovel, a hose and water source to moisten the site, a tape measure, a transit or a surveyor's level used with a surveying tripod and surveyor's rod, a calculator for any calculations that may need to be made, a circular saw, a carpenter's or framing square, and lumber and 16d duplex-head nails for the forms.

Forms

Once this equipment has been obtained, construction can begin on the forms for pouring the concrete. Forms are structures designed to hold the concrete in the proper shape and location until it sets and hardens. Forms can be constructed of different materials, such as wood, aluminum or metal alloys, and earth.

Wood forms for pouring a sidewalk or slab are usually made of 2" × 4" or 2" × 6" boards. The wood should be free of knots and decay, which will weaken the form. Wood forms are usually coated with a lightweight oil to prevent the concrete from sticking to the form. 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. Hardboard, a wood composite sometimes called Masonite, is sometimes used when forming curves because of its strength and flexibility. Wood forms are easy to construct and are relatively inexpensive.

Aluminum or metal alloy forms will give a smoother, more uniform finish to the concrete. These forms are structurally stronger than wood forms. They will yield extremely straight, square concrete, since the forms do not bend or sway under the weight of the concrete like wood forms will. Aluminum or metal alloy forms are expensive to purchase and cannot be easily constructed like wood forms.

Earthen forms can be constructed by shoveling soil in a pile in the desired location. 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. Earthen forms are rarely used and result in a poor quality slab.

Constructing Forms

Once a type of form has been chosen, forms can be purchased or made. This section of the lesson will describe the construction of wood forms because they are the most commonly used type.

The first step in constructing forms is determining the desired height of the forms. For a 4-inch slab, which is a common size, 2" × 4" boards are used. However, if the board has been planed or smoothed, the end product is only 1½" × 3½". 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. If thicker slabs are desirable, wider boards, such as 6-inch or 8-inch boards, are required for the sides of the forms.

The edges of the boards are put in place directly underneath the string or twine used when laying out the corners of the slab, as described in the last lesson. Small stakes should be driven at least 6 inches into the ground with a hammer every 4 feet along the outside of the boards to stabilize them and hold them in place. The tops of the stakes must be below the edge of the form to allow the slab to be worked as the concrete dries. If the stakes are above the edge, they will interfere with leveling the concrete. If necessary, the tops of the stakes can be cut level with the form using a circular saw. The stakes are nailed to the boards using duplex-head nails attached on the outside of the forms. This type of nail makes the removal of the nails easier when the forms are taken apart after the concrete sets.

Once the outside edges of the forms are in place, the forms should be checked to ensure that they are square. A tape measure can be used to check whether the diagonals are equal. If they Once the forms are square, a carpenter's level or the transit with its tripod and surveyor's rod should be used to determine if the forms are level. If they are not level, a hammer can be used on the higher spots of the form to decrease its height. At this point, whether the slab should slope or be level should be considered. 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. This slope should be figured into the final placement of the forms.

If the slab is to curve, plywood can be used in place of boards to make the forms. 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. The stakes should be placed only 1 to 2 feet apart on curves instead of every 4 feet. Curves place more stress on the form, and more stakes are necessary to keep the forms in place.

Forms should be secured tightly at the corners to prevent them from separating. Sometimes corners are attached using bolts or screws, which are stronger than nails.

The Purposes of Reinforcement in Concrete

Concrete must often be reinforced to make it stronger and prevent various types of damage. Reinforcement can strengthen the concrete and help it to resist the forces acting on it. Concrete by nature has great compressive strength, which is the strength to resist forces pressing downward on the concrete. However, concrete does not have good tensile strength, which is the ability to withstand tension or pull. For example, a heavy weight, like a tractor, close to the edge of a slab might cause the concrete to crack or break because of the tension on the concrete at the edge. Reinforcing the concrete will increase its tensile strength, especially at the edge of the slab. Reinforcement will also reduce the tendency of the concrete to crack due to changes in temperature.

Types of Reinforcement

are not, the forms should be adjusted until they are square.

The most common types of reinforcement are made of steel. Steel has high tensile strength, which helps resist the forces acting on the concrete. To be effective, the steel used in concrete for reinforcement must be clean and free of rust and organic debris like leaves. In some cases, specially manufactured fibers can be added to the concrete as reinforcement in place of structural steel.

Steel rods are also commonly known as reinforcing bars, or rebar. Rebar can be purchased in a variety of sizes, from ¼ inch up to 2 inches in diameter. These rods are typically sold in lengths of 20 feet and are cut to fit. Steel rods are identified by a number, such as 2, 3, 4, 5, or 6. These numbers refer to the diameter of the rod, expressed in eighths of an inch. Number 4 rebar is ½ inch in diameter.

The other common type of reinforcement is steel wire mesh. Wire mesh consists of rods of steel wire joined in a crisscross pattern to form a mesh. The steel comes in a number of different diameters, ranging from 0000, which is thin, up to 16 gauge. Meshes also differ in the spacing between the wire rods in the mesh. Common spacings are 2, 3, 4, 6, 8, 10, 12, and 16 inches. Rolls of wire mesh are commonly sold in widths of 36, 42, 48, and 60 inches. Common lengths are 150, 200, and 300 feet.

Installing Reinforcement

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. Both rods and wire mesh need to be joined where they meet. 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. The reinforcement should be tied with thin wire where the bars or wire mesh meet. When installing steel reinforcement, be sure to place the rebar or mesh around the outside edges of the slab. However, 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. After the rebar or mesh is Sometimes the edges of the concrete are thickened to provide additional reinforcement for the rebar. Thickened edges involve placing a thicker, deeper layer of concrete at the edges of a concrete slab as a type of footing. The edge should be 4 to 6 inches thicker than the slab itself. 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, as shown in Figure 4.1. This type of reinforcement is used on the perimeter of feeding floors and driveway edges where livestock or vehicles enter the paved area.

Expansion and Control Joints

Larger slabs of concrete like a concrete pad or sidewalk will at times move for various reasons, such as settling or pressure. A way to reduce the cracking of the concrete that results is to use expansion and control joints. 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. 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. The straight grooves commonly seen across sidewalks and driveways are expansion and control joints.

Expansion and control joints can be made using several different methods. For joints consisting of grooves in the concrete, a piece of angle iron, which is L-shaped, or a V-shaped piece of wood can be pushed in a straight line through the drying concrete. A mason's trowel can also be used to inscribe a groove into the drying concrete. Another method is to saw grooves in the concrete. These joints are cut into the dried concrete with a masonry saw 4 to 12 hours after the concrete is poured. The depth of the groove created using each of these methods will be less than one inch. An alternative method of installing expansion and control joints is to place small strips of IKO board on edge in the form in place, concrete is poured on top of the reinforcement.

before the concrete is poured. IKO board is soft and spongy and is sometimes used to make bulletin boards. The board will expand and contract as the concrete dries and shrinks or moves due to expansion and contraction. Both of these types of control joints may be used in some situations.

Expansion and control joints should always be placed in straight lines perpendicular to each other in the concrete slab. The joints should make squares in the concrete and can be formed using a framing square. 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.

Summary

Pouring a concrete slab is a common task when working with concrete. Knowing the proper tools to use, the proper methods of forming and reinforcing concrete, and how to control expansion and breakage will result in a higher quality finished product.

Credits

Ahrens, Donald L. *Concrete and Concrete Masonry*. St. Paul, Minn.: Hobar Publications, 1976.

Boyd, James S., and Carl L. Reynolds. *Practical Farm Buildings*. 3rd. ed. Danville, Ill.: Interstate Publishers, 1993.

Cooper, Elmer L. *Agricultural Mechanics: Fundamentals and Applications*. Albany, N.Y.: Delmar Publishers, 1997.

Lindley, James A., and James H. Whitaker. *Agricultural Buildings and Structures.* Rev. ed. St. Joseph, Mich.: American Society of Agricultural Engineers, 1996.

Materials Science and Technology (MAST) Teacher's Workshop. "Concrete." Produced by the Department of Materials Science and Engineering at the University of Illinois, Urbana/Champaign. http://mach-pc66.mse.uiuc.edu/~tw/concrete/concrete.html (29 Aug. 1998).

The Concrete Pages. “Control Joints for Concrete Slabs.” http://www.concretepages.com/tcjts.html (19 Oct. 1998).