Lesson 7: Pouring Concrete Walls

Concrete walls are common in construction. They may be used for the sides of a building or for pits to store silage or manure. Also, when building a house, many people prefer to have a crawl space or basement under the house. In order to have these items, a concrete wall must be poured on top of the footings to support the rest of the building. This lesson will discuss the equipment and procedures used in pouring concrete walls.

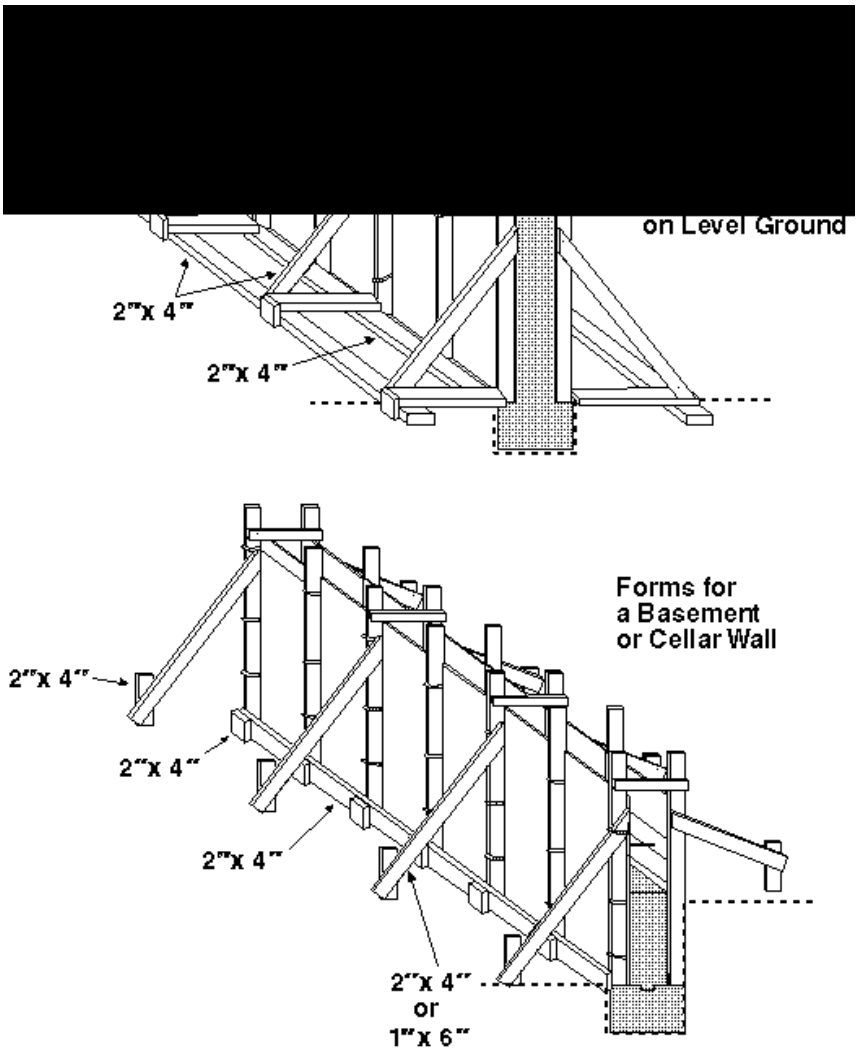
Tools for Pouring Walls

Many of the tools needed for pouring a concrete wall are the same as those used for slabs, although some additional items are necessary. The tools and equipment needed to pour a concrete wall include a trowel, steel tamp rod, shovel, hand level, tape measure, circular saw, and hammer for nailing forms together.

Types of Forms

Several materials are commonly used to construct forms for pouring concrete walls. Wood is the most commonly used material. The forms are typically constructed of plywood made with an exterior glue, which is waterproof and will not come apart when exposed to moisture. Plywood forms are illustrated in Figure 7.1.

Aluminum or metal forms are also made for walls. The use of metal forms will produce straighter walls because the metal does not bend from the weight of the concrete as much as wood forms do. However, metal forms are more expensive than plywood forms.



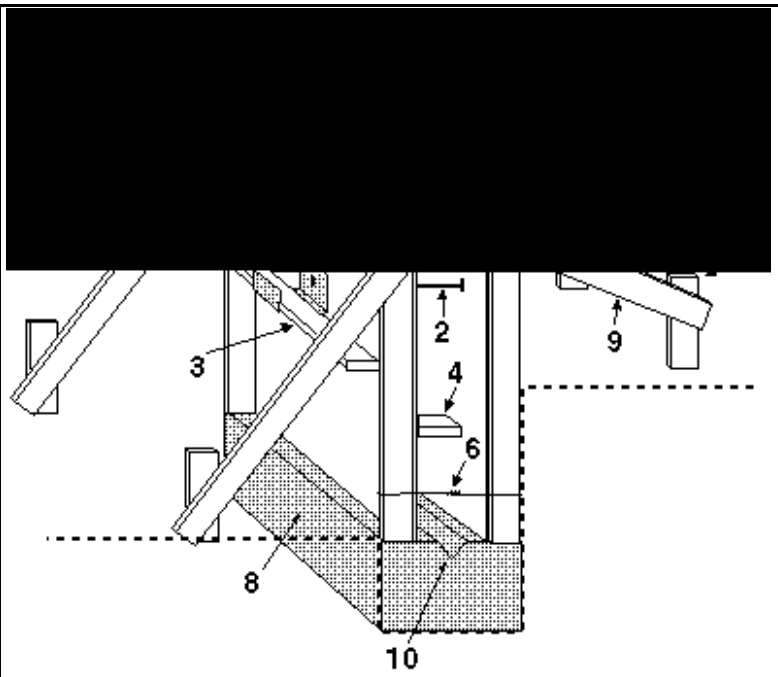
A new type of wall form has been developed in the last few years. These forms are made of Styrofoam with steel mesh embedded in it to add strength to the form. With this type of form, the form is not removed after the concrete is poured into it. Instead, it becomes a permanent part of the wall. Styrofoam forms have several shapes, including one resembling cinder blocks.

Styrofoam forms have several advantages and disadvantages. Less labor is required because the forms are not removed. They allow for construction in all types of weather because moisture will not alter the form as it does wooden forms. The forms are lightweight and snap together for ease of construction. Less bracing is required than with wooden forms. Wiring and pipes can be run through these forms easily because they provide passages through the concrete for plumbing and electricity; with standard forms, wires and pipes will have to be run on the outside of the concrete wall. The forms are energy efficient, as the Styrofoam is an insulator and will serve as insulation for the wall. Finally, the finished product can be finished or painted with exterior paint. A disadvantage of Styrofoam forms is that the forms are not reusable. They are also much more expensive than wooden forms and slightly more expensive than the metal forms.

Constructing Forms for Walls

Since most concrete forms are made of wood, this section will concentrate on how to build wood forms, which have several parts. The parts of a wooden form are illustrated in Figure 7.2.

Stake - Stakes are typically made from a 2" × 4" board, which will allow the form to be braced to keep it straight and vertical. For strength, they are placed 4 feet apart or less.



1. Holder
2. Tie Snap
3. Wale
4. Spreader
5. Sheathing
6. Tie Wire
7. 1˝x 4˝ Tie
8. Footing
9. Brace
10. Key
11. Stake
12. Marker Nail

Brace - Braces are nailed to the stake and the form to help keep the forms vertical. Braces can be cut to the correct lengths needed with a circular saw.

1" x 4" tie - The ties keep the two sides of the form apart to give the wall the desired thickness. Each end of a tie is nailed to one side of the form.

Sheathing - The sheathing that forms the sides of the form is typically made of plywood.

Wale - A wale is a 2" × 4" board that prevents the wall from bulging outward due to the weight of the concrete. It is nailed to the form with the wide side down.

Holder - Holders, which are typically made of metal, hold wales and snap ties in place. Once the sheathing is standing in place, the holder is placed over the snap ties and wales are placed in the holder. The holder holds the entire form together.

Snap tie - Snap ties are specially constructed pieces of wire that will run through the concrete wall. Snap ties help hold the forms the correct width apart. The snap tie has a wider spot that allows the holder to clamp tight on it without slippage. Once the concrete has set and before attempting to remove the forms, the holders should be removed, and the ends of the ties can be snapped off by bending them back and forth.

Spreader - A spreader typically consists of a 2" × 4" board cut to a length that is equal to the thickness of the wall. Spreaders are placed inside the form to keep its sides apart while the concrete is poured. During pouring, the spreaders are removed just before the concrete reaches that level.

Wire tie - Like snap ties, wire ties hold the forms the correct width apart. Wire ties are used on the ends of a form, while snap ties are used in the middle. They are constructed of twisted wire and are broken off after the concrete sets.

Key - The key is a groove made in the footing that will allow the concrete from the walls to bond to the concrete in the footing.

Marker nails - Marker nails are driven through the form from the outside to mark the desired height of the concrete if it will not be poured to the top of the form. These nails are removed when the concrete reaches the desired level to allow the surface to be worked with a trowel or float.

Assembly of the forms begins with standing the sheathing upright where the wall will be poured. The holders, snap ties, and wales should be put on to hold the two sides together. Spreaders can be added on the inside of the form at this time. Next, stakes are placed in the ground about 5 to 8 feet away from the form and the braces are cut to the correct distance to reach the stakes. The form should be checked using a level to make sure it is level and plumb, or straight up and down. If the forms are not level and plumb, adjust the braces until the form is correct. Then the braces are nailed to the forms and the stakes to hold the forms in the correct position. After the braces and stakes are in position, the wire ties are placed on the ends of the forms, and the 1" x 4" ties are secured to the ends of the forms with duplex-head nails.

The forms must be square, because if they are not, the building will not be square. The diagonal method is used to check whether they are square. If the diagonals are not equal, the form will have to be adjusted.

All of the pieces on the form must fit tightly together, and the forms must be strong. They should be checked prior to pouring the concrete. Forms that are loose or weak will lead to blow-outs, or concrete flowing out of weak spots in the form that break due to the weight of the concrete. Usually these weak spots occur at corners or where two forms meet. These spots can be braced using additional 1" x 4" ties and duplex-head nails attached diagonally across the corners, or across the joint where the forms meet.

High quality lumber must be used in constructing forms. Weak spots from cracks, knot holes, or other problems will reduce the strength of the form.

Reinforcement of Walls

After the forms have been set up and are square, reinforcement can be added. Just like slabs, walls require reinforcement. Typically they are reinforced with rebar. The rebar should be placed in the middle of the wall at an equal distance from each side of the form, and it should not stick out the top. The rods are placed length-wise through the walls, spaced 8 to 12 inches apart. Rods are driven vertically in the ground every 4 feet to support the horizontal rods. The vertical and horizontal rods are tied together using thin wire.

Pouring the Walls

The process for pouring concrete walls is relatively simple. Before filling the forms with concrete, they should be lightly oiled to prevent the concrete from sticking. The concrete is then poured from one end or corner, working along the wall. The corner must be filled before moving on to the rest of the wall. Enough concrete should be poured in one spot to fill the form before moving so that the concrete does not have to be shoveled backward to fill low spots. Spreaders must be removed as the form is filled. When the form is filled to the desired level, the steel tamp rod is run up and down through the concrete to help work out air bubbles. As soon as one wall is finished, another wall can be started if the forms are in place.

After each of the walls has been poured, the top surface of the concrete must be smoothed and leveled. The top surface needs to be flat and relatively smooth so a wall that is built on top of it will seal against the concrete and not allow air to leak into the building. This task can be done using a small trowel or a board cut the width of the wall. The tool is worked along the top of the forms in a process similar to screeding.

After the first wall has been leveled and smoothed and the surface starts to dry, anchor bolts can be inserted into the concrete. Anchor bolts are standard bolts that are placed with the head of the bolt in the moist concrete. These bolts will anchor the wooden portion of the structure. They should be at least 3/8 of an inch in diameter and are typically 4½ to 5 inches long. Anchor bolts are generally set at least 2 inches into the concrete. The bolts should be straight.

Anchor bolts are spaced 4 to 6 inches apart along each side of the building, with one bolt set in from the corner near each end of a wall. The distance between them depends on the wind loads that will affect the structure. They should be only 4 inches apart in areas with more winds but may be further apart in areas with little wind. The anchor bolts will help secure the walls to the foundation in strong winds. The bolts should also be placed where they will not interfere with the upright studs in the walls. If an anchor bolt is located where the stud will be, either the stud will have to be moved, which would weaken the wall, or the bolt will have to be cut off, which decreases the wall's ability to resist winds

Before the forms are removed, concrete walls should cure for at least one week, preferably longer. The concrete will take longer to cure because the outside air is not reaching as much of the surface.

When the concrete has cured enough, the forms are removed. All holders and wales are loosened first. The braces and stakes are then removed. Finally, the sheathing is carefully removed. They should come off without the use of excessive force. After the forms have been removed, the snap ties can be twisted back and forth until they break or snap off to leave a relatively smooth wall surface. If wire ties were used, cement paste can be used to fill in the holes left in the concrete.

Preventing the Entry of Moisture

Even though concrete is mostly waterproof, moisture may still flow through, especially at joints or cracks. To completely seal a concrete wall, the use of some method of repelling or removing moisture is necessary. A vapor barrier is a specially constructed protective material attached to the inside of the underground portion of a concrete wall to eliminate condensation. Waterproofing materials painted on the outside of a wall also prevent the entry of the water. Typically, they are made of polyurethane, rubber, tar, or other waterproofing compounds. It may also consist of a layer of polyethylene plastic glued to the outside of the wall that will repel water from the soil. Another way to keep water from entering the concrete is the use of a waterstop. Waterstops are synthetic materials placed between concrete construction joints to stop

water from entering through the joints. Drainage pipes can also be placed around the structure to move excess water away, reducing the chance of water problems.

Pouring concrete walls is an important step in building construction. If the forms are built and braced correctly, the building will be square and strong. Care should be given to carefully constructing the forms, pouring the concrete, and allowing the concrete to cure. Properly reinforcing the concrete will yield much stronger walls that can withstand the years of pressure and stress from the weight of the building. A water stop can be used to completely waterproof a wall.

Credits

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

Summary

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).