CHAPTER 5
FORMS FOR CONCRETE

Forms play a major role in concrete construction. They give the plastic concrete its shape and hold it until it hardens. Forms protect the concrete, assist in curing it, and support any reinforcing rods or conduits embedded in the concrete. This chapter familiarizes the carpenter with the design and construction of various types of forms.

FORM DESIGN

Forms for concrete must be tight, rigid, and strong. If forms are not tight, loss of concrete may cause a honeycomb effect, or loss of water may cause sand-streaking. The forms must be braced enough to stay in alignment. Special care is needed when bracing and tying down forms used in applications such as retainer walls, where the mass of concrete is large at the bottom and tapers toward the top. In this type of construction and in the first pour for walls and columns, the concrete tends to lift the form above its proper elevation. (Field Manual 5-742 gives formulas and tables for designing forms of proper strength.)

FORM CONSTRUCTION

Although forms are generally constructed from wood, fiber, earth, or metal, the TO carpenter usually constructs wood or fiber forms.

Wood forms are the most common in building construction. They are economical, easy to handle, and easy to produce, and they adapt to many shapes. Form lumber can be reused for roofing, bracing, or similar purposes.

Lumber should be straight, strong, and only partially seasoned. Kiln-dried lumber tends to swell when soaked with water. Swelling may cause bulging and distortion. If green lumber is used, allow for shrinkage, or keep it wet until the concrete is in place. Softwoods (pine, fir, and spruce) are the most economical; they are light, easy to work with, and generally available.

Wood coming in contact with concrete should be surfaced (smooth) on the side towards the concrete and on both edges. The edges may be square, shiplap, or tongue-and-groove. Tongue-and-groove lumber makes a more watertight joint, which reduces warping.

Plywood is economical to use for wall and floor forms; however, plywood used for this purpose should be made with waterproof glue and marked for use in concrete forms. Plywood is warp-resistant and can be used more often than other lumber.

An advantage of using plywood for forms is the great number of sizes available. It is made in thicknesses

CAUTION

· Watch for protruding nails. They are the principal cause of accidents on form work.
· Inspect tools frequently.
· Place mud sills under shoring that rests on the ground.
· Protect all men on scaffolds and on the ground.
· Do not raise large form panels in heavy gusts of wind.
· Brace all shoring securely to prevent collapse of form work.

of 1/4, 3/8, 1/2, 5/8, and 3/4 inch, and in widths up to 48 inches. The 8-foot lengths are most commonly used. The 6/8- and 3/4-inch thicknesses are most economical. Thinner plywood requires solid backing to prevent deflection. The 1/4-inch thickness is useful for curved surfaces.

Waterproof cardboard and other fiber materials are used for round concrete columns and other preformed shapes. Forms are made by gluing layers of fiber together and molding them to the right shape. The advantage is that fabrication at the job site is not necessary.

FOUNDATION AND FOOTING FORMS

When possible, earth is excavated to form a mold for concrete-wall footings. If wood forms are needed, the four sides are built in panels.

Panels for two opposite sides are made at exact footing width; the other pair has two end cleats on the inside spaced the length of the footing plus twice the sheathing thickness. One-inch-thick sheathing is nailed to vertical cleats spaced on 2-foot centers. Two-inch dressed lumber should be used for the cleats.

NOTE: Panels are held in place with form nails until the tie wire is installed. Nails should be driven only part way from the outside so that they can be easily removed.

Tie wires are wrapped around the center cleats. Wire holes on each side of the cleat should be less than 1 inch in diameter to prevent mortar leaks. Reinforcing bars must be placed before the wire is installed.

For forms 4 feet square or larger, stakes are driven as shown in Figure 5-1. These stakes, and 1 x 6 boards nailed across the top of the form, prevent spreading. Panels may be higher than the required depth of footing, since they can be marked on the inside to show the top of the footing. If the footings are less than 1 foot deep and 2 feet square, forms can be constructed of 1-inch sheathing without cleats (Figure 5-2).

When placing a footing and a small pier at the same time, the form is built as shown in Figure 5-3. To ensure that support for the upper form does not interfere with the placement of concrete in the lower form, 2 x 4 or 4 x 4 pieces

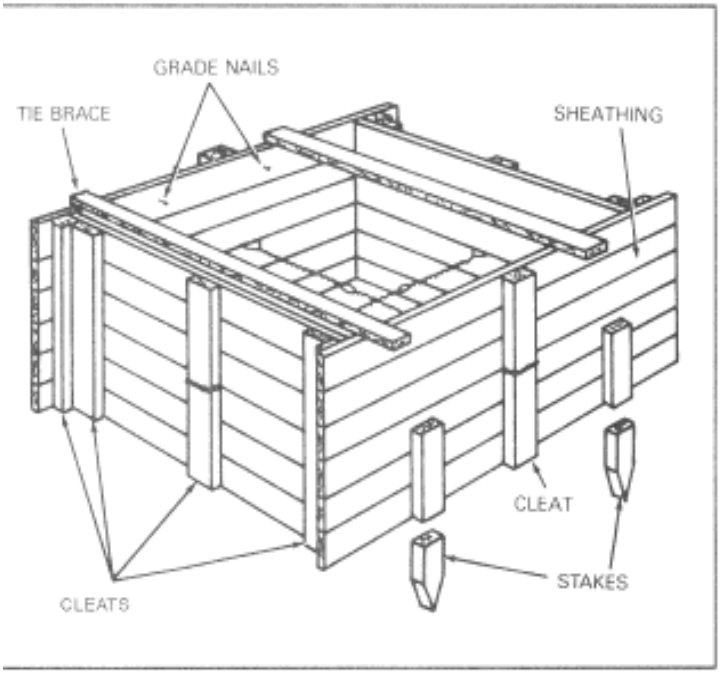


Figure 5-1. Typical large footing form

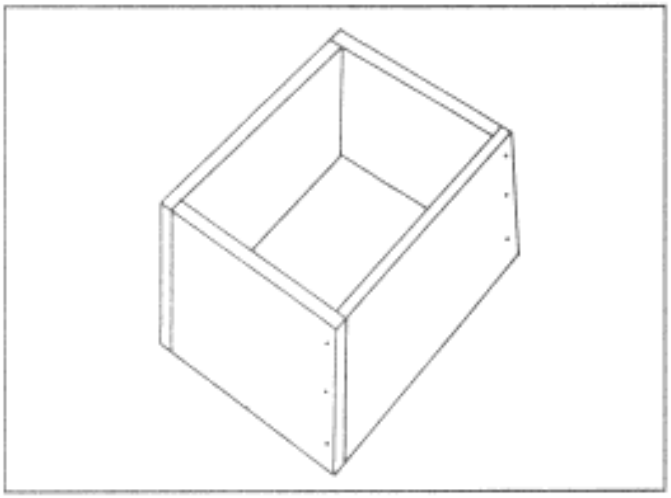


Figure 5-2. Typical small footing form

are nailed to the top of the lower form (as shown). The top form is then nailed to these pieces.

Construction and bracing of forms for wall footings are shown in Figure 5-4. The sides are 2-inch lumber held in place by stakes and held apart by spreaders. The short brace shown at each stake holds the form in line.

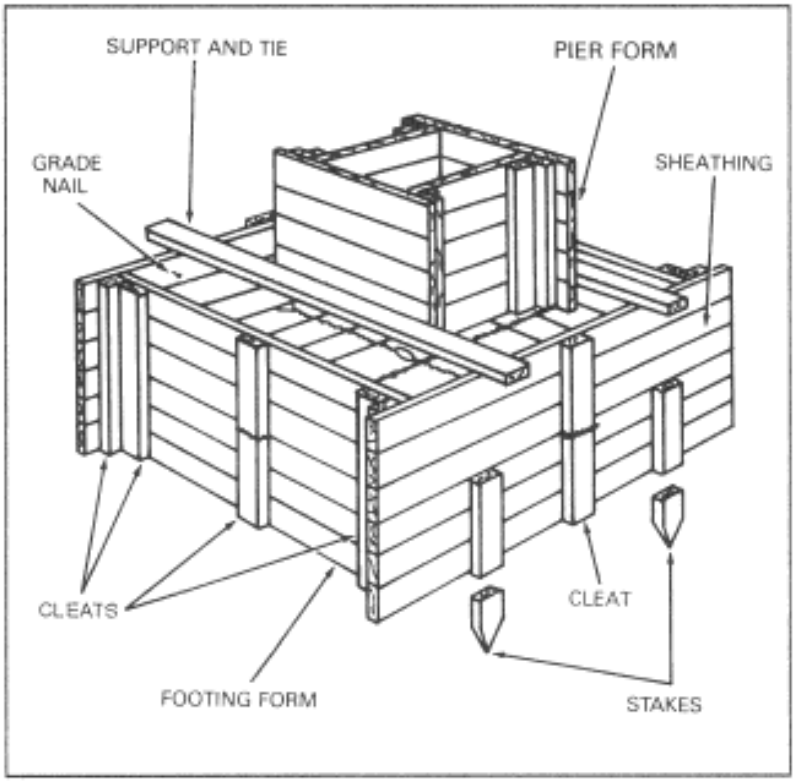


Figure 5-3. Footing and pier form

WALL FORMS

Wall forms are made of wall "panels" and other parts shown in Figure 5-5 page 5-4. These Darts are described as follows:

Wall Panels

Wall panels are made by nailing the *sheathing* to the *studs* and can be built in place or prefabricated elsewhere. Prefabricated wall panels should be no more than 10 feet long so that they can be easily handled. Figure 5-6, page 5-4, shows how wall panels are connected and how wall corners are constructed.

Sheathing

Sheathing forms the surface of the concrete. It should be smooth, especially if the finished surface is to be exposed. It is normally 1-inch (3/4-inch dressed) tongue- and-groove lumber or 3/4-inch plywood. Concrete is plastic when placed in the form, so sheathing should be watertight. tongue-and-groove lumber or plywood gives a watertight surface. Reinforce sheathing to prevent bulging from the weight of the concrete.

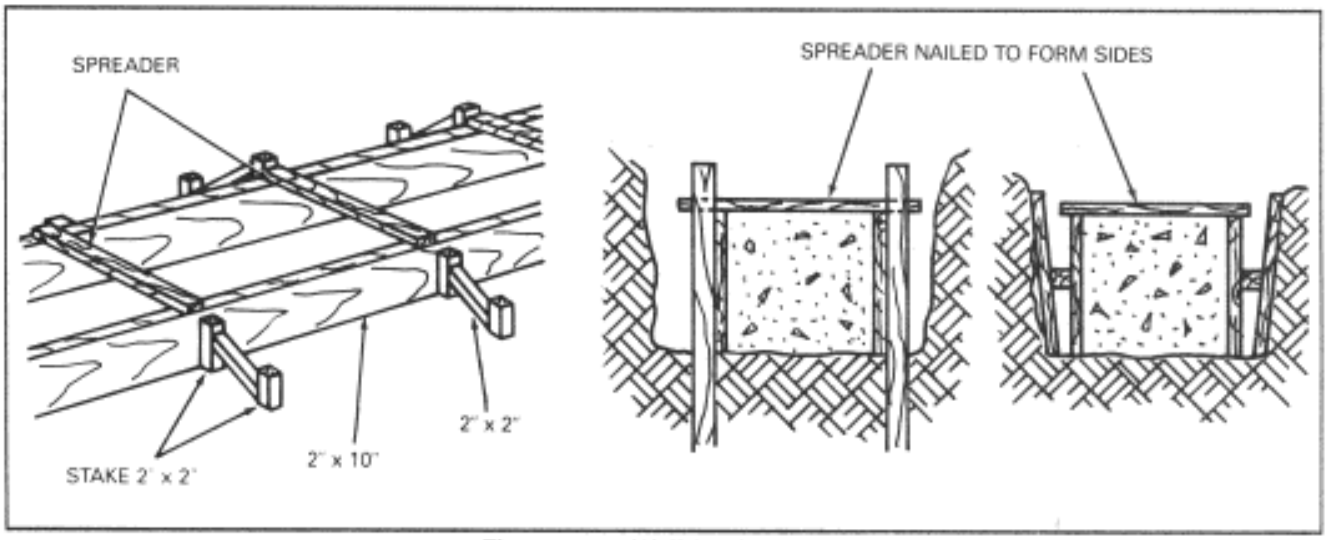


Figure 5-4. Wall-footing forms

Studs

Vertical studs make the sheathing rigid. These studs are generally made from 2 x 4 lumber. Studs also require reinforcing when they extend more than 4 feet.

Wales

Double wales reinforce the wall form. They also tie wall panels together and keep them in a straight line. They run horizontally and are lapped at the corners.

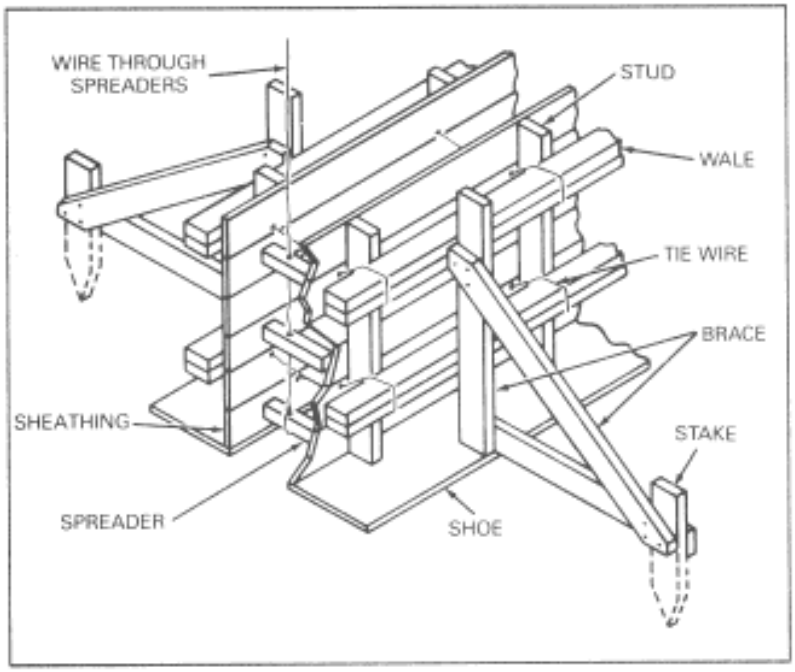


Figure 5-5. Concrete wall form

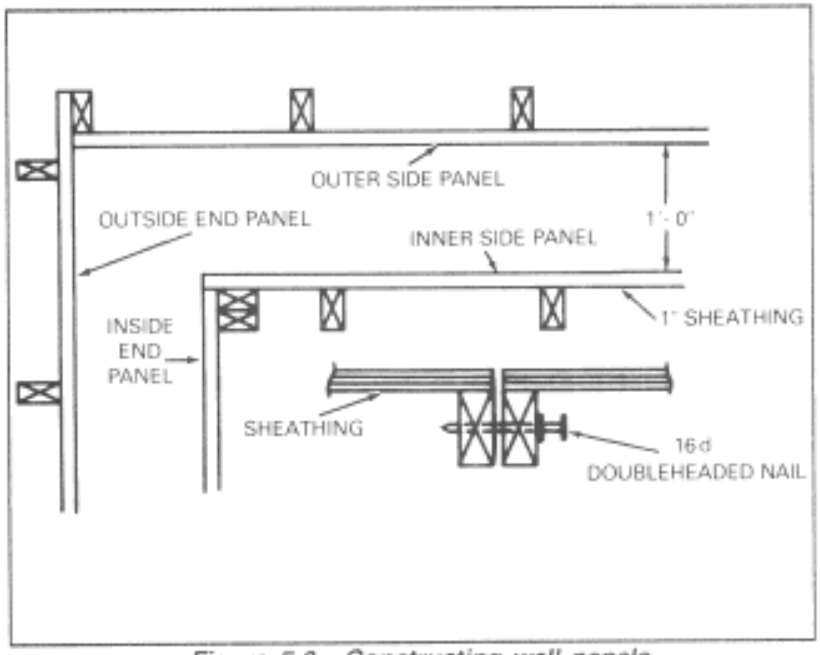


Figure 5-6. Constructing wall panels

Braces

Braces give the forms stability. The most common brace uses a horizontal member and a diagonal member nailed to a stake and to the stud or wale. The diagonal member of the brace should make a 30° angle with the horizontal member. Additional bracing may be provided by strongbacks (vertical members) behind the wales or in the corner formed by intersecting wales. (Braces are not part of the form design and are not considered as providing additional strength.)

Shoe Plates

Shoe plates are nailed into the foundation or footing and must be carefully placed to maintain the wall dimensions and alignment. Studs are tied into the shoe plate.

Spreaders

Spreaders must be placed near each *tie wire.* Spreaders are cut to the same length as the thickness of the wall and placed between the two sheathing surfaces of the forms. They are not nailed, but are held in place by friction.

Spreaders are removed as the forms are filled (Figure 5-7), so that they will not become embedded as the concrete hardens. A wire is attached to the spreaders to allow them to be pulled out of the form after the concrete has put enough pressure on the walls to allow easy removal. The wire fastened to the bottom spreader passes through a hole drilled off center in each spreader above it.

Pulling on the wire will remove the spreaders one after another as the concrete level rises in the forms.

Tie Wires

Tie wires hold the forms secure against the lateral pressures of unhardened concrete. Double strands are always used. Ties keep wall forms together as the concrete is positioned; Figure 5-8 shows two ways of doing this. The wire should be No. 8 or 9 gauge, black, annealed iron wire. Barbed wire may be used in an emergency. Tie spacing should be the same as the stud placing, but never more than 3 feet. Each tie is formed by looping the wire around a wale, bringing it through the form, and looping it around the wale on the opposite side. The tie wire is made taut by twisting it with a smooth metal rod or a spike.

NOTE: Wire ties should be used only for low walls or when *tie rods* are not available.

Tie Rods

An alternate to tie wires and spreaders, the tie rod and spreader combination is shown in Figure 5-9, page 5-6. After the form is removed, each rod is broken off at the notch. If appearance is important, the holes should be filled with a mortar mix.

The use of a wood strip as a wedge when curtain walls and columns are placed at the same time is shown in Figure 5-10, page 5-6. In removing the forms, the wedge is removed first.

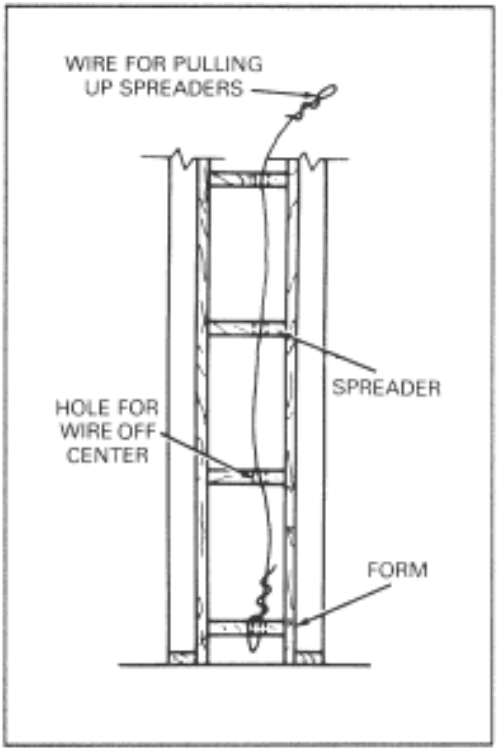


Figure 5-7. Removing wood spreaders

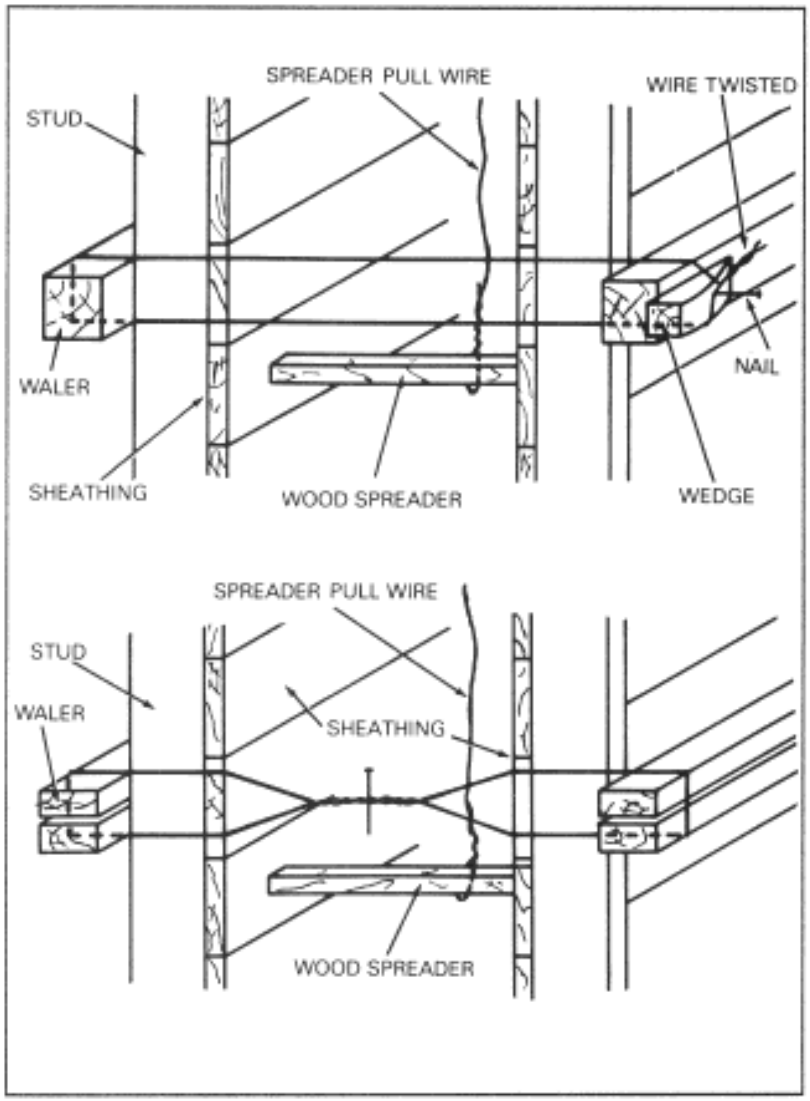
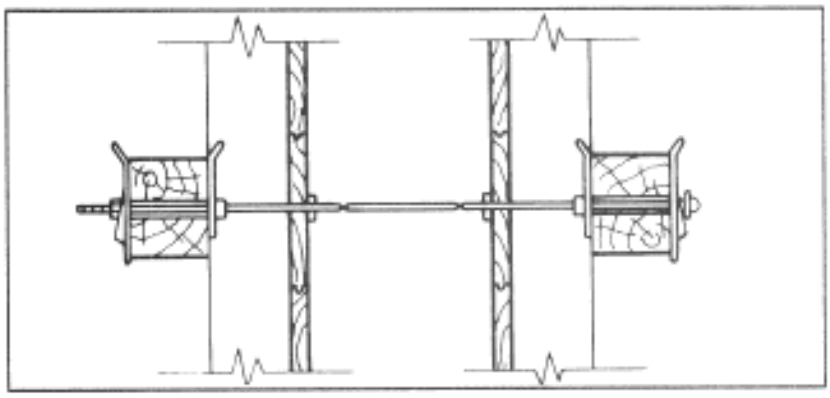


Figure 5-8. Wire ties for form walls



COLUMN FORMS

Sheathing runs vertically in column forms to save saw cuts. Corner joints are firmly nailed to ensure watertight construction. Battens or narrow strips of boards (cleats) are placed directly over the joints to fasten the several pieces of vertical sheathing together.

A column and footing form is shown in Figure 5-11. The column form is erected after the steel reinforcement is assembled and is tied to dowels in the footing. The form should have a **cleanout** hole in the bottom to help remove debris. The lumber removed to make the cleanout holes should be nailed to the form so that it can be replaced before the concrete is positioned.

BEAM AND GIRDER FORMS

Figure 5-12 shows both beam and girder forms. The type of construction of these forms depends on whether the form is to be removed in one piece or whether the bottom is to be left until the concrete is strong enough for shoring to be removed. Beam forms receive little bursting pressure but must be shored at close intervals to prevent sagging.

The bottom of the form is the same width as the beam; it is in one piece for its full width. Form sides are 1-inch tongue-and-groove material; they lap over the bottom (as shown). The sheath is nailed to 2 x 4 struts placed on 3-foot centers. A 1 x 4 piece is nailed along the struts to support the joists for the floor panel. The sides of the form are not nailed to the bottom but are held in position by continuous strips. Crosspieces nailed on top serve as spreaders. After erection, the slab panel joints hold the beam in place.

A beam and girder assembly is shown in Figure 5-13, page 5-8. The beam bottom butts tightly against the side of the girder and rests on a 2 x 4 nailed to the girder side. Details in Figure 5-13 show the clearances for stripping and the allowances for movement caused by the concrete's weight. The 4 x 4 posts are spaced to support the concrete and are wedged at the bottom or top for easy removal.

FLOOR FORMS

Floor panels are built as shown in Figure 5-14, page 5-9. The 1-inch tongue-and-groove sheathing or 3/4-inch plywood is nailed to 1 x 4 cleats

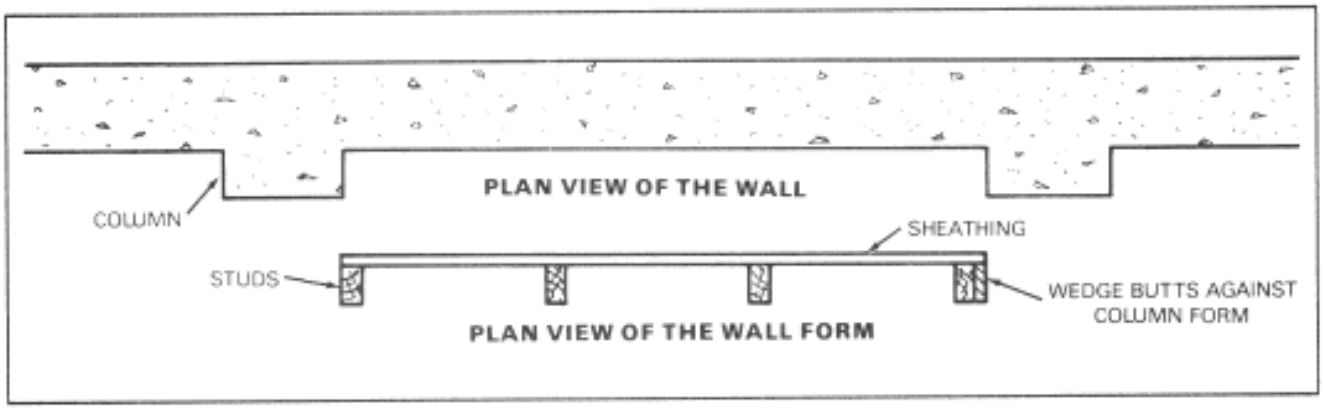
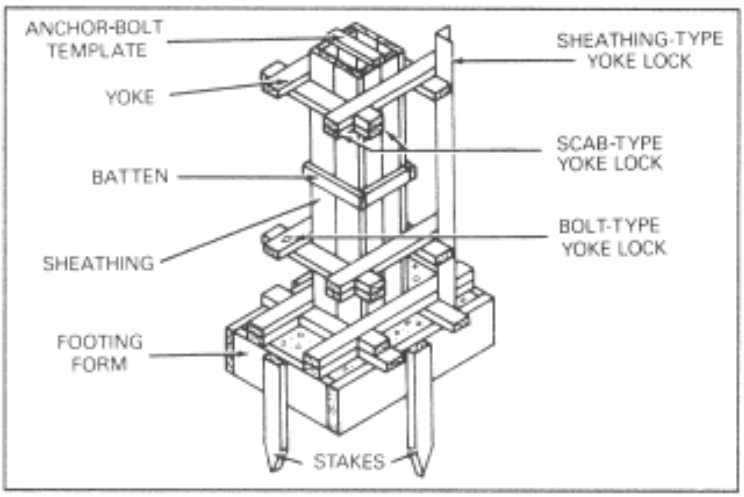


Figure 5-10. Wall form for curtain walls



on 3-foot centers. These panels are supported by 2 x 6 joists. Spacing of joists depends on the thickness of the concrete slab and the span of the beams. If the slab spans the distance between two walls, the panels are used in the same manner as when beams support the floor slab.

STAIR FORMS

A method for building stair forms up to 3 feet in width is shown in Figure 5-15, page 5-9. The underside of the steps should be 1-inch tongue-and-groove sheathing. This platform should extend 12 inches beyond each side of the stairs to support stringer bracing blocks. The back of the panel is shored with 4 x 4 pieces (as shown). The 2 x 6 cleats nailed to the shoring should rest on wedges to make both adjustments and removal of the posts easy. The side stringers are 2 x 12 pieces cut as required for the treads and risers. The face of the riser should be 2-inch material, beveled (as shown).

FORM REMOVAL

Forms should be built to allow easy removal without danger to the concrete. Before concrete is placed, forms are treated with oil or other coating material to prevent the concrete from sticking. The oil should penetrate the wood to prevent water absorption. A light

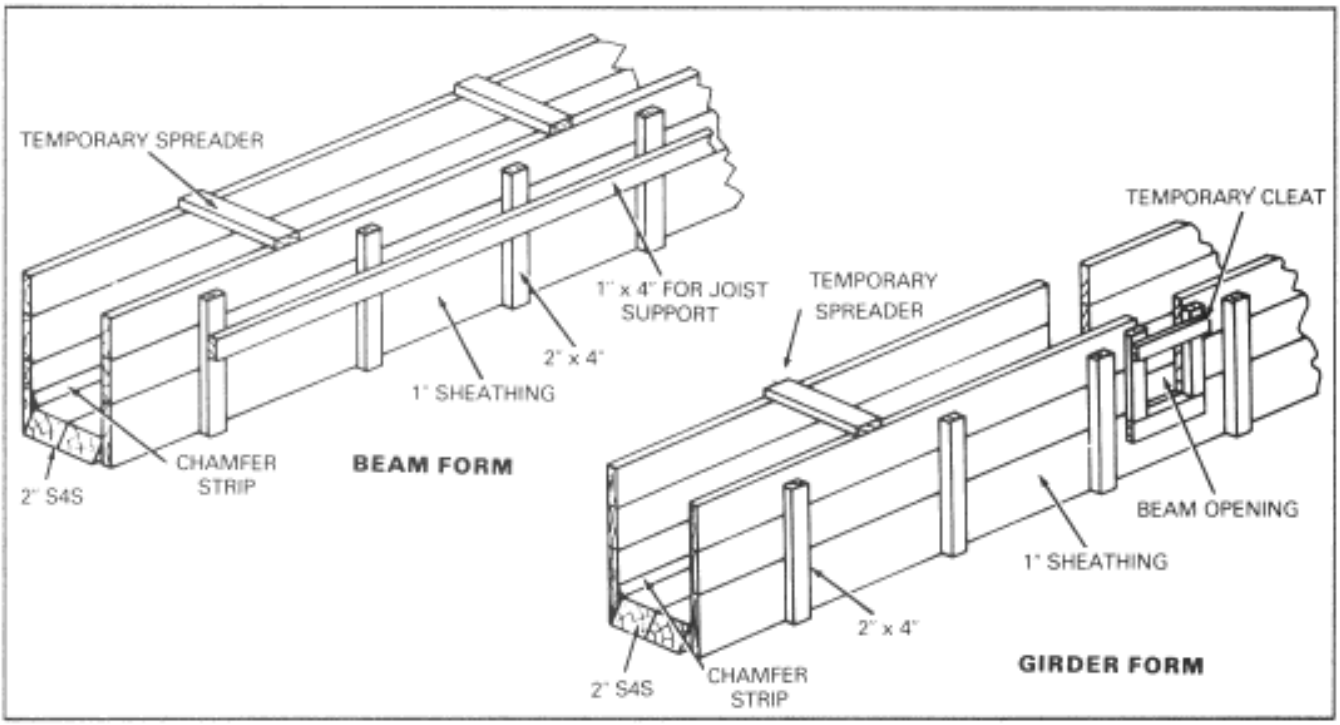


Figure 5-12. Beam and girder forms

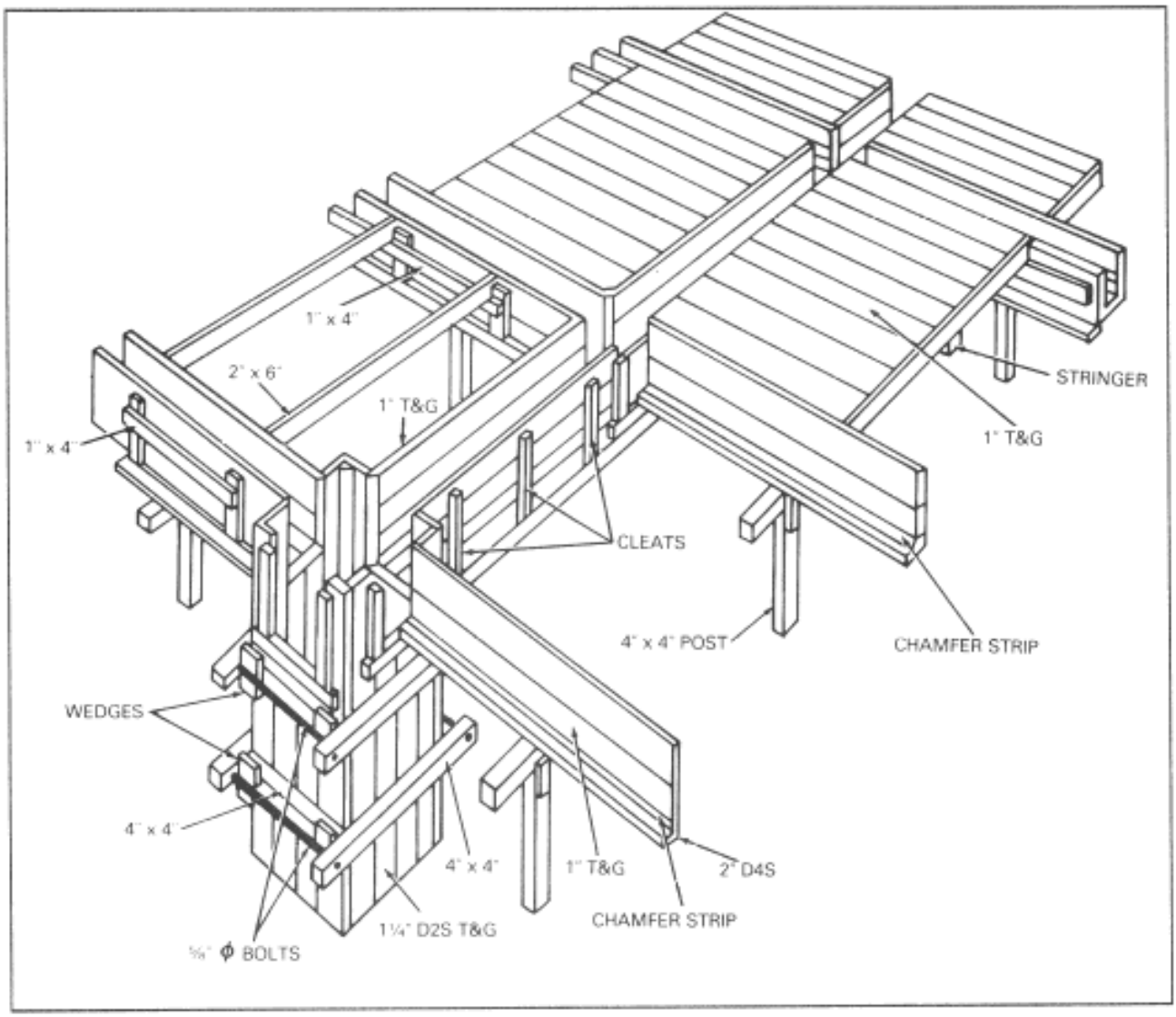


Figure 5-13. Beam, column and floor form

bodied petroleum oil will do. On plywood, shellac is more effective than oil. If forms are to be reused, painting helps preserve the wood.

If form oil is not available, wetting with water may be substituted in an emergency to prevent sticking.

Wood wedges should be used to wedge forms against concrete, rather than a pinchbar or other metal tool. To avoid breaking the edges of concrete, forms should not be jerked off after wedging has been started at one end. Forms to be reused should be cleaned and oiled immediately. Nails should be removed as forms are stripped.

CAUTION

--Permit only workmen doing the stripping in the immediate area.
--Do not remove forms until the concrete has set.
--Pile stripped forms immediately to avoid congestion, exposed nails, and other hazards.

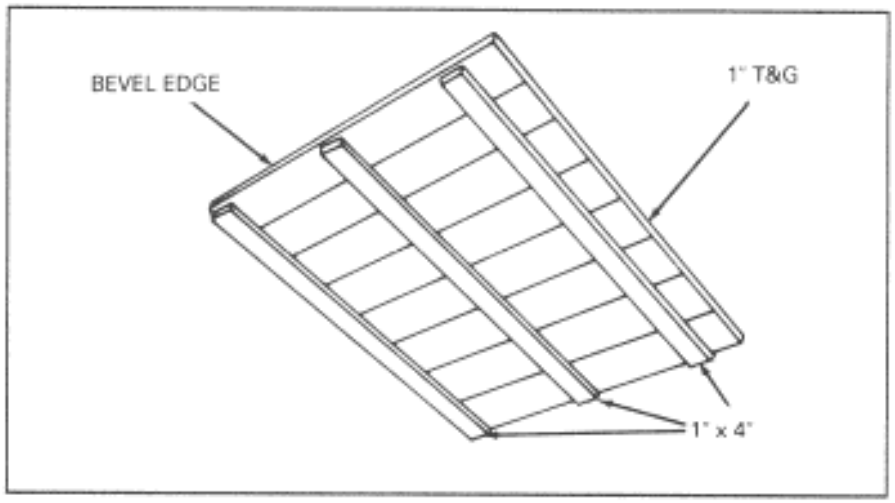


Figure 5-14. Floor slab form

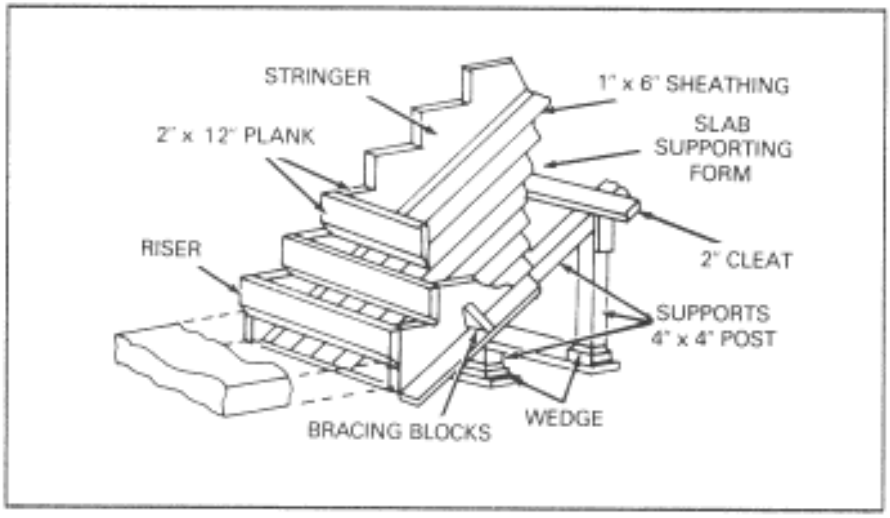


Figure 5-15. Stairway slab form