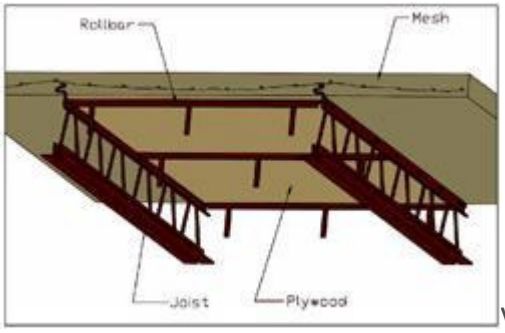
CONCRETE FLOOR DECKS

By Pieter Vanderwerf

Reinforced concrete floor decks have become increasingly popular in homes over the last decade. In part, this is because consumers' interest in their advantages (strength, rigidity, durability, sound attenuation, and suitability for in-floor radiant heating and decorative concrete finishes) has steadily increased. The growth in homes with concrete walls is a second factor because these walls provide adequate support for the heavier concrete floor without extra measures.Many of the floor systems used are adapted from commercial construction. However, some newer systems have been developed with lighter residential construction in mind. This has decreased costs and also contributed to concrete floors' popularity.

Composite steel bar joists

For more than 30 years, a system based on welded steel bar joists has been popular because of its flexibility and efficient use of labor and materials. The proprietary component is a steel bar joist, which includes a deformed steel top chord that extends vertically upward about 2 inches, L-shaped steel bottom chords, and a web of steel bars welded to the chords. The wide spacing of the bars leaves the joist webs mostly open. The contractor orders the joists to length and in the proper depth. Spans of 40 feet are routine, and spans up to 65 feet are possible with deep joists and a thicker concrete cover.



View of a composite steel bar joist floor from below before removal of roll bars and plywood.

The crew sets the joists on the walls with a spacing of slightly over 4 feet on center. Special "roll bars" go between the joists to hold them steady and support plywood on top. Standard sheets of plywood are set on top of the roll bars, filling the space between joists. The top chord of each joist protrudes above the plywood. The crew drapes a layer of welded wire mesh over these top chords and casts about 3 inches of concrete on top. The concrete encases the top flanges and the mesh creating a composite structure. Both of these types of embedded steel reinforce the concrete.

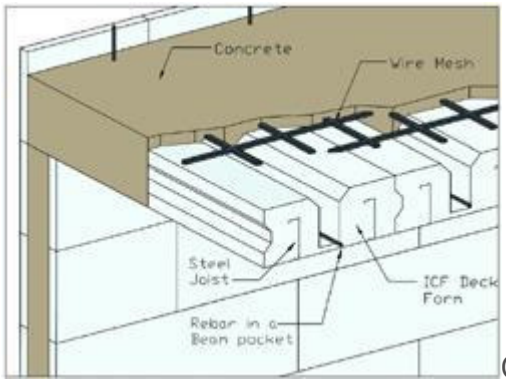
After curing, workers remove the roll bars and plywood from below. Utilities can run relatively free through the joists. To create a finished ceiling, a hat channel can be wired to the bottom of the joists and wallboard screwed to the hat channel.

Composite cold-formed steel joist

A newer version of the composite bar joist system uses joists made of a single piece of cold-formed steel instead of heavy steel pieces welded together. Besides the different joist, installation is nearly identical. The main flanges of the joists are punched with large holes for utility pass-through. This system can have its advantages: It may be easier to cut and alter the joists in the field, the cold-formed steel provides a more familiar product for residential crews, and it may be less expensive in shorter spans.

ICF

In the 1990s, vendors released deck forms made of foam with embedded light-gauge steel joists. Concrete floors created with these forms tend to be more expensive than the composite steel joist floors, however, the forms are easy to cut and modify in the field. Finishing ceilings with this system is easy-simply attach wallboard to the bottom of the steel joists. The insulating value of the foam may also be useful in maintaining different heating/cooling zones.



Cutaway view of an ICF floor on ICF walls.

The deck forms consist of 2-foot-wide sections. The supplier may cut these to specified length before shipping to the job. Each section contains two steel joists running lengthwise, embedded entirely in the foam. Deep depressions in the foam surface between the joists, also running the length of the section, form beam pockets.

The sections are cut to fit within the walls and are supported by a line of bracing installed underneath at least every 6 feet. Rebar is set on chairs in the beam pockets and lapped with rebar in the walls. Mesh is set on chairs and placed over the entire floor area 1 to 2 inches above the top of the forms. Concrete is cast on top to a depth of about 3 inches over the top of the forms, encasing the rebar in the beam pockets and the mesh. The bracing comes out after curing.Some brands of forms have preformed chases that run the length of each section, where the trades can run utility lines. Alternatively, chases can be cut into the foam.

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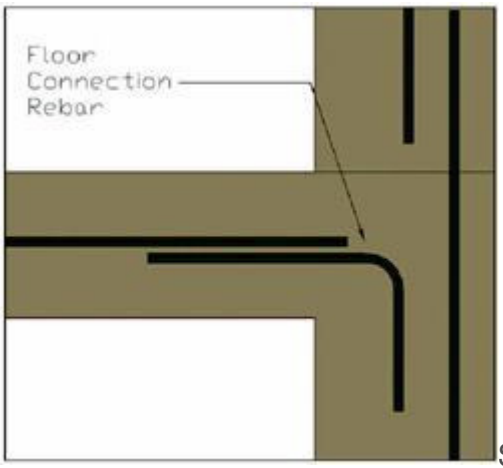
Removable forms

Floors created with removable forms are particularly popular over removable form walls. Building removable form walls and floors together provides construction efficiencies. Frequently the floor is created with the same forms used in walls. These are metal forms that are 2 to 3 feet wide and 8 to 10 feet long. They have a smooth surface for the concrete side and a metal frame for rigidity on the opposite side. Typically, fittings along their edges connect each form to its neighbors. Some companies offer special floor forms, which are smaller and therefore easier to lift.

The forms are set horizontally and braced from below as needed. The forms around the perimeter connect to the wall forms, which may be done with ledger forms.

In some cases, the loading on the floor dictates that it include beams, not simply a deck of a constant thickness. Beam pockets can be created with a combination of right angle forms. The right angle forms are placed between two lines of flat forms and create a trough with the U-shaped profile for a beam. Shoring may be required below.

Reinforcement typically consists of rebar in the floor that is lapped with the vertical bars in the walls, plus a layer of welded wire mesh to inhibit cracking. All reinforcement is supported on chairs. If the floor features beams, one or two lines of rebar lies in each pocket. Concrete is cast over the forms to a depth of about 3 inches above the top of the form-work. The forms are removed from below after curing.



Section view of a removable forms floor on removable forms walls.

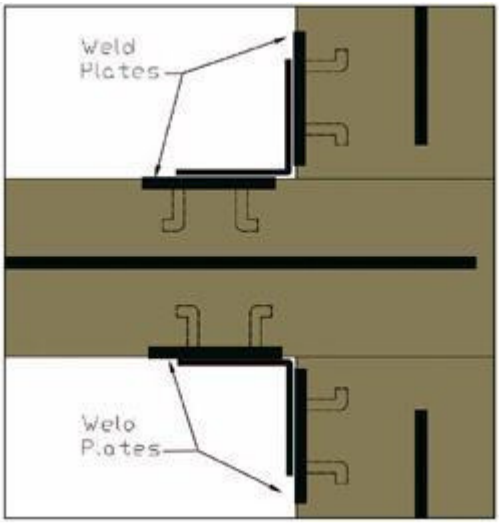
Precast plank

Floors of some homes are assembled of precast plank. Plank can be installed on all types of concrete walls, although when the walls are also precast, all components can be set by one crane and crew.

Traditional hollow-core planks are 2 feet wide, and several inches thick. They contain steel reinforcement and cylindrical hollows running the length of the plank, spaced at regular intervals. Typically two rebar run between each pair of hollows, one near the top surface of the plank and one near the bottom.Other systems use "truss" planks. These include two parallel layers of concrete, each about 2 inches thick. Steel trusses connect the layers, with one chord embedded in each layer. The open space between the concrete layers can be varied to match the loading requirements of the floor and it can be filled with foam if insulation is desired.

The planks are produced to length and shipped to the site. A crane lifts them into place, with their ends bearing 3 to 4 inches on the walls. Some are outfitted with steel plates and connected to the walls by welding; others connect to the walls by way of a bond beam that is cast around the perimeter of the planks over the walls. In this situation, a thin topping of concrete may also be cast over the planks. Rebar extend from the floor into the beam, where they lap bars from the walls.

Finishing below is typically with plaster. Utilities may be run in the hollow cores or truss space of the planks. Furring strips can also be applied and wallboard attached.



Concrete masonry

Systems are available for constructing floors using standard concrete blocks set on special steel trusses. These use materials efficiently and require no heavy equipment. The trusses typically have a bottom chord made by welding two L-profile steel channels back-to-back and a flat, vertical top chord. The web consists of welded steel bars, much like those in the composite steel bar joist system.

Workers set the ends of the joists on top of the walls, spacing the joists slightly farther than the length of the blocks. The blocks are set crosswise between the joists, with their ends resting on the bottom chords.

With the blocks in place, a layer of thin grout is cast over the deck, creating a smooth surface that flows between the blocks to surround the top chord of each truss and lock them into the assembly. The trusses serve as the reinforcement. These floors may be secured to the walls with a bond beam, similar to that used for pre-cast planks. The ceiling below can be finished by painting the underside of the assembly or outfitting it with furring strips and wallboard.

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