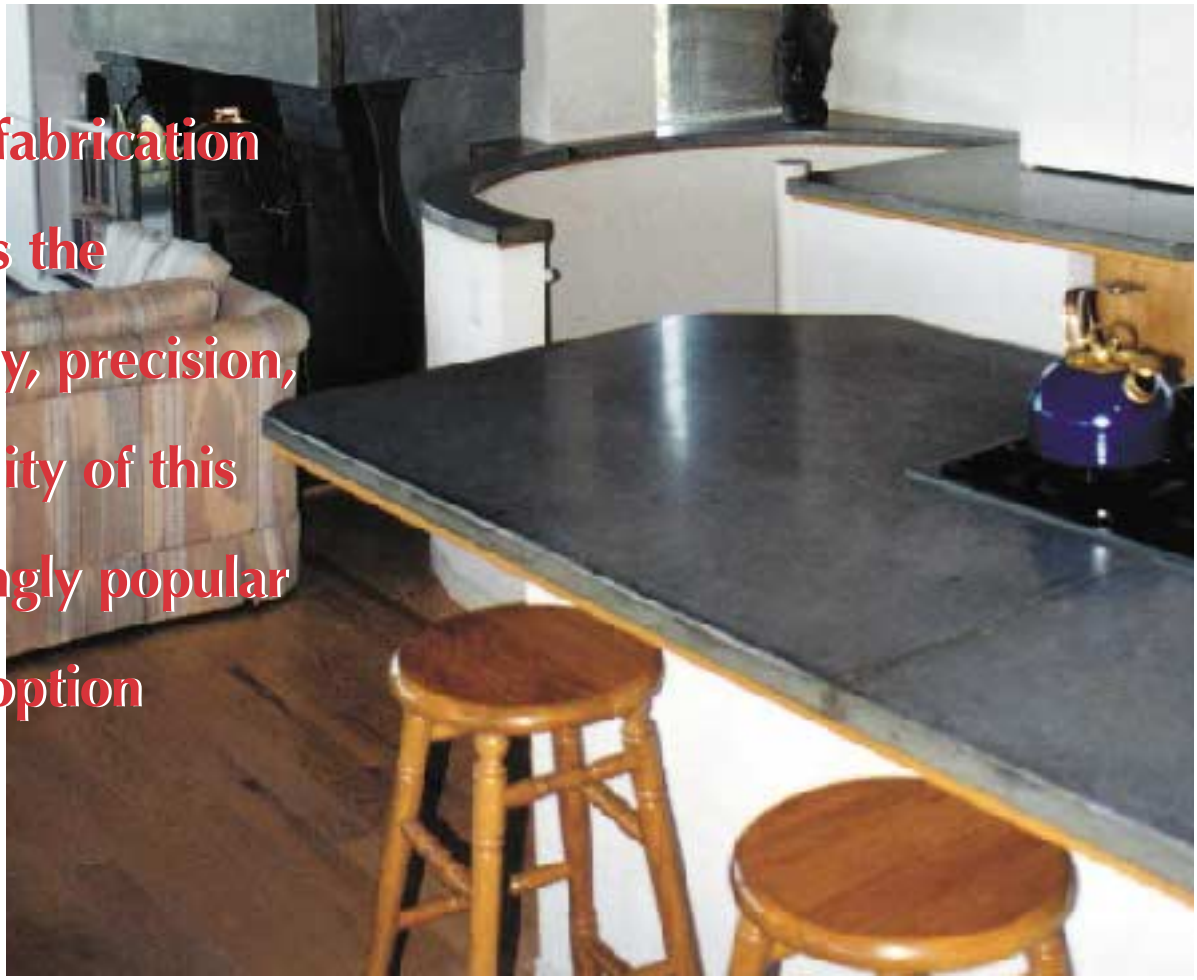
CASTING
Concrete Countertops

Off-site fabrication improves the versatility, precision, and quality of this increasingly popular surface option



by Derek Oliver

If you look in the kitchens of countless homes, rich or poor, south of the U.S. border, you'll notice among other things that the countertops are often made of concrete. This isn't in response to any current design trend; it's just an economical, traditional way to set up a kitchen. However, if you look in just about any domestic home journal, you're likely to come across an article either praising the hot new look of concrete, or warning consumers of the pitfalls of this trendy countertop option. Concrete has long been a favorite material for many architects and designers due to its wonderful ability to be shaped and colored, coupled with its strength and durability upon curing. Its recent use by creative designers and fabricators as a countertop surface has opened the eyes of many consumers to the endless possibilities inherent in the material. Concrete counters have become less a hot trend and more of a viable alternative to conventional choices such as stone and

solid-surfacing. This was confirmed for me when one solid-surfacing manufacturer came out with an option that imitates the look of concrete, reinforcing my sense that "designer concrete" is here to stay.

Perceived Problems

Objections to the use of concrete as a countertop material typically include the potential to be stained by food, rough or irregular surface texture, air bubbles, honey-combing, pinholes, and cracking. While staining is a problem, it's not unique to concrete — solid-surface material, natural stone, and wood are all prone to discoloration. As a fabricator of concrete counters, I address the other complaints by casting the concrete in molds off-site, rather than taking a trowel-in-place approach. By doing so, I can produce a consistent, high-quality product; a typical reaction to my work is, "Wow — is this concrete?"

Other advantages of off-site fabrication include not having to modify the cabinets to support the pour and, generally, much less time spent on site. Whereas pouring a countertop on site can tie up a kitchen for many days, I'll be on site for an average of five hours total, including measuring, making templates, and installation. The flexibility to create unusual shapes is also much greater. For example, an integrally cast lavatory bowl would be very difficult to do in place, but can be routinely incorporated in the shop (see Figure 1). Details like surface transitions and matching backsplashes are difficult, at best, to form in place.

Casting in molds is a more elaborate approach to making a countertop, and in some respects more difficult than casting in place, but the results can be far superior. The entire process, from the beginning of fabrication to installation, takes about five weeks. On average, forming and casting only take a few days, but nothing leaves my shop until after the initial, standard curing time for concrete of 28 days.

Lauan Templates

As with solid-surface or stone countertops, good templates facilitate the entire process. Once the builder has installed the cabinets and has the sink and appliances available for dimensioning, I bring several sheets of 5.5-mm-thick lauan plywood to the job site. With a sheet of plywood laid directly on the cabinets, I'll trace the outline to make a template that represents the finished dimensions of the countertop section, including planned overhangs and cutouts (Figure 2). I scribe the plywood to 1/8-inch accuracy for a slightly loose fit between fixed ends. The templates ensure a safe dry-run test-fit and identify and record any out-of-square conditions. To avoid confusion back at the shop, I label the template for right side up and its orientation in the layout. The 4x8 plywood corresponds to the size of the surface I'll cast the tops on, which automatically restricts the size of the sections. This is a convenient limitation, because it helps to reduce the possibility of shrinkage cracks and makes the individual sections easier to lift and transport. A 1 1/2-inch-thick top weighs between 15 and 20 pounds per square foot, depending on the type of aggregate used in the mix. There isn't any practical way to make a concealed joint between segments. For a countertop longer than 8 feet, I'll plan the joints to become part of the design. I distribute the joints for best appearance and function. Although it makes for a slightly delicate casting, I like to avoid joints around an undermount sink cutout because it gives a more seamless appearance and cleans up easier.

Forms and Setup

For my shop, I've designed a couple of casting tables with welded frames and 4x8-foot work surfaces. The steel legs are equipped with heavy-duty casters, so that I can move the loaded tables around. And they can be screw-adjusted for level, so that the cast concrete will lie absolutely flat in the forms. To make a form, I lay on the table a 4x8 sheet of 13-ply, 3/4-inch-thick Finn Form made from Baltic birch plywood. Made for concrete form work, this plywood costs about $120 per sheet delivered, has a smooth, grainless surface and a phenolic plastic release-film veneer on both sides. Finn Form can be difficult to

Figure 1. Prefabricating cast concrete makes it possible to create compound shapes and incorporate something as complex as a custom integral sink basin into a countertop.

Figure 2. Lauan plywood templates, cut to the final outline of the countertops, precisely copy the site conditions and direct the shaping of the casting forms. The author traces a spacer block to establish the cut line of an edge overhang.

obtain — I buy mine from F.D. Sterritt Lumber (P.O. Box 9156, Watertown, MA 02272; 617/349-1150). It's also sold as McFin Concrete Form by McCausey Lumber (32205 Little Mack Ave., Roseville, MI 48066; 800/365-9663; www.mccauseylumber.com). I also use the less-expensive nine-ply Beto-Ply, which has a release-film overlay, but the underlying wood veneers are not as smooth. Concrete picks up very subtle irregularities from the surface it's cast on, including wood grain patterns and fills in the surface veneer. I've used this characteristic to creative advantage on occasion, but generally I prefer a smooth surface for kitchen and bathroom counters. It's certainly possible to cast on plastic laminate; I do when I need a surface wider than 4 feet, but the resulting finish seems almost too smooth to me.

I place the lauan templates face-down on the Finn Form and carefully outline them with $1^1/_2$-inch-wide strips — representing the finished thickness of the slab — cut from a sheet of Beto-Ply. Then I fasten the strips on edge to the Finn Form, and to each other, using 2-inch drywall screws (Figure 3). With the lauan template removed, I thoroughly spray the interior of the form with a concrete release agent, such as

Figure 3. The author casts his pieces on a custom-built table that can be adjusted to dead level. After laying the template face-down on a sheet of ultra-smooth Finn Form plywood, which has a plastic release-film facing, the author surrounds it with sawn strips of form ply, screwing them to the base panel to create the casting form for the countertop section.

Crete-Lease 20-VOC or Crete-Lease 880 (Cresset Chemical, P.O. Box 367, Weston, OH 43569; 800-367-2020; www.cresset.com), distributing it with a soft cloth in swirling motions. The release agent can be applied days before or immediately before the pour, it's non-toxic, and is very easy to work with. It's important to use the agent, even with the release film on the plywood, because the film alone isn't 100% effective. To relieve the otherwise sharp outside corners of the concrete, I apply a bead of silicone caulk to the intersection between the sides and the surface of the form and to the junctions in the form's side strips (Figure 4). Shaped with my fingertip, the silicone transfers a subtle, soft radius to the concrete's edges and transitions.

Casting Guidelines

There is no existing standard for cast-concrete countertops that I know of. Mix ratios, aggregate type, size, and content, compressive strength, reinforcement, and issues of appearance and quality are all left to the individual fabricator.

Reinforcement. Before I mix any concrete, I fabricate the steel reinforcement, paying close attention to where stress loads will be placed, and plan the reinforcement accordingly (Figure 5). I like fiber mesh as secondary reinforcement, but I don't generally use it for countertops because the fibers may show over time. Once I have all the steel cut and tied, I remove it from the forms and set it aside.

Rules of thumb. Steel and concrete are uniquely suited to each other; concrete bonds well to steel, steel provides tensile strength and controls cracking, concrete provides stiffness, and the two materials react in concert to temperature changes. There are some established rules of thumb for the placement of steel reinforcement and the depth of its embedment for performance strength. In general, nothing greater than #9 wire mesh is necessary in the body of my countertops. The smaller diameter allows the steel to be properly placed closest to the tension, or underside, of the piece, where it will be most effective in reinforcement and crack prevention. I use #3 rebar to strengthen a narrow casting and on thicker pieces spanning distances of 5 feet or more. To be effective, steel reinforcement should also be encased in concrete at least one-and-a-half times its diameter; in other words, 1/2-inch-diameter rebar must be surrounded by concrete no less than 3/4 inch deep on all sides. In a 1 1/2-inch-thick countertop, even if it's placed right in the middle of the slab, 1/2-inch rebar is not only overkill, but it cannot be adequately encased. If placed too close to the surface, the rebar could in effect become a cold joint, inviting rather than preventing a fracture.

To check the service strength of my castings, I have loaded a 1 1/2-inch-thick by 26-inch-wide test piece over a 28-inch clear span with 1,000 pounds of dead weight, resulting in only minute deflection and no visible cracking.

The basic mix. Mix design is critical to the process and has a direct effect on the end results. I closely measure and adjust the sand-, coarse aggregate-, and water-to-cement ratios, depending on the specific casting. To remove dust and

Figure 4. To eliminate any chance of the concrete sticking to the form, the author rubs a thin layer of release agent onto the form. Silicone caulk, applied to all inside corners and tooled smooth with a fingertip, imparts a subtle radius to the edge and corners of the cured concrete piece. The release agent also makes the silicone easy to peel away when the form is disassembled.

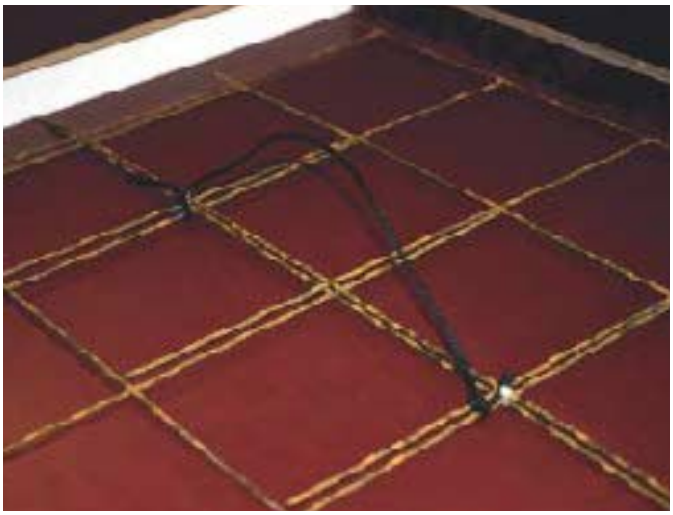


Figure 5. The author fabricates the reinforcement using wire cutters to drop an overlaid sheet of #9 wire mesh into the form. Narrow sections, such as the strip around a sink cutout, may be reinforced with a length of #3 rebar. Nylon cord, tied to the mesh, creates a lifting handle for moving the cured slab. After fitting, the steel is temporarily set aside.

impurities that could discolor the mix and suck up mix water, I prewash the coarse aggregates. I generally like to use lightweight, synthetic aggregate, which is made from environmentally safe industrial waste and is 25% lighter in weight than natural stone. I also use a plasticizer, which, simply put, makes the water "wetter," allowing me to have a nice, workable mix while keeping the actual water volume down. Too much water weakens the compressive strength of the concrete. If you think about it, water occupies space in the mix and, when it evaporates, leaves an air-filled void. On the other hand, the more solidly interlocked particles of various size aggregate there are — bonded by Portland cement in the mix — the denser and stronger the concrete is.

Coloring Concrete

The color in my castings is integral; I add the color in both liquid and powder form to the batch in the mixer (Figure 6). You can achieve beautiful colors in concrete with acid-dyes, which etch the color into the surface after the concrete has cured. However, due to the etching, you pay a penalty in the smoothness of the surface. Over time, I've developed ratios for the amount of pigment required to produce specific custom colors. Color in wet concrete is significantly different from the color when the concrete is surface-dry, and different again from a sample that is thoroughly cured and sealed. I show customers sample castings from prior experimentation, and can vary shades endlessly by combining dyes, or by using white Portland cement instead of gray (Figure 7, next page). Depending on whether I want consistent coloration or a mottled appearance in the concrete, I'll add the color early or late during mixing. Longer agitation homogenizes the color in the mix. Concrete color is also enhanced by the type of surface sealer you apply.

The concrete itself has some unpredictable qualities that always render the appearance of the end-product somewhat irregular, like that of natural stone. The reaction between Portland cement

Figure 6. Cast concrete is integrally colored during mixing; both liquid and powdered colorants are used to achieve a wide selection of custom shades. A mottled-color effect can be produced by adding the color late in the mixing process.

Figure 7. Over time, the author has developed a record of mix ratios and dye combinations, along with an array of color and texture samples, which aptly displays some of the versatility of his concrete to prospective customers.

Figure 8. The author places the steel reinforcement after filling the forms two-thirds full. He uses colorized concrete to complete the perimeter of the casting and less costly, untinted concrete to fill in the field of the underside, which will not show. This ensures that the steel is properly located closer to the bottom of the counter, where it will best resist tension forces that may develop in service.

and water results in an endlessly variable pattern of dark and light striations, leaving each piece truly unique. It's this quality of uniqueness that aficionados of concrete find so aesthetically appealing.

Filling the Forms

I fill the forms about two-thirds full with the colorized concrete. After leveling the mix, I lay in the steel, and use the balance of the mix to build up the entire perimeter to the rim of the form (Figure 8). The underside of the counter, which faces up during casting, gets filled with less-costly, uncolored concrete.

Vibration. The secret to a smooth surface is to make sure that you've driven as many voids and as much air as possible out of the mix. Lately, I've begun to use electric vibrators, strategically attached to the underside of the casting tables. I also still use my original, tried-and-true method of rhythmically pounding the underside of the table with a pair of rubber mallets (Figure 9). The results are obvious, as a sea of bubbles rises to the surface of the wet concrete. Vibration condenses the mix by settling the various-sized aggregates into each other and driving out air pockets. When bubbles cease to appear on the surface, I know the mix is well-settled in the form. To make sure the underside of the counter will lie flat on the base cabinets, I screed the surface with a length of steel angle, straddling the form, to remove excess fill and eliminate high and low areas.

Curing time. After the bleed-water has risen to the surface and been reabsorbed, I smooth the concrete with a steel trowel. I make sure that the casting gets a slow, even cure by covering it with a sheet of poly and letting it rest in the forms for at least four days before breaking down the form or attempting to move the slab (Figure 10). The poly retards the rate of evaporation from the concrete, allowing the concrete to continue to hydrate, leading to a stronger product. If I cast on a Monday, I can remove the form edges on Friday and turn the slab over for

inspection. Moving a large, hardened casting from the table requires the aid of an assistant.

After cleaning the surrounding plywood of any minute particles that could scratch the casting's surface, we lift the slab and lay it back on the table over wood stickers, finished side up.

Minor defects. Even after vibrating the concrete, there are still a few inevitable voids in the surface, especially on the edges. The pits and pockets in concrete can be quite sharp-edged, and detract from its functionality and appearance. I've developed a colored grout mix that I use to rub and polish the pieces, and to fill minor imperfections (Figure 11, next page). By using contrasting or complementary colors in the grout, the overall coloration of the casting takes on a striking depth and textural complexity.

I lean the cast slabs against the walls of my shop to cure for a full four weeks before applying a surface sealer and transporting them to the site for installation.

Sealing the Surface

Concrete is an absorptive material. To address the problem of accidental staining, it's important to seal the surface. Basically, for food contact surfaces, there are three options: wax finishes, oil finishes, and my preference, a water-borne polycarbon/polycarbonate penetrating film-building sealer called UltraShield (Pro-Seal Products, 16541 Redmond Way #363-C, Redmond, WA 98052; 800/349-7325; www.prosealproducts.com). I like the effect that the clear film has on the colorized concrete, highlighting the subtle variations in shade. The film can take a while to fully cure, remaining soft in places while the concrete continues to give off evaporative moisture. Once fully cured, though, it provides an inert, food-safe barrier against accidental stains and requires far less maintenance than other sealing options. I apply UltraShield using a good quality paint pad after the concrete has cured in my shop for four weeks. If scratched or damaged, it can be recoated. The

Figure 9. Vibration from the rhythmic pounding of a pair of rubber mallets settles the mix, driving out air bubbles to create a dense, solid mass and a smooth, void-free finished surface. Alternatively, the author uses electric vibrators, strategically mounted to his casting tables.

Figure 10. To slow water evaporation and prolong hydration of the cement, the casting is covered with poly and allowed to rest in the form for at least four days before removal.

Figure 11. A few small pits and imperfections are always present in the surface of a countertop. The author has developed a special colorized grout mixture to rub and polish the surface, filling the voids and creating a flawless surface. Contrasting and complementary grout colors add to the complexity of a countertop's appearance.

manufacturer provides good technical support to guide you through a repair or refinishing process.

Wax finishes are attractive, but require frequent reapplication and buffing to maintain a reliable, reasonably stain-proof finish. You can use Butcher's Wax, beeswax, or other paraffin-based finishes in oil suspension.

An oil finish, such as mineral or baby oil, penetrates deep into the concrete and must be applied regularly, even weekly, before the concrete is fully saturated and an even finish is obtained. A benefit is that an oily spill will have little or no effect on the concrete and, if the finish is regularly replenished, other spills will tend to bead up rather than bleed into the surface. As a caveat, an oil finish will significantly darken the concrete, but it doesn't work equally well on all colors. Vegetable oils may tend to become rancid, and toxic petroleum-based oils should be strictly avoided.

Transportation and Installation

Transportation and installation techniques are the same for a concrete top as they are for a stone countertop. If the preparatory work and template fabrication were done properly, and there are no surprise changes at the job site, installation goes smoothly. Except in the case of a long cantilevered piece, gravity is the primary fastening agent. I'll shim under the pieces to align seams, which I glue together with two-part clear epoxy or a good quality urethane-based adhesive, such as PL Premium (OSI Sealants, 7405 Production Drive, Mentor, OH 44060; 800/999-8920; www.osisealants.com). I top off the joints with matching colored grout.

The era of use, wear, and aging begins, a process that these counters endure gracefully.

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