



By Joe Nasvik

**H**uge sections of formwork complete with scaffolding dangle from a crane cable. Workers on the ground swing the form sections into position, guided by guy ropes, then by hand. Brent Byford, assistant project manager for Walsh Construction, Chicago, supervises as the gang forms are plumbed, then braced, for a retaining wall on a highway project on Chicago's west side.

Gang forms are several unit forms attached together, or a single large form, usually moved into position by crane because sections are too heavy to set by hand. The length of a gang form for walls is often determined by the distance between control joints or by the capacity of the jobsite crane.

Mike Miller, general product manager for Symons, Des Plaines, Ill., says that contractors use gang forms because of their versatility and capacity, the appearance of the finished work, and increased productivity. With gang forms,

a forming and concrete placement cycle can be completed every day. In addition, the routine positioning increases safety and accuracy. Gang forms are often used for retaining walls, sound walls, bridge abutments, water treatment facilities, and building walls and columns. Formliners attached to gang forms can result in economical high-quality architectural walls.

Gang forms can be purchased from manufacturers of forming systems or built from basic materials on a jobsite. They can be steel, aluminum, wood, plastic, or some combination of these materials. A wide selection is available from the various form manufacturers. The system that you choose will be based on the number of reuses you hope to get, gang form weight, lateral pressures anticipated during concrete placement, cost, and the degree of architectural finish required.

Byford says Walsh built its own retaining wall gang forms for the I-294 highway widening project, placing standard plywood form panels over 2x6-

inch lumber wales supported by manufactured strongbacks. There is a "haunch" formed into the top of the wall (a thicker concrete wall section that will become the footing for a traffic barrier wall) that had to stay at a constant elevation. But since the footing for the wall was at various elevations, Byford says, they designed the forms so that sections (face, wales, and strongbacks) could be attached to the bottom of the gang form in order to keep the haunches at a constant elevation. This wall will retain roadway subgrade on one side and won't be seen by the public on the other. The finish was therefore not critical, so Walsh used plywood form panels which typically get about 40 reuses. Plywood faces swell when they get wet, so the resulting concrete surfaces can be either positively or negatively imprinted.

#### Form pressures

Forming systems are rated by their ability to resist a certain pressure (in pounds per square foot—psf) that the concrete exerts against the form dur-

# Working with Gang Forms

Increased productivity, more accurate workmanship,  
and higher profits  
on projects with repetitive work



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ing placement. Form pressures will be low when only a few vertical feet of wall are placed each hour, or they can approach full liquid head when concrete is fresh from the bottom to the top of a placement.

A significant safety issue for contractors is the decision about the forming system for their project and the rate of concrete placement. Steffen Pippig, engineering manager for Meva Formwork Systems, Springfield, Ohio, says that formwork companies usually tell their customers what the maximum lateral form pressures are for a particular form-and-tie system. They cannot, however, tell them how fast they can place concrete to stay within those limits since too many factors influence lateral pressure in the field, including ambient and concrete temperatures, fluidity of concrete mixes, accelerating and retarding admixtures, and the use of pozzolans in the mix. Placing fly ash concrete in cold weather, for example, could easily result in full liquid head pressures on the forms. Guidance on a safe rate of placement can be found in ACI 347, "Guide to Formwork for Concrete."

Self-consolidating concrete (SCC) can also result in high lateral pressures. The advantages of SCC, though, are that it does not require vibration, flows easily around congested reinforcement, and greatly reduces bug holes (see "Formwork for Self-Consolidating Concrete," CONCRETE CONSTRUCTION, October 2004, p. 32). The form manufacturers are working with the American Concrete Institute to develop guidelines for placing SCC, including defining the maximum lateral pressures to be expected.

**Left: Gang forms can be up to 50 feet high and 40 feet wide, making it possible to accurately set forms in a very short time. Center: All-aluminum gang forms have the advantage of being lightweight—about half the weight of other systems. They also can withstand high lateral pressures while maintaining flat concrete surfaces. Above: To accurately set gang forms you can drill rebar pins into the slab or footing and set the form face against them. This also sets the proper wall thickness at the bottom.**

### Forming systems

The basic elements of a gang form system include the sheathing (the surface that faces the concrete), studs, wales or walers, stiff backs or strongbacks, angle braces, ties, and safety equipment—including attached walkways and safety rails for workers to use during concrete placement and tie-offs for safety harnesses. Longer sections of gang forms require a spreader beam to better distribute lifting forces from the crane. Wales and strongbacks are not needed in some manufactured forming systems that incorporate their functions into the construction of the frame.

Many different manufactured forming systems are available. There are standard unit panels that can be connected to make gang forms or panels that are manufactured specifically for gang forms. One popular unit panel has steel frames with plywood sheathing insets. They are typically rated for about 1000 psf. Both the plywood and the steel leave a mark on the concrete surface. The plywood can be overlaid with plastic resins to provide better finish and get more reuses, but these forms aren't used for architectural surfaces. Miller says Symons makes a forming system, designed for 1200 psf lateral pressures, with a steel channel on the back, and plywood faces that butt against each other for flatter transitions be-

tween forms. The plywood for both systems is replaceable.

There are also all-aluminum gang form systems. Greg Peacock, president of BEP Forming Systems, Fayetteville, Ga., makes gang forms that weigh only 5½ to 6 pounds per square foot—most gang form systems weigh between 10 and 15 pounds per square foot so aluminum systems can be moved with smaller cranes. Aluminum forms can be reused as often as 3000 times when they are properly maintained. Peacock's panels have an interlocking panel feature that stops leakage, making architectural finishes easier to achieve.

Steel gang forms are the heaviest system and can withstand high lateral pressures—as much as 2600 psf. Miller says Symons' steel panels have ¾-inch-thick steel faces with built in strongbacks and can be ganged into sections as large as 10x20 feet. Panels are bolted together to reach the gang sizes required.

### European form systems

Several European manufacturers, including Doka, Meva, Peri, and Ulma, have developed form panels that use special clamps to join panels quickly and easily (sometimes called Euro-forms). These systems can be assembled in very large gangs and joined with only a hammer. Their welded steel frames replace both walers and strongbacks, and they

are available in both metric and Imperial (inch-foot) sizes.

Meva uses a unique face material for its forms—a foamed plastic core with metal reinforcement layers and plastic toppings on both sides (called alkus sheets). Although these panels can be nailed as easily as plywood, workers on the jobsite can repair holes and scratches by applying polypropylene from a hot glue gun and sanding the patches flush. The resulting concrete finishes are very smooth and flat, and the face material can be reused more than 800 times.

### Form ties

Form ties are an important component of a gang form system. Bob Lab, production manager for Peri Forms, Hanover, Md., says that ties for typical hand-set forming operations can hold 3000-pound loads, but ties for gang forms have a capacity of up to 20,000 pounds. The three common systems are taper ties, she bolts, and thru ties. The part of the taper tie exposed to concrete is conical. When the forms are removed, the tie is tapped loose from the small diameter side and reused.

There are two types of she bolts commonly used. One has a cylindrical rod that runs through the concrete and is left in place. Coil-threaded rods screw into the rod at either end and are secured by bolts to the forms. The threaded rods and bolts are reusable. The other system has two cylindrical rods that screw together with a coil-threaded rod at the center of the wall. If the threaded rod is exposed to concrete, it becomes



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**Left: A dry line, set at the top of the gang form provides workers a fast way to plumb the top of the form using angle braces for adjustment. The first gang form should be plumb before the second form is positioned. Right: These she bolts are joined in the middle with short coil-threaded rods. The threaded rod is the only sacrificial part of the tie assembly.**

the only sacrificial part of the system.

Thru rod tie systems use a piece of PVC pipe that goes through the concrete as a spacer. It is left behind afterwards. Threaded rod goes through the pipe and secures the form. This assembly is reused repeatedly.

The spacing of the ties depends on their location in a wall form, the forming system used, the concrete mix design, ambient conditions, and the height of the wall. For gang forms engineered to withstand high form pressures, tie

spacing can be as much as 4 feet horizontally and 5 feet vertically.

Miller says that when jobs are in the bidding stage, contractors call the form manufacturers for help engineering and pricing gang form systems. Systems are available for lease or purchase. When a bid is successful, the manufacturer provides layout drawings for the forms, which the contractor approves. When contractors aren't experienced with gang forming, manufacturer representatives will be on the jobsite as the forms are assembled and positioned, and when the first concrete is placed. A safety session for the crew is also provided. ■

## Tips and tricks for easier and safer installation

■ Byford says that it's important to first place level footings or slabs for gang forms to rest on. Walsh crews place chalk lines to locate the face side of the form on the footing then set small rebar pieces vertically to locate the form and set the thickness of the wall. Additional pieces of rebar are drilled into the footing on the outside edge of the form to hold it in position laterally. Unless a form is battered, it's not actually anchored to the footing but held down by its own weight.

■ When a crane sets a gang form in position, workers attach anchor brackets (anchored into the footing slab or into "dead men") to plumb the form at both

ends. Walsh crews set a dry line across the top of the form so workers can quickly set plumb for the interior parts of the form.

■ Byford says they use rebar pins drilled into their footings to set the proper thickness of the wall at the base. They place dry ties at the top—ties that are placed above the concrete—to set the proper thickness at the wall's top.

■ It's good to have a carpenter on standby to make adjustments for plumb and to be available for other problems as the concrete is placed.

■ Miller suggests designing a gang form for its largest size. "It's easier to reduce the size

of a form than to increase it."

■ Lab says that it's easier to strip gang forms than handset forms. This is because of the weight of the forms and because a crane does the lifting. But you should never use a crane to break forms free from the concrete. This can be very dangerous. When the crane is supporting the form, workers should wedge it free at the top to debond it from the concrete.

■ Miller adds that forms are normally moved each day. If that doesn't happen, each day the forms should at least be separated from the concrete and the ties broken loose.