Fig. 14.11: Rustication joints create visual patterns (Photo courtesy Olympic Panel Products LLC)

Other Overall Decorative Patterns

Rustication joints can be used to provide decorative patterns, hide joints between sheathing sheets by emphasizing a break in a flat surface, and create a weakened plane that encourages shrinkage cracks to locate in the rustication and be less noticeable (Fig. 14.11). For these reasons, rustication joints are one of the oldest visual techniques of architectural concrete. Rustication joints may be formed using beveled wood strips (Fig 14.12) or manufactured joint materials.

An endless variety of overall sculptured or relief patterns can be achieved by attaching specially prepared form liners. Plastic, glass fiber-reinforced polymer, and rubber are among the patterned lining materials that can be nailed or attached with waterproof adhesives to the inside form surface. Ready-made liners (Fig. 4.20) can recreate wood grain, board marks, masonry, or the patterns obtained by tooling concrete. If the pattern is simple or geometrical (Fig. 14.13), strips or blocks attached to the forms may be sufficient for forming the shape or decoration. Best results are generally achieved with a pattern or mold that is beveled and free of undercuts for easy stripping; however, even this requirement may be eliminated with flexible materials or single-use shapes of rigid foamed plastic that can be chipped, brushed, dissolved, or blasted away from the concrete after the forms are removed. If patterned molds or inserts are used, they should be aligned and kept level to give continuity to the overall pattern (Fig. 14.14). Symmetry with respect to liner seams and matching the modularity of the liner are important work practices for good visual results.

A number of suppliers produce brick and concrete masonry pattern form liners and several manufacture reusable wall form panels with the masonry design an integral part of the form sheathing. Some of these forms are capable of producing a surface that can be painted or stained and be virtually indistinguishable from brick at ordinary viewing distance.

Rigid plastic foams, particularly polystyrene, can be used to create complex form liners with repetitive over-all patterns or one-of-a-kind original works of art. Desired plastic shapes may be cut or molded, then nailed or glued to form sheathing. Multiple cutting machines facilitate rapid production of unique patterns for one-job use. Cut edges of plastic foams have open cells that may cause bonding to concrete unless a coating or membrane seal is applied over the cut surfaces.

If molded or sealed plastic is coated with a release agent, forms can be stripped and, according to some suppliers, reused. Others working with the same type of foamed plastic expect that it will bond to the concrete and must be destroyed during removal—scraped, chipped, dissolved, or sandblasted away. One proprietary process treats cut shapes with sealers, pigments, or other materials, and as soon as concrete is cured makes use of a solvent that liquefies the plastic foam and deposits a glaze on the concrete.

The method of removal of plastic liners depends in part on site labor and form fabrication costs, but also on the shapes of patterns being formed. Dissolving the plastic makes possible patterns of almost incredible delicacy but requires an environmental plan for disposal of the effluent. Chipping or abrading away the plastic makes it possible to form undercut shapes from which other types of form could not be removed. Molded shapes coated with form release leave smooth concrete and minimize stripping labor.

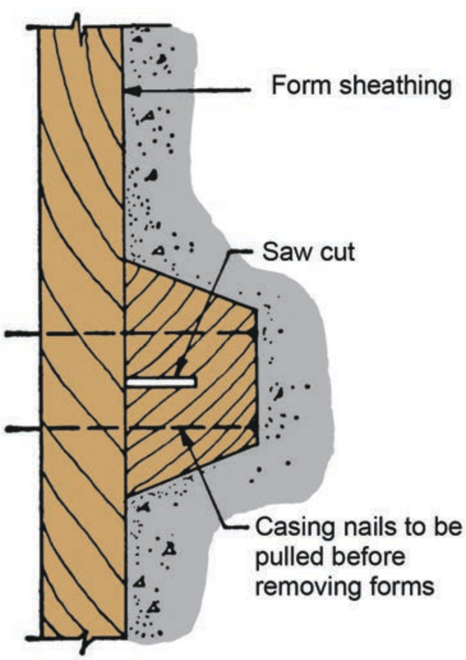

Fig. 14.12: A suggested method of attaching rustication strips to forms (Image courtesy Portland Cement Association)

14.3.3 Precast Panels as Forms or Liners

Unusual or decorative surfaces can be incorporated in precast panels that serve as the exterior form or as a form liner that bonds permanently to the cast-in-place concrete. If

Fig. 14.13: Visual pattern formed in cast-in-place water tank structure (Photo courtesy Landmark Structures)

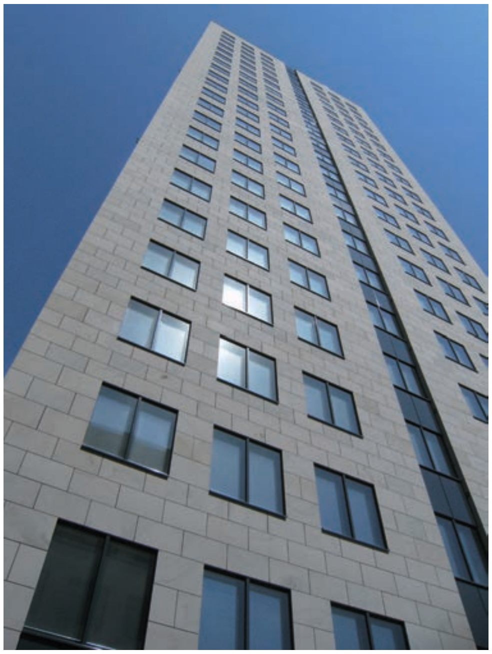

Fig. 14.14: Alignment of joints and rustications is critical to appearance (Photo courtesy MEVA Formwork Systems)

the panels are to serve structurally as forms, they should be suitably reinforced to resist anticipated lateral pressures from the fresh concrete placed behind them. Erection and bracing to resist wind and other lateral forces must also be considered. If they function merely as stay-in-place liners, they may be of lesser strength and thickness. Recommendations for design and fabrication of form panels of concrete are given in Reference 14.6 and in Section 9.7 of ACI 347R (see Appendix).

In addition to the factors recommended by ACI 347R, the potential effects should be considered of differential shrinkage or creep between cast-in-place concrete and precast forms for columns and bearing walls. Control of cracking in architectural surfaces is also important. This may be achieved by keeping concrete stresses below the modulus of rupture or by lightly prestressing the panels.

The panels are fabricated with lifting inserts and anchors to attach them to the cast-in-place concrete. When the panels are to be used as exterior forms against which concrete is cast, form ties may be attached to embedded anchors, reinforcement, or inserts provided in the panels for that purpose (Fig. 14.15), or ties may be installed at joints between panels when suitable backing and provision for precise alignment of the panels is made. Any embedded metal that remains exposed to the elements after the structure is completed should be made of noncorrosive material.

At the intersection of horizontal and vertical jointing, a temporary bolt through blocking is used to assure holding corners of all four slabs in the same plane during casting of concrete. Wales may be used on the concrete form face to maintain alignment. Rate of rise of concrete in such forms should be limited according to recommendations of the manufacturer of the panels. Thorough consolidation of concrete behind the forms is desirable to prevent voids that would interrupt the bond of the form to the concrete, but sufficient care must be exercised to prevent damage of concrete panels by contact with vibrators. If horizontal construction joints are made about 3 in. below the top edge of precast concrete form panels, instead of on the form panel line, the possibility of water leakage through the construction joint will be reduced.

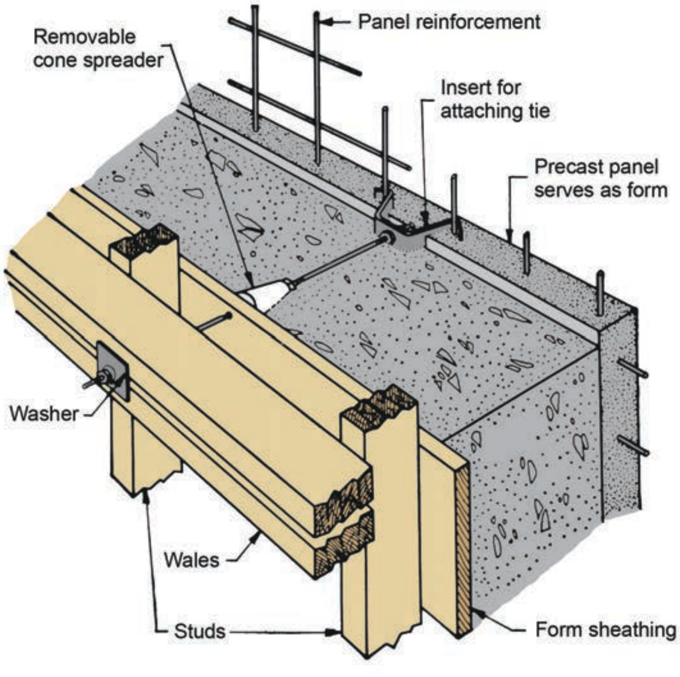

Fig. 14.15: Wall form assembly showing how precast concrete panel serves as one face of the form

Precast concrete panels that serve as forms must be protected during transportation and erection to prevent chipping, spotting, cracking, or other damage of the units. Where field welding of panel connections is required, the welding process should be controlled to avoid spalling and scorching of concrete.

Where architectural concrete form panels adjoin or are supported by other forming materials, care must be taken to use materials that will not stain the exposed concrete surface. Any concrete that is accidentally spilled on such panels must be washed off before it hardens. After concreting, precast architectural concrete form facings should be wrapped or covered with nonstaining materials to protect them from other construction materials, debris, or mechanical damage.

Joints between precast units are normally shimmed to establish proper spacing, and then caulked, plastered, or taped on the inside or outside to prevent mortar leakage during concreting. A gasket of low-density closed-cell neoprene rubber or other durable, resilient material may be installed at this time to seal forms and remain in the permanent structure. Depending on design details, joints may require filling or caulking after concreting is completed. This filling or caulking should not cause any damage to adjoining surfaces, and any cement-based joint filler should be adequately cured to make joints watertight.

Reinforcement of concrete and mortar with glass fibers also has applications in formwork. One type of this composite material is made of hydraulic cement mortar and chopped strands of alkali-resistant glass fiber, sprayed up similarly to fiber-reinforced polymers. Including the glass fibers provides a tough material that can be formed into plain or patterned sheets about 1/2 in. thick, strengthened by heavier ribs where required. The material has been used both as a stay-in-place form for bridge decks and as façade panels for buildings. It also has potential as a liner for producing architectural surface finishes while weighing less than stay-in-place forms of conventional precast concrete.[14.7]

14.4 Construction of Forms for Architectural Concrete

Whether panel forms, built-in-place forms, or a combination of the two should be used depends largely upon the architectural treatment. Where they can produce the required surface, panel forms have numerous advantages as they do in structural concrete. Methods of building formwork for architectural concrete generally follow the techniques outlined in Chapter 11, Building and Erecting the Formwork. The purpose of this section is to point out additional considerations required for architectural work.

Apart from quality of contact surfaces already discussed, the main concern is for ornamental details; accurate alignment; and the prevention of disfiguring deflection, leakage, and staining. Better-quality materials are usually required for architectural concrete formwork, and particular attention is given to meeting the dimensional tolerances specified by the architect/engineer.

Because the surface appearance of the architectural concrete is so important, extra vibrating or placing pockets may be needed to facilitate placement and consolidation of the concrete to prevent segregation, honeycombing, sand streaking, or cold joints. It should be noted that if pour pockets are required on the forms for architectural concrete, they will normally leave a mark on the finished concrete. The location of pour pockets should be coordinated with the architect.

Exposed reinforcing bars or bars too close to the concrete surface can cause unsightly rust stains. Use of noncorroding side form spacers is recommended to maintain proper cover over reinforcing steel on all vertical architectural concrete members. Be sure that the spacers selected will not leave undesirable patterns on the concrete surface. Care should be exercised in placing the reinforcement so that force required to close the form does not cause the reinforcement spacers to indent the form facing and protrude from the concrete surface.

14.4.1 Walls

Wall forms for architectural concrete are built the same as for structural concrete, but more attention is given to alignment, perfection of corners, the contact surface, and especially to treatment of joint location (Fig. 14.16). All wales should be constructed of two members with joints staggered to minimize deflection. Minor defects in alignment and construction, which may not be objectionable in structural work, show up badly in architectural concrete. It is difficult to get good alignment with wood wales or strongbacks when rigid

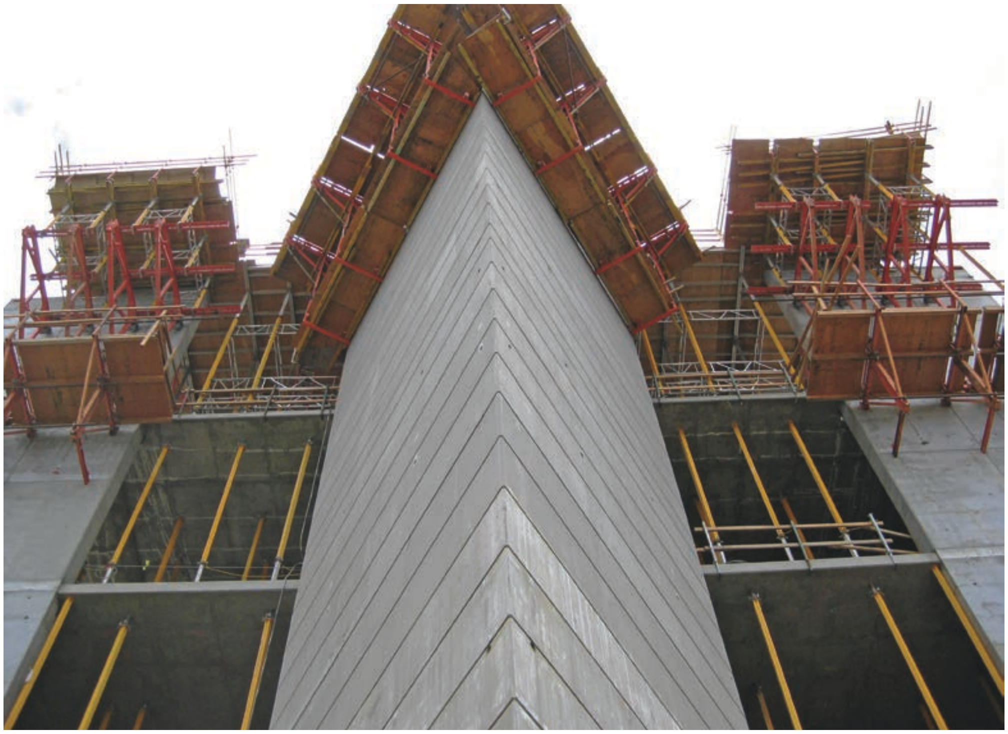

Fig. 14.16: Tight form joint intersections produce well-defined edges (Photo courtesy Morley Builders)

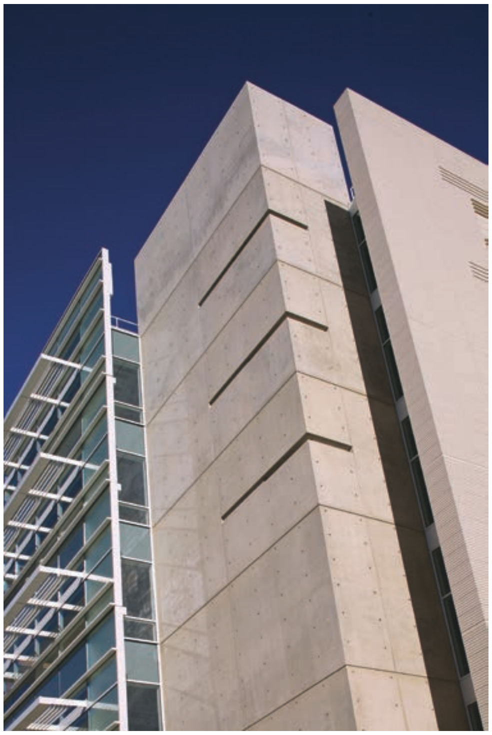

Fig. 14.17: Sheathing quality for reuse must be higher to produce uniform architectural concrete surfaces (Photo courtesy Morley Builders)

tolerances are required. Substitution of lightweight steel studs, steel or aluminum channels back to back, or laminated veneer lumber will give much better alignment.

Any amount of care exercised in securing good horizontal and vertical alignment is time well spent. One method for aligning a long section of forms is to set points about 30 ft apart on the floor with a theodolite or total station. These points may be set 3 or 4 ft back from the face of the wall to be well out of the way. Alignment at the top of the wall can then be accurately set by plumbing up from the floor points and measuring over to the wall. Intermediate points are set from a chalk line on the floor between the control points. Aligning of forms is best done when there is little wind.

Sheathing and Lining

Architectural concrete form sheathing should be of appropriate quality to maintain the reasonable uniformity of concrete surfaces (Fig. 14.17) through multiple uses and to control deflection within appropriate limits. Plywood, steel, glass fiber-reinforced polymer, aluminum, and other suitable materials can all be used as sheathing or facing materials.

Plywood (see Chapter 4) is one of the most widely used sheathing materials, either as a support for lining materials or as a smooth contact surface for the form. Smooth contact surfaces are best formed with overlaid or coated plywood so that the wood grain pattern is concealed. If plywood is used as sheathing, full-size sheets are preferred and edges should be butted or otherwise jointed. All vertical joints should be backed solidly, and the edges of abutting sheets should be nailed to the same stud or beam; or if preassembled in panels (Fig. 14.18), the edge members should be carefully aligned. For best appearance, plywood sheets should be arranged as symmetrically as possible about the center line of each exposed surface. The grain of the outer plies should run at right angles to the studs for maximum strength. If plywood is used with grain parallel to studs, closer stud spacing must be used as indicated in the design tables of Chapter 9.

To avoid swelling of plywood edges, which would cause a visual effect on the concrete surface, all plywood cut edges should be sealed, including tie holes. Many plywood manufacturers can supply, for field application, the same edge sealers used in factory production or a wood sealer can be used.

Plywood sheathing can also be fastened by back-fastening. Two layers of sheathing are used. One layer is fastened to the wall form studs or beams with nails or screws from the sheathing surface into the support. The second layer, the form facing, is then screwed

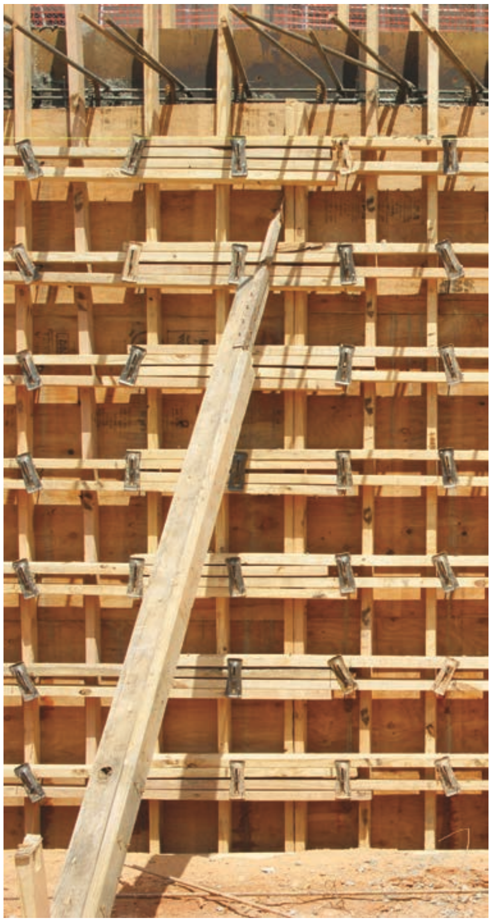

Fig. 14.18: Job-built panels with double studs at vertical joints

from the back side of the first layer. This eliminates any concrete surface fastener imprints or discoloration.

Whenever the architect permits prefabricated form panels to be used as wall sheathing, similar care must be taken to keep horizontal joints level, vertical joints plumb, and all joints mortar-tight. Panels, such as plywood sheets, should be laid out symmetrically about the center line of the exposed wall face.

Either smooth or rough board finish may be specified by the architect. Because these terms can cover an almost limitless range of possibilities, a good understanding of the architect's intent should be established during the preconstruction conferences. At times, irregular surfaces with projecting fins are desired; in other cases, a faithful reproduction of wood grain is needed (Fig. 14.19 and 14.20). Board sheathing should be built in place unless otherwise specified or permitted, except that prefabricated form sections may be used if a single section forms an entire area from one reveal to another.

Fig. 14.19: Wood board sheathing joint and grain pattern (Photo courtesy Doka USA)

When smooth board sheathing is required for architectural concrete surface appearance, great care is taken to prevent leakage through form joints. Vertical boards should have all vertical joints plumb, and horizontal boards should have all horizontal joints level and continuous. The vertical joints between horizontal boards should not be over one board wide, should be staggered at least 2 ft, and should be located at studs or other supporting members. Each board must be driven up snug and nailed at every vertical stud or horizontal beam. Sheathing of 6 in. boards should be double nailed, and 8 in. and 10 in. boards should be nailed at both edges and at the center. Placing the bark side of sheathing boards toward the concrete will give a more even surface by reducing the natural cupping that occurs when the boards contact wet concrete.

Fig. 14.20: Attachment of wood board sheathing in place (Photo courtesy Doka USA)

The top three boards below horizontal construction joints should be ripped to approximately one-third of the closure needed. This helps make the horizontal lines look more evenly spaced. For example, if 24 in. remain at the top of a wall formed with 10 in. boards, appearance will be better if each of the top three boards is 8 in. wide rather than having an entire wall of 10 in. material with a single 4 in. board tacked on at the top.

The backing for the form lining should be constructed of a good grade of plywood or form lumber that is solid, straight, and free from defects. Treat backing sheathing material with form oil like that used on the face to help prevent warping.

Liners should be handled and assembled with care to avoid distortion. Many form liners, particularly the plastics, expand and contract noticeably with temperature changes and exposure to full sunlight. The expansion can cause buckling of the liner and bulges in the concrete unless appropriate relief is provided at joints. Keep plastic and light- or heat-sensitive liner materials out of direct sunlight.

Joints in the lining should be offset from those in the backing. Proprietary liners should be attached following the manufacturer's recommendations. Liner layout should consider the modular repetition and the dimensions of the structural element being formed. Generally, the lining material should be attached beginning at the center of the board or sheet and working toward the edges to prevent buckling. It may be fastened to the forms with adhesives, staples, screws, or nails, depending on the type of liner material. Nails should have thin flat heads and should be spaced not more than 8 in. on centers at edges of lining material. There should be at least one nail in every square foot.

All liners should be used in the widest size possible. Areas less than 4 ft wide should be lined with a single width of fiberboard, plywood, or other lining material. Edges of abutting sheets should be attached to the same backing board, just as for sheathing. Joints between liner sheets should be caulked to prevent leakage unless the material has its own interlocking joints, as is the case for some proprietary sheet liners.

Fig. 14.21: Tie holes located to become part of the visual design (Photo courtesy Morley Builders)

Ties

Form ties for architectural concrete require special consideration. Marks left by the ties can detract from the finished surface or they may become an integral design element in the finished façade (Fig. 14.21) when properly executed. Tie holes should be bored from the inside of the forms whenever possible to prevent the formation of burrs on the contact face. The smallest possible hole should be used to prevent mortar leakage. Special care should be taken during stripping so the concrete is not broken around the tie holes.

The ties should be adjustable to permit tightening of forms and should leave no metal closer than 1-1/2 in. to the surface for steel ties and 1 in. for stainless steel ties. Any lugs, cones, washers, or other fittings, if permitted, should not leave depressions of a diameter greater than their depth at the exposed surface of the concrete if the hole is to be patched. The mortar plug is less likely to become loose and leak if the side slope of the recess hole is smaller. Twisted wire or band iron ties should not be permitted. Some specifications also prohibit snap ties that are not fitted with spreader cones because of the difficulty in controlling depth of breakback. When breakback can be controlled, some architects may prefer the small holes left by snap ties without cones.

If ties do not fit tightly, holes should be sealed to prevent leakage. Tie layout should be planned so as to be symmetrical with the member formed; and, wherever possible, ties should be located at rustication marks, control joints, or other points where the visual effect will be minimized unless the tie hole pattern is part of the architectural effect. Ties penetrating a liner should be selected for visual effect and sealed at the penetration so concrete cannot migrate between the liner and the substrate.

Where the architect specifies ties such as pencil rods, taper ties, or other bolts that are pulled out after use, they should be coated with nonstaining bond-breaker or encased in sleeves to facilitate removal. These ties should incorporate positive spreading devices instead of relying on wood spreaders that are removed as concreting progresses. Occasionally the architect may specify externally braced forms to eliminate surface blemishes associated with ties, or go to the other extreme of emphasizing tie holes as part of the surface design. Fiberglass ties (Fig. 14.22), sometimes colored to match the concrete, can be cut off flush with the surface.

Fig. 14.22: Fiberglass ties colored to match concrete and aligned in rustication joints to further minimize visibility after final trimming is completed (Photo courtesy RJD Industries)

Corners and Openings

Forming corners and openings in architectural concrete (Fig. 14.23) is a critical operation. The formwork must be unusually tight and braced so that no movement occurs because imperfections in construction and alignment are most noticeable at corners. A slight opening of a corner will cause bleeding that may result in sand streaks or an irregular line of honeycomb and a fin that cannot be easily removed or covered. Inserting closed-cell neoprene material 1/4 in. thick at corner joints will prevent this leakage.

One way of forming corners for architectural concrete is shown in Fig. 14.24. Vertical kick strips are attached to intersecting wales at the outside corner, and the wales are wedged tightly to prevent leakage. Alternate methods using prefabricated corner ties, shown in Chapter 11, will keep wales at the same elevation and maintain a uniform tie pattern on walls. Methods are generally the same as for structural concrete, except that greater precision and attention to detail are required.

Fig. 14.23: Alignment and tightness of joints at corners and windows is critical in architectural concrete (Photo courtesy MEVA Formwork Systems)

Forms for wall openings are built as described in Chapter 11. Precision is again the main consideration, especially at the joint between the wall sheathing and the opening form. Many difficulties can be avoided if the lumber is selected for straightness so that it fits accurately between the forms, leaving no blemishes in the concrete.

14.4.2 Columns and Pilasters

Modern architectural designs often require that structural columns be left exposed for architectural effects. Round or rectangular columns are formed much the same as regular structural concrete columns (see Chapter 11), except for the attention required for surface finishing and ornamental details. Smooth sheathing or lining and filled and sealed joints are essential, unless other provisions are made for a textured surface.

Columns are often sculptured or ornamented and require special fabrication of details. Glass fiber-reinforced polymer has been used with good results in forming decorative

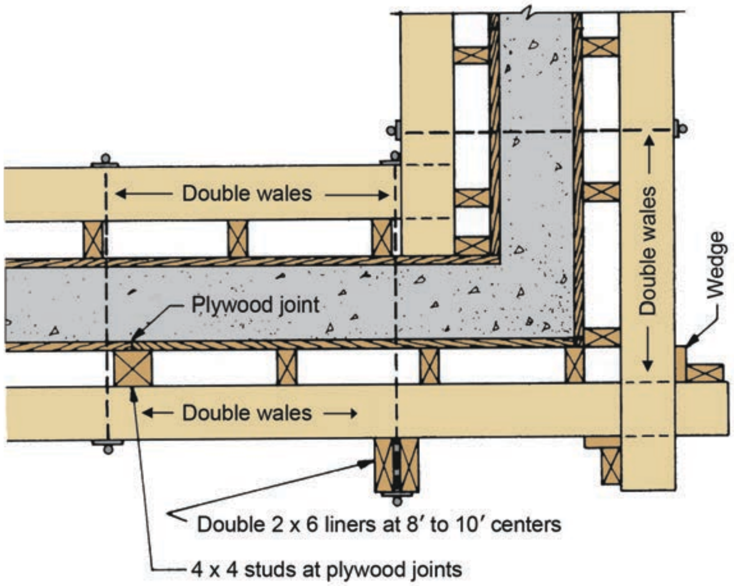

Fig. 14.24: Typical details of straight wall forms showing one method of securing a tight corner (Image courtesy Portland Cement Association)

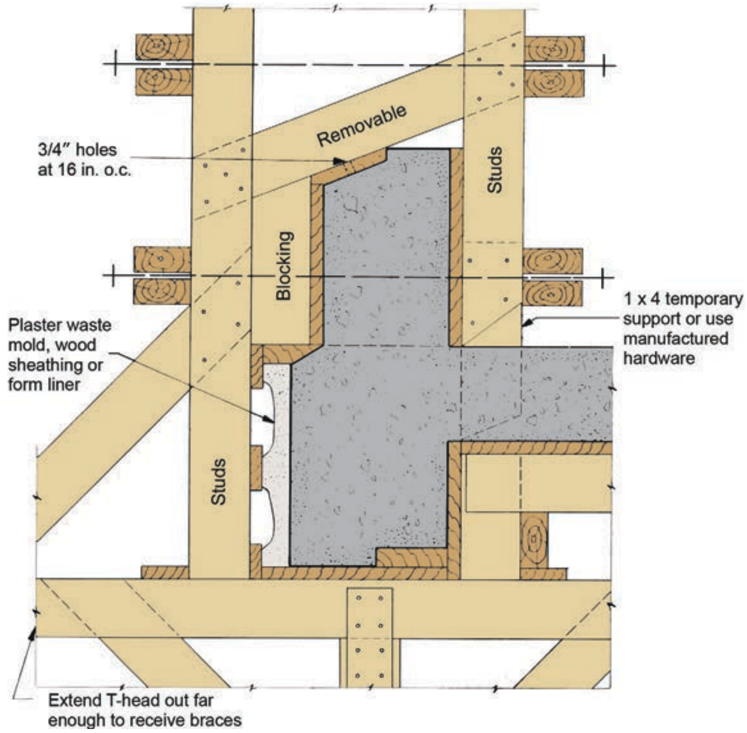

Fig. 14.25: Ornamental spandrel beam form design suitable for casting in two stages because face design would tend to hide construction joint at the top of the floor slab (Image courtesy Portland Cement Association)

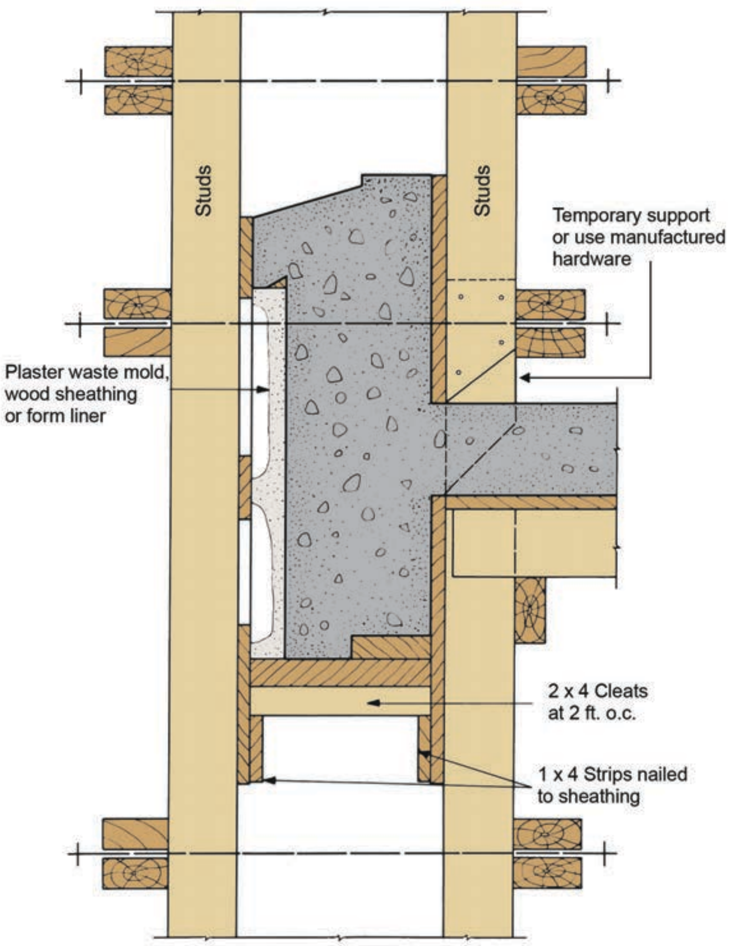

Fig. 14.26: Spandrel form supported by studs extended past wall opening and sheathing also extended part way across opening (Image courtesy Portland Cement Association)

columns. Precast concrete panels that stay in place permanently as a decorative facing have also been used as forms for architectural columns.

Generally, the face form for a pilaster (Fig. 11.46) can be made as a panel. Accuracy in forming is important, as such details are frequently the focus of attention in the façade of the building. Corners and sheathing joints must be straight and true, and marks of the edge grain of the form sheathing should not be visible from the front.

14.4.3 Spandrels and Parapets

Spandrels are often decorative features of a building and may require the use of molds if they are complicated in design. Depending on the spandrel elevation relative to the floor slab elevation, the spandrel top may be at the floor level or upset above the floor. In the latter case, the spandrel can be cast in one or two parts, depending on the design of the spandrel. If the spandrel is to be cast in two parts, it is desirable to have the joint obscured by placing it at some architectural detail. If the structural design requires casting the upset spandrel integrally with the adjoining floor slab, this should be indicated by the architect/engineer. This point should be rechecked if there is any doubt.

Two methods of forming an upset spandrel are shown in Fig. 14.25 and 14.26. These forms can be used whether the spandrel is to be cast in one or two operations. The inside wall form is supported on 1x4s resting on the floor slab form if casting is a single operation. These supports are withdrawn before the floor slab concrete has hardened. Fabricated metal adjustable supports are available for the same purpose, or precast concrete block supports left in the floor slab can be used.

Usually, forms for the inside of parapet walls are made in panels erected as a unit. Panels 10 to 12 ft long are convenient for the average project. The method of support is the same as pictured for spandrel forms.

14.4.4 Soffits

If the underside of a concrete slab, beam, or arch is to be exposed to view, either painted or as bare concrete, extra care in form preparation, jointing, and sealing will be required (Fig. 14.27 and 14.28). Flat surfaces may be formed with steel, plywood, board sheathing, or other materials; however, coffered or ribbed ceilings are frequently selected for exposed areas for structural as well as aesthetic reasons (Fig. 14.28). Glass fiber-reinforced polymer pans and dome forms—both standard and custom sizes—have become popular for this application because of the generally good quality of the off-the-form finish, favorable stripping characteristics, and easy handling due to light weight. These forms can be trimmed or adjusted in the field to meet special forming requirements. Custom-made spandrel and other beam forms of glass fiber-reinforced polymer are also used to achieve improved surface finish and reduce site labor.

Exposed ceilings and beam soffits require formwork that is kept clean and free of rust deposits when concrete is placed. Mill scale may flake off the reinforcing as it is placed and accumulate on horizontal form surfaces. If reinforcement or metal scrap remains in position for some time before concreting, rust may be deposited on the soffit form and leave a stain on the concrete. Compressed air or water jets are sometimes used to clean surfaces of loose rust. For highest-quality work, consider using reinforcing bars that are resistant to surface corrosion if they must be exposed on slab forms for a lengthy time before concrete is placed.

Fig. 14.27: Erection of soffit form for arch (Photo courtesy Morley Builders)

14.4.5 Cantilevers

Because canopies and other cantilevered structural members are such conspicuous architectural features, it is particularly important that their forms provide adequate support to maintain architectural lines. In designing the forms, the formwork engineer/contractor will allow for any expected settlement or deflection of the forms themselves, while the architect/engineer will specify any camber needed to compensate for deflection of the member after forms are removed. If no camber is specified in the contract documents, the contractor should request guidance from the architect/engineer to help them realize the risk of a sagging span of concrete.

One or more checks should be made before concreting to be sure that proper camber is provided. Any needed adjustment of the form by jacking and wedging must be made before concrete placement. Adjustment of form elevation during or after concrete placement should not be performed. The upper surface of a cambered slab or beam should be screeded as nearly parallel as possible to the cambered form surface, so that a level surface results when the structure deflects. As with other soffit formwork, measurements of elevation to check compliance with the specifications should be made after the concrete sets but before forms and shoring are removed. Full, continuous support

Fig. 14.28: Concrete arch and coffered two-way joist ceiling become major statements contributing to architecture (Photo courtesy Morley Builders)

should be provided beneath a cantilever until it is capable of sustaining dead and live loading. Stripping the member and then providing reshoring only at the free end may cause tension failure in the bottom of the slab or beam. This danger exists because the principal reinforcement is placed near the upper face to sustain tension only when the member acts as a cantilever. Placing support only at the outer end converts it to a simply supported beam with tension at the bottom where steel may not have been provided.

14.4.6 Ornamental Detail

Molds for casting concrete ornament can be constructed from wood, plastic, plaster, rubber, concrete, glass fiber, metal, or other materials. The type of material selected for the mold depends upon the shape to be formed, desired number of reuses, cost of making the mold, and ease of erection and stripping. Ornamental castings may be needed either for new work or for restoration projects.

The molds should be set in the forms and securely held in position to reproduce the design shown on the drawings. Where wood forms adjoin molds, the wood should be neatly fitted to the profile of the mold and all joints should be sealed. The molds and the adjacent wood forms should be detailed so that the wood forms can be stripped without disturbing the molds. A slight draft or taper on the edge of molds or pattern strips will permit removing the detail material without damaging the concrete. Special provisions should be made for early form removal, retardation, or both when sand blasting, wire brushing, or other treatments are required.

Wood molds are best used for ornaments that have straight lines with no undercuts, such as fluting and molding on pilasters and cornices. Complex ornaments with curved surfaces and undercuts should be cast against molds made of materials such as plaster, plastic, and rubber that can be formed around a pattern for a true reproduction of the shape desired. Sheet metal can be rolled to shape molds for cylindrical sections. Precast concrete ornamentation is also used; components may be placed inside the form and concrete cast against or around them. At times, precast concrete ornamentation is attached after the forms are stripped.

Wood Molds

Wood molds are made of white pine, soft vertical-grain Douglas fir, or other softwood run to size and shape in a commercial mill or a form shop with the necessary shapers. Molds of wood are well adapted to ornamentation on belt courses, cornices, and other long details; for such purposes, the mold is made up of several long moldings or strips run to the needed shape. It should be made of material that does not warp or split easily. Combinations of standard moldings are used whenever possible.

Special attention must be given to joint construction. Objectionable fins will be formed in the concrete if the mold joints are not mortar tight. Each joint should be sealed with caulk, tape, joint compound, or a compressible gasketing material before the concrete is cast.

Longitudinal joints between the mold members should be made by overlapping at reveals or returns whenever possible (Fig. 14.29). If butt or miter joints are used, alternate shrinking and swelling may open them to cause fins in the finished concrete. When joints occur where there is no return or reveal, tongue-and-groove lumber or shiplap should be used. Joints may also be splined or biscuited. Butt joints can be used when the pieces are attached to a solid backing that prevents distortion of the mold due to swelling or shrinkage of the pieces. Brackets of 2x4 and 1x6 material cut to the approximate shape of the cornice are preassembled and scabbed to studs. Cornice form parts are then attached.

If transverse joints between successive pieces on a long wooden mold all occur at the same place, they are easily detected in the finished concrete, and there will be a distinct break in continuity that weakens the mold. Staggering joints overcomes both of these problems, and small joints can be made almost invisible by sealing.

Because wood swells when wet, the mold must be built so that this property will not distort the mold or open joints. Swelling may also break the newly formed concrete. Thin, narrow boards should be used because they warp and swell less than thick, wide boards. They also save lumber. Saw cuts in the back of the mold members (Fig. 14.29) will also reduce warping and wedging caused by swelling and will make the forms easier to strip. Proper treatment of wood with sealer (two coats) will reduce swelling and produce a more uniform concrete surface.

Perfectly square pieces will bind in a formed recess and will have to be cut out with a chisel. To avoid this extra labor and possible damage to the concrete, make wood inserts with a slight bevel or draw and with saw cuts in the back.

Much time can be saved in erecting and stripping forms for a detail involving many pieces of run moldings if brackets are made in the shop to the approximate profile of the proposed mold. The brackets can be fastened to a major part of the formwork and the mold pieces attached without excessive blocking.

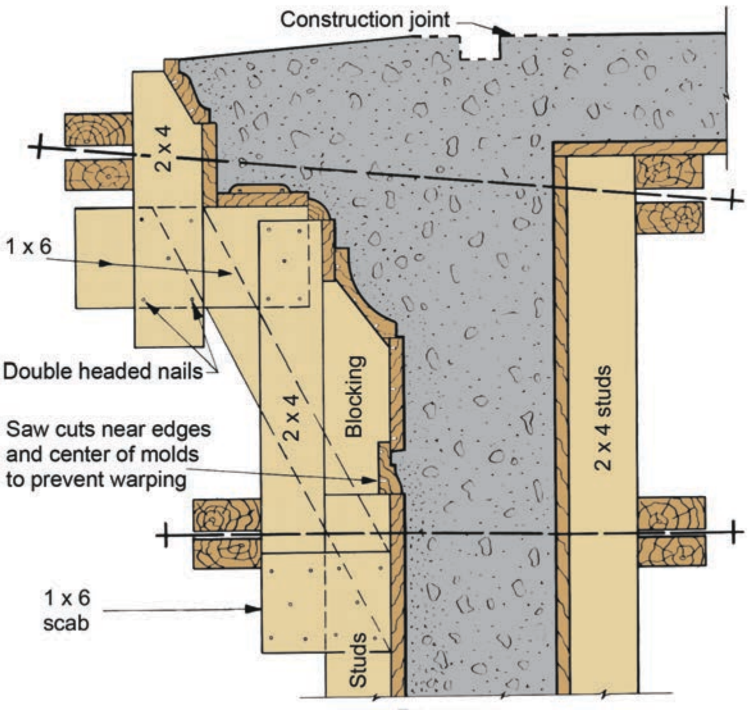

Fig. 14.29: Wood mold for cornice showing how longitudinal joints are made by overlapping pieces rather than by butting or mitering (Image courtesy Portland Cement Association)

Plaster Molds

Plaster molds for casting intricate ornamentation are called "waste" molds because they are broken in stripping and cannot be reused. However, where elements of the design are repeated a number of times, duplicate molds, perhaps made in fiberglass, can be mass-produced from the same master pattern or model.

These molds are usually built by the ornamental plasterer who applies plaster reinforced with fibers to a pattern of wood, clay, or other material. The pattern is first made to the exact form of the proposed ornament and then the mold plaster is applied. When the mold has hardened sufficiently, it is taken off the pattern and finished to the texture of the form sheathing that is to surround the mold so the concrete finish of the decorative detail will match the surrounding concrete. The contact side of the mold is then waterproofed with several coats of shellac or other sealing compound. This prevents the mold from absorbing water from the fresh concrete, which would weaken the mold and the concrete, as well as possibly discoloring the concrete.

A 1/4 in. layer of colored plaster placed next to the pattern when forming the mold will aid in the stripping operation by indicating when the plaster has been chipped close to the concrete surface. The coloring must be such that the concrete will not be stained if the waterproofing agent fails or is chipped off the contact surface of the mold.

The contractor and plasterer should work together in developing a mold that is strong enough to withstand the pressure of the fresh concrete. The mold maker must be given complete instructions as to how the mold will be attached to the formwork so that extensive blocking will not be necessary. The mold must also be able to withstand handling during erection.

The shape of the back of the mold varies according to the size and shape of the ornamentation to be formed. For small molds or flat surfaces with shallow ornamentation, the back of the mold will be made flat to bear directly against the studs or wales. Molds for deep ornamentation would be too heavy if the plaster were brought out to a flat surface in back, so they are made 1-1/2 to 2 in. thick with the back of the mold made to approximate the profile of the contact surface. The mold is then blocked out around the edges and other points with plaster reinforced with jute fibers or burlap to contact the formwork.

A wooden frame is often added to the back of a mold to prevent deflection and cracking during transportation and erection. The frame is detached when the mold is set in place.

The edges of the mold require special attention. If possible, the joints between the mold and the form sheathing should be hidden at reveals or returns. The edges of each piece should be rabbeted so they will fit closely with the form sheathing, making a tight joint.