An essential part of the architectural vision for the new U.S Courthouse in San Diego is the 45x11-foot exposed concrete elevator core running the full 17-story height and more. The story of how this core—actually a C-shaped concrete structure in its own right—was formed and placed is one of innovation and comprehensive planning among builder, designer, and supplier. Representatives from contractor Hensel Phelps, Irvine, Calif., and formwork supplier Atlas Construction Supply met once a week for more than six months prior to construction to plan the core and the many other concrete elements of the building.

Formwork Innovation

BUILDING AN ARCHITECTURAL CONCRETE ELEVATOR CORE TOOK COMPREHENSIVE PLANNING.

With the form panels and three platforms, the entire formwork system stretched to nearly 55 feet.

PHOTO: KELAN QUINN, ATLAS CONSTRUCTION SUPPLY
Once construction started, everything worked like it was supposed to; very little onsite improvisation was required.

Placed ahead of the structural steel, which trailed a few levels below to allow both the steel and concrete to tie together smoothly, the elevator core is a rectangular C with a 45-foot face and two short 11-foot returns. The 16 lifts needed to construct this 12-inch-thick wall varied from 14 to 25 feet high. Because the exterior of the core is a highly visible architectural element of the building, the project team decided early on that the exterior form panels would be set first in order to ensure proper elevation and alignment of reveals, joints, and tie locations prior to rebar placement.

Concrete for the core structure was designed with a 6000-psi 28-day compressive strength. With a water-cement ratio of 0.42, Vulcan, the concrete producer, got a 7-inch slump using high-range water reducer (Grace’s ADVA). To get the color the architect wanted, Vulcan blended a 65-35 mix of white and gray cement (no supplemental cementitious materials) with a buff colored admixture (Davis 5447). Hensel Phelps noticed a faster set time than usual with the white cement, which was controlled with a hydration stabilizer (Grace’s Recover). To help with blending of any color variation between batches, two truckloads were required to be at the pump during placing to blend the colors.

**Forms and platforms**

Atlas Construction Supply Inc. designed and supplied the forms, which included a single panel for the long exterior architectural face of the core to provide a seamless concrete finish. This panel was 47 feet wide, 26 feet tall, and weighed 15,000 pounds, requiring the use of a spreader beam to maintain the integrity of the form during hoisting. Once construction began to move vertically, four work platforms—two on the long side and one on each short side—braced and supported the formwork above. These platforms were mounted to architectural tie holes from the previous lift and designed to adequately brace and support the largest form panels that would be required.

Three additional platforms trailed the main work platforms, providing access to the wall to remove rustication strips and tie hole cones, and to allow retrieval of the attachment hardware and some minor wall finishing. The overall height of the work platform assemblies reached nearly 30 feet; when the wall form panels were set for the tallest 25-foot lift, the overall height of the formwork system stretched to nearly 55 feet.

For the interior formwork, a 43x8-foot truss platform was prefabricated in Atlas’ San Diego yard and delivered to the site. At the end of each side of the truss platform were flipper pales (like keys or a locking mechanism) that supported the platform by fitting into tapered void pockets that had been cast into the wall during the previous lift. The hoisting operation of the interior truss platform simply required lifting the platform until the flipper pales clicked into place at the next level of void pockets.

An important requirement of the interior truss platform was that it had to allow crane access from above.
for installation of structural steel columns and beams within the core. The W27x94 perimeter steel beam for each floor level was centered 9 feet from the long inside wall of the core putting it just outside of the platform. The more challenging provision was to accommodate W16x36 columns located on the inside ends of the short return walls. The platform needed to cross the space above these steel columns so the crew could travel between the outside and inside platforms—this created an interference problem with installation of the steel columns. The solution was to make 6x6-foot hinged sections of platform at each end. These hinged sections were down 95% of the time to allow working access between inside and outside platforms. When it came time to install the steel columns, which occurred eight times during core construction, the hinging platforms were swung up out of the way, providing crane access so the columns could be placed below.

Because the concrete core preceded the rest of the building, it needed its own access from the completed floors below. To accomplish this, a temporary stair system was installed inside the core under the truss platform. Ladders extended from the top stair landing to the lower truss platform, and then from there another ladder allowed workers to reach the upper truss platform. As the platforms were raised additional sections of temporary stairs were added.
Ties and patterns

Project architect Richard Meier & Partners, Los Angeles, set the tie pattern and plywood pattern, which limited flexibility for locating ties at ideal locations for structural placements and platform attachments. A double laminate of 3/4-inch plywood with high-quality 5x10-foot sheets as the face laminate were used to achieve the architectural surface requirements. Sleeved ties with architectural cones spaced at specific locations, on a 5 feet horizontal by 4 1/2 feet vertical module, governed a concrete placement of 8 feet per hour. Hensel Phelps consolidated the concrete using vibrators with head diameters of 1 to 1 ½ inches vibrating at 10,500 vpm, and a withdrawal rate of 2 to 4 inches per second.

At tie locations that would eventually be used to attach the working platforms, a custom-made coil tie was used. The coil ties ended up with the same finished look as the rest of the ties, but served as an anchor to allow a one-sided attachment of the mounting hardware for the platforms. The advantage of a one-sided attachment was that the inside truss platform did not then also have to extend 30 feet below the tie hole to allow workers to put a washer and nut on the backside of the wall as would be needed for a through-tie.

As a result of the many different lift heights and the need to conform to the tie hole pattern, the exterior platform mounting locations varied widely relative to the construction joints, which were laid out to always fall at one of the rustications. This meant that the distance from the bottom of the wall panels to the platform varied from as little as 6 inches to more than 5 feet.

To accommodate such a large range, Atlas developed a system of sliding strongback channels for rough adjustment combined with screwjack assemblies for fine adjustment to elevate and level the panels at the various locations.
Topping out
The top of the core had its own set of challenges. At 282 feet up, the 11-foot return walls extended to 20 feet long on each side. To form this wider cantilevered section, the return wall panels were swapped for wider panels. Then the challenge was supporting the gravity load of the concrete as it was placed for the cantilevered portion of the wall.

The first lift of this 9-foot extension included 13-feet of the narrower wall and a 10-foot section of the wider wall that was suspended concrete beyond the confines of the steel structure. To support the heavy suspended loads, a void box was installed in the wider forms for the lower 13-feet of the lift. The suspended wall panel assembly was supported by shoring towers, which in turn were supported by a platform comprised of two 36-inch deep castellated beams. These castellated beams were stiff enough to provide negligible deflection under the 15,000-pound cantilevered gravity load, and were themselves supported by spanning across three steel beams of the structural steel frame below.

To top out the core, one additional 15-foot lift was placed, also with the 20-foot-wide return walls, but this lift had the luxury of the concrete below to both support the concrete gravity load and to provide an attachment for 5x5-foot brackets to support the additional wall panel width. After the final pour, the shoring platform was unbolted at the center into two sections that were individually removed through the core.

There were many other formwork-related challenges throughout the project, including two suspended concrete decks, 14-foot-tall architectural one-sided walls, and an architectural cast-in-place stair structure that rises to the top of the building. Success was achieved through a two-way effort between Hensel Phelps and Atlas Construction Supply, with planning starting nearly a year prior to construction and continuing all the way through to completion. The teamwork between the project management team, the skilled carpenters, and Atlas with its formwork systems brought the dramatic concrete structure safely and successfully 337 feet up from its base.

Kelan Quinn was Atlas Construction Supply’s project manager for the San Diego Courthouse elevator core.