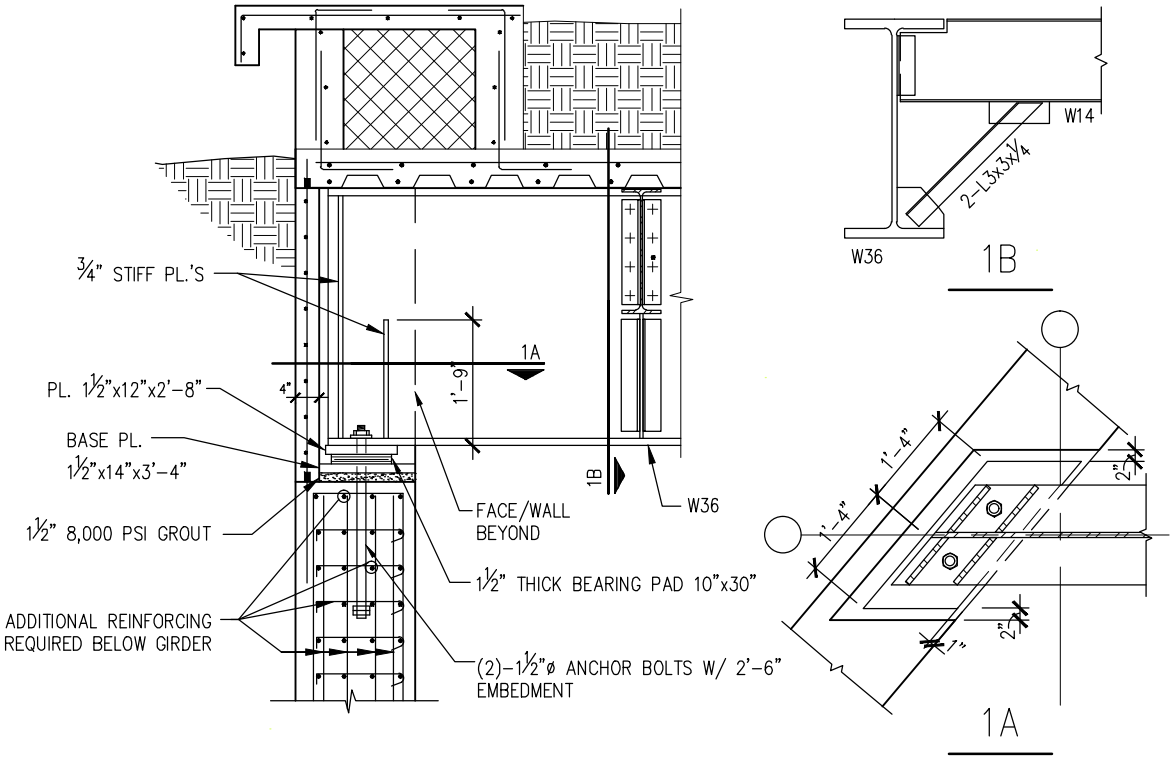
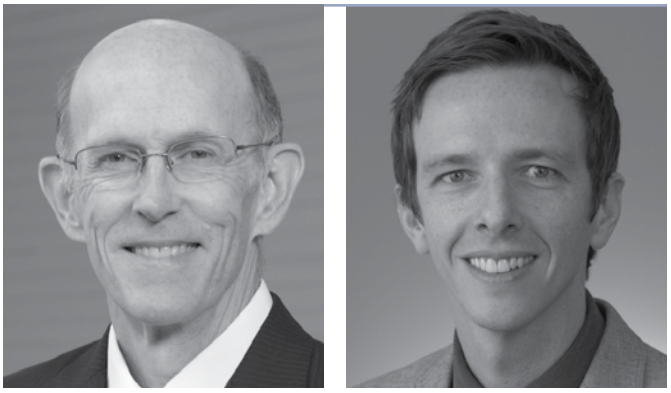
The small, above-ground entrance to the Harris County Jury Plaza belies the expansive steel structure below grade.

Tip of the Iceberg

BY WALLY B. FORD, P.E., AND BRANDON COFFEY



The long-span W36 girders that support the vegetated roof have support reactions of 280 kips and are supported by wall pockets, which bear directly on the concrete wall.



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ON THE SURFACE, there's not much to the Harris County Jury Plaza in downtown Houston.

At street level, it appears as a modest glass pavilion, elegant in its simple form and topped with a gentle steel barrel vaulted roof. It's surrounded by a verdant manicured landscape and is dwarfed by the surrounding high-rises. Descend 20 ft underground to the main space, however, and the project takes on new proportions and forms.

Jury Plaza is the gathering point for jurors and prospective jurors serving the five judicial facilities surrounding the plaza. The facility totals 33,500 sq. ft, with much of it located underground. The main program areas include a security checkpoint at street level, four juror rooms for up to 250 people each, workstations for clerks and bailiffs, open plan gathering areas with laptop/phone charging stations and a coffee shop—all located below grade. Jurors and employees have secure access to the surrounding judicial facilities and parking via underground pedestrian tunnels linked directly to the Plaza.

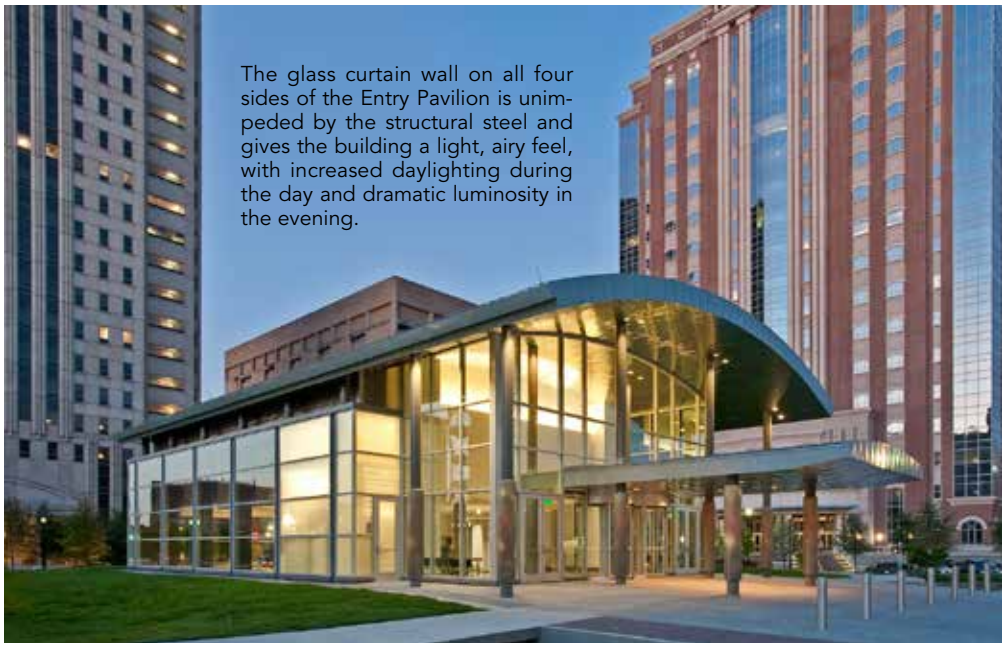
All photos: Hall Puckett

➤ At first glance, the Jury Plaza facility in downtown Houston looks deceptively simple. The Entry Pavilion occupies only a small portion of the site at grade; 85% of the program areas are below grade and extend to the perimeter of the site on three sides.

Down the Rabbit Hole

Though the entry pavilion occupies only a small portion of the site at grade, the subterranean facility extends to its very edges on three sides and accounts for 85% of the facility's square footage. The approximately 62,000-sq.-ft site itself is owned by Harris County, but the surrounding streets and underground utilities are City of Houston property, and the subterranean tunnels connecting to adjacent buildings are owned by the Texas Department of Transportation (TxDOT).

Haynes Whaley also worked with Schnabel Foundation Company, the temporary retention system subcontractor, and the City of Houston (which owns the streets that tightly paralleled three sides of the excavation) to ensure the efficacy of the retention system that would support city streets throughout the duration of the excavation and backfill. To stabilize the excavation, W18×106 wide-flange columns were installed as cantilevered piles with wood lagging spanning between them. Where room was available, a stable slope from the edge of the street down to the edge of the excavation was provided to minimize the length of the cantilevered piles. However, a portion of the excavation was so close to the street that the retention system extended up to street level. To retain the 22-ft, 6-in. resulting soil height, the steel piles required additional support. However, utilities buried below the street prevented drilling tiebacks to provide this support. The solution was to place horizontal steel walers across the face of the cantilevered piles. Steel pipe rakers braced these walers and were connected to the new building footings, which were modified to accommodate the rakers' thrust.



The glass curtain wall on all four sides of the Entry Pavilion is unimpeded by the structural steel and gives the building a light, airy feel, with increased daylighting during the day and dramatic luminosity in the evening.

➤ The site excavation came within feet of buried utilities and pedestrian access tunnels around the site perimeter.

A Quicker Composite Roof

The contractor's objective was to backfill as quickly as possible after the excavation was complete and the basement walls were up and waterproofed. However, the backfill couldn't be placed until the basement roof structure itself was in place to brace the top of the walls. Luckily, the composite steel beam framing system used for the roof provided faster construction than would have a cast-in-place scheme, allowing the backfill to be placed sooner. The composite system also avoided the cost premium the non-orthogonal fan-shaped assembly rooms would have created for a concrete formwork system.

The 6.5-in. normal-weight concrete slab that formed the roof of the underground portion included a 2-in. composite galvanized steel deck that spanned a maximum of 7 ft. It was placed 2 ft, 3 in. below the finished floor of the entry pavilion. It not only supports 2 ft of soil for the vegetated roof at grade but also forms a diaphragm between the tops of the basement walls from one side of the excavation to the other, a distance of 175 ft. The raised entry pavilion slab interrupts the continuity of the lower slab, creating a 50-ft by 68-ft hole in the diaphragm, which in turn creates shears and chord forces in the diaphragm as it spans the bracing loads around the opening.

▲ A view from inside the entry pavilion.

➤ The elevator shaft supports the "floating" stairs that cantilever from it, and the opening around it brings natural light to the lower level. Attention to steel connection detailing results in a clean open stair tread that appears to float free of the wall.

The vertical reactions of the steel beams supporting the vegetated roof were transferred via shear by clip angles welded to embedded plates on the face of the basement walls. The long spans across the four jury assembly auditoriums beneath the vegetated roof required two girders that had wall reactions of 280 kips. At these locations, a wall pocket was required to allow the W36×280 and W36×300 girders to bear directly onto the concrete wall.

Different Systems, Different Needs

The sub-grade and at-grade components of Jury Plaza required two distinctly different structural systems. The underground portion is designed like a combination bunker/submarine, with 20-in.-thick waterproofed exterior walls. In sharp contrast, the facility above grade is the "public face" of jurisprudence and required a fitting aesthetic. Architecture firm Page Southerland Page conceived a simple glass box to be emblematic of transparency of the judicial system; it is intended to appear as floating just above the ground.

The glass entry also fills the practical purpose of allowing more daylight into the underground areas. Architecturally exposed structural steel (AESS) HSS12.75×0.500 columns are incorporated at the perimeter of the glass walled pavilion. They span 22 ft from the pavilion entry level to its curved roof. (The curved metal roof required 55-ft-long W12 steel beams rolled to a 69-ft, 9-in. centerline radius.) The curtain wall terminates 4 ft below the column tops to expose them and to allow the curved roof to "float" above the glass box. These columns and the horizontal tubes spanning between them were designed to support the horizontal wind reactions of the glass within its ¾-in. deflection criteria for a 15-year return period, which for Houston is a 3-second gust velocity of approximately 90 mph. These columns extend down into the basement where they are also exposed. The column splices located 4 ft above the entry level are concealed by a section of architectural accent cladding, thus eliminating the AESS (visual finish) requirement for the all-around partial penetration weld used to make the splice.

The entry pavilion has glass a curtain wall on all four sides that stands 17 ft, 3 in.; it is braced to the primary structure at the top and bottom. The elevator shaft is in the center of the

All the building's lateral bracing is hidden behind the panels of the elevator shaft, allowing the remainder of the structure to be made lighter.

entry, and the area around the shaft is open to the lower level on three sides and serves as the light well for the main circulation area below. Even though the entry pavilion is only 50 ft by 68 ft in plan, its lateral stability in Houston's 50-year design wind of 110 mph was still a challenge due to the architectural goal of minimizing any structure that would block the flow of light into the building. The chosen system allowed columns to be freestanding from the entry level to the roof and the roof members to be only 12 in. deep. Diagonally braced frames on three sides of the elevator shaft form a 9-ft by 18-ft channel-shaped section, which engages the curved roof diaphragm and resists lateral forces. This channel shape is oriented such that its strong axis resists broad face wind. The torsional stability of this channel shape under eccentric winds is created by connecting the tips of its flanges with diagonal bracing above each of the elevator door frames, thus creating a sufficient torque box. Since all of the building's lateral bracing is within the walls of the elevator shaft, the remainder of the structure could be made much lighter.

The AESS stair to the basement level cantilevers from steel columns within the wall of the elevator shaft. The stair treads are HSS10×2×0.250 sections, which are welded to the stringers along the 2-in. vertical sides of the HSS treads. The stair treads support a terrazzo finish that covers the top as well as the sides of the stair treads, thus concealing the welded connections to the stringers. Stringer size was controlled by stiffness such that foot traffic would not crack the terrazzo finish. The HSS16×4×0.3125 stringers were field welded with mitered joints at the bends and are supported by cantilevers built up from steel plates to form a tapered box section to match the look of the tube-shaped stringers and treads. The taper allowed the tip of the cantilever to be shallow enough to be concealed by the exterior stringer that it supports and deep enough at the supporting column to provide sufficient strength and stiffness. Built-up welds were used for the moment connection of the box-shaped cantilevers to the columns to provide sufficient connection capacity while avoiding full-penetration welds and the special efforts associated with successfully completing them around the corners of tube members where continuous backer bars are difficult. The result is an architecturally clean open tread stair that appears to float free of the wall and blocks minimal light from the glass entry pavilion.

And the Verdict Is?

Harris County actively sought a design solution for Jury Plaza that would complement the architecture of the surrounding buildings; in their words the facility should be a simple "door in the ground." The design team went beyond that request. Jury Plaza reclaimed a brownfield site and transformed it into a tranquil and verdant oasis in downtown Houston. The site also factors significantly into downtown Houston's design strategy by serving as a link between historic squares, bike routes and the growing "green necklace" of open public space along the nearby Buffalo Bayou. The site is a nexus for bus routes on three adjoining streets, making public transportation to the whole judicial campus much easier. Despite subterranean site challenges, multiple coordinating agencies and exacting architectural requirements, Jury Plaza met all of Harris County's requirements and maintains Houston's reputation as a jury-friendly city. MSC

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