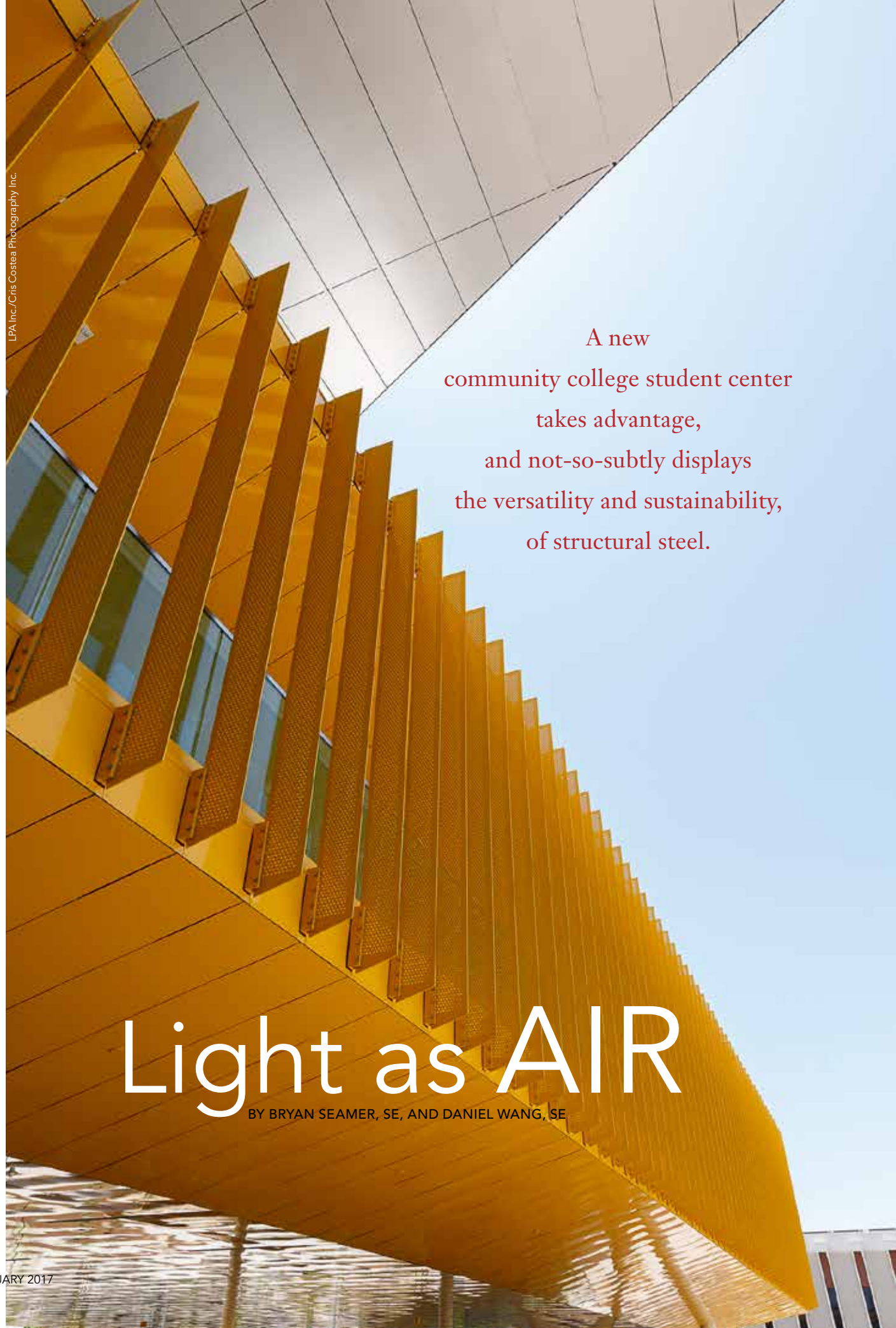

LPA Inc./Cris Costea Photography Inc.

A new
community college student center
takes advantage,
and not-so-subtly displays
the versatility and sustainability,
of structural steel.

Light as AIR

BY BRYAN SEAMER, SE, AND DANIEL WANG, SE

LPA Inc./Cris Costea Photography Inc.

The building's "skybox" houses the student activity center and student union.

The modern design is highlighted by the butterfly-form solar umbrella canopy.

LPA Inc./Cris Costea Photography Inc.

LOS ANGELES VALLEY COLLEGE'S Monarch Center appears light enough to take flight.

Located in Los Angeles' San Fernando Valley, the new 41,000-sq.-ft student center's dramatic architectural form includes a soaring butterfly canopy and an elevated skybox that showcase the versatility, lightness and elegance of structural steel as a building material.

The structural form of the modern $30 million building also plays a vital part in some of the building's most important sustainability strategies. On track for LEED Silver certification, the building is designed in a U-shaped plan with a food court and cafeteria located in the center of the facility, a one-story bookstore wing to the east and the student activity center wing to the west. The courtyard in the middle is designed to be an active student events plaza and is protected from the occasional Southern California rain and more frequent harsh summer sun by a prominent 20,000-sq.-ft, sloping, steel-framed butterfly-form "solar umbrella" that towers 41 ft above finished grade at its highest point. This feature is celebrated

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Courtesy of LPA Inc.

The solar umbrella roof, under construction.

This illustrative site plan highlights the sustainable garden winding around and through the building.

by a rainwater-fed waterfall from the solar umbrella that scuppers rainwater off one edge of the roof and into a weir. Once the weir reaches capacity, it ushers water into bio-retention areas that flow to a larger retention basin where on-site water slowly filters into the ground.

A "sustainable mall" with native and drought-tolerant landscape and additional storm water management systems connects the plaza to other campus buildings. To allow this campus long pathway to flow through the building into the shaded courtyard, the west wing of the building is elevated a full-story above grade, creating a student center "skybox" that invites students in and offers unparalleled views of the campus. The steel-framed butterfly roof, the rainwater collection system and the sustainable garden (which winds through the building beneath the elevated second floor, connecting the central plaza space to the adjacent campus mall) have become central elements of the campus's architectural identity. In this way, the long-span, cantilevered sloping steel roof serves as both a functional and inspirational demonstration of the college's commitment to holistic sustainable design.

Courtesy of LPA Inc.


Courtesy of LPA Inc.

▲ The butterfly-form roof under construction. Rainwater is collected through the cantilevered scupper into the sustainable garden below.

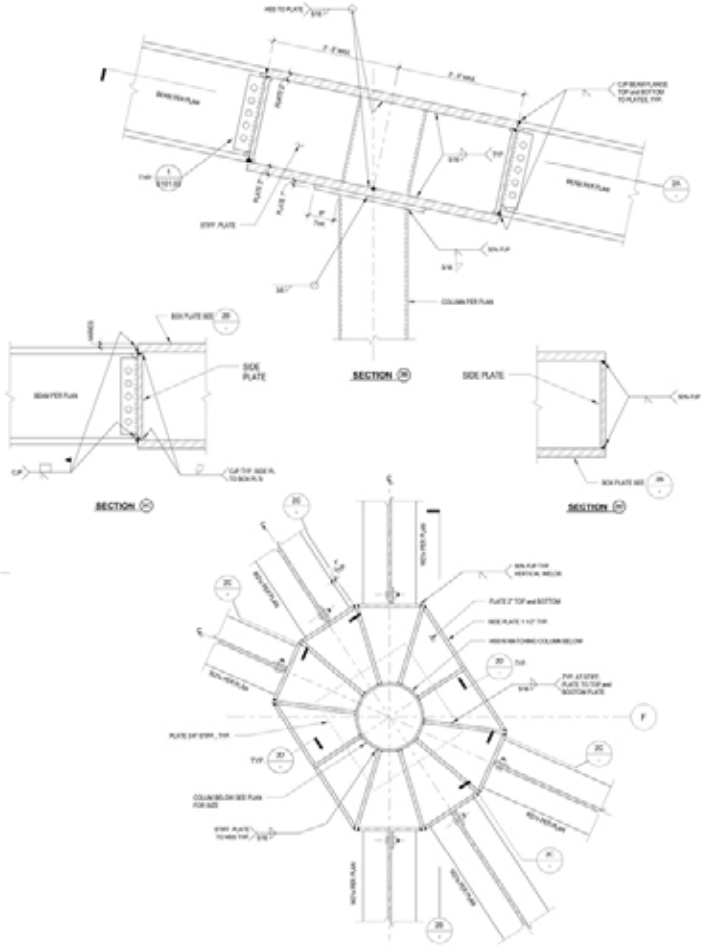
▲▼ Steel box plate connector hubs connect as many as six cantilevered beams across a single column.

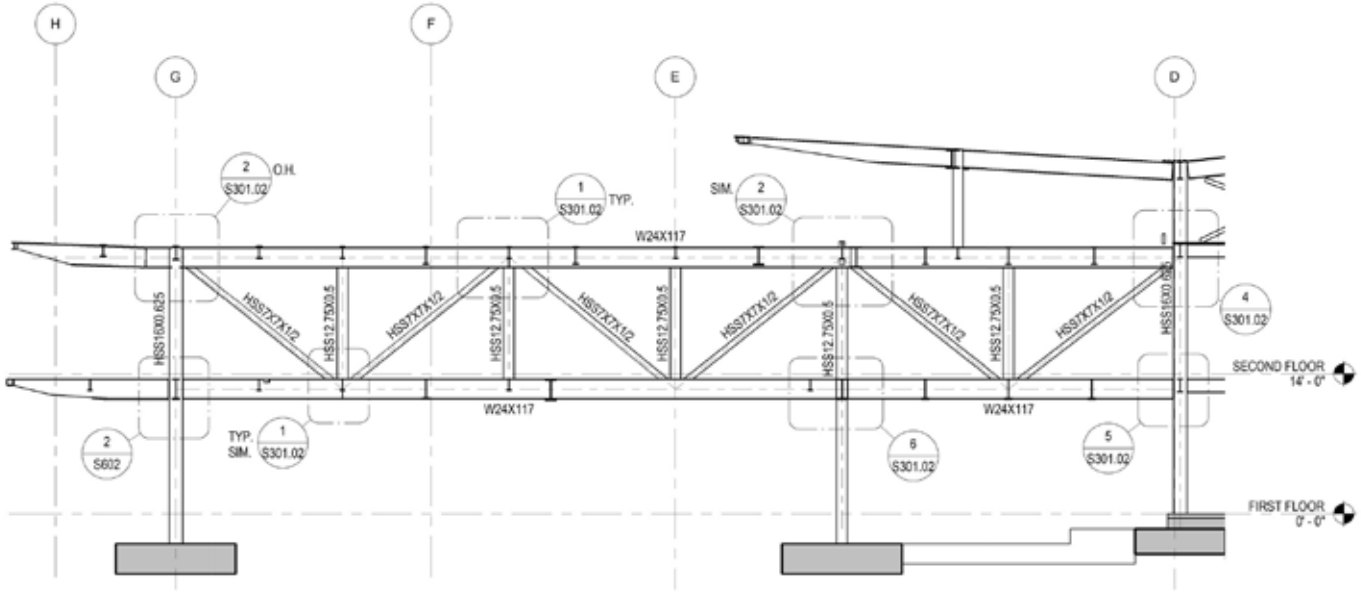
Flying Roof

On seeing the original conceptual rendering of the flying cantilevered roof, a representative of Los Angeles Community College District was impressed but skeptical, saying, "We love it… but is it even structurally possible?"

While the conceptual rendering was inspiring, the cantilevered roof form seemed to defy gravity, and the few 16-in.-diameter HSS columns that did reach the ground, more than 40 ft below, appeared unrealistically slender. Early iterations of the design concept included canopy forms that were both smaller in plan and that lacked the ability to collect rainwater. Close collaboration between LPA's integrated architectural, civil engineering and structural engineering teams at the earliest stages of the conceptual design process proved that the more dramatic canopy form was not only feasible but could also enhance the overall sustainability of the building in support of LA Valley College's project goals. A 3D ETABS model of the building formed the starting point for the design team's analysis of the structure, ensuring that the aggressive design was safe, resilient and serviceable and also satisfied the stringent structural safety requirements of California's Division of the State Architect (DSA).

The structural steel framing of the butterfly canopy design was optimized such that only five 16-in.-diameter steel pipe columns land in the heavily-used 9,000-sq.-ft courtyard. The edges of the canopy winnow down to a thin profile and are supported by a series of tapered steel beams that cantilever up to 20 ft to create the dramatic





▲ The skybox is supported by floor-to-roof long-span steel trusses.

form of the canopy. The primary cantilevered girders consist of W21×83, W21×122 and W21×166 steel sections cut and shaped so that they narrow down to a depth of only 8 in. at their ends.

Due to the complex geometry of the intersecting cantilevered steel beams, a special steel box plate connector was designed for constructability, allowing rapid erection of the main steel components. As many as six wide-flange steel beams intersect above the pipe columns, connected to a weldment of plates from ¾-in. to 2-in.-thick steel plates. This steel connection hub transfers vertical reactions as well as the large bending moments that result from the cantilevered leading edge of the roof form.

The solar umbrella roof is also unique in that it is designed to transfer all seismic or wind-induced loading into the lateral force resisting system of the main structure at the interior side of the roof, instead of relying on the outer line of canopy columns to provide lateral resistance through cantilever action or added bracing. This allows the columns to be much smaller in both size and quantity, and ultimately less intrusive in the open space of the courtyard below.

▲ The central plaza is shaded by the solar umbrella canopy.

➤ A view from the main plaza.

▼ The Monarch Center is a hub of student activity and a place for students to call home on campus.

▲ The yellow metal panels reflect the school color.

▲ An exterior walkway is shaded by perforated metal panels.

▼ The column-free area beneath the skybox.

Levitating Skybox

The student activity center is located on the second floor "skybox" that forms the west wing of the building and features panoramic views of the campus from the integral outdoor patio and walkway. Clad in bright yellow metal panels to reflect the official school color and shaded by vertical perforated metal fins, the skybox is visually inviting and welcoming from all directions. The skybox is supported by an innovative steel truss system between the roof and second floor that preserves the open column-free environment within the courtyard. These 100-ft-long roof-to-floor trusses, with six bays of diagonal steel webs, span over steel columns near each end of the skybox, thus providing unobstructed ground-floor space for student gathering and pedestrian circulation to the adjacent courtyard, health center and cafeteria.

The trusses also define the interior space of second floor. With steel beams spanning 50 ft between the trusses, the interior of the skybox is virtually column-free. With extensive use of glass, the truss system allows the floor space to maximize natural daylight, a key part of the sustainable energy performance strategy of the building. Tapered steel floor beams are cantilevered from the trusses to create a floating effect for the skybox. These beams also support the outdoor second-floor patio and walkway where students gather, collaborate and socialize.

Located in one of the most seismically active regions of the country, the building incorporates strategically placed special concentric steel braced frames and limited special concrete shear walls to resist seismic loads. Like the truss diagonal members, these braced frames and shear walls are integrated seamlessly into the architectural design.

The building's site, climate and program provide the input parameters that the design team used to create the building's final form. In the case of Valley College Monarch Center the ideal form is irregular, with nontraditional building elements and configurations such as sloping/tapering roof forms and "levitating" long-span building wings. Close collaboration between the design-build team of LPA and McCarthy during the preconstruction phase resulted in an efficient erection process. Long-span trusses were shop-fabricated to minimize field welding. Where field-welding was unavoidable, such as for the multiple intersecting cantilevered beams that form the solar umbrella canopy, connections were detailed to allow for as much shop assembly as possible and for the welding to be performed in the flat (as opposed to overhead) welding position.

The versatility and adaptability of structural steel allowed the design team to create a resilient and sustainable building that has become a focal point of campus life and a resource for students, staff and visitors to the Los Angeles Valley College community. The open floor plan blurs the boundaries between indoors and outdoors, offers access to a variety of spaces for students to gather, study, socialize or simply "see and be seen," transforming this commuter campus into a social and academic hub for the student body. ■

Owner
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Architect and Structural Engineer
LPA, Inc.