ENTRY FORM

DVASE
2022 Excellence in Structural Engineering Awards Program

PROJECT CATEGORY (check one):

Buildings under $5M		Buildings Over $100M	X
Buildings $5M-$15M		Other Structures Under $1M	
Buildings $15M - $40M		Other Structures Over $1M	
Buildings $40M - $100M		Single Family Home	

Approximate construction cost of facility submitted:	$220 MILLION
Name of Project:	The Laurel Rittenhouse Square
Location of Project:	1911 Walnut St, Philadelphia, PA 19103
Date construction was completed (M/Y):	August 2022
Structural Design Firm:	The Harman Group
Affiliation:	**All entries must be submitted by DVASE member firms or members.**
Architects:	Solomon Cordwell Buenz
General Contractor:	Hunter Roberts Construction Group

Company Logo (insert .jpg in box below)

Important Notes:

Please .pdf your completed entry form and email to bsagusti@barrhorstman.com.

Please also email separately 2-3 of the best .jpg images of your project, for the slide presentation at the May dinner and for the DVASE website. Include a brief (approx. 4 sentences) summary of the project for the DVASE Awards Presentation with this separate email.

Provide a concise project description in the following box (one page maximum). Include the significant aspects of the project and their relationship to the judging criteria.

The Laurel Rittenhouse Square is a 50-story, 583,000 square foot residential tower currently under construction in Philadelphia. The project features an ultra-luxury mixed-use tower consisting of 65 condominiums and 184 apartments on top of a three-story podium with 44,000 square feet of retail and dining spaces. Once complete, The Laurel will rise 604 feet, making it the tallest residential building in Center City. The 50-story tower is constructed of a cast-in-place concrete flat plate system with concrete shear walls. A portion of the podium outside the tower's footprint is a steel-framed structure. Two concrete below-grade levels accommodate mechanical equipment space and parking.

Foundations | With assistance from the CM, a concrete mat foundation was chosen as the most cost-effective solution. The mat thickness varies from 15 feet under the building core to seven feet outside of the core and extends throughout the footprint of the main tower. This allows the engagement of all tower columns and the requisite dead loads to resist the overturning forces on the foundation. It further spreads the tower loads out over the entire footprint. A 6,000 psi concrete was chosen, using a 70% slag cementitious substitute mix to slow the heat of hydration and, therefore, heat gain in the concrete.

Tight Urban Site | Because the site is surrounded by existing buildings and public streets and the project occupies nearly all the site, construction methodologies needed to be considered in the structural design from street level down. The entire structure below grade was concrete construction. Foundation walls were designed to be constructed using a one-sided form system. The exterior side of the wall would be placed against the blind side waterproofing applied to the support of excavation (SOE) structure. This required accommodation of more liberal tolerances consistent with SOE systems, including accommodating variations in the thickness of the wall and coordinating the interior spaces to accommodate that variation. The foundation wall inside face was located such that any variation in the SOE system would be accommodated on the outside face of the foundation wall while maintaining minimum wall design thickness. The mat foundation was placed directly against the SOE on all four sides. This also required that reinforcing steel accommodate the potential variations in SOE location.

Tower Occupant Comfort and the Lateral System | RWDI performed preliminary wind analysis and the final wind tunnel testing to assess the best system to address wind-induced motion in this tall tower. The results were used to develop structural loads, and an iterative process was applied to optimize the structure, balancing wind-induced accelerations against structural size and cost. The team turned to "tuning" the lateral structural system to meet a one-year return period (8 milli-g) and 10-year return period (15 to 18 milli-g) residential building motion limits while optimizing the structure. Ultimately, an outrigger system was introduced at the 25th floor, engaging exterior columns to improve the behavior of the building and to help avoid supplemental damping.

The main lateral load-resisting system is a central shear wall core. The design team used steel link beams embedded in the concrete link beams to resist high shear and moment loads imposed on those beams in some shear walls. This involves considering the transfer of forces from one wall, across the opening through the beam, and back to the wall on the other side of the opening. While the governing loads for these link beams are wind-induced, the AISC *Seismic Design Manual* section on composite coupling beams and other research was useful in guiding the design of these beams.

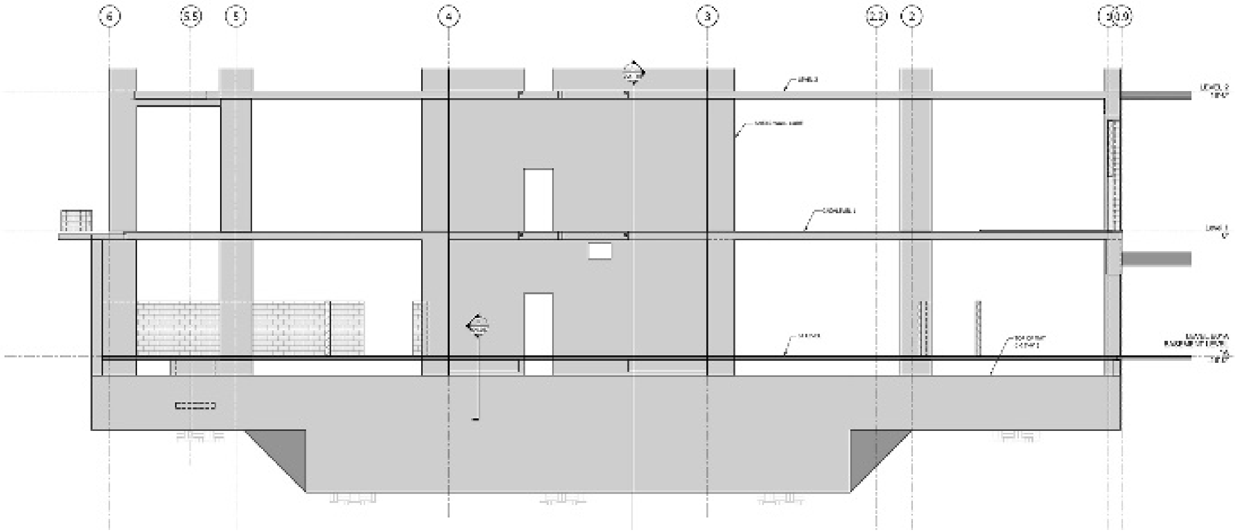
Walking Columns | For this project, there were conflicting desires. The local community desired a limit to the height of the building. The developer wanted to maximize the FAR (floor to site area ratio) to that permitted by Code, yet a portion of the site was occupied by a three-story historic building that would be preserved. To capture additional floor area, the floors above the height of the historic structures were expanded to the west, requiring the edge columns to be located outboard of the locations below. Walking columns were utilized in four successive floors to achieve the transferred column location in the more than 40 floors above.

There are considerable horizontal loads at the top of the uppermost and bottom of the lowermost columns. These horizontal forces needed to be resolved in the design of the floor diaphragms and drag struts to provide a load path to the concrete core. In tension strut locations, mechanically terminated tension drag struts were designed to drag these forces into the core. In areas outboard of the core, similar drag struts were designed, and then supplemental diaphragm reinforcing transferred the forces into the core.

Concrete Strength | High-strength concrete was required to accommodate the design of this structure. Based on experience, available data in the local supplier market, and extensive laboratory testing, these strengths were pre-validated early in the design process. Laboratory testing submissions were specified to demonstrate not only strength but a prescribed modulus of elasticity for concrete to be used in columns and shear walls. Shear wall and column concrete ranged from 14,000 psi at lower levels in the building to 8,000 psi at upper levels. Floor slabs required 8,000 psi at the lower floors to meet ACI 318 requirements for load transmission through floors and avoid placing higher strength concrete at the column/slab interface (*puddling*). Puddling requires placing high-strength column concrete within a two-foot zone beyond the column/slab interface. This can be difficult to control during concrete slab placement. Floor slabs required 6,000 psi concrete at upper floors where column concrete strengths were lower. A 56-day strength testing procedure was specified to accommodate the slow rate of hydration.

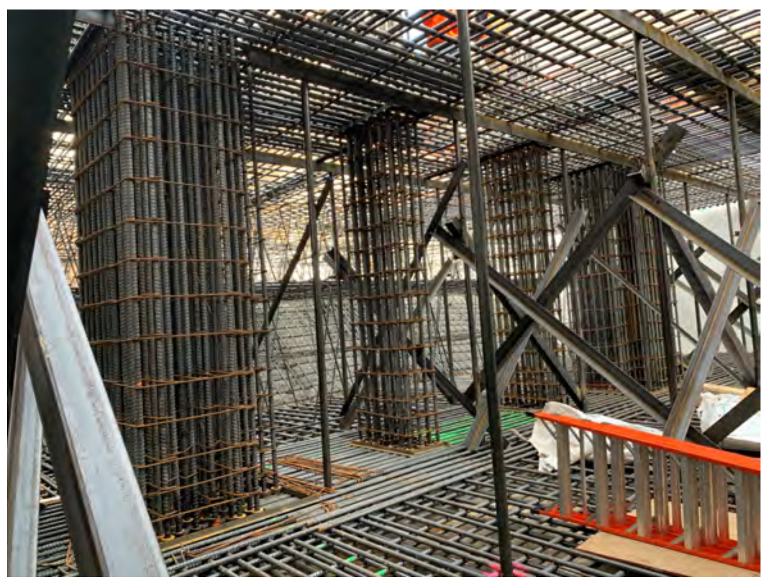
The following 5 pages (maximum) can be used to portray your project to the awards committee through photos, renderings, sketches, plans, etc...

Rendering courtesy of Solomon Cordwell Buenz

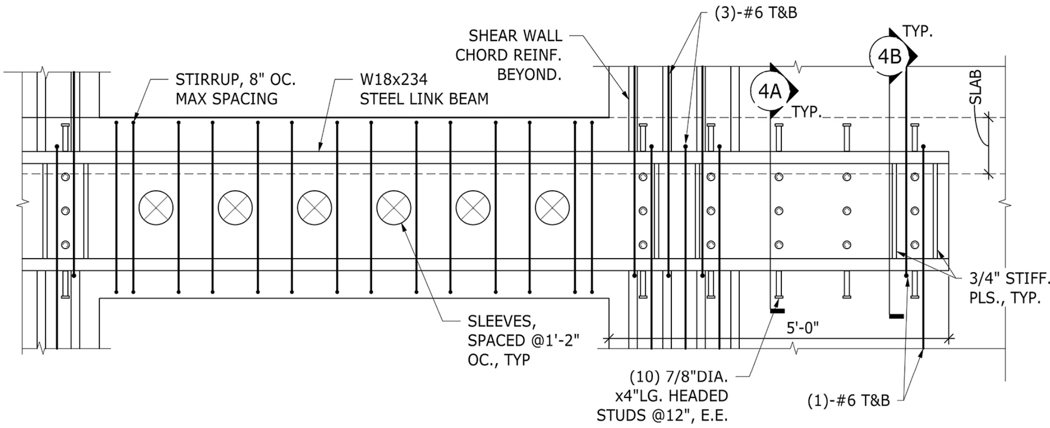


Mat Foundation 7-15 feet thick

Mat Foundation Reinforcing Steel



Interior of the Mat



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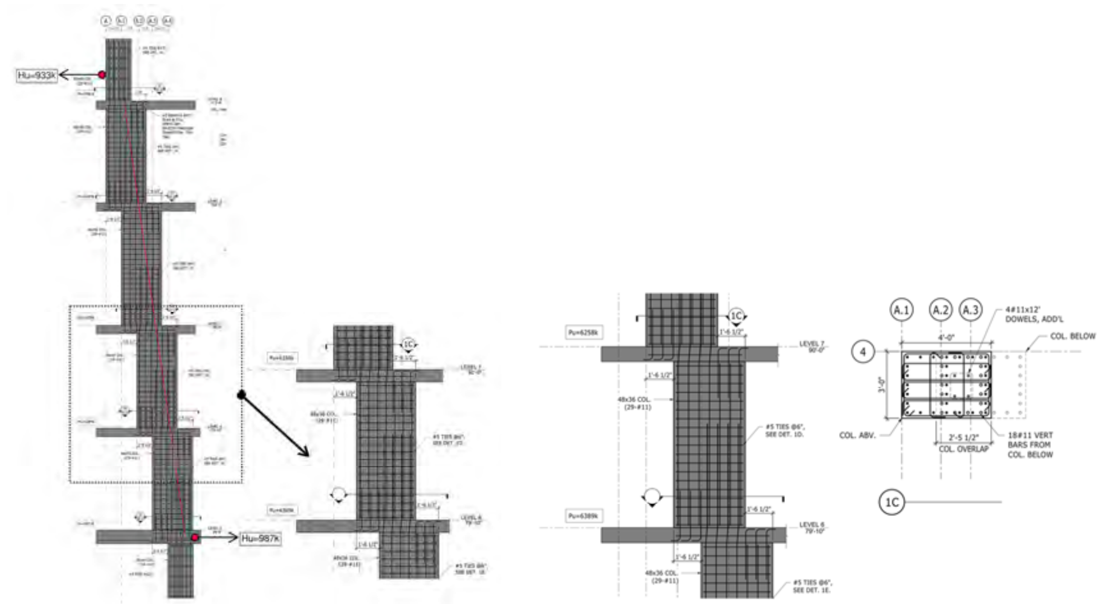
Steel link beam



Walking columns above the historic structures


NEXT YEAR
LAUREL

By signing, signatory agrees to the following and represents that he or she is authorized to sign for the structural design firm of record:

All entries become the property of DVASE and will not be returned. By entering, the entrant grants a royalty-free license is granted to DVASE to use any copyrighted material submitted.

If selected as an award winner, you may be offered the opportunity to present your project at a DVASE breakfast seminar. Would you be willing to present to your colleagues? ☑ ***YES*** ***NO***

Submitted by:

<table>
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4/8/2022</td></tr>
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