*ENTRY FORM*

# DVASE
# 2017 Excellence in Structural Engineering Awards Program

**PROJECT CATEGORY (check one):**

| | | | |
|---|---|---|---|
| Buildings under $2M | | Buildings Over $100M | |
| Buildings $2M-$10M | | Other Structures Under $5M | |
| Buildings $10M - $30M | X | Other Structures Over $5M | |
| Buildings $30M - $100M | | Single Family Home | |

| | |
|---|---|
| Approximate construction cost of facility submitted: | $17 Million |
| Name of Project: | Pennovation Center |
| Location of Project: | Philadelphia PA |
| Date construction was completed (M/Y): | October 2016 |
| Structural Design Firm: | Ballinger |
| Affiliation: | **All entries must be submitted by DVASE member firms or members.** |
| Architect: | HWKN (Design), KSS Architects (Architect of Record) |
| General Contractor: | Hunter Roberts Construction Group |

Company Logo (insert .jpg in box below)

B A L L I N G E R

**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 62,000 square foot Pennovation Center is the newly renovated flagship building on the University of Pennsylvania's South Bank Campus, located at 35th Street and Gray's Ferry Avenue in West Philadelphia. With the vision of creating affordable, laboratory incubator space for recent Penn graduates and other promising start-ups in the technology industry, the University charged the design team with creating an iconic, brand-worthy anchor building to attract talent across the river to the rebranded "Pennovation Works" campus. Specifically, our charge was to renovate and add onto existing "Building 176", which formerly housed a Dupont paint testing facility. A tenant had already been obtained for the third floor, but limited funds were available for construction, given the risk associated with the creation of a new campus. An early structural steel and foundation package had to be issued 2.5 months after the building was handed over to the construction manager for interior demolition, and the design team had $17 million dollars to work with. No existing drawings of the structure were available, aside from the foundation plan and first floor framing plan.

Structured in the classic Philadelphia factory style, the original c. 1953 building frame consists of a steel-framed structure with 11'x22' column grids, with a combination of one-way concrete, steel plate, and precast plank floor systems. The perimeter steel columns and beams are encased in concrete. Although the gravity load system of the existing frame is robust (with some portions of the first floor designed for 600 psf live load), no apparent lateral system existed beyond the beam to column shear connections.

Architecturally, to provide the iconic design desired by the University, the concept of a dynamic explosion of thought and innovation was conceived by Matthias Hollwich, Principal of HWKN Architects. HWKN's design intent called for the *"transformation of an existing industrial building into a focal point, with a faceted northern facade that bursts from the existing building. Reaching toward the University's main campus to the north, the illuminated facade is both a beacon for the Center and the interface where invention meets business."*

Architecturally, this vision manifested itself into a random, geometrically complex glass-enclosed north addition, housing a "pitch" bleacher, conference rooms, view bar, and offices. Structurally, this translates into a highly complex framing system, with the requirement that the same thickness of existing horizontal banding created by the perimeter concrete-encased steel floor beams be carried northward into the "bursting" north addition. *No beams deeper than 10" depth were permitted to structure the entire north addition,* which was to appear to cantilever 32' at its longest point.

Rather than rely on heavy, deep cantilevered members to frame the north addition, we developed the framing concept to be a series of diagonal compression props/columns with corresponding tension ties at the floor levels (or vice versa), in order to minimize the new structure's weight and depth. Twenty-eight distinct connection nodes exist: 7 column bays wide x 4 floor levels high. Each of the seven new column line elevations were analyzed separately to determine the magnitude of compression or tension in each floor member or prop. Then, the existing structural frame was modeled with the new tension or compression point loads imposed at each of the 28 connection nodes where the addition meets the existing structure. Depending on the location, magnitude, and direction of new load, new wide flange horizontal in-plane bracing was inserted where the new structure connected to the existing columns, in order to push or drag the new point loads into the existing floor planes (the existing diaphragms were not capable of supporting these loads). The horizontal in-plane bracing is in turn laced back to three new diagonally vertically braced frames inserted full height into the existing building. One of these three new braced frames is exposed architecturally within the new co-working areas as part of the raw, industrial interior aesthetic, while the other two are hidden within solid walls.

At the base of the three braced frames, the tension forces imposed by the new addition accumulate into several hundred kips of net vertical uplift. Therefore, the bases of the braced frames are encased in 22'-long x 30" thick x full basement story height ballast walls, with uplift column base anchor rods.

The structural drawings for this north addition were produced in 2.5 months, with the design phase beginning on the date that the contractor was allowed access to the building to begin interior demolition, and finishing with the issue of contract documents 10 weeks later to meet the contractor's lead time schedule for steel. Needless to say, this effort required numerous survey trips to the building to verify existing structural members during the ongoing phases of demolition. Significant demolition of the existing concrete encasement was required, at the locations on the existing north elevation where the new addition would connect. Finding only W12x26 existing steel column shapes within the concrete encasements, custom gusset plate connection plan details and sections were provided at each of the 28 connection points, to allow the compression or tension force to bypass the existing steel column and be transferred directly into the new network of in-plane horizontal braces.

Revit modeling of this structure was indispensable, especially in describing the complex geometry of the connection details to the steel fabricator. In turn, the steel fabricator provided a Total Station survey of each of the 28 existing connection points on the north elevation prior to fabrication, to confirm that field misalignments would not occur. Not a single misalignment was reported, or field retrofit required, during steel erection.

<u>Additional challenges on this project include:</u>

1) The installation of horizontal in-plane bracing in the ceiling of an existing, functioning data center: No downtime was permitted for this room. Therefore, bolted, spliced members were erected from the floor above, above a temporary ceiling in place to protect the existing conduit and data cables in this room. Bolted splices were used to eliminate welding and the risk of setting off the sprinkler system in this room.

2) The framing of the pitch bleacher, which is the central focal point on the second floor of the new addition: This feature was created as a space for technology entrepreneurs to present their "pitch" to potential investors. The concrete-framed stairs added another level of complexity, having to frame to an already complex substructure forming the major "point" of the north addition.

3) The existing rooftop dunnage was salvaged, reused, retrofit, and added onto to support the large new Pennovation sign, which is highly visible from the Schuylkill Expressway at Grays Ferry.

4) The central bleacher, which is used often for presentations and gatherings on the first floor of the center: In order to create this dramatic feature, the existing second floor was removed at the new opening, with new girders inserted to resupport existing beams that were partially cut back to frame out the opening.

5) Brick support detailing: The support of the full brick masonry on the north addition had to be carefully detailed, in coordination with the mason. Inverted triangles of brick were implemented, starting at a single point and widening at the top. Steel support angles are carefully hidden within the frame, and were left adjustable in the field for proper alignment.

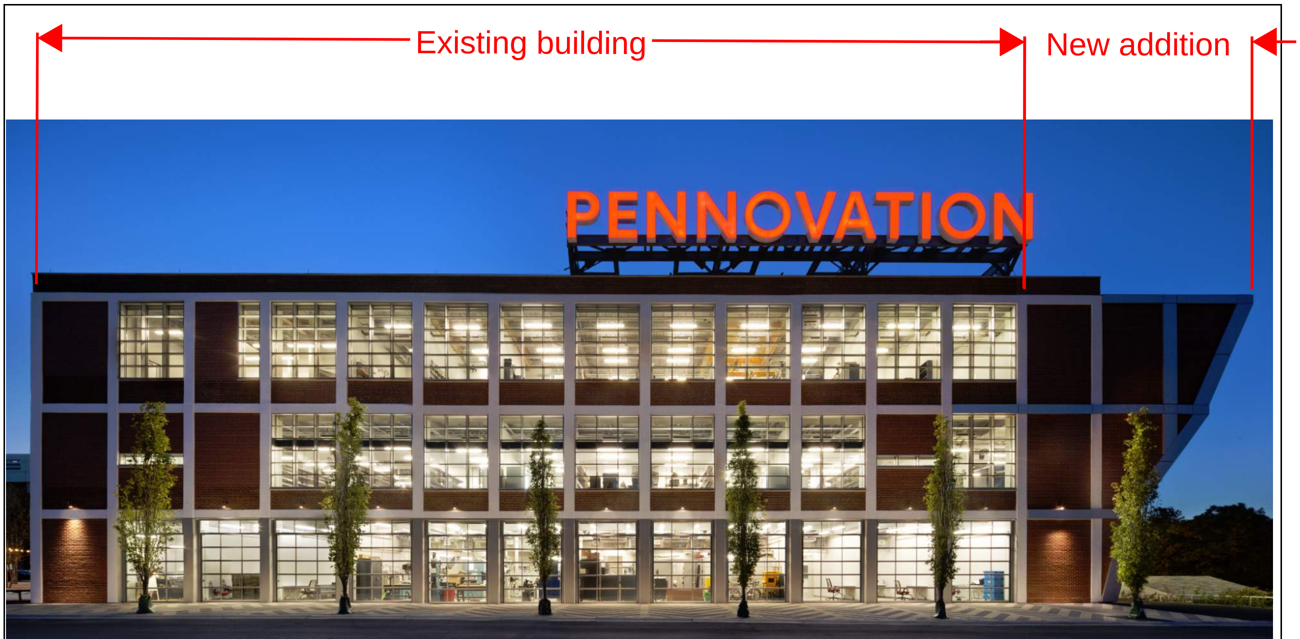
As a testament to the success of this project, all laboratory spaces are fully leased, and Penn is proceeding with studies for developing the remainder of this campus. In addition, the Center is fully booked as an event space through spring of next year.

"*The Pennovation Center design creates a truly iconic landmark for Penn and will be a dynamic hub for Penn's culture of innovation and interdisciplinary collaboration,*" *said Penn President Amy Gutmann.* "*The Center is designed to bring together the University's eminent researchers, scientists and students, along with the private sector, to foster creative exploration, entrepreneurship, new alliances, and generate economic development for the region.*"

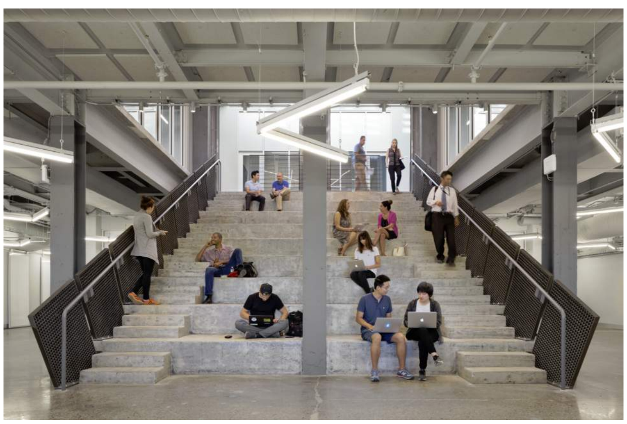
- The following 5 pages (maximum) can be used to portray your project to the awards committee through photos, renderings, sketches, plans, etc…


After: Exterior Perspective - New North Addition and West Elevation

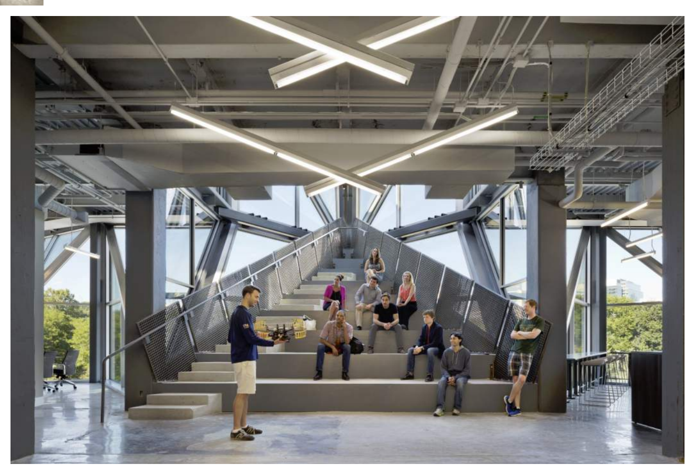
Before: Exterior Perspective - Prior to Renovation




Completed West Elevation



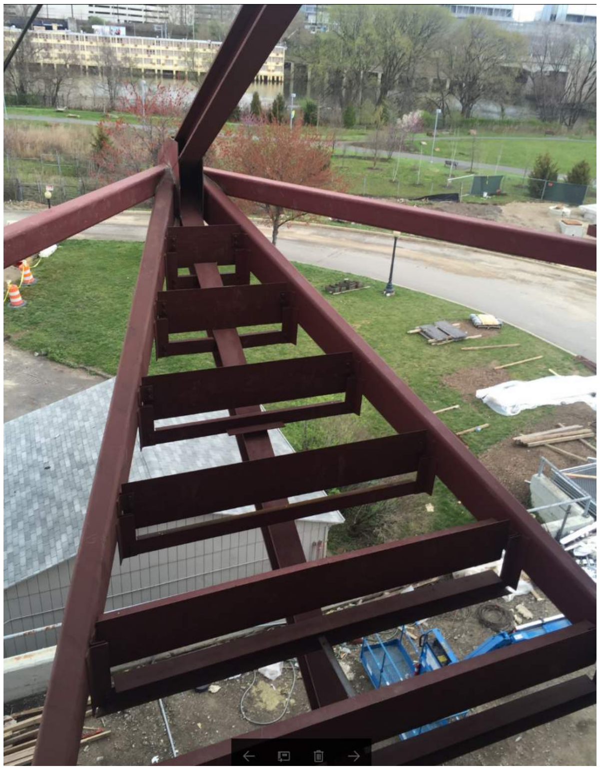
New Central Bleacher



New Pitch Bleacher within North Addition


Construction of the North Addition

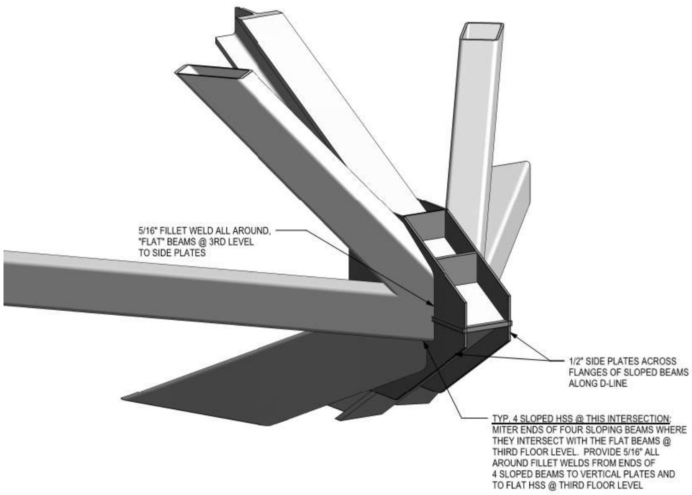
Curtainwall and Brick Installation on New North Addition



Pitch Bleacher Under Construction

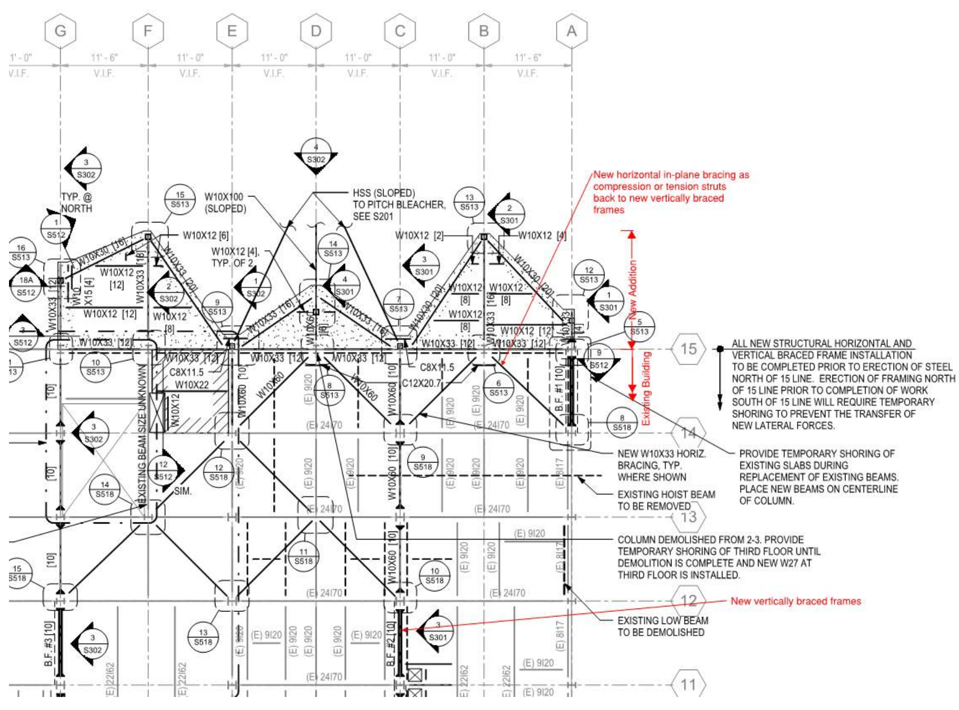
One of the Twenty-Eight Custom Connections at the North Elevation to Existing Building Interface

<u>3D Perspective Pitch Bleacher Connection Detail</u>




5 D-NORTH PITCH BLEACHER CONNECTION 3D VIEW

<u>Partial Second Floor Framing Plan</u>



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 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:

| **Print name:** | **Signature:** | **Date:** |
|---|---|---|
| Angela Fante, PE, SECB | Angela Fante | 4.13.17 |

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|---|---|---|
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