**STRUCTURAL ENGINEERING INSTITUTE**

**Mohawk-Hudson Chapter**



# 2020 STRUCTURAL ENGINEERING AWARDS ENTRY FORM

**PROJECT CATEGORY** (check one)

X Building Structures

_______ Bridge Structures

_______ Other Structures

_______ Studies/Investigations

**PROJECT INFORMATION**

Project Name: SCIENCE & ENGINEERING COMPLEX

Project Location: UNION COLLEGE, SCHENECTADY NY

Approximate Construction Cost of Project: $75 000 000

Owner: UNION COLLEGE

Architect (if applicable): EYP ARCHITECTURE & ENGINEERING

Engineer/Design Firm: EYP ARCHITECTURE & ENGINEERING

CONSTRUCTION MANAGER: ~~General Contractor~~: TURNER CONSTRUCTION CO.

Construction Completion Date: AUGUST 2020 ±

**APPLICANT'S SIGNATURE**

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 entry materials become the property of the SEI Mohawk-Hudson Chapter (hereby known as the Chapter) and will not be returned. If the entry submitted is one of the winning entries, the Chapter is hereby granted the right to use or publish entries and accompanying material in any of the Chapter's publications, on the Chapter's ASCE Mohawk-Hudson Section website, or in other news/social media/websites; and in addition, a royalty-free license is granted to the Chapter to use any copyrighted material submitted.*

Submitted by: MARK KANONIK [signature] 24 JUNE 2020

(Print Name) (Signature) (Date)

72076 NY

(License Number) (State of License)

Submitting Firm: EYP ARCHITECTURE & ENGINEERING

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**OWNER'S ENDORSEMENT (recommended, but not required)**

By signing, signatory represents that he or she is authorized to sign for the project owner's firm (hereby known as the Owner), and that the Owner has given consent to the Applicant for the submission of the project.

Endorsed by: ____________________

(Print Name) (Signature) (Date)

Owner's Firm: ____________________

Mailing Address: ____________________

Telephone: ( ) __________ Email: __________

**Structural Engineering Institute, Mohawk-Hudson Chapter**

**2020 Structural Engineering Awards Submission (Building Structures)**

**New Science and Engineering Building @ Union College, Schenectady NY**
**submitted by Mark Kanonik, PE**

In the late 1950s, Union College constructed the Science and Engineering Building, a 125,000-sq.-ft comprised of five interconnected "academic towers" housing multiple science and engineering disciplines. But as science and engineering curricula and equipment evolved over the decades, both faculty and students began to realize that the building was becoming outdated to the point of hindering academic progress.

*Existing Building:*

The existing building is a four-story steel-framed building, including a mechanical attic, atop a concrete podium basement. Towers 1, 2, and 3 of the existing building, totaling about 74,000 sq. ft, are being completely renovated, and Towers 4 and 5, comprising roughly 50,000 sq. ft, will be demolished in 2020 and turned into green space. As with any renovation project, the existing building presented many challenges, including an unusual column grid, unacceptable vibrational characteristics of the floor framing, and incomplete drawings.

For the most part, the existing building has no interior columns. Instead, the floors are framed with W33 beams that span from exterior wall to exterior wall on a column grid measuring 12 ft x 58 ft, 4 in. in plan. The floor framing is suitable for classrooms and offices when analyzed in accordance with AISC Design Guide 11: *Floor Vibrations Due to Human Activity*, but the floors were not suitable for sensitive equipment used by faculty and students today. It was even reported that some faculty elected to perform some of their research on weekends when few students were present.

The floor-to-floor height of the existing building ranged from 12 ft to 14 ft, and the headroom from floor to structure above was only about 9 ft to 11 ft. In addition, the W33 beams were also encased in concrete for fire protection. Combined with the low ceiling height, this meant that reinforcing the beams to increase their stiffness would be effectively impossible. The only feasible method to improve the vibrational characteristics would be to reduce the span of the W33 beams, so HSS4-1/2x4-1/2 "vibration posts" were added inside the partition walls - reducing the spans of the W33 beams by about half. The posts generally do not align floor-to-floor due to building use constraints, and some transfer beams were necessary where the vibration posts did not align with the W33 beams. The posts are carried down to the basement and founded on spread footings. Through careful coordination with the architectural floorplans and judicious placement of the vibration posts, the vibrational velocity of the floor framing was improved to approximately 8,000 micro-inches per second based on a moderate walking pace, a dramatic improvement without any limitations to the use of the spaces. Some areas of the building that were programmed for offices or other "non-sensitive" areas (such as utility rooms) were not stiffened since the floor framing was adequate for these uses. Because the vibration posts are not required to carry gravity loads but rather were installed purely for serviceability reasons, it was not necessary to fireproof them.

The existing building had no explicit lateral force-resisting system (LFRS). The exterior walls and most of the interior partition walls are unreinforced masonry and acted as lateral load-resisting elements, even if they were not explicitly detailed as such. In order to repurpose the building, all masonry walls had been completely removed, leaving the building theoretically unstable. Eight braced frames were added throughout the building to recreate the LFRS. Schenectady, N.Y. is in an area of relatively low seismicity, so the braces were design as R=3 without any specific seismic detailing. The foundations were adequate for the new LFRS, but some of the columns were reinforced to resist wind and seismic loads.

*Bailey Connector:*

Connected to the existing building on the east side is Bailey Hall, a 1920s-era building without a basement. Bailey Hall was built with no elevator and only one stair, so the Science and Engineering Building provided both the elevator and a second stair to Bailey Hall. As neither the stair nor the elevator are compliant with the *New York State Building Code*, significant reconfiguration of the Bailey Connector between the two buildings was necessary. It was ultimately decided that building a new connector would be easier and quicker (and therefore less costly) than reconfiguring the existing one. Prior to the original construction of the Science and Engineering Building's basement, a deep foundation system was installed under Bailey Hall. While some documentation of this system was available, no "as-built drawings" were found. As there was no evidence of adverse settlements in either building, the design team decided to reuse the existing foundations and basement walls up to the underside of the first floor, with new steel framing employed above, which eliminated the need for excavation bracing adjacent to Bailey Hall. The architects had to carefully coordinate the floorplans with existing structural elements, but the decision ultimately saved considerable construction time and money.

*S&E Expansion:*

The Science and Engineering Building was also expanded to the north via an "academic main street"—an open balcony fronting a five-story atrium space, itself a dramatic space that invites students and faculty to stop and socialize. The balcony is supported by W33 beams that cantilever from the existing columns to create a column-free space; W33 beams were chosen to match the existing floor framing to simplify the moment connections at the existing columns. The beams are tapered down to 6-in. at their ends to reduce the profile of the floor structure and to provide an interstitial space for utilities. The roof of the atrium is a significant structural element using architecturally exposed structural steel (AESS) and is complemented by a monumental stair comprised of AESS. The building is also currently being expanded to the south, with an addition of about 7,900 sq. ft of new office space over three floors, and the framing for this portion, which houses offices without any stringent vibrational criteria, was also designed in accordance with AISC Design Guide 11. This south addition will be connected directly to the Science and Engineering Building without any isolation joints.

*Ainlay Hall:*

The overall project also includes Ainlay Hall, a new building located north of but isolated from the Science and Engineering Building which was completed last year. This horizontally curved, steel-framed building rises four stories (including a full mechanical penthouse) atop a concrete podium basement. The new building houses laboratory spaces, faculty offices, student gathering spaces and a mechanical penthouse, and is connected to the Science and Engineering Building via a five-story atrium. Structural steel was chosen for the framing system given the complex geometry and large open spaces necessary for the laboratories, although a concrete podium at Level 1 was chosen simply to match the framing of the Science and Engineering Building. The framing in the western half of Ainlay Hall is relatively orthogonal in configuration, and the framing in the eastern half is mostly radial and tangential in configuration. The columns on the north and south façades are closely spaced, eliminating the need for horizontally curved edge beams.

The architectural plan of Ainlay Hall presented conflicting challenges; the new building was designed to vertically match the Science and Engineering Building but was also designed to current laboratory standards. The sheer volume of air circulated in today's laboratories is significantly larger than when the Science and Engineering Building was originally designed and constructed, but the relatively low floor-to-floor height of the original building did not easily accommodate the larger ductwork required by today's lab spaces. In addition, the majority of the new lab space required column-free spaces, which can exacerbate vibrational issues if not properly addressed. As a result, routing the ductwork became a very difficult task. Shallow beams would simplify routing the ductwork, but deeper beams would improve the floor's vibrational characteristics. A compromise was found with an atypical floor framing scheme: shallow filler beams were placed in the short direction, and deep girders were placed in the long direction. The ductwork was successfully routed to all spaces without beam penetrations - main supply ducts were placed on one side of the girders and main return ducts were placed on the other side of the girders, with only small ducts crossing under the girders. As a result, the floors have acceptable vibrational characteristics, the rooms have ample vertical space and air is circulated throughout the spaces with minimal effort. An unintentional but surprising benefit of this atypical floor framing scheme was that it resulted a slightly lower total tonnage of steel when compared with a traditional scheme (that is, filler beams in the long direction and girders in the short direction). The vast majority of Ainlay Hall was designed for a vibrational velocity of 2,000 micro-inches per second based on a medium walking pace in accordance with AISC DG 11, although the vibrational criteria was relaxed in "non-sensitive" area such as offices, gathering spaces and the mechanical penthouse.

*North Connector:*

The North Connector is a three-story addition connecting Ainlay Hall with two other buildings, Steinmetz and Butterfield Halls. Currently under construction, the steel-framed building provides an elevator and an egress stair, gathering spaces for students and utility rooms, and is joined to Ainlay Hall via a two-story steel-framed bridge with glass cladding. The bridge was constructed early to provide temporary egress from Ainlay Hall, but the remainder of the North Connector will not be completed until later this year, after an existing stair and elevator tower are removed. The North Connector and its bridge are isolated from the three adjacent buildings to which they adjoin, and all lateral loads are resisted by rigid frames designed as R=3.

**Owner**: Union College, Schenectady, N.Y.

**Structural Engineer of Record**: Mark Kanonik; EYP Architecture & Engineering, Albany

**Architect of Record**: David Clemenzi; EYP Architecture and Engineering, Albany

**Construction Manager**: Turner Construction Co, Albany N.Y.

**Photographs**:

Photo 1 – architectural rendering of Science and Engineering Building and adjacent buildings

Photo 2 – eastern façade of Ainlay Hall

Photo 3 – structural steel framing @ eastern end of Ainlay Hall

Photo 4 – atrium space, with Ainlay Hall to the left and Science & Engineering Building to the right

Photo 5 – monumental stair in atrium


AINLAY HALL


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