

Building Statistics

Joseph S. Murray

Structural Option



General Building Statistics:

Building Name:	Science, Technology, Environment, Policy, Society (S.T.E.P.S.) Building
Location:	Bethlehem, Pennsylvania
Building Occupant Name:	Lehigh University
Type of Building:	Education and Research
Size:	135,000 ft. ²
Total Levels:	5 stories with a rooftop penthouse for mechanical systems
Dates of Construction:	Began August 2008 Finished August 2010
Overall Project Cost:	\$ 62 million
Project Delivery:	Design-Bid-Build

Primary Project Team:

Owner:	Lehigh University Bethlehem, PA www.lehigh.edu
Construction Management:	Alvin H. Butz Allentown, PA www.butz.com
Architect:	Bohlin Cywinski Jackson Philadelphia, PA www.bcj.com
Civil:	Barry Isett & Associates Trexlerstown, PA www.barryisett.com
MEP, Fire:	Flack & Kurtz New York, NY www.wspgroup.com/en/Welcome-to-WSP-Flack--Kurtz
Landscape Architect:	Lager Raabe Skafte Philadelphia, PA www.lrsla.com
Laboratory Systems:	Health, Education, and Research Associates, Inc. Philadelphia, PA www.herainc.com

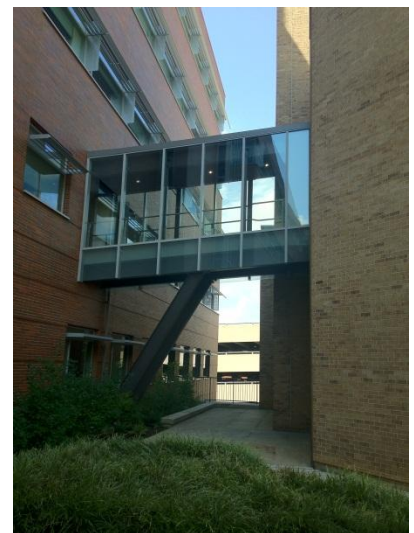
Architecture:



Function:

The S.T.E.P.S. Building at Lehigh University's Asa Park Campus is a multilevel education and research building. Part of the design of the building is to encourage collaborative efforts between researchers and colleagues through proximity of workspaces and research laboratories. Social Sciences, Engineering, and Chemistry are three of the departments benefiting from this building.

Through this effort, there is a mixture of classroom spaces, research space, laboratories, and faculty offices. The faculty is on one side of the building and the laboratories are on the other, but the spaces are still extremely close and mixed. One example of how they intend to link spaces and accomplish interaction is pictured to the right. It is a raised pathway connecting an upper floor of the S.T.E.P.S. Building with an existing education building.



Art is emphasized strongly throughout the building using fritted glass in the shapes of trees, ornamental fountains, and custom tiling. Other creative efforts were made to encourage a healthy learning environment. Beautiful stained hardwood is used throughout Wing A, and cantilevered study spaces provide a scenic view of the street with significant amounts of daylight.

Floor Plan:



Image courtesy BCJ Architects

Model Codes

2006 Pennsylvania Uniform Construction Code (PUCC)

2006 International Building Code (IBC)

2006 International Fire Code

2006 International Fuel Gas Code

2006 International Mechanical Code

ASCE 7-05, Minimum Design Loads for Buildings and Other Structures

AISC Steel Construction Manual, 13th Edition

ACI 318-05, Building Code Requirements for Structural Concrete

ACI 530-05, Building Code Requirements for Masonry Structures

Zoning: City of Bethlehem Institutional Overlay District (I-O)

Historical Requirements: Not Applicable

Building Enclosure & Façade:

Overall:

The building is comprised of three main components. One is a low-rise entry structure which will be called "Wing A". This is connected to a 4 story structure which will be called "Wing B." Lastly, Wing B is attached to a 5 story structure which will be called "Wing C." Artwork can be found all throughout the project. Examples can be seen in custom fritted glass in the shapes of trees and nature. A small courtyard on the side of Wing A incorporates a waterfall with a sculpture as well as artwork on the tiling in the center of the lobby.

Wing A:

The low rise section of the S.T.E.P.S. Building is diverse in material use. It has wood finishes on portions of it with a high-efficiency glazing. There is an overhang over the entryway to the building which shades the glass glazing and doors on the Southern side. There is a clear story to allow natural light to get in. The wood for the roof is hardwood and stained in varying shades for a natural feel. The building is mostly masonry construction over spray foam insulation, which is tied back into the steel structural system.

Wing B & C:

Wings B & C, shown in the image to the right, have similar enclosures and only differ in one story. They are also masonry construction but do not have green roofs. There is an individual mechanical penthouse for each wing. Much of this has to do with exhausting laboratories through fume hoods. There is a large mechanical exhaust fan which exhausts in cases of emergency. There is a glazed atrium connecting the two wings that is mostly glass.



Sustainability:

The building is certified as LEED Gold by the United States Building Council. Part of this was achieved with a green roof on the roof of Wing A. It is a 12" deep green roof.

Lehigh University strove to keep and maintain the grass area on the existing building site which students had used for leisure and sporting activity previous to construction of the S.T.E.P.S. Building. It is used for several types of recreation including Frisbee, touch football, and croquet. The building was designed around this field in order to keep it after construction.

Passive solar shading and fritted glass attempt to minimize cooling loads.

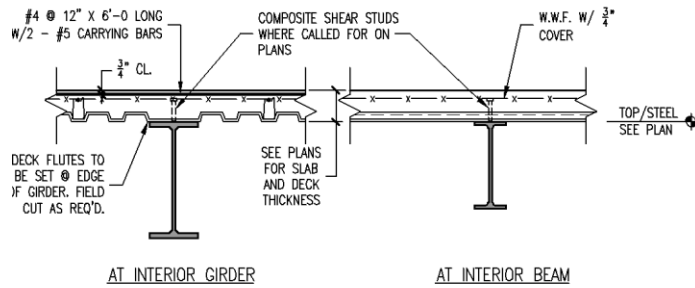
Structural:

Foundation:

The foundation is composed mainly of spread footings below the columns with some mat foundations present in the center of the building. The spread footings are square and range from 11'x11' to 16'x16', whereas the mat foundation is 18' wide and 54' long. Since there is a distance of one story between Wing B and Wing C, the footings vary in global depth with the hill that the building sits on. For the square footings, the depths range from 1'-6" to 2' below the slab on grade. The depth of the mat foundation was 3'-6" below the concrete slab. Columns terminate in baseplates which sit on concrete piers above the footings.

Framing:

The building consists of composite wide flange steel beams that frame into steel girders. The decking is a 3" deep 18 gauge steel deck with 4-1/2" normal weight concrete topping and welded wire fabric.



K COMPOSITE FLOOR DECK DETAILS
 NOTE: PROVIDE DIAGONAL #5 X 6'-0" LONG AT RE-ENTRANT CORNERS CENTER BAR ON CORNER

Typical beams are W24x55, and typical girders are W21x44. Wide flange columns are used throughout the system to resist the gravity loads. The most common column size is a W14 with a weight varying from a W14x90 to a W14x192 on the lower floors.

Lateral Force Resisting System:

The beams and girders frame into the columns using semi-rigid wind clips to resist lateral loads. These wind clips exist at the greater majority of the column connections in the building forming a large system of moment frames. There are no braced frames or concrete shear walls located in the building.

Mechanical System

S.T.E.P.S. is a laboratory building which required two extensive rooftop air handling penthouses on top of Wing B and Wing C. These are dedicated laboratory exhaust systems used with kilns and other controlled equipment. This helps to prevent contamination of the facility while still providing a technologically advanced educational and research facility. Individual thermal controls and high efficiency heat recovery wheels helped contribute to the LEED rating.

Lehigh University has two central heating and refrigeration plants which feed the building with steam and chilled water. These are distributed through underground tunnels to the S.T.E.P.S. and are used to fulfill the cooling and heating needs. Natural gas lines were also a necessity for the laboratories in the building.

One unique mechanical feature about the building is a large exhaust system located above the atrium connecting Wing B and Wing C. It is an emergency system designed to quickly evacuate all of the air in the building while supplying fresh air to avoid depressurization. The duct is made of a flexible, breathable mesh which allows the fan to exhaust air out of the entire atrium at the same time.

Lighting & Electrical System

One feature that also helped S.T.E.P.S. achieve LEED Gold certification is the automated photosensors that are in all of the rooms in the building. These sense occupancy and help reduce the electrical load. Daylighting is emphasized throughout the building with extensive curtain walls and clearstories. This has the dual benefits of creating a better learning environment through the use of natural light and reducing the electrical load from lighting.

Electricity at Lehigh University comes from a University-owned substation. This is then transferred to the buildings by a system of wires also owned and operated by Lehigh's Facilities Services. Wiring is run vertically up through the building to electrical rooms located on each floor. It is then run in one main line longitudinally down the building in the drop ceiling until it reaches the electrical panels located along the corridor and in the closets of some rooms.

Plumbing

Plumbing runs vertically through the building in the stair towers next to the standpipe for the sprinklers at each end. It is then distributed horizontally to the laboratories and bathrooms on each floor. Low flow and dual flush plumbing fixtures contributed to the sustainable design.

Fire Protection

Overhead sprinklers are located throughout the building complying with NFPA regulations. They are fed by two wet standpipes located in the stair towers on opposite ends of the building. The floor system was a 2-hour rated steel deck assembly topped with concrete. Automatic fire alarms and exit signage exist at required intervals throughout the corridors.

Transportation

There are three main stair towers in the building as well as two elevators, with one staircase located in each wing and one in the atrium. One elevator is located at the far end of Wing C, and the other is in the central atrium next to the stairs. There are two main entrances to the building. Pedestrians can enter the atrium from either the campus side or the street side, and Wing A provides the other entrance. An underground truck entrance provides an area for materials to be delivered safely and securely into the building. This is important considering some of the sensitive chemicals being used for laboratory and research purposes.

Sustainability

The building is LEED Gold certified. A large effort was made by Lehigh to ensure the building was modern and sustainable. High efficiency glazing was incorporated to save on energy costs while still allowing daylighting to be prevalent. A large lawn area was also kept and new sod was placed after construction to allow for students to socialize there.

Some LEED components:

- Custom air handlers with heat recovery wheels
- CO₂ monitoring sensors
- Radiant floor slabs in open areas
- Occupancy sensors
- No VOC (Volatile Organic Compound) finishes
- 8,000 square foot green roof on Wing A
- Diverted construction waste

Construction

Construction of the S.T.E.P.S. Building began in August 2008 and continued for two years until completion in August 2010. The project was performed by Alvin H. Butz, Inc. under a design-bid-build contract. Total project cost was \$62 million for the 135,000 square foot facility. The primary obstacle to construction was the heavy pedestrian traffic on this central corner of Lehigh's campus. All neighboring facilities also needed to remain open and operational throughout construction. Construction waste was also removed safely and recycled according to LEED requirements to prevent it from ending up in landfills.

<u>Construction Schedule:</u>	<u>START</u>	<u>END</u>
Mobilization, procurement, site prep	August 2008	
Excavation, foundations	September 2008	February 2009
Steel structure	January 2009	July 2009
Concrete decking	March 2009	July 2009
Exterior (brick, glass, roof)	April 2009	November 2009
Interiors (partitions, finishes, casework)	April 2009	April 2010
Mechanical, electrical, plumbing (MEP)	January 2009	April 2010
Commissioning	April 2010	

Completion

June 2010

Move-in (furnishings, equipment)

May 2010

August 2010