2.0 Existing Building Description

2.1 The Building Program

The Ann and Richard Barshinger Life Science and Philosophy Building is the largest construction project in the long history of Lancaster, Pennsylvania's Franklin and Marshall College. The three-story Georgian Revival structure will house the departments of biology, psychology, and philosophy, as well as two interdisciplinary programs in biological foundations of behavior and scientific and philosophical students of mind. At a total cost of $45 million, the 102,000 square-foot building will include state-of-the-art classrooms and laboratories, a greenhouse, a multi-story atrium, a 125-seat lecture hall, a Humanities Common Room for meetings and gatherings, and a basement vivarium for the study of primates, rodents, and other small animals.

2.2 Superstructure

The building superstructure is comprised of composite slab-on-deck in combination with composite wide-flange steel beams supported by wide-flange columns bearing on concrete piers and shallow footings. The framing system is divided into approximately 20'x30' bays. Floor-to-floor heights are typically found to be 14-feet. A typical floor frame consists of 2-inch composite metal deck with 4 ½-inches of normal weight concrete above the flutes. The composite slab is then carried by W16x26 filler beams spaced 7-feet apart. Interior girders, of size W18x40, are typically carried by W12x65 columns, sized for ease of fabrication and erection considering the OSHA-required four anchor bolt pier connection.

2.3 Lateral Force Resisting Systems

The structure's main lateral force resisting system is composed of ten concentrically braced steel frames of varying sizes. These frames utilize wide-flange shapes for the vertical and horizontal members with ½-inch thick HSS shapes for the diagonal braces. The ten frames are located throughout the structure according to the Figure 2.3.1 below. The basic structure of each frame is depicted in Figure 2.3.2 on the next page.

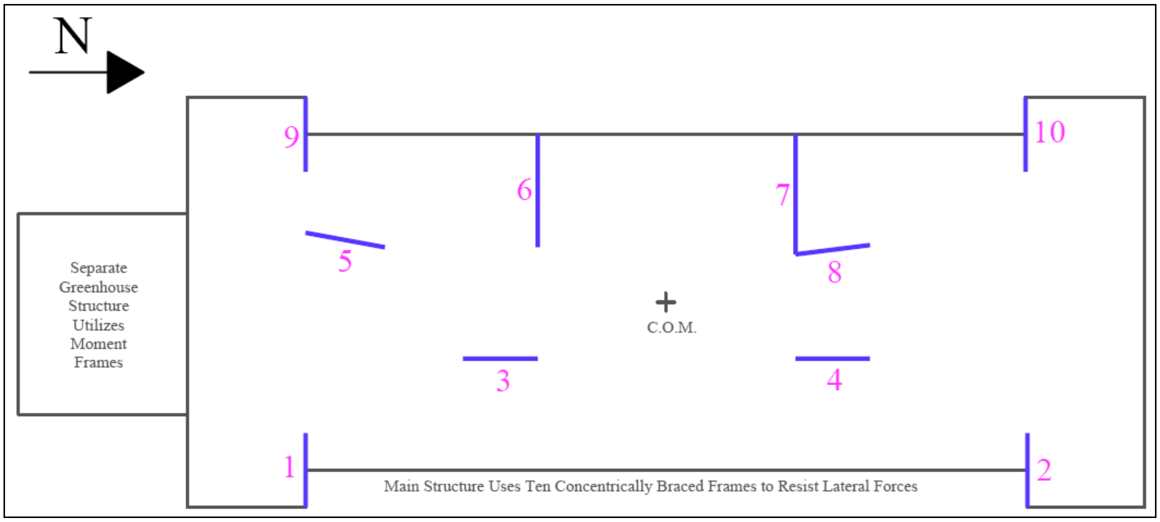

Figure 2.3.1 Layout of the 10 Concentrically Braced Frames

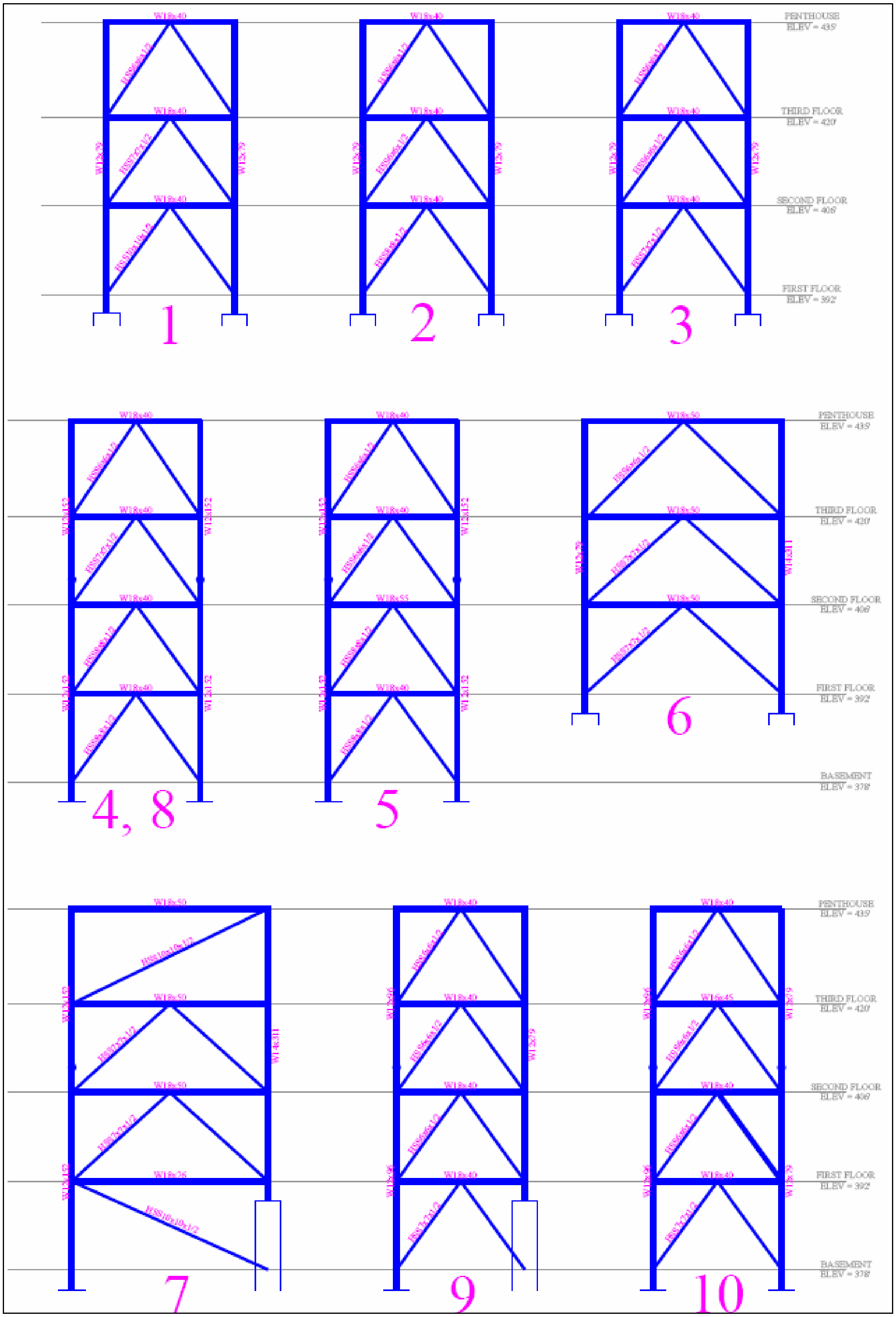

Figure 2.3.2 The 10 Concentrically Braced Frames in the Main Lateral Force Resisting System

The greenhouse wing on the building's southern exposure uses aluminum moment frames to resist the lateral forces. Large areas of glass were necessary to create the light, airy, and habitable space necessary for its greenhouse function. Moment frames were chosen over of the clumsier-looking braced frames due to the glass requirements as well as the lightweight nature of the structure that includes a glass and an aluminum-framed barrel roof. The greenhouse wing is separated from the main building by an expansion joint in order to keep the lateral resisting systems separate.

2.4 Foundations

The superstructure of the Barshinger Building rests upon shallow foundations, specifically spread footings. In the geotechnical report for the site, Advanced GeoServices Corp. of West Chester, Pennsylvania recommended that the foundations not exceed an allowable bearing pressure of 3,000 pounds per square foot (psf). Large footings will be necessary to transfer the loads from the braced frames into the ground and to resist the potential overturning moments. Test borings encountered intact rock at depths ranging from 3 to 23.5 feet. The intended construction method will involve excavating the rock where necessary and supplying a soil cushion beneath the footings in the excavated areas to discourage issues with differential settlement.

2.5 Cladding

The building employs a relatively heavy cladding system. The red brick façade is backed by concrete masonry units and certainly increased the seismic design loads on the structure. However, the cladding system is consistent with all of the other buildings on the Franklin and Marshall College campus.

2.6 Unique Structural Feature – Vierendeel Truss

The building has one peculiar structural feature: a Vierendeel truss. This statically indeterminate truss is comprised of rigid upper and lower girders, connected by vertical beams using rigid joints. The configuration of elements creates bending moments in all the members under gravity loading. Trusses of this type are found in some bridges, and were also used in the frame of the World Trade Center's Twin Towers. The vertical beams create regular openings for rectangular windows in the western facade. The truss, illustrated in Figure 2.6.1, spans nearly 70-feet over the large 125-seat lecture hall to create an open and uninterrupted space for the audience to enjoy. However, the truss requires exceptionally large wide-flange members that could present difficult erection issues for the contractor, including the need for a special crane that is larger than necessary for the rest of the job.

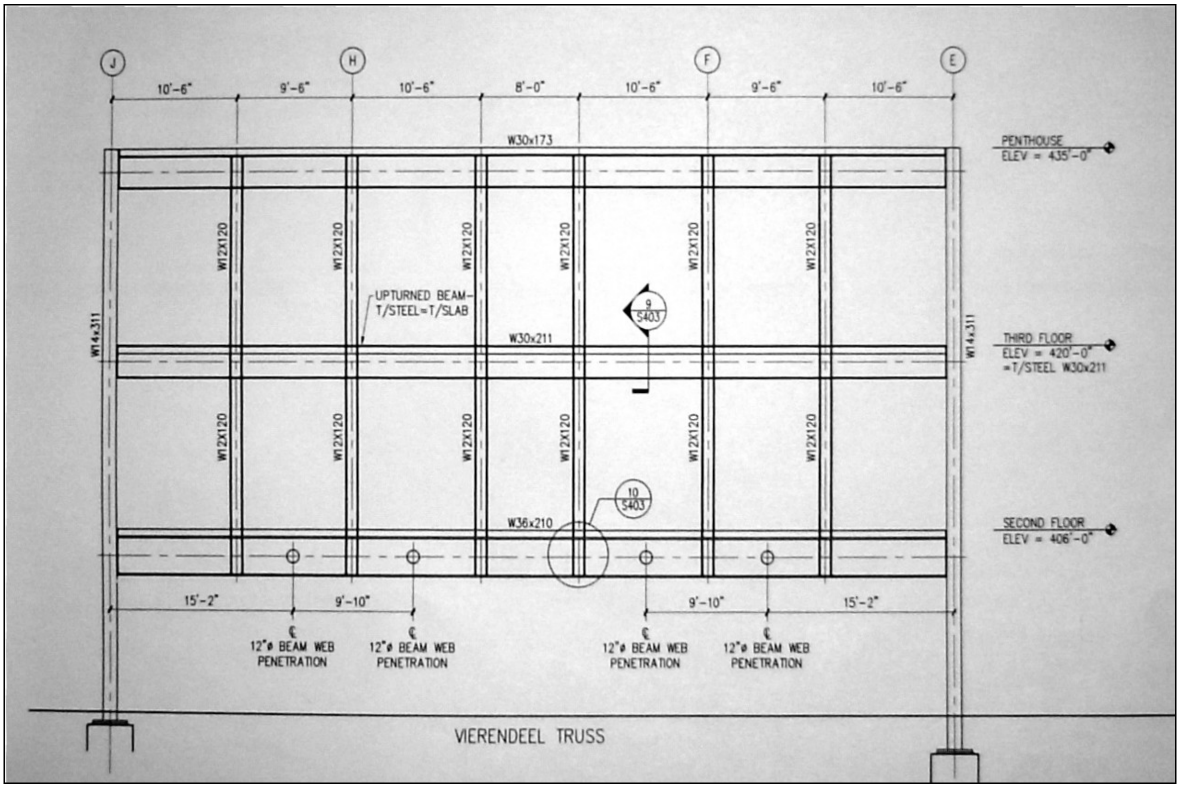

Figure 2.6.1 Vierendeel Truss

2.7 Material Strengths

The desired material strengths listed below in Figure 2.7.1 have been taken from the General Notes page of the Structural Drawings provided by Einhorn Yaffee Prescott, PC (EYP).

Concrete	f'_c	Unit Weight
Footings	3000 psi	150 pcf
Foundation Walls, Piers	4000 psi	150 pcf
Concrete on Metal Deck (Floor)	3500 psi	150 pcf
Concrete on Metal Deck (Roof)	3500 psi	150 pcf
Slabs on Grade	3500 psi	150 pcf
All Other Concrete	4000 psi	150 pcf
Reinforcing		
Typical Bars	ASTM A615	Grade 60
Welded Bars	ASTM A706	Grade 60
Welded Wire Fabric	ASTM A185	
Metal Deck Properties		
Roof Deck	3" Type "N"	20-gage
Composite Floor Deck	2" Type "B"	18-gage
Steel Members		
Wide-Flange Shapes	ASTM A992	
Channels & Angles	ASTM A36	
Pipe	ASTM A53	Grade B
Tubular Shapes	ASTM A500	Grade B
Base Plates	ASTM A36	

All Other Steel Members	ASTM A36
Steel Connections	
High Strength Bolts	ASTM A325 or A490
Nuts & Washers	(Min. ¾" Diameter)
Anchor Rods	ASTM F-1554 Grade 55
Welding Electrode	E70XX
Metal Deck Welding Electrode	E60XX Min.
Masonry Properties	
Mortar	Type S
CMU Strength	F'_m = 1500 psi

Figure 2.7.1 Material Strengths & Properties for Design

2.8 Major Design Codes & Standards

The Barshinger Life Science and Philosophy Building was designed using the following major design codes and standards.

- International Building Code (IBC), 2000
- ASCE 7-98
- ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures"
- ACI 318 "Building Code Requirements for Reinforced Concrete"
- ACI 530 "Building Code Requirement for Masonry Structures"
- ACI 531 "Specifications for Masonry Structures"
- AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings"

2.9 Design Loads

Design building loads were obtained from the General Notes page of the Structural Drawings provided by EYP. However, I also verified the values through simplified calculations using ASCE7-02 and the International Building Code (IBC) 2000 to determine the live, dead, snow, wind, and seismic loads acting on the building. The resulting load values are summarized in Figure 2.9.1 below. The verifying calculations are available for review in Appendix A.

Live	Offices	50 psf (+20 psf partitions)
	Laboratories	60 psf
	Public Spaces	100 psf
Dead	Floor Loads	120 psf
	Exterior Walls	45 psf
Snow	Flat Roof	25 psf
	Sloped Roof	28 psf
Wind	N-S Base Shear	65.5 k
	E-W Base Shear	143.2 k
Seismic	Base Shear	895 k

Figure 2.9.1 Building Loads for Design