

FLATS FIFTH



PennState
College of Engineering

**ARCHITECTURAL
ENGINEERING**

Flats on Fifth Pittsburgh, PA

Derek Gombos | Structural Option
Advisor: Dr. Thomas Boothby, P.E., R.A.

The Pennsylvania State University
2019 AE Senior Thesis



Flats on Fifth Pittsburgh, PA

Agenda

General Information

Existing Structural Systems

Proposed Structural Systems

Economics Breadth

Acoustics Breadth



Flats on Fifth

Pittsburgh, PA

General Information



Flats on Fifth Pittsburgh, PA

General Information

Existing Structural System

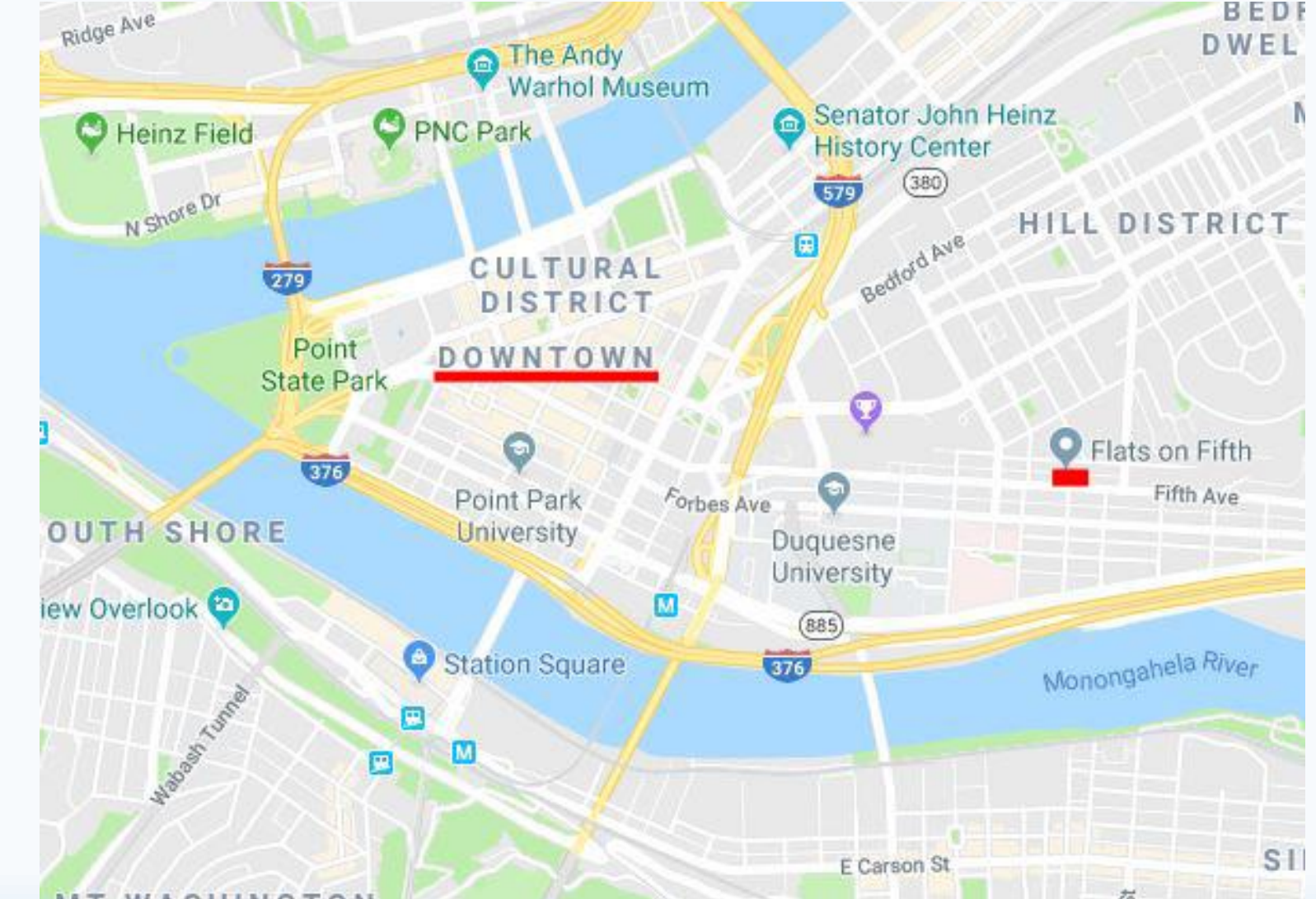
Proposed Structural System

Economics Breadth

Acoustics Breadth

General Information

- Location: Pittsburgh, PA – Uptown District
- Occupancy Type: Residential
- Area: Approx. 90,000 sq.ft.
- Floors: 7
- Height: 82'-8"



Map of Pittsburgh, Site Marked

Flats on Fifth Pittsburgh, PA

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General Information

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- Occupancy Type: Residential
- Area: Approx. 90,000 sq.ft.
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3D map of Uptown District

Flats on Fifth

Pittsburgh, PA

Existing Structure



Flats on Fifth Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

Economics Breadth

Acoustics Breadth

Podium Building

Podium Levels

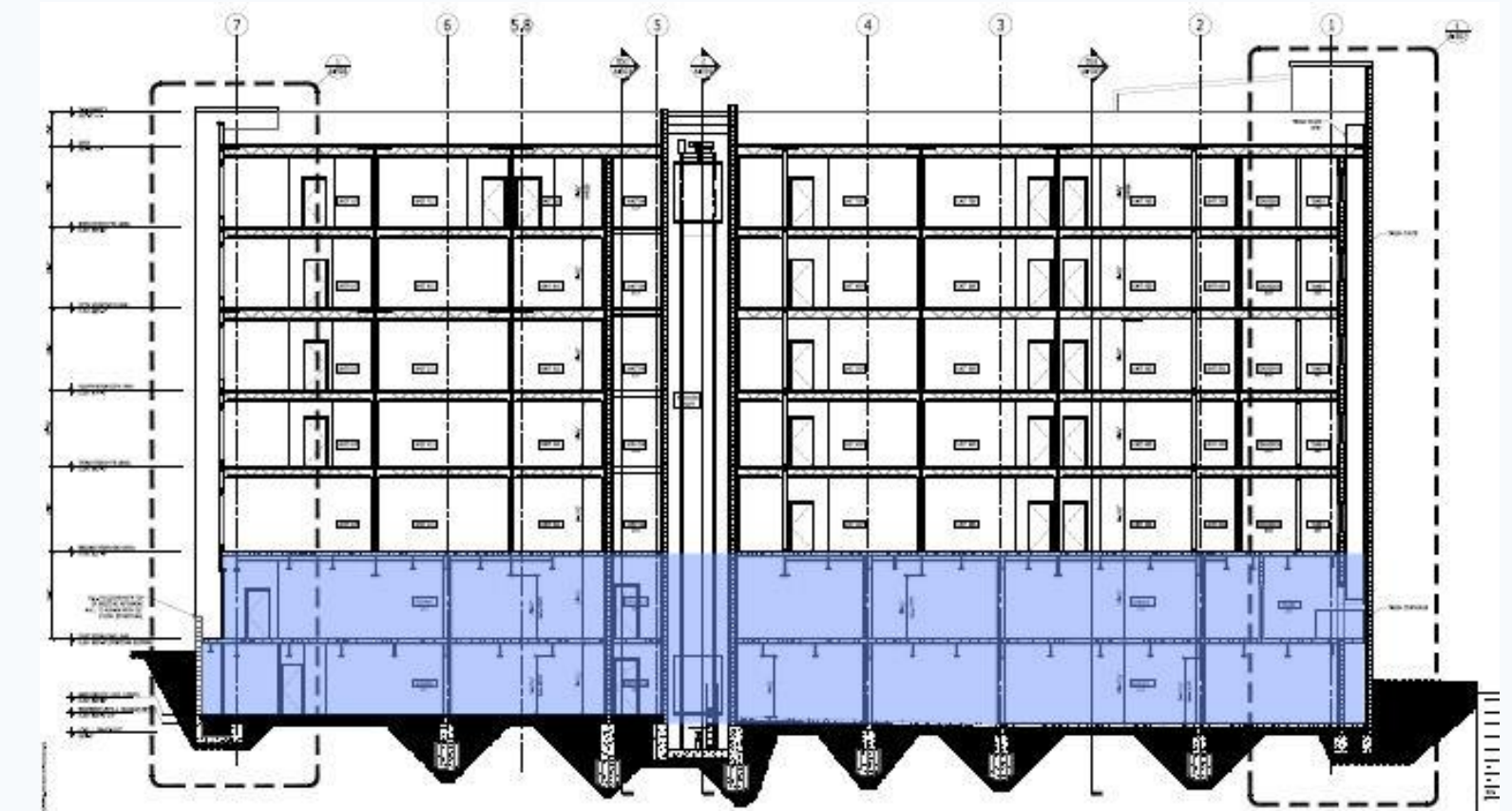
Steel Framing

Residential Levels

Wood Trusses and Stud Walls

Lateral System

Masonry Shear Walls



Building Section, Steel Framing Levels

Flats on Fifth Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

Economics Breadth

Acoustics Breadth

Podium Building

Podium Levels

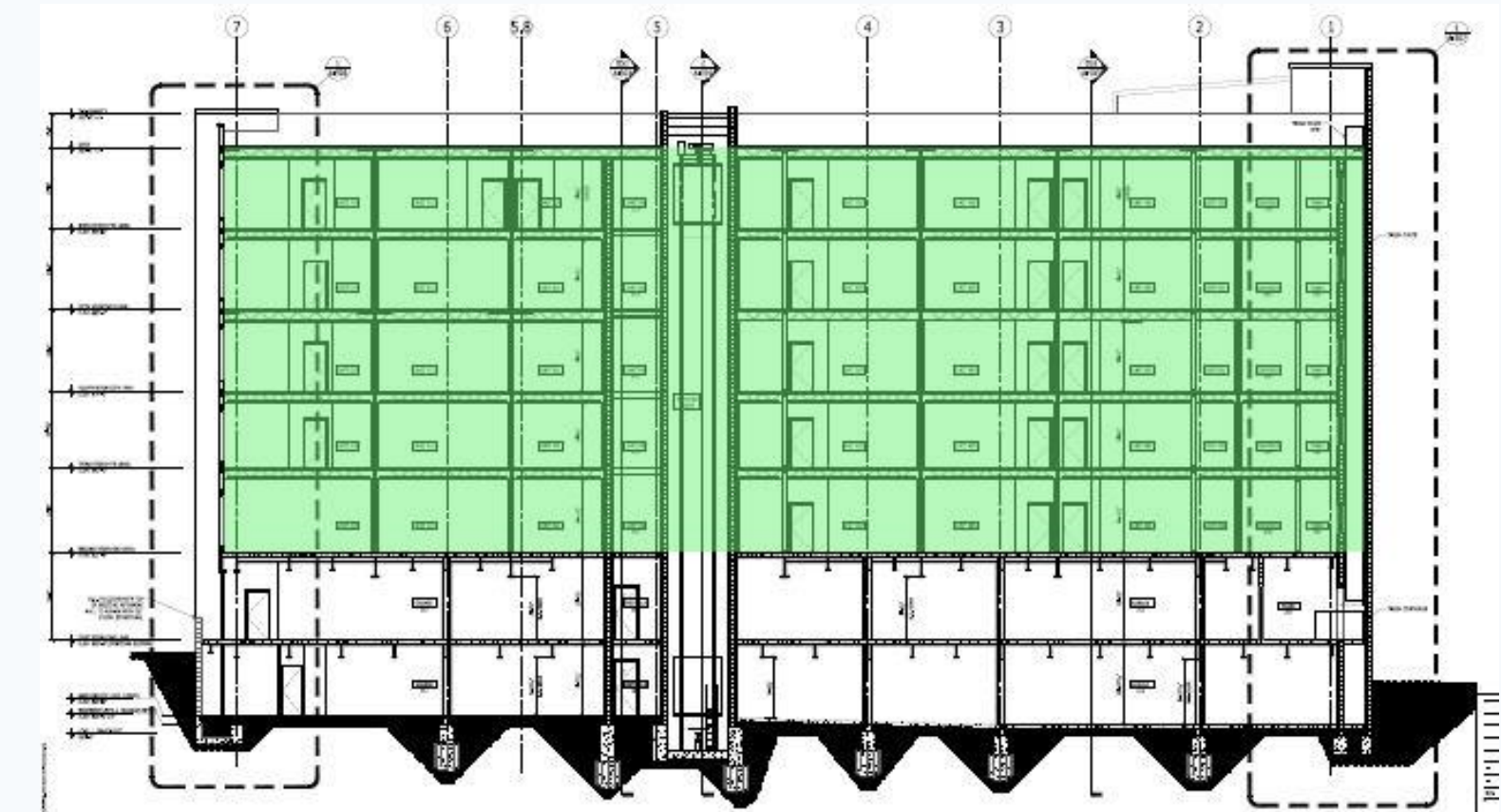
Steel Framing

Residential Levels

Wood Trusses and Stud Walls

Lateral System

Masonry Shear Walls



Building Section, Wood Framing Levels

Flats on Fifth Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

Economics Breadth

Acoustics Breadth

Podium Building

Podium Levels

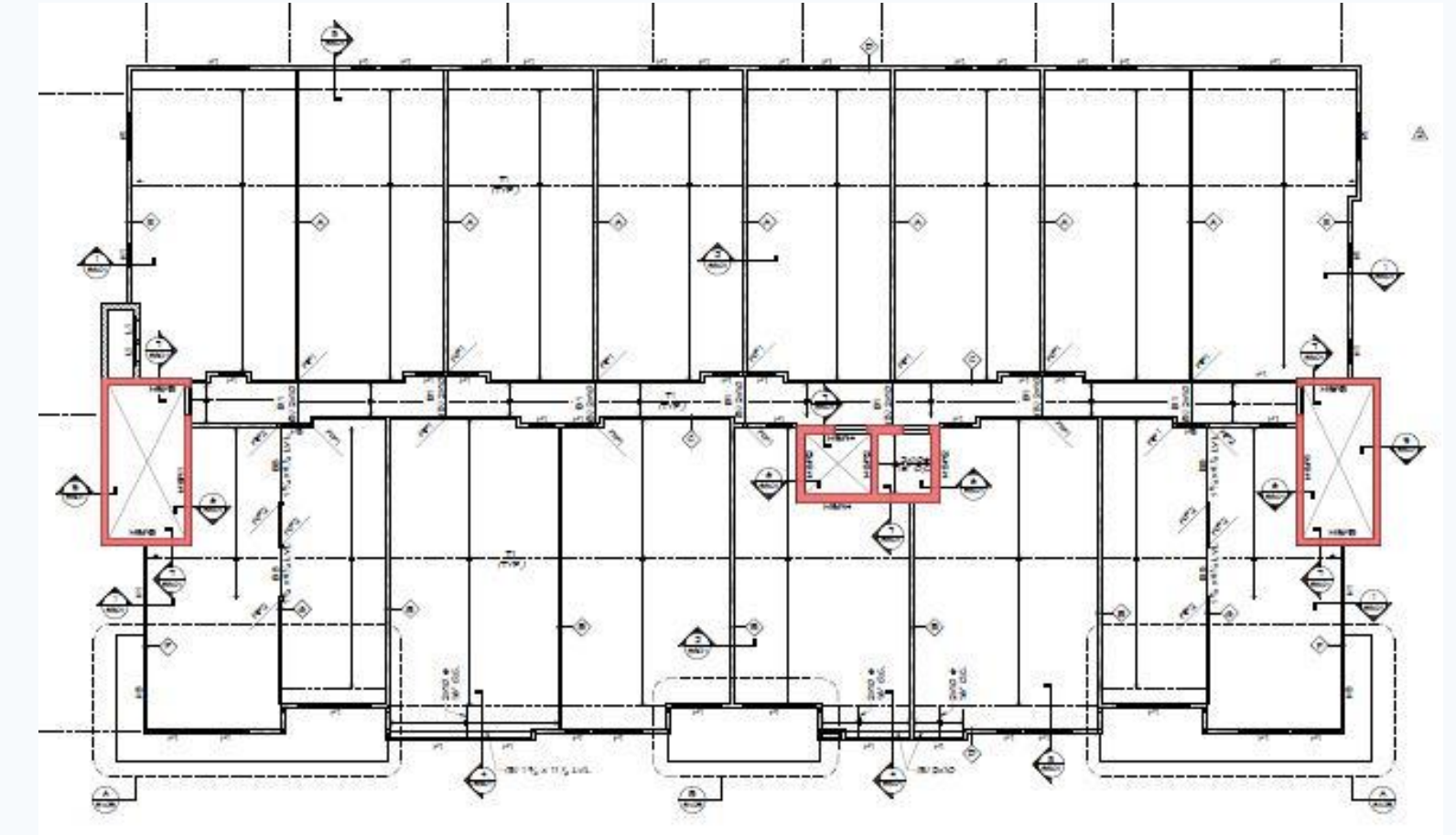
Steel Framing

Residential Levels

Wood Trusses and Stud Walls

Lateral System

Masonry Shear Walls



Floor Plan, Masonry Shear Walls

Flats on Fifth

Pittsburgh, PA

General Information

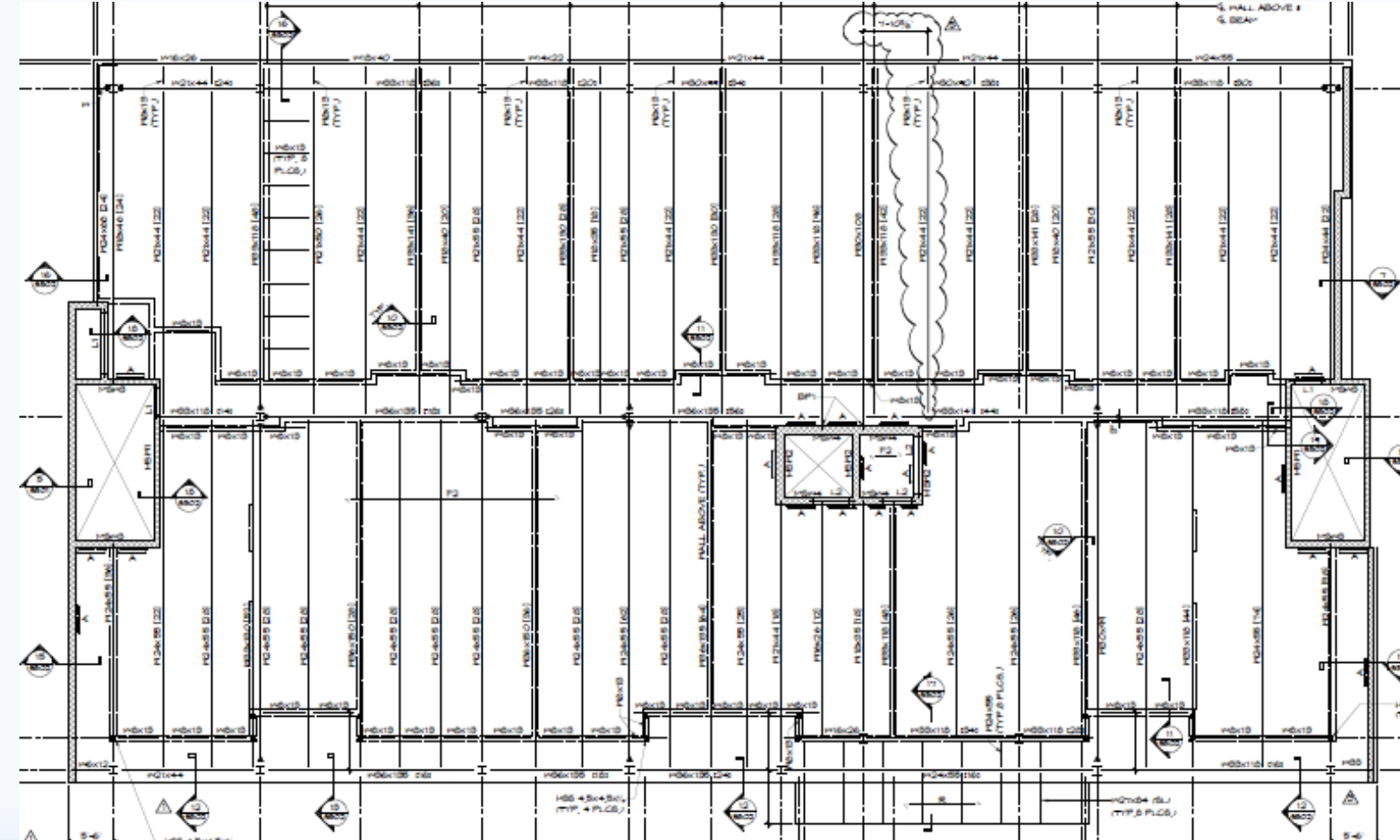
Existing Structural System

Proposed Structural System

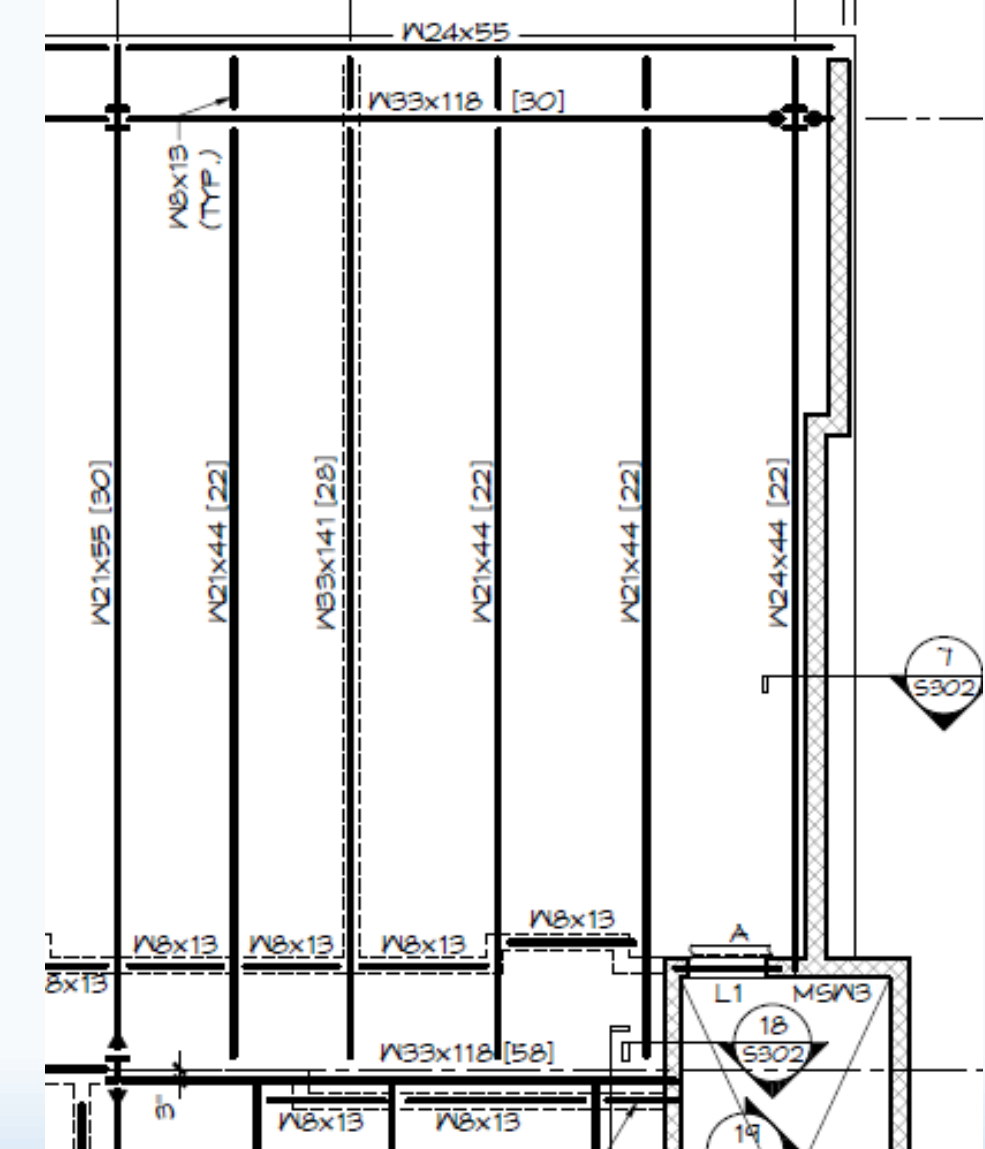
Economics Breadth

Acoustics Breadth

Steel Framing



Level 2 Framing Plan



Enlarged Typical Bay

Flats on Fifth Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

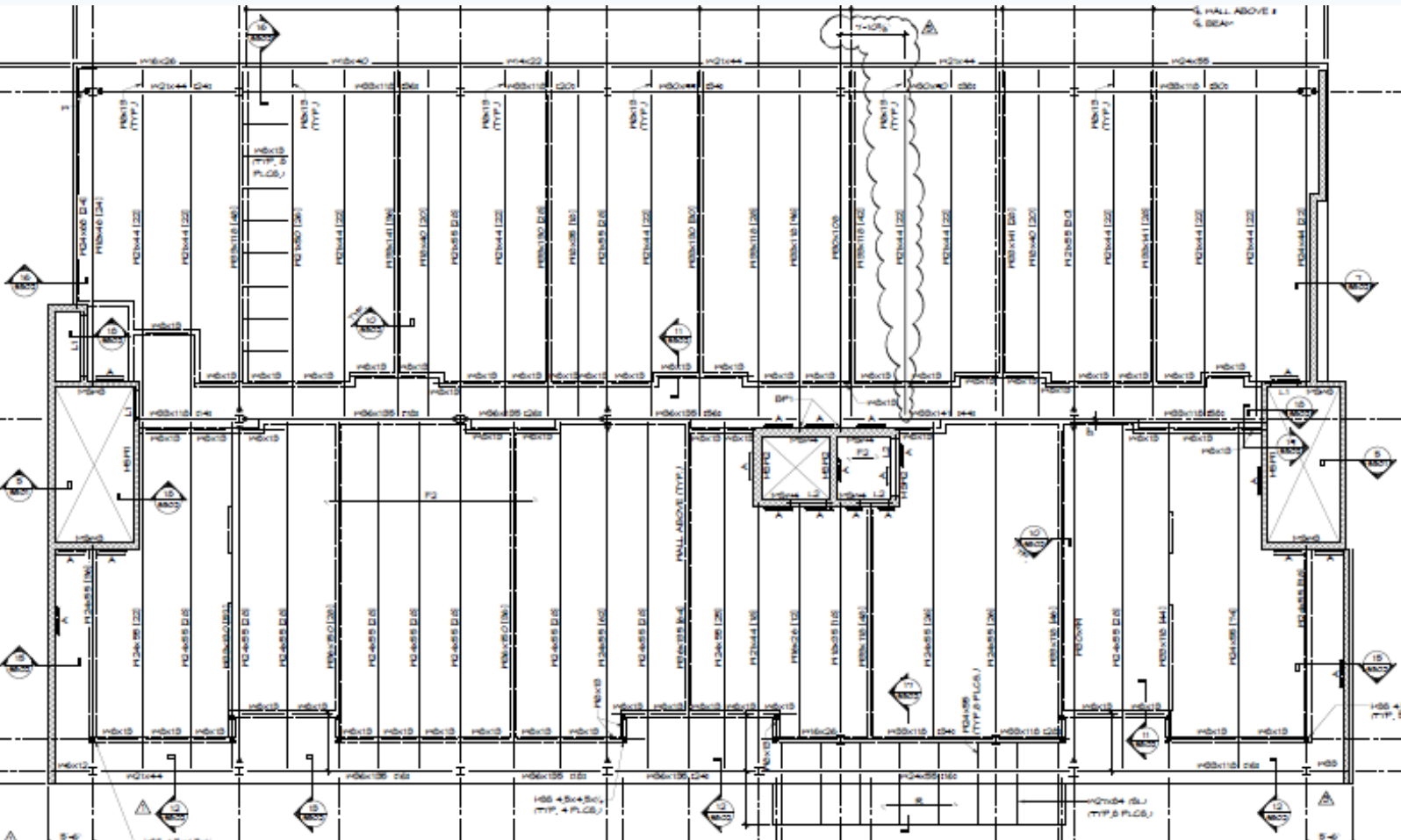
Economics Breadth

Acoustics Breadth

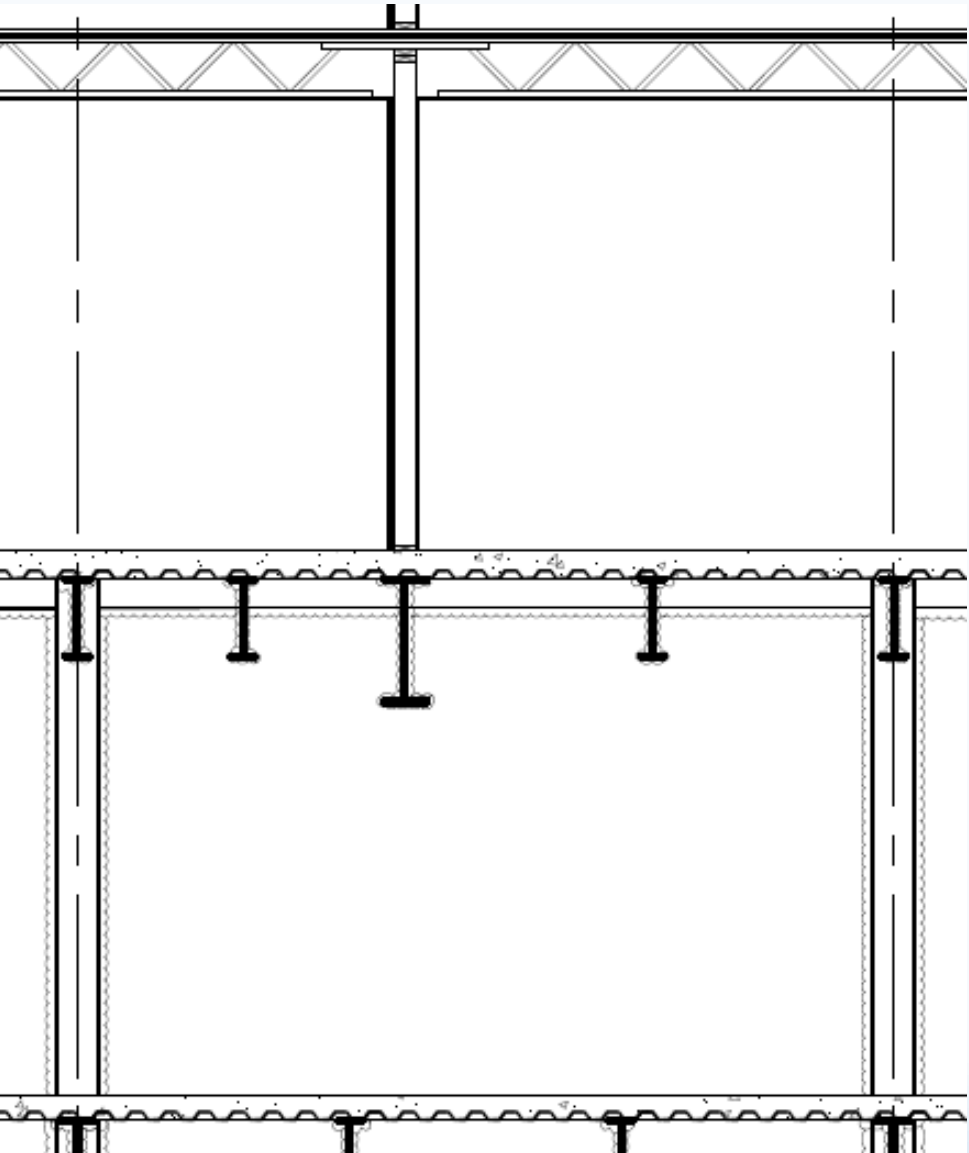
Steel Framing

Beams:
W24 – W27

Columns:
W12



Level 2 Framing Plan



Bearing Wall over Beam

Flats on Fifth Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

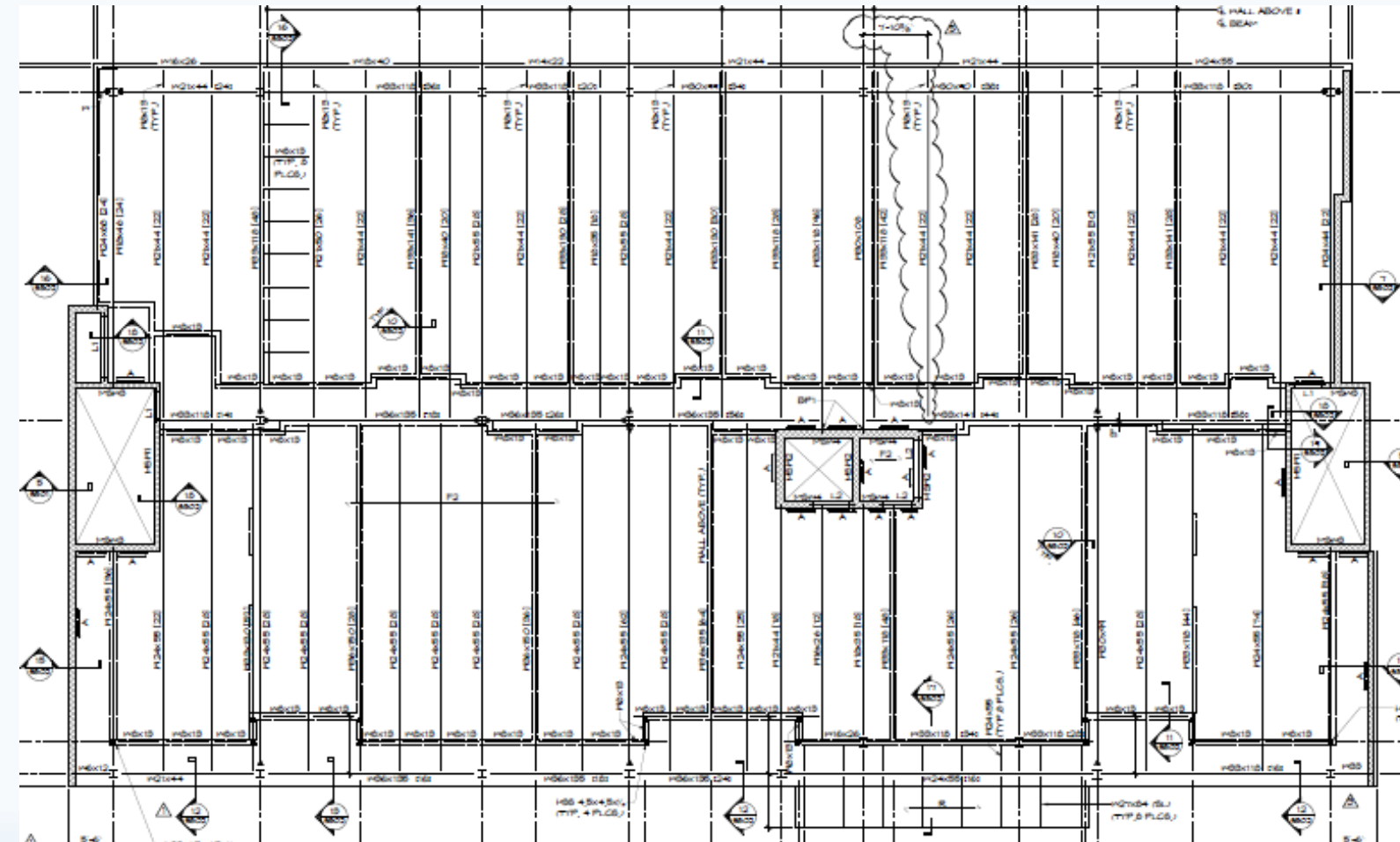
Economics Breadth

Acoustics Breadth

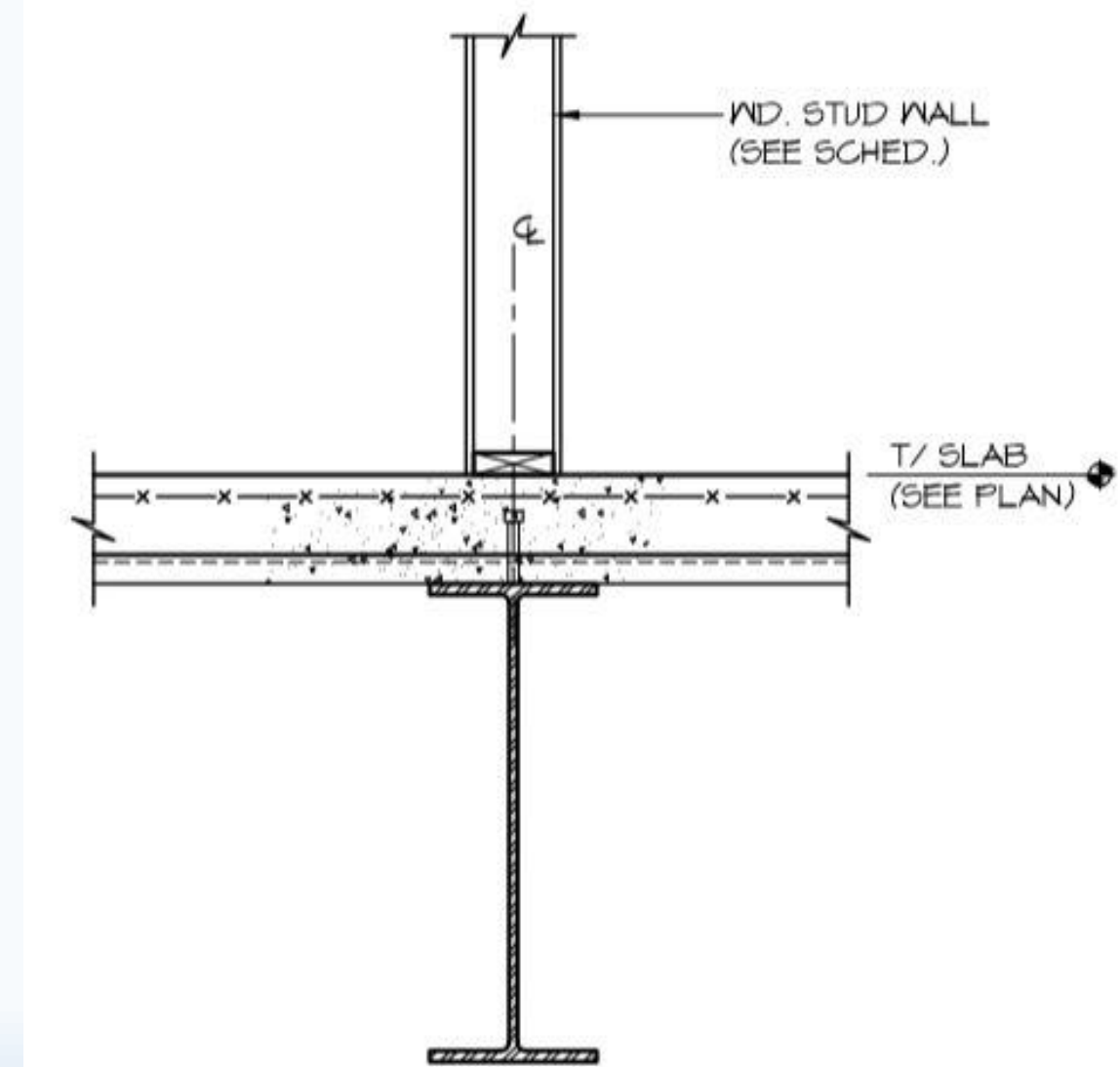
Steel Framing

Beams:
W24 – W27

Columns:
W12



Level 2 Framing Plan



Floor Structure Detail

Flats on Fifth

Pittsburgh, PA

General Information

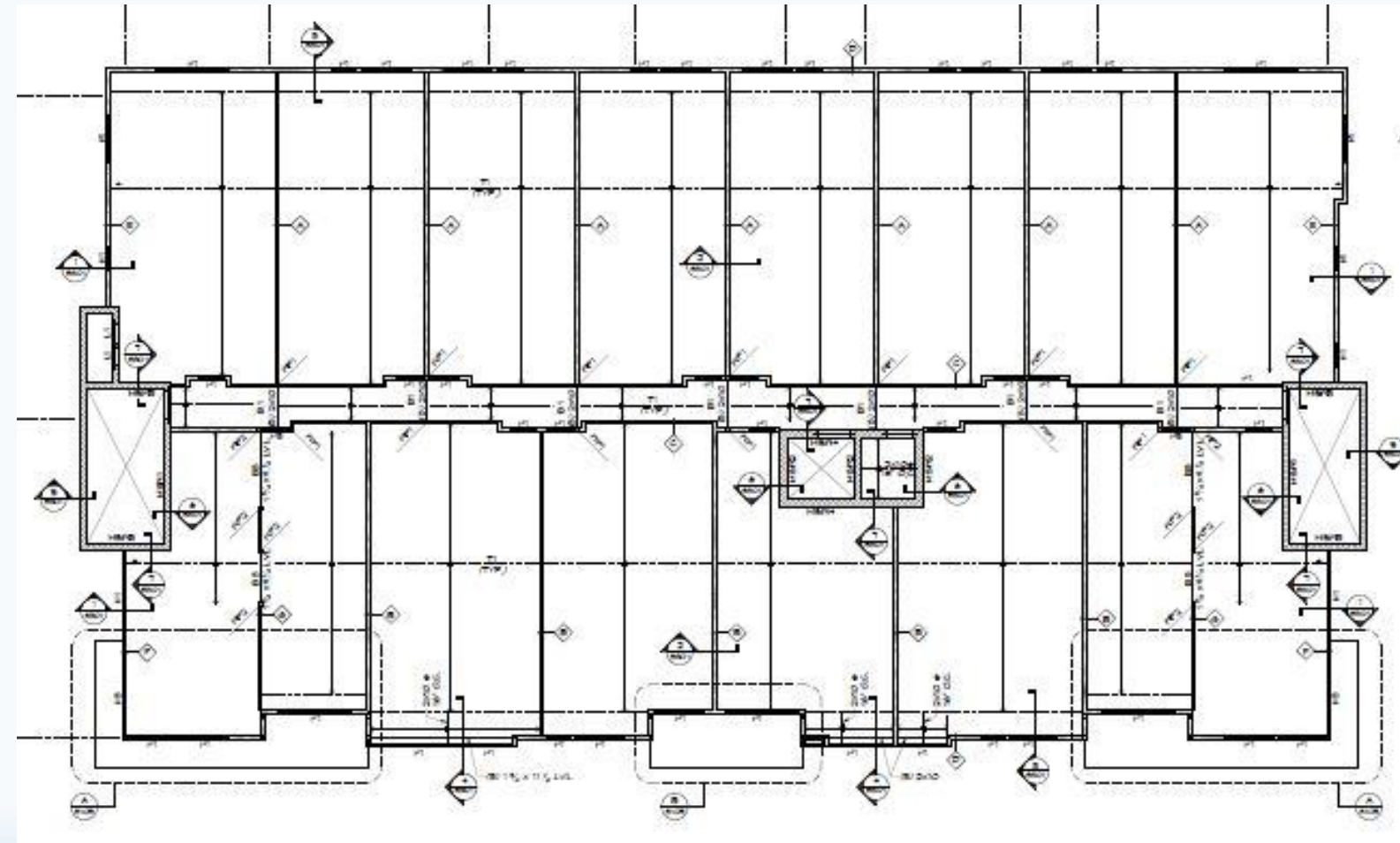
Existing Structural System

Proposed Structural System

Economics Breadth

Acoustics Breadth

Wood Framing



Levels 3-7 Framing Plan



Wood Framed Construction

Flats on Fifth

Pittsburgh, PA

General Information

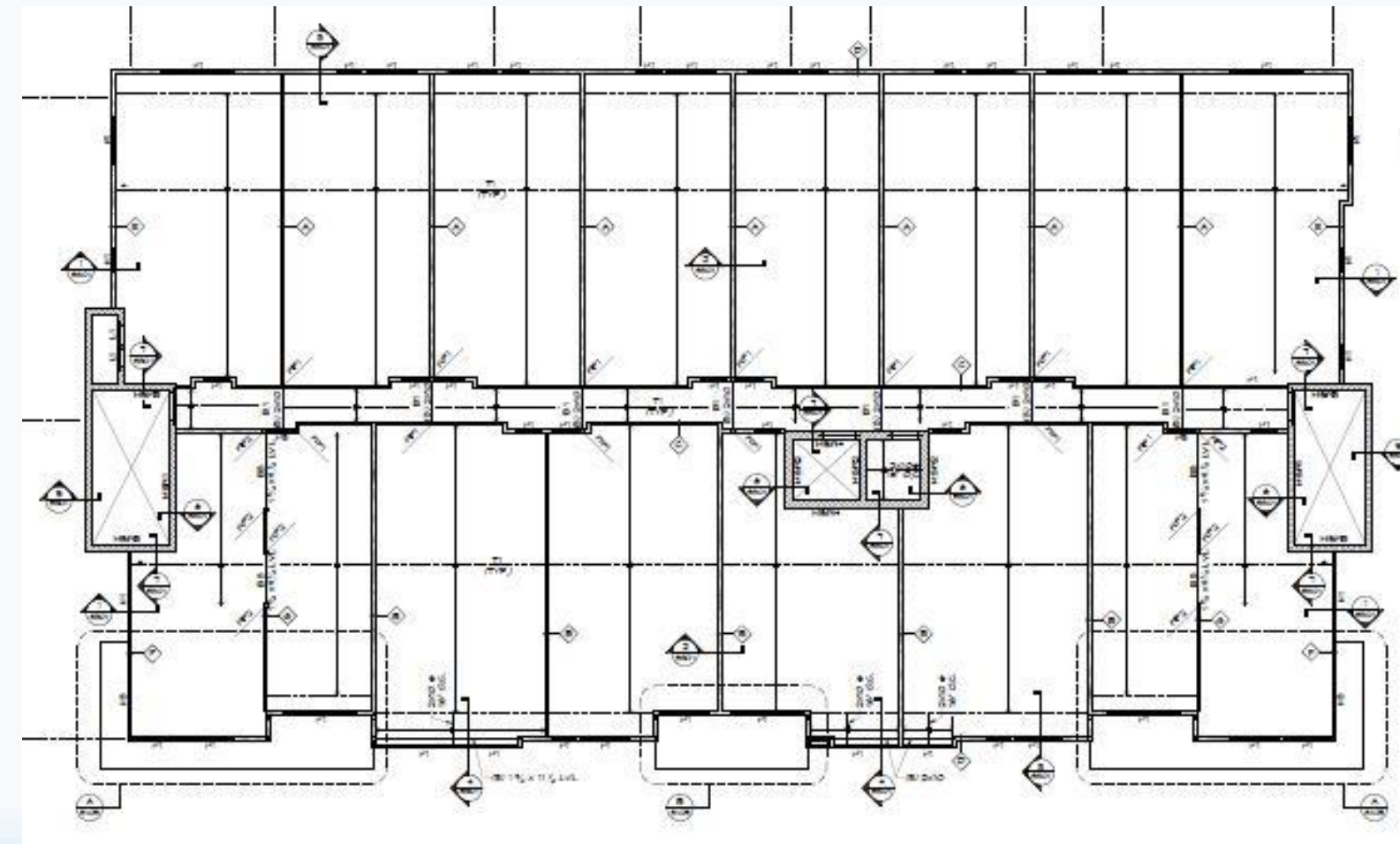
Existing Structural System

Proposed Structural System

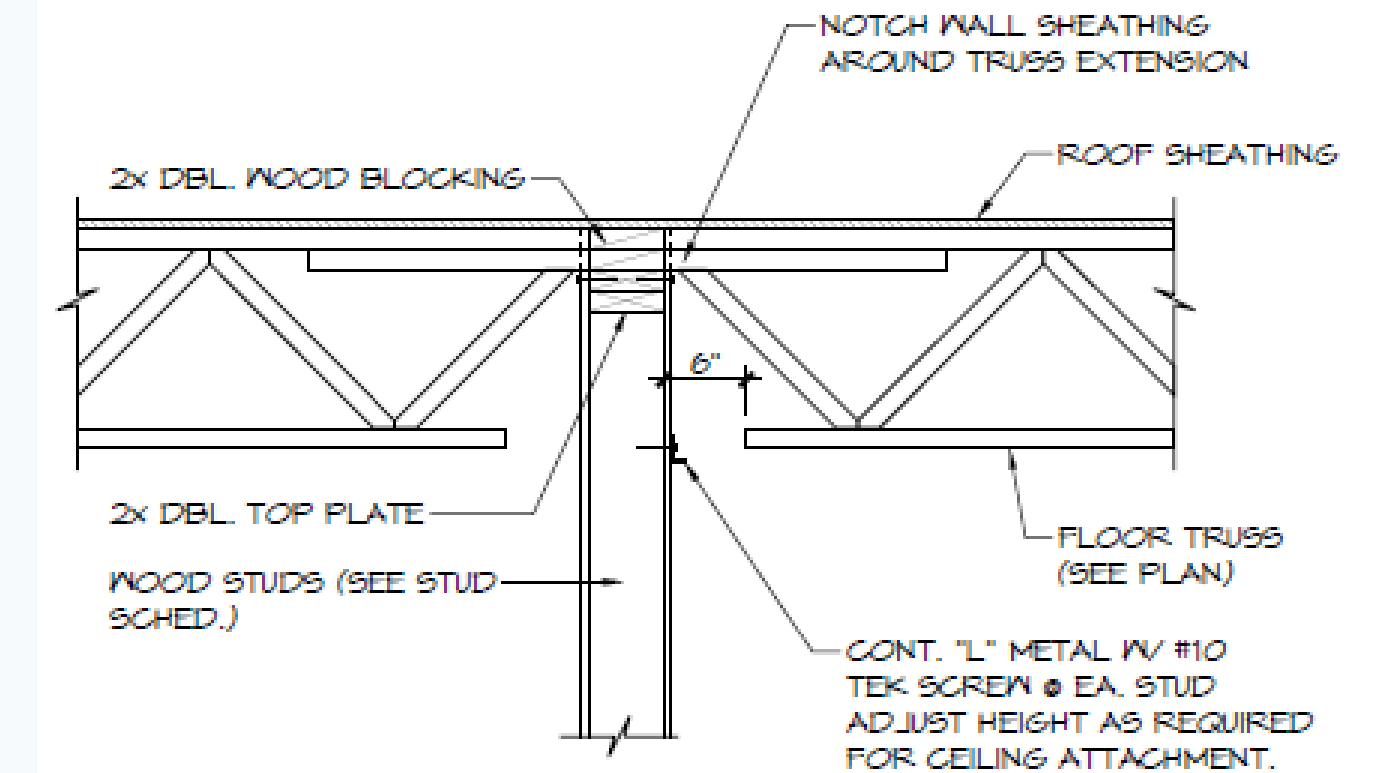
Economics Breadth

Acoustics Breadth

Wood Framing



Levels 3-7 Framing Plan



Floor Structure Detail

Flats on Fifth

Pittsburgh, PA

General Information

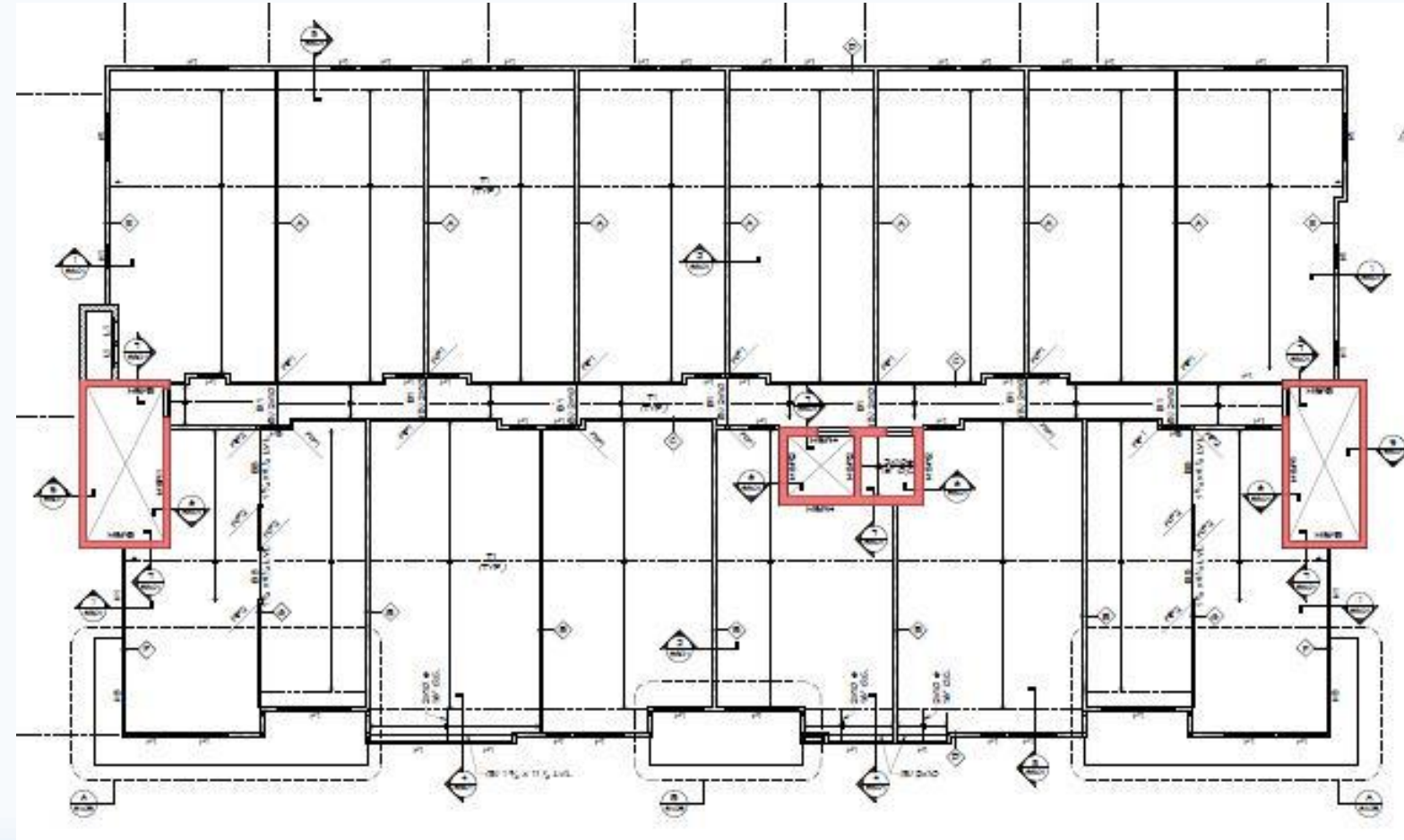
Existing Structural System

Proposed Structural System

Economics Breadth

Acoustics Breadth

Masonry Shear Walls



Floor Plan, Masonry Shear Walls



Masonry Shafts During Construction

Flats on Fifth

Pittsburgh, PA

Proposed Structural System



Design Goals

- Retain Ability for Off-Site Prefabrication.
- Do Not Disturb Building Architecture.
- Reduce Building Cost.



Flats on Fifth Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

Economics Breadth

Acoustics Breadth

Overview of Structural System

Levels 1-2

Steel Framing

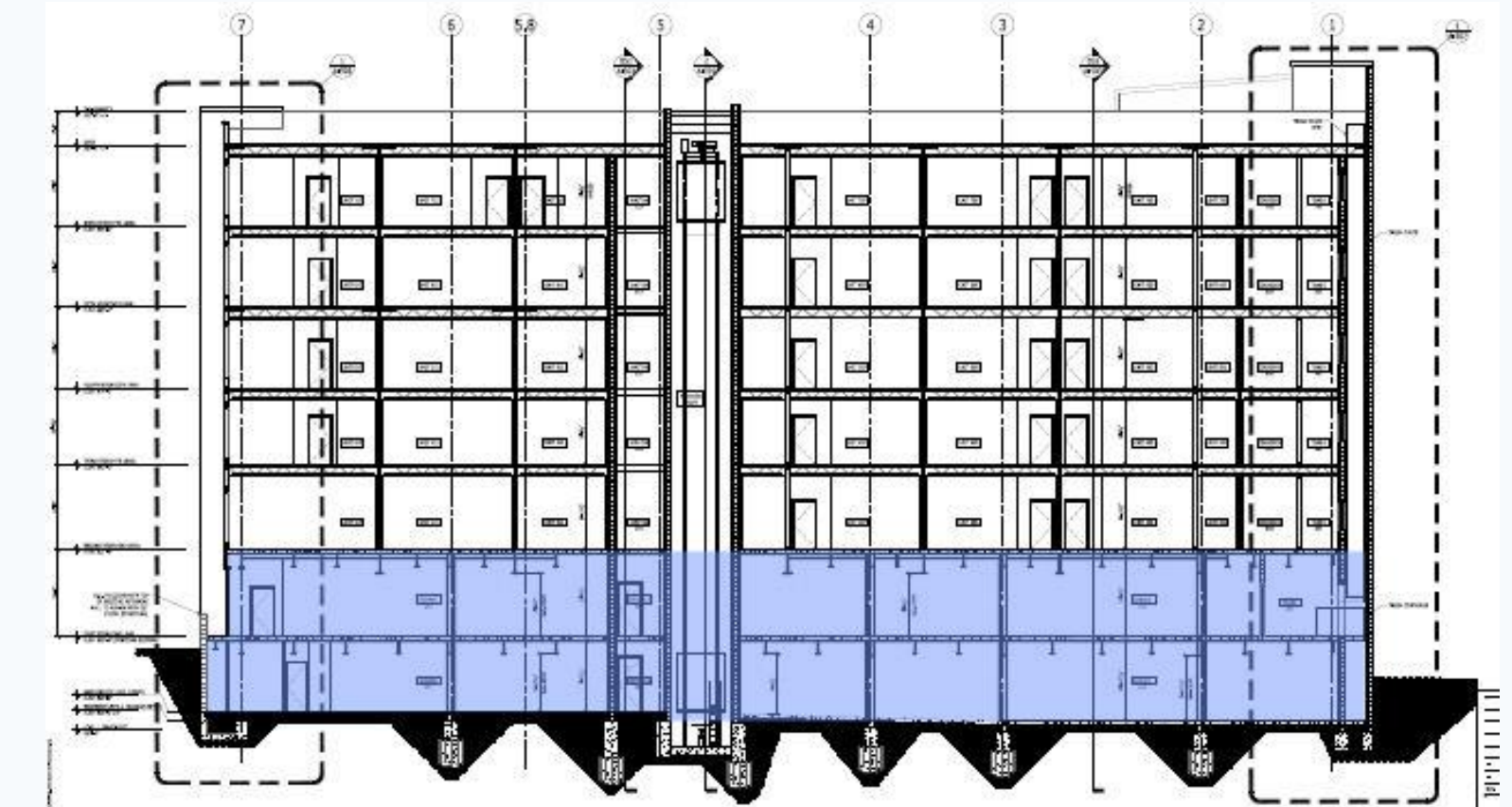
Levels 3-7

Steel Bar Joists and Light Gauge

Stud Walls

Lateral System

Masonry Shear Walls



Building Section, Steel Framing Levels

Flats on Fifth Pittsburgh, PA

General Information

Existing Structural System

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Economics Breadth

Acoustics Breadth

Overview of Structural System

Levels 1-2

Steel Framing

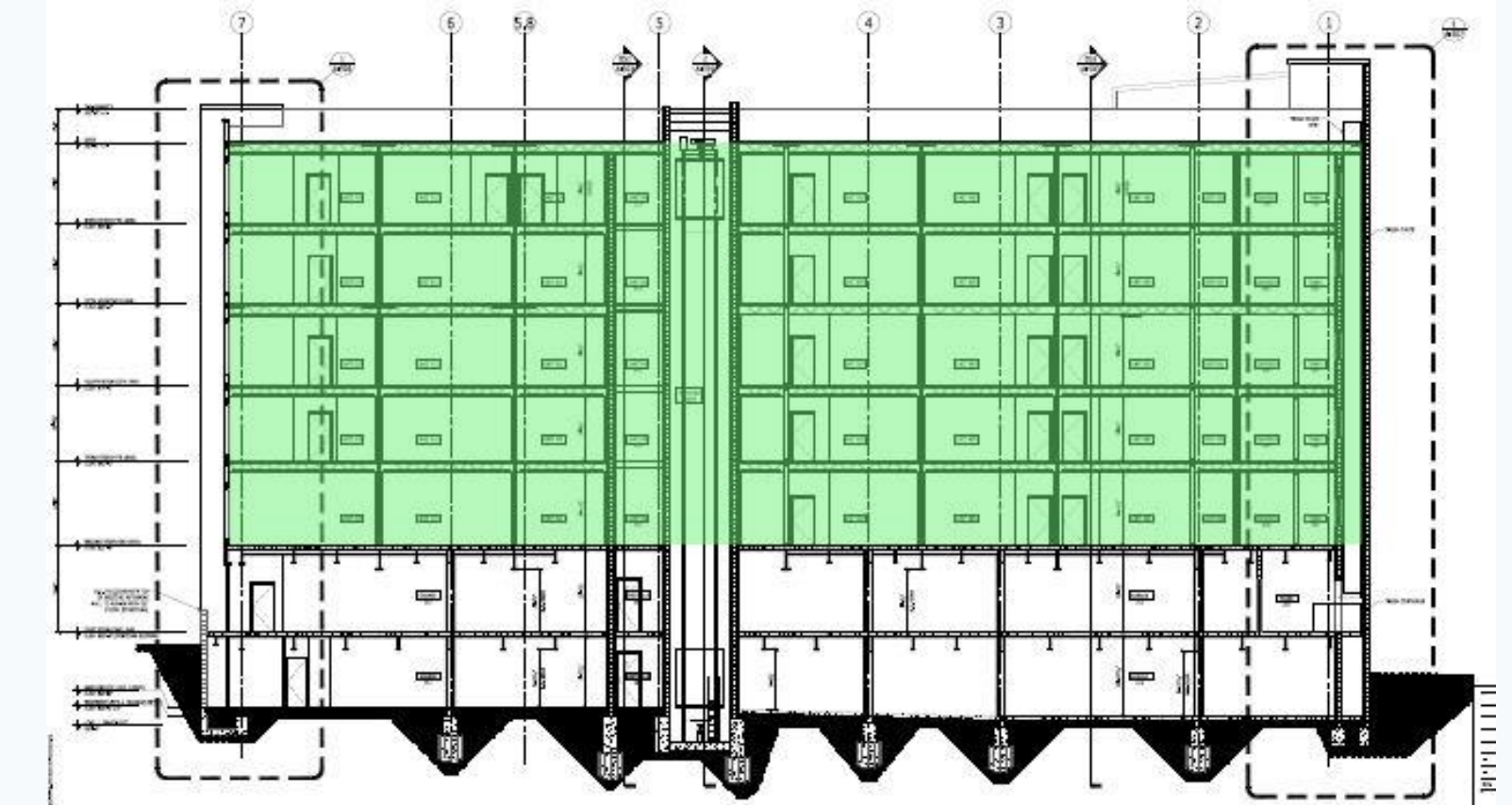
Levels 3-7

Steel Bar Joists and Light Gauge

Stud Walls

Lateral System

Masonry Shear Walls



Building Section, Light Gauge Framing Levels

Flats on Fifth Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

Economics Breadth

Acoustics Breadth

Overview of Structural System

Levels 1-2

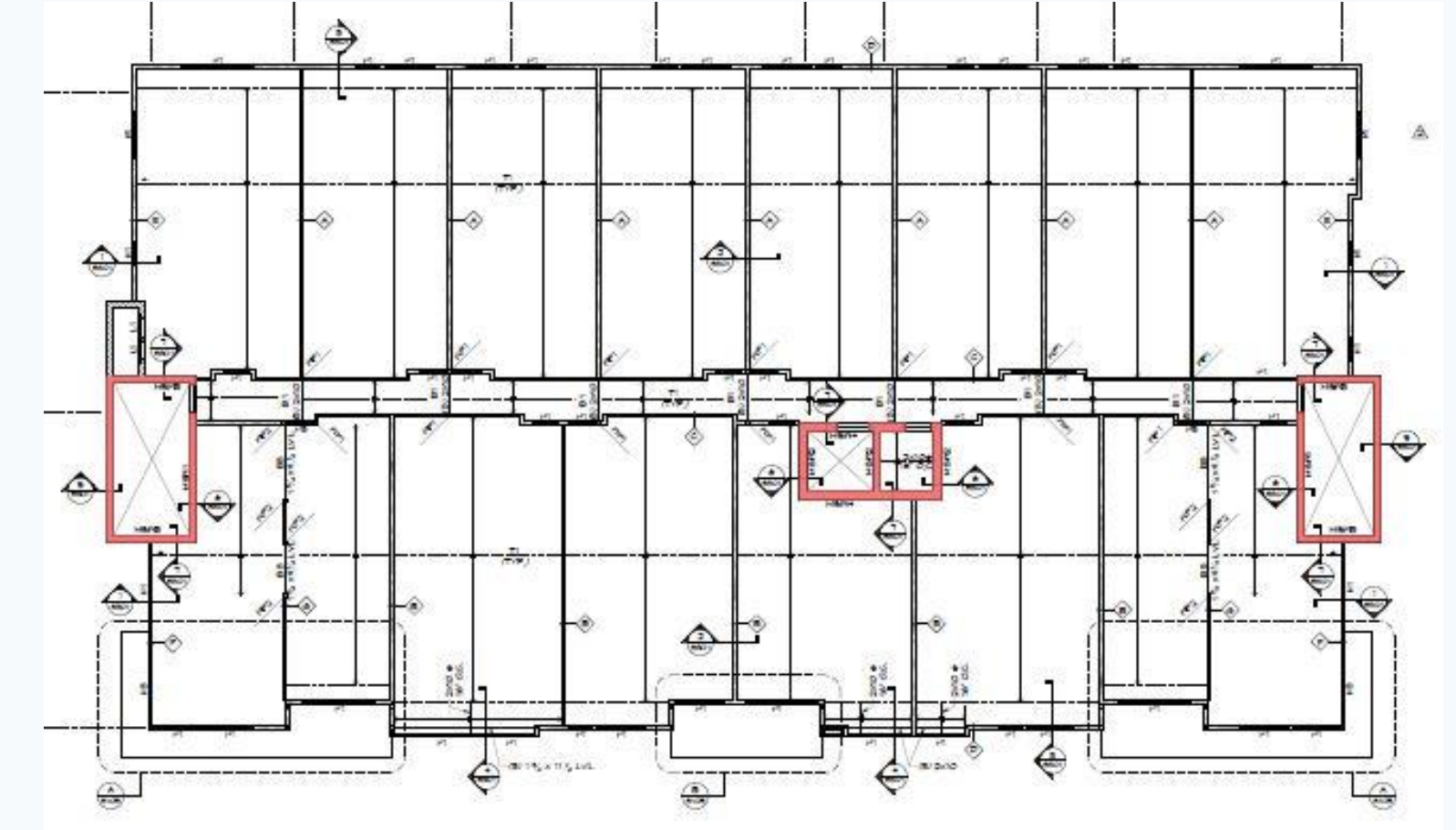
Steel Framing

Levels 3-7

Steel Bar Joists and Light Gauge
Stud Walls

Lateral System

Masonry Shear Walls



Floor Plan, Masonry Shear Walls

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

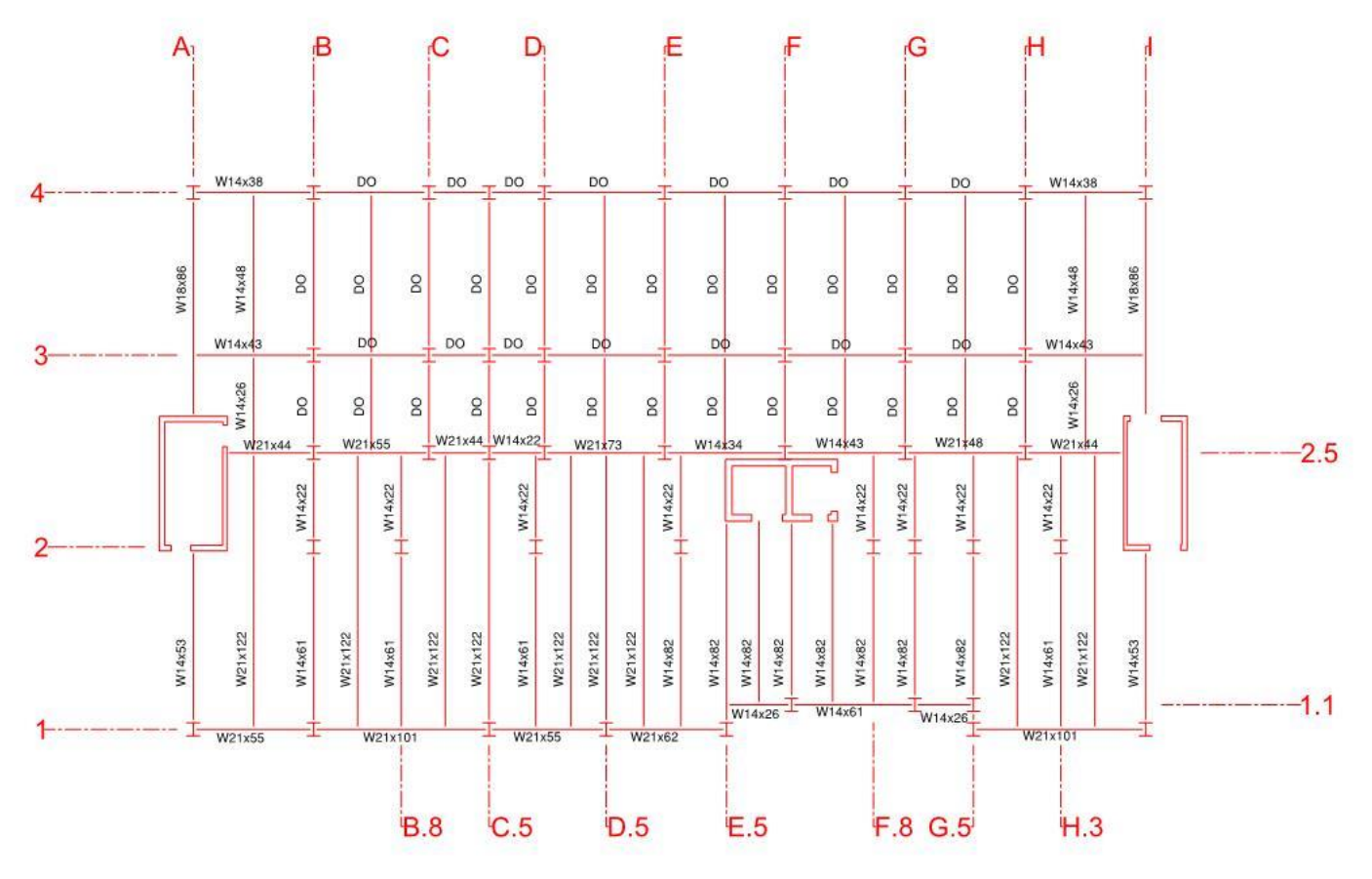
Proposed Structural System

Economics Breadth

Acoustics Breadth

Gravity System

Levels 1-2



Beams:
W14 – W21

Columns:
W12

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

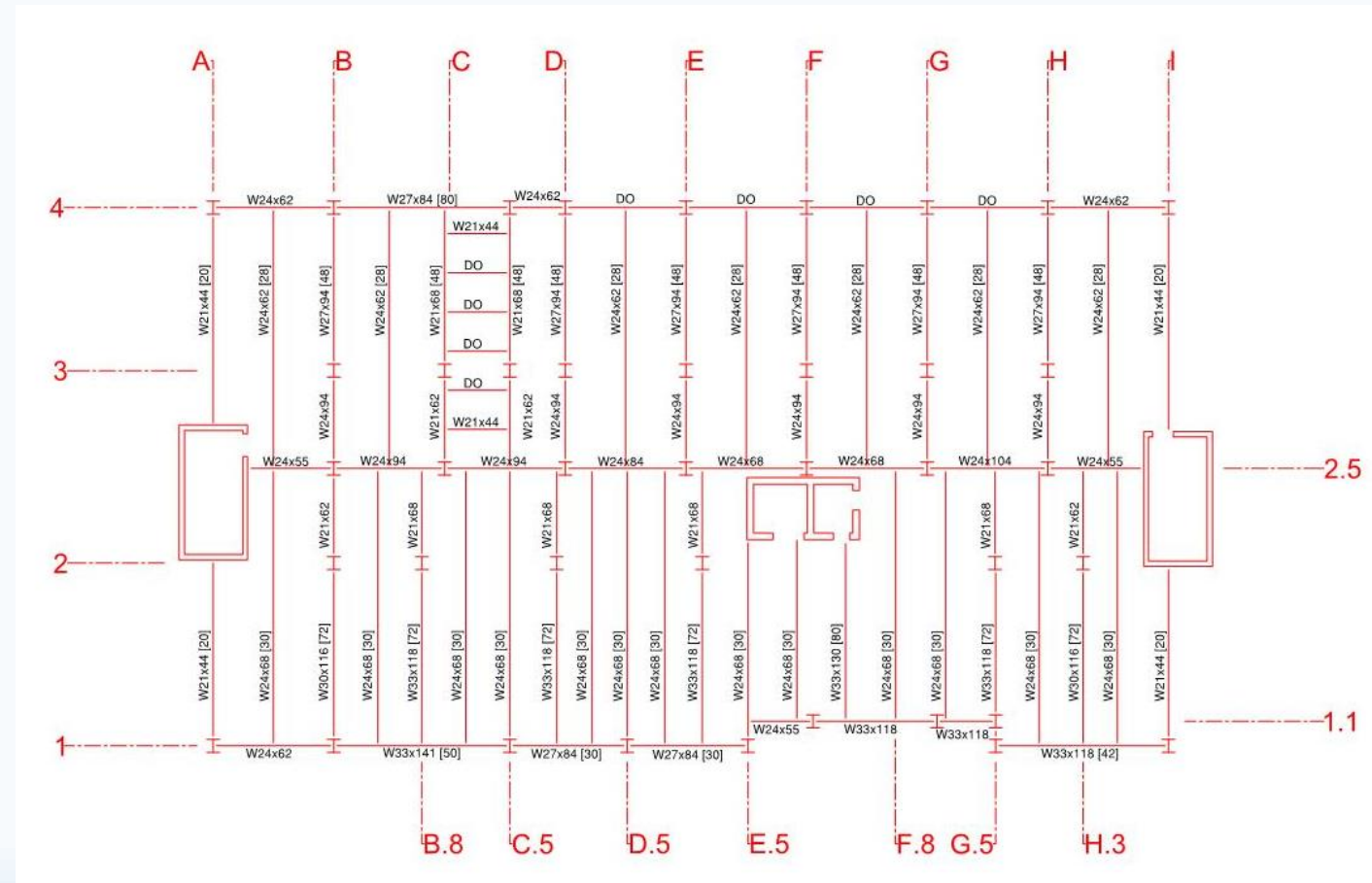
Proposed Structural System

Economics Breadth

Acoustics Breadth

Gravity System

Levels 1-2



Level 2 Framing Plan

Beams:
W24 – W27

Columns:
W12

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

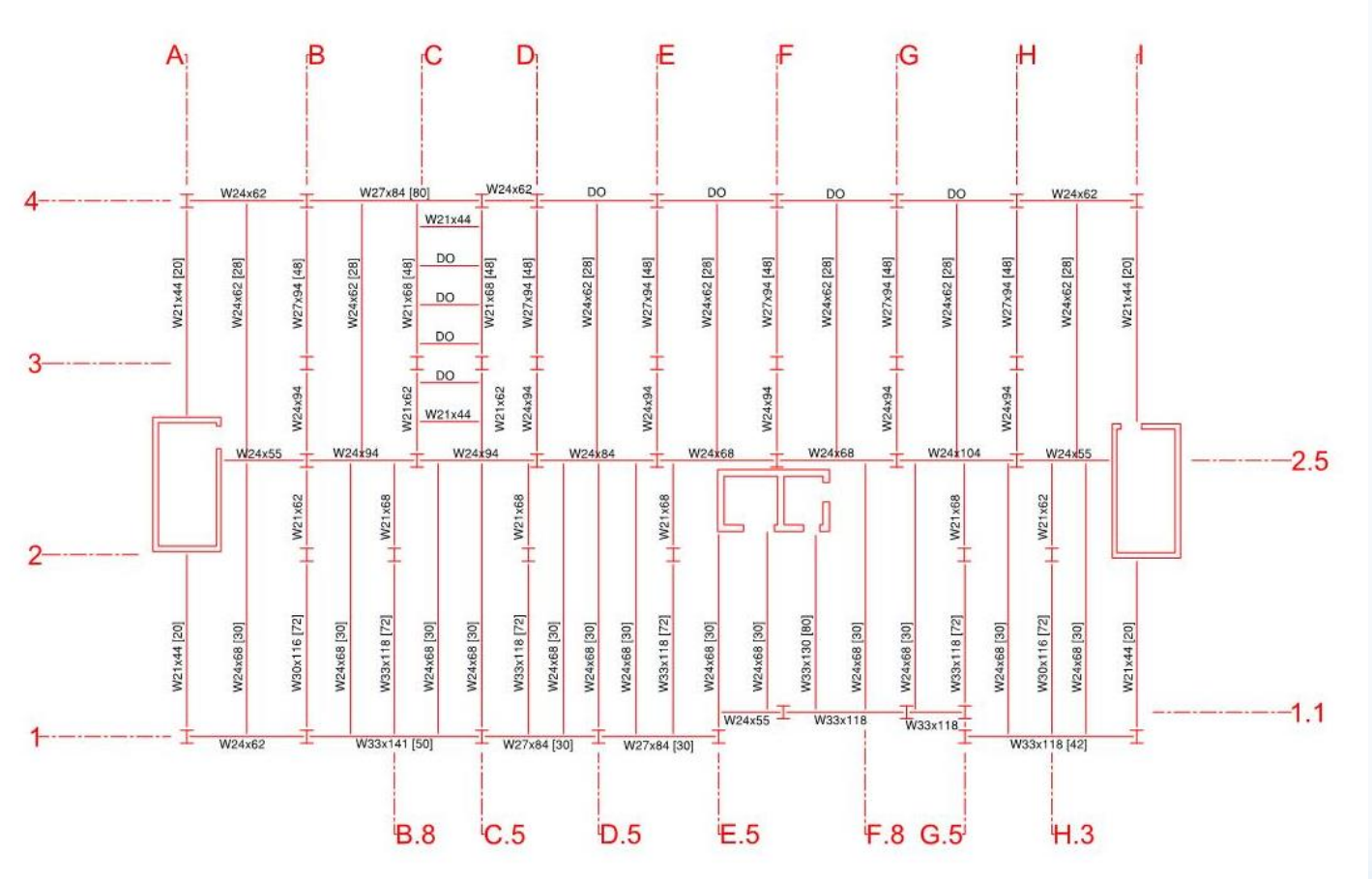
Proposed Structural System

Economics Breadth

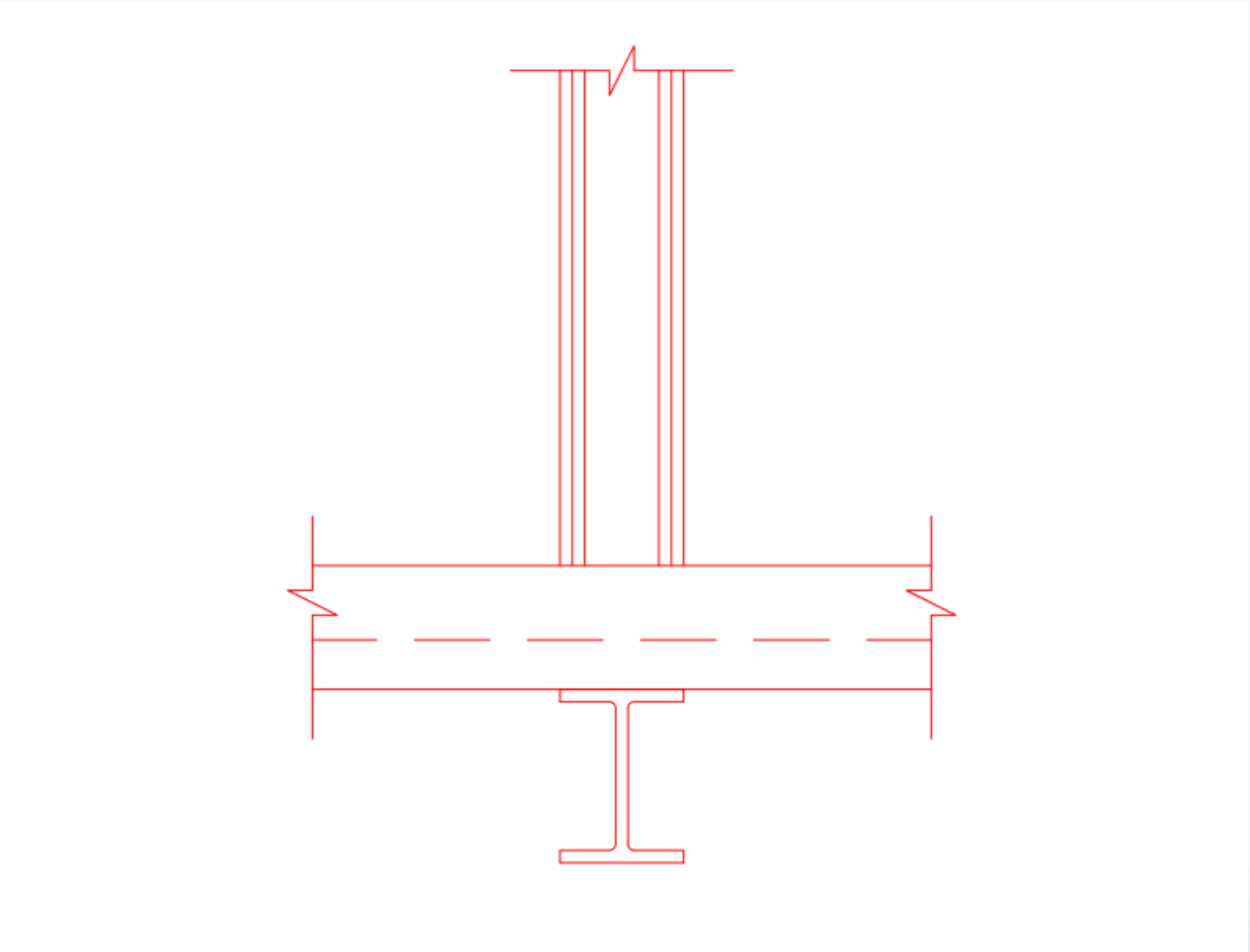
Acoustics Breadth

Gravity System

Levels 1-2



Level 2 Framing Plan



Bearing Wall Over Beam Detail

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

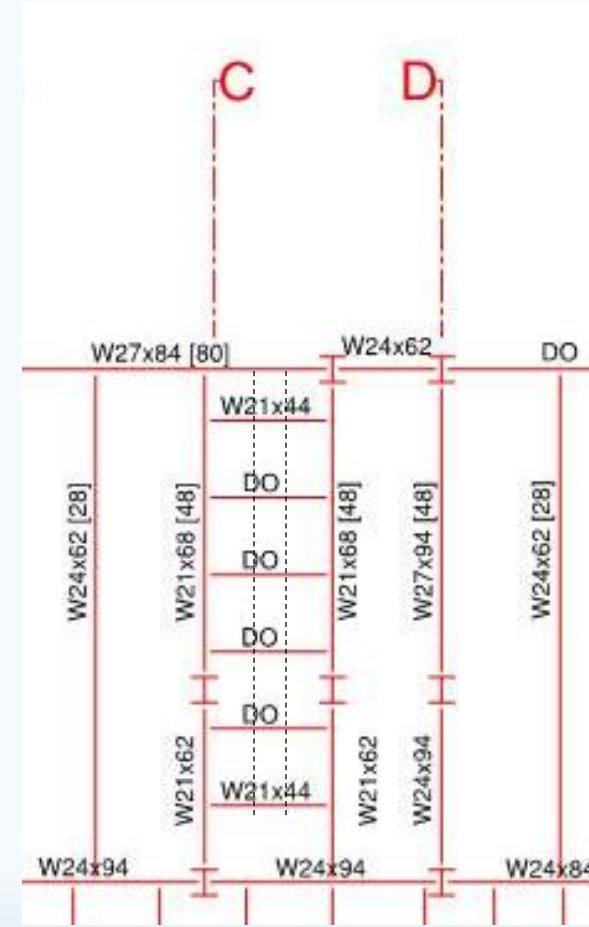
Proposed Structural System

Economics Breadth

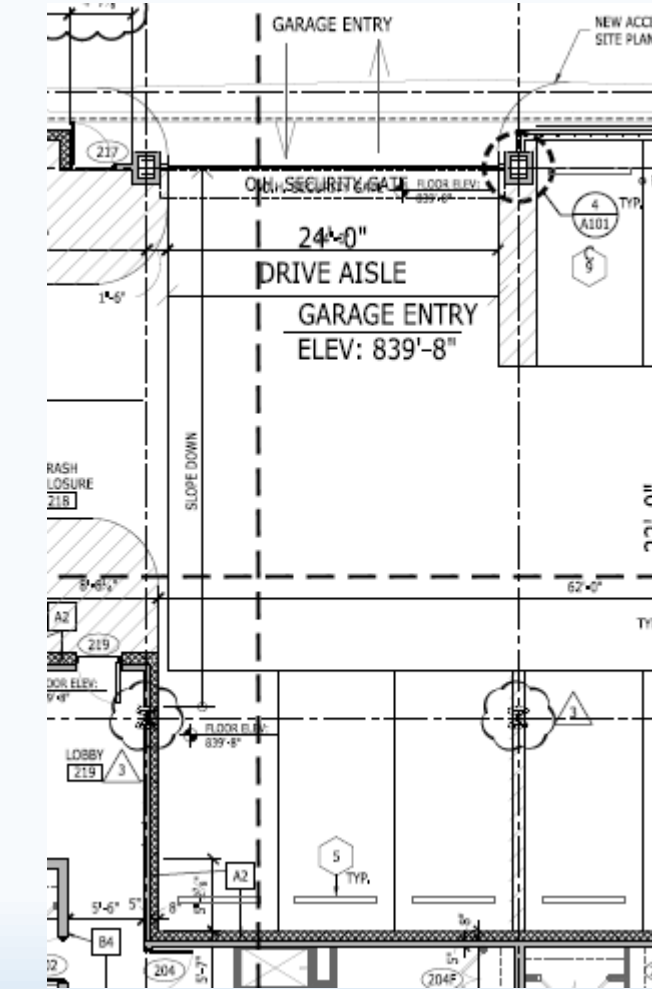
Acoustics Breadth

Gravity System

Levels 1-2



Enlarged View of Framing at Level 2 Garage Entrance



Enlarged View of Level 2 Garage Entrance

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

Economics Breadth

Acoustics Breadth

Gravity System

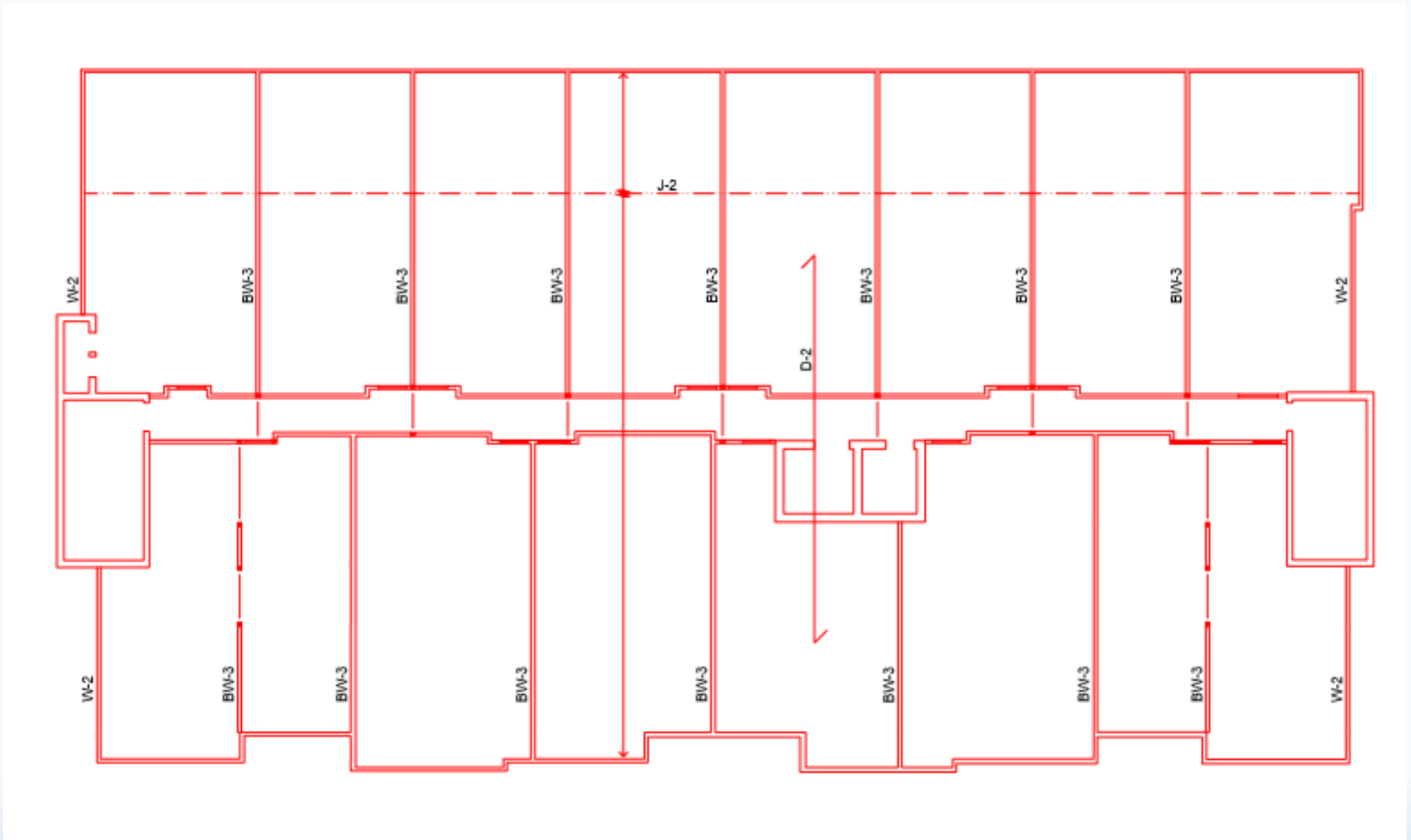
Levels 3-7

BW-3: (2) 6" Metal Studs @ 12: o.c.

W-2: 4" Metal Studs @ 12" o.c.

J-2: 14k4 @ 16" o.c.

D-2: 1.5VLI22 with 2" Concrete Topping



Level 3 Framing Plan

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

Economics Breadth

Acoustics Breadth

Gravity System

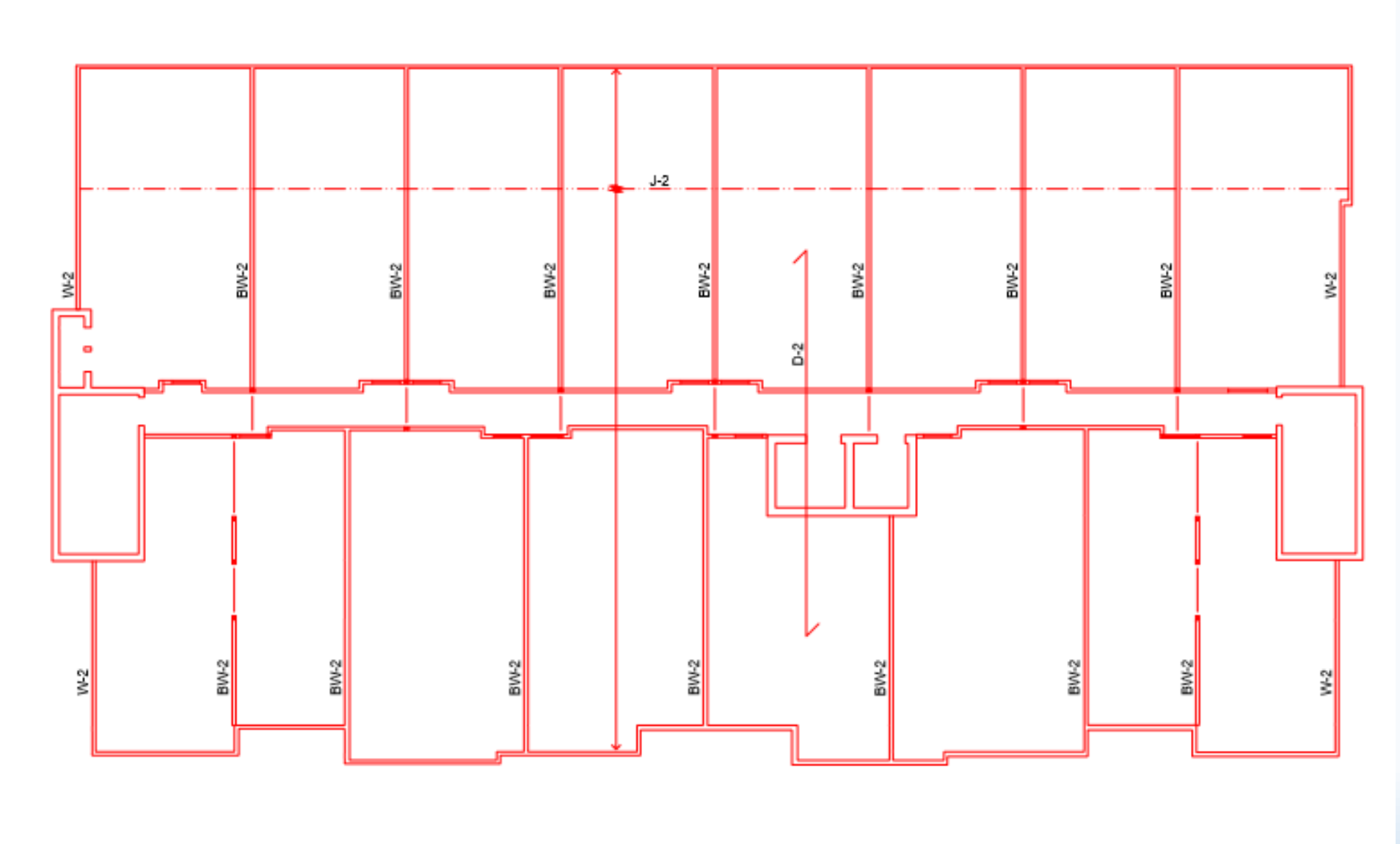
Levels 3-7

BW-2: 6" Metal Studs @ 12" o.c.

W-2: 4" Metal Studs @ 12" o.c.

J-2: 14k4 @ 16" o.c.

D-2: 1.5VLI22 with 2" Concrete Topping



Levels 4-5 Framing Plan

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

Economics Breadth

Acoustics Breadth

Gravity System

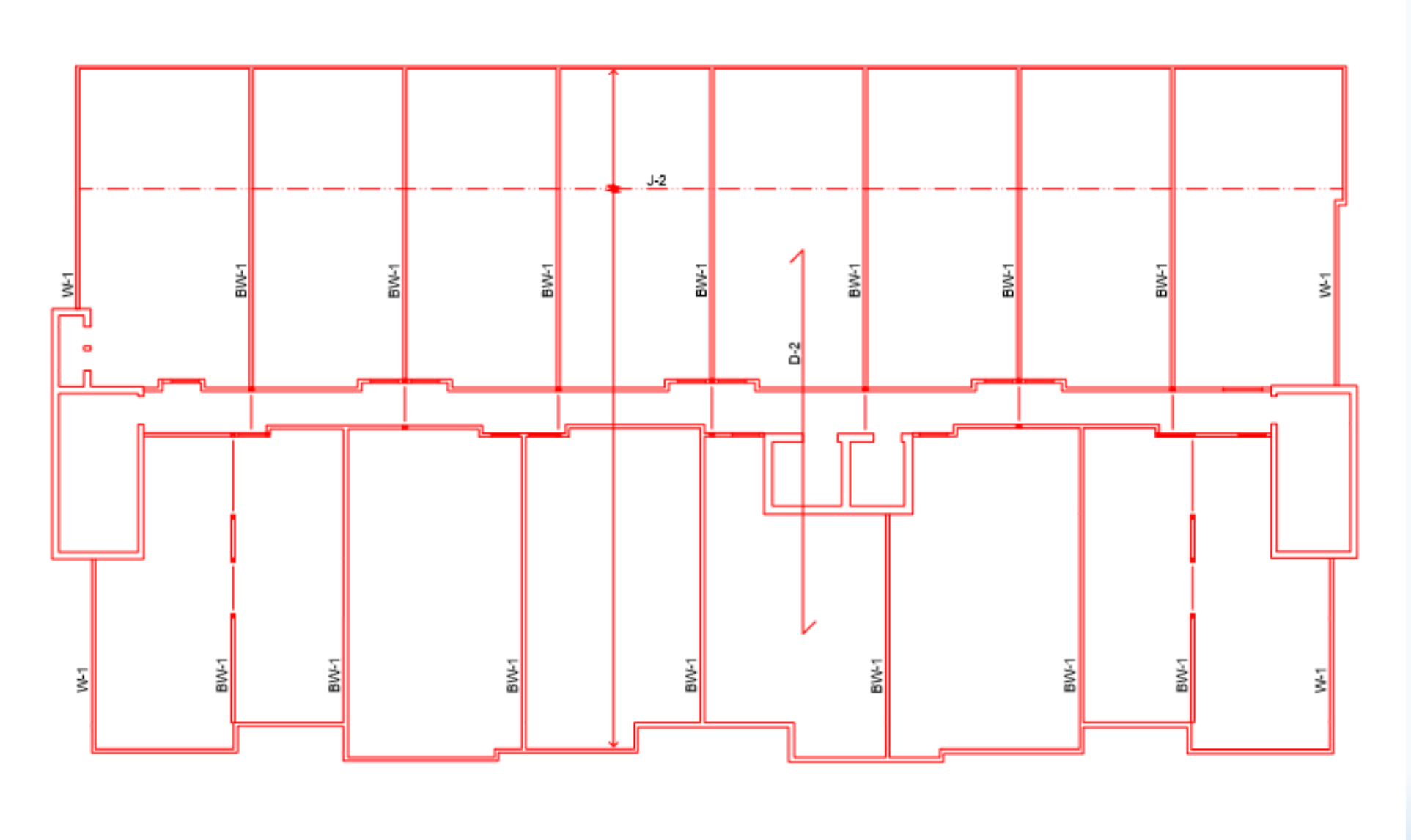
Levels 3-7

BW-1: 4" Metal Studs @ 12" o.c.

W-1: 4" Metal Studs @ 12" o.c.

J-2: 14k4 @ 16" o.c.

D-2: 1.5VLI22 with 2" Concrete Topping



Level 6 Framing Plan

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

Economics Breadth

Acoustics Breadth

Gravity System

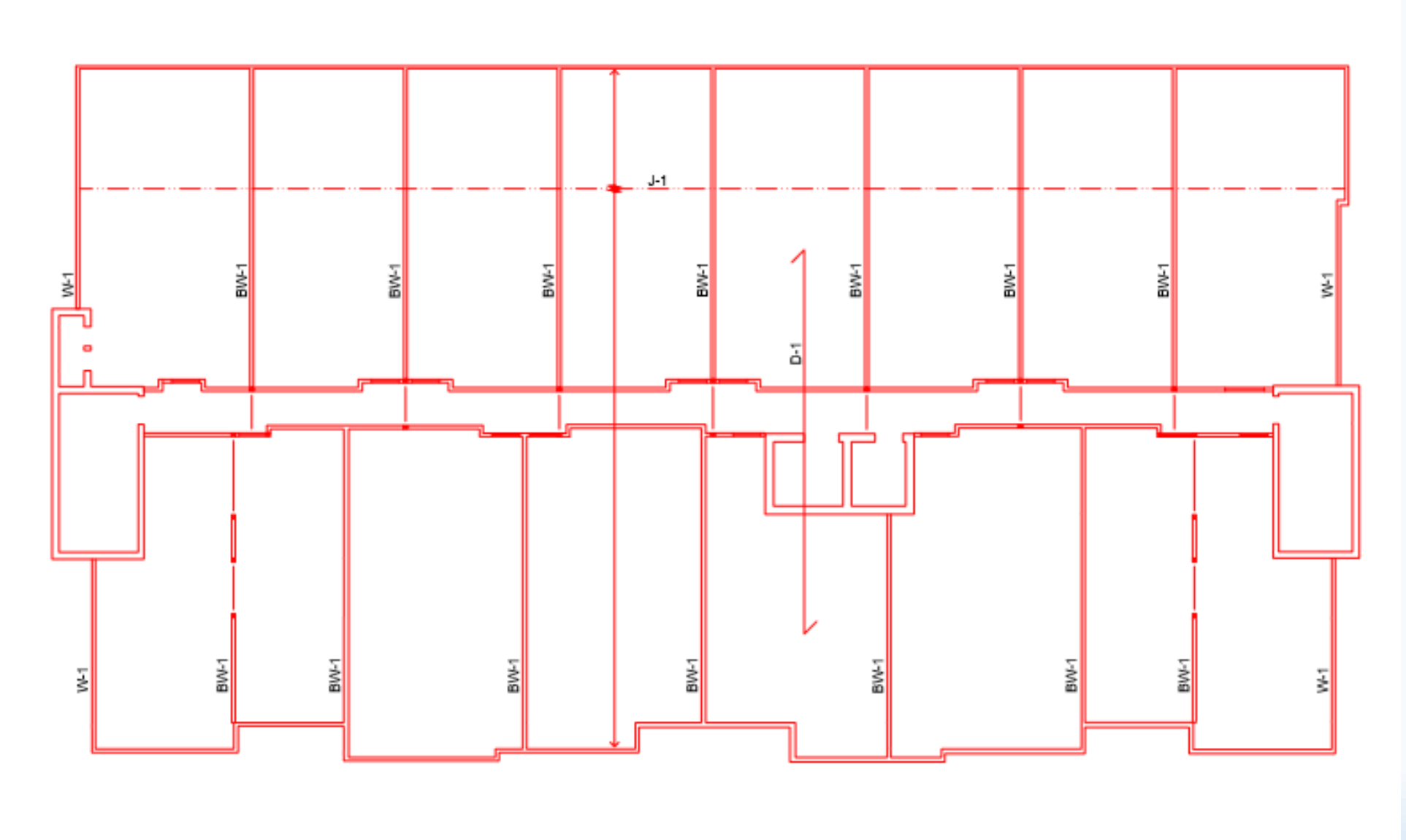
Levels 3-7

BW-1: 4" Metal Studs @ 12" o.c.

W-1: 4" Metal Studs @ 12" o.c.

J-1: 12k5 @ 16" o.c.

D-1: 1.5B24



Level 7 Framing Plan

Flats on Fifth

Pittsburgh, PA

General Information

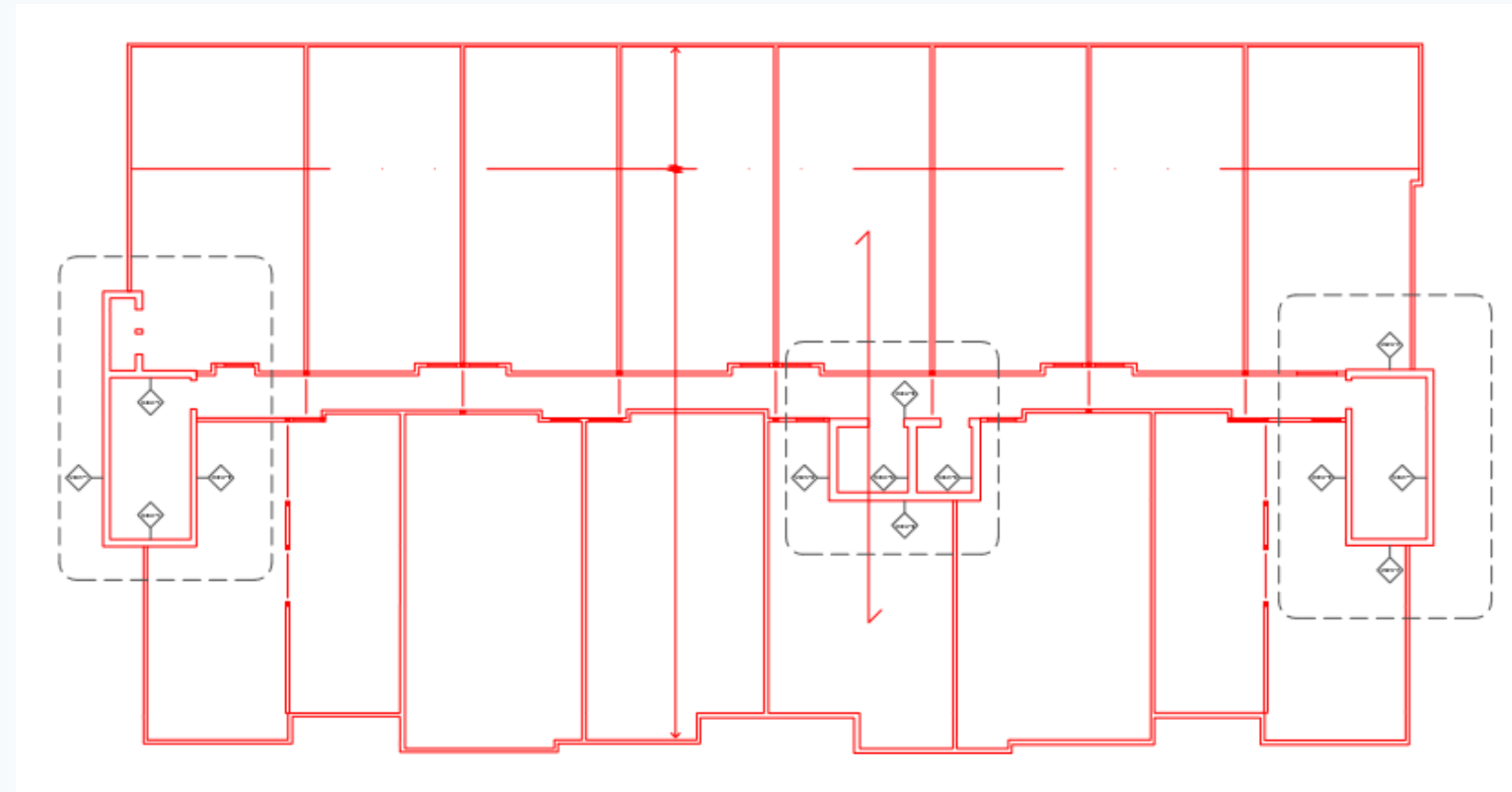
Existing Structural System

Proposed Structural System

Economics Breadth

Acoustics Breadth

Lateral System



Floor Plan with Masonry Shear Wall Callouts

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

Economics Breadth

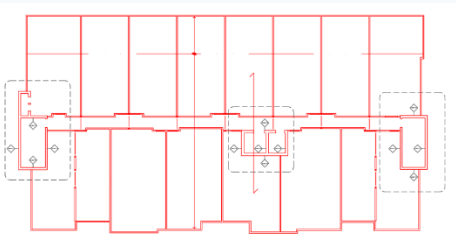
Acoustics Breadth

Lateral System

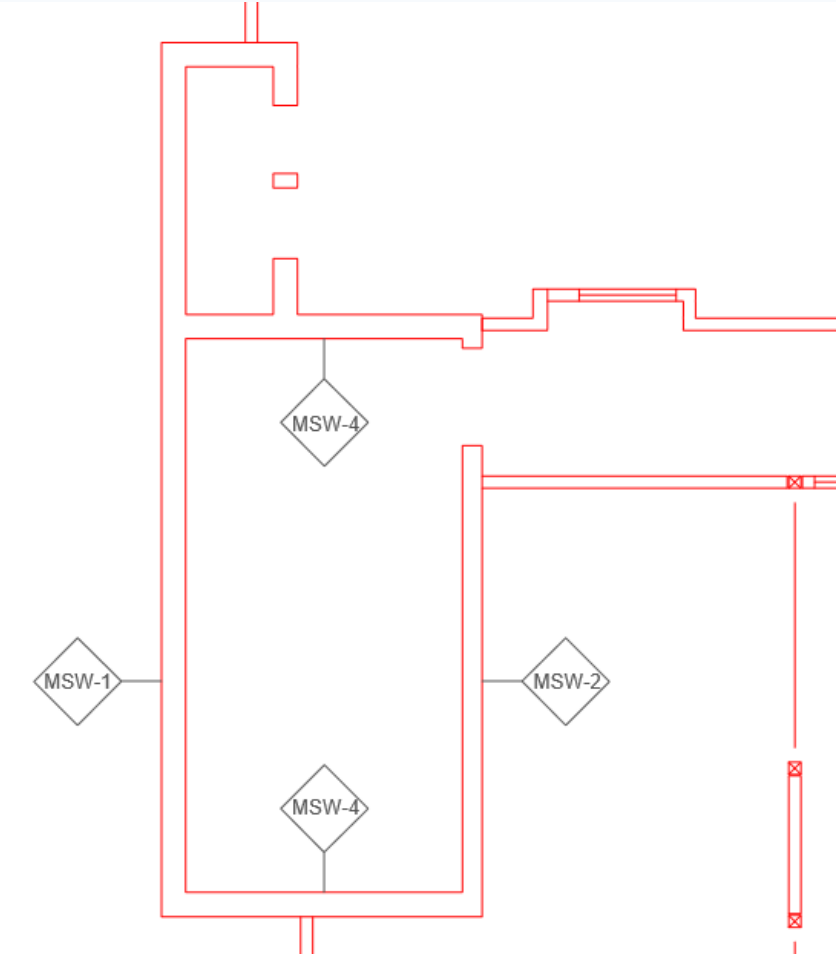
MSW-1: 10" CMU, (12) #8 End Bars

MSW-2: 12" CMU, (14) #8 End Bars

MSW-4: 12" CMU, (6) #8 End Bars



Key Plan



Plan Left Callout

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

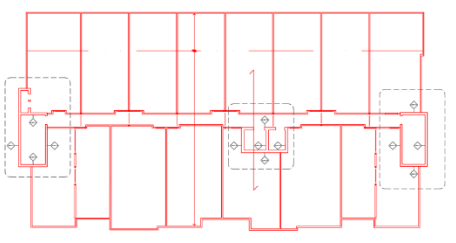
Economics Breadth

Acoustics Breadth

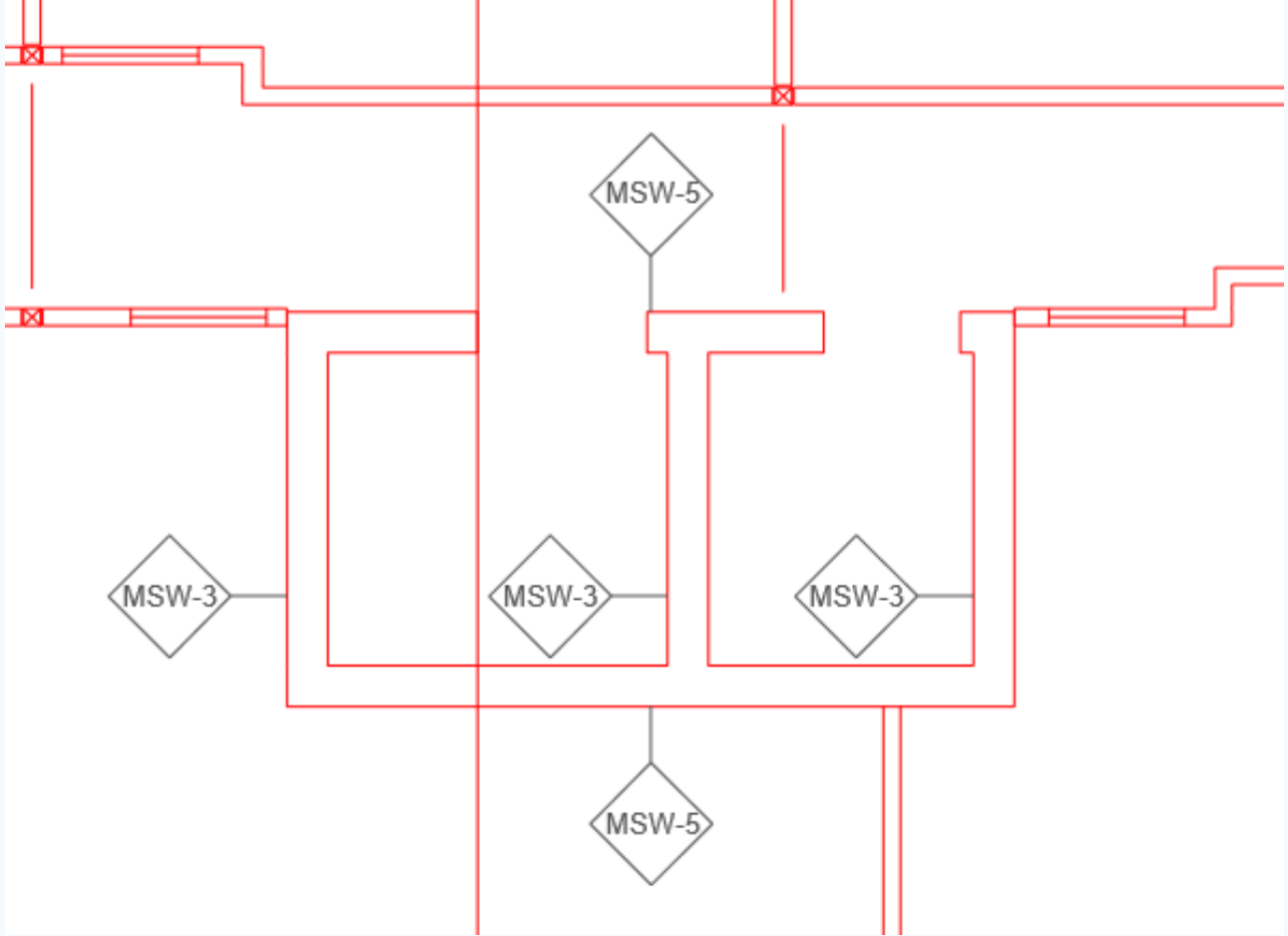
Lateral System

MSW-3: 12" CMU, (4) #8 End Bars

MSW-5: 12" CMU, (16) #8 End Bars



Key Plan



Plan Center Callout

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

Economics Breadth

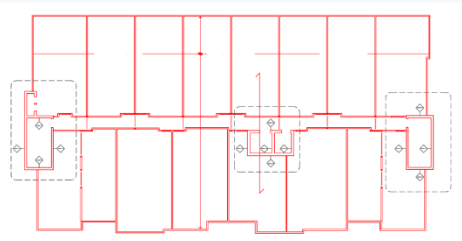
Acoustics Breadth

Lateral System

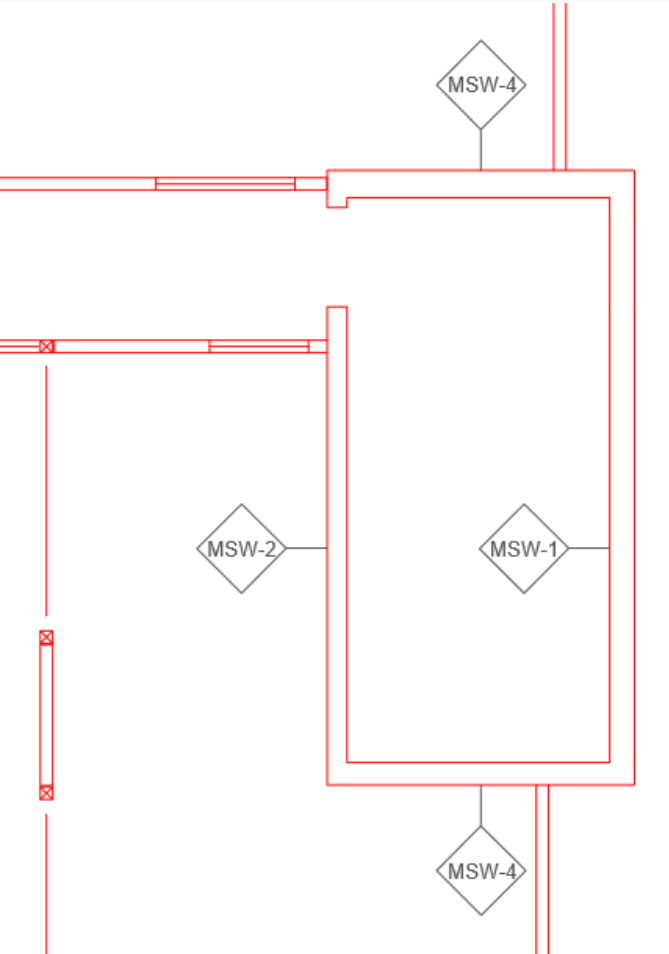
MSW-1: 10" CMU, (12) #8 End Bars

MSW-2: 12" CMU, (14) #8 End Bars

MSW-4: 12" CMU, (6) #8 End Bars



Key Plan



Plan Right Callout

Flats on Fifth

Pittsburgh, PA

Extended Studies



Flats on Fifth Pittsburgh, PA

General Information

Existing Structural System

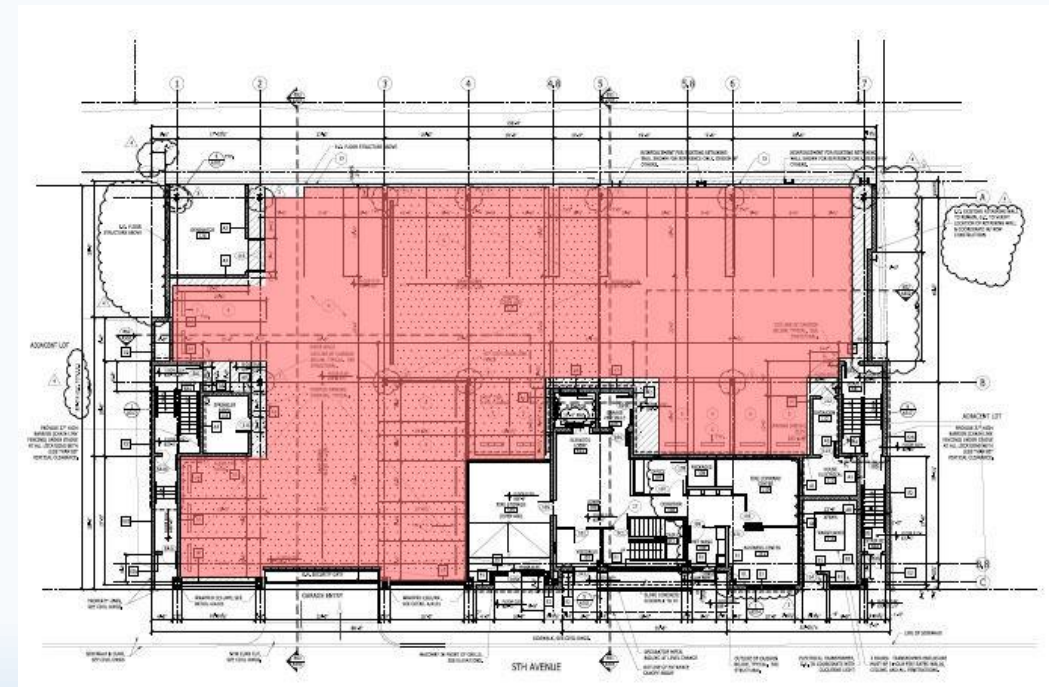
Proposed Structural System

Economics Breadth

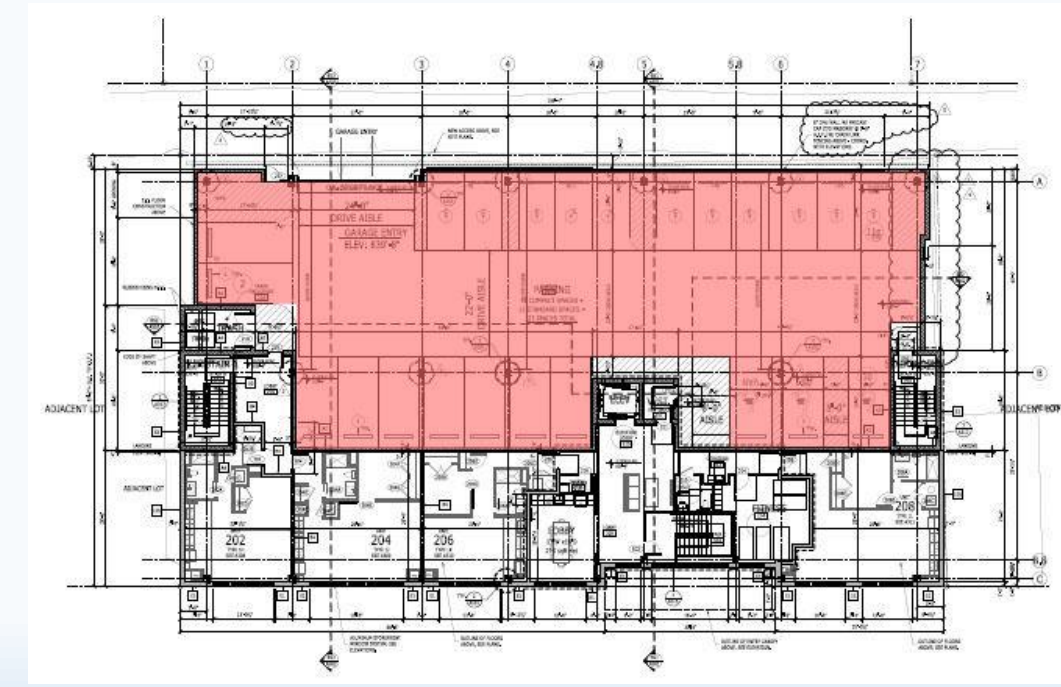
Acoustics Breadth

Economics Breadth

The goal of this breadth is to determine the economic feasibility of creating more apartment units by relocating parking below grade.



First Floor Parking



Second Floor Parking

Existing Apartment Area: 2712 ft²

Proposed Apartment Area: 10238 ft²

Area Gained: 7526 ft²

Average Rent per ft²: \$1.20

Flats on Fifth Pittsburgh, PA

General Information

Existing Structural System

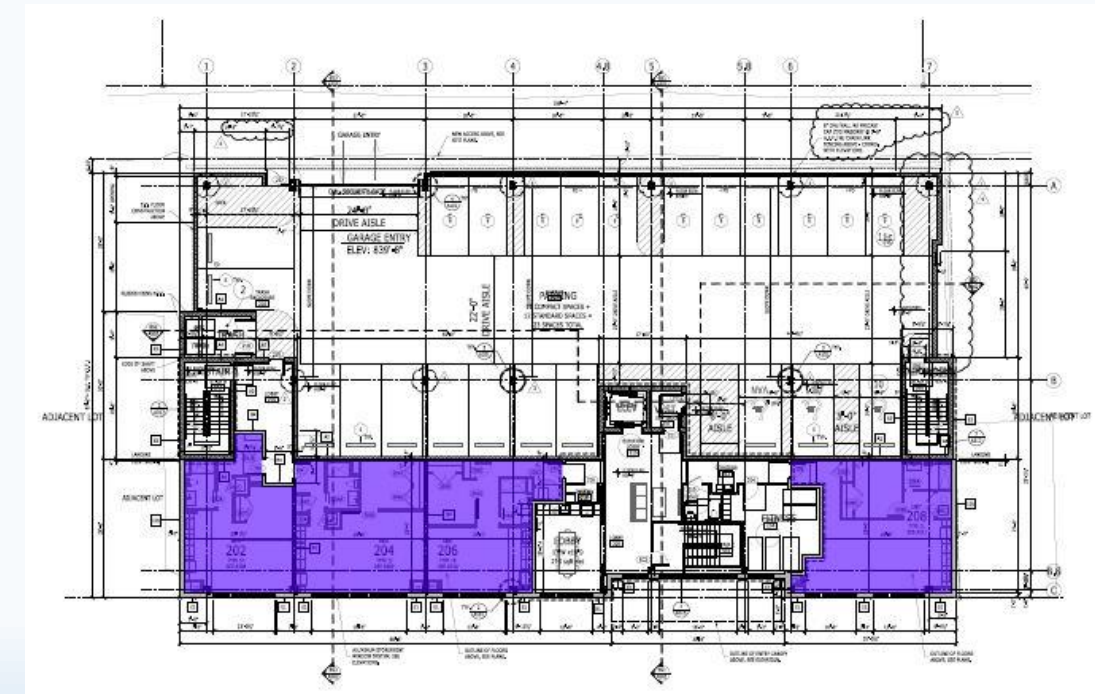
Proposed Structural System

Economics Breadth

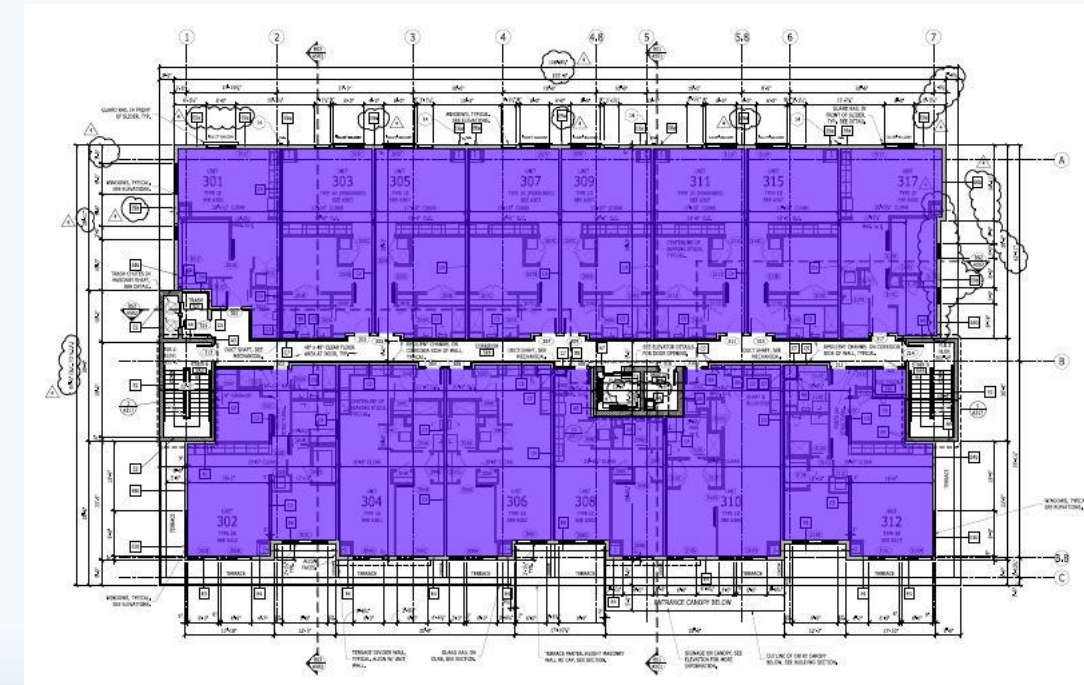
Acoustics Breadth

Economics Breadth

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Existing Apartment Area



Proposed Apartment Area

Existing Apartment Area: 2712 ft²

Proposed Apartment Area: 10238 ft²

Area Gained: 7526 ft²

Average Rent per ft²: \$1.20

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

Economics Breadth

Acoustics Breadth

Economics Breadth

Present Value of Rent Paid to Owner

Term Payment: $1.20 \times 7526 = \$9031.21$

Terms: 20 years

Interest: Assuming 5%

Present Value: \$112,548.71

Cost to Construct Parking Level

Total Cost: \$665,511.76

Decision

Cost Difference: -\$552,963.05

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

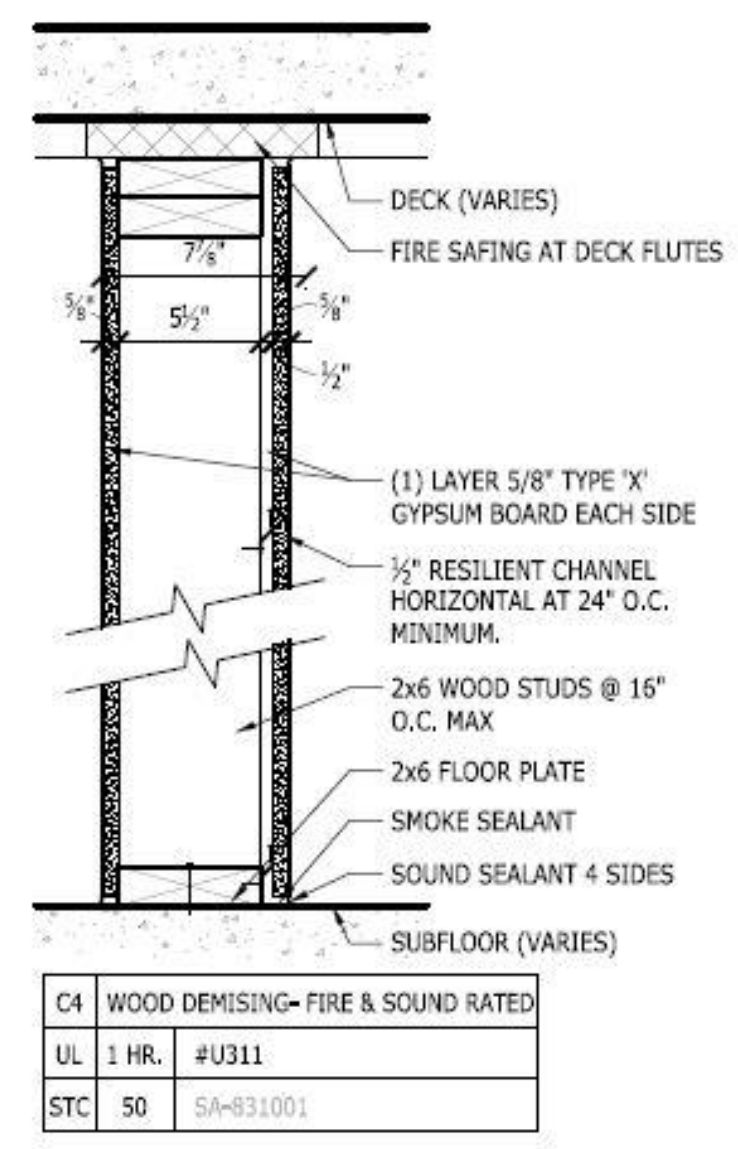
Economics Breadth

Acoustics Breadth

Acoustics Breadth

The goal of this breadth is to determine if the proposed light gauge framing system for the residential levels meets STC and IIC criteria.

Required STC	50
Mass of Existing	.36 Slugs
STC of Existing	50
Mass of New	.48 Slugs
STC of New	51.7



Existing Party Wall Assembly

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

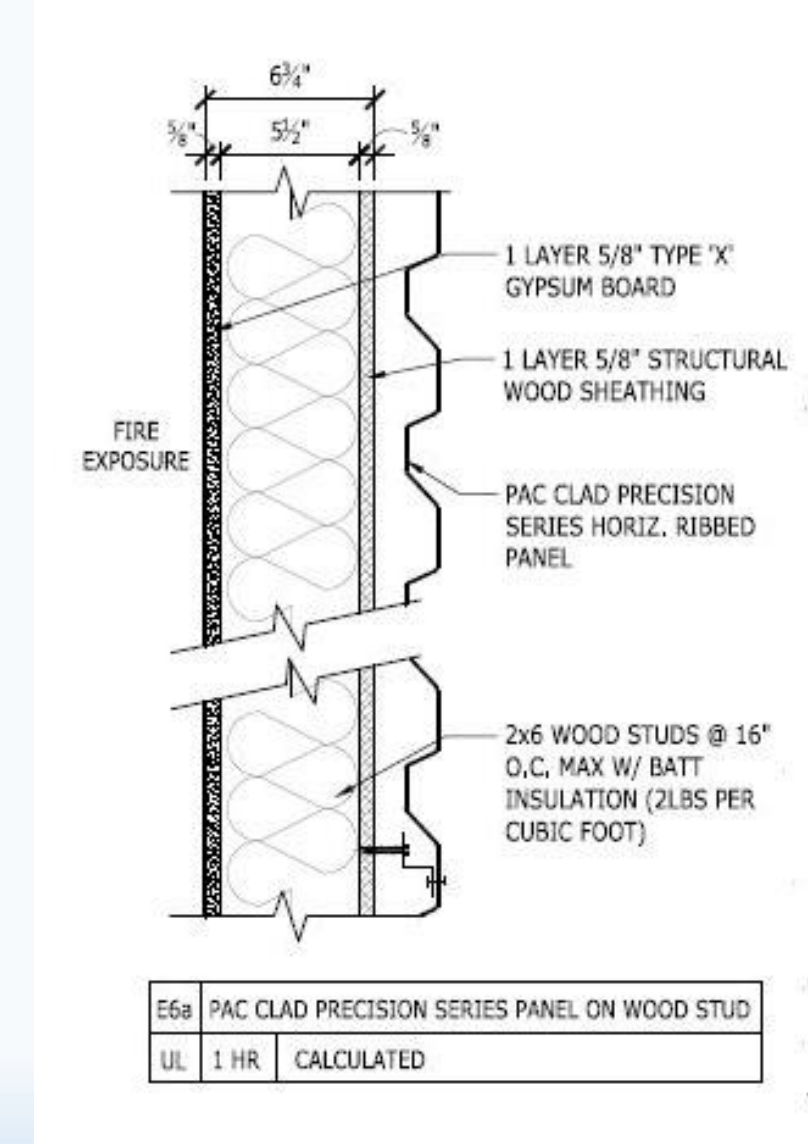
Economics Breadth

Acoustics Breadth

Acoustics Breadth

The goal of this breadth is to determine if the proposed light gauge framing system for the residential levels meets STC and IIC criteria.

Required STC	30
Mass of Existing	.36 Slugs
STC of Existing	--
Mass of New	.57 Slugs
STC of New	--



Existing Exterior Wall Assembly

Flats on Fifth

Pittsburgh, PA

General Information

Existing Structural System

Proposed Structural System

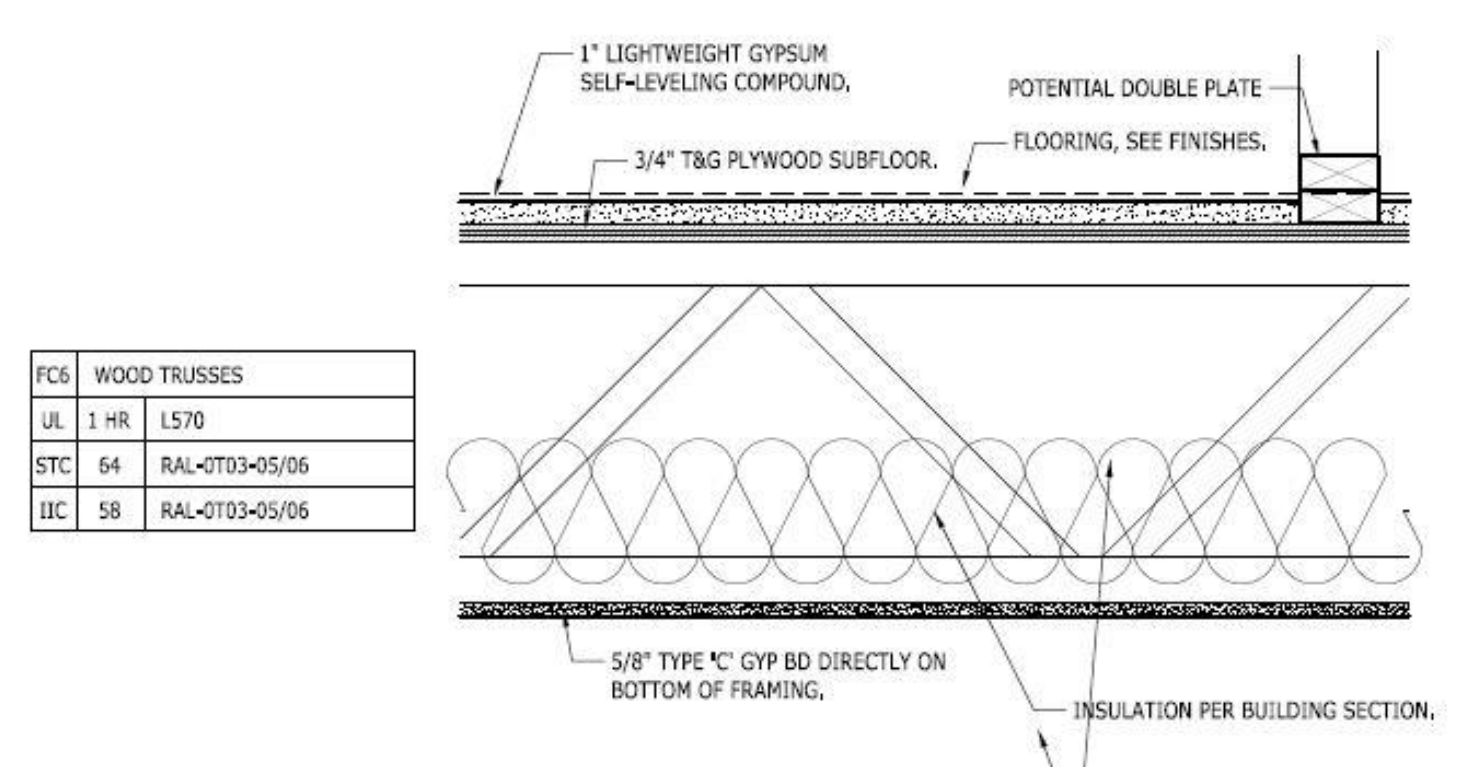
Economics Breadth

Acoustics Breadth

Acoustics Breadth

The goal of this breadth is to determine if the proposed light gauge framing system for the residential levels meets STC and IIC criteria.

Required STC	50	Required IIC	50
Mass of Existing	.60 Slugs	IIC of Existing	50
STC of Existing	64	IIC of New	67
Mass of New	1.28 Slugs		
STC of New	69.3		



Existing Floor Assembly

Concluding Remarks

Design Goals

- Retain Ability for Off-Site Prefabrication.
- Do Not Disturb Building Architecture.
- Reduce Building Cost.

Cost of Existing Structure	\$4.7 million
Cost of Proposed Structure	\$3.2 million
Difference	\$1.5 million





Acknowledgements

Special thanks to...

The AE faculty Especially Dr. Boothby.
Mark Sipos and Keystone Structural Solutions.
David Laffey and Castlebrook Development Group.
The rest of the Flats on Fifth Design team.

Also...

Classmates
Family

