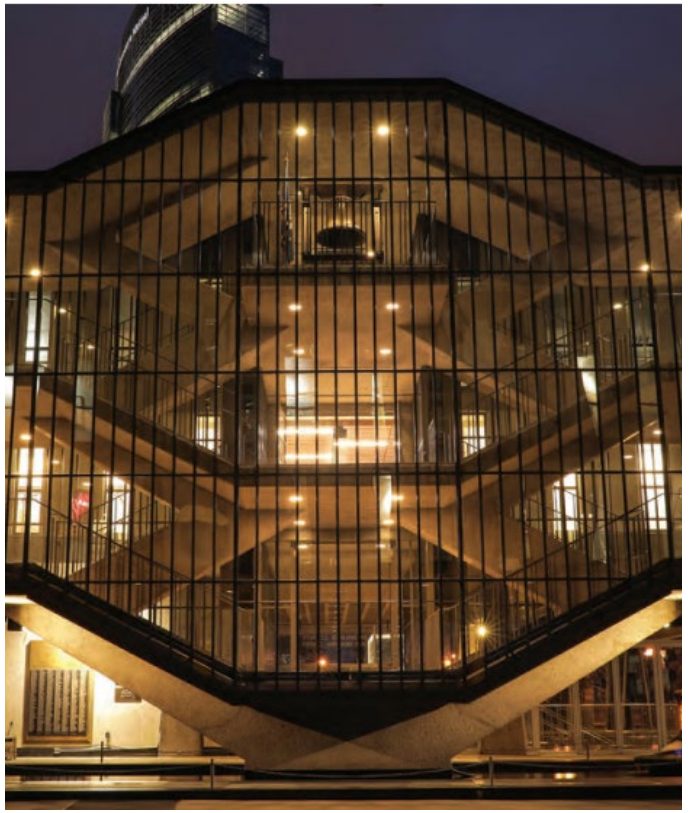
NGA GLASS CONFERENCE™ MILWAUKEE

AUGUST 6-8, 2024

NGA
NATIONAL GLASS ASSOCIATION with GANA

3 Case Studies: Milwaukee High-performance Building Innovations



3 Case Studies: Milwaukee High-performance Building Innovations

Nick Yule, technical services manager, Viracon

Steve Panaro, P.E., associate, Thornton Tomasetti

Kyle Sword, R&D director North America, NSG Pilkington

Northwestern Mutual

- Project Info:
  - Glazing Contractor: Benson
  - Architect: Pickard Chilton
  - Development Manager: Hines
  - 32 Floors
  - 390,000 sq ft of Insulating Glass
  - 12,600 IG Units
  - Glass Type: GL-1

    1-1/8" VRE1-59 Insulating Glass

    3/8" Clear, heat strengthened or fully tempered – heat soak

    VRE-59 #2, edge deletion

    1/2" airspace - black SST, Argon fill

    Sightline: 13/16"

    1/4" Clear, heat strengthened or fully tempered – heat soak

Photo Credit: JHVEPhoto

Northwestern Mutual

- Project Highlights:
  - NWM and Milwaukee desired local impact
    - Benson transformed rail car factory to unitizing facility
  - Developer used Riverpoint Chicago as a basis of design
  - Architect selected the coating to emphasize building curvature and SHGC
- Project Challenges:
  - High wind loads on building design and proximity to lakefront
    - 2SSG application - deeper sightlines
    - Heavy exterior glass
  - 30 Glass Types
  - Heat Soaking
  - Printed Glass

Photo Credit: Gottography

Northwestern Mutual

Photo Credit: Tony Savino

ASCENT + EDISON

A Case Study of Mass Timber in Milwaukee

Steve Panaro, P.E.

Thornton Tomasetti

Edison Rendering courtesy of HPA

OUR LOCATIONS

1,700
ENGINEERS, ARCHITECTS, SCIENTISTS AND OTHER PROFESSIONALS

150
COUNTRIES WORKED IN

45+
OFFICES

5
CONTINENTS

Thornton Tomasetti

ABOUT ME

STEVE PANARO, P.E.

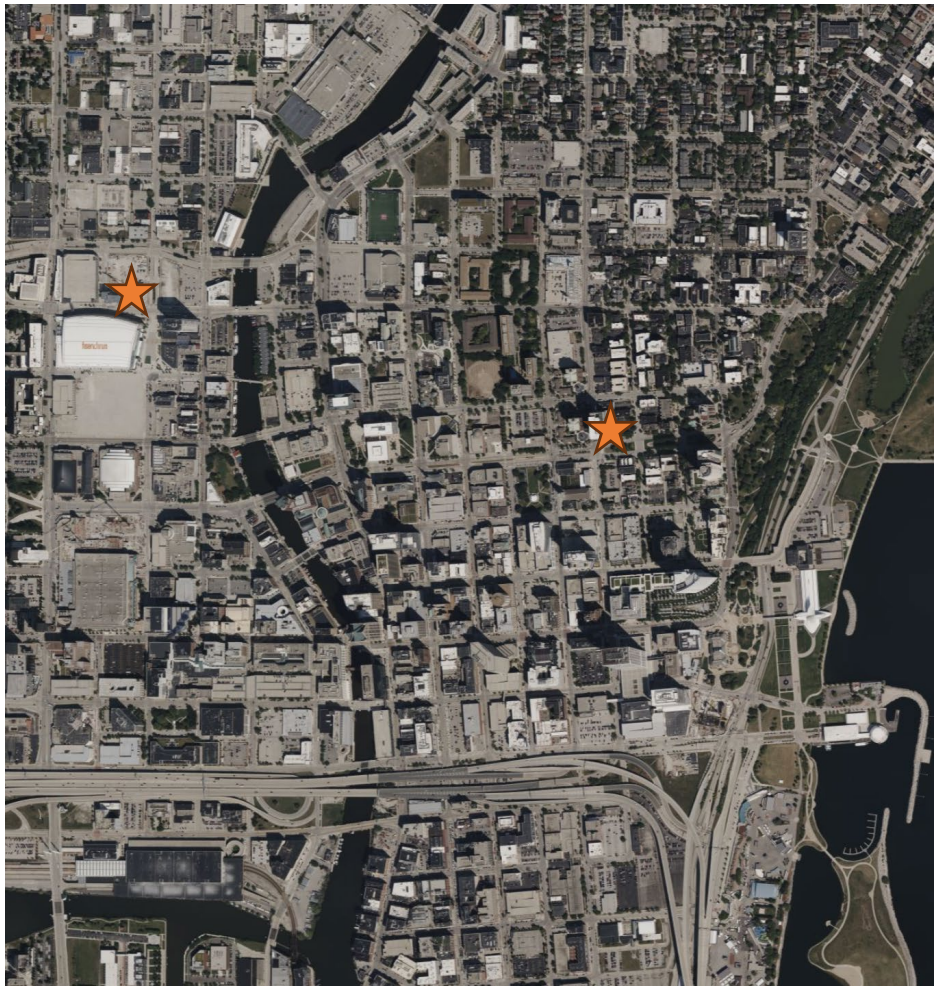
MSOE

B.S. IN ARCHITECTURAL ENGINEERING
STRUCTURAL ENGINEERING FOCUS

SPECIAL INTERESTS

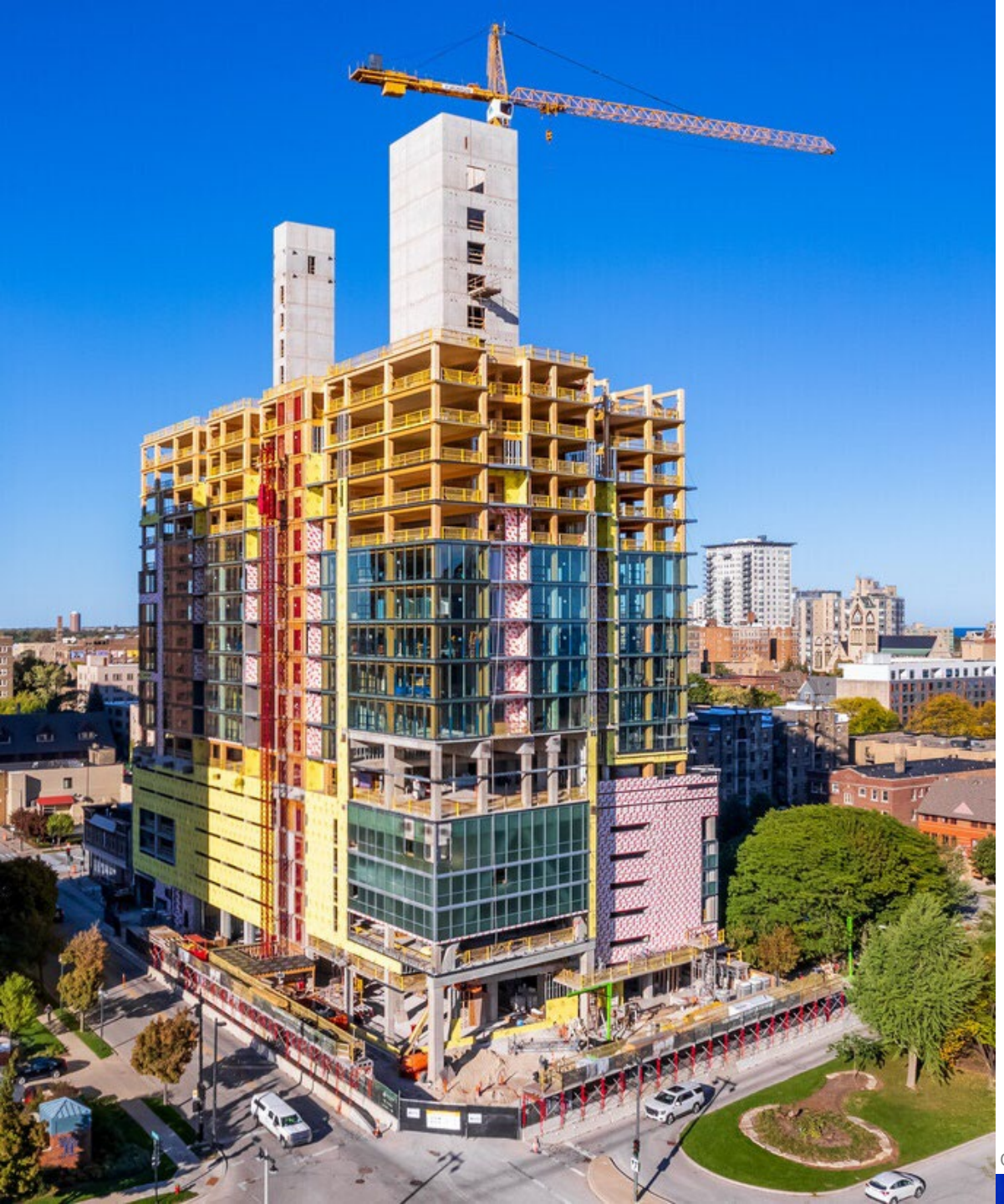
ALUMINUM & GLASS DESIGN
“SPECIAL” STRUCTURES
SUSTAINABLE DESIGN
ARTIFICIAL INTELLIGENCE + MACHINE LEARNING

ASCENT



CREDIT: KORB + ASSOCIATES

Thornton Tomasetti



CREDIT: KORB + ASSOCIATES

Ascent

TEAM:

Architect – Korb + Associates

(now Korb Architecture)

Structural Engineer – Thornton Tomasetti

Contractor – CD Smith

Developer – New Land Enterprises

Envelope – Klein Dickert Glass

Height – 284 ft, 26 stories

Gross Area – 456,000 sf

Housing – 259 apartments

Structural Topping Out – December 2021

Completion – Summer 2022

Ascent

ENVELOPE TEAM:

KD GLASS
Klein-Dickert Milwaukee, Inc.

Oldcastle BuildingEnvelope®

SIGNATURE 8000 SERIES WINDOW WALL

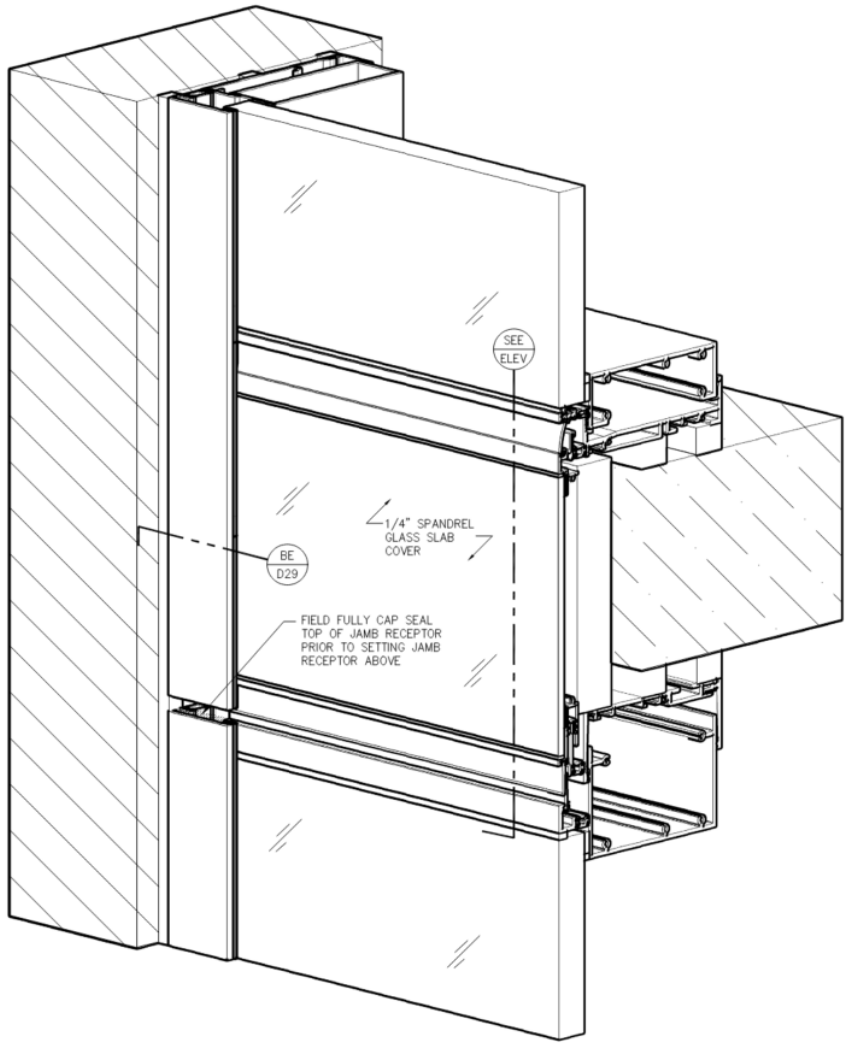
KAWNEER
AN ARCONIC COMPANY

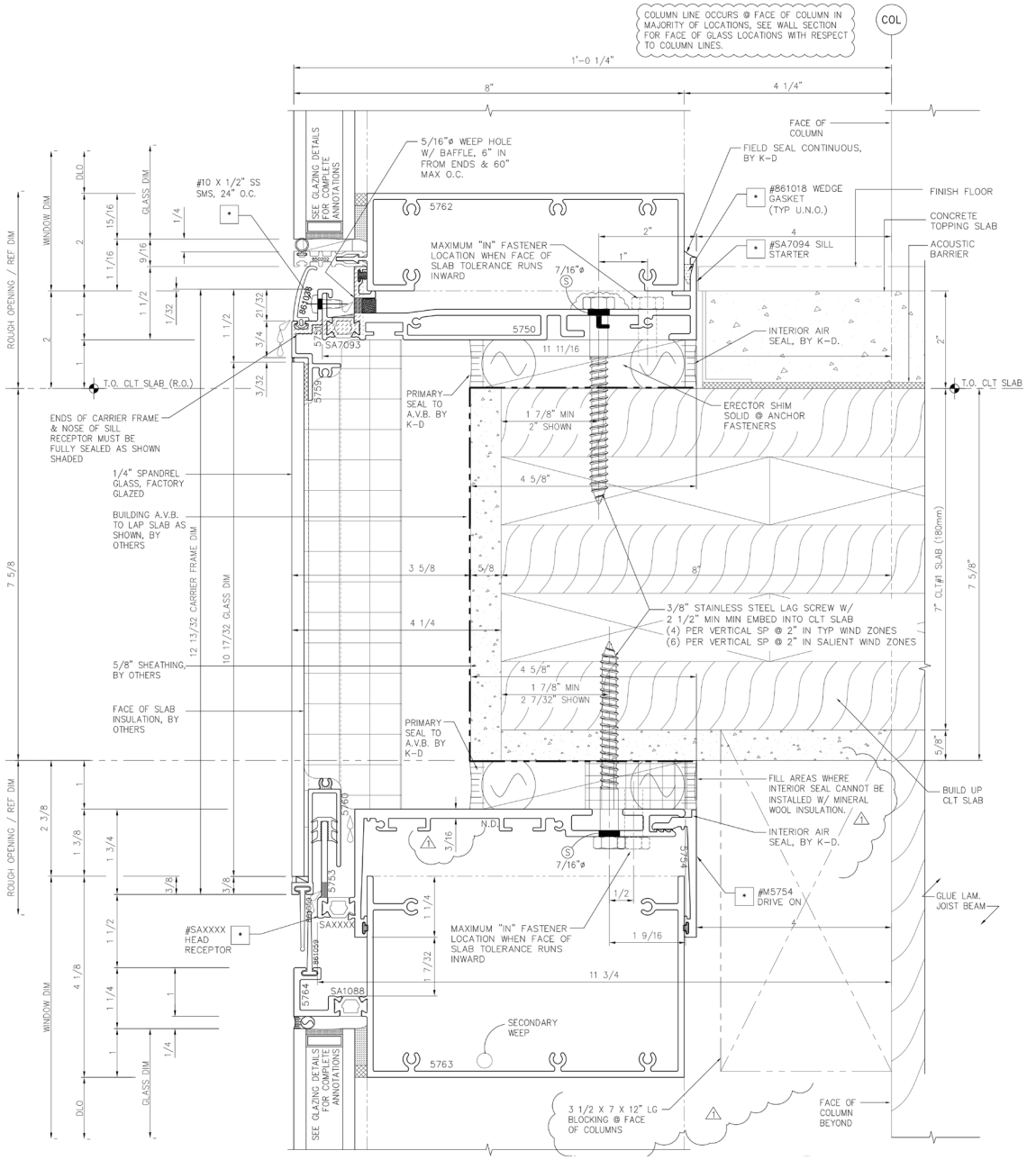
1600 SYSTEM 1 & TRIFAB 451T STOREFRONT

INTUS WINDOWS

POLYMER STEEL REINFORCED SUPERA WINDOWS &DOORS

Ascent


SEE ELEV
1/4" SPANDREL GLASS SLAB COVER
BE D29
FIELD FULLY CAP SEAL TOP OF JAMB RECEPTOR PRIOR TO SETTING JAMB RECEPTOR ABOVE

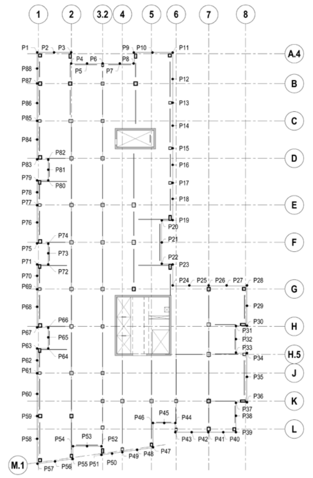

COLUMN LINE OCCURS @ FACE OF COLUMN IN MAJORITY OF LOCATIONS, SEE WALL SECTION FOR FACE OF GLASS LOCATIONS WITH RESPECT TO COLUMN LINES.
COL
1'-0 1/4"
8"
4 1/4"
FACE OF COLUMN
5/16"ø WEEP HOLE W/ BAFFLE, 6" IN FROM ENDS & 60" MAX O.C.
FIELD SEAL CONTINUOUS, BY K-D
#861018 WEDGE GASKET (TYP U.N.O.)
FINISH FLOOR
CONCRETE TOPPING SLAB
ACOUSTIC BARRIER
#SA7094 SILL STARTER
#10 X 1/2" SS SMS, 24" O.C.
SEE GLAZING DETAILS FOR COMPLETE ANNOTATIONS
5762
MAXIMUM "IN" FASTENER LOCATION WHEN FACE OF SLAB TOLERANCE RUNS INWARD
7/16"ø
5750
INTERIOR AIR SEAL, BY K-D.
SA7093
T.O. CLT SLAB (R.O.)
T.O. CLT SLAB
PRIMARY SEAL TO A.V.B. BY K-D
ERECTOR SHIM SOLID @ ANCHOR FASTENERS
ENDS OF CARRIER FRAME & NOSE OF SILL RECEPTOR MUST BE FULLY SEALED AS SHOWN SHADED
1/4" SPANDREL GLASS, FACTORY GLAZED
BUILDING A.V.B. TO LAP SLAB AS SHOWN, BY OTHERS
5/8" SHEATHING, BY OTHERS
FACE OF SLAB INSULATION, BY OTHERS
3/8" STAINLESS STEEL LAG SCREW W/ 2 1/2" MIN MIN EMBED INTO CLT SLAB
(4) PER VERTICAL SP @ 2" IN TYP WIND ZONES
(6) PER VERTICAL SP @ 2" IN SALIENT WIND ZONES
7" CLT#1 SLAB (180mm)
BUILD UP CLT SLAB
FILL AREAS WHERE INTERIOR SEAL CANNOT BE INSTALLED W/ MINERAL WOOL INSULATION.
INTERIOR AIR SEAL, BY K-D.
#M5754 DRIVE ON
GLUE LAM. JOIST BEAM
#SAXXXX HEAD RECEPTOR
SAXXXX
MAXIMUM "IN" FASTENER LOCATION WHEN FACE OF SLAB TOLERANCE RUNS INWARD
SA1088
SECONDARY WEEP
5763
3 1/2 X 7 X 12" LG BLOCKING @ FACE OF COLUMNS
FACE OF COLUMN BEYOND
ROUGH OPENING / REF DIM
WINDOW DIM
GLASS DIM
DLO
12 13/32 CARRIER FRAME DIM
10 17/32 GLASS DIM
7 5/8
2 3/8
4 1/8

Ascent

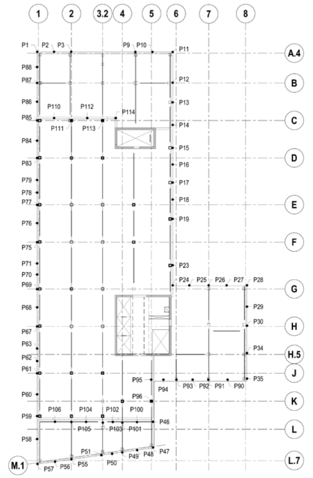
NATIONAL GLASS ASSOCIATION with GANA

SHEET NOTES

1. FLOOR LIVE LOAD DEFLECTION IS INSTANTANEOUS LIVE LOAD DEFLECTION IRRESPECTIVE OF TIME OF LOADING
2. POSITIVE MOVEMENT INDICATES POINT ABOVE THEORETICAL LEVEL HEIGHT
3. NEGATIVE MOVEMENT INDICATES POINT BELOW THEORETICAL LEVEL HEIGHT



1 TYPICAL LEVELS DEFLECTION CONTROL POINTS
SCALE: 1" = 20'-0"



2 UPPER LEVELS DEFLECTION CONTROL POINTS
SCALE: 1" = 20'-0"

PREDICTED TOWER VERTICAL MOVEMENTS

CONTROL POINT	AT FACADE INSTALLATION																		
	LVL 8	LVL 9	LVL 10	LVL 11	LVL 12	LVL 13	LVL 14	LVL 15	LVL 16	LVL 17	LVL 18	LVL 19	LVL 20	LVL 21	LVL 22	LVL 23	LVL 24	LVL 25	ROOF
P1	1/16"	1/8"	1/8"	3/16"	1/4"	5/16"	5/16"	3/8"	7/16"	1/2"	1/2"	9/16"	9/16"	5/8"	5/8"	11/16"	11/16"	3/4"	0"
P2	0"	1/8"	1/8"	3/16"	3/16"	1/4"	5/16"	3/8"	3/8"	7/16"	7/16"	1/2"	1/2"	9/16"	9/16"	5/8"	5/8"	11/16"	0"
P3	1/16"	1/8"	1/8"	3/16"	1/4"	5/16"	5/16"	3/8"	3/8"	7/16"	1/2"	1/2"	9/16"	9/16"	5/8"	5/8"	5/8"	11/16"	0"
P4	-1/16"	1/16"	1/16"	1/8"	3/16"	1/4"	1/4"	5/16"	5/16"	3/8"	7/16"	7/16"	1/2"	1/2"	1/2"	9/16"	9/16"	0"	0"
P5	-1/16"	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	9/16"	5/8"	11/16"	11/16"	11/16"	3/4"	11/16"	0"	0"
P6	1/8"	1/4"	3/8"	7/16"	1/2"	5/8"	11/16"	3/4"	13/16"	7/8"	15/16"	1"	1 1/16"	1 1/16"	1 1/16"	1 1/16"	1 1/16"	0"	0"
P7	-1/16"	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	9/16"	5/8"	11/16"	11/16"	11/16"	3/4"	3/4"	0"	0"
P8	-1/16"	1/16"	1/8"	3/16"	3/16"	1/4"	1/4"	5/16"	3/8"	7/16"	7/16"	1/2"	1/2"	9/16"	9/16"	9/16"	9/16"	0"	0"
P9	1/16"	1/8"	1/8"	3/16"	1/4"	5/16"	5/16"	3/8"	3/8"	7/16"	1/2"	1/2"	9/16"	9/16"	9/16"	5/8"	5/8"	11/16"	0"

Ascent

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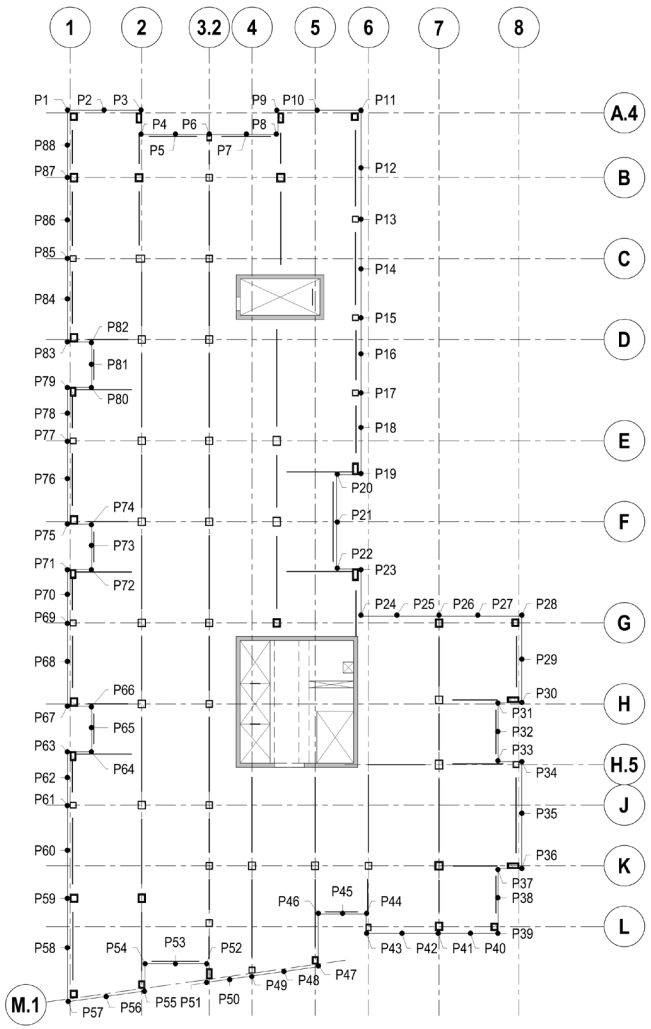


1 TYPICAL LEVELS DEFLECTION CONTROL POINTS

SCALE: 1" = 20'-0"

PREDICTED TOWER VERTICAL MOVEMENTS

CONTROL POINT	AT FACADE INSTALLATION																									CONTROL POINT
	LVL 8	LVL 9	LVL 10	LVL 11	LVL 12	LVL 13	LVL 14	LVL 15	LVL 16	LVL 17	LVL 18	LVL 19	LVL 20	LVL 21	LVL 22	LVL 23	LVL 24	LVL 25	ROOF	
P1	1/16"	1/8"	1/8"	3/16"	1/4"	5/16"	5/16"	3/8"	7/16"	1/2"	1/2"	9/16"	9/16"	5/8"	5/8"	11/16"	11/16"	3/4"	0"	P1
P2	0"	1/8"	1/8"	3/16"	3/16"	1/4"	5/16"	3/8"	3/8"	7/16"	7/16"	1/2"	1/2"	9/16"	9/16"	5/8"	5/8"	11/16"	0"	P2
P3	1/16"	1/8"	1/8"	3/16"	1/4"	5/16"	5/16"	3/8"	3/8"	7/16"	1/2"	1/2"	9/16"	9/16"	5/8"	5/8"	5/8"	11/16"	0"	P3
P4	-1/16"	1/16"	1/16"	1/8"	3/16"	1/4"	1/4"	5/16"	5/16"	3/8"	7/16"	7/16"	1/2"	1/2"	1/2"	9/16"	9/16"	0"	0"	P4
P5	-1/16"	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	9/16"	5/8"	11/16"	11/16"	11/16"	3/4"	11/16"	0"	0"	P5
P6	1/8"	1/4"	3/8"	7/16"	1/2"	5/8"	11/16"	3/4"	13/16"	7/8"	15/16"	1"	1 1/16"	1 1/16"	1 1/16"	1 1/16"	1 1/16"	0"	0"	P6
P7	-1/16"	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	9/16"	5/8"	11/16"	11/16"	11/16"	3/4"	3/4"	0"	0"	P7
P8	-1/16"	1/16"	1/8"	3/16"	3/16"	1/4"	1/4"	5/16"	3/8"	7/16"	7/16"	1/2"	1/2"	9/16"	9/16"	9/16"	9/16"	0"	0"	P8
P9	1/16"	1/8"	1/8"	3/16"	1/4"	5/16"	5/16"	3/8"	3/8"	7/16"	1/2"	1/2"	9/16"	9/16"	9/16"	5/8"	5/8"	11/16"	0"	P9
P10	-1/16"	1/16"	1/8"	3/16"	3/16"	1/4"	1/4"	5/16"	3/8"	7/16"	7/16"	1/2"	1/2"	9/16"	9/16"	9/16"	9/16"	5/8"	0"	P10
P11	1/16"	1/8"	1/8"	3/16"	1/4"	5/16"	5/16"	3/8"	3/8"	7/16"	1/2"	1/2"	9/16"	9/16"	9/16"	5/8"	5/8"	11/16"	0"	P11
P12	-3/16"	-1/16"	-1/16"	1/16"	1/8"	3/16"	3/16"	1/4"	5/16"	5/16"	3/8"	7/16"	7/16"	1/2"	1/2"	1/2"	1/2"	5/8"	0"	P12
P13	1/8"	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	9/16"	5/8"	11/16"	3/4"	3/4"	3/4"	13/16"	13/16"	13/16"	13/16"	13/16"	0"	P13
P14	-1/8"	-1/16"	1/16"	1/8"	3/16"	1/4"	5/16"	5/16"	3/8"	7/16"	1/2"	1/2"	9/16"	9/16"	9/16"	5/8"	5/8"	3/4"	0"	P14
P15	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"	1/2"	9/16"	5/8"	11/16"	11/16"	3/4"	3/4"	13/16"	13/16"	13/16"	3/4"	P15
P16	-1/8"	-1/16"	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	3/8"	7/16"	1/2"	1/2"	9/16"	9/16"	5/8"	5/8"	11/16"	11/16"	11/16"	P16
P17	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"	1/2"	9/16"	5/8"	5/8"	11/16"	11/16"	3/4"	3/4"	3/4"	13/16"	3/4"	P17

CONTROL POINT	AT CONSTRUCTION COMPLETION																									CONTROL POINT
	LVL 8	LVL 9	LVL 10	LVL 11	LVL 12	LVL 13	LVL 14	LVL 15	LVL 16	LVL 17	LVL 18	LVL 19	LVL 20	LVL 21	LVL 22	LVL 23	LVL 24	LVL 25	ROOF	
P1	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P1
P2	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P2
P3	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P3
P4	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P4
P5	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P5
P6	1/8"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P6
P7	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P7
P8	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P8
P9	1/16"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P9
P10	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P10
P11	1/16"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P11
P12	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	0"	P12
P13	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P13
P14	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P14
P15	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P15
P16	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P16
P17	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P17

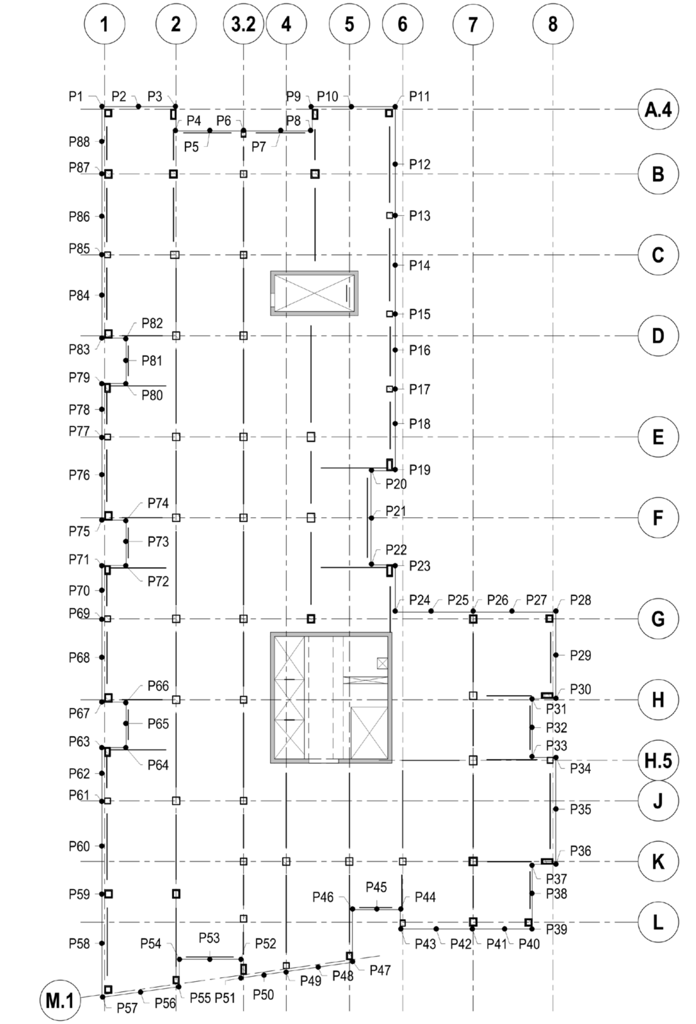
CONTROL POINT	TOTAL LONG TERM (INCLUDES LIVE LOAD AT EACH LVL)																									CONTROL POINT
	LVL 8	LVL 9	LVL 10	LVL 11	LVL 12	LVL 13	LVL 14	LVL 15	LVL 16	LVL 17	LVL 18	LVL 19	LVL 20	LVL 21	LVL 22	LVL 23	LVL 24	LVL 25	ROOF	
P1	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P1
P2	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P2
P3	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P3
P4	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P4
P5	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P5
P6	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P6
P7	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P7
P8	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P8
P9	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P9
P10	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P10
P11	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P11
P12	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P12
P13	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P13
P14	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P14
P15	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P15
P16	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P16
P17	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	0"	P17

CONTROL POINT	FLOOR LIVE LOAD DEFLECTION (SEE NOTE 1)																									CONTROL POINT
	LVL 8	LVL 9	LVL 10	LVL 11	LVL 12	LVL 13	LVL 14	LVL 15	LVL 16	LVL 17	LVL 18	LVL 19	LVL 20	LVL 21	LVL 22	LVL 23	LVL 24	LVL 25	ROOF	
P1	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P1
P2	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P2
P3	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P3
P4	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	0"	P4
P5	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-1"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-1"	0"	P5
P6	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P6
P7	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-1"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-1"	0"	P7
P8	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P8
P9	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P9
P10	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	0"	P10
P11	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P11
P12	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-1"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-1"	0"	P12
P13	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P13
P14	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	0"	P14
P15	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P15
P16	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	0"	P16
P17	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P17

Ascent

SHEET NOTES

1. FLOOR LIVE LOAD DEFLECTION IS INSTANTANEOUS LIVE LOAD DEFLECTION IRRESPECTIVE OF TIME OF LOADING
2. POSITIVE MOVEMENT INDICATES POINT ABOVE THEORETICAL LEVEL HEIGHT
3. NEGATIVE MOVEMENT INDICATES POINT BELOW THEORETICAL LEVEL HEIGHT



1 TYPICAL LEVELS DEFLECTION CONTROL POINTS

SCALE: 1" = 20'-0"

PREDICTED TOWER VERTICAL MOVEMENTS

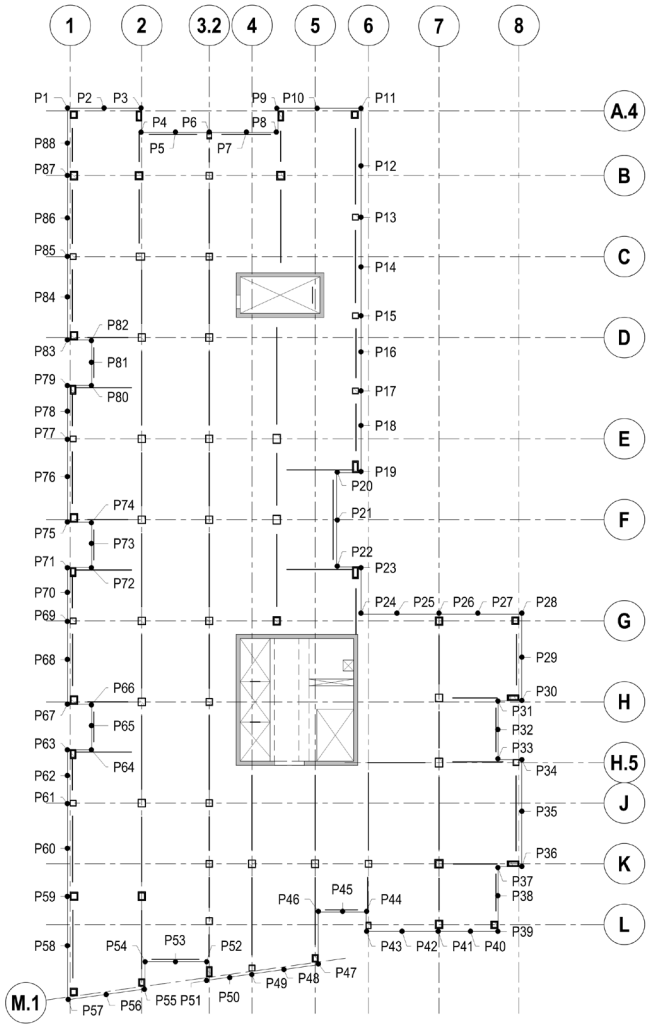
AT CONSTRUCTION COMPLETITION

LVL 8	LVL 9	LVL 10	LVL 11	LVL 12	LVL 13	LVL 14	LVL 15	LVL 16	LVL 17	LVL 18	LVL 19	LVL 20	LVL 21	LVL 22	LVL 23	LVL 24	LVL 25	ROOF
-1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	3/16"	3/16"	3/16"	0"
-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/16"	-1/8"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	1/16"	0"
-1/16"	1/16"	-1/16"	1/16"	0"	1/16"	0"	1/16"	1/16"	1/16"	1/16"	1/16"	0"	1/16"	0"	1/16"	-1/16"	1/16"	0"
-3/16"	-1/8"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	0"	0"
-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	0"	0"
1/16"	1/16"	1/16"	1/16"	1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-3/16"	-1/4"	-1/4"	0"	0"
-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	0"	0"
-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	0"	0"
-1/16"	0"	-1/16"	0"	-1/16"	0"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	0"
-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-1/4"	-3/16"	-1/4"	-3/16"	-1/4"	-3/16"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-3/16"	0"
-1/16"	0"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/8"	-1/16"	0"
-3/8"	-3/8"	-3/8"	-7/16"	-7/16"	-7/16"	-7/16"	-1/2"	-1/2"	-1/2"	-1/2"	-1/2"	-9/16"	-9/16"	-9/16"	-9/16"	-5/8"	-1/2"	0"
1/16"	1/8"	1/16"	1/16"	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-3/16"	-3/16"	-1/4"	-1/4"	-1/4"	-1/4"	-5/16"	-5/16"	-3/8"	0"
-3/8"	-5/16"	-3/8"	-3/8"	-3/8"	-7/16"	-7/16"	-7/16"	-1/2"	-1/2"	-1/2"	-1/2"	-1/2"	-1/2"	-9/16"	-9/16"	-9/16"	-1/2"	0"
-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-3/16"	-1/4"
-1/4"	-1/4"	-5/16"	-5/16"	-5/16"	-5/16"	-3/8"	-3/8"	-3/8"	-3/8"	-3/8"	-3/8"	-3/8"	-7/16"	-7/16"	-7/16"	-7/16"	-3/8"	-3/8"
-1/16"	-1/16"	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-5/16"	-3/8"

Ascent

SHEET NOTES

1. FLOOR LIVE LOAD DEFLECTION IS INSTANTANEOUS LIVE LOAD DEFLECTION IRRESPECTIVE OF TIME OF LOADING
2. POSITIVE MOVEMENT INDICATES POINT ABOVE THEORETICAL LEVEL HEIGHT
3. NEGATIVE MOVEMENT INDICATES POINT BELOW THEORETICAL LEVEL HEIGHT



1 TYPICAL LEVELS DEFLECTION CONTROL POINTS

SCALE: 1" = 20'-0"

PREDICTED TOWER VERTICAL MOVEMENTS

AT FACADE INSTALLATION | AT CONSTRUCTION COMPLETION | TOTAL LONG TERM (INCLUDES LIVE LOAD AT EACH LVL) | FLOOR LIVE LOAD DEFLECTION (SEE NOTE 1)

CONTROL POINT	LVL 8	LVL 9	LVL 10	LVL 11	LVL 12	LVL 13	LVL 14	LVL 15	LVL 16	LVL 17	LVL 18	LVL 19	LVL 20	LVL 21	LVL 22	LVL 23	LVL 24	LVL 25	ROOF
P1	-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-3/16"	-3/16"	-1/4"	-1/4"	-1/4"	-1/4"	-5/16"	-5/16"	-5/16"	-5/16"	-3/8"	-3/8"	0"
P2	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-7/16"	-7/16"	-1/2"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-5/8"	-5/8"	-5/8"	-11/16"	-5/8"	0"
P3	-1/16"	-1/16"	-1/8"	-1/8"	-3/16"	-3/16"	-1/4"	-1/4"	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	0"
P4	-7/16"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-5/8"	-11/16"	-3/4"	-3/4"	-3/4"	-13/16"	-7/8"	-7/8"	-15/16"	-15/16"	0"	0"
P5	-11/16"	-3/4"	-13/16"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	-1 1/4"	-1 5/16"	-1 3/8"	-1 7/16"	-1 7/16"	-1 1/2"	0"	0"
P6	-1/16"	-1/8"	-1/4"	-5/16"	-3/8"	-7/16"	-1/2"	-5/8"	-11/16"	-3/4"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	0"	0"
P7	-5/8"	-11/16"	-3/4"	-3/4"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	-1 1/4"	-1 5/16"	-1 3/8"	-1 7/16"	-1 1/2"	0"	0"
P8	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-11/16"	-11/16"	-3/4"	-3/4"	-13/16"	-13/16"	-7/8"	0"	0"
P9	-1/16"	-1/8"	-1/8"	-3/16"	-1/4"	-1/4"	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-5/8"	0"
P10	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-11/16"	-11/16"	-3/4"	-3/4"	-13/16"	-7/8"	-7/8"	-15/16"	-15/16"	-1"	-1"	-1 1/16"	-15/16"	0"
P11	-1/16"	-1/8"	-3/16"	-3/16"	-1/4"	-1/4"	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-5/8"	-11/16"	0"
P12	-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	-1 5/16"	-1 3/8"	-1 7/16"	-1 1/2"	-1 1/2"	-1 9/16"	-1 5/8"	-1 11/16"	-1 3/4"	-1 3/4"	-1 13/16"	-1 7/8"	-1 5/8"	0"
P13	-1/16"	-1/16"	-3/16"	-1/4"	-3/8"	-7/16"	-1/2"	-5/8"	-11/16"	-3/4"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	0"
P14	-15/16"	-15/16"	-1"	-1 1/8"	-1 3/16"	-1 1/4"	-1 5/16"	-1 3/8"	-1 7/16"	-1 1/2"	-1 9/16"	-1 5/8"	-1 11/16"	-1 11/16"	-1 3/4"	-1 13/16"	-1 7/8"	-1 1/2"	0"
P15	-1/16"	-1/8"	-1/8"	-3/16"	-1/4"	-1/4"	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-5/8"	-1"
P16	-11/16"	-3/4"	-13/16"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	-1 1/4"	-1 5/16"	-1 3/8"	-1 7/16"	-1 7/16"	-1 1/2"	0"	0"
P17	-1/16"	-1/8"	-1/4"	-5/16"	-3/8"	-7/16"	-1/2"	-5/8"	-11/16"	-3/4"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	0"	0"
P18	-5/8"	-11/16"	-3/4"	-3/4"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	-1 1/4"	-1 5/16"	-1 3/8"	-1 7/16"	-1 1/2"	0"	0"
P19	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-11/16"	-11/16"	-3/4"	-3/4"	-13/16"	-13/16"	-7/8"	0"	0"
P20	-1/16"	-1/8"	-1/8"	-3/16"	-1/4"	-1/4"	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-5/8"	0"
P21	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-11/16"	-11/16"	-3/4"	-3/4"	-13/16"	-7/8"	-7/8"	-15/16"	-15/16"	-1"	-1"	-1 1/16"	-15/16"	0"
P22	-1/16"	-1/8"	-3/16"	-3/16"	-1/4"	-1/4"	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-5/8"	-11/16"	0"
P23	-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	-1 5/16"	-1 3/8"	-1 7/16"	-1 1/2"	-1 1/2"	-1 9/16"	-1 5/8"	-1 11/16"	-1 3/4"	-1 3/4"	-1 13/16"	-1 7/8"	-1 5/8"	0"
P24	-1/16"	-1/16"	-3/16"	-1/4"	-3/8"	-7/16"	-1/2"	-5/8"	-11/16"	-3/4"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	0"
P25	-15/16"	-15/16"	-1"	-1 1/8"	-1 3/16"	-1 1/4"	-1 5/16"	-1 3/8"	-1 7/16"	-1 1/2"	-1 9/16"	-1 5/8"	-1 11/16"	-1 11/16"	-1 3/4"	-1 13/16"	-1 7/8"	-1 1/2"	0"
P26	-1/16"	-1/8"	-3/16"	-1/4"	-5/16"	-3/8"	-7/16"	-1/2"	-9/16"	-9/16"	-5/8"	-11/16"	-11/16"	-3/4"	-3/4"	-13/16"	-13/16"	-7/8"	-1"
P27	-11/16"	-3/4"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	-1 1/4"	-1 5/16"	-1 3/8"	-1 3/8"	-1 7/16"	-1 1/2"	-1 1/2"	-1 3/8"	-1 1/4"
P28	-1/8"	-3/16"	-1/4"	-5/16"	-3/8"	-7/16"	-1/2"	-9/16"	-5/8"	-11/16"	-3/4"	-13/16"	-7/8"	-15/16"	-15/16"	-1"	-1"	-1 1/16"	-1 1/4"

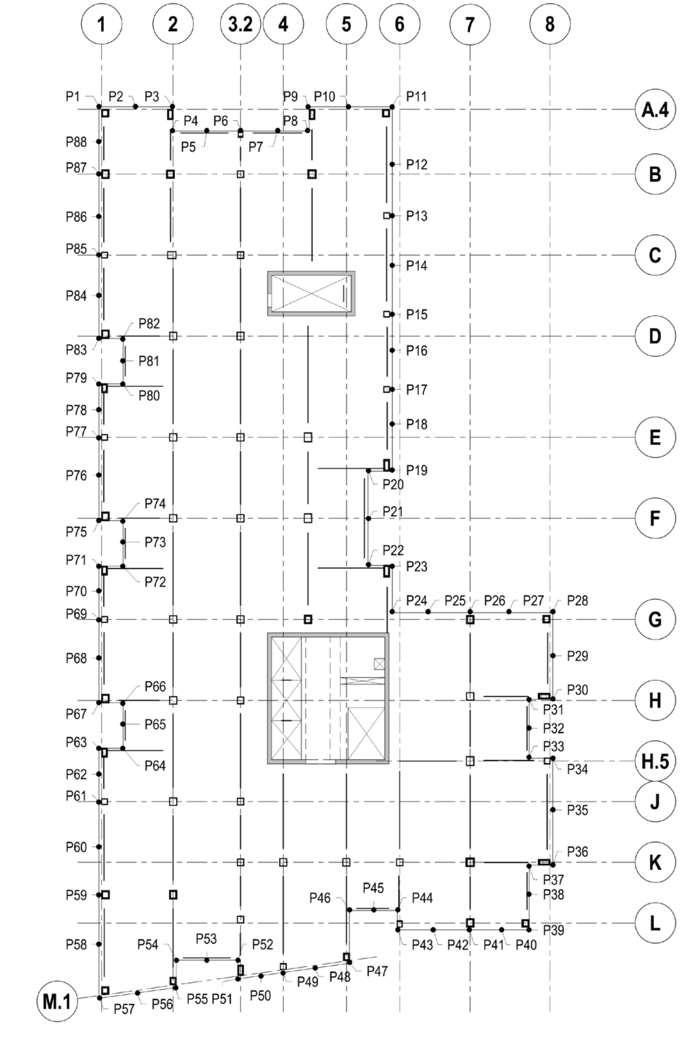
TOTAL LONG TERM (INCLUDES LIVE LOAD AT EACH LVL)

LVL 8	LVL 9	LVL 10	LVL 11	LVL 12	LVL 13	LVL 14	LVL 15	LVL 16	LVL 17	LVL 18	LVL 19	LVL 20	LVL 21	LVL 22	LVL 23	LVL 24	LVL 25	ROOF
-1/16"	-1/16"	-1/8"	-1/8"	-1/8"	-1/8"	-3/16"	-3/16"	-1/4"	-1/4"	-1/4"	-1/4"	-5/16"	-5/16"	-5/16"	-5/16"	-3/8"	-3/8"	0"
-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-7/16"	-7/16"	-1/2"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-5/8"	-5/8"	-5/8"	-11/16"	-5/8"	0"
-1/16"	-1/16"	-1/8"	-1/8"	-3/16"	-3/16"	-1/4"	-1/4"	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	0"
-7/16"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-5/8"	-11/16"	-3/4"	-3/4"	-3/4"	-13/16"	-7/8"	-7/8"	-15/16"	-15/16"	0"	0"
-11/16"	-3/4"	-13/16"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	-1 1/4"	-1 5/16"	-1 3/8"	-1 7/16"	-1 7/16"	-1 1/2"	0"	0"
-1/16"	-1/8"	-1/4"	-5/16"	-3/8"	-7/16"	-1/2"	-5/8"	-11/16"	-3/4"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	0"	0"
-5/8"	-11/16"	-3/4"	-3/4"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	-1 1/4"	-1 5/16"	-1 3/8"	-1 7/16"	-1 1/2"	0"	0"
-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-11/16"	-11/16"	-3/4"	-3/4"	-13/16"	-13/16"	-7/8"	0"	0"
-1/16"	-1/8"	-1/8"	-3/16"	-1/4"	-1/4"	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-5/8"	0"
-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-11/16"	-11/16"	-3/4"	-3/4"	-13/16"	-7/8"	-7/8"	-15/16"	-15/16"	-1"	-1"	-1 1/16"	-15/16"	0"
-1/16"	-1/8"	-3/16"	-3/16"	-1/4"	-1/4"	-5/16"	-5/16"	-3/8"	-3/8"	-7/16"	-1/2"	-1/2"	-9/16"	-9/16"	-5/8"	-5/8"	-11/16"	0"
-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	-1 5/16"	-1 3/8"	-1 7/16"	-1 1/2"	-1 1/2"	-1 9/16"	-1 5/8"	-1 11/16"	-1 3/4"	-1 3/4"	-1 13/16"	-1 7/8"	-1 5/8"	0"
-1/16"	-1/16"	-3/16"	-1/4"	-3/8"	-7/16"	-1/2"	-5/8"	-11/16"	-3/4"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	0"
-15/16"	-15/16"	-1"	-1 1/8"	-1 3/16"	-1 1/4"	-1 5/16"	-1 3/8"	-1 7/16"	-1 1/2"	-1 9/16"	-1 5/8"	-1 11/16"	-1 11/16"	-1 3/4"	-1 13/16"	-1 7/8"	-1 1/2"	0"
-1/16"	-1/8"	-3/16"	-1/4"	-5/16"	-3/8"	-7/16"	-1/2"	-9/16"	-9/16"	-5/8"	-11/16"	-11/16"	-3/4"	-3/4"	-13/16"	-13/16"	-7/8"	-1"
-11/16"	-3/4"	-13/16"	-7/8"	-15/16"	-1"	-1 1/16"	-1 1/8"	-1 3/16"	-1 1/4"	-1 1/4"	-1 5/16"	-1 3/8"	-1 3/8"	-1 7/16"	-1 1/2"	-1 1/2"	-1 3/8"	-1 1/4"
-1/8"	-3/16"	-1/4"	-5/16"	-3/8"	-7/16"	-1/2"	-9/16"	-5/8"	-11/16"	-3/4"	-13/16"	-7/8"	-15/16"	-15/16"	-1"	-1"	-1 1/16"	-1 1/4"

Ascent

SHEET NOTES

1. FLOOR LIVE LOAD DEFLECTION IS INSTANTANEOUS LIVE LOAD DEFLECTION IRRESPECTIVE OF TIME OF LOADING
2. POSITIVE MOVEMENT INDICATES POINT ABOVE THEORETICAL LEVEL HEIGHT
3. NEGATIVE MOVEMENT INDICATES POINT BELOW THEORETICAL LEVEL HEIGHT



1 TYPICAL LEVELS DEFLECTION CONTROL POINTS

SCALE: 1" = 20'-0"

PREDICTED TOWER VERTICAL MOVEMENTS

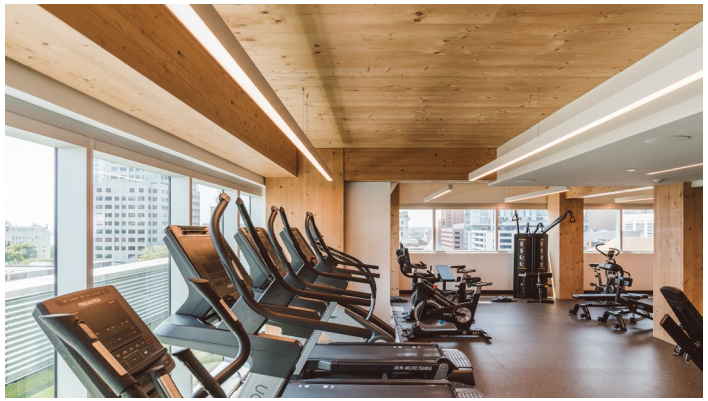
AT FACADE INSTALLATION / AT CONSTRUCTION COMPLETION / TOTAL LONG TERM (INCLUDES LIVE LOAD AT EACH LVL) / FLOOR LIVE LOAD DEFLECTION (SEE NOTE 1)

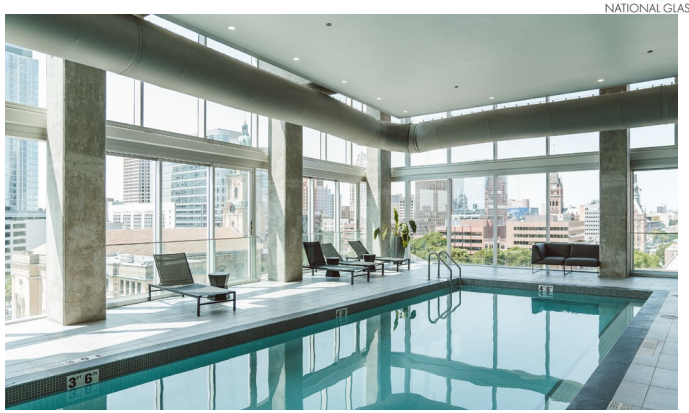
FLOOR LIVE LOAD DEFLECTION (SEE NOTE 1)																			CONTROL POINT
LVL 8	LVL 9	LVL 10	LVL 11	LVL 12	LVL 13	LVL 14	LVL 15	LVL 16	LVL 17	LVL 18	LVL 19	LVL 20	LVL 21	LVL 22	LVL 23	LVL 24	LVL 25	ROOF	
0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P1
-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/16"	0"	P2
0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P3
-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	0"	0"	P4
-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	0"	0"	P5
0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P6
-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	0"	0"	P7
-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	0"	0"	P8
0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P9
-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	-1/8"	0"	P10
0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P11
-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-5/16"	-3/16"	0"	P12
0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P13
-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/4"	-1/8"	0"	P14
0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P15
-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	-3/16"	P16
0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	0"	P17

NATIONAL GLASS ASSOCIATION with GANA


COMING
SUMMER 2022
www.AscentMKE.com


C.D. SMITH
DensGlass
GP
3M





CREDIT: TIMBERLAB

Edison

Architect – HPA

Structural Engineer – Thornton Tomasetti

Contractor – CD Smith

Developer – The Neutral Project

Envelope – Reflection Window & Wall

Height – 364 ft, 32 stories

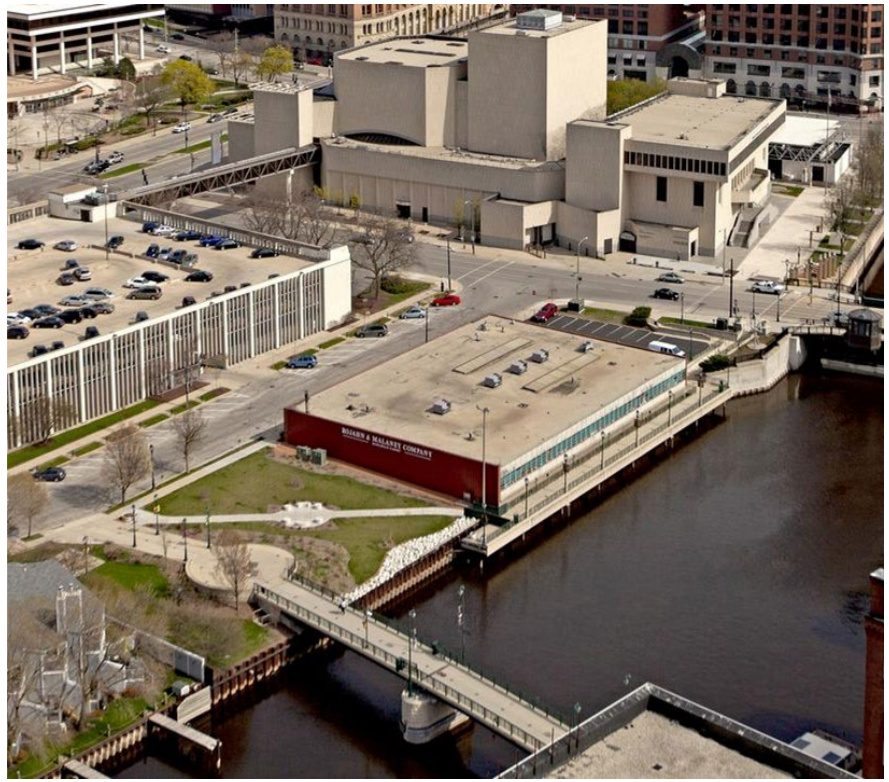
Gross Area – 535,000 sf

Housing – 383 apartments

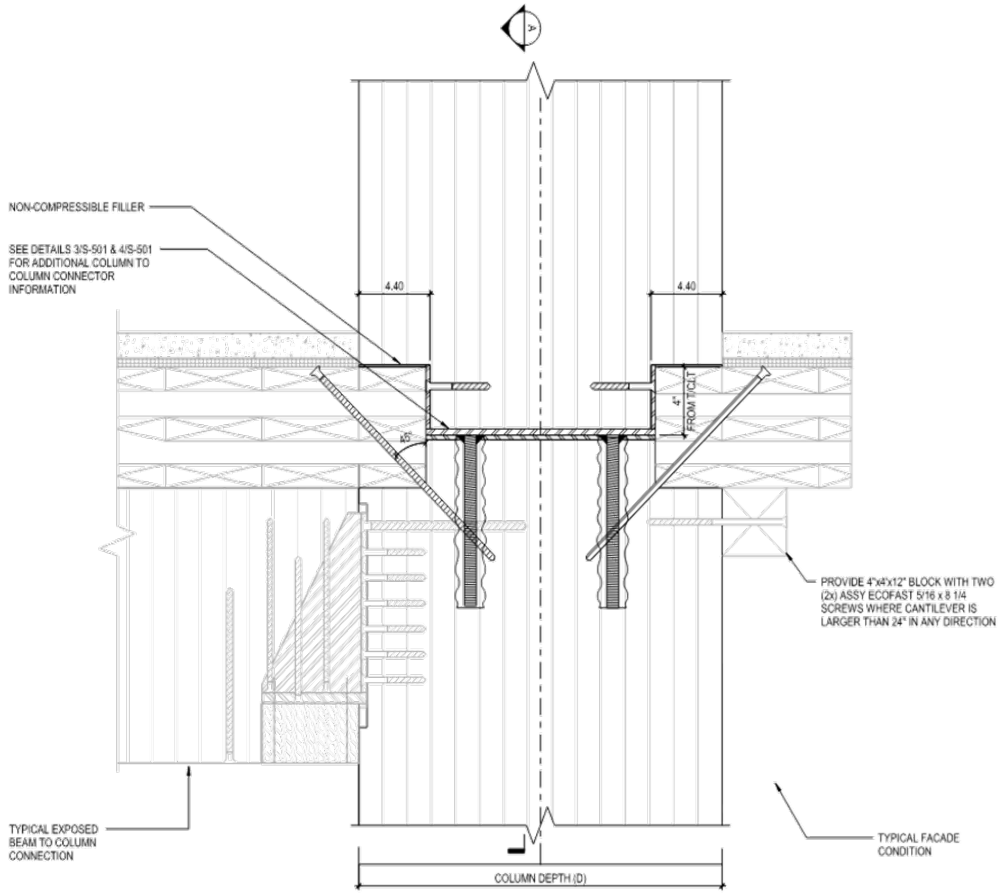
Pursuing Passive House Certification (PHIUS Core 2024)

Edison

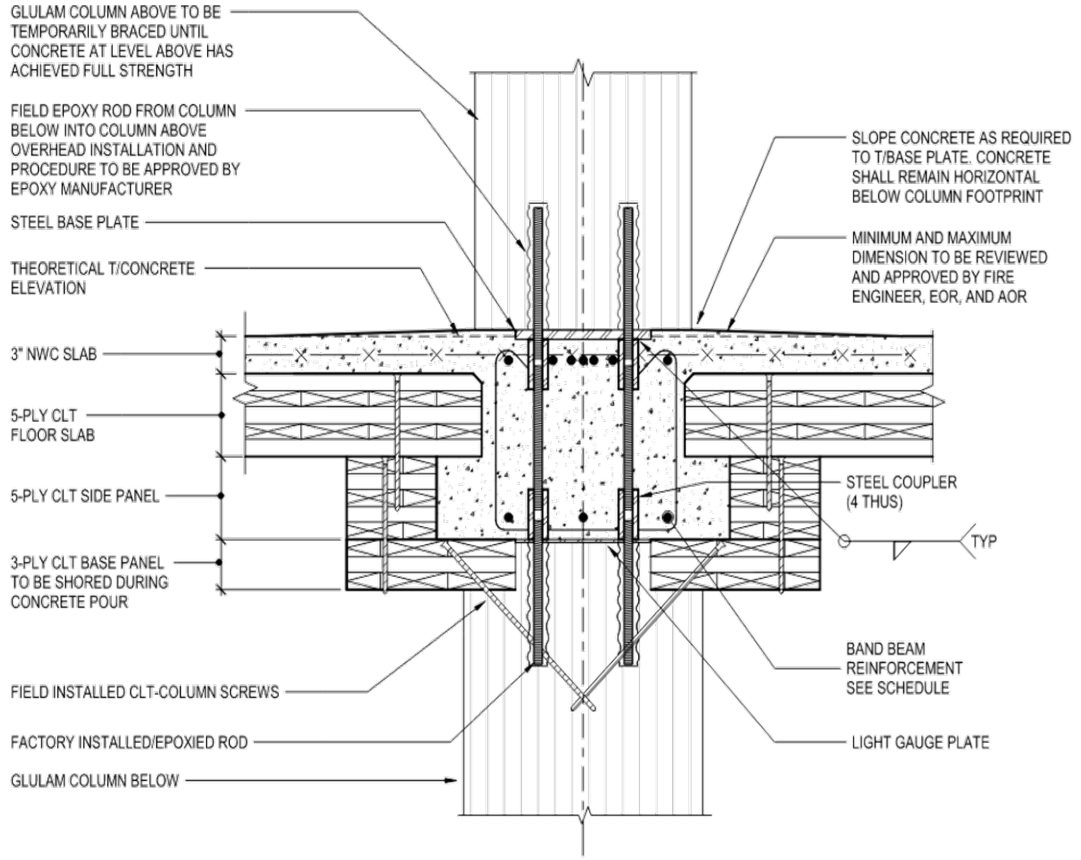

Brewery District
Fiserv Forum
THE EDISON
YANKEE HILL
Milwaukee School of Engineering
Parking Structure
Veterans Park
Ascent MT Tower
Old World Third Street Historic District
WESTOWN
UW-Milwaukee Panther Arena & Theatre
Performing Arts Center
City Hall
Theatre District
Hyatt Regency Milwaukee
Milwaukee Public Museum
01.1 mi / 25 min
EAST TOWN
Milwaukee Bay Lake Michigan
Wisconsin Center
River Walk
Milwaukee Art Museum
Discovery Word
N
794 E



Edison vs Ascent

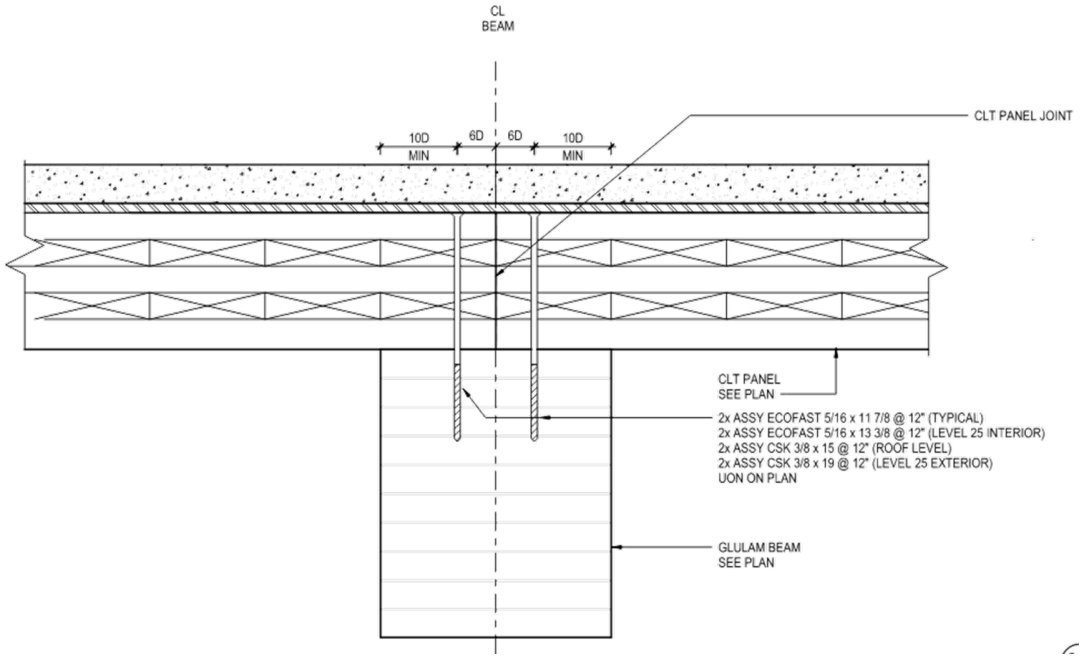


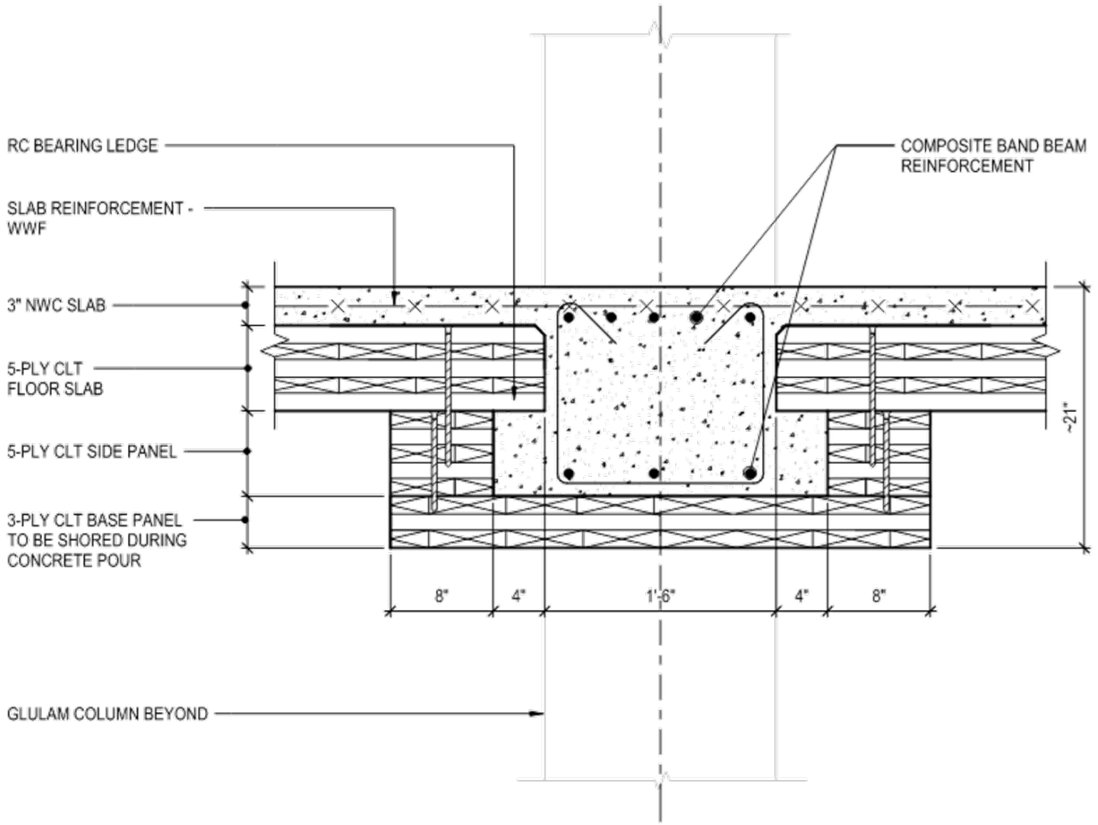
Ascent



The Edison

Edison vs Ascent

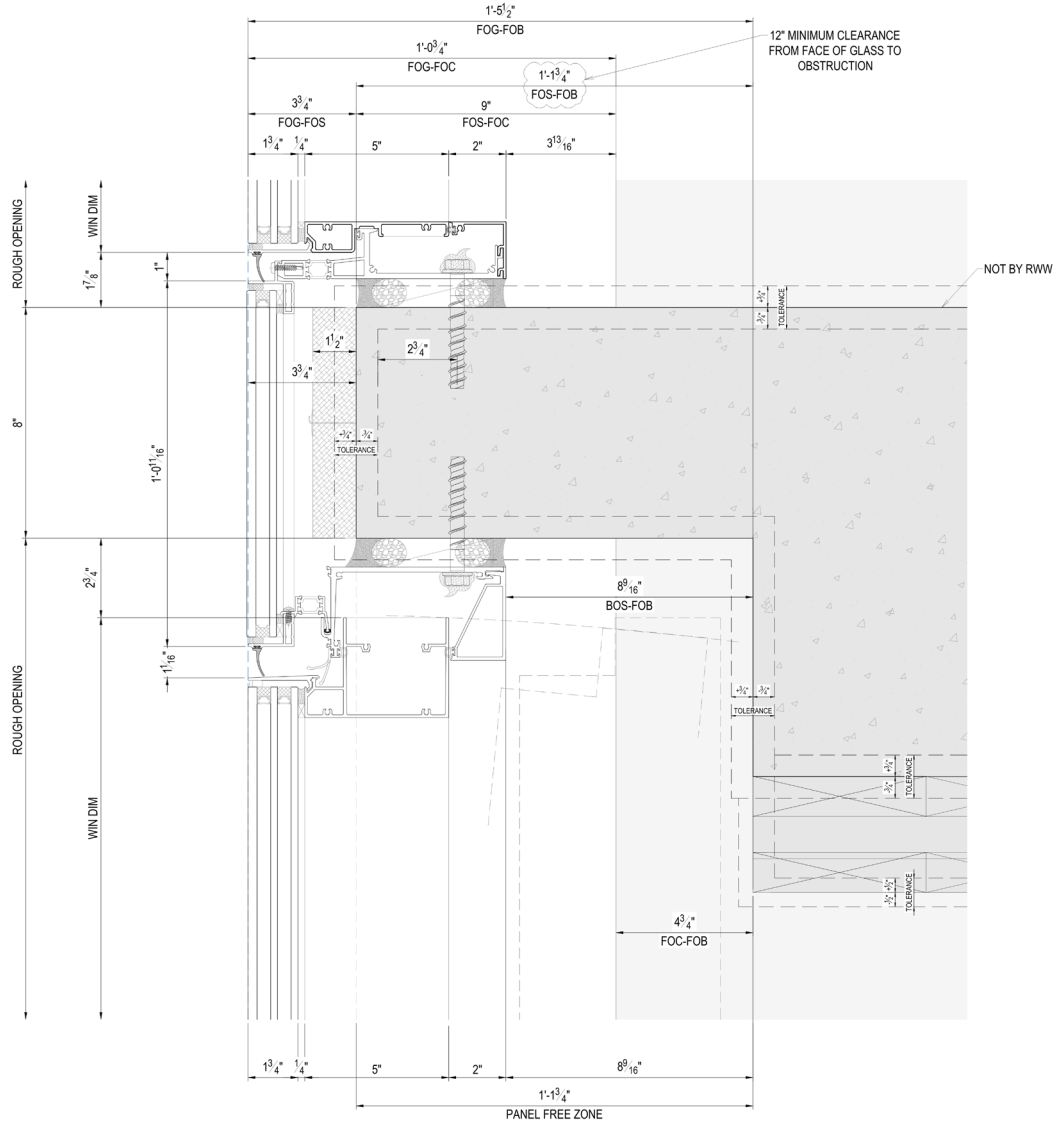


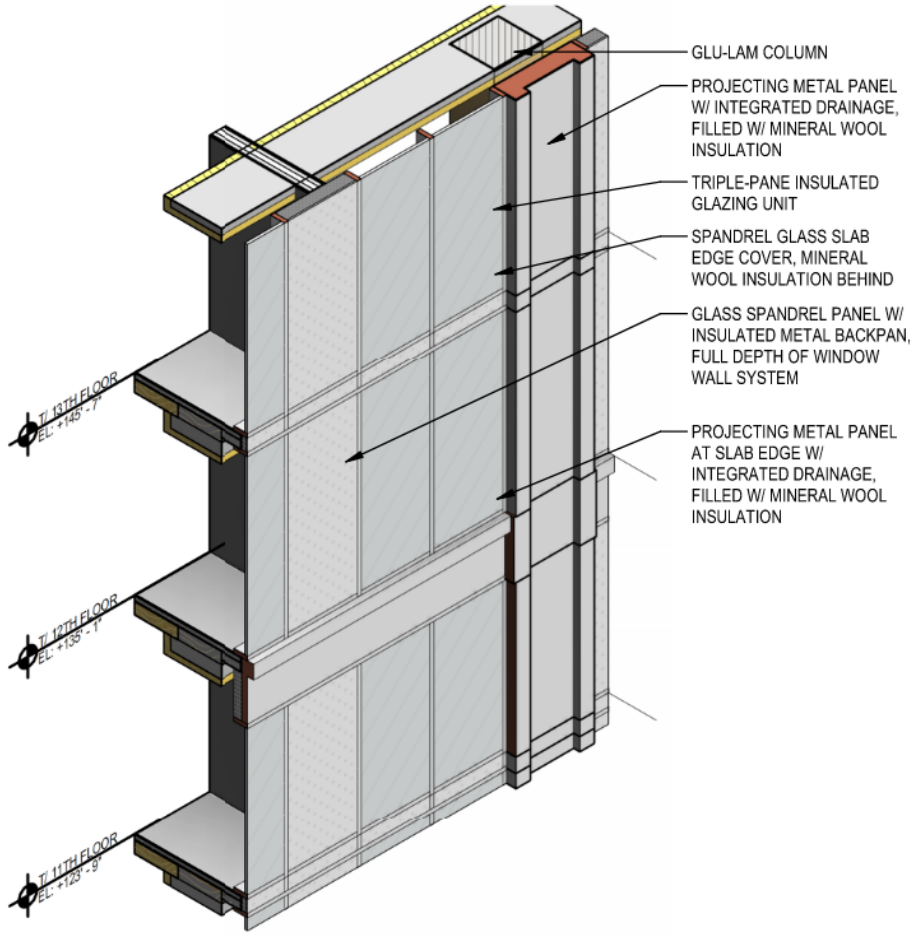


Ascent

The Edison

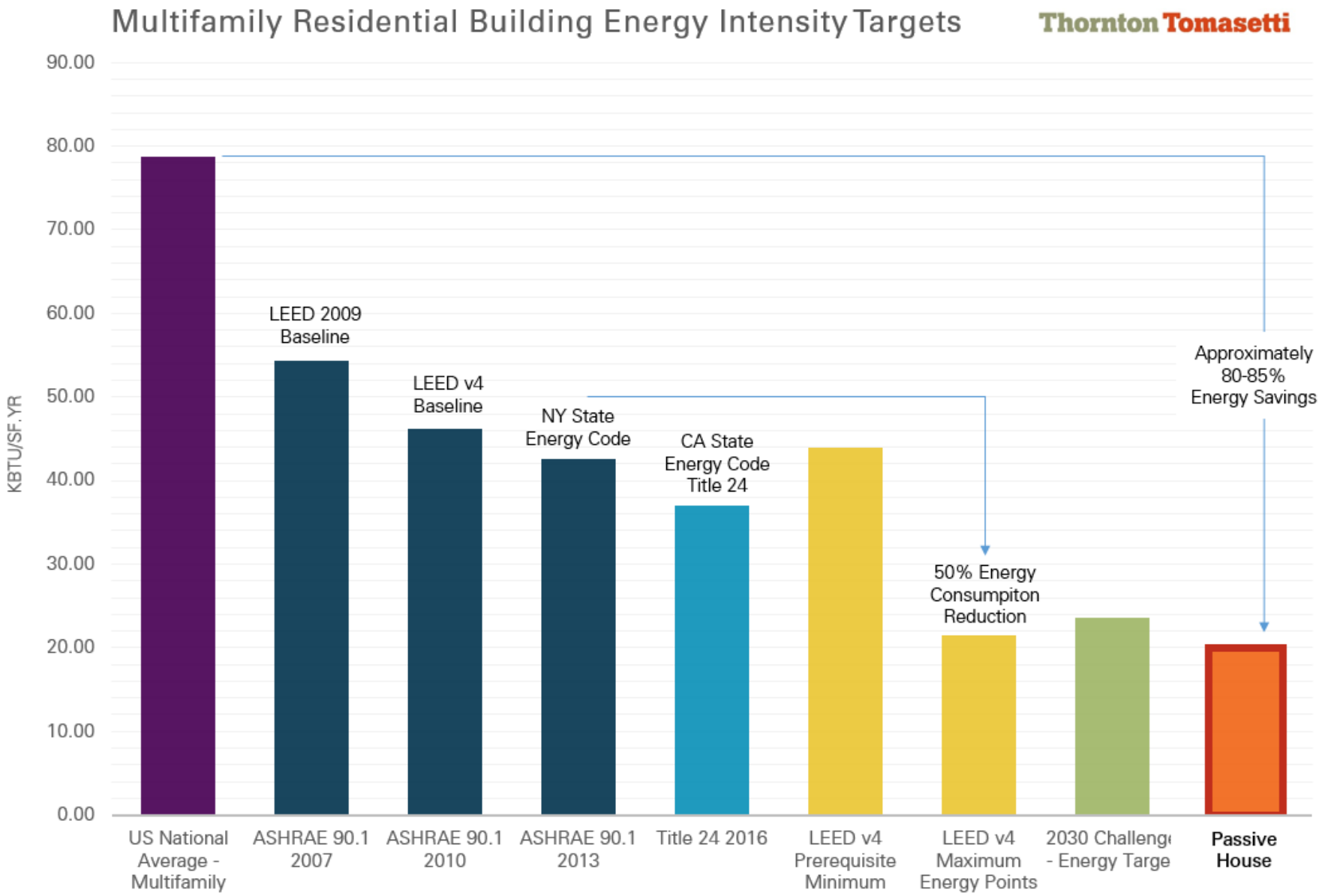
Edison


1'-5 1/2" FOG-FOB
1'-0 3/4" FOG-FOC
1'-1 3/4" FOS-FOB
12" MINIMUM CLEARANCE FROM FACE OF GLASS TO OBSTRUCTION
3 3/4" FOG-FOS
9" FOS-FOC
1 3/4"
1/4"
5"
2"
3 13/16"
ROUGH OPENING
WIN DIM
1 7/8"
1"
8"
1'-0 11/16"
NOT BY RWW
TOLERANCE
1 1/2"
2 3/4"
3 3/4"
2 3/4"
11/16"
8 9/16" BOS-FOB
4 3/4" FOC-FOB
PANEL FREE ZONE

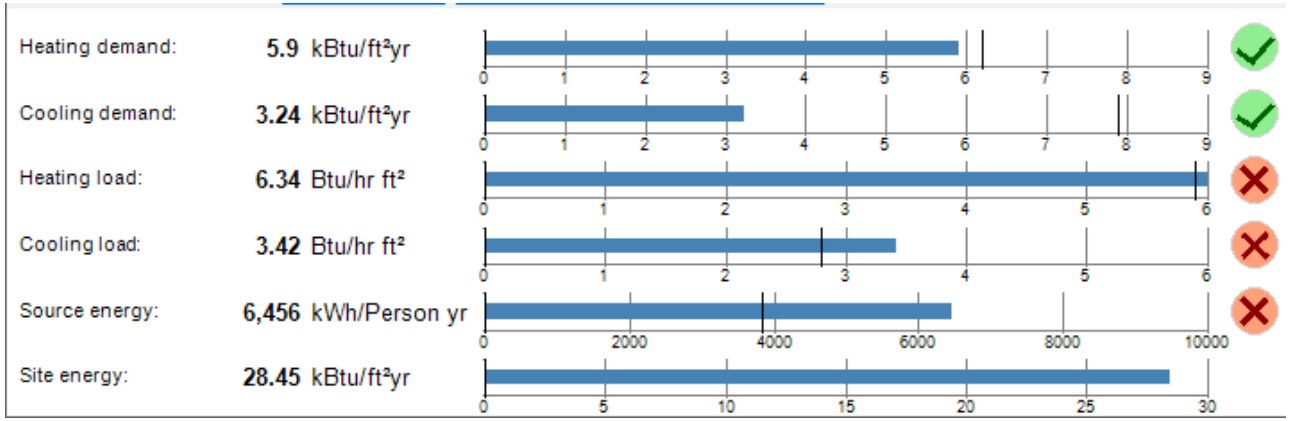

GLU-LAM COLUMN
PROJECTING METAL PANEL W/ INTEGRATED DRAINAGE, FILLED W/ MINERAL WOOL INSULATION
TRIPLE-PANE INSULATED GLAZING UNIT
SPANDREL GLASS SLAB EDGE COVER, MINERAL WOOL INSULATION BEHIND
GLASS SPANDREL PANEL W/ INSULATED METAL BACKPAN, FULL DEPTH OF WINDOW WALL SYSTEM
PROJECTING METAL PANEL AT SLAB EDGE W/ INTEGRATED DRAINAGE, FILLED W/ MINERAL WOOL INSULATION
TL 13TH FLOOR EL: +145' - 7"
TL 12TH FLOOR EL: +135' - 1"
TL 11TH FLOOR EL: +123' - 9"

Edison

- Quiet
- High indoor air quality & ventilation
- Energy efficient
- Comfortable
- Humidity control
- Resilient
- Low maintenance
- Odor Control



Edison



Heating Demand = **6.2 kBtu/ft2/yr**

Cooling Demand = **7.9 kBtu/ft2/yr**

Peak Heating Load = **5.9 Btu/ft2/hr**

Peak Cooling Load = **2.8 Btu/ft2/hr**

Source Energy = **5,225 kWh/person/yr**

Name	Glass Type	Coating	Argon	Visible Transmittance	Solar Transmittance	U-Value (Winter)	SHGC	Shading Coefficient	Relative Heat Gain	Exterior Solar Reflectance	Interior Visible Reflectance	Exterior Visible Reflectance	UV Transmission
Triple VE1-2M (2 + 4)	Clear	VE-2M	No	56.0%	22.3%	0.16	0.3	0.35	71	31.9%	13.6%	12.9%	2.3%
Triple VE1-2M (2 + 4)	Clear	VE-2M	Yes	56.0%	22.3%	0.12	0.3	0.34	70	31.9%	13.6%	12.9%	2.3%
Triple VE13-2M	Starphire Low Iron	VE-2M	No	60.5%	27.3%	0.16	0.33	0.38	78	41.6%	15.2%	12.7%	4.2%
Triple VE13-2M (2 + 4)	Starphire Low Iron	VE-2M	Yes	60.5%	27.3%	0.12	0.33	0.38	78	41.6%	15.2%	12.7%	4.2%
Triple SB60 Clear (2 + 4)	Clear	Solarban 60	No	56.0%	22.8%	0.16	0.31	0.36	74	29.3%	14.3%	12.4%	5.9%
Triple SB60 Clear (2 + 4)	Clear	Solarban 60	Yes	56.0%	22.8%	0.12	0.31	0.35	73	29.3%	14.3%	12.4%	5.9%
Triple SB60 Acuity (2 + 4)	Acuity Low Iron	Solarban 60	No	59.4%	25.9%	0.16	0.32	0.37	77	38.1%	14.5%	12.7%	7.3%
Triple SB60 Acuity (2 + 4)	Acuity Low Iron	Solarban 60	Yes	59.4%	25.9%	0.12	0.32	0.37	76	38.1%	14.5%	12.7%	7.3%
Triple SB60 Starphire (2 + 4)	Starphire Low Iron	Solarban 60	No	60.4%	27.0%	0.16	0.33	0.38	78	43.0%	14.6%	12.9%	7.9%
Triple SB60 Starphire (2 + 4)	Starphire Low Iron	Solarban 60	Yes	60.8%	27.6%	0.12	0.33	0.38	77	43.0%	14.8%	12.9%	8.2%
Triple SB67 Acuity (2 + 4)	Acuity Low Iron	Solarban 67	No	35.1%	14.6%	0.16	0.21	0.24	50	45.9%	19.2%	23.9%	2.8%
Triple SB67 Acuity (2 + 4)	Acuity Low Iron	Solarban 67	Yes	50.1%	16.9%	0.12	0.21	0.25	51	50.0%	17.0%	16.1%	1.2%
Triple SB72 Acuity (2)	Acuity Low Iron	Solarban 72	No	61.3%	23.0%	0.21	0.26	0.3	62	49.8%	19.7%	17.0%	7.1%
Triple SB72 Acuity (2)	Acuity Low Iron	Solarban 72	Yes	61.3%	23.1%	0.18	0.25	0.29	61	23.1%	19.7%	17.0%	7.1%
Triple VRE1-54 + VE-85 (2 + 4)	Clear	VRE-54 (2) + VE-85 (4)	No	40.7%	19.1%	0.17	0.26	0.29	61	38.0%	19.1%	33.1%	7.9%
Triple VRE1-54 + VE-85 (2 + 4)	Clear	VRE-54 (2) + VE-85 (4)	Yes	40.7%	19.1%	0.13	0.25	0.29	60	31.9%	19.2%	33.1%	7.9%

Questions?

Steve Panaro, P.E.
Thornton Tomasetti

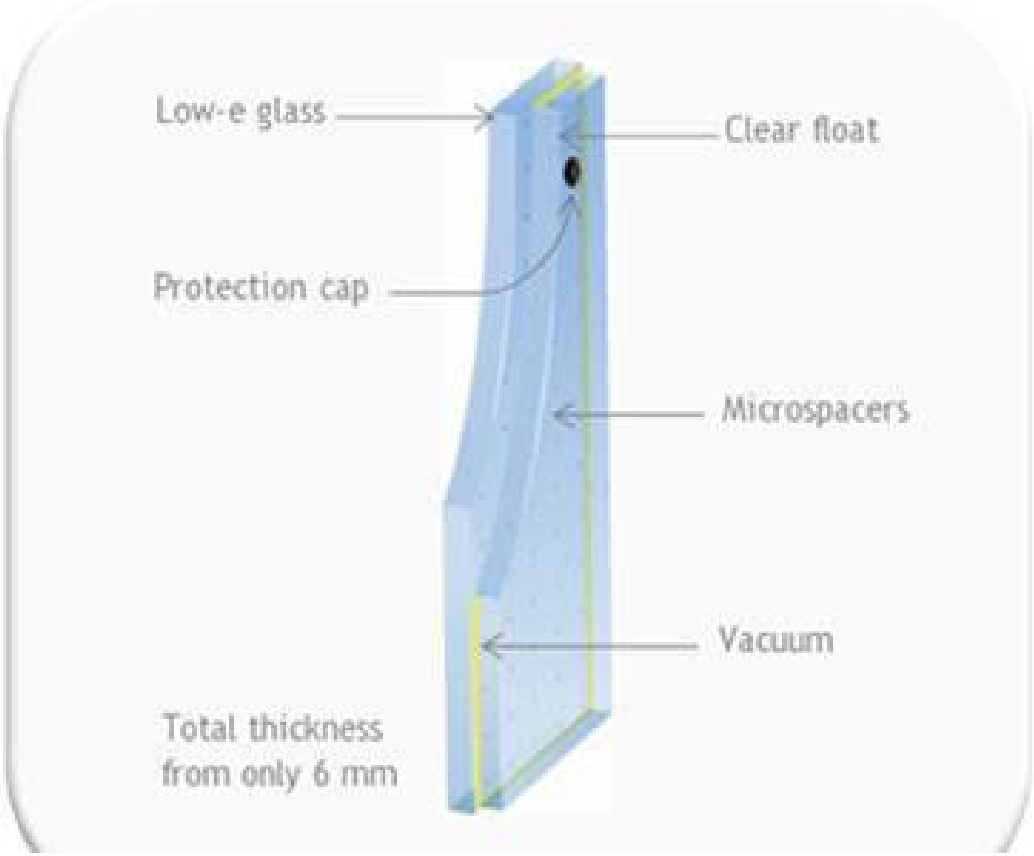
Vacuum Insulated Glazing (VIG)

Kyle Sword

NSG Pilkington

R&D Director, North America

Introduction to VIG



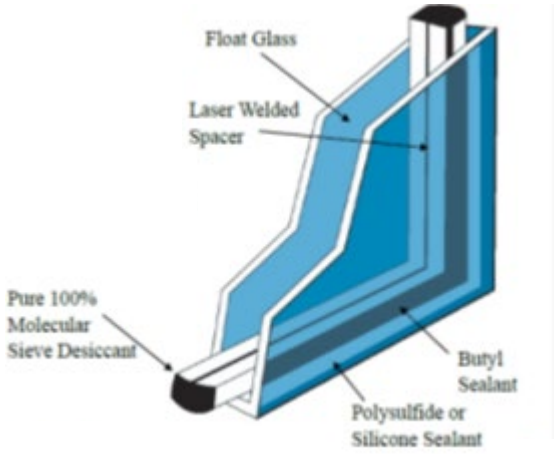
VIG is a double glazed IG unit where all the air between the two panes of glass has been extracted, therefore creating a partial vacuum.

Many new solutions manage heat transfer through windows.
Vacuum insulated glazing (VIG) – 1st patent in 1913.
1st commercial product – 1997 – University of Sydney, NSG

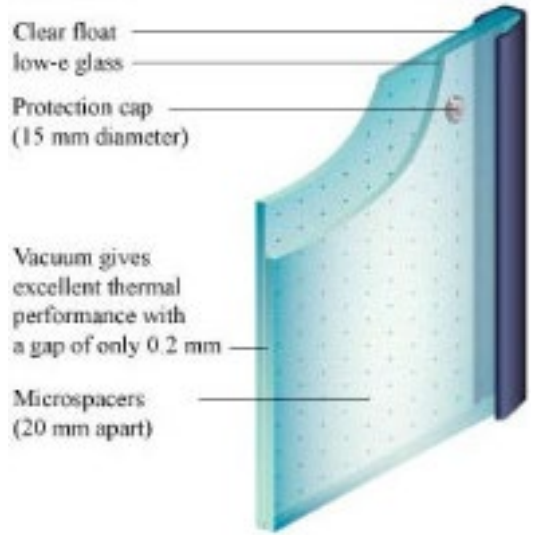
Ultra thin form factor and vacuum make unique solution.

Introduction to VIG

Typical IGU – 1” Thick



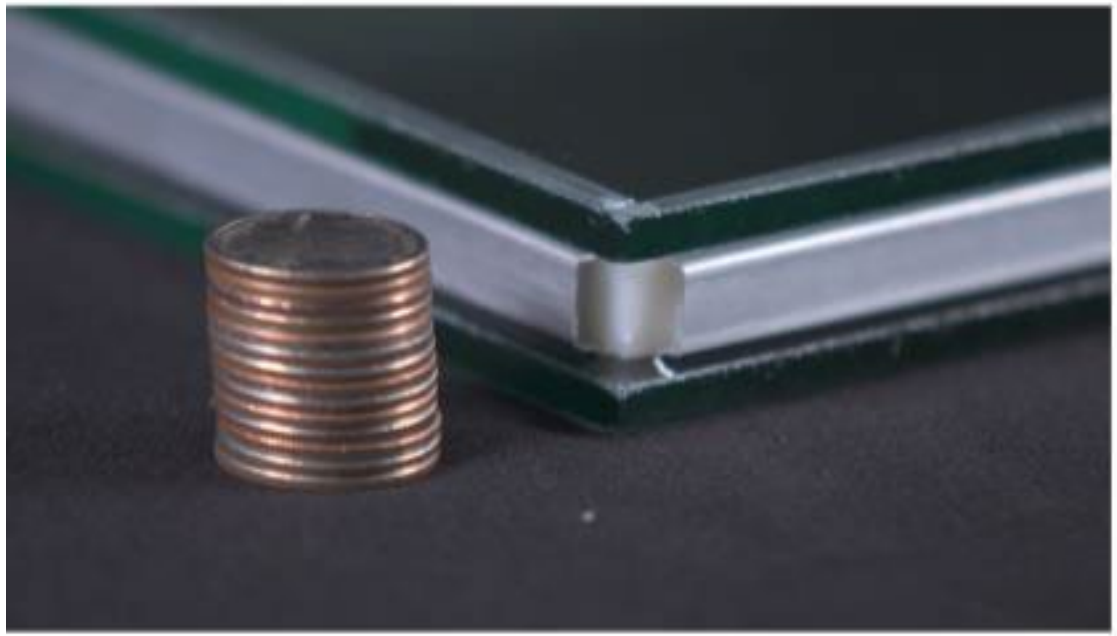
VIG – ¼” Thick

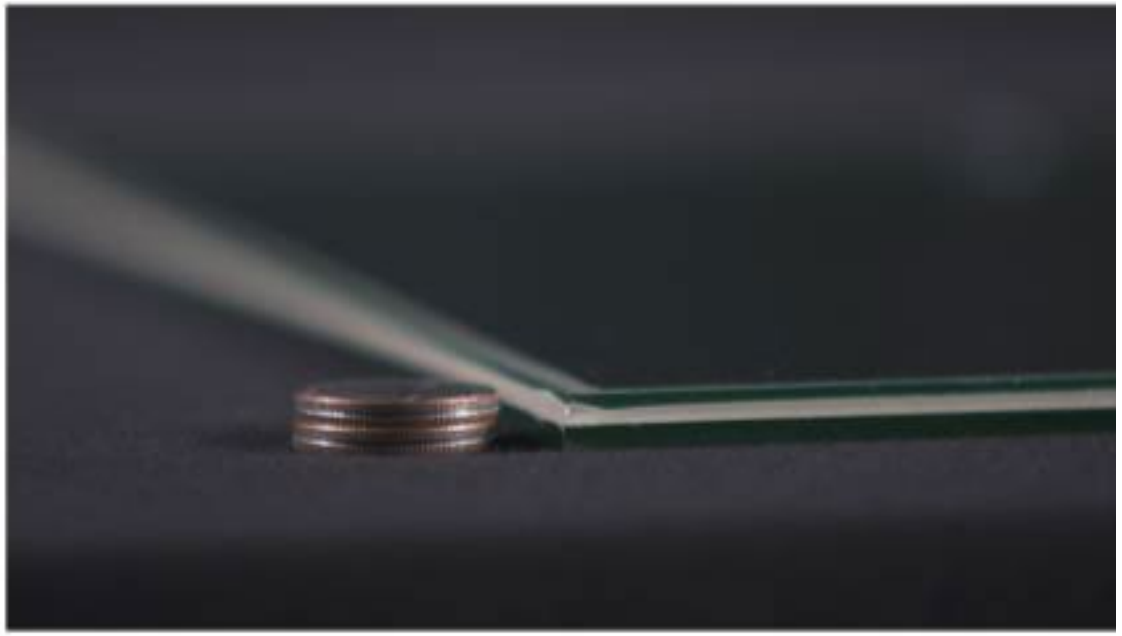


Total thickness
from only 6 mm

- VIG benefits
  - No gas for convection/conduction
  - Thin (fits existing sash)
  - Light weight – Operable windows
  - Avoids known issues with organic IG seal failure
  - Sound reduction – Vacuum = STC
  - Fully reversible

IGU versus VIG construction





Milwaukee County War Memorial project

Milwaukee County War Memorial

- National Landmark, designed by famed Finnish architect Eero Saarinen (pictures pre-construction).
- Steel frame construction – Maintained structure, design.
- Monolithic wire glass. Restored 2017.

Milwaukee County War Memorial

Video – Project link

- The Bird Cage: Renovation Project - Period Homes (period-homes.com)

Milwaukee County War Memorial

- Thick, steel sash

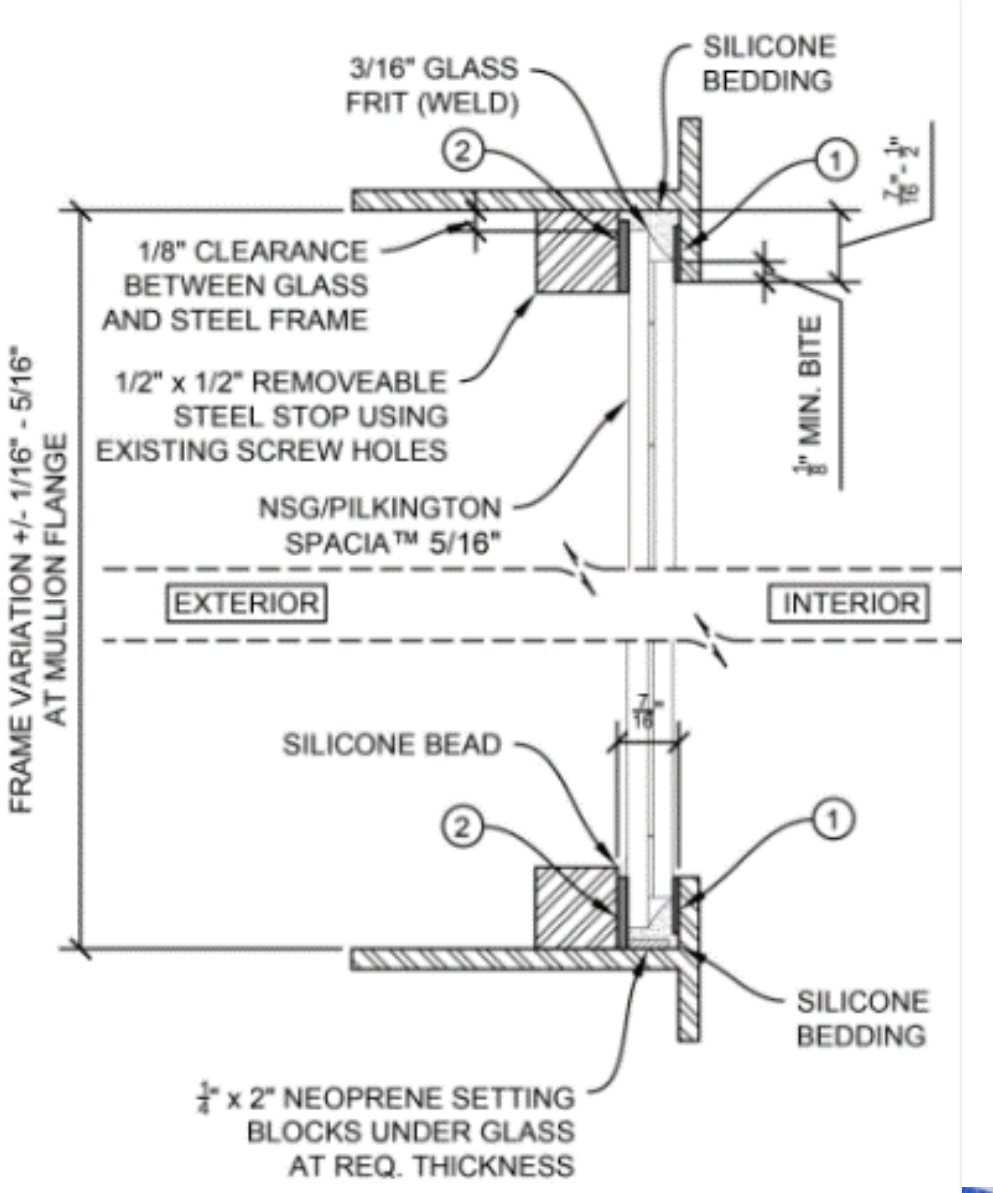
Other alternatives

- Re-glaze, monolithic

  v.

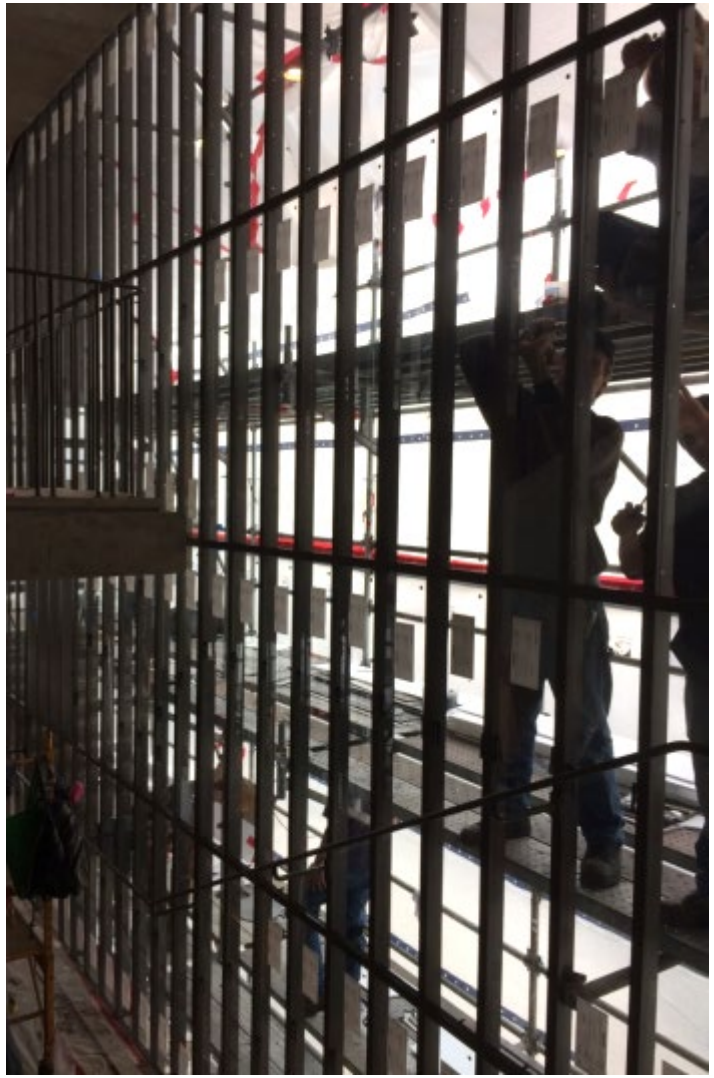
- Re-tap glazing bars

- Restoration w/ VIG
  - Lower cost and kept historic facade v. curtainwall replacement
  - Met energy targets



Milwaukee County War Memorial

- Glazed using Pilkington **Spacia**™ in April 2017
- Monolithic Pilkington **Energy Advantage™** on Clear in small, shaped parts (below)
- Allowed restoration of existing frame and stops without re-tapping glazing bars.



Milwaukee County War Memorial

Project detail

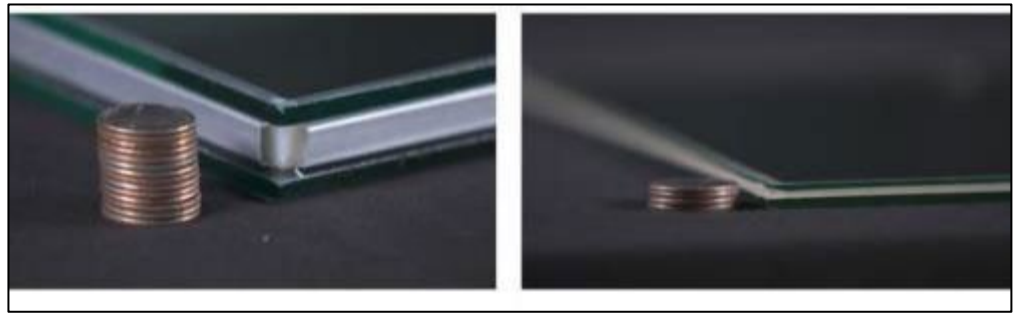
- Glazing contractor, Nal Vogel, Restoric, LLC
- Architect - Hammel, Green, and Abrahamson, Inc. – Russell Drewry, AIA
- Preservation consultant - Donna Weiss
- Milwaukee County DAS – Julie Bastin, PE, M. Arch

Carbon reduction & reuse

The Kahn

Current operating carbon (metric tons CO2 eq)	1273

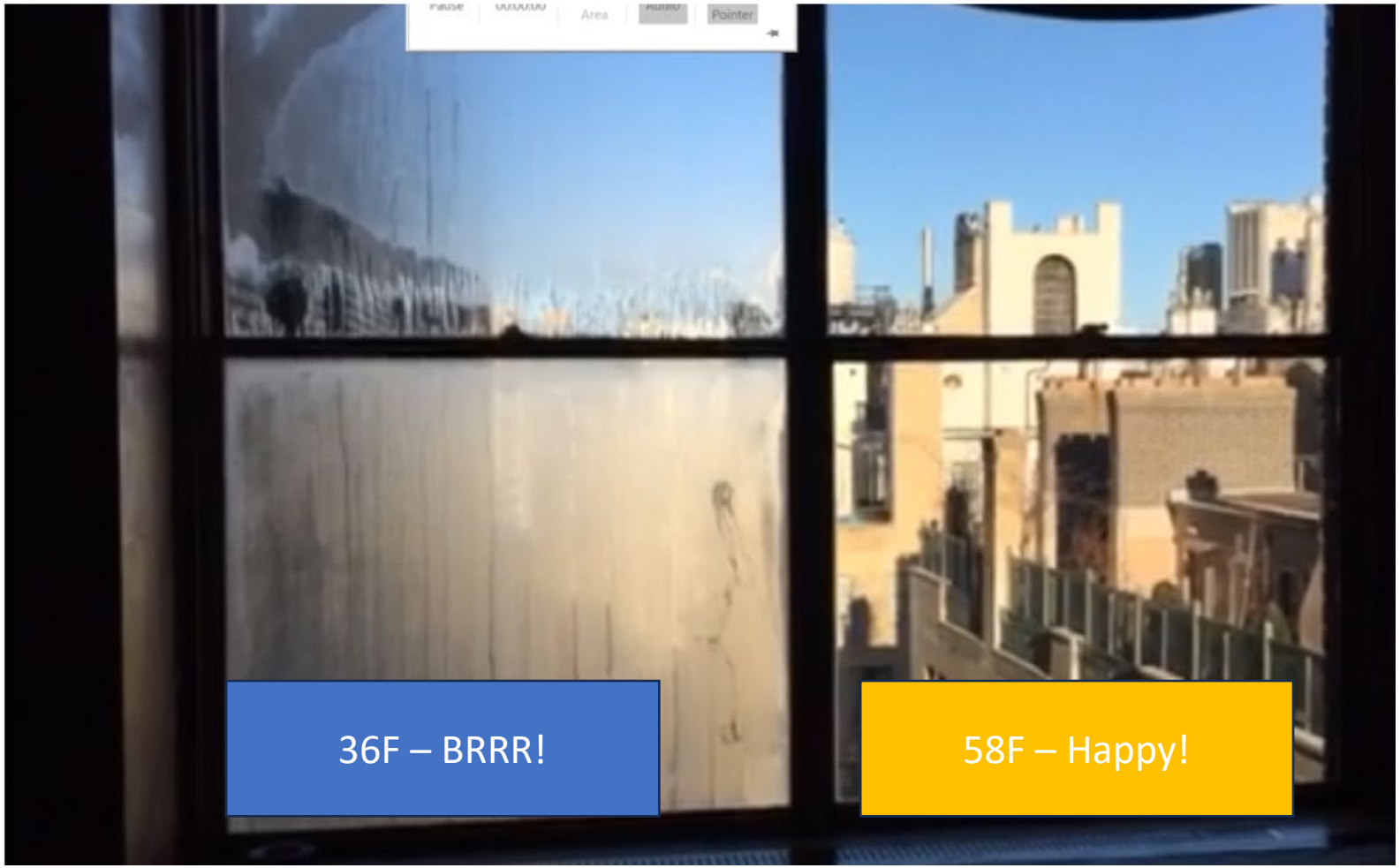
	Reglazing with VIG	Storm window (1/4")	Al storm windows (1/4")	Al replacement windows
Embodied carbon total (metric tons CO2 eq)	25	41	59	99
Operating carbon annual savings (metric tons CO2 eq)	-226	-161	-161	-233
Total Y1 carbon impact (metric tons CO2 eq)	-201	-120	-102	-134
Embodied carbon debt payback (months)	1	3	3	5
Breakeven point - Years payback for embodied carbon				11



- 1931
- 11 story
- 320,000 ft^2 building, 17,500 ft^2 glazing area
- 700 bronze, double-hung windows, monolithic ¼” glass

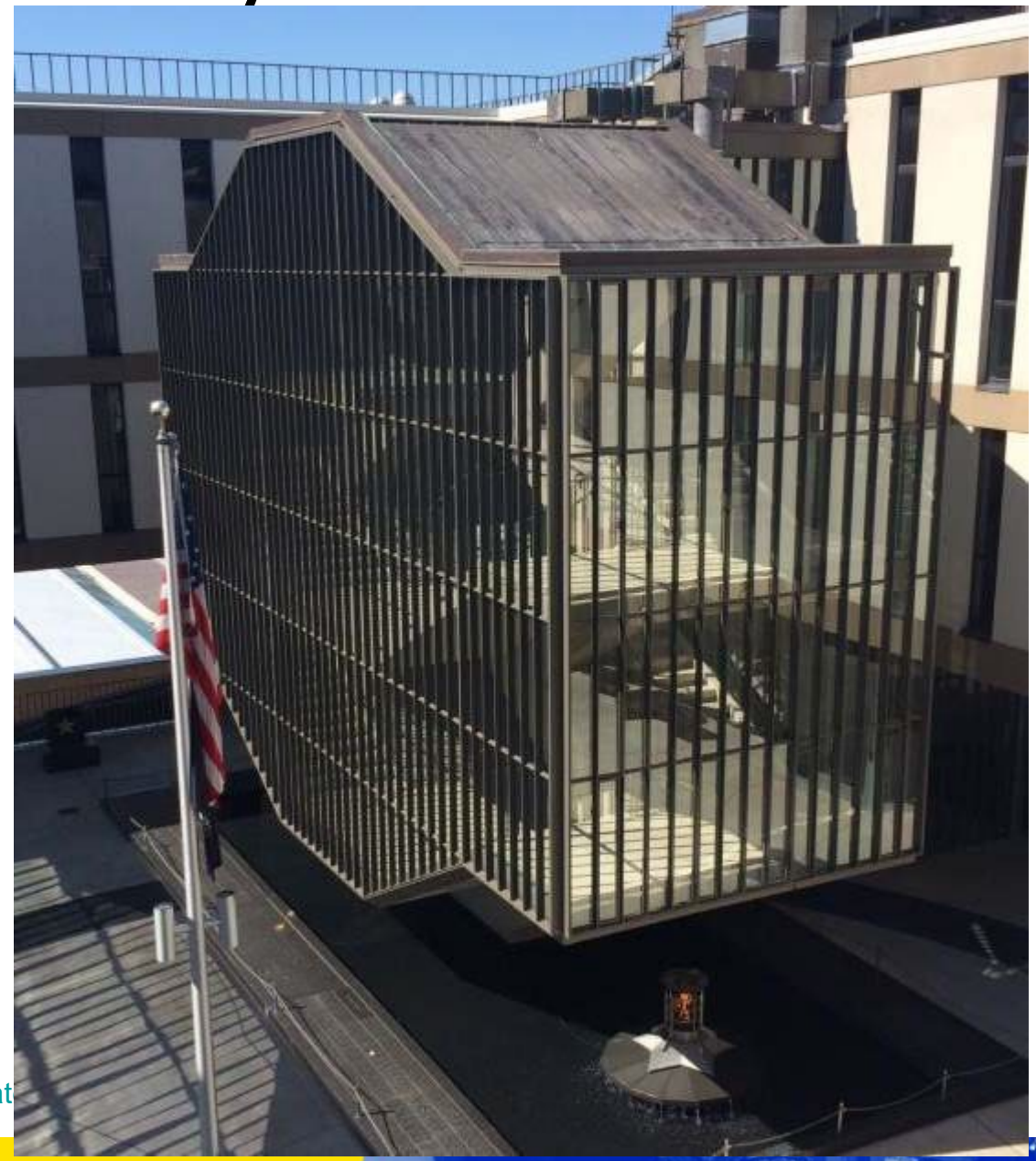
- 13% energy savings
- 1 month carbon payback

Monolithic v. VIG (cold day)

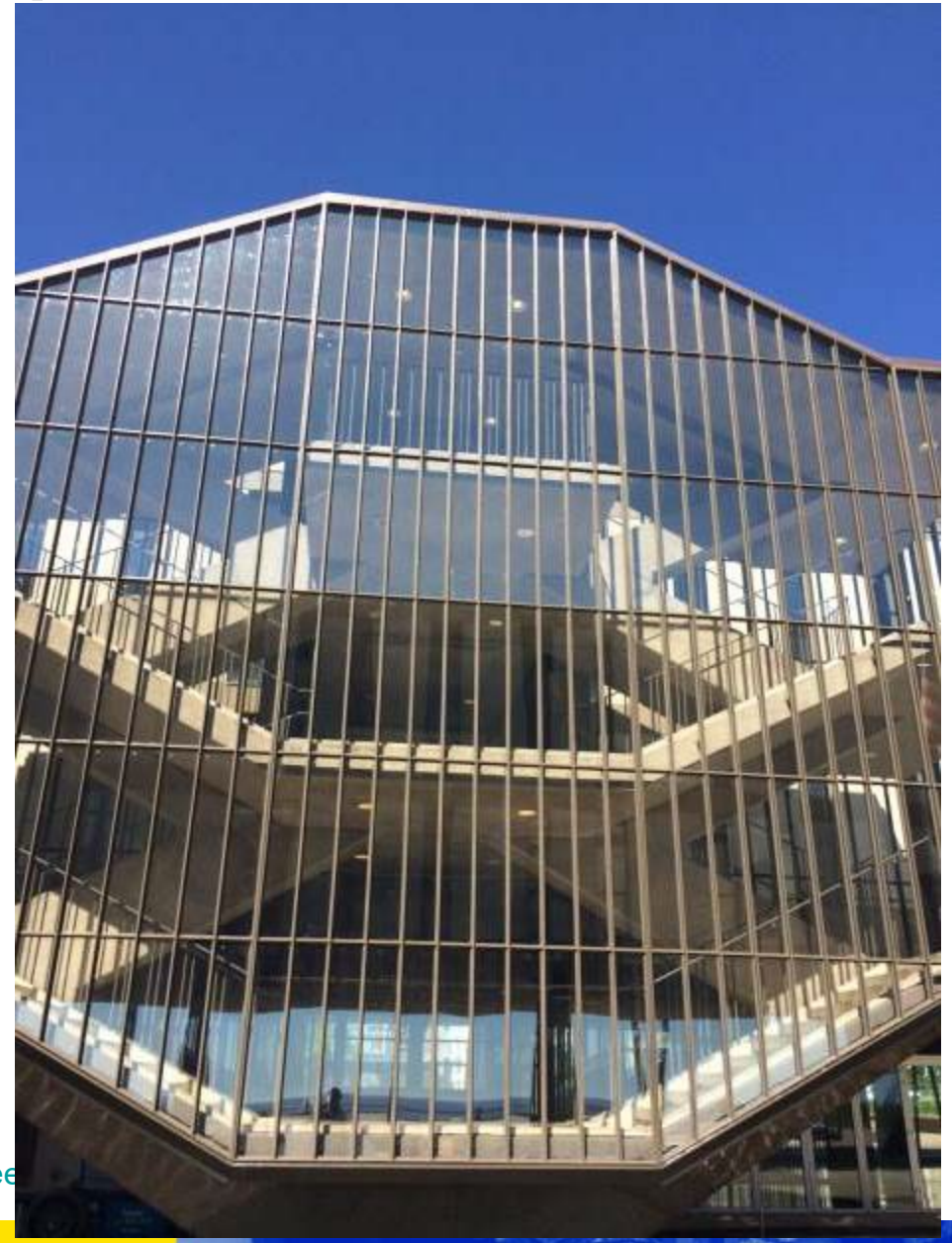


Milwaukee County War Memorial

Milwaukee County War Memorial



Milwaukee County War Memorial



Milwaukee County War Memorial

Video – Project link

- The Bird Cage: Renovation Project - Period Homes (period-homes.com)

Articles

- The Bird Cage Stair: Pilkington Spacia™ Restoration Project - Traditional Building
- Pilkington Spacia™ transforms "Bird Cage" staircase from replacement project to restoration project (archpaper.com)
- Pilkington Spacia™ transforms "Bird Cage" staircase from replacement project to restoration project (archpaper.com)

- Video on Winston Salem - Union Train Station - https://www.traditionalbuilding.com/product-report/winston-salem-union-station-restoration
- Video explaining VIG and Pilkington **Spacia™** - https://www.period-homes.com/buying-guides/pilkington-spacia-innovation-for-historic-restoration
- Intelligent Glass Solutions magazine – Glass and window history, VIG for restoration/retrofitting - https://igsmag.com/videos/glass-and-window-basics-vig-for-historic-restoration-kyle-sword/
- Albert Kahn restoration case study - https://mailchi.mp/thekraemeredge/kdg-historic-project-spotlight-the-albert-kahn-building?e=81c7f13bd3
- Fine Homebuilding magazine – Jan 2021
- https://www.finehomebuilding.com/2020/11/06/insulating-glass-keeps-getting-better

NSG

GROUP

NGA GLASS CONFERENCE™ MILWAUKEE

AUGUST 6-8, 2024

NGA
NATIONAL GLASS ASSOCIATION with GANA