

COMPUTATIONAL THINKING SPEAKERS



PHIL KOLBO

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Populous*



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*Vice President of Design
Radius Track Corporation*



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Assistant Professor
HGA Architects & Engineers /
University of Minnesota*



PERMASTEELISA GROUP

DIGITAL TECHNOLOGY AND COMPLEX FACADES

CHINI MURALI







GLOBAL APPROACH

Serving a market synergistically operating from both the inside and outside



Beekman Tower - New York, NY
Gehry Partners



Uber Headquarters - San Francisco, CA
SHoP



Walt Disney Concert Hall - Los Angeles, CA
Gehry Partners

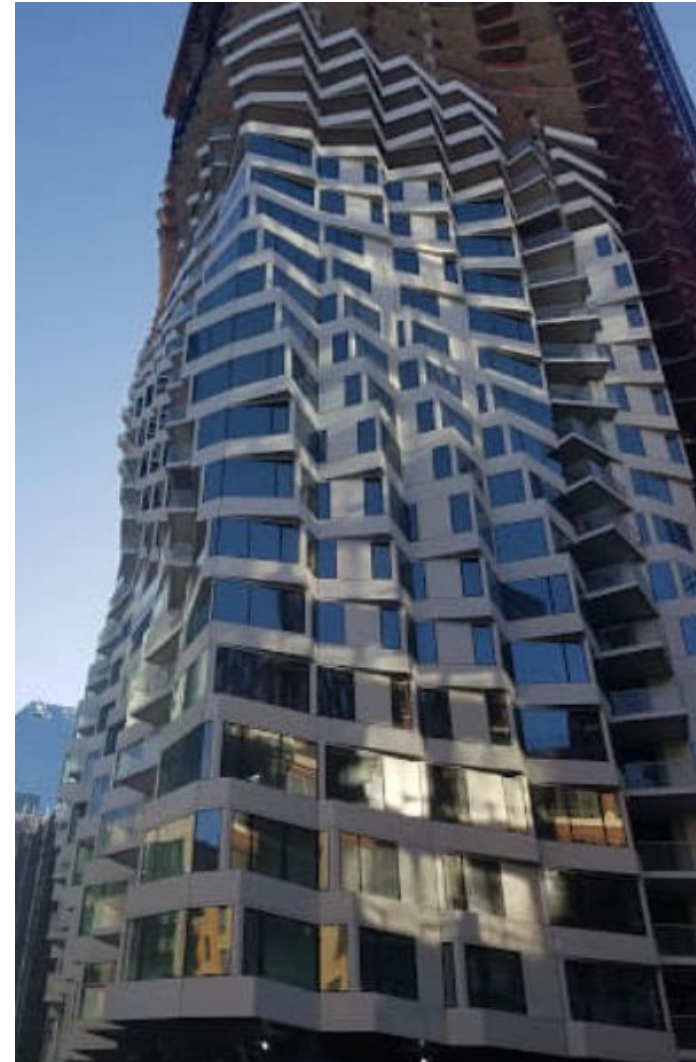
Our (very varied) Portfolio



PERMASTEELISA GROUP



1144 15th - Denver, CO
Pickard Chilton



Mira Tower - San Francisco, CA
Studio Gang



- PMF: Permasteelisa custom software
- Realizing geometry
- Speaking the architect's language
- BIM





- Custom software built by Permasteelisa in collaboration with Autodesk
- Streamline the flow of information through AutoCAD, Inventor, Navisworks, SAP

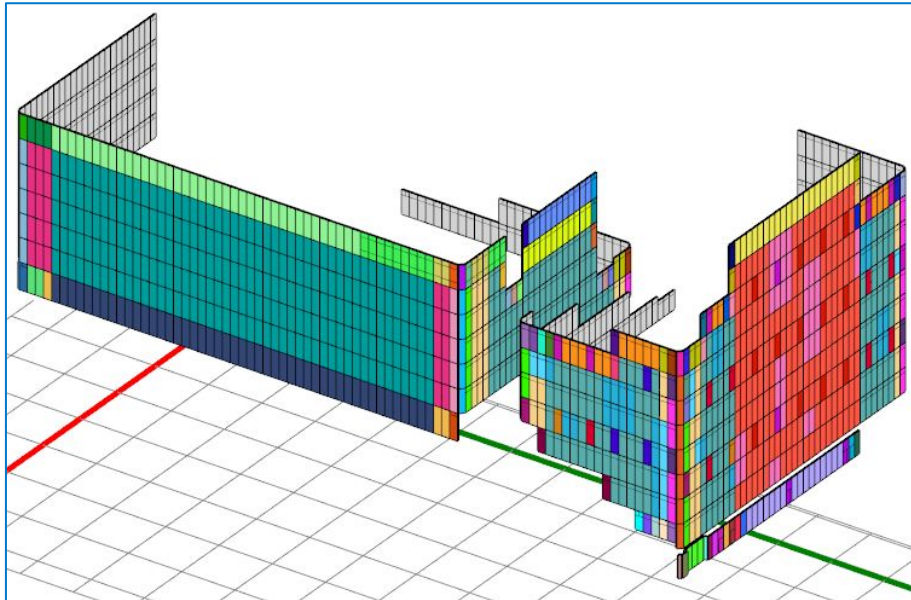


Library of materials, their properties, and BOMs

The screenshot displays the 'Component Definitions' software interface. On the left, a tree view shows a hierarchy of material groups. The 'Material Groups' folder is expanded, showing sub-folders from '01 Accessories' to '17 Profile (Machining)'. Under '17 Profile (Machining)', the '17.1.1 Straight Profiles Custom-made Alu' folder is expanded, listing various profiles like '17.1.1 [A] PMU 1' through '17.1.1 [K] VMU 4'. The 'IPA101E1' material is selected and highlighted in light blue. Its description is 'FEMALE MULLION-OFFICE'. Below it, 'IPA101E1A1' is listed with the description 'FEMALE MULLION-OFFICE TY...'. On the right, the 'Selection: IPA101E1' panel is active, showing tabs for 'Basic properties', 'Cross section / visual', 'Technical', 'Bill of material', 'Shapes', 'Documents', 'Costs', 'Parameters', and 'Classifier'. The 'Cross section / visual' tab is selected, displaying the 'Visual appearance' section with an 'Icon' dropdown set to 'Default' and an 'Icon Manager...' button. Below this, the 'Related cross section shape' section shows the 'Name' as 'IPA101' and a 'Set cross section...' button. A checkbox for 'Allow manual overwrite of area and perimeter' is unchecked. A large blue 3D model of the 'IPA101' cross-section is shown, which is a U-shaped profile with a top flange and a bottom flange.

Material Group	Description
Material Groups	
01 Accessories	
02 Assembled Profiles, Frames, and Structures	
03 Bars	
04 Brackets	
06 Finished Products	
07 Fasteners and Embeds	
08 Gaskets	
09 Glass	
10 Grids, Grates and Mesh	
11 Hardware and Electrical Devices	
12 Insulation and Membranes	
13 Special Components	
14 Packings	
15 Pressworks	
17 Profile (Machining)	
17.1.1 Straight Profiles Custom-made Alu	
17.1.1 [A] PMU 1	
17.1.1 [B] PMU 2	
17.1.1 [D] PMU 3	
17.1.1 [H] VMU 1	
17.1.1 [K] VMU 4	
IPA101E1	FEMALE MULLION-OFFICE
IPA101E1A1	FEMALE MULLION-OFFICE TY...

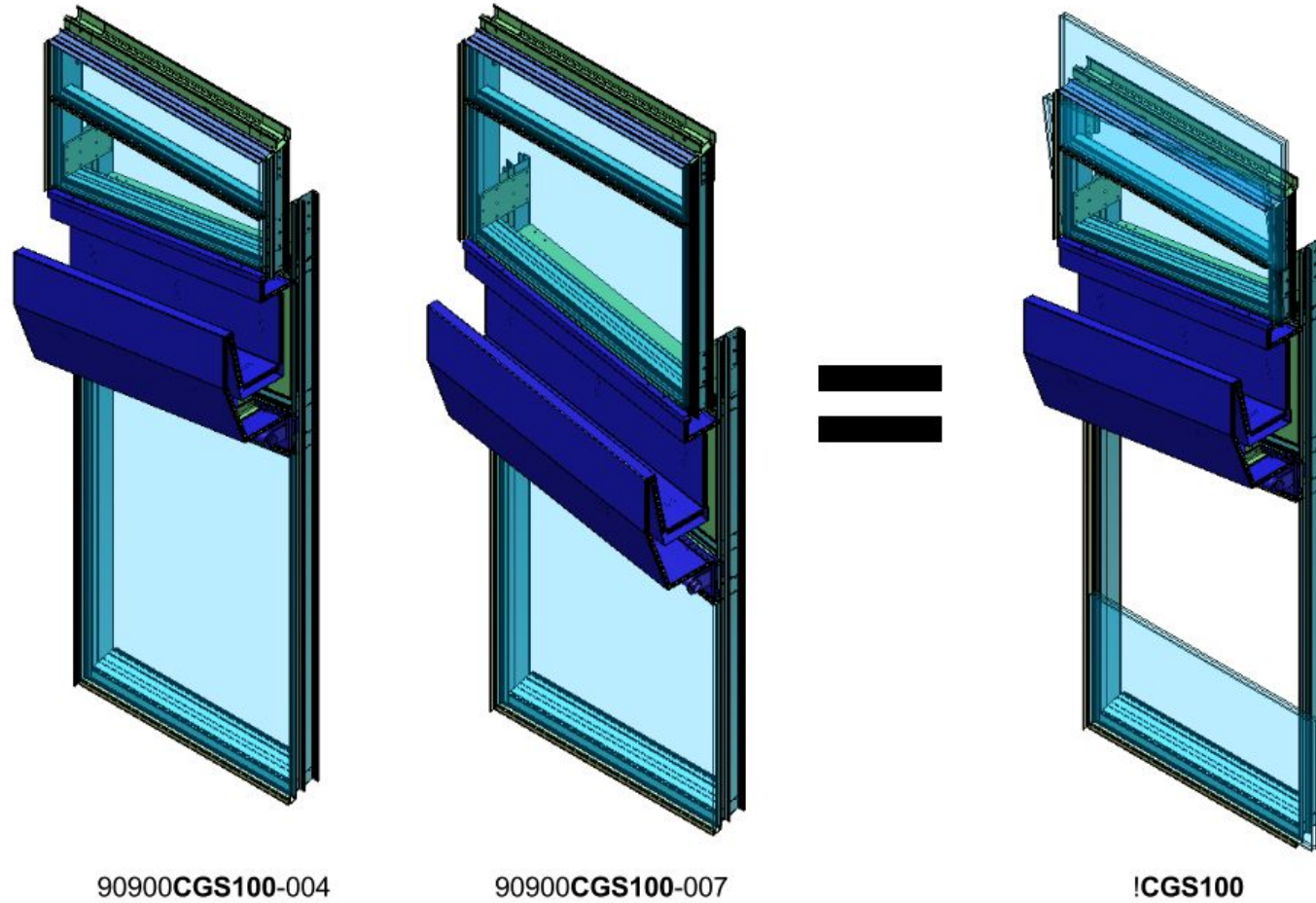
Manage “uniqueness” and find the “sameness” amongst units and parts



Uber Headquarters - Exterior

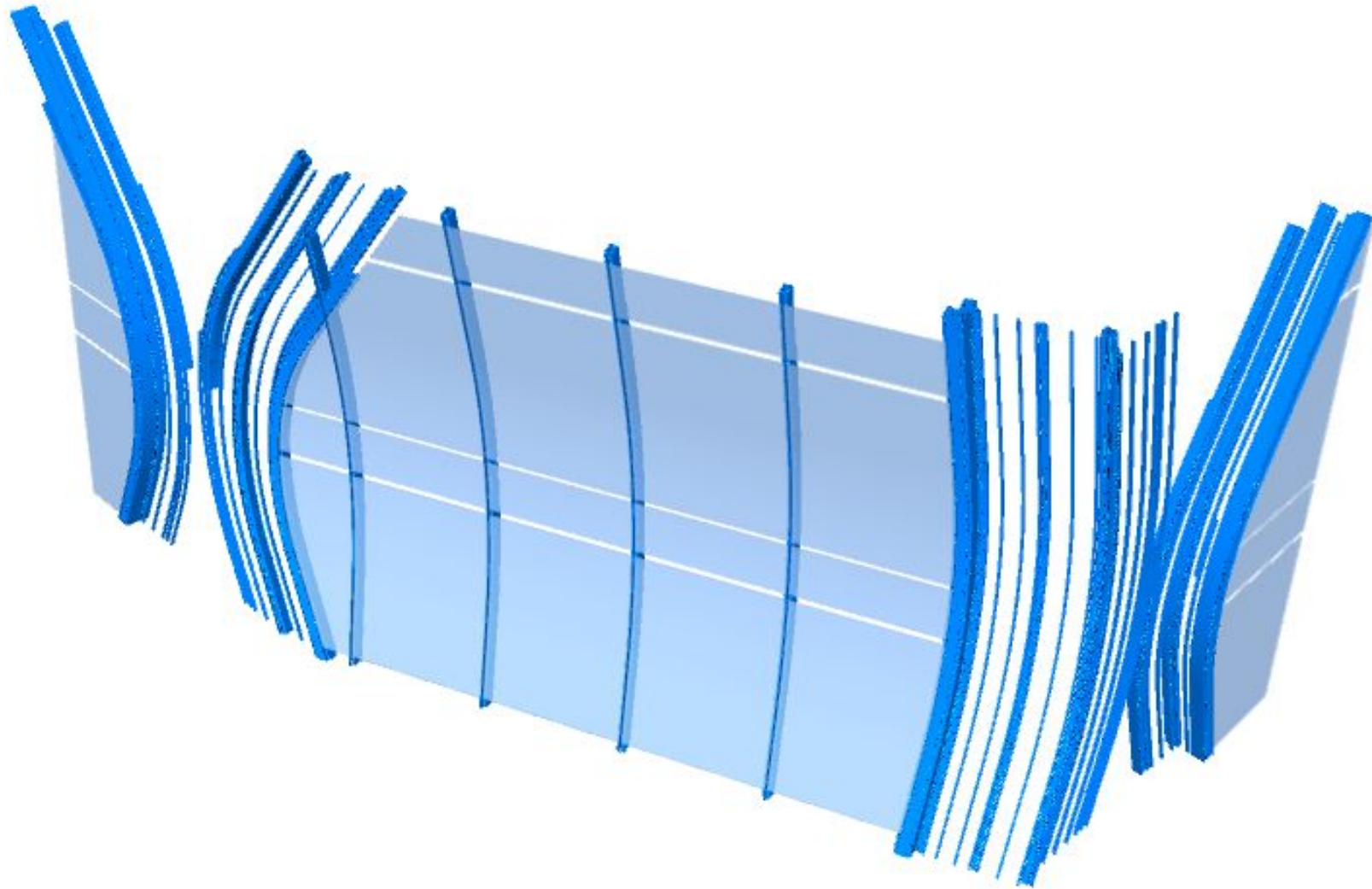
Uber Headquarters - Interior







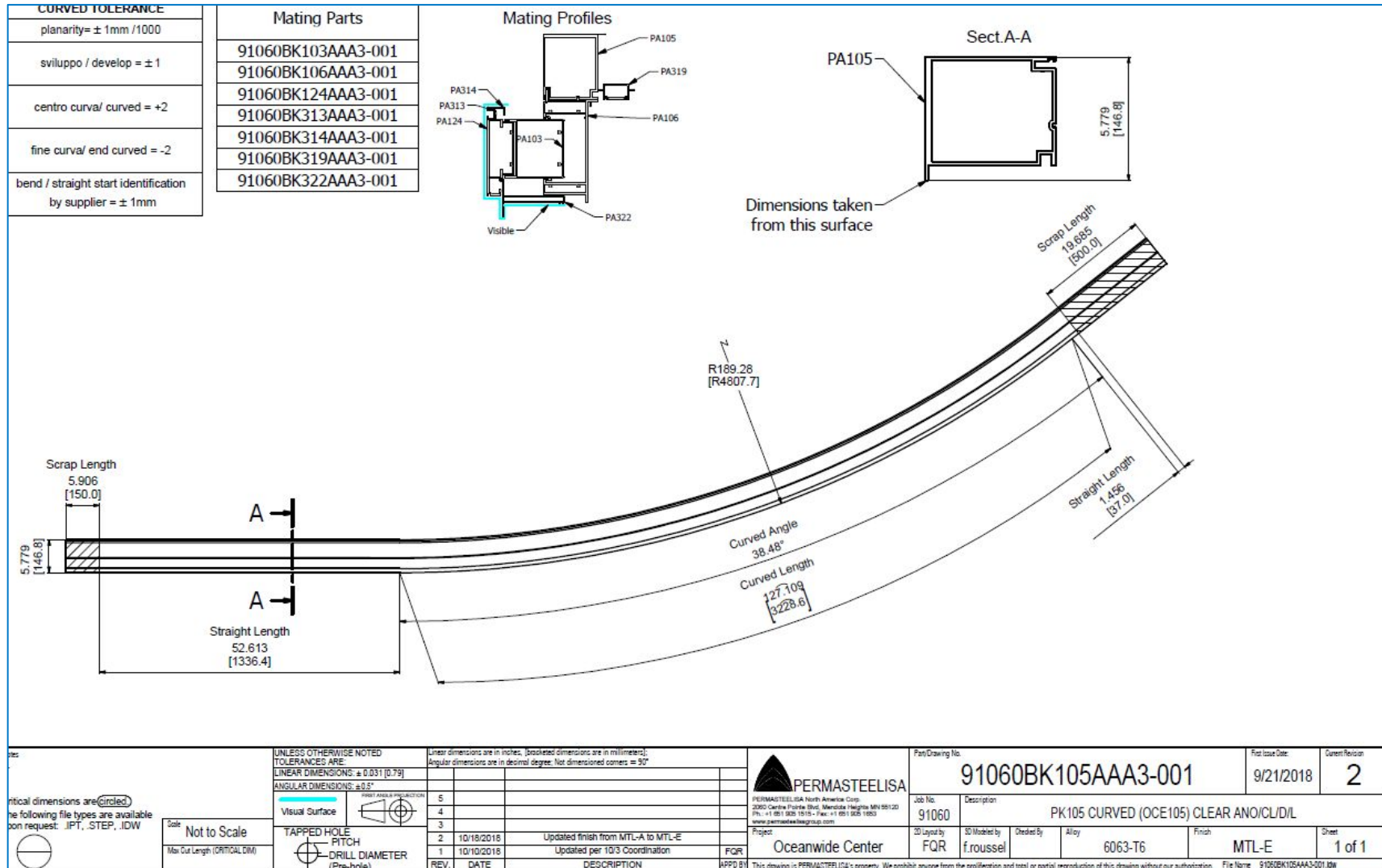
Oceanwide 1st Street Tower - San Francisco, CA
Foster + Partners



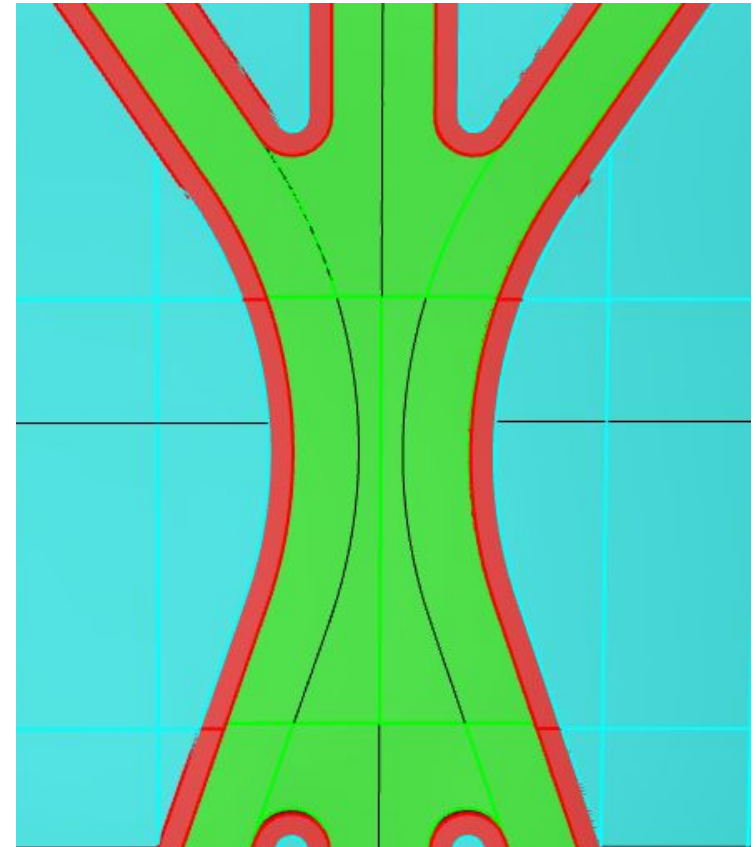
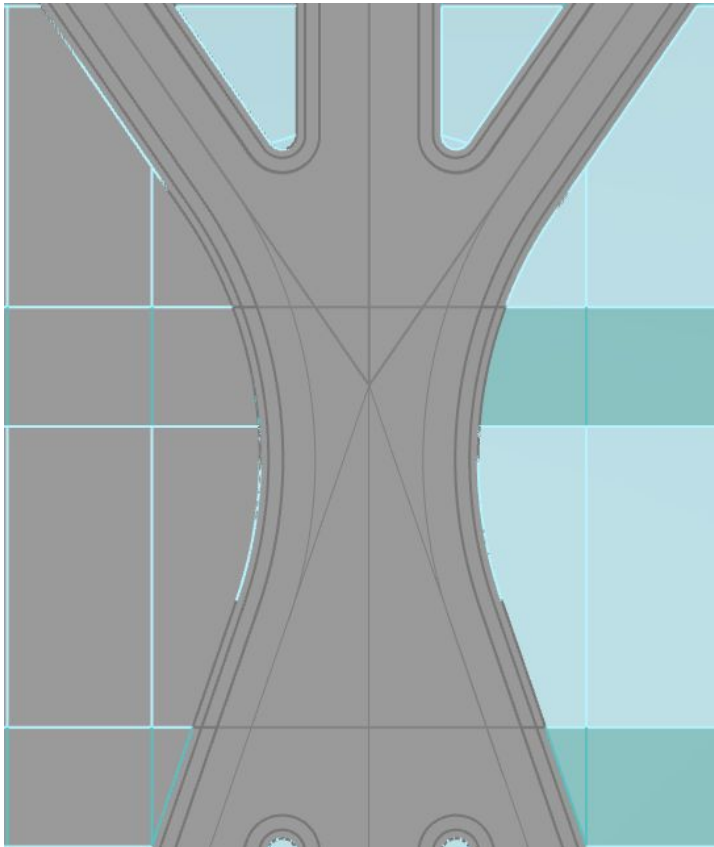
Realizing Geometry: Curved Extrusions



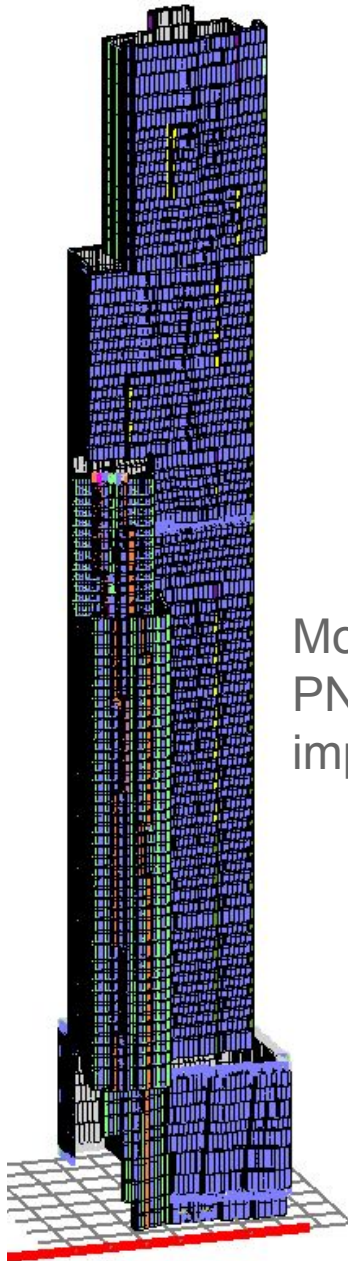
PERMASTEELISA GROUP



- PermaSteelisa has a responsibility to realize the vision of the architect *and* to keep that vision grounded in reality
- Most straightforward way is being involved in a **design assist** capacity
- Another way is for us to adopt the architect's tools and suggest changes







Rhino model developed by Architect and shared as contract document

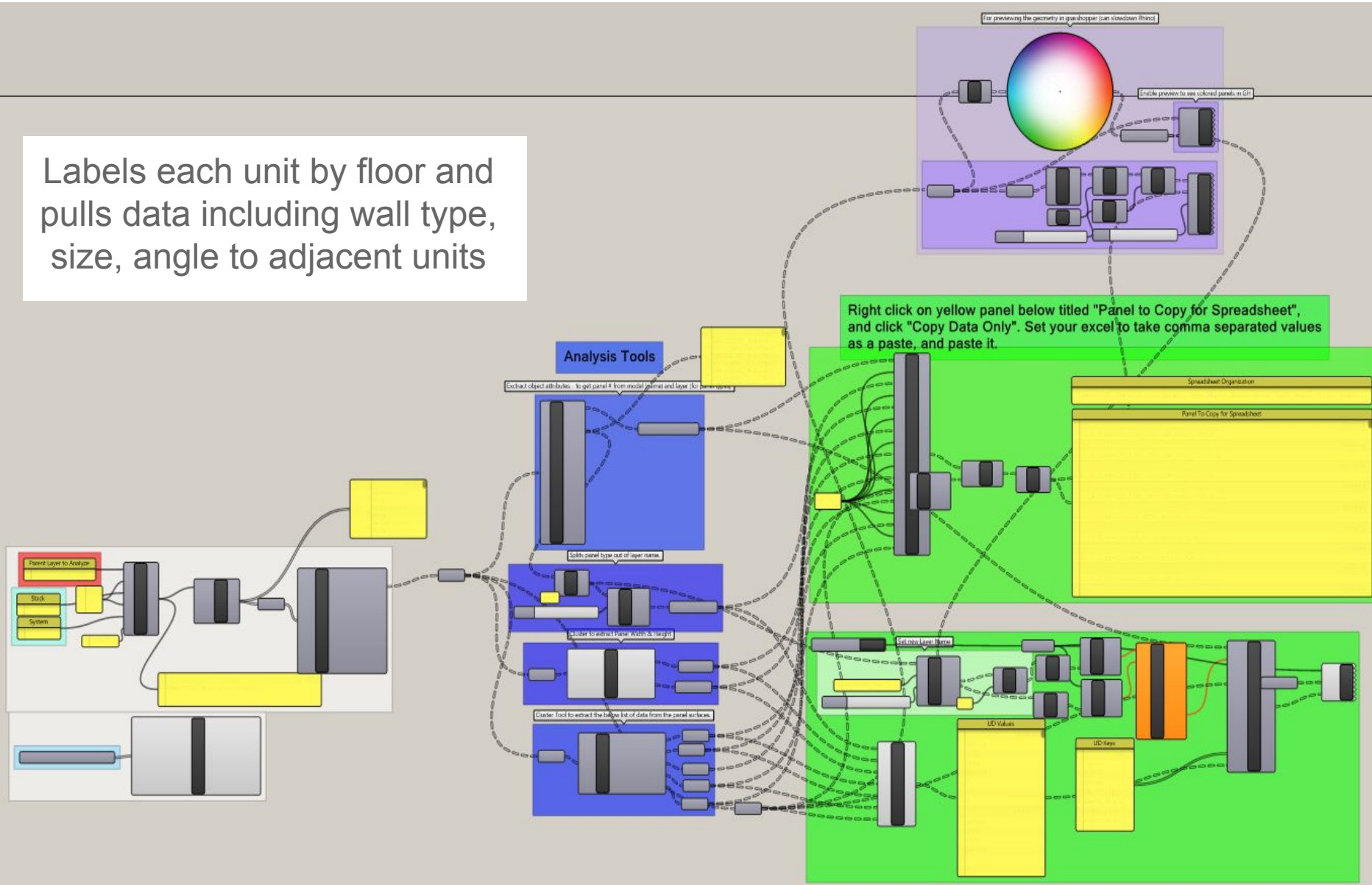
Model unitized per PNA request and imported into PMF

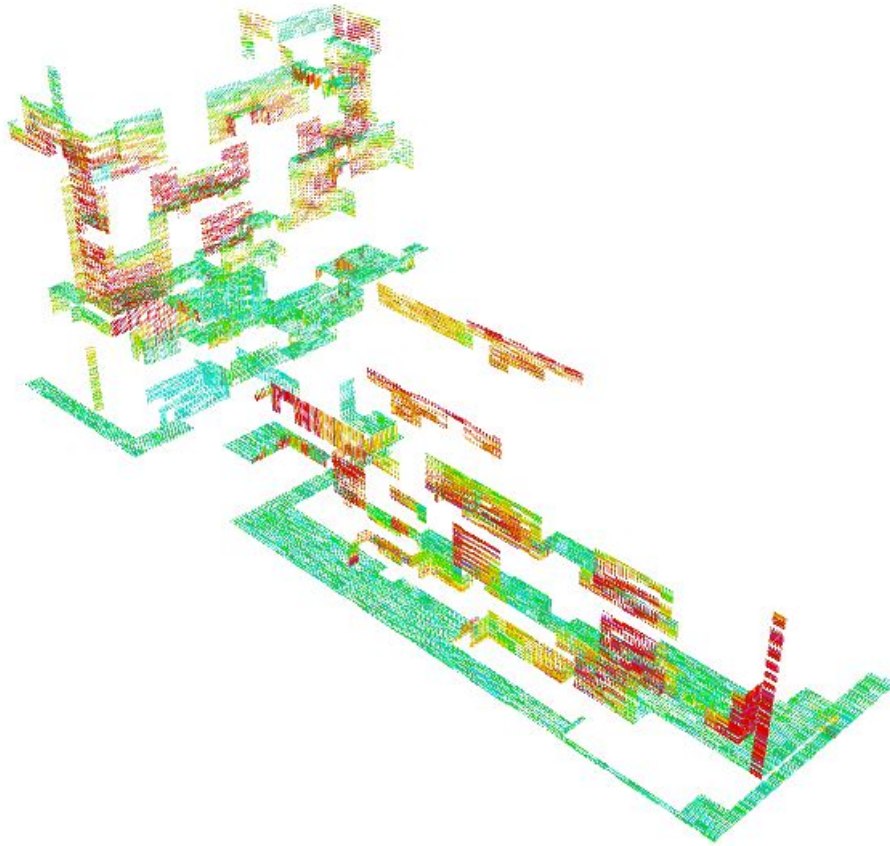
King Street Tower, Toronto - Canada
Gehry



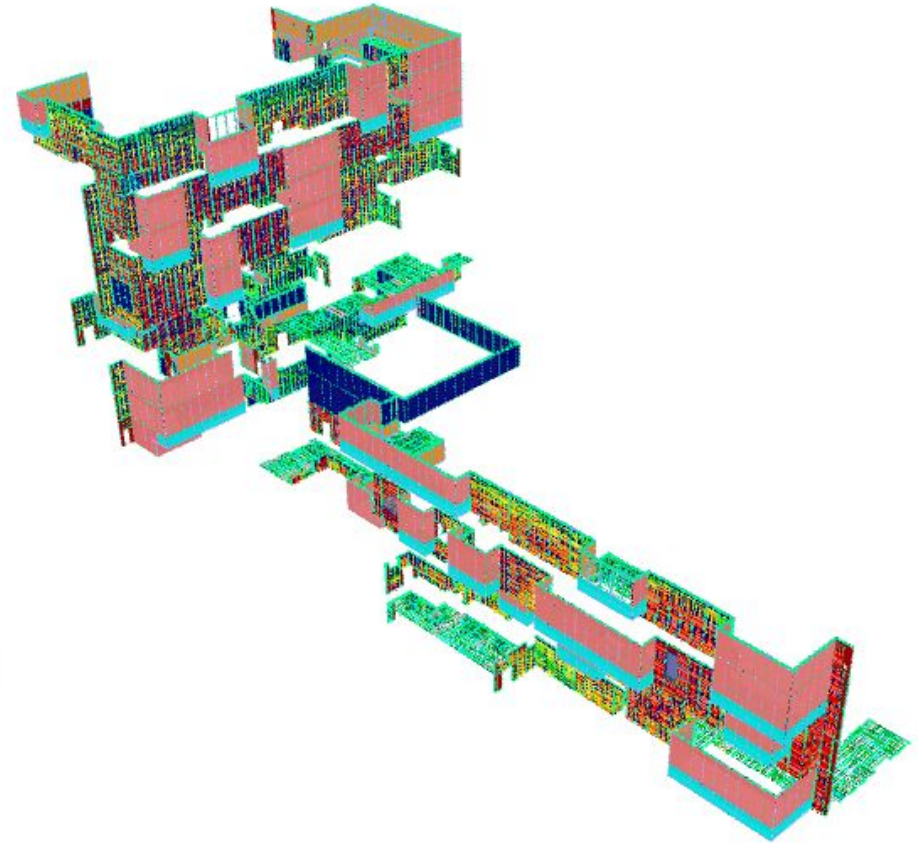


Labels each unit by floor and pulls data including wall type, size, angle to adjacent units

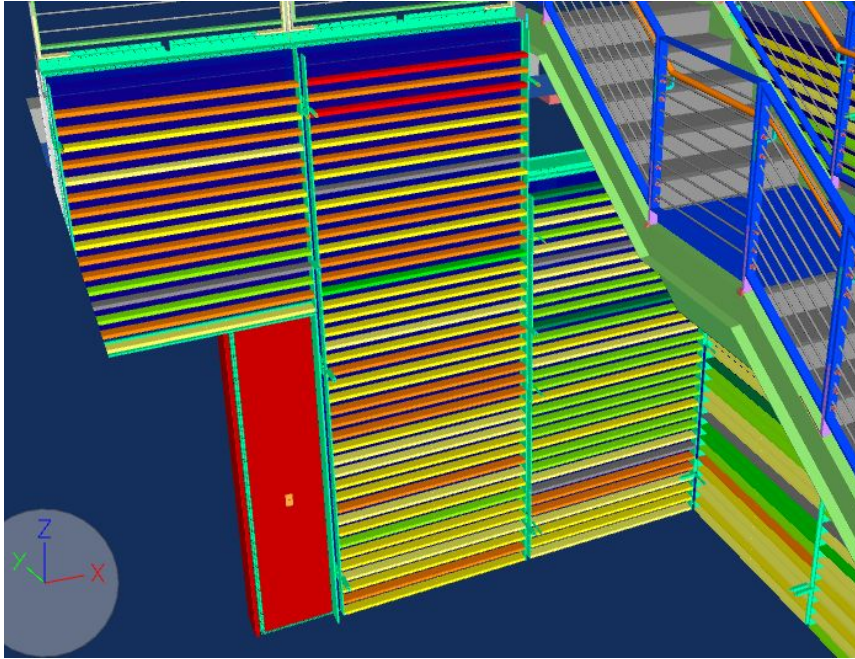




Uber HQ - SHoP Rhino Wood Model

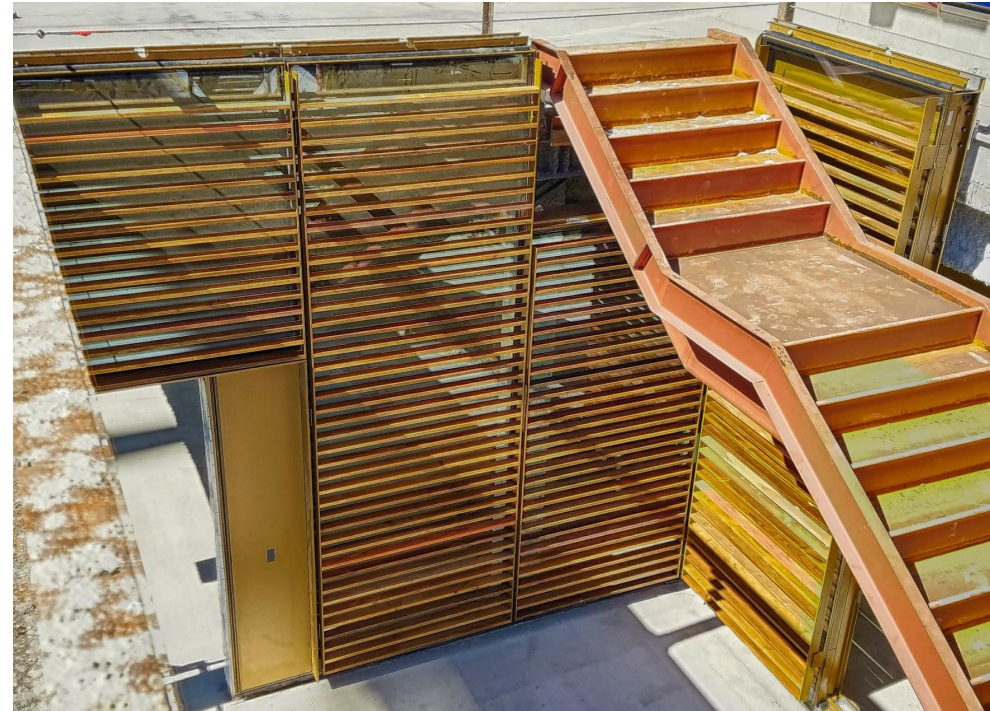


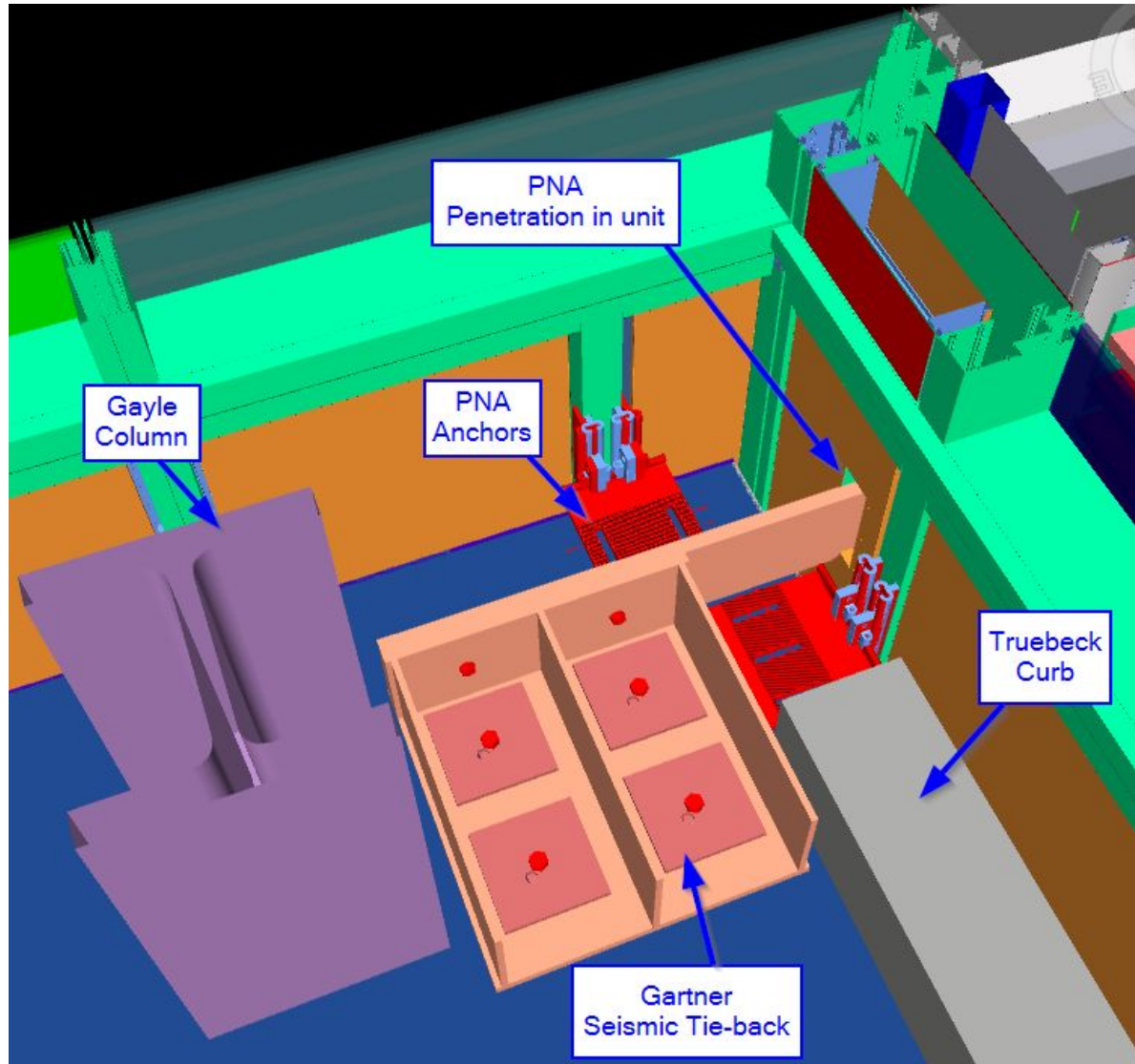
Uber HQ - PNA Navisworks Building Model



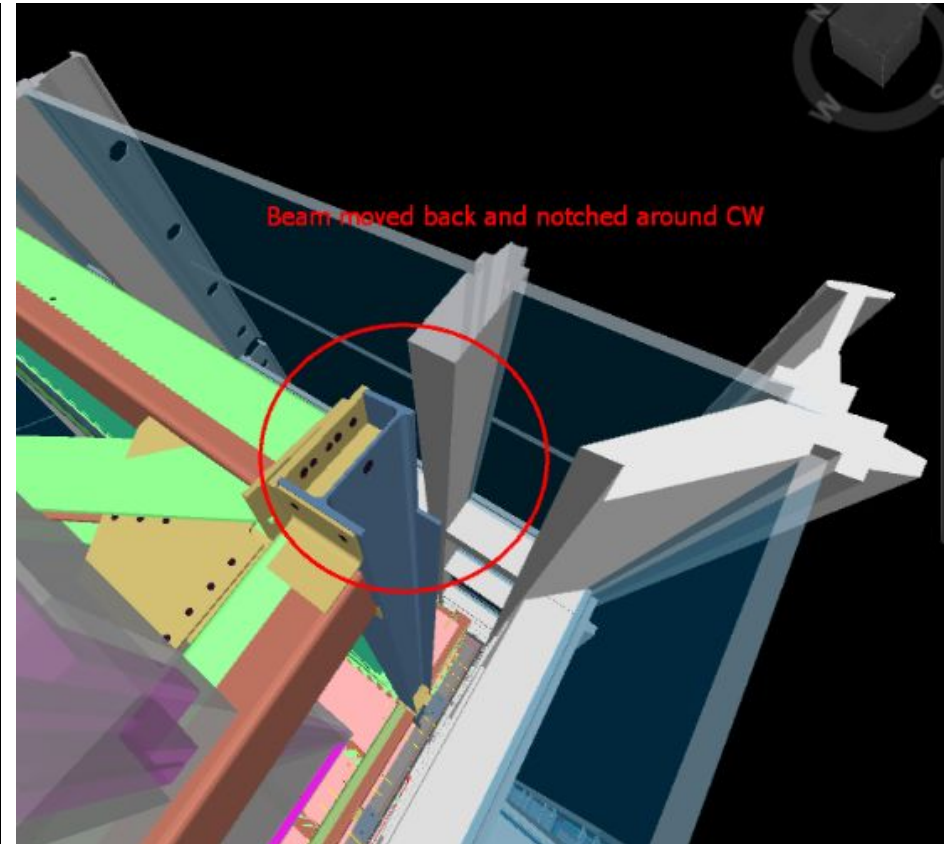
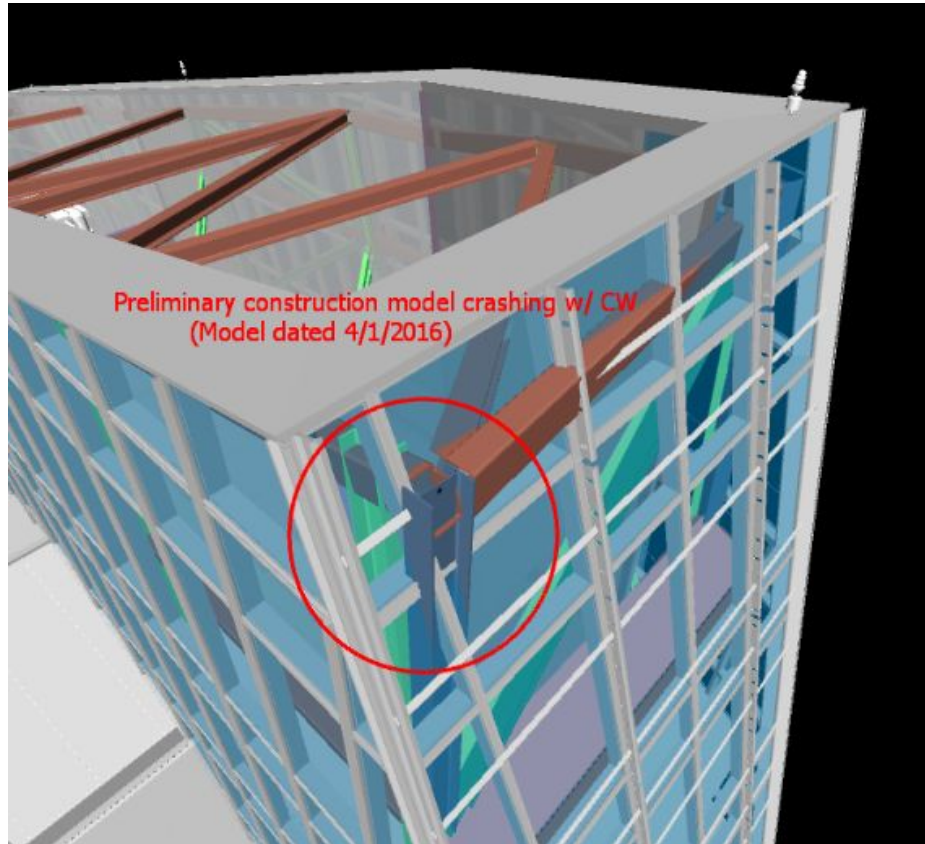
Uber HQ - PNA Navisworks Building Model

Uber Headquarters - On site





Uber HQ - PNA Navisworks Building Model



1144 15th - Architect Revit model vs Steel



- Evolving rapidly
- Continuous coordination and feedback
- Use the right tool
- More than digital technology



Rhino 6





PERMASTEELISA GROUP

THANK YOU!



Ryan Rademacher, AIA

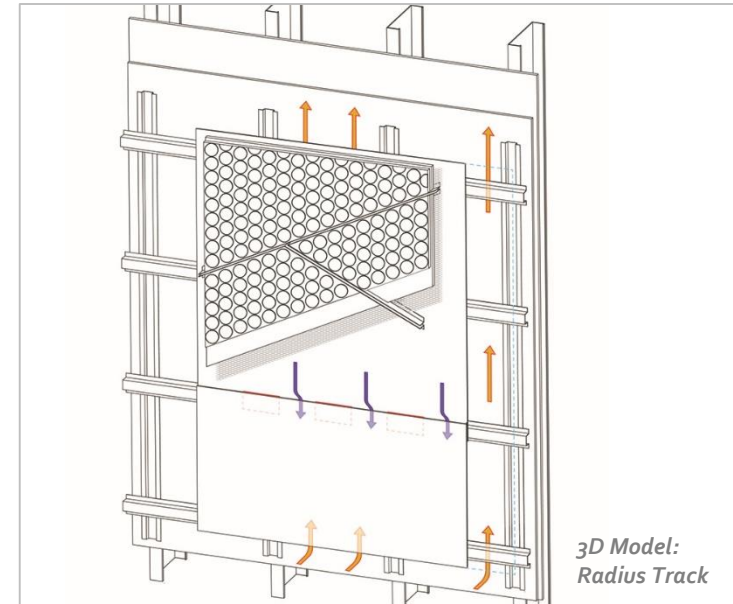
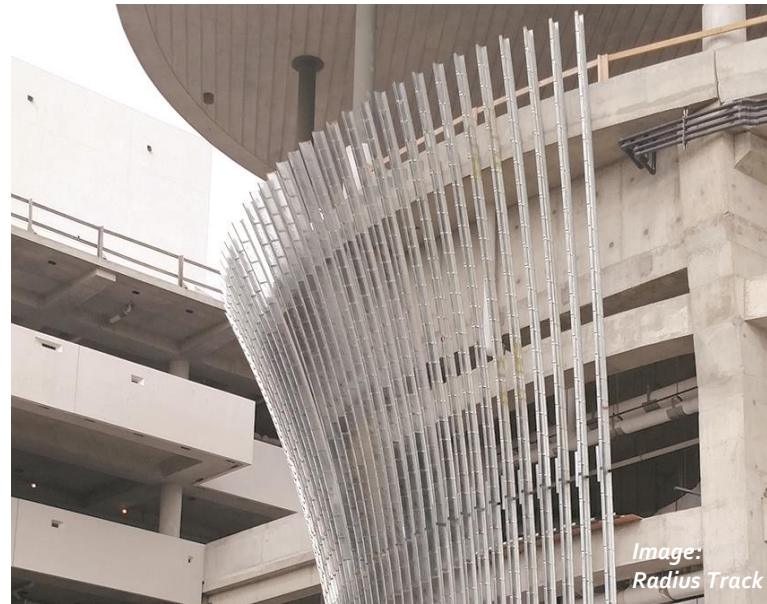
Radius Track Corporation
Vice President of Design

SESSION 2

Computational Thinking

ADVANCED DIGITAL TECHNOLOGY IN THE DESIGN
AND DELIVERY OF COMPLEX FACADES

04/15/19



Frost Museum of Science | Museum Park Miami, FL

2017 ENR Southeast Regional Best Project Award & 2017 ENR National Best of the Best Projects Award



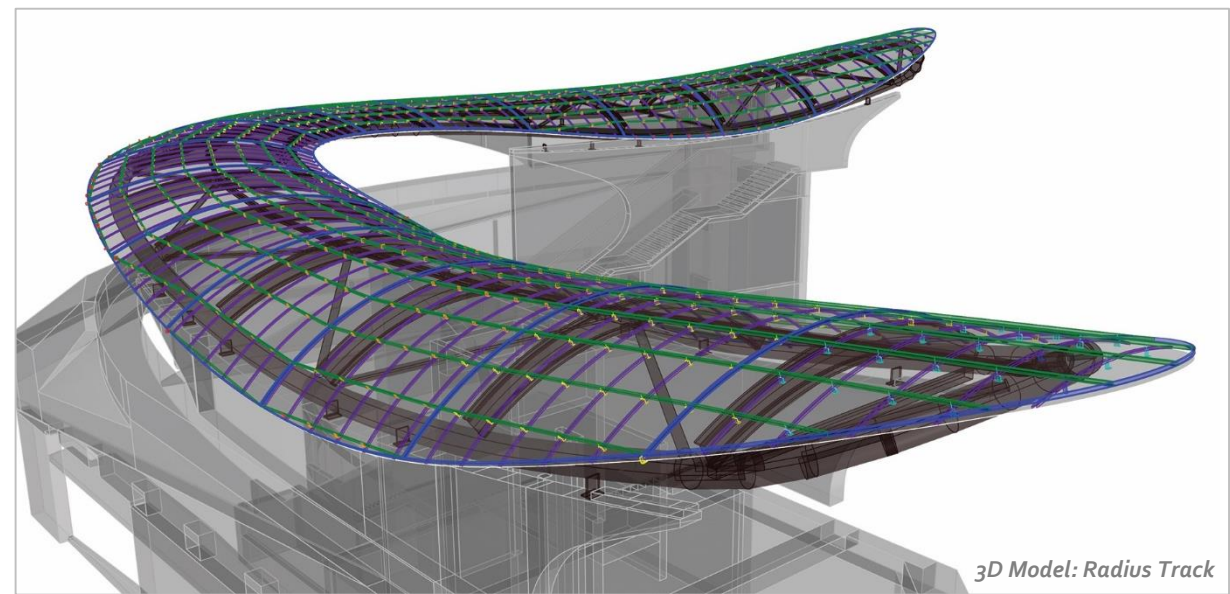
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Image: Radius Track



Image: Radius Track



3D Model: Radius Track

York University Station | Toronto, ON

2018 Canadian Roofing Contractors' Association (CRCA) Award for Workmanship and Innovation



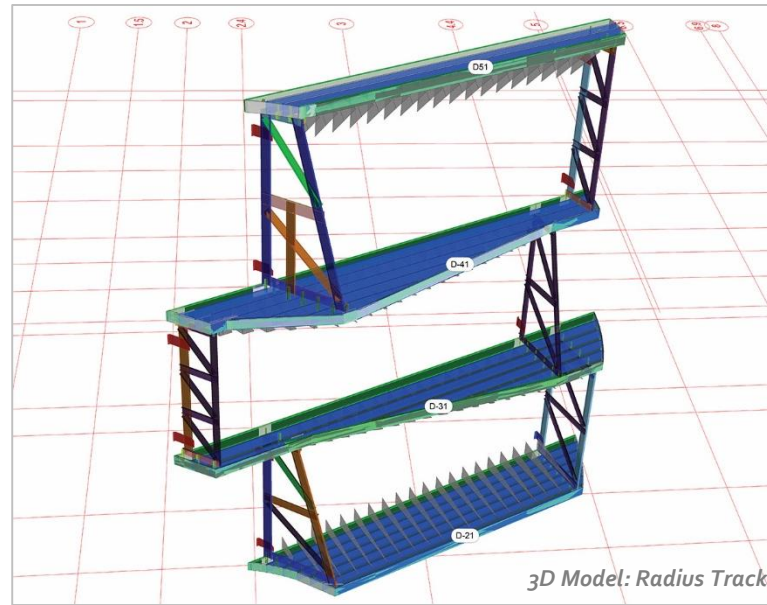
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Image: Andrew Pogue



Image: Josh Partee



3D Model: Radius Track



Image: Josh Partee

Karuna East & West Buildings at One North | Portland, OR

2016 ENR Regional Best Project Award Winner, Category: Office/Retail/Mixed-Use



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Image courtesy of Diller Scofidio + Renfro



Project Team

Owner: U.S. Olympic Museum

Design Architect: Diller Scofidio + Renfro

Executive Architect: Anderson Mason Dale

CM & GC: GE Johnson

Structural Design Engineer: Arup

Executive Structural Engineer: KL&A

Façade Metal Panel &

Glazing Contractor: M.G. McGrath

Façade Framing Contractor: Spacecon

Façade Framing Design: Radius Track Corporation

Façade Framing Engineering: McClure Engineering

U. S. Olympic Museum | Colorado Springs, CO

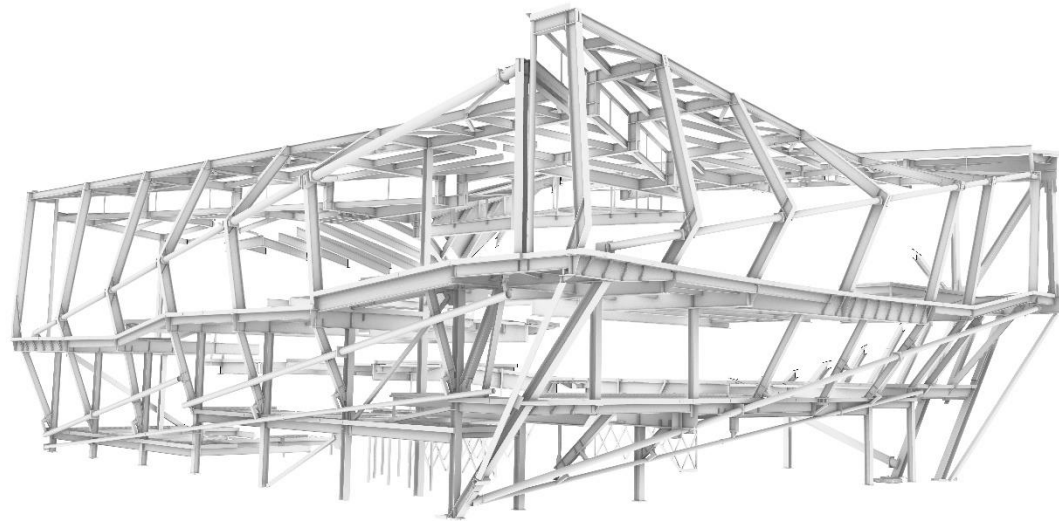


Select Software Used

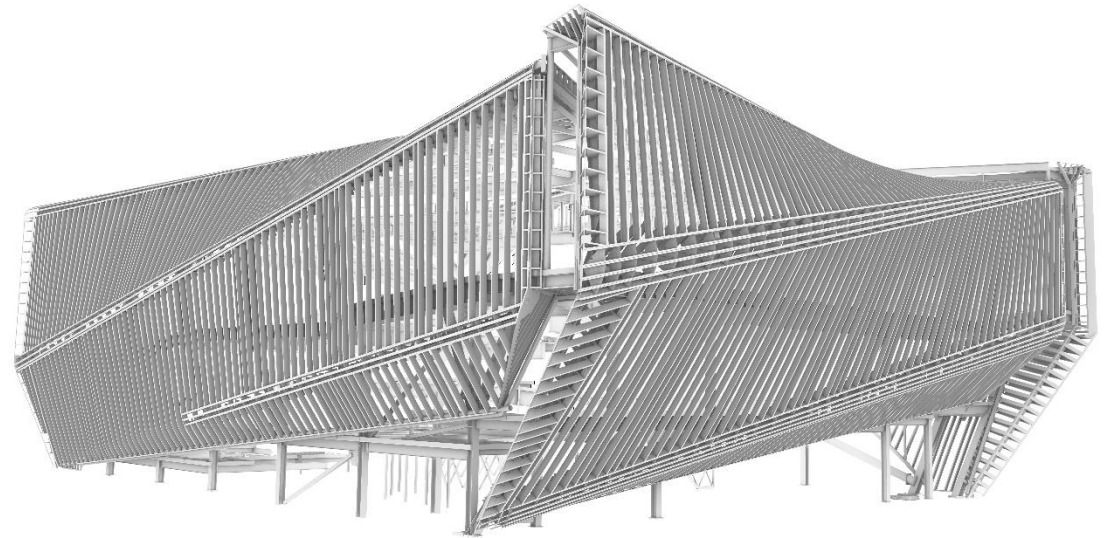


- Assemble – GE Johnson (through preconstruction)
- Prolog – GE Johnson & all trades
- Rhino / grasshopper (+ other plug-ins) – Radius Track, DS+R
- AutoCAD – Radius Track
- Revit – GE Johnson, AMDA, DS+R
- Navisworks – GE Johnson & all trades
- Civil 3D – GE Johnson
- Catia (Dassault Systems 3DEXPERIENCE) – MG McGrath
- Bluebeam – All parties
- Excel – All parties
- Autodesk Recap Pro – Point cloud modeling software
- Leica MS-60 and P-40 laser scanning device;
Software: Leica Infinity & Leica Cloudworx
- Box – GE Johnson, MG McGrath, Radius Track (file sharing)
- Plangrid – Spacecon, Radius Track (file sharing)
- Skype – remote meetings
- GoToMeeting – remote meetings
- Hilti Total Station – Spacecon (surveying)

Structure + Sub-Structure



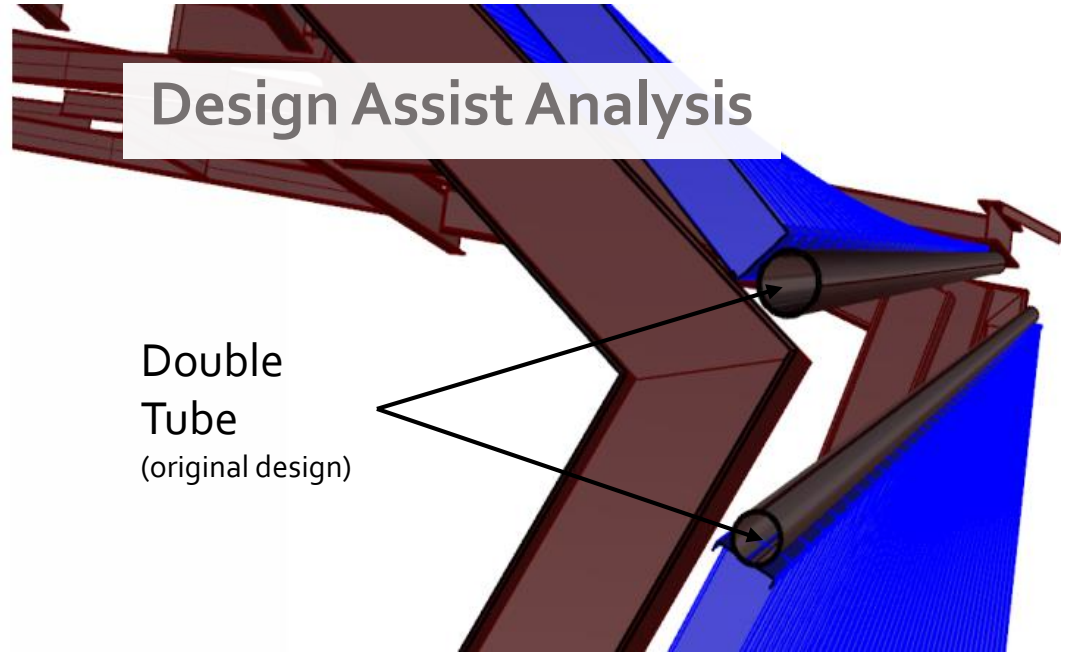
Revised Structure
(post Design Assist)



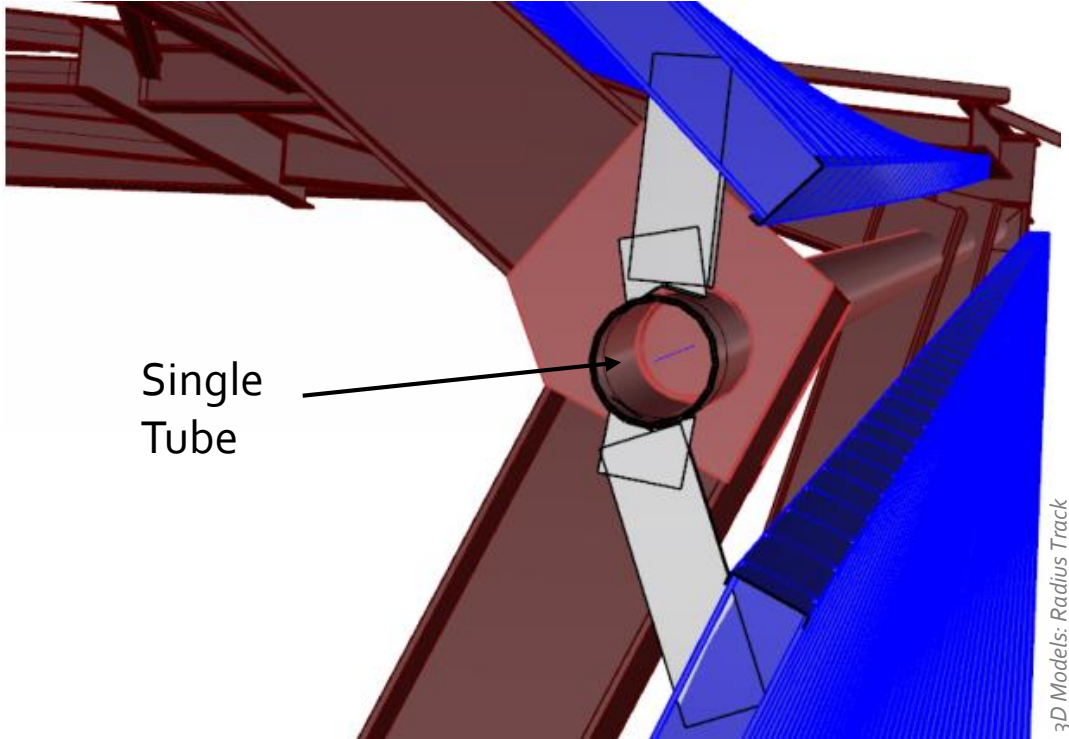
Complete Sub-Structure

Design Assist Analysis

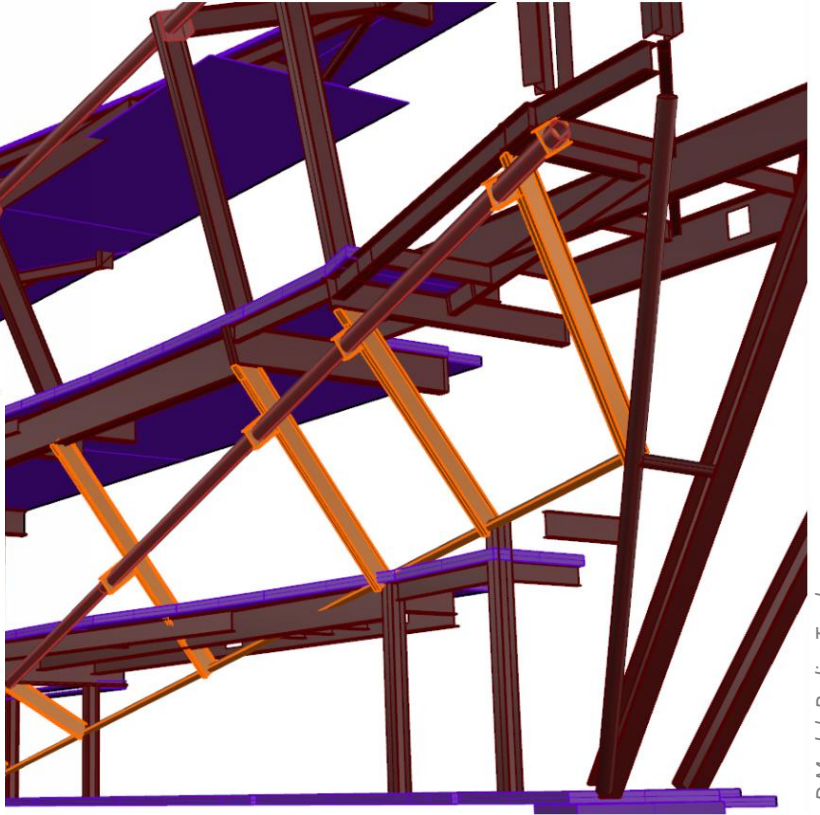
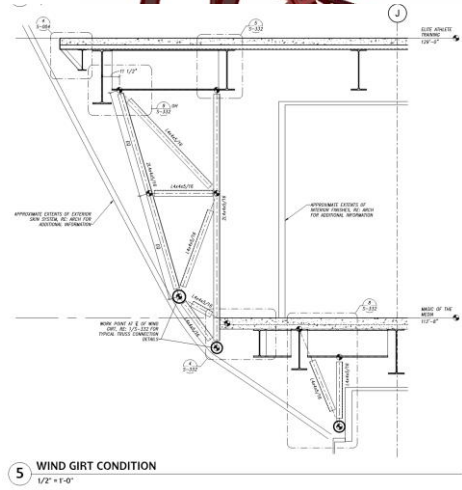
Double Tube
(original design)



Single Tube



Single wide-flange columns (in orange) replace the wind girt trusses to reduce the number of steel parts required for assembly and on site installation. Wide flange outriggers are welded to the flange of the column to connect a single steel pipe at the knuckle.

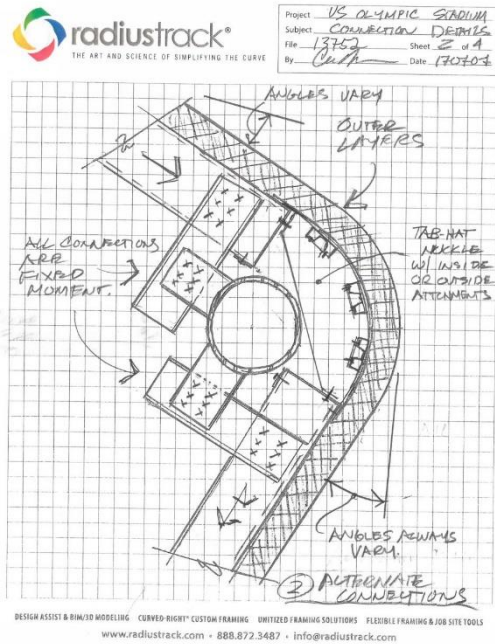


Single Columns Replace Wind Girt Trusses

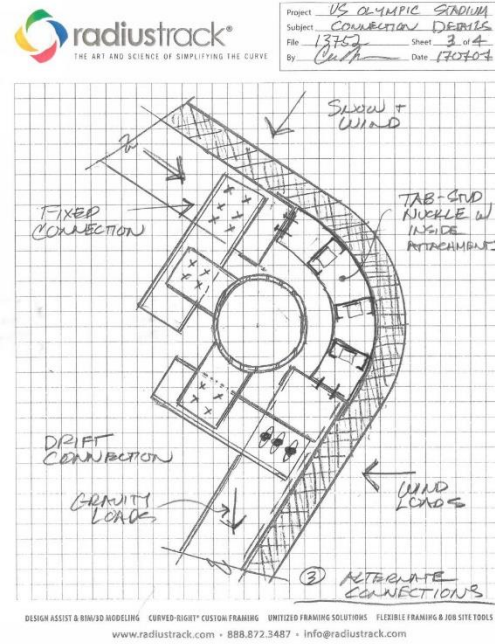
3D Models: Radius Track

3D Model: Radius Track

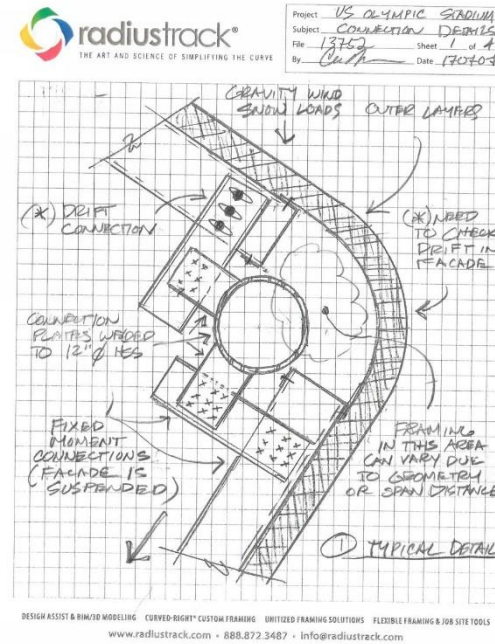
Design Assist Analysis



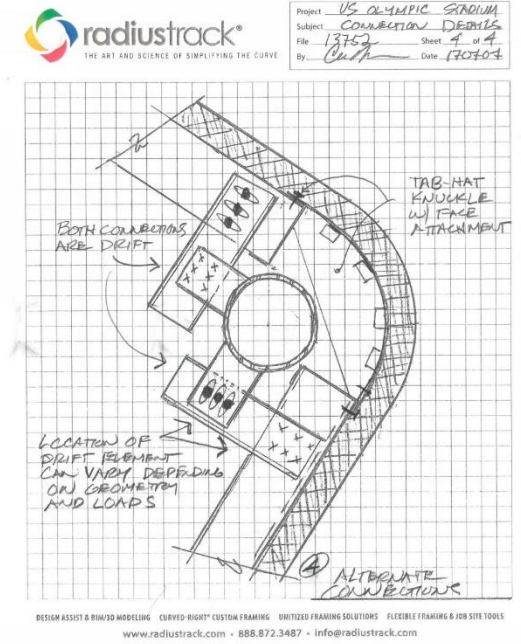
Fixed Connections



Top of Wall Slip

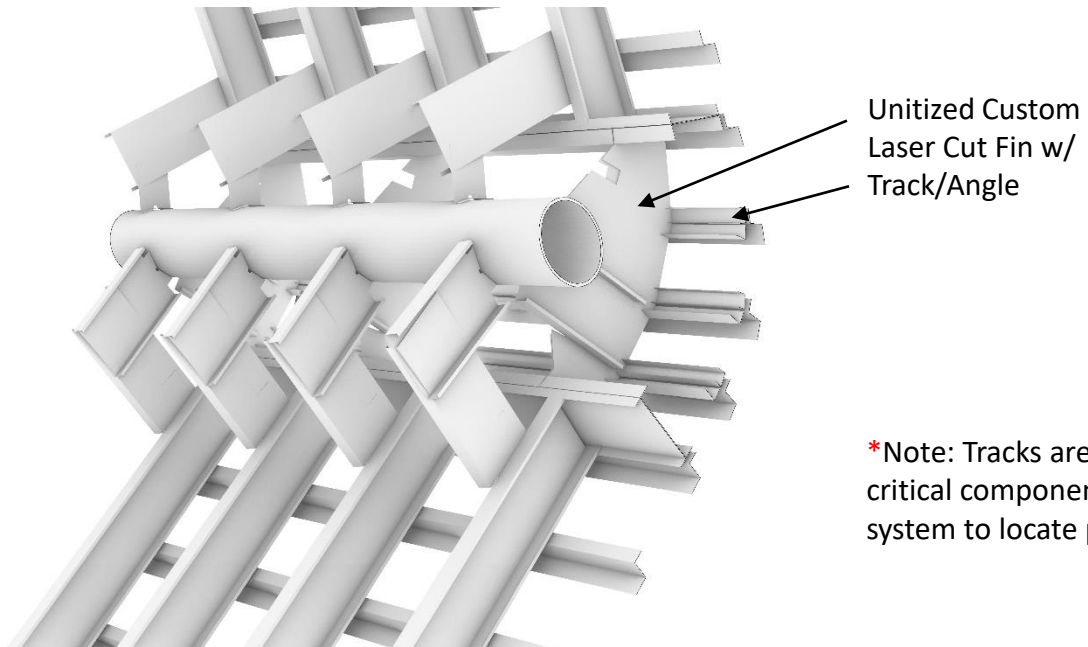
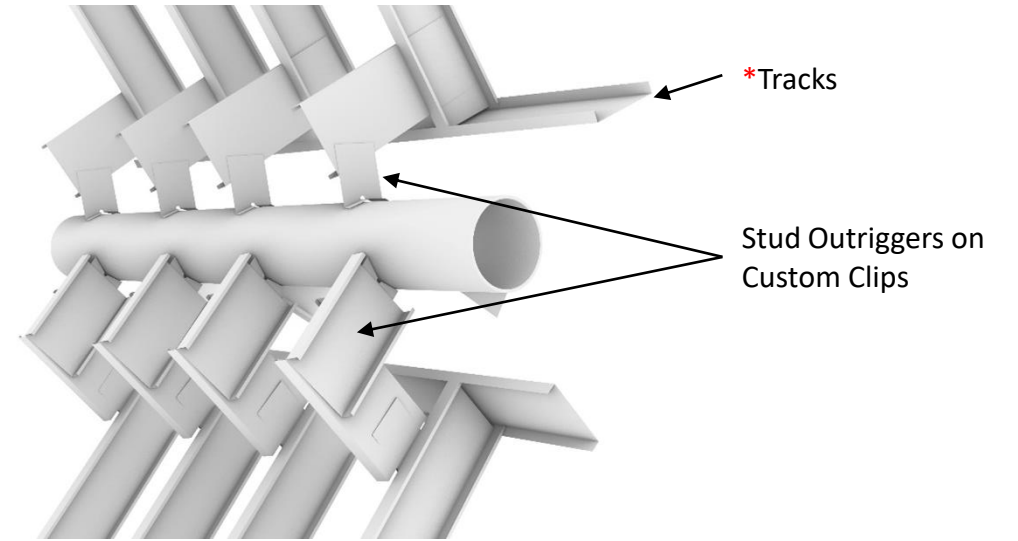
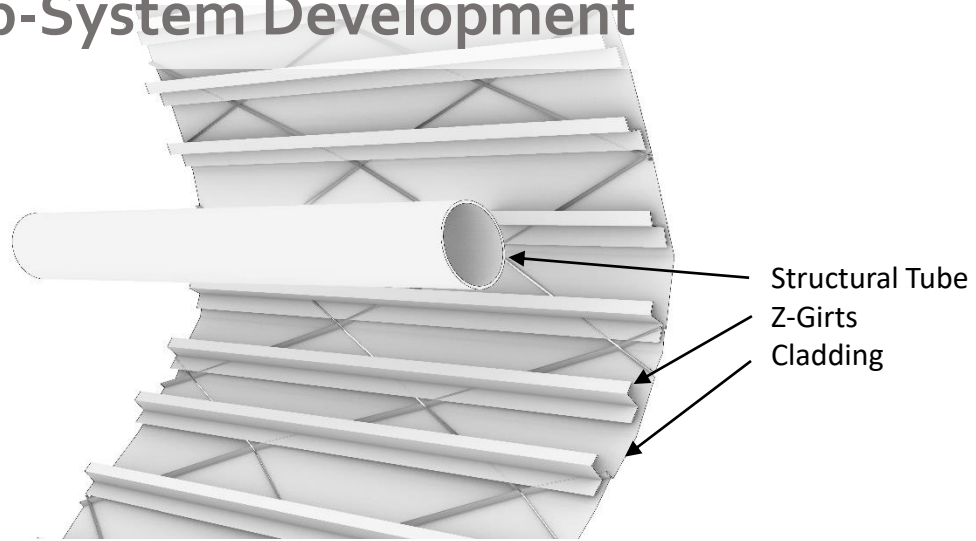


Bottom of Wall Slip

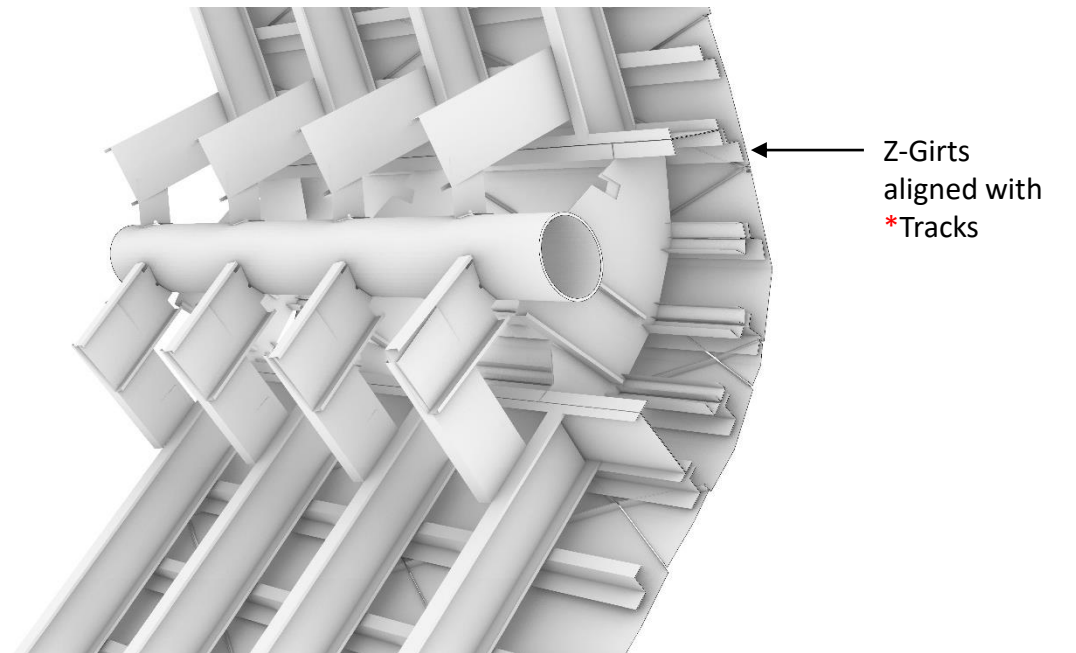


Top & Bottom Slip

Sub-System Development



*Note: Tracks are most critical component of system to locate precisely



Mock-up



Image: Radius Track



Image: Radius Track

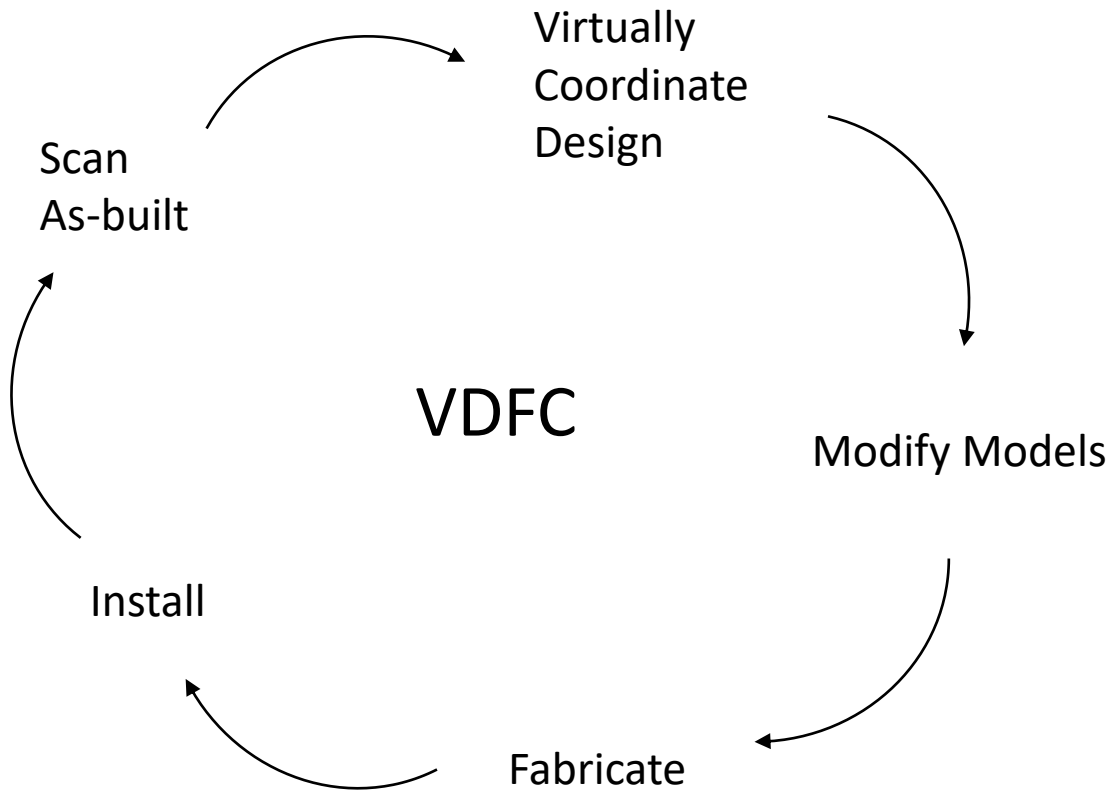


Image: Radius Track

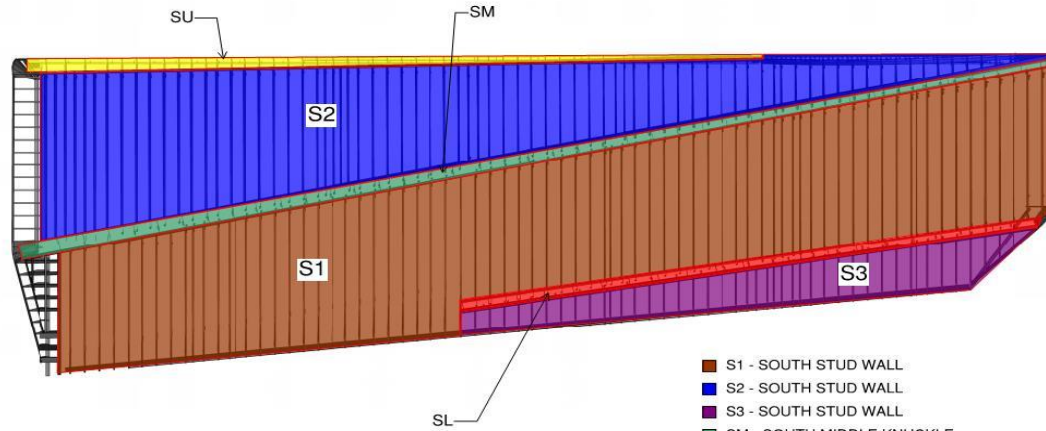
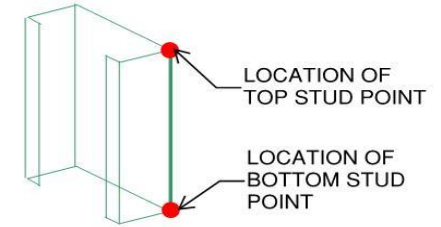
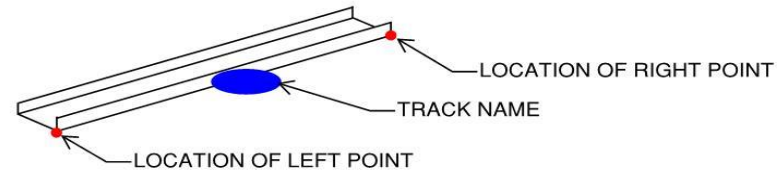
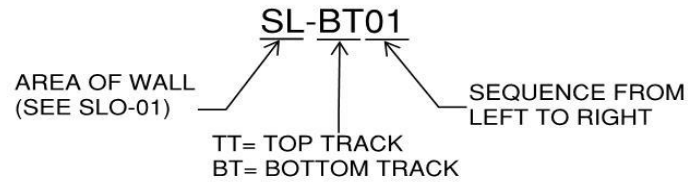


Image: GE Johnson

Validation Loop



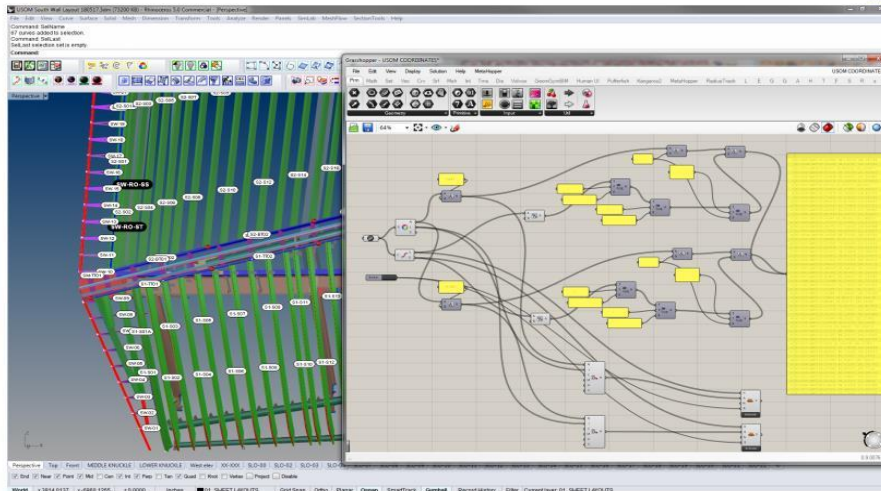
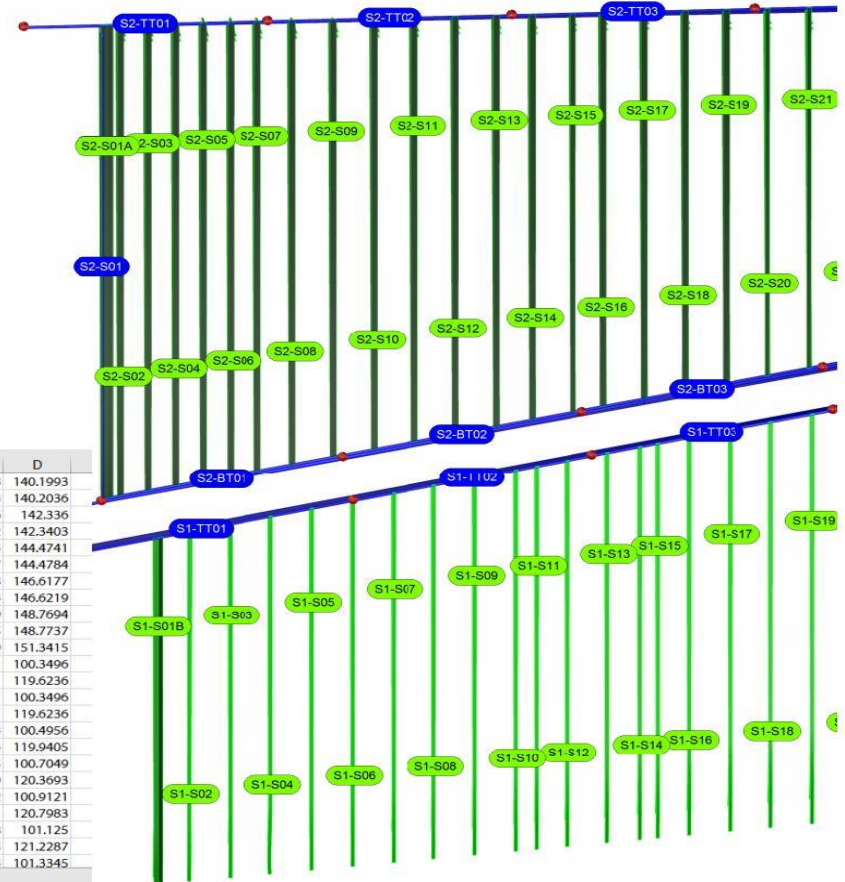
Install Methodology



SOUTH WALL AREA LEGEND

- S1 - SOUTH STUD WALL
- S2 - SOUTH STUD WALL
- S3 - SOUTH STUD WALL
- SM - SOUTH MIDDLE KNUCKLE
- SL - SOUTH LOWER KNUCKLE
- SU - SOUTH UPPER KNUCKLE

SOUTH ELEVATION, EAST SIDE TRACK AND STUD LAYOUT



	A	B	C	D
208	SM-TT09-RIGHT	67.99211	179.2508	140.1993
209	SM-TT10-LEFT	67.98644	179.2704	140.2036
210	SM-TT10-RIGHT	65.12482	189.1456	142.336
211	SM-TT11-LEFT	65.11913	189.1652	142.3403
212	SM-TT11-RIGHT	62.24849	199.0374	144.4741
213	SM-TT12-LEFT	62.24279	199.057	144.4784
214	SM-TT12-RIGHT	59.36428	208.9258	146.6177
215	SM-TT13-LEFT	59.35856	208.9454	146.6219
216	SM-TT13-RIGHT	56.47507	218.8109	148.7694
217	SM-TT14-LEFT	56.46935	218.8305	148.7737
218	SM-TT14-RIGHT	53.03651	230.5679	151.3415
219	S1-S01A-BTM	98.63418	98.74421	100.3496
220	S1-S01A-TOP	92.08715	96.81561	119.6236
221	S1-S01B-BTM	98.63418	98.74421	100.3496
222	S1-S01B-TOP	92.08715	96.81561	119.6236
223	S1-S02-BTM	98.196	100.2494	100.4956
224	S1-S02-TOP	91.64046	98.32674	119.9405
225	S1-S03-BTM	97.61944	102.1635	100.7049
226	S1-S03-TOP	91.07062	100.2439	120.3693
227	S1-S04-BTM	97.03337	104.0482	100.9121
228	S1-S04-TOP	90.50046	102.161	120.7983
229	S1-S05-BTM	96.42819	105.9888	101.125
230	S1-S05-TOP	89.92817	104.0853	121.2287
231	S1-S06-BTM	95.84785	107.9034	101.3345

USOM_S Coordinates

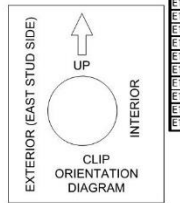
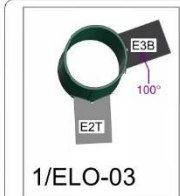
Install Methodology

- 20 3-
- 22' 3-1/2"
- 24' 3-7/8"
- 26' 4-1/4"
- 28' 5-5/16"
- 30' 5-11/16"
- 32' 6-1/16"
- 34' 1-3/8"
- 35' 0"
- 36' 7-1/4"
- 38' 7-1/8"
- 40' 1-7/8"
- 41' 2-3/16"
- 43' 2-9/16"
- 45' 2-15/16"
- 47' 3-1/4"
- 49' 4-5/16"
- 51' 4-11/16"
- 53' 5-1/16"
- 55' 5-3/8"
- 57' 5-3/4"
- 59' 1/2"

GLAZING PIPE CLIP LOCATIONS

1' 4-3/4"	32' 3-13/16"	68' 10-3/16"	105' 1/2"
3' 4-7/8"	34' 3-15/16"	70' 10-7/8"	107' 1/2"
5' 5"	36' 4-1/16"	73' 7/16"	108' 7-3/16"
6' 11-5/8"	38' 4-3/16"	75' 9/16"	109' 7-3/16"
7' 10-3/16"	40' 4-5/16"	77' 11/16"	111' 7-3/8"
9' 10-5/16"	42' 4-7/16"	79' 13/16"	113' 7-1/2"
11' 10-7/16"	44' 4-9/16"	81' 1"	115' 7-9/16"
13' 10-9/16"	46' 4-11/16"	83' 1-1/8"	117' 7-7/8"
15' 10-11/16"	48' 4-13/16"	85' 1-1/4"	119' 8-3/16"
17' 10-13/16"	49' 11-7/16"	87' 1-3/8"	121' 8"
19' 11"	50' 9"	88' 11-1/2"	123' 8"
21' 11-1/8"	52' 9-1/8"	90' 11-5/8"	125' 8-3/16"
23' 5-1/16"	54' 9-1/4"	92' 11-3/4"	
24' 5-1/4"	56' 9-3/8"	94' 11-7/8"	
25' 11-3/8"	58' 9-1/2"	97' 0"	
27' 7/8"	60' 9-5/8"	99' 1/8"	
27' 11-1/2"	62' 9-3/4"	101' 1/4"	
29' 6-1/8"	64' 9-15/16"	102' 7"	
30' 9"	66' 10-1/16"	103' 5-1/2"	

MEASURE THIS DIRECTION FROM GUSSET



E1B-1 1'6-13/16"	E1T-1 3'7-5/16"	E1T-4 0'4-1/2"	E2B-3 2'11-5/8"	E2T-5 0'2-15/16"
E1B-1 3'7-3/16"	E1T-1 5'10-5/16"	E1T-4 2'5-7/16"	E2B-3 5'9/16"	E2T-5 1'7-7/16"
E1B-1 5'7-9/16"	E1T-1 7'11-3/16"	E1T-4 4'6-5/16"	E2B-3 7'2-5/16"	E2T-5 3'1-1/6"
E1B-1 7'8"	E1T-1 10'7-1/6"	E1T-4 6'7-1/4"	E2B-3 9'3-5/16"	E2T-5 5'5/8"
E1B-1 9'8-3/8"	E1T-1 12'1-1/2"	E1T-4 8'8-3/16"	E2B-3 11'4-1/4"	E2T-5 7'1-3/16"
E1B-1 11'8-13/16"	E1T-1 14'2-5/16"	E1T-4 10'9-9/16"	E2B-3 13'5-1/4"	E2T-5 8'8-1/8"
E1B-1 13'9-3/16"	E1T-1 16'3-7/16"	E1T-4 12'10-7/16"	E2B-3 14'10-7/16"	E2T-5 10'2-1/16"
E1B-1 15'4"	E1T-1 17'10-13/16"	E1T-4 14'11-3/8"	E2B-3 16'4-3/4"	E2T-5 12'2-5/8"
E1B-1 17'2-9/16"	E1T-1 19'5-1/16"	E1T-4 16'6-9/16"	E2B-3 17'7-7/16"	E2T-5 14'3-3/16"
E1B-1 19'3"	E1T-1 21'6"	E1T-4 18'7-7/16"	E2B-3 19'2-5/8"	E2T-5 16'3-13/16"
E1B-1 21'3-7/16"	E1T-1 23'6-15/16"	E1T-4 20'9-1/8"	E2B-3 21'3-9/16"	E2T-5 18'4-3/8"
E1B-2 2'11-5/8"	E1T-1 25'7-7/8"	E1T-4 22'10"	E2B-3 22'7-11/16"	E2T-5 20'5"
E1B-2 4'4"	E1T-1 27'8-13/16"	E1T-4 24'10-15/16"	E2B-3 24'1-3/16"	E2T-5 22'5-9/16"
E1B-2 6'4-7/16"	E1T-1 29'9-7/8"	E1T-4 26'11-13/16"	E2B-3 26'2-3/16"	E2T-6 0'2-1/8"
E1B-2 8'4-13/16"	E1T-1 31'10-13/16"	E1T-4 29'11/16"	E2B-3 28'3-1/2"	E2T-6 1'2-7/16"
E1B-2 10'5-1/4"	E1T-1 33'11-3/4"	E2B-1 21'8-1/4"	E2B-3 28'3-1/2"	E2T-6 3'3-9/16"
E1B-2 12'5-5/8"	E1T-1 35'7"	E2B-1 23'8-3/16"	E2B-3 30'4-1/4"	E2T-6 5'4-1/8"
E1B-2 14'6"	E1T-1 37'6-1/16"	E2B-1 25'10-5/16"	E2T-1 1'1-5/8"	E2T-6 7'4-3/4"
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E1B-2 29'8-1/8"	E1T-2 11'11-1/4"	E2B-2 1'6-1/8"	E2T-2 14'6-13/16"	E2T-7 1'7-5/8"
E1B-2 31'8-1/2"	E1T-2 13'4-1/8"	E2B-2 3'7-1/16"	E2T-3 0'3"	E2T-7 3'1/4"
E1B-2 33'8-7/8"	E1T-2 15'5-1/16"	E2B-2 5'9-1/8"	E2T-3 2'2-5/8"	E2T-7 5'5/16"
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E1B-3 22'7-7/16"		E2B-2 29'2-1/4"	E2T-4 17'2-7/8"	E3B-3 7'9-7/8"
E1B-3 24'7-7/16"		E2B-2 30'8-3/8"	E2T-4 18'3-7/16"	E3B-3 9'5-3/8"
E1B-3 26'7-7/16"		E2B-2 32'10-13/16"	E2T-4 20'4-1/16"	
			E2T-4 22'4-5/8"	
			E2T-4 23'9-7/8"	

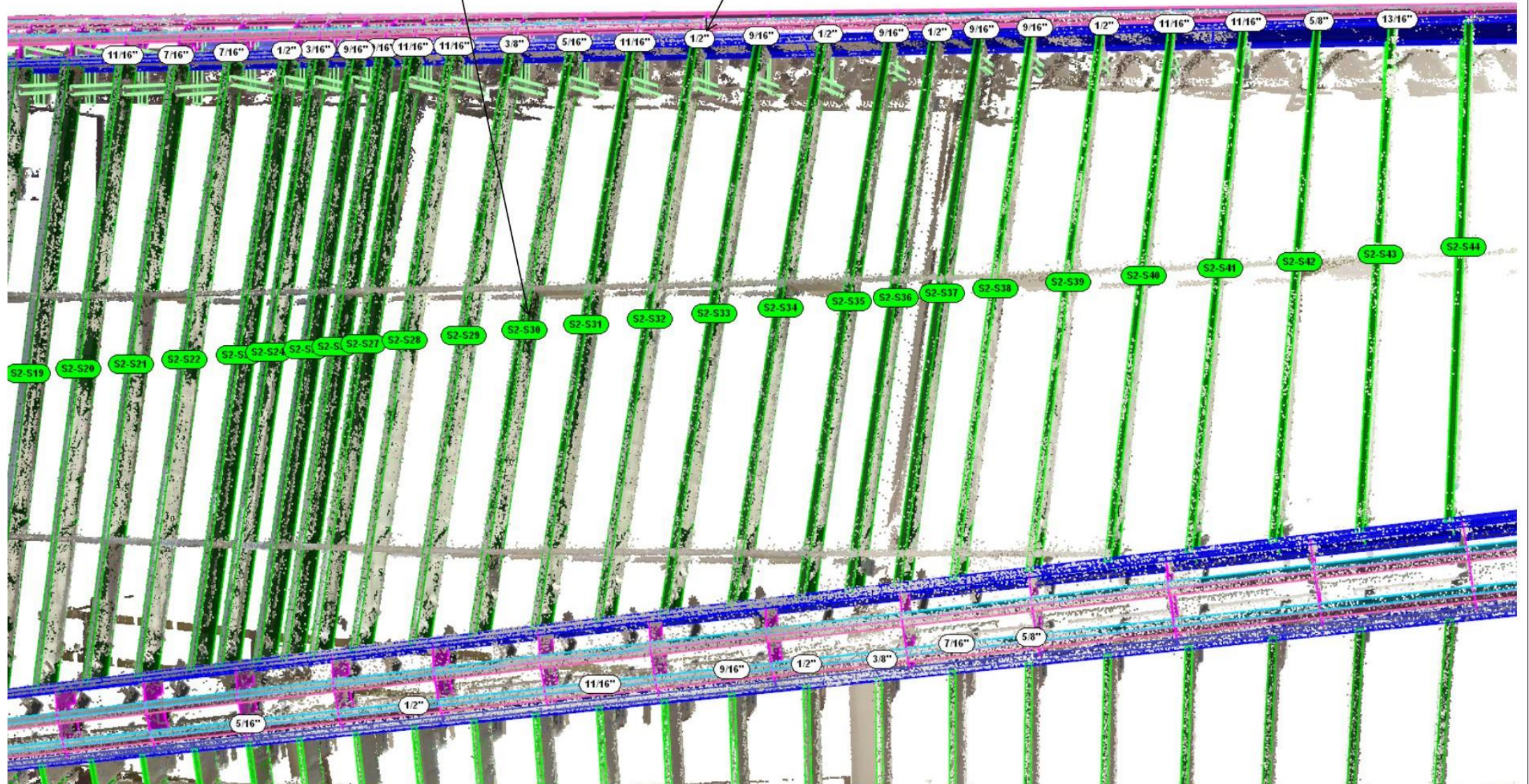
MEASURE THIS DIRECTION FROM END OF PIPE

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			SHEET TITLE: SOUTH WALL CLIP LAYOUT DESIGNER: SMA DATE: PROJECT NO: SHEET NO:		

Scan Analysis

GREEN DOTS ARE NAMES OF STUDS FOR LOCATION REFERENCE

WHITE DOTS ARE DIMENSIONS FROM POINT CLOUD SCAN FROM INTENDED FRAMING SURFACE

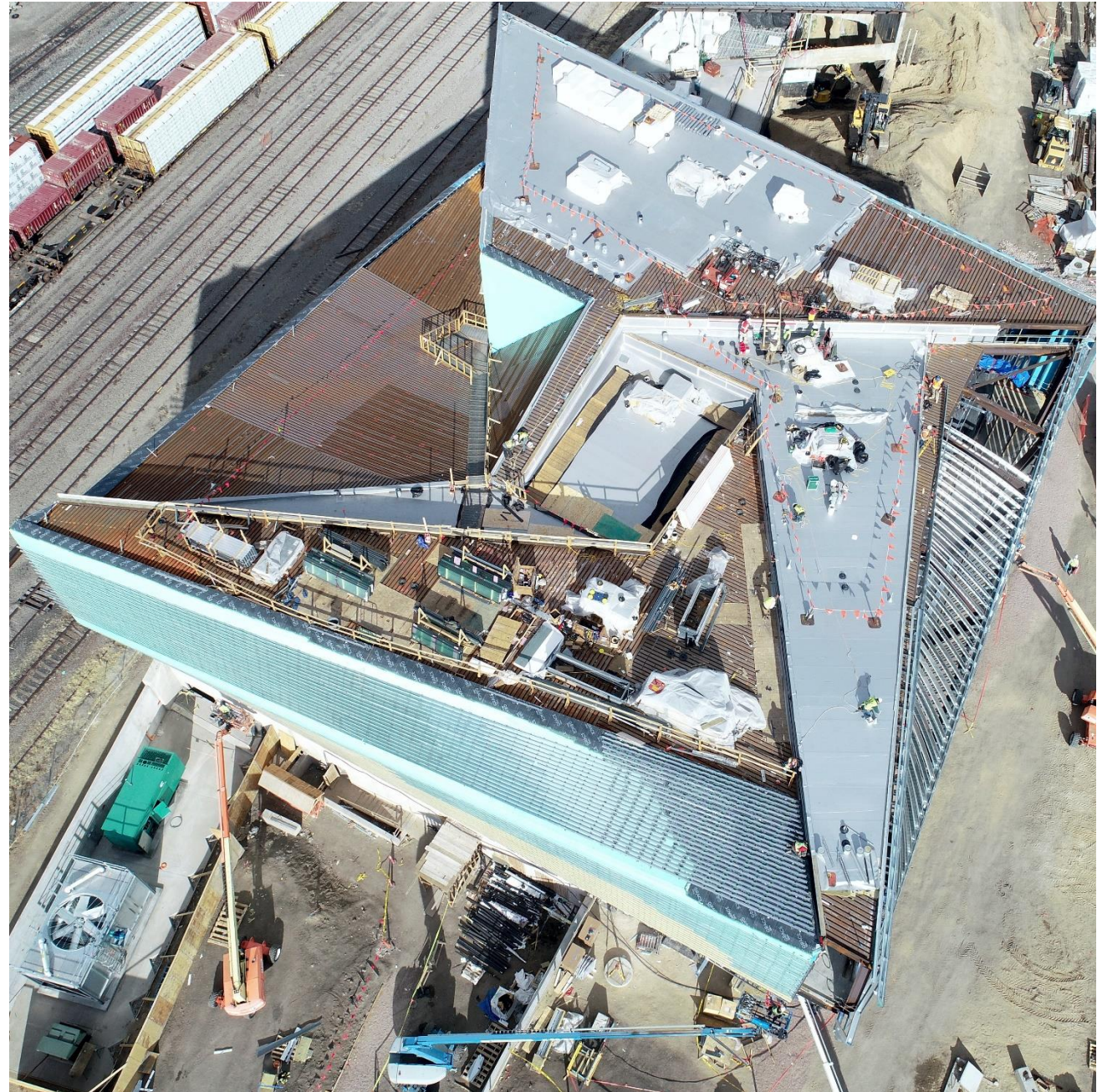


Rock It!



Image: Spacecon

USOM



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*Sr. Building Information Leader
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ALEX TERZICH

*Senior Associate / Adjunct
Assistant Professor
HGA Architects & Engineers /
University of Minnesota*