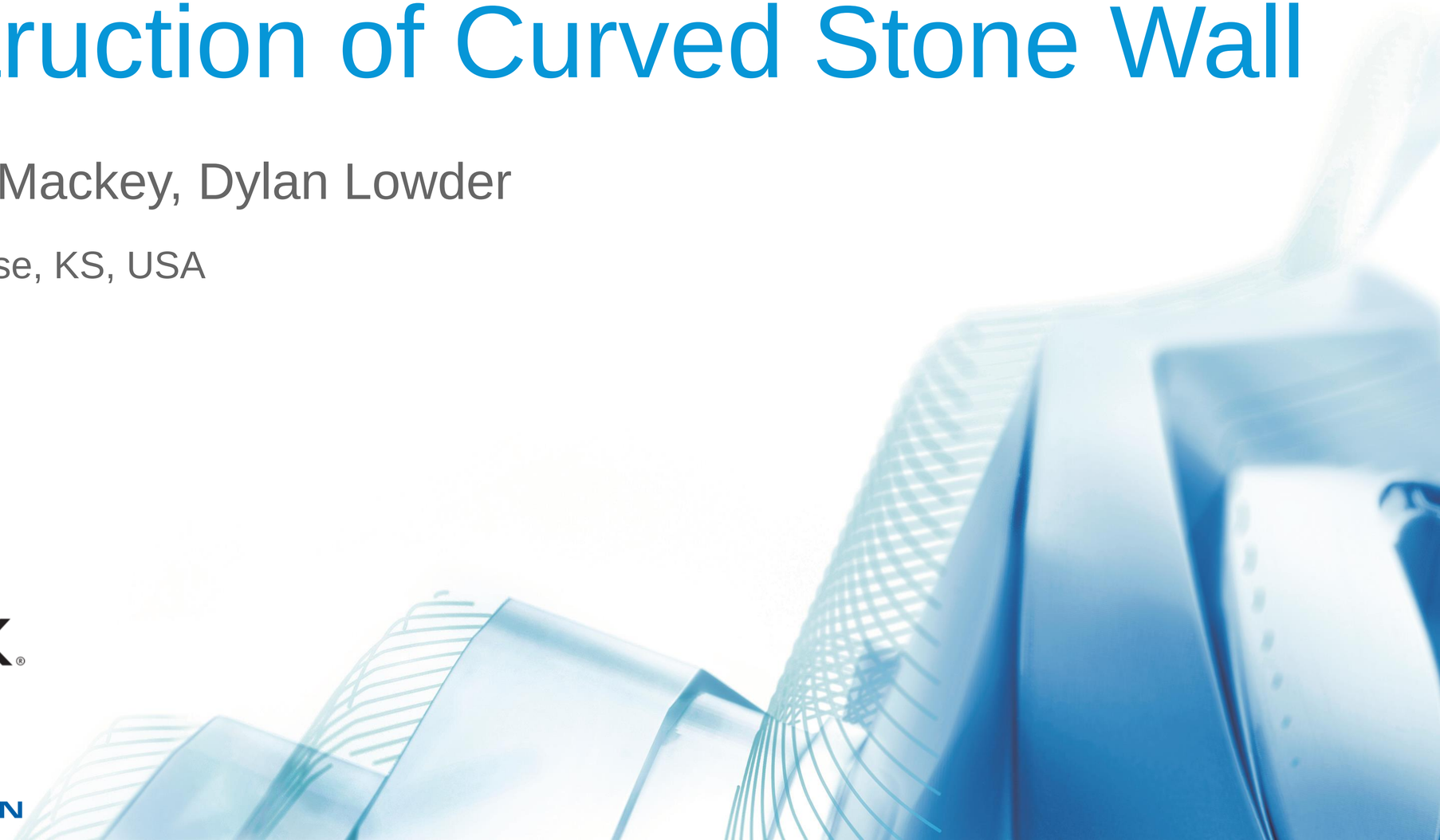
AS323927

# Case Study of Design, Documentation and Construction of Curved Stone Wall

Zahra Mirian, Brian Mackey, Dylan Lowder

Johnson County Courthouse, KS, USA



AUTODESK. UNIVERSITY

FENTRESS ARCHITECTS | MACKEY CONSULTING | JE DUNN CONSTRUCTION

# About the speaker

## Zahra Mirian Hosseinabadi

Zahra Mirian Assoc. AIA is architectural designer whose work focuses on building information modeling and integration of design and construction process for more effective workflow. She received her Master of Architecture from North Carolina State University and Master of Building Construction Science and Management from Virginia Tech and is currently working for Colorado-based design firm, Fentress Architects. She also has previous work experience as BIM Specialist. Her passion is using new tools to optimize the design/construction workflow.

# Brian Mackey

## BD Mackey Consulting

BIM/Revit Consultant based in Denver, CO

30+ Years in Industry

15+ Years using Revit

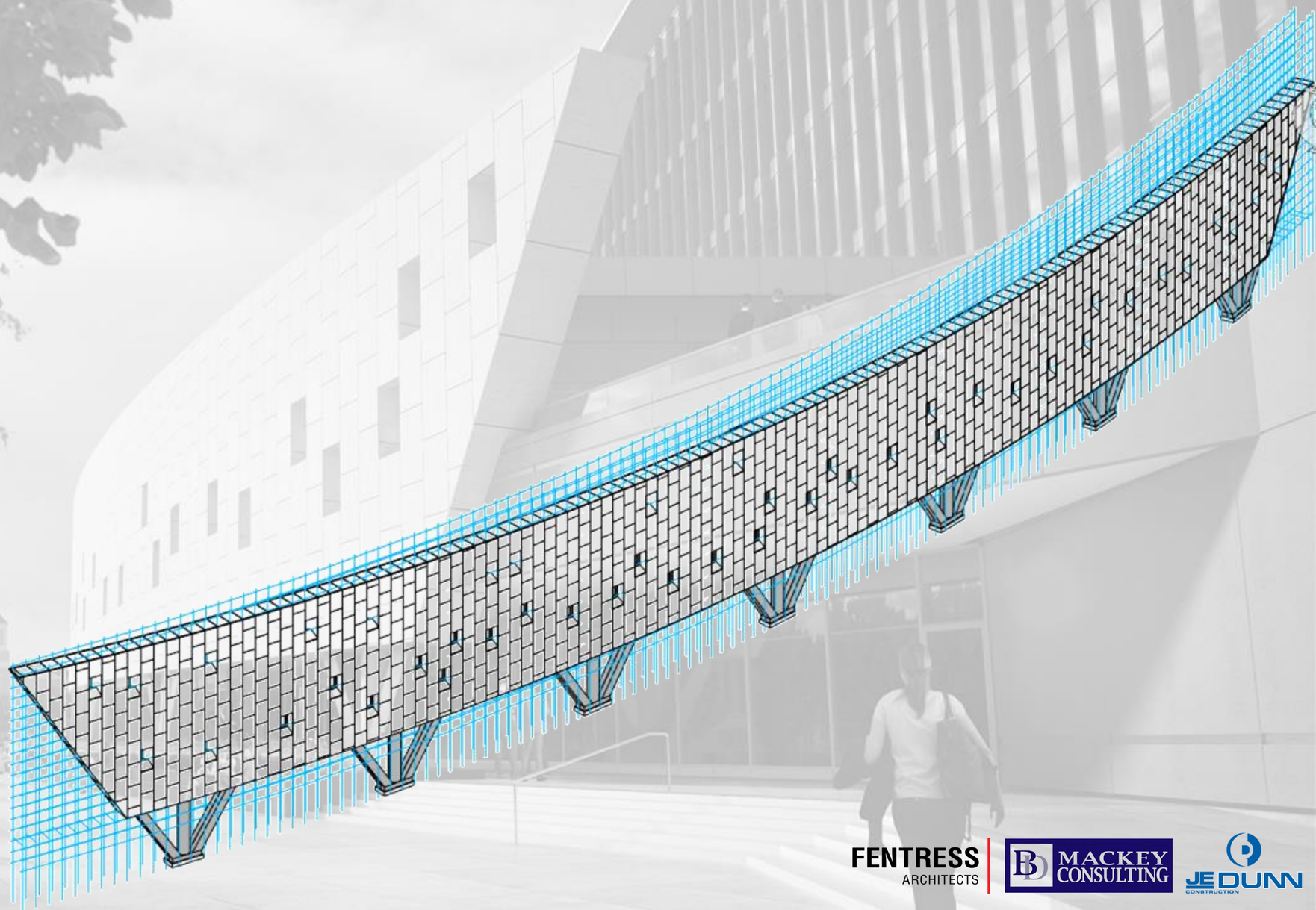
# About the speaker

## Dylan Lowder

I hold a B.S. in Architectural Studies and a M.Arch from Southern Illinois University. While in school I found my interests were really in understanding how designs were to be built. It was during my time working digital fabrication shop at SIU that this passion grew. After graduating I spent a brief time working in a fabrication shop where I was a detailer and did tool-pathing for CNC milling. In 2011 I joined the VDC team at JE Dunn. For the last 4 years my focus at JE Dunn has really been in what capabilities and with what resources can our VDC team work with and help our Self Perform Group. My interests are focused around self perform drawing creation, the layout process, and working directly with our superintendents and foreman to deliver exceptional products to our clients. We are builders and the digital tools I have allow me to directly have an impact on the work that is being put in place everyday.

# Agenda

1. Project Introduction
2. Design
3. Modeling
4. Documentation
5. Construction





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# 1 Project Introduction

Site, Project Team, Delivery Method

Photo credit : SevenG - FA

# CLIENT

JOHNSON COUNTY KANSAS

FACILITIES MANAGEMENT DEPARTMENT

# DESIGN-BUILD TEAM

JE DUNN CONSTRUCTION

GENERAL CONTRACTOR

TREANORHL

ARCHITECT OF RECORD

FENTRESS ARCHITECTS

DESIGN ARCHITECT

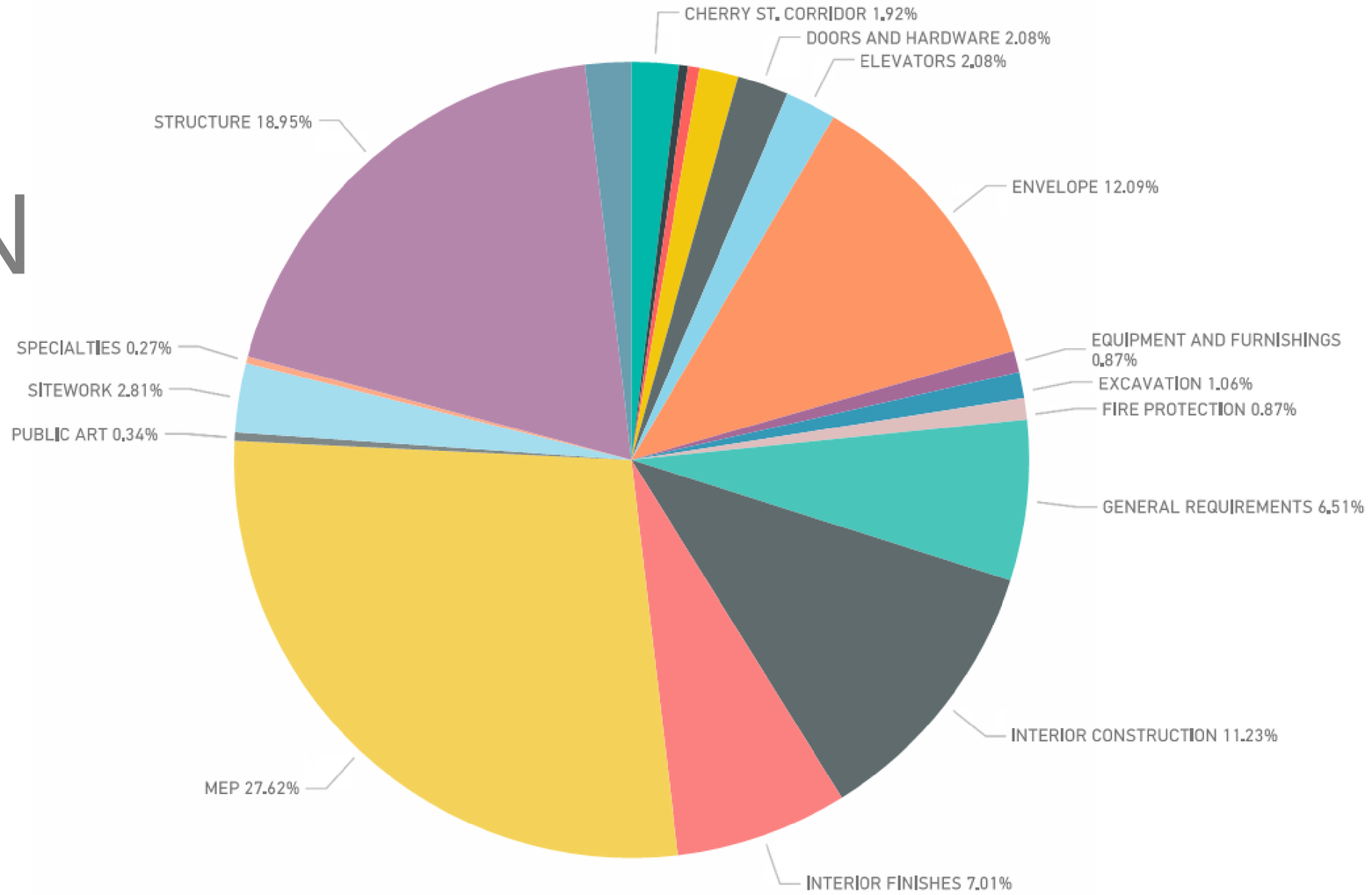
# $175 MILLION

# 350,000 SF

## 140 FT TALL

## 7 FLOORS + BASEMENT

## 28 COURTROOMS



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CONCEPT DESIGN BEGINS
DECEMBER 2017

GROUND BREAKING
JULY 13, 2018

CONSTRUCTION COMPLETION
FALL 2020


Photo credit : JE DUNN



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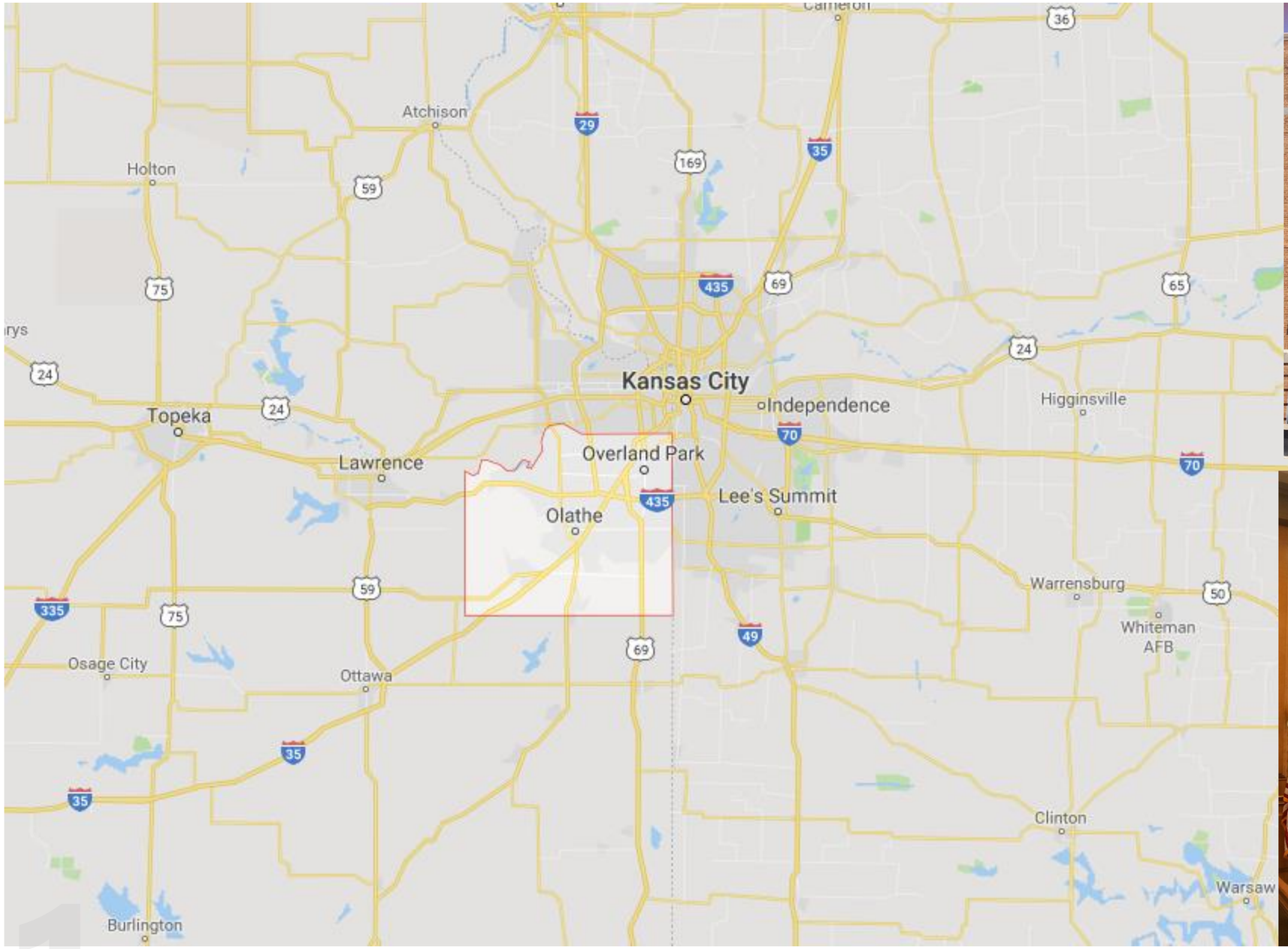


Photo credit : Google Map


Photo credit : FA / JE DUNN

# Site and Existing Courtroom

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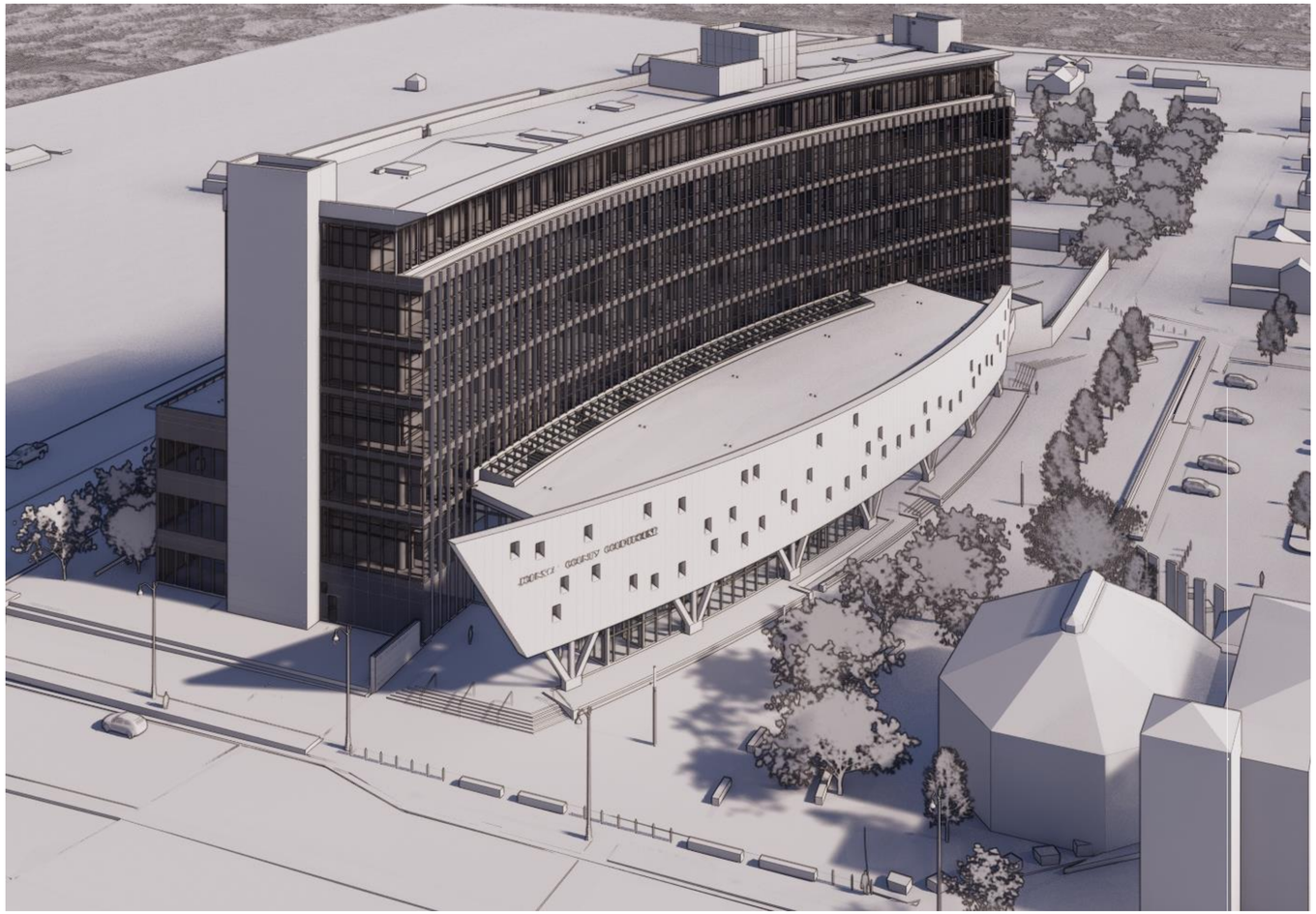
# 2 Design

## Overall Concept, Ribbon Wall From Studies

Photo credit : SevenG - FA



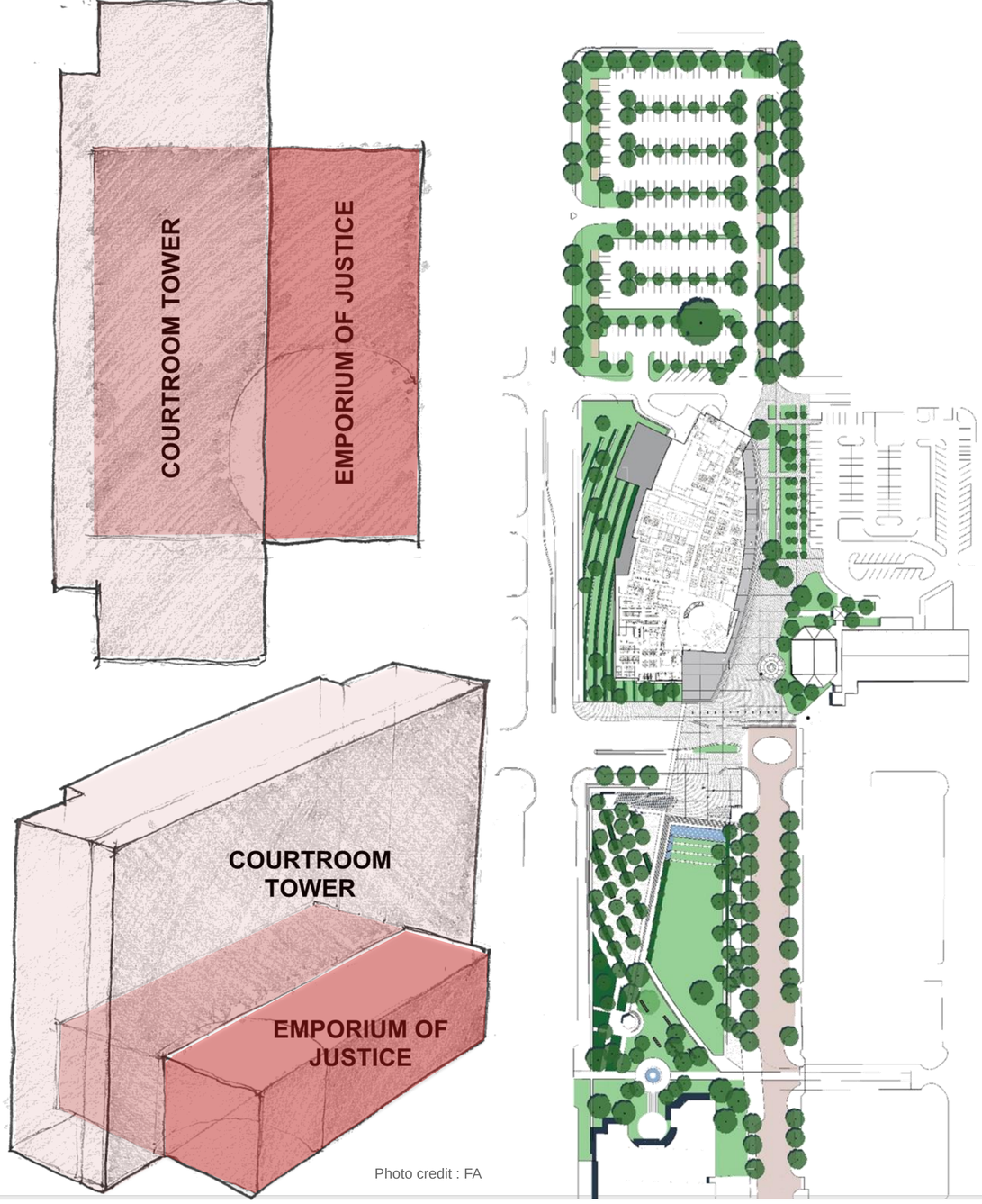



Photo credit : FA

2

# Site Plan

FENTRESS ARCHITECTS | MACKEY CONSULTING | JE DUNN CONSTRUCTION


Photo credit :
https://en.wikipedia.org/wiki/Santa_Fe_Trail



# Inspiration

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Photo credit : FA

2

# Massing Study

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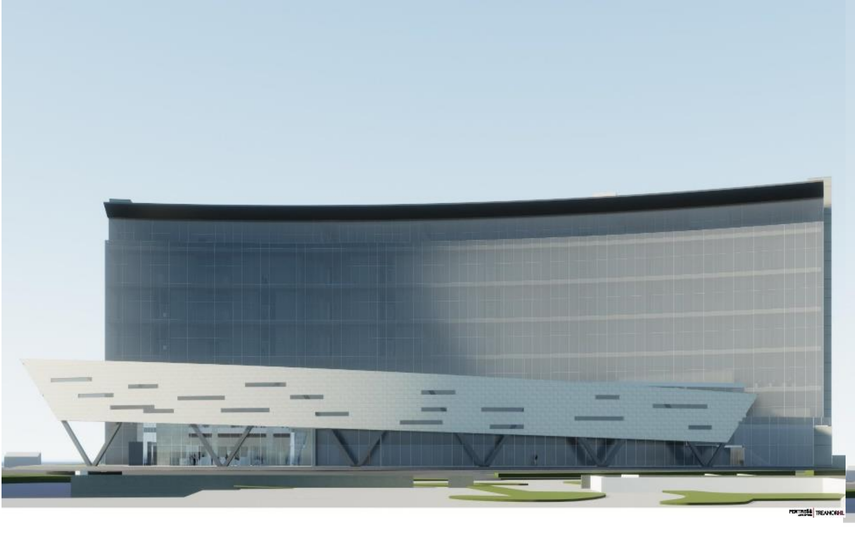

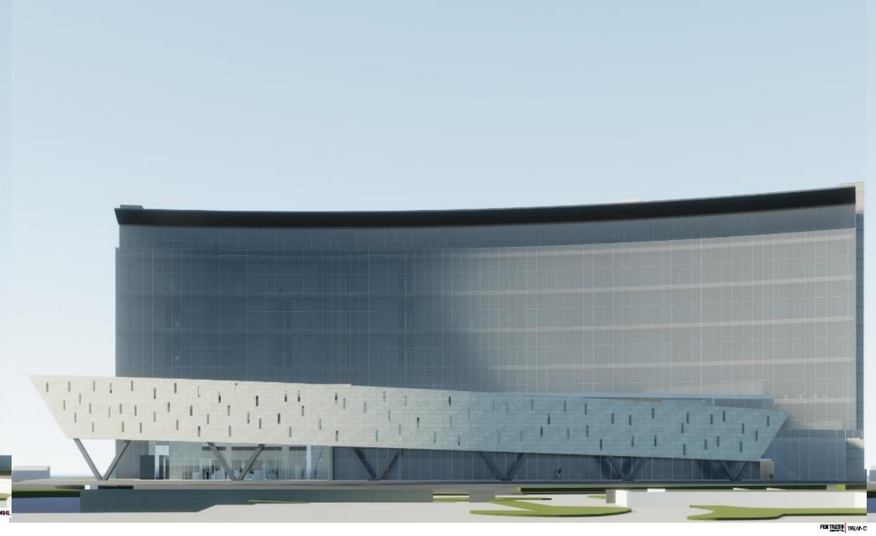

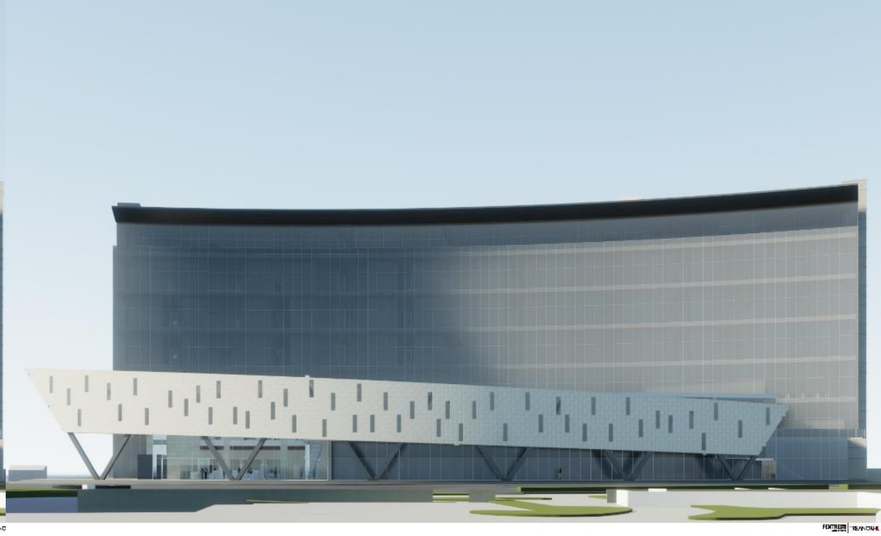

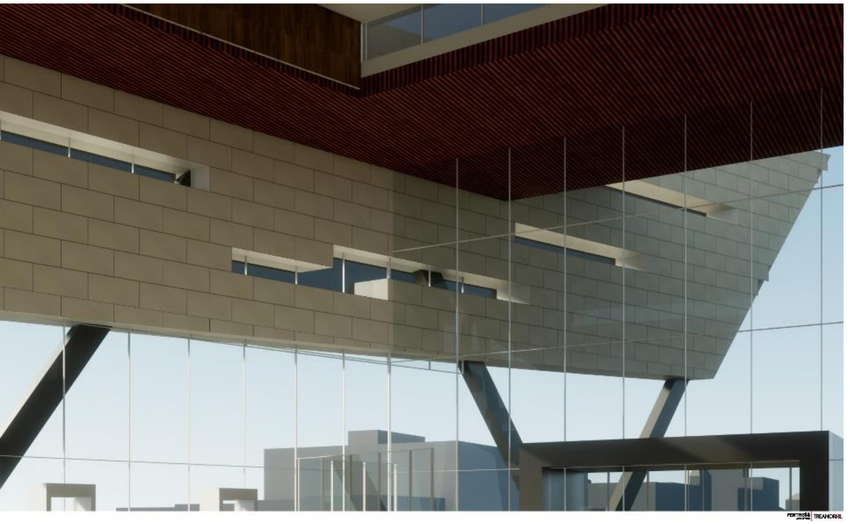

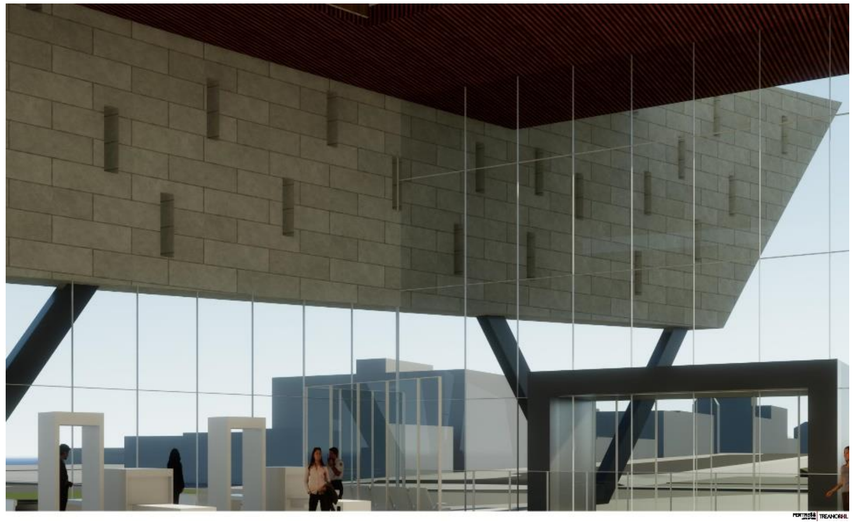

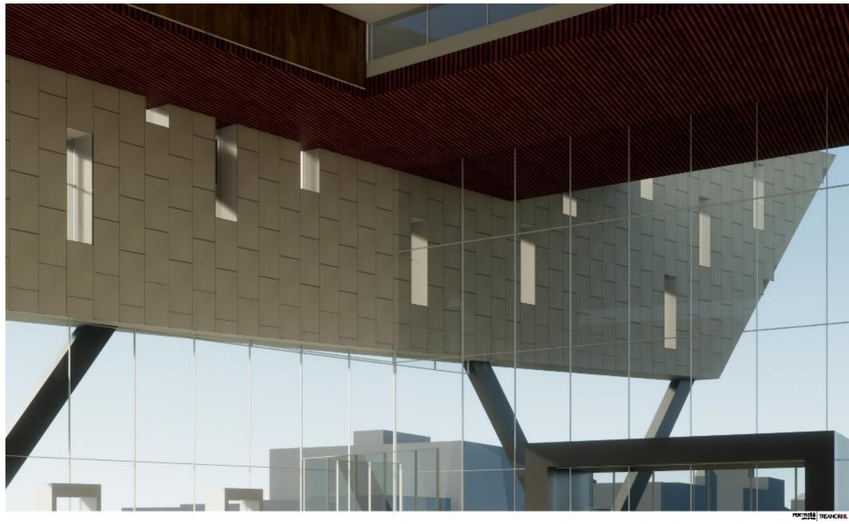

2

# Window and Opening Study

Photo credit : FA

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# 2 Final Design - Exterior

Photo credit : SevenG - FA

# Final Design - Exterior

Photo credit : SevenG - FA

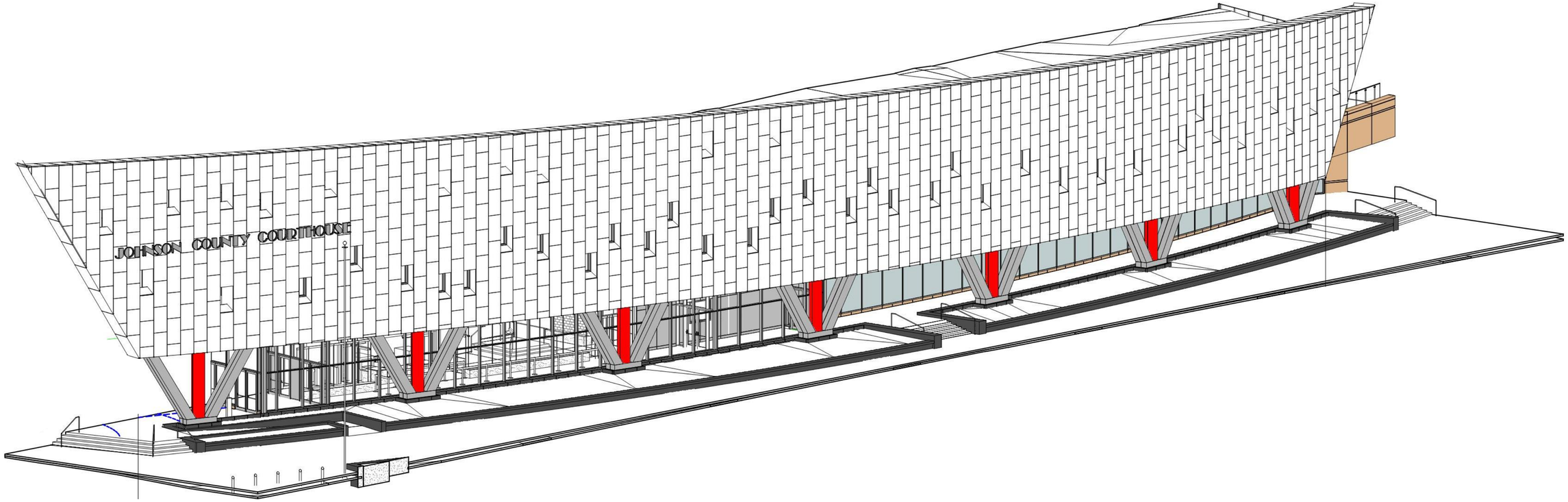

2

# Final Design - Interior

Photo credit : FA

# Final Design - Interior

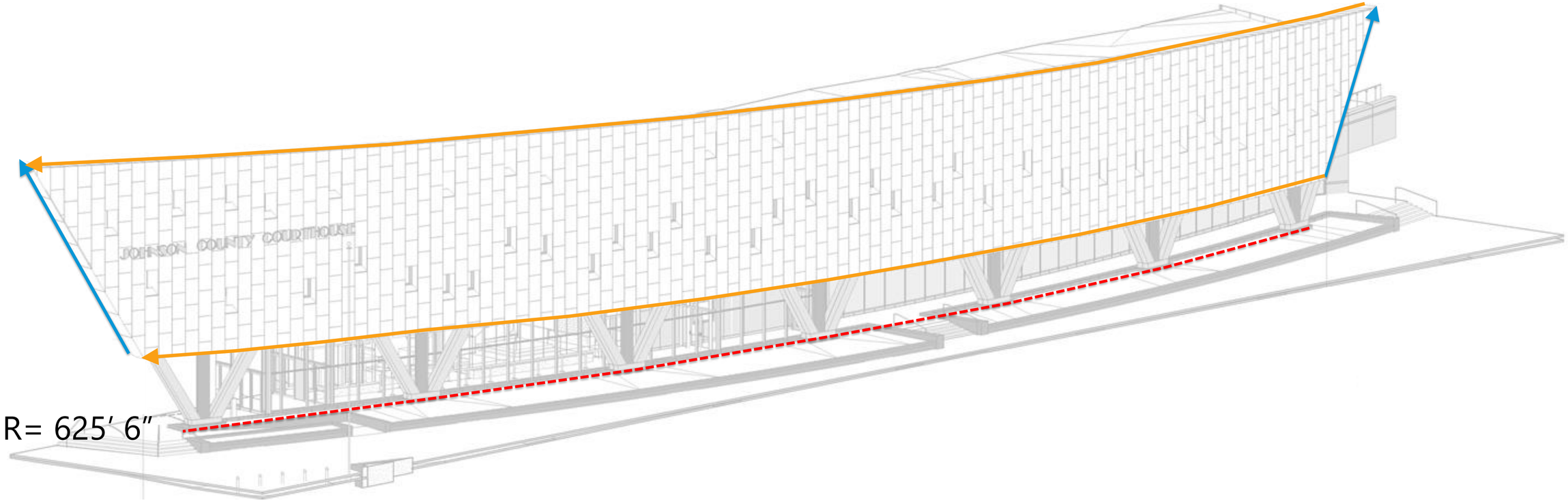
Photo credit : FA




2

# Final Ribbon Wall Form

FENTRESS ARCHITECTS | MACKEY CONSULTING | JE DUNN CONSTRUCTION

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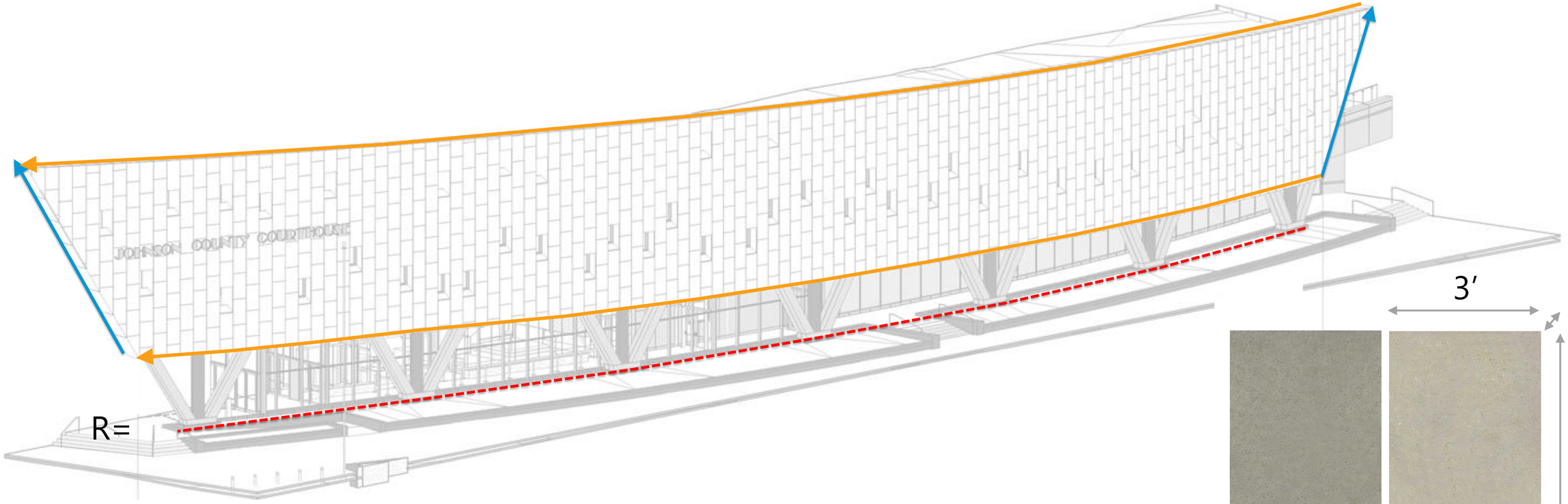
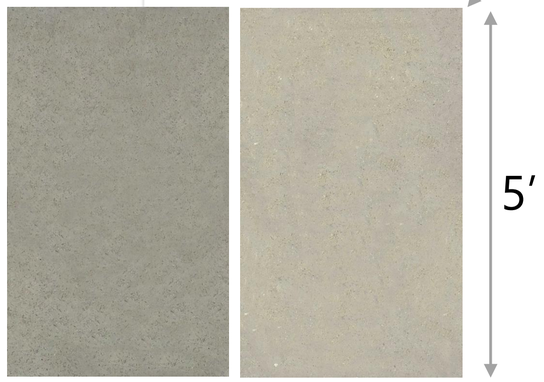
# Final Ribbon Wall Form

FENTRESS ARCHITECTS | MACKEY CONSULTING | JE DUNN CONSTRUCTION



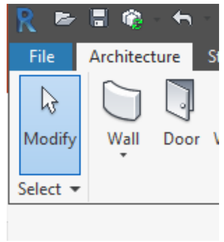




Joint: 3/8″

2

## Final Ribbon Wall Form

FENTRESS ARCHITECTS | MACKEY CONSULTING | JE DUNN CONSTRUCTION




## Modeling the wall using Revit curved wall


## Modeling the wall using Revit's adaptive component

## Submitting XYZ coordinates to the contractor for construction and mock-up

Concept Design

Schematic Design

Design Development

Construction Document

Construction Administration

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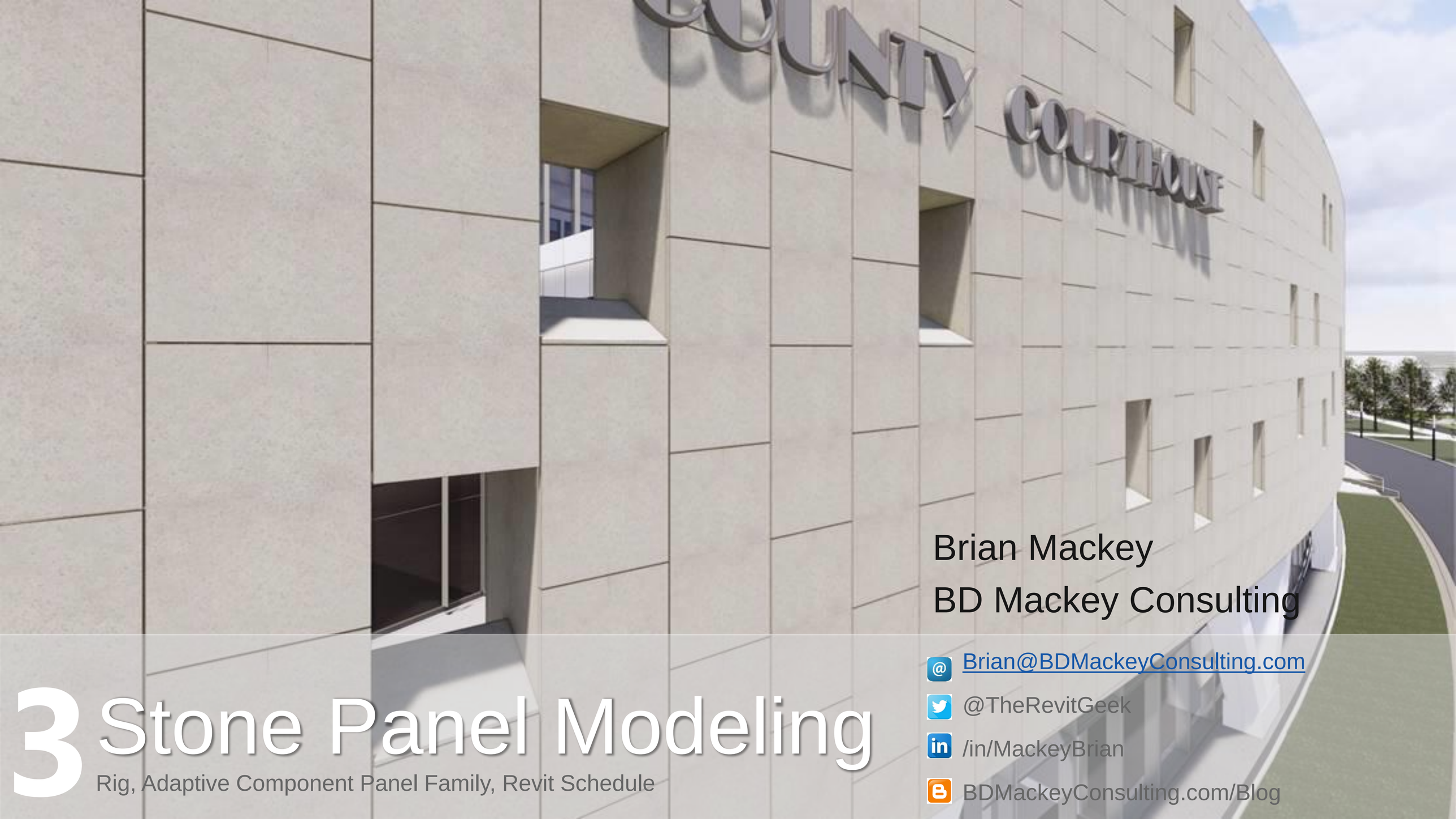


# 3 Stone Panel Modeling

Rig, Adaptive Component Panel Family, Revit Schedule

Brian Mackey

BD Mackey Consulting

Brian@BDMackeyConsulting.com

@TheRevitGeek

/in/MackeyBrian

BDMackeyConsulting.com/Blog

# Shameless Plug

- If you like this session consider watching my previous session:
  - Using Revit Structure in Investigative Engineering – SE1595
  - Conceptual Structural Design Using Revit Adaptive Components and Dynamo – ES122256




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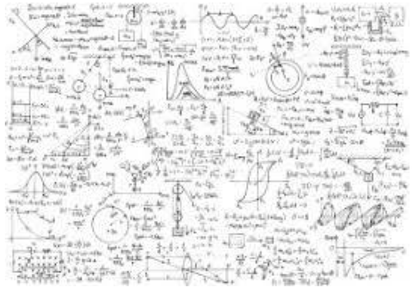
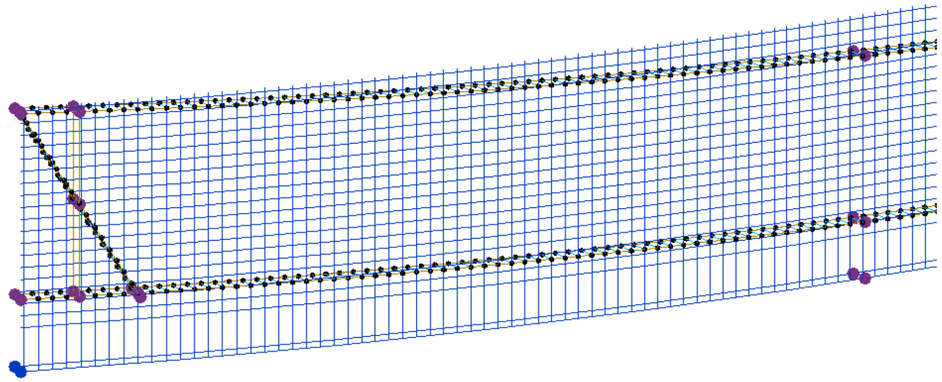
# Survey

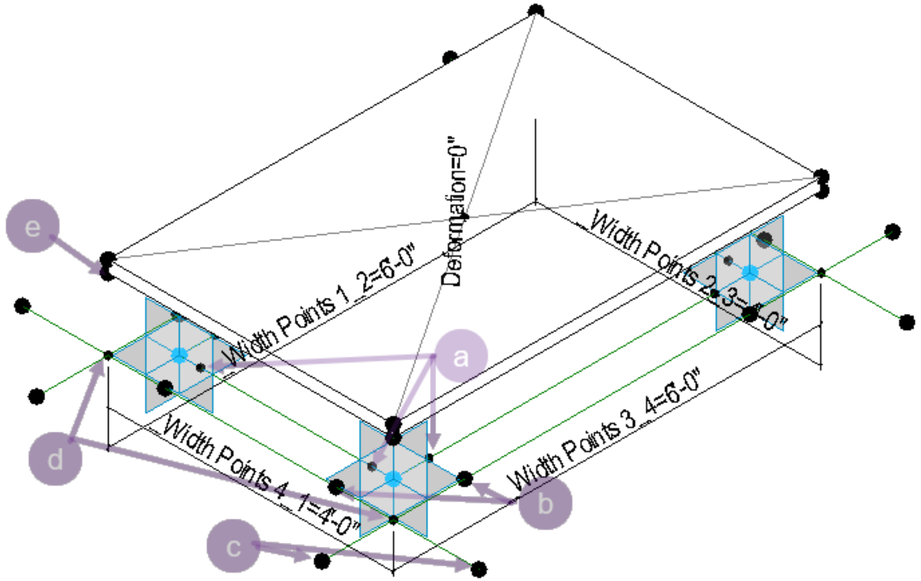
- Contractors
  - General
  - Sub
- Design Team
  - Architect
  - Engineer
- Fabricator



# Topics

- Adaptive Component
  - Rig
  - Panel Families
- Placing The component
  - Nuances
  - Best Practices





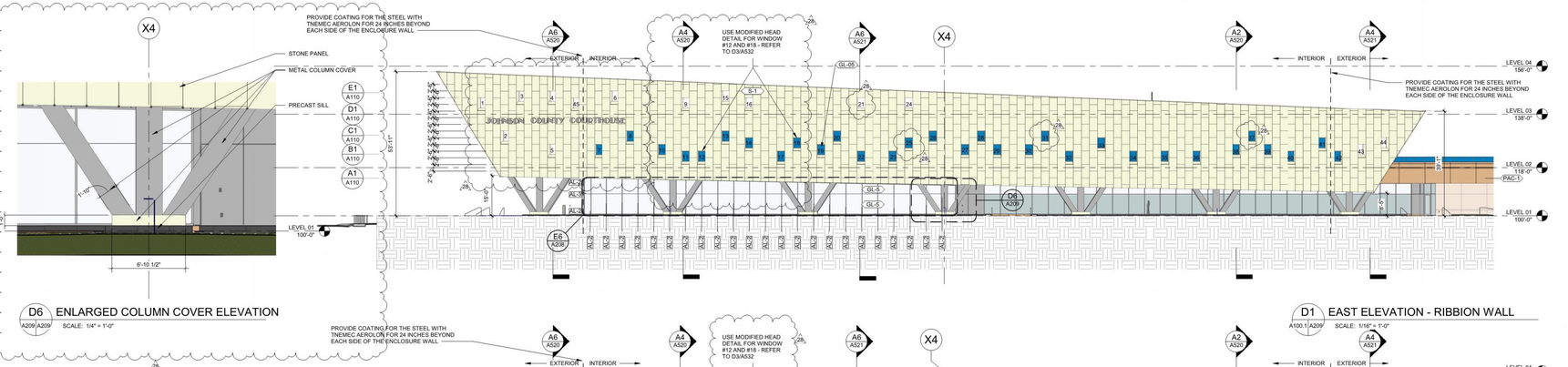
# 4 Documentation

## Conventional vs. New Method

Photo credit : Fentress Architects

# Documentation Methods

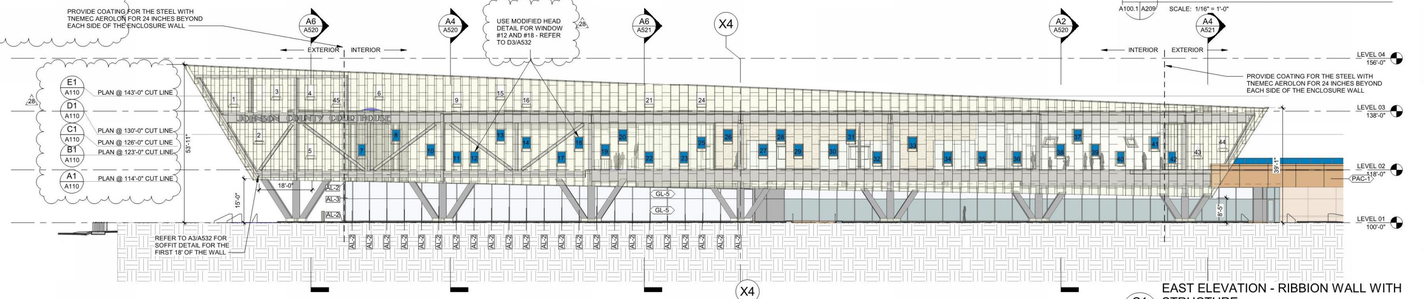
- Conventional – 2D
  - Plans, Elevation, Section, Wall Sections, …
- BIM-Assisted Method – 3D
  - Adaptive Point Sphere: Used for Point extraction for contractor
  - Dynamo for X,Y,Z points
  - Revit Schedule
    - For Panel Sizes
    - Point Exports



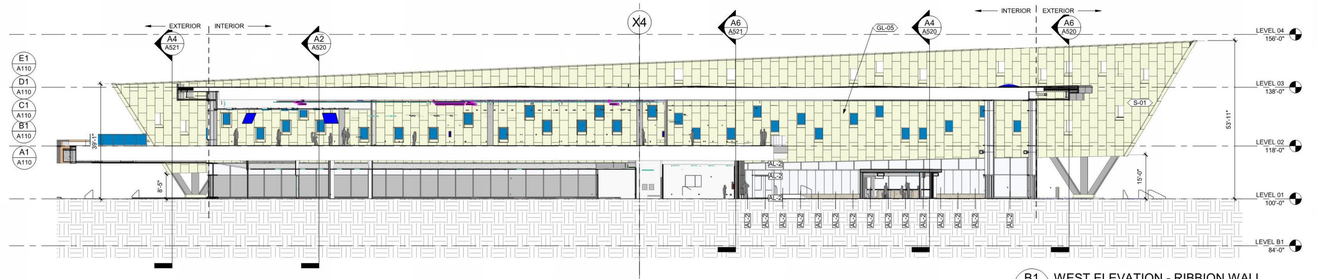

D6 ENLARGED COLUMN COVER ELEVATION
A209 A209 SCALE: 1/4" = 1'-0"



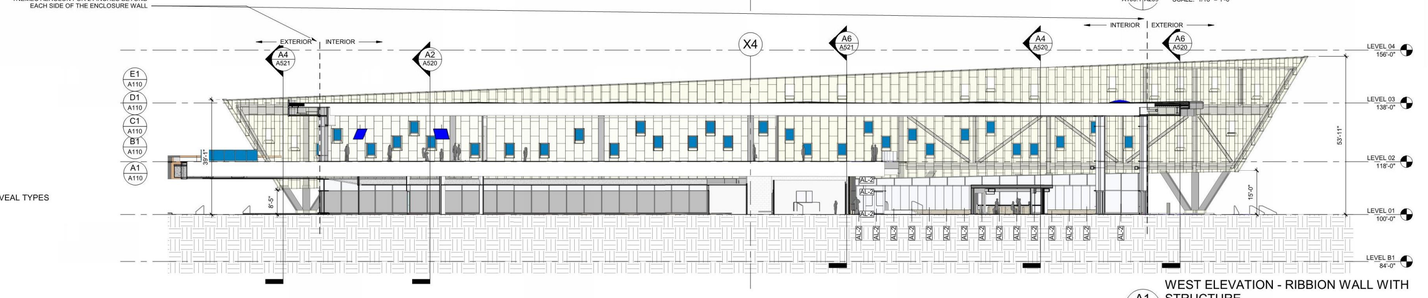

D1 EAST ELEVATION - RIBBION WALL
A100.1 A209 SCALE: 1/16" = 1'-0"




C1 EAST ELEVATION - RIBBION WALL WITH STRUCTURE
00000 A209 SCALE: 1/16" = 1'-0"

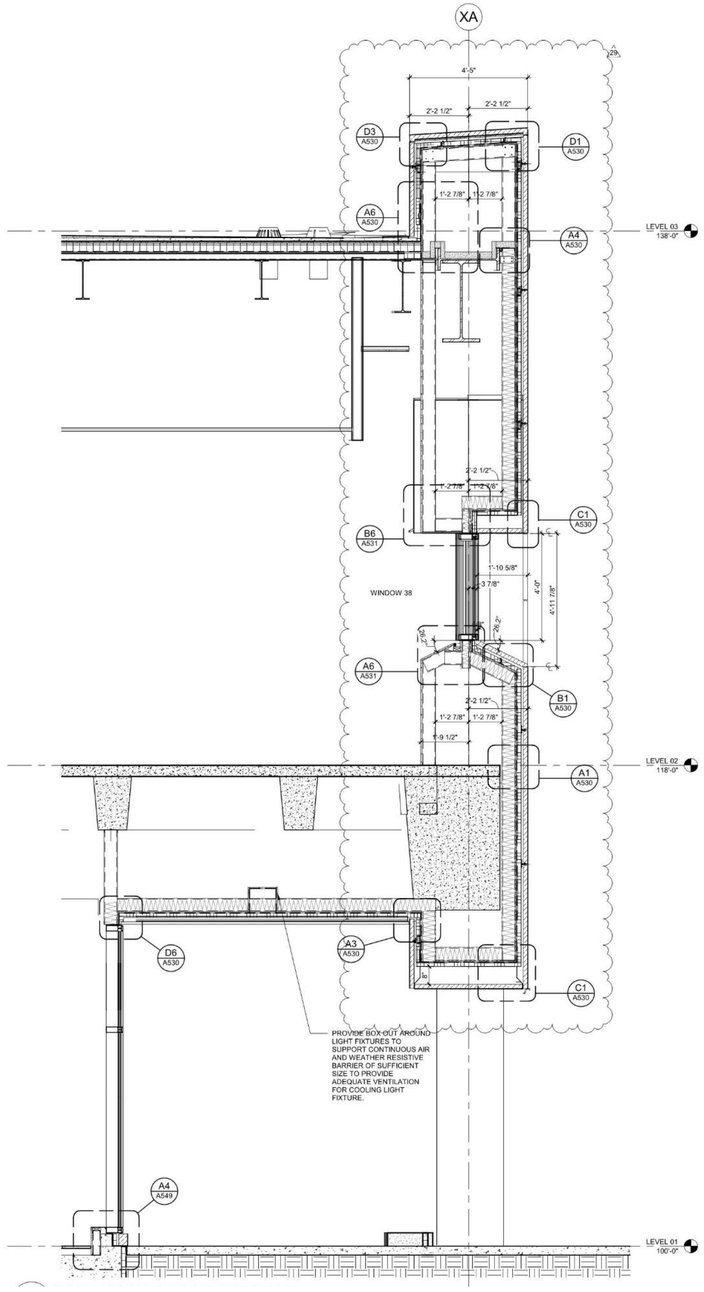



B1 WEST ELEVATION - RIBBION WALL
A100.1 A209 SCALE: 1/16" = 1'-0"




A1 WEST ELEVATION - RIBBION WALL WITH STRUCTURE
00000 A209 SCALE: 1/16" = 1'-0"

NOTE: RE: SHEET G212 FOR MULLION AND REVEAL TYPES



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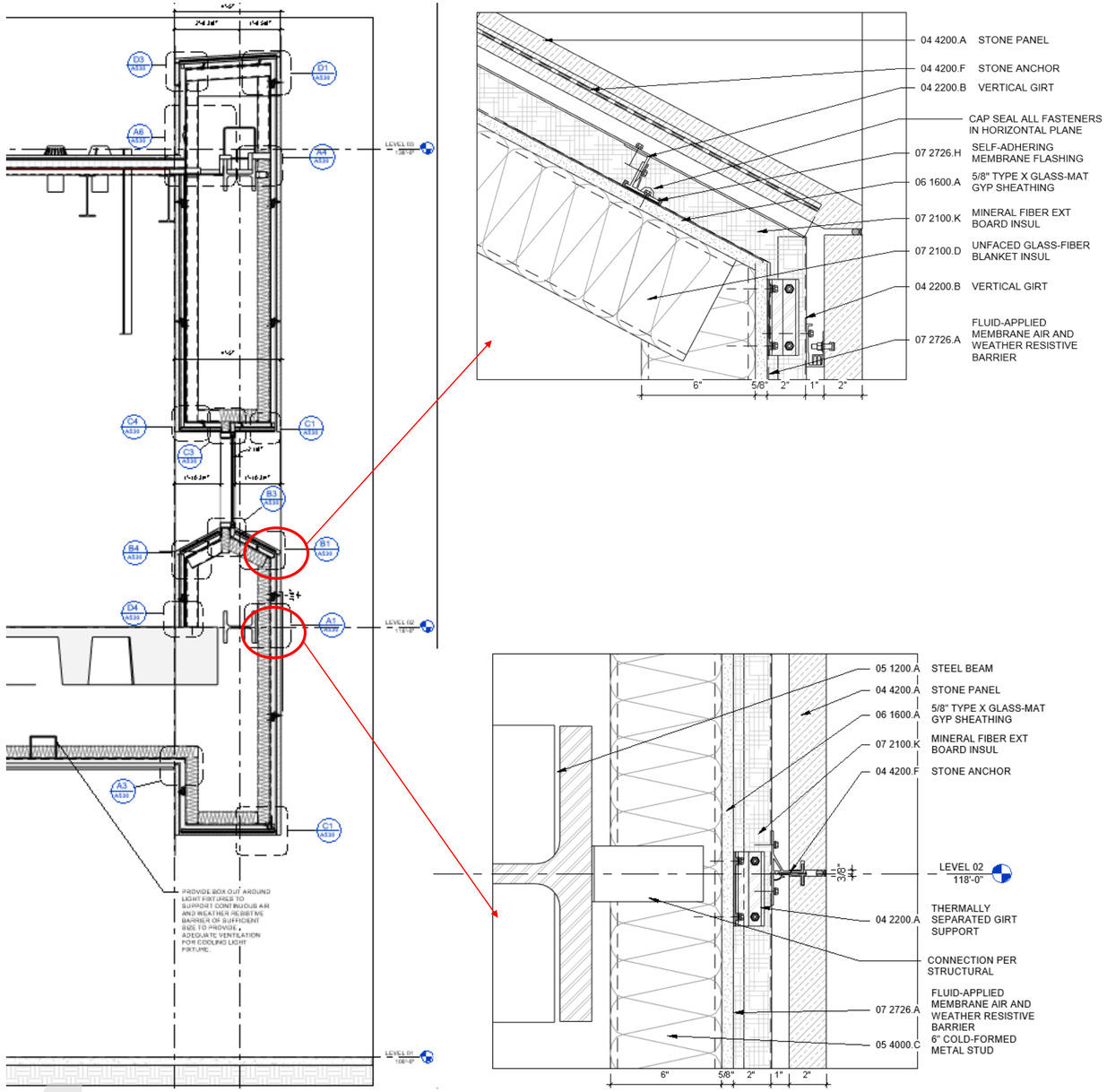








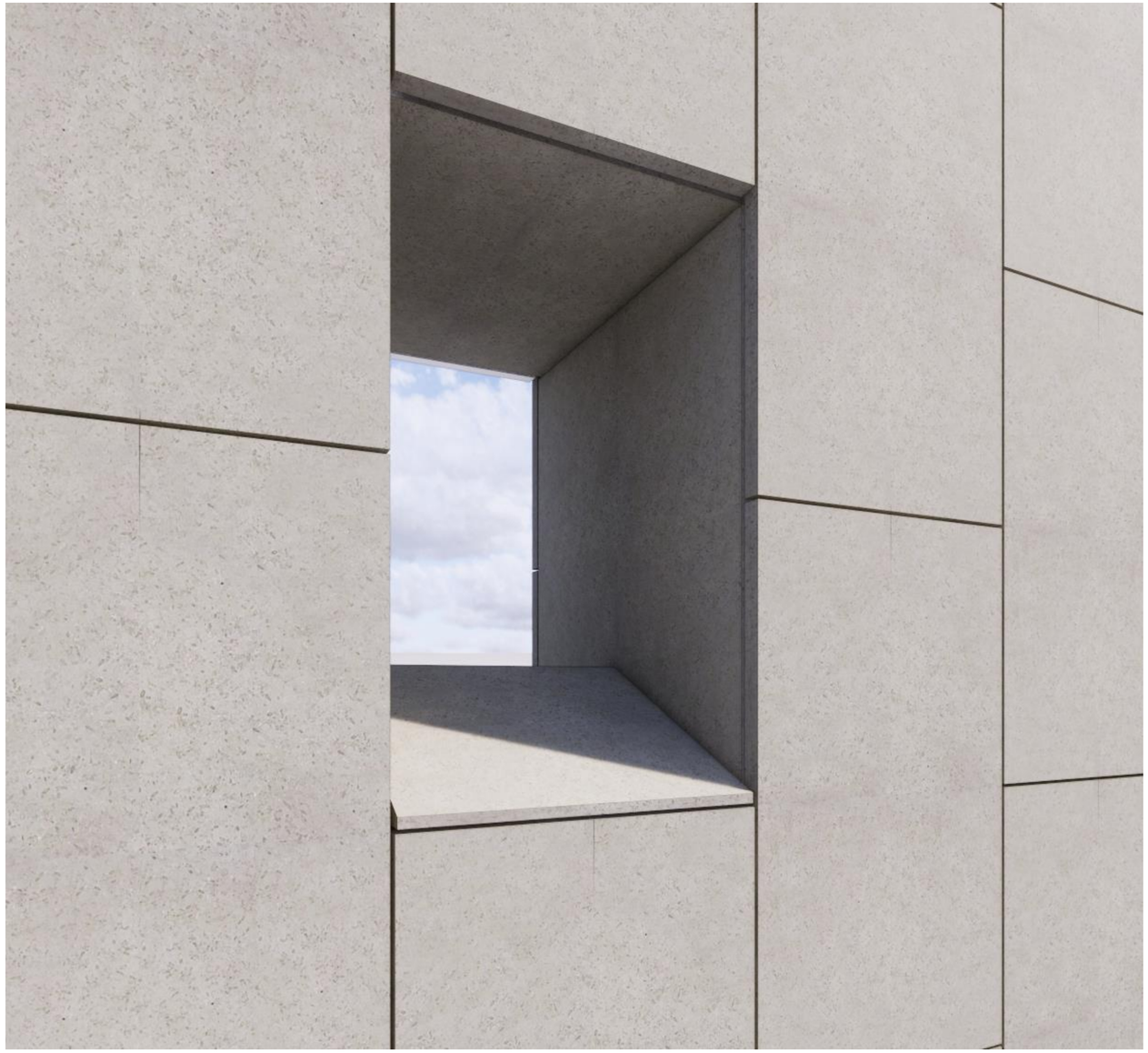

# Ribbon Wall – Wall Section, Section Details

# Details at Joints - Opening



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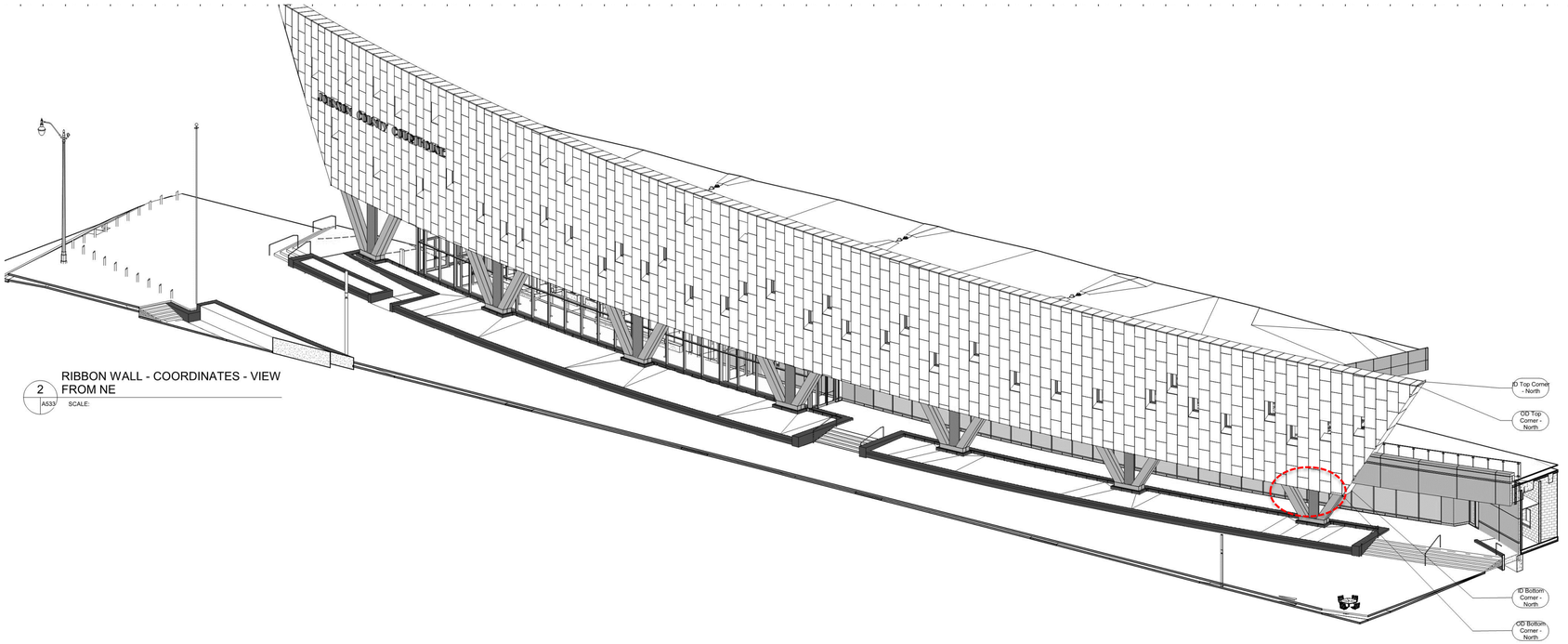
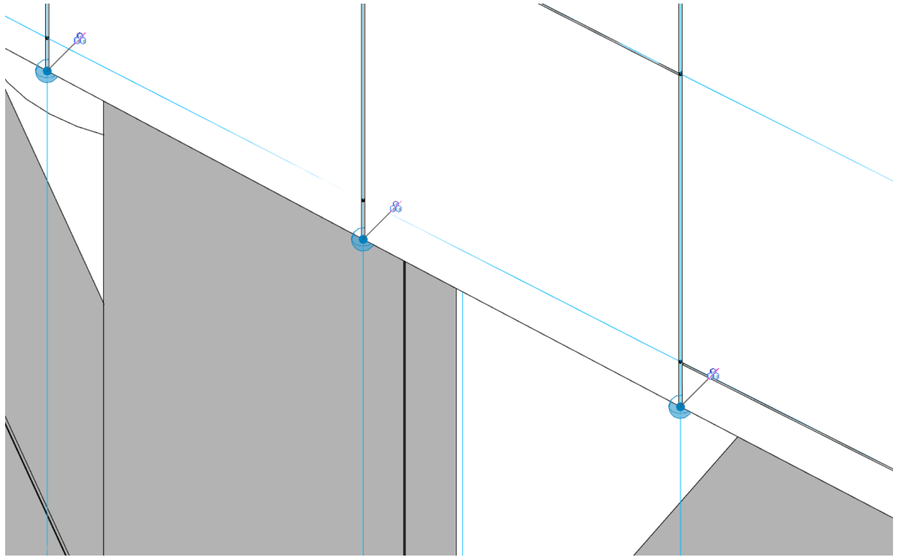
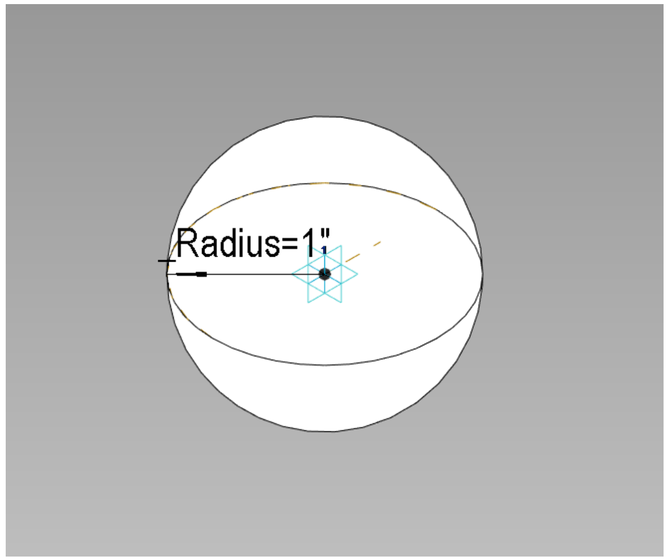





Family Types

Type name:

Search parameters

| Parameter | Value | Formula | Lo |
|---|---|---|---|
| **Graphics** | | | |
| Shpere | ☑ | = | |
| **Materials and Finishes** | | | |
| Sphere Material | <By Category> | = | |
| **Dimensions** | | | |
| _Diameter | 0' 2" | = _Radius * 2 | ☑ |
| _Radius | 0' 1" | = | ☑ |
| **Data** | | | |
| Coord_X (default) | 0' 0" | = | ☑ |
| Coord_Y (default) | 0' 0" | = | ☑ |
| Coord_Z (default) | 0' 0" | = | ☑ |
| **Identity Data** | | | |

Manage Lookup Table

How do I manage family types?

OK Cancel Apply



FENTRESS ARCHITECTS | MACKEY CONSULTING | JE DUNN CONSTRUCTION

| Point Locations XYZ | | | |
|---|---|---|---|
| Comments | Coord_X | Coord_Y | Coord_Z |
| OD Bottom Corner - North | 161.274 | -11.749 | 108.730 |
| ID Bottom Corner - North | 160.965 | -7.343 | 108.750 |
| OD Bottom Corner - South | -159.348 | 50.932 | 114.602 |
| ID Bottom Corner - South | -157.391 | 54.891 | 114.581 |
| ID Top Corner - South | -179.121 | 66.090 | 153.662 |
| OD Top Corner - South | -181.355 | 62.289 | 153.916 |
| OD Top Corner - North | 181.059 | -10.045 | 139.074 |
| ID Top Corner - North | 180.452 | -5.667 | 138.831 |
| OD PG 1 | -159.194 | 50.856 | 114.599 |
| OD PG 2 | -156.422 | 49.504 | 114.545 |
| OD PG 3 | -153.719 | 48.203 | 114.493 |
| OD PG 4 | -151.010 | 46.914 | 114.441 |
| OD PG 5 | -148.295 | 45.639 | 114.388 |
| OD PG 6 | -145.573 | 44.376 | 114.336 |
| OD PG 7 | -142.846 | 43.127 | 114.283 |
| OD PG 8 | -140.113 | 41.890 | 114.231 |
| OD PG 9 | -137.374 | 40.667 | 114.178 |
| OD PG 10 | -134.629 | 39.456 | 114.126 |
| OD PG 11 | -131.878 | 38.259 | 114.073 |
| OD PG 12 | -129.122 | 37.075 | 114.020 |
| OD PG 13 | -126.360 | 35.904 | 113.967 |
| OD PG 14 | -123.592 | 34.746 | 113.915 |
| OD PG 15 | -120.819 | 33.602 | 113.862 |
| OD PG 16 | -118.040 | 32.471 | 113.809 |
| OD PG 17 | -115.256 | 31.353 | 113.756 |
| OD PG 18 | -112.467 | 30.248 | 113.703 |
| OD PG 19 | -109.673 | 29.157 | 113.650 |
| OD PG 20 | -106.873 | 28.079 | 113.596 |
| OD PG 21 | -104.068 | 27.015 | 113.543 |
| OD PG 22 | -101.259 | 25.964 | 113.490 |
| OD PG 23 | -98.444 | 24.926 | 113.437 |
| OD PG 24 | -95.624 | 23.902 | 113.383 |
| OD PG 25 | -92.799 | 22.892 | 113.330 |
| OD PG 26 | -89.970 | 21.895 | 113.277 |
| OD PG 27 | -87.136 | 20.911 | 113.223 |
| OD PG 28 | -84.297 | 19.941 | 113.170 |
| OD PG 29 | -81.454 | 18.985 | 113.116 |
| OD PG 30 | -78.606 | 18.042 | 113.063 |
| OD PG 31 | -75.753 | 17.112 | 113.009 |
| OD PG 32 | -72.897 | 16.197 | 112.956 |
| OD PG 33 | -70.035 | 15.295 | 112.902 |
| OD PG 34 | -67.170 | 14.407 | 112.848 |
| OD PG 35 | -64.300 | 13.532 | 112.795 |
| OD PG 36 | -61.427 | 12.671 | 112.741 |
| OD PG 37 | -58.549 | 11.824 | 112.687 |
| OD PG 38 | -55.667 | 10.991 | 112.634 |
| OD PG 39 | -52.781 | 10.171 | 112.580 |
| OD PG 40 | -49.891 | 9.366 | 112.526 |
| OD PG 41 | -46.998 | 8.574 | 112.472 |
| OD PG 42 | -44.100 | 7.796 | 112.419 |
| OD PG 43 | -41.199 | 7.032 | 112.365 |
| OD PG 44 | -38.295 | 6.281 | 112.311 |
| OD PG 45 | -35.387 | 5.545 | 112.257 |
| OD PG 46 | -32.475 | 4.822 | 112.203 |

| Point Locations XYZ | | | |
|---|---|---|---|
| Comments | Coord_X | Coord_Y | Coord_Z |
| OD PG 47 | -29.560 | 4.114 | 112.149 |
| OD PG 48 | -26.642 | 3.419 | 112.095 |
| OD PG 49 | -23.720 | 2.738 | 112.042 |
| OD PG 50 | -20.795 | 2.072 | 111.988 |
| OD PG 51 | -17.867 | 1.419 | 111.934 |
| OD PG 52 | -14.936 | 0.780 | 111.880 |
| OD PG 53 | -12.001 | 0.155 | 111.826 |
| OD PG 54 | -9.064 | -0.455 | 111.772 |
| OD PG 55 | -6.124 | -1.052 | 111.718 |
| OD PG 56 | -3.181 | -1.635 | 111.664 |
| OD PG 57 | -0.236 | -2.203 | 111.610 |
| OD PG 58 | 2.712 | -2.758 | 111.556 |
| OD PG 59 | 5.663 | -3.298 | 111.502 |
| OD PG 60 | 8.617 | -3.824 | 111.448 |
| OD PG 61 | 11.573 | -4.336 | 111.395 |
| OD PG 62 | 14.531 | -4.834 | 111.341 |
| OD PG 63 | 17.492 | -5.318 | 111.287 |
| OD PG 64 | 20.455 | -5.788 | 111.233 |
| OD PG 65 | 23.420 | -6.243 | 111.179 |
| OD PG 66 | 26.387 | -6.685 | 111.125 |
| OD PG 67 | 29.356 | -7.112 | 111.071 |
| OD PG 68 | 32.328 | -7.525 | 111.017 |
| OD PG 69 | 35.301 | -7.924 | 110.964 |
| OD PG 70 | 38.276 | -8.308 | 110.910 |
| OD PG 71 | 41.253 | -8.678 | 110.856 |
| OD PG 72 | 44.232 | -9.035 | 110.802 |
| OD PG 73 | 47.212 | -9.376 | 110.749 |
| OD PG 74 | 50.195 | -9.704 | 110.695 |
| OD PG 75 | 53.178 | -10.017 | 110.641 |
| OD PG 76 | 56.163 | -10.316 | 110.587 |
| OD PG 77 | 59.149 | -10.601 | 110.534 |
| OD PG 78 | 62.137 | -10.872 | 110.480 |
| OD PG 79 | 65.126 | -11.128 | 110.427 |
| OD PG 80 | 68.116 | -11.370 | 110.373 |
| OD PG 81 | 71.108 | -11.598 | 110.319 |
| OD PG 82 | 74.100 | -11.811 | 110.266 |
| OD PG 83 | 77.093 | -12.010 | 110.213 |
| OD PG 84 | 80.088 | -12.195 | 110.159 |
| OD PG 85 | 83.083 | -12.365 | 110.106 |
| OD PG 86 | 86.079 | -12.521 | 110.052 |
| OD PG 87 | 89.075 | -12.663 | 109.999 |
| OD PG 88 | 92.072 | -12.791 | 109.946 |
| OD PG 89 | 95.070 | -12.904 | 109.893 |
| OD PG 90 | 98.069 | -13.003 | 109.839 |
| OD PG 91 | 101.067 | -13.087 | 109.786 |
| OD PG 92 | 104.066 | -13.157 | 109.733 |
| OD PG 93 | 107.066 | -13.213 | 109.680 |
| OD PG 94 | 110.066 | -13.255 | 109.627 |
| OD PG 95 | 113.065 | -13.282 | 109.574 |
| OD PG 96 | 116.065 | -13.295 | 109.521 |
| OD PG 97 | 119.065 | -13.293 | 109.468 |
| OD PG 98 | 122.065 | -13.277 | 109.415 |
| OD PG 99 | 125.065 | -13.247 | 109.363 |
| OD PG 100 | 128.065 | -13.203 | 109.310 |

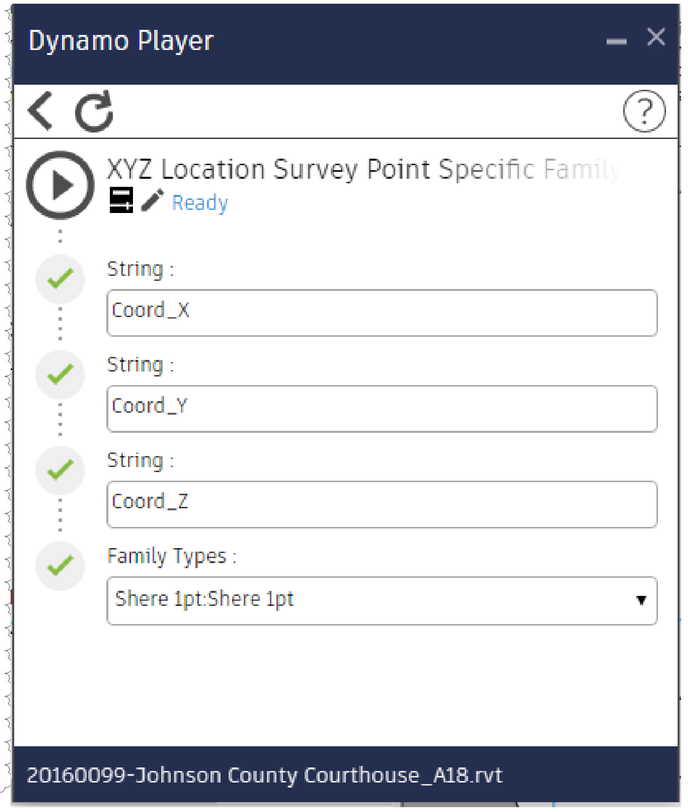
| Point Locations XYZ | | | |
|---|---|---|---|
| Comments | Coord_X | Coord_Y | Coord_Z |
| OD PG 101 | 131.064 | -13.144 | 109.257 |
| OD PG 102 | 134.063 | -13.071 | 109.205 |
| OD PG 103 | 137.062 | -12.983 | 109.152 |
| OD PG 104 | 140.060 | -12.881 | 109.100 |
| OD PG 105 | 143.058 | -12.765 | 109.047 |
| OD PG 106 | 146.055 | -12.635 | 108.995 |
| OD PG 107 | 149.051 | -12.490 | 108.942 |
| OD PG 108 | 152.047 | -12.331 | 108.890 |
| OD PG 109 | 155.042 | -12.157 | 108.838 |
| OD PG 110 | 158.036 | -11.969 | 108.786 |
| OD PG 111 | 161.029 | -11.767 | 108.734 |
| Base Point | 0.000 | 0.000 | 0.000 |

NOTES:

BASE POINT IS LOCATED AT THE INTERSECTION OF GRID XA AND GRID X4
BASE POINT AT LEVEL 1 IS:
X: 0
Y: 0
Z: 100'

OD PG POINTS REFER TO ALL THE VERTICAL STONE JOINTS ON THE RIBBON WALL WITH THE Z VALUE = THE BOTTOM OF THE SOFFIT ELEVATION

Dynamo



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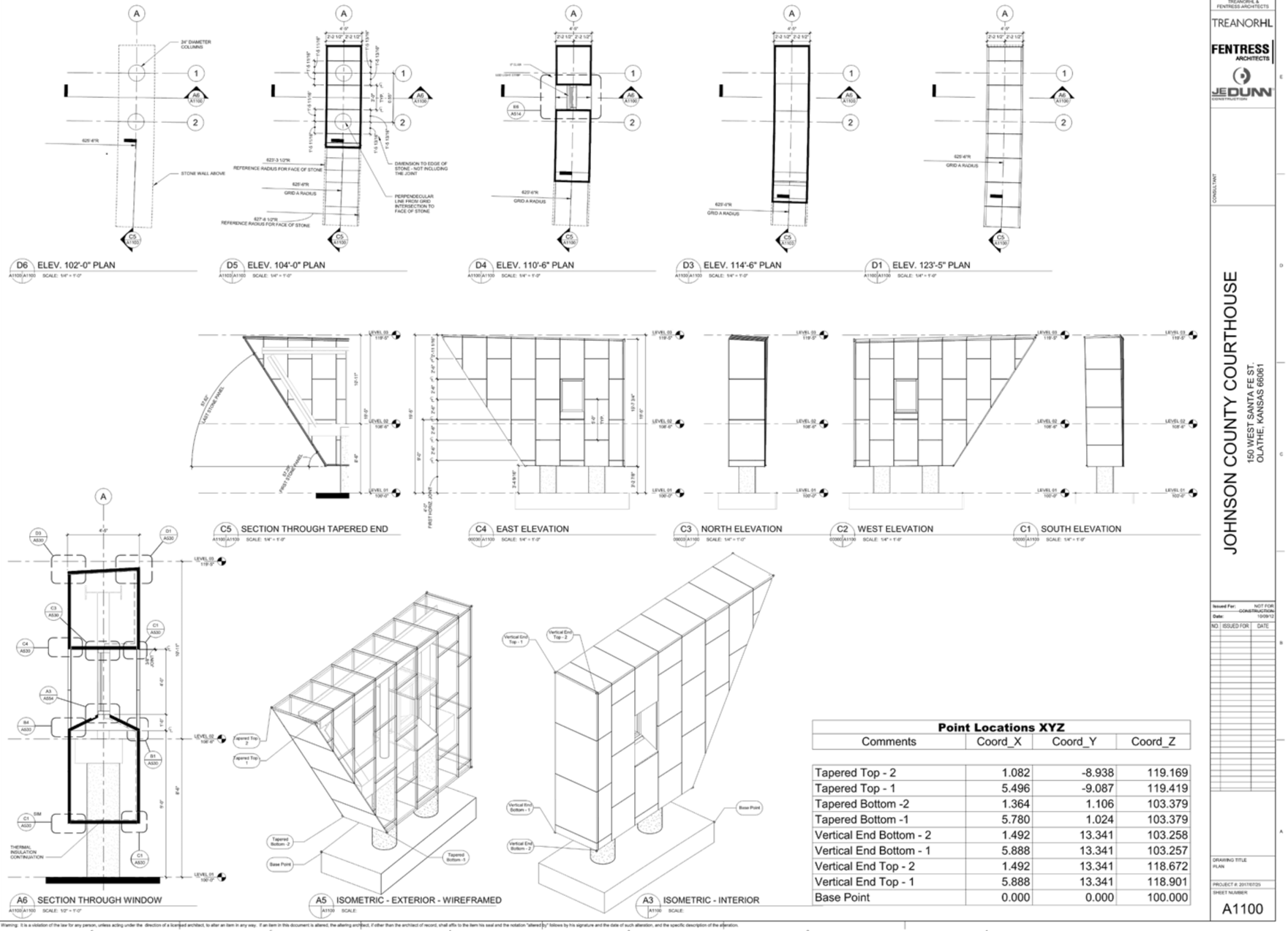




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# Mock up

## Model, documentation and construction

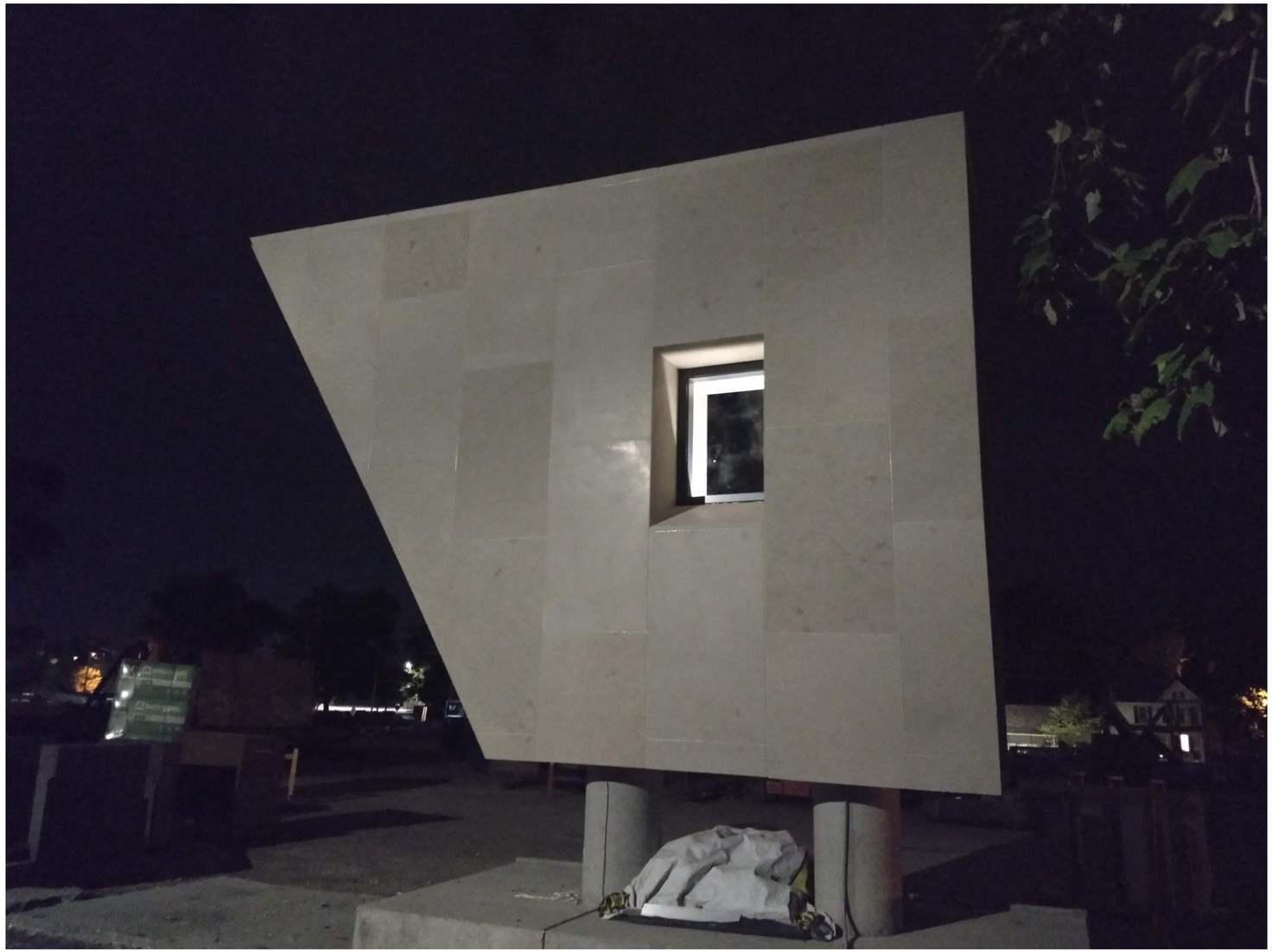

Photo credit : FA



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# 5 Construction

Site, Project Team, Delivery Method


Dylan Lowder – JE DUNN

Dylan.Lowder@jedunn.com

/in/Dylan Lowder

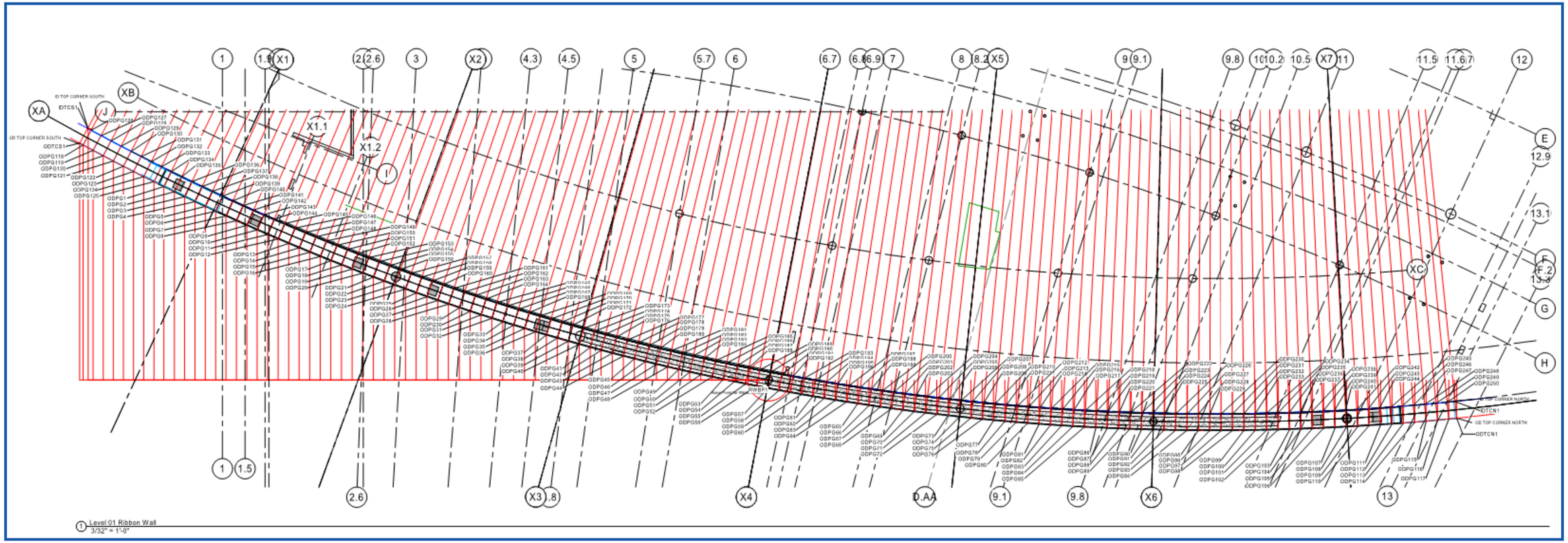

Courtesy of PCI

# Step 1 : Mock-Up

- A full scale mock-up was created for the Ribbon Wall. digital mock-up was provided as well
- Allowed us to check if framing and stone were on the same radius.
- Verify points provided by Fentress

# Step 2 : Template

- 2’4” Wide back of framing to back of framing.
- Located XA on the template itself.




# Step 3 : Point Verification

- Verified all points provided in CD’s matched the provided model.
- Autodesk Point Layout points were placed at those joint intersections on the East and West facades.
- Exported these points to the data collector.

Ribbon Wall Center of Panel Points_Top Corner_Bottom Corner Points - Notepad

File Edit Format View Help

```
POINT NUMBER,Y,X,Z,DESCRIPTION
IDBCS1,216369.0722783,2217437.71601247,30,Control Point
ODBCN1,216689.88439643,2217493.16864935,30,Control Point
ODBCS1,216367.26475587,2217441.74937111,30,Control Point
RWBP1,216528.29796277,2217487.07221308,16,Control Point
ODPG1,216367.42137419,2217441.82009859,16,Control Point
IDTCN1,216708.83774392,2217486.41905478,16,Control Point
ODTCN1,216709.59762291,2217490.77312379,16,Control Point
IDTCS1,216346.97327119,2217427.29281058,16,Control Point
ODTCS1,216344.87369353,2217431.16968183,16,Control Point
IDBCN1,216689.42135467,2217488.77616607,30,Control Point
ODPG2,216370.23897275,2217443.07369631,16,Control Point
ODPG3,216372.98580613,2217444.27976598,16,Control Point
ODPG4,216375.73837208,2217445.47269445,16,Control Point
ODPG5,216378.49660774,2217446.65245448,16,Control Point
ODPG6,216381.26045013,2217447.81901909,16,Control Point
ODPG7,216384.02983612,2217448.97236164,16,Control Point
ODPG8,216386.80470247,2217450.11245576,16,Control Point
ODPG9,216389.58498581,2217451.2392754,16,Control Point
ODPG10,216392.37062263,2217452.35279482,16,Control Point
ODPG11,216395.16154932,2217453.45298856,16,Control Point
ODPG12,216397.95770214,2217454.53983149,16,Control Point
```

**Point Locations XYZ**

| Comments | Coord_X | Coord_Y | Coord_Z |
|---|---|---|---|
| OD Bottom Corner - North | 161.274 | -11.749 | 108.730 |
| ID Bottom Corner - North | 160.965 | -7.343 | 108.750 |
| OD Bottom Corner - South | -159.348 | 50.932 | 114.602 |
| ID Bottom Corner - South | -157.391 | 54.891 | 114.581 |
| ID Top Corner - South | -179.121 | 66.090 | 153.662 |
| OD Top Corner - South | -181.355 | 62.289 | 153.916 |
| OD Top Corner - North | 181.059 | -10.045 | 139.074 |
| ID Top Corner - North | 180.452 | -5.667 | 138.831 |
| OD PG 1 | -159.194 | 50.856 | 114.599 |
| OD PG 2 | -156.422 | 49.504 | 114.545 |
| OD PG 3 | -153.719 | 48.203 | 114.493 |
| OD PG 4 | -151.010 | 46.914 | 114.441 |
| OD PG 5 | -148.295 | 45.639 | 114.388 |
| OD PG 6 | -145.573 | 44.376 | 114.336 |
| OD PG 7 | -142.846 | 43.127 | 114.283 |
| OD PG 8 | -140.113 | 41.890 | 114.231 |
| OD PG 9 | -137.374 | 40.667 | 114.178 |
| OD PG 10 | -134.629 | 39.456 | 114.126 |
| OD PG 11 | -131.878 | 38.259 | 114.073 |
| OD PG 12 | -129.122 | 37.075 | 114.020 |



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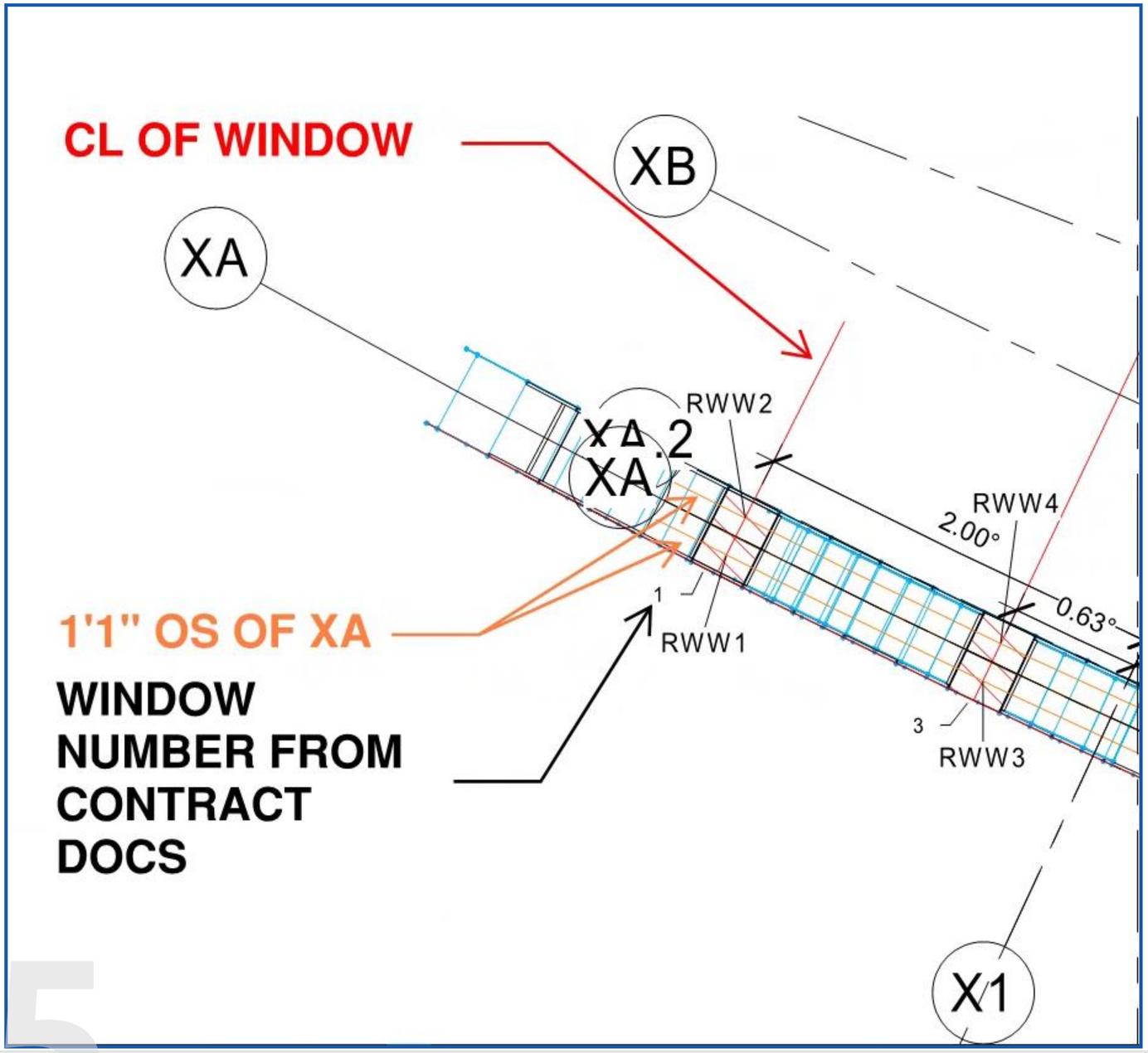
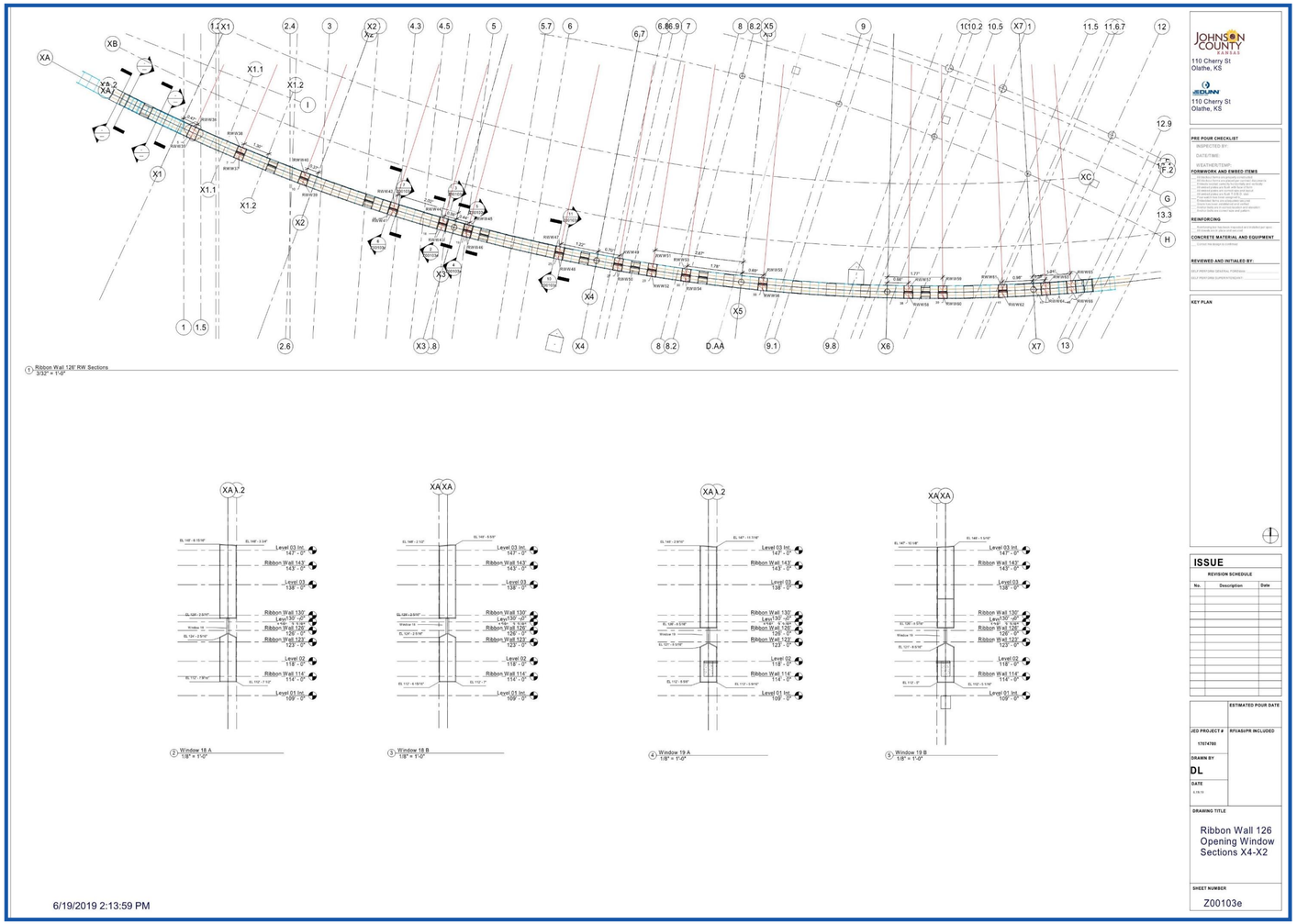


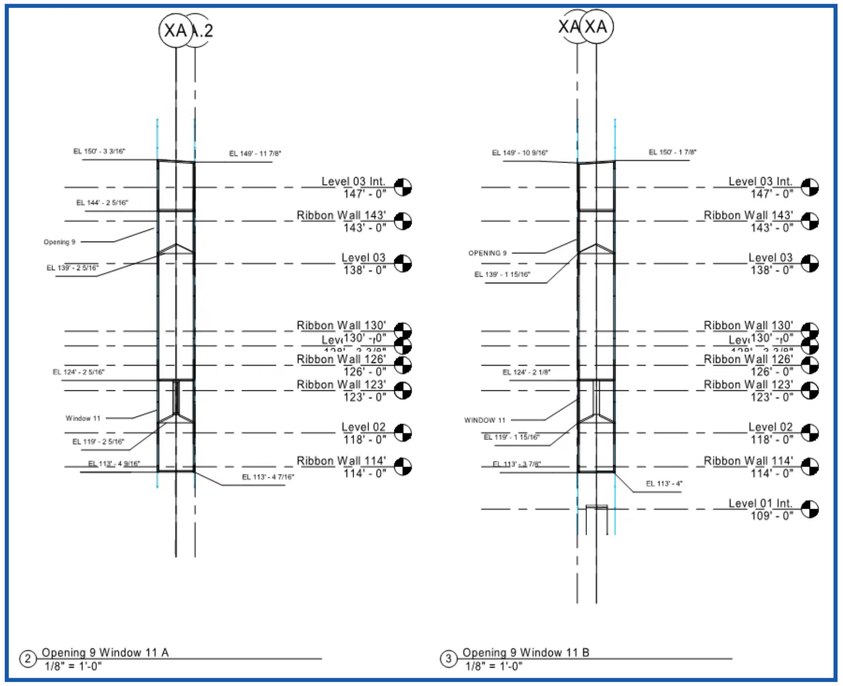

# Step 4 : Window Layout

- JE Dunn decided to performed all layout on the Ribbon Wall.
- Verified all windows in the Ribbon wall model matched CD’s.
- Laid out center line of all windows and openings on the template.



FENTRESS ARCHITECTS | MACKEY CONSULTING | JE DUNN CONSTRUCTION




# Step 5 : Jamb Stud Elevations

- 2 sections through every window / opening.

  A North and South section was created.
- Finish face of stone at the top of the wall, soffit, head, and sill of each window were given.
- Studs were cut to length on the ground and the elevations were marked on each stud.



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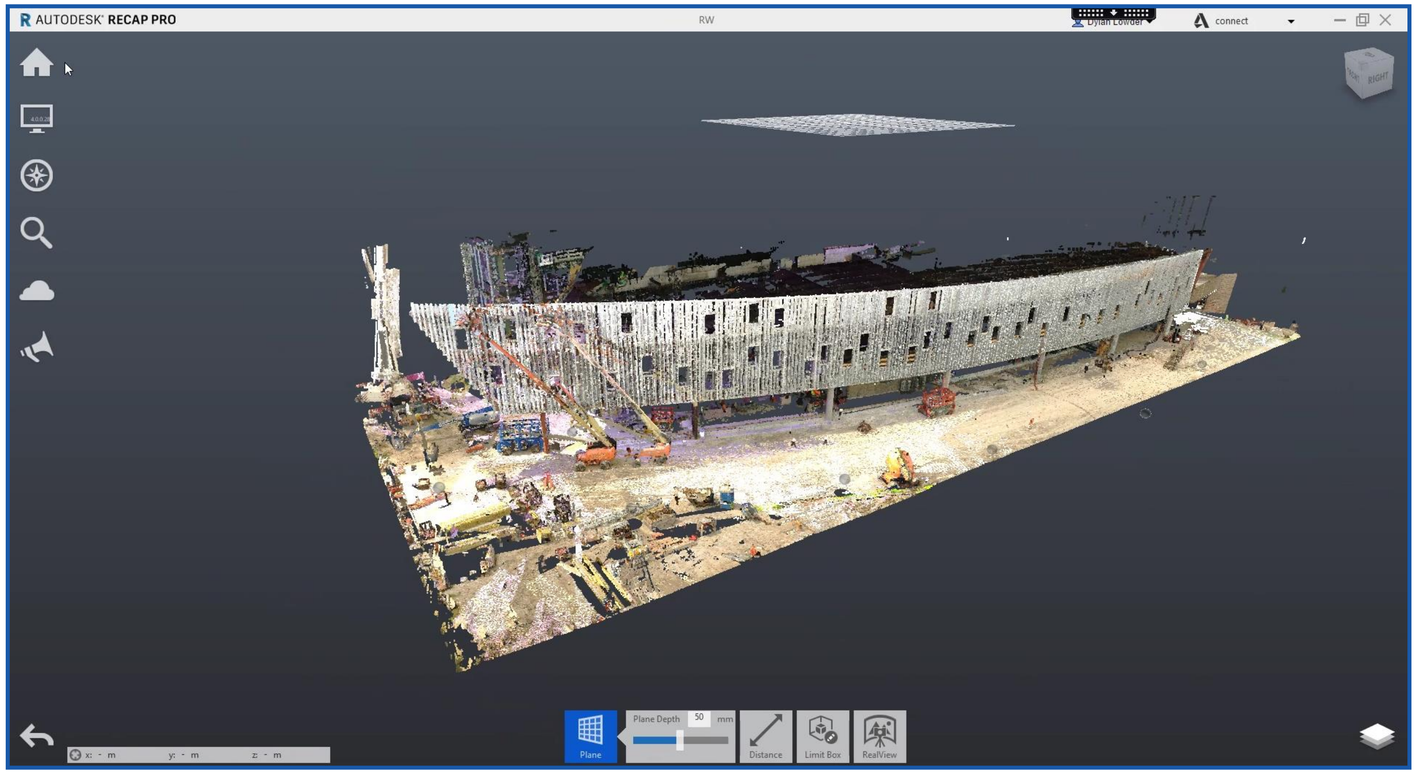


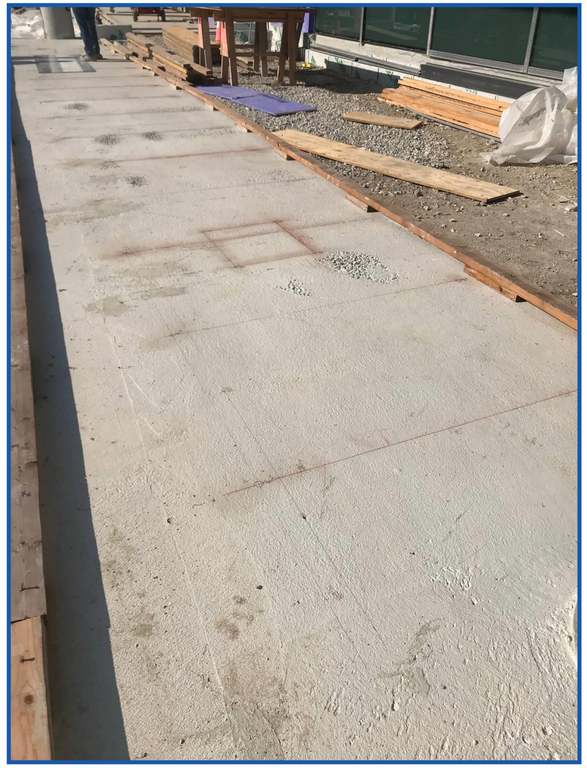

# Step 6 : Laser Scan

- JE Dunn laser scanned the wall once framing was

  complete.
- Verified framing was plumb, within tolerance, and placement of windows was correct.

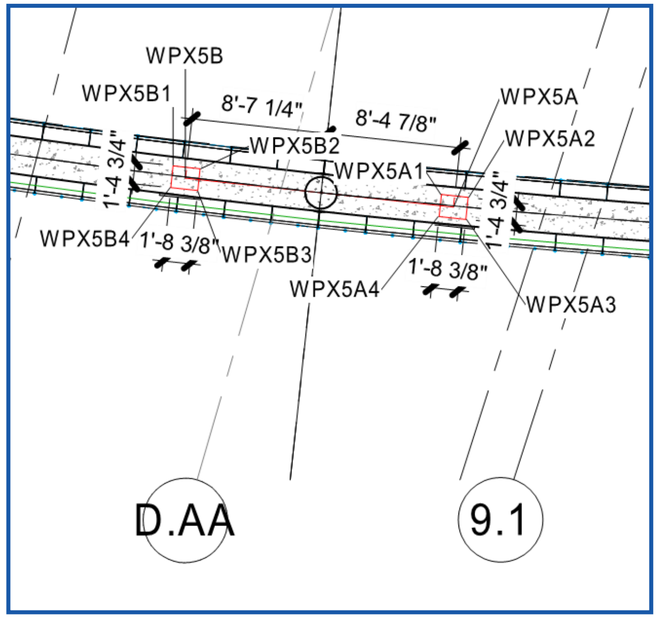


FENTRESS ARCHITECTS | MACKEY CONSULTING | JE DUNN CONSTRUCTION



# Step 7 : Center of Joint Layout

- A mud slab was poured below the length of the entire wall Center of panel joints were laid out on mud slab.
- These points allow the JE Dunn masons to shoot a laser up the face of the wall for joint locations.




# Step 8 : Y-Column Layout

DUNN right®

- Y-Columns that flank each round column at the base of the Ribbon Wall.
- Having the locations of the Y-Columns gave the masons the locations of what stone panels needed to be cut to receive the columns.



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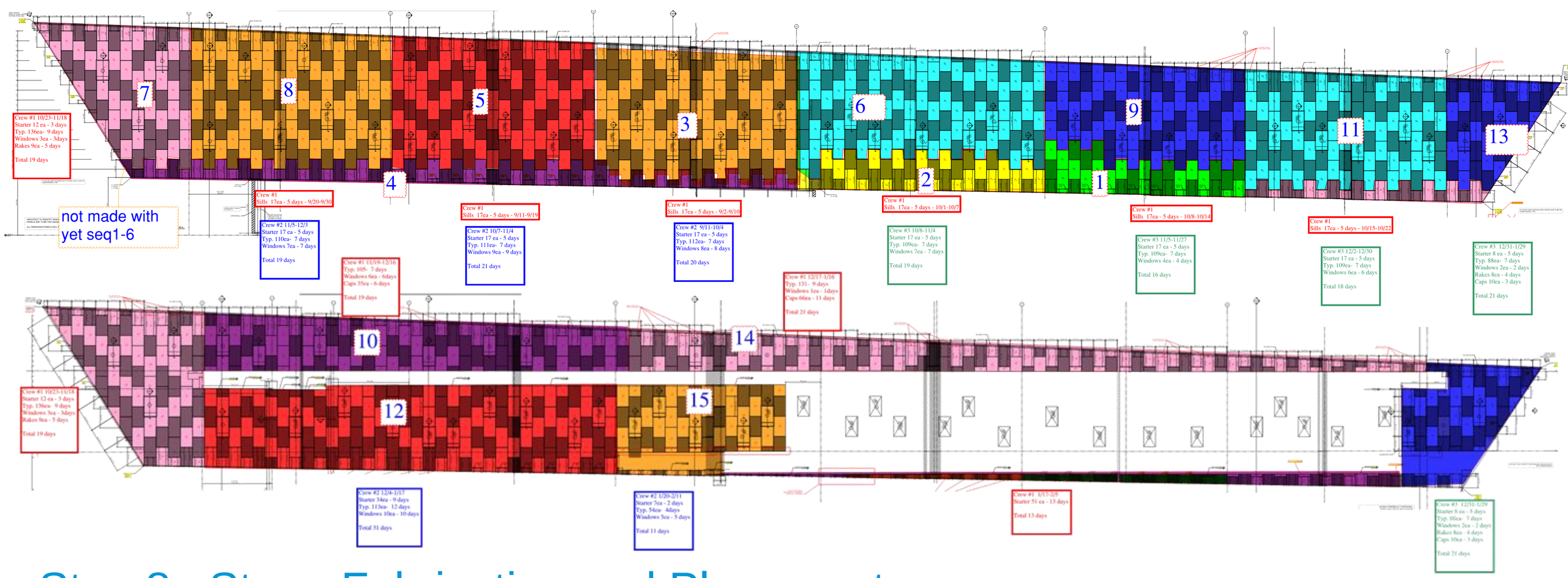


# Step 8 : Stone Fabrication and Placement

- Started fabricating and placing stone on soffits 1,2,4 first – this established the vertical joints on the outside and inside face of the wall
- Identified all “typical” 3x5 pieces because of schedule requirement all typical pieces of stone needed to be set first
- Second crew started sequence 3 working left or South when complete a 3rd crew starts on sequence 6 working North or right
- EZ Scaffold System is being used during stone placement
- Breaking the wall into sequences this way allowed US Stone to fill a delivery truck completely maximizing on site deliveries.



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# Facts & Numbers

**42,500**
LINEAL FEET OF STUDS

**70**
TONS OF STEEL

**187**
TONS OF STONE
1.326 PCS

**19,916**
MAN HOURS

PCI PERFORMANCE CONTRACTING INC

MSC MIDLAND STEEL COMPANY

U.S. STONE INDUSTRIES

JE DUNN CONSTRUCTION

Photo credit : FA – JE DUNN

# First Stone Panels Installed!

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Photo credit : FA – JE DUNN



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Photo credit goes here



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# Final Questions

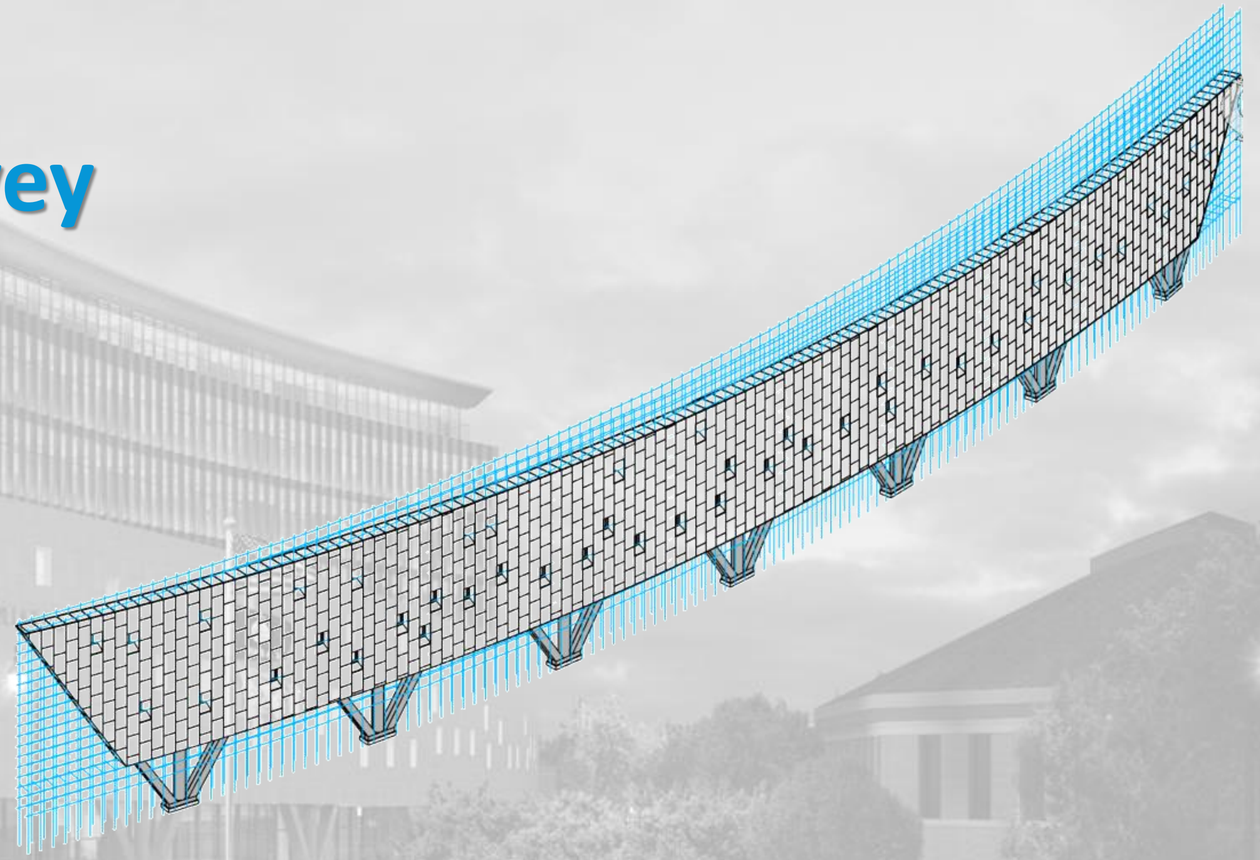
- Please remember to fill out your **survey**
- Zahra Mirian

- For more information


mirian@fentressarchitects.com

https://twitter.com/zahramirian

https://www.linkedin.com/in/zahra-mirian-hosseinabadi-2306a550/

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