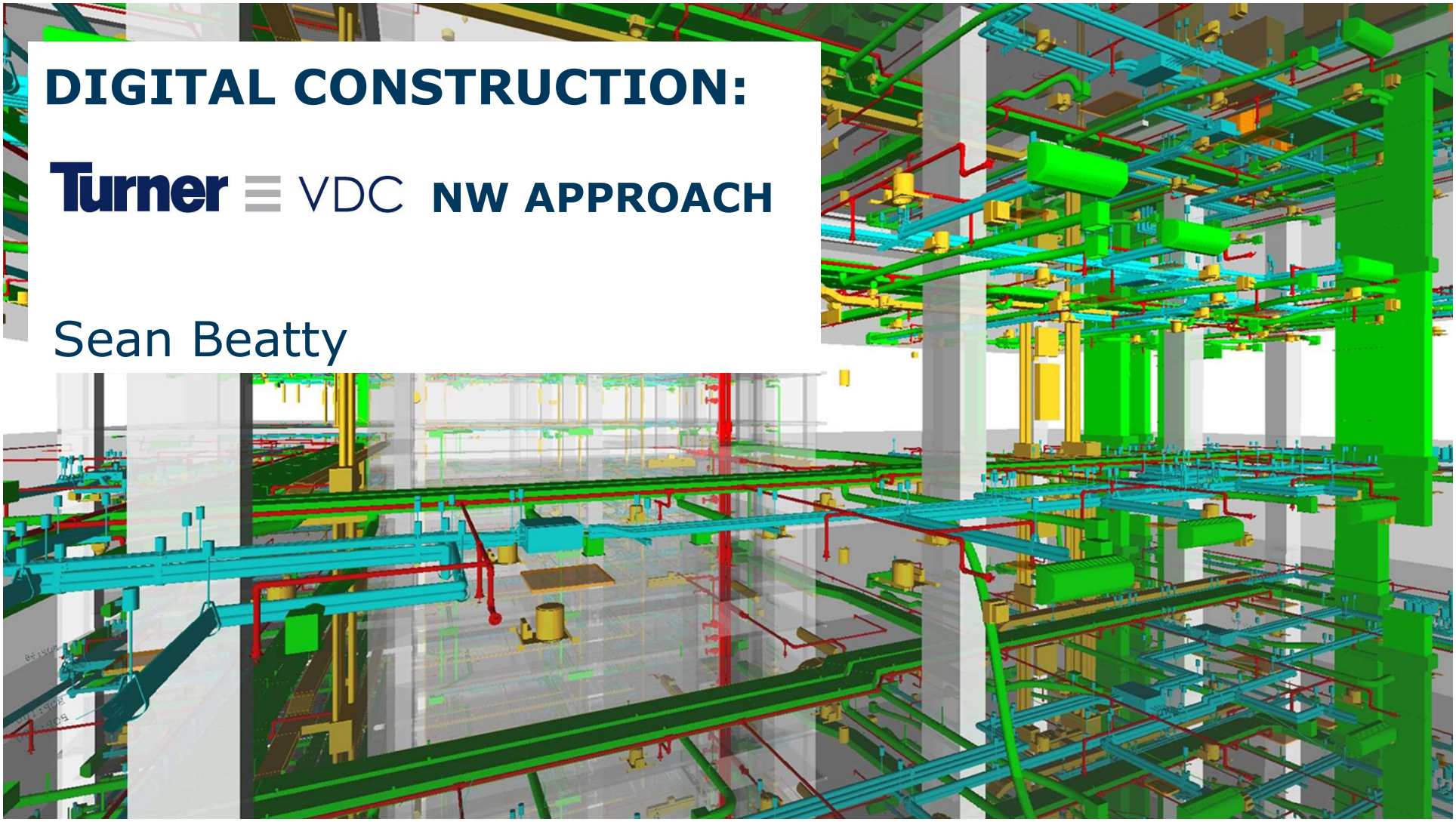
DIGITAL CONSTRUCTION:

Turner ≡ VDC NW APPROACH

Sean Beatty



Turner

Who We Are: North American Locations

- **Founded in 1902, HQ in NYC**
- **More than 6,100 Active Employees**
- **3,801 Active Projects**
- **$12.5 Billion Annual Construction**
- **$18.5 Billion in backlog!**
- **Global Network of Offices**



Sean Beatty

VDC Dept. Manager, Regional Innovation Champion

Turner Construction (Seattle/Vancouver)

- MArch – Washington State Univerity
- MSCM – University of Washington
- 15 Years with Turner Construction
  - 4 Years as Field Engineer
  - 4 Years as VDC Engineer
  - 2 Years as VDC PM
  - 3 Years as VDC DM



VDC SERVICES







SPO MODELING
-ESTIMATING
-DETIALING
-REBAR
-LAYOUT

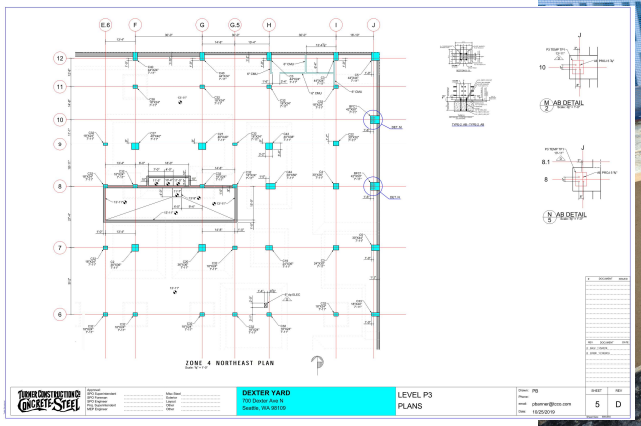
PRECON / SALES
-VISUAL STORY TELLING
-ESTIMATING MODELS
-SEQUENCE MODELS
-MISC. MODELING
-LOGISTICS
-RENDERING / ANIMATION

Turner ≡ VDC

DIGITAL FAB / R&D
-DIGITAL FAB
-PHYSICAL MODELS
-DRONES
-PHOTOGAMMETRY
-LASER SCANNING
-SCRIPTING / CODING

MEPF COORDINATION
-LAYOUT
-AUTODESK APPS
-AR / VR
-TRADE PARTNERS

SPO HISTORY









- De-Siloing Information
- Improved communication
- Everybody owns the data

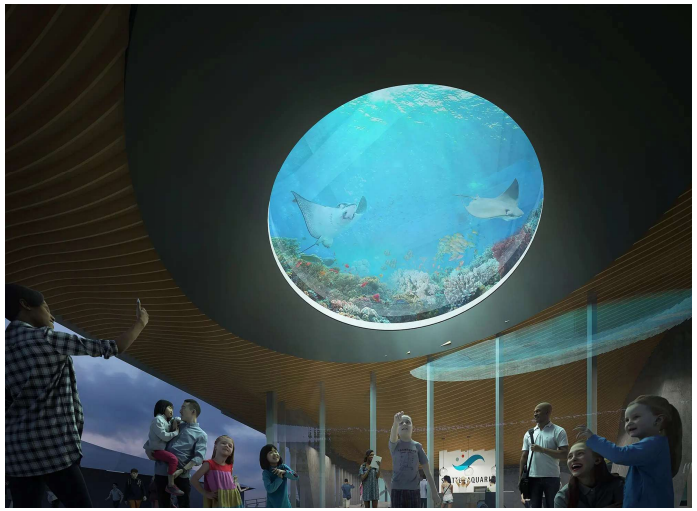


Turner



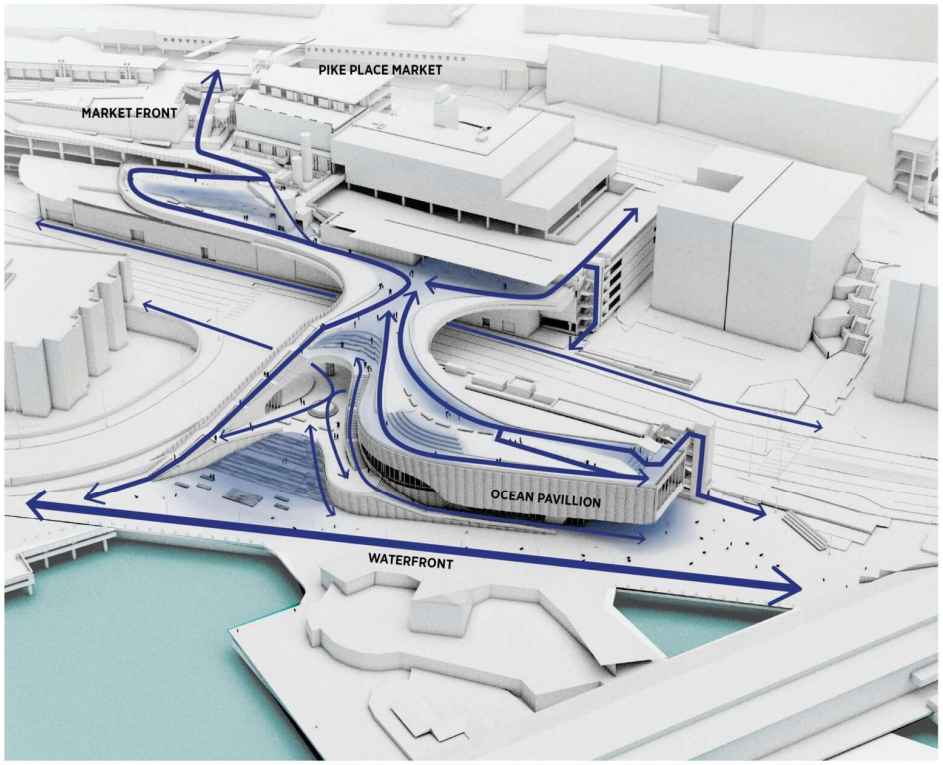
SEATTLE AQUARIUM
OCEAN PAVILION





PROJECT DESCRIPTION

- Located in Seattle, WA waterfront
- Will be home to around 3,500 tropical fish a invertebrates
- Focus of the building is to research the conservation of marine animals
- The project is pursuing ILFI Zero Carbon Certification and LEED Gold, which includes Embodied carbon reduction component.





OVERLOOK WALK
City Team



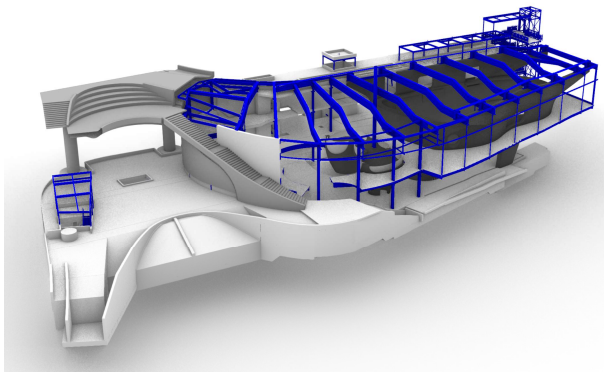
OCEAN PAVILION
Aquarium Team



STREET IMPROVEMENT
AND WATERFRONT
PROMENADE
SDOT and City Team

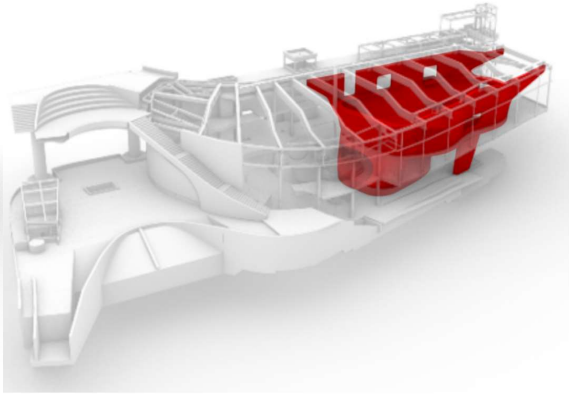
Turner

PROJECT DESCRIPTION - STRUCTURE



Concrete + Steel Structure

- Combination of concrete and steel structure



Coral Canyon Tank As Main Bldg. Structure

- The tank is a heavily significant part of the structure of the building.
- Roof steel beams and precast concrete sit on Main Tank
- Steel structure is partially hanging from Main Tank

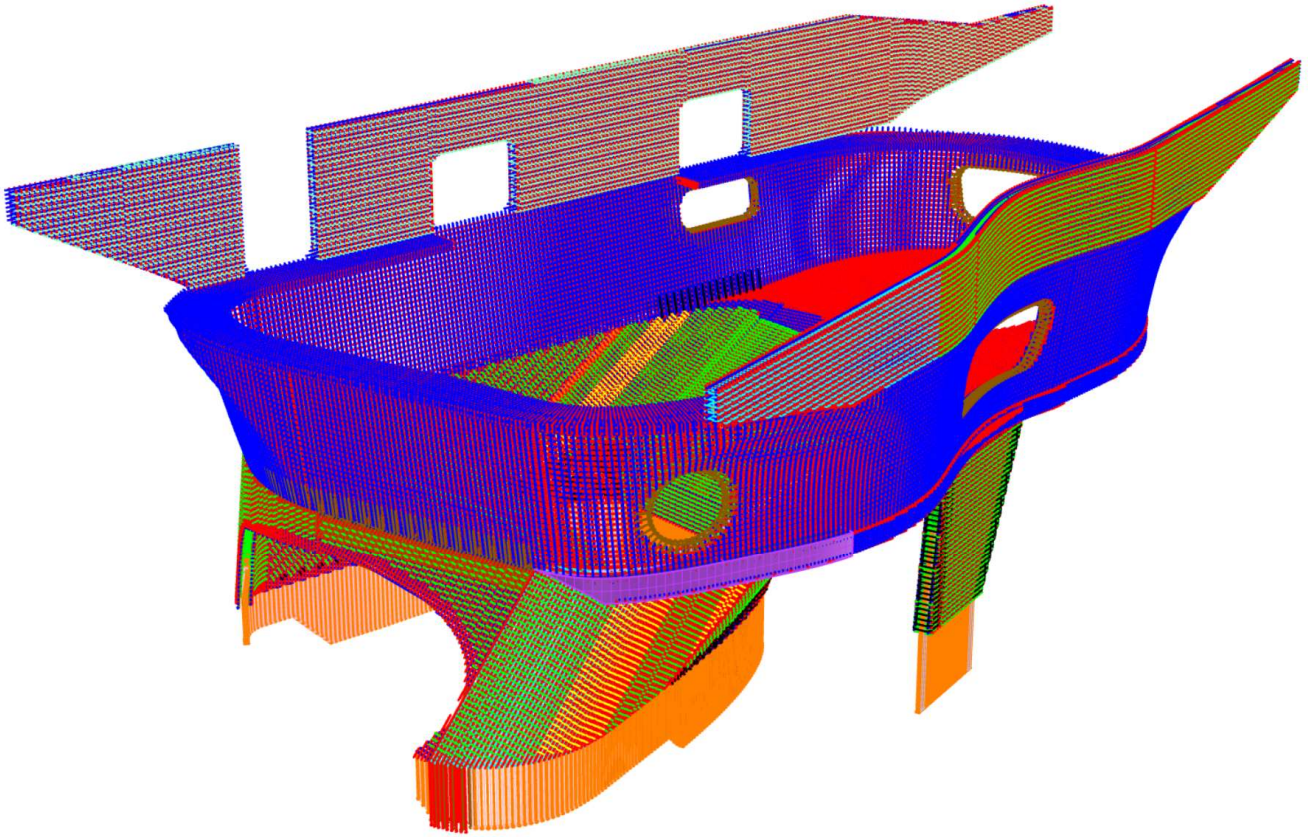


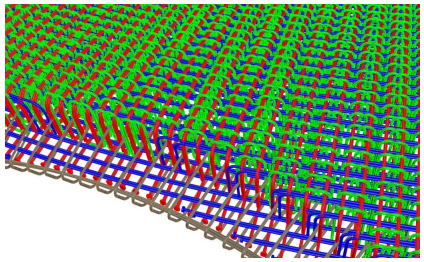
Tank Structure

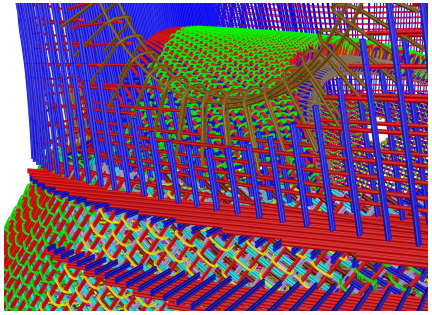
- Total water capacity is 325,000 Gallons
- 1,100 lb of rebar per cy (3 times more than a typical core wall)

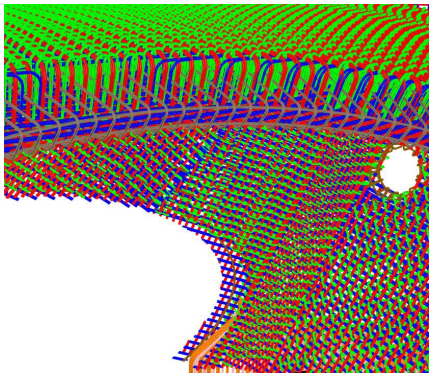
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MAIN TANK REBAR







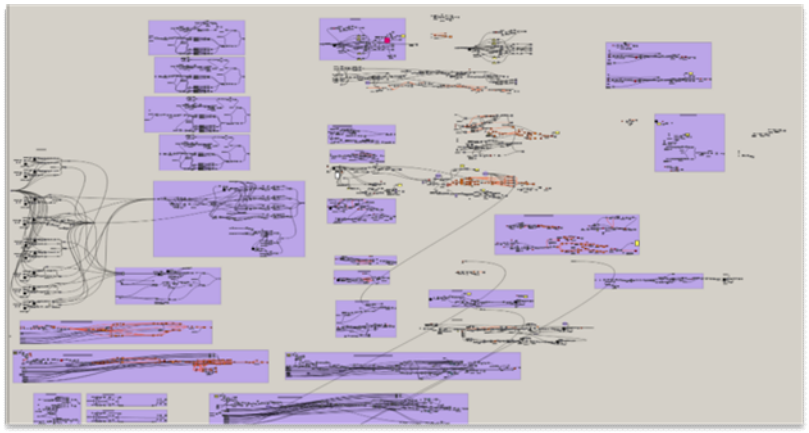


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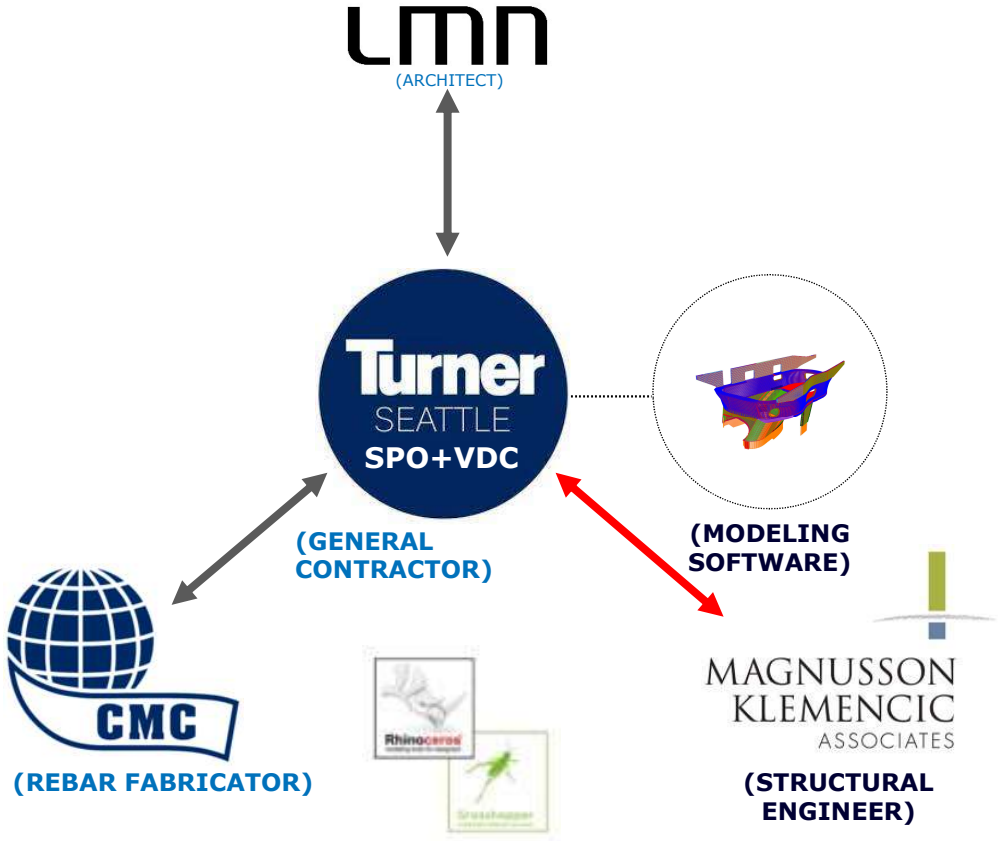
MAIN TANK REBAR MODEL / COORDINATION

- Turner SPO+VDC utilized the CONTRACTUAL MODEL to help LMN+MKA REDESIGN the rebar

- CMC referenced Tuner's rebar MODEL to fabricate and generate rebar shops



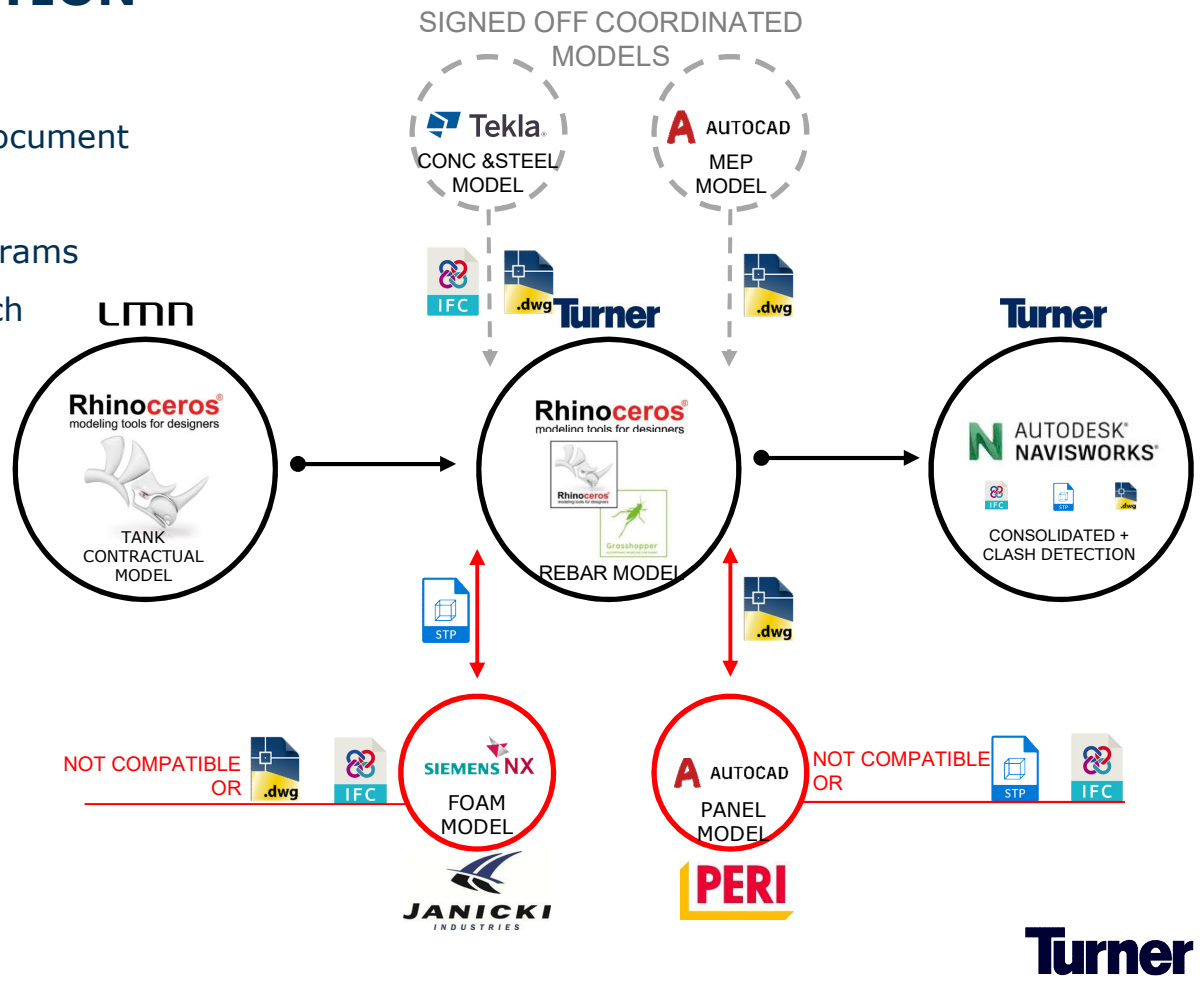
GRASSHOPPER SCRIPT FOR REBAR MODELING



Turner

FORMWORK COORDINATION

- Models provided as 3D contractual document
- Fabrication level 3D model
- Trade partners utilized different programs
- Turner was the conduit for QAQC each iteration of exports
- Exploration of compatible file format
- Embracing the integrity of the model geometry and data

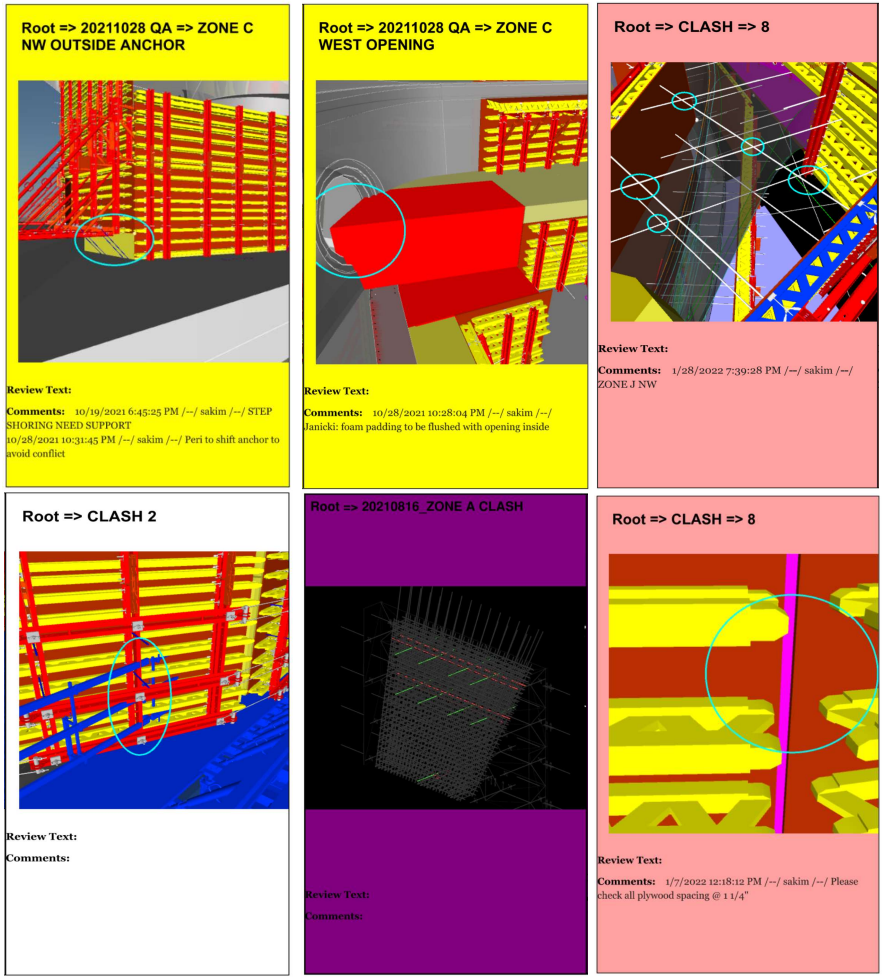


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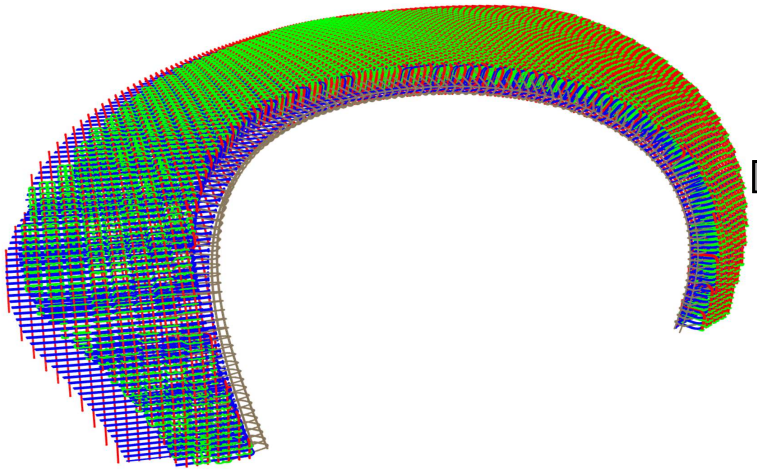
FORMWORK COORDINATION

CONSTRUCTABILITY & CLASH REPORT

- Alignment with formwork padding compatible with formwork module
- Acrylic rebate ½” tolerance
- ¼” buffer around the tie holes
- Tierod vs Rebar conflicts
- Integrate MEP penetrations
- LSS vs Rebar conflicts
- 8” LSS sleeve extrusion
- Formwork vs matslab steps
- Formwork support system to avoid anchor penetrations to the concrete
- Foam block transition details
- 1/8” spacing between the formwork plywood
- No tie-zone at 6” SOMD + embed around the tank
- Formwork anchor vs foam



MAIN TANK REBAR
FABRICATION + ON SITE ASSEMBLY



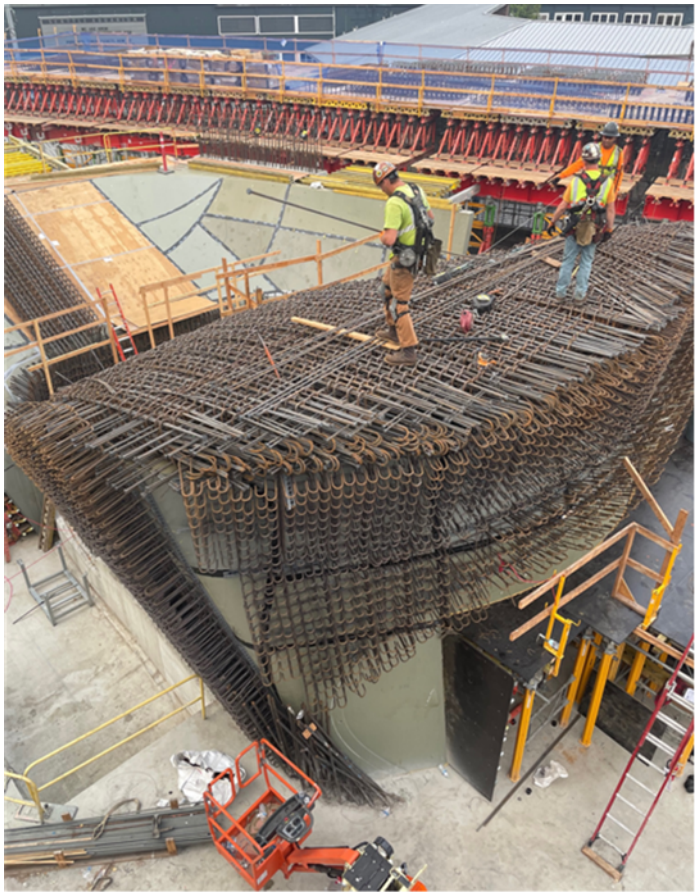


REBAR PLACEMENT ONSITE
(INSIDE ZONE C)

Turner

MAIN TANK REBAR
FABRICATION + ON SITE ASSEMBLY

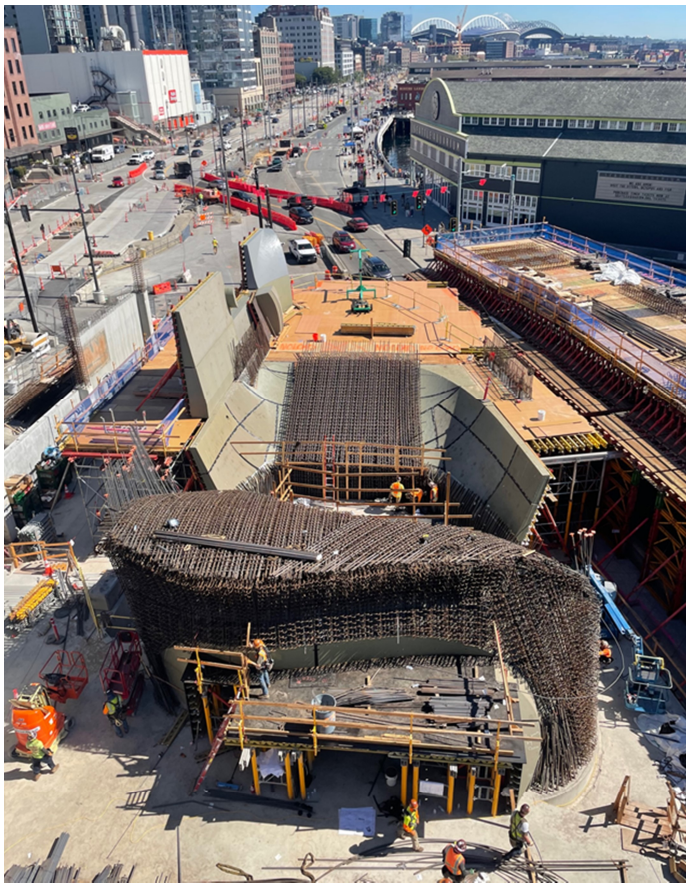
30% BENT ON SHOP VS
70% BENT ON SITE

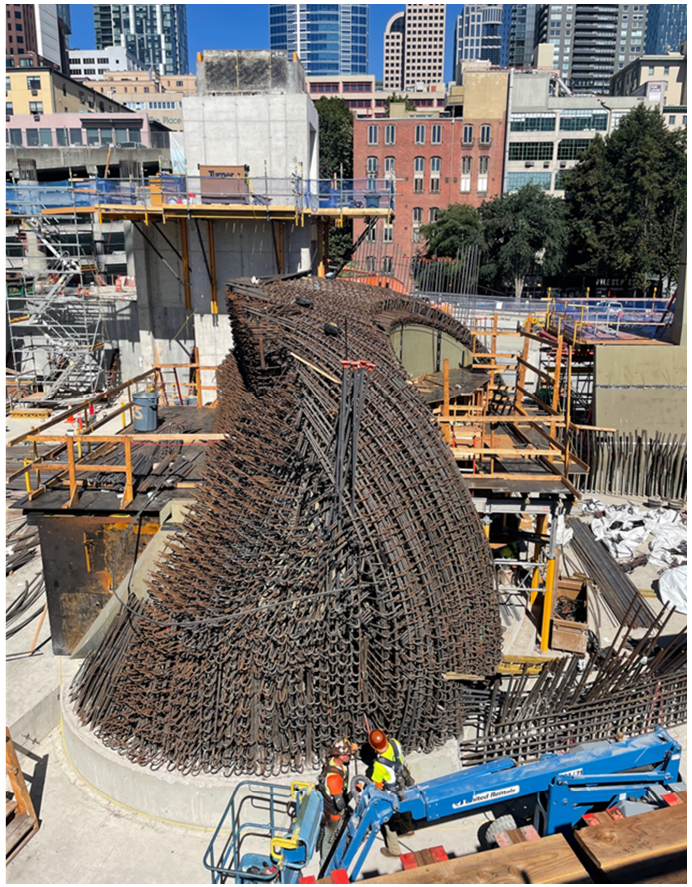




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REBAR ASSEMBLY



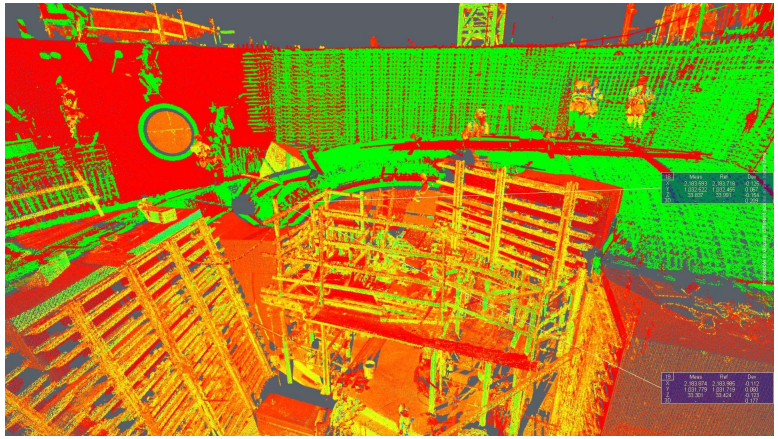


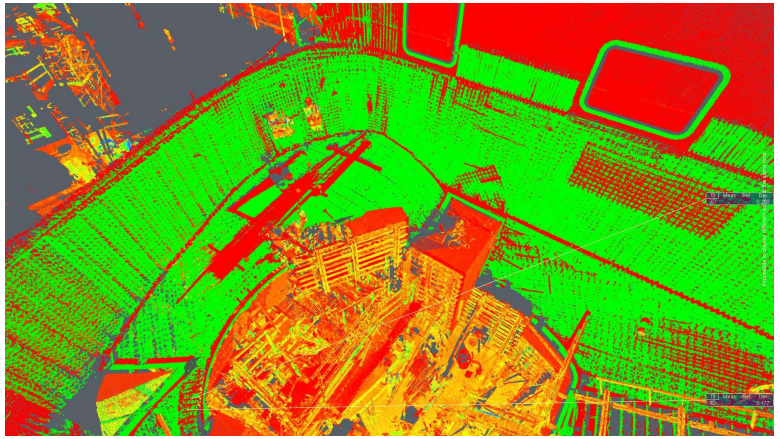


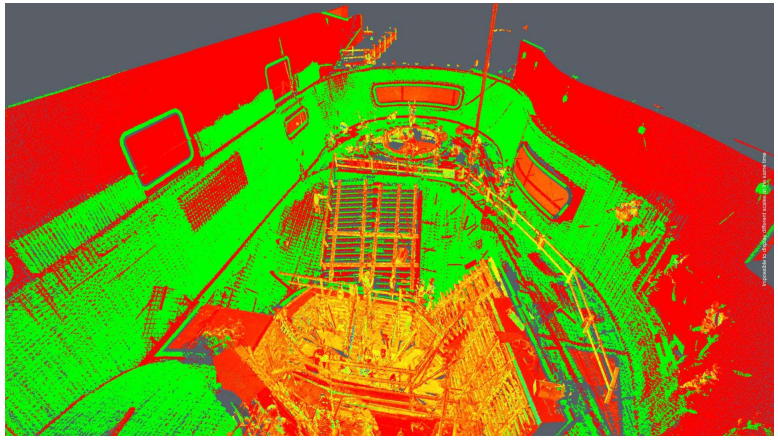


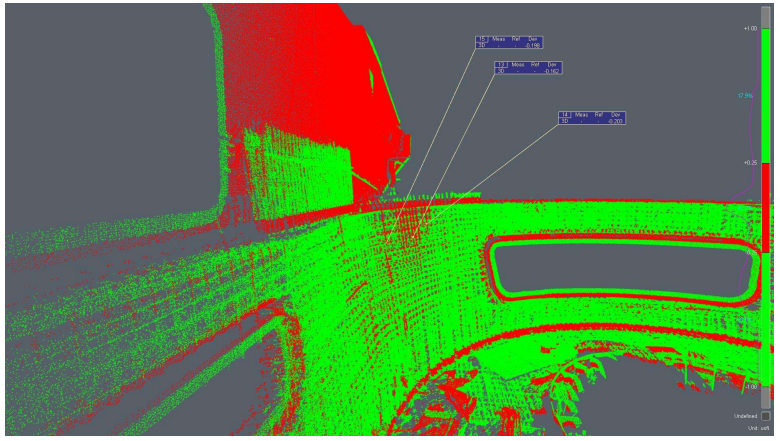
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QA/QC (3D SCAN)











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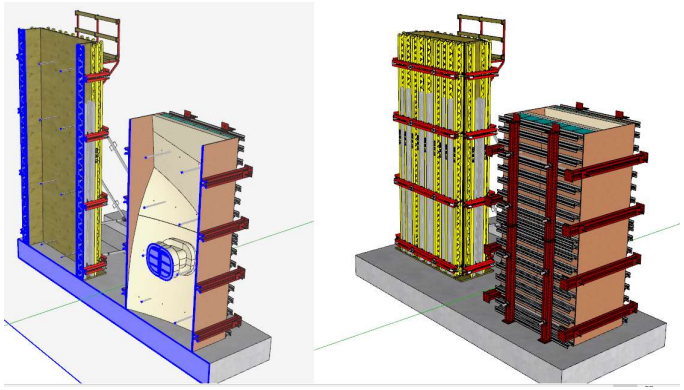
MAIN TANK CHALLENGES

Pour Pressure:

- Walls need to pour 32' to put CJ above the water level.
- SCC pressure on formwork system was not studied before.
- 4 ft/hr placing rate results in 35% less pressure

Service Life:

- Tank SCC mix has apparent chloride diffusion (Da)
- of 2.3 x 10-10 IN2/SEC, 33 times denser than typical concrete

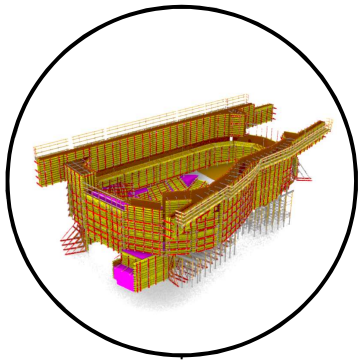






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FABRICATION MODEL FOR FIELD CONSTRUCTION



SIGNED OFF TANK FORMWORK/FOAM MODEL FOR FABRICATION AND CONSTRUCTION

4D SEQUENCE MODEL (VISUAL PLANNING)

FORMWORK LIFT DRAWING (FIELD INSTALLATION)

MODEL BASED LAYOUT (FIELD LAYOUT)

FABRICATION (FORMWORK + FOAM)

AS-BUILT VS SIGNED OFF MODEL (QUALITY CONTROL)

SHIFT PLACEMENT

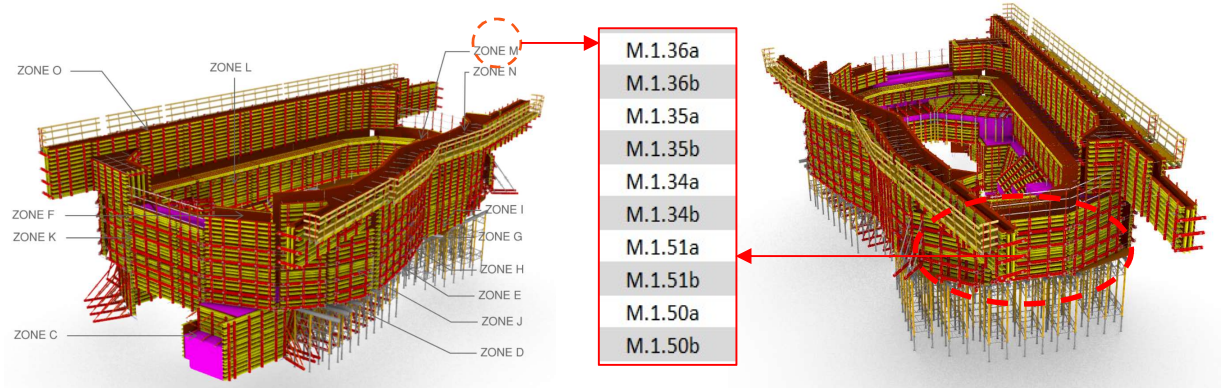
MODEL VISUALISATION (COMPREHENSION)

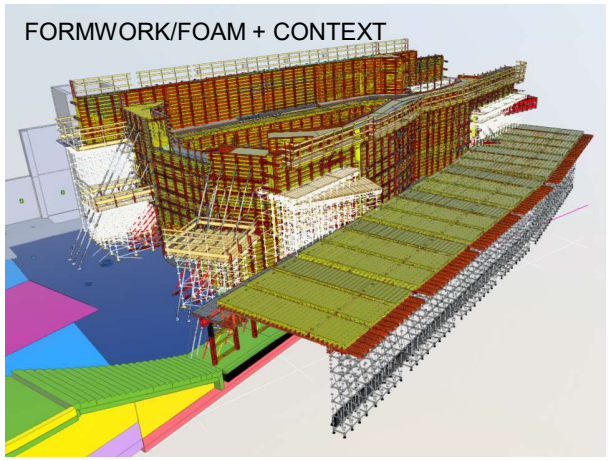
ACCESSED THROUGH TABLET OR PHONE ON SITE

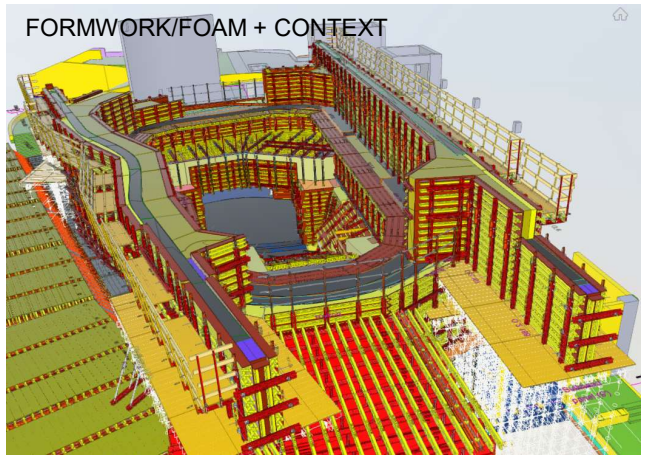
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CONSOLIDATED FORMWORK

- 229 Panels and
  40 Foam Inserts
- Broken out by
  Zones (A to O)

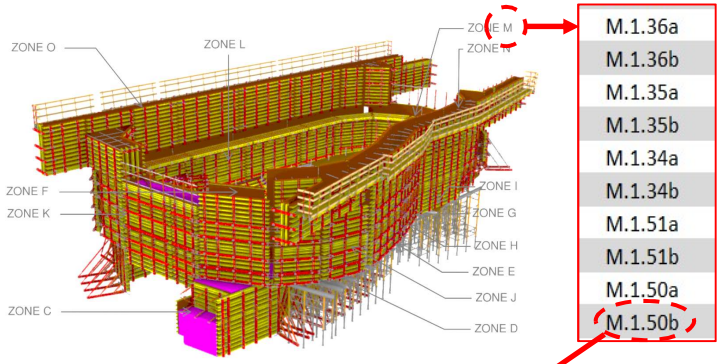




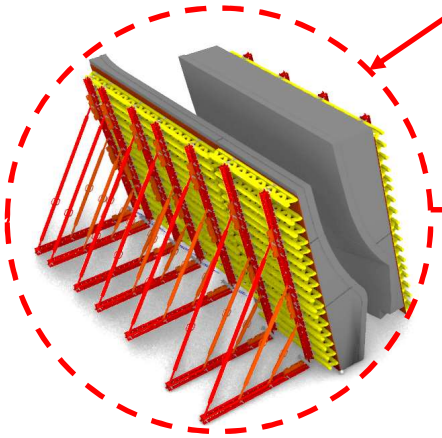


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FOAM/PANEL MODULE ON SITE



M.1.36a
M.1.36b
M.1.35a
M.1.35b
M.1.34a
M.1.34b
M.1.51a
M.1.51b
M.1.50a
M.1.50b



Module 20’x16’ @ max



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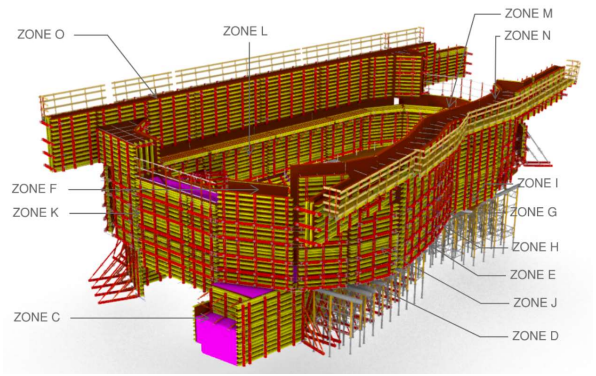
FORMWORK PLACEMENT

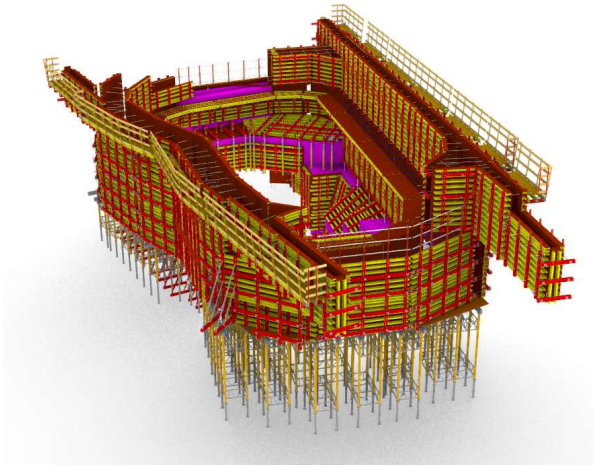




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FORMWORK PLACEMENT







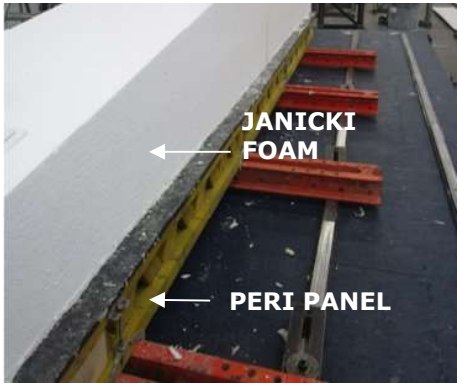
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CNC FOAM/PANEL PRODUCTION

JANICKI CNC'ED + GLUED TO PERI PANEL

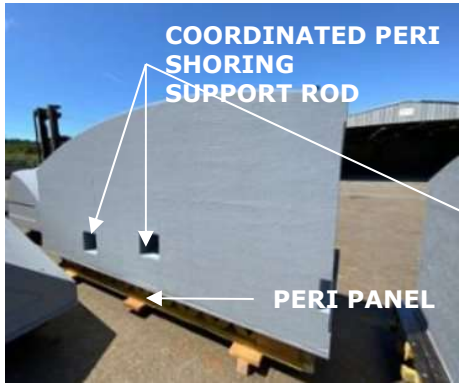






SPRAY COATED BY PSC







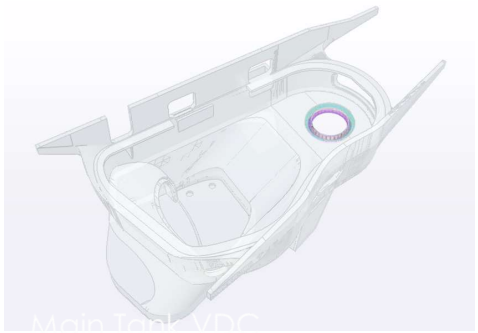
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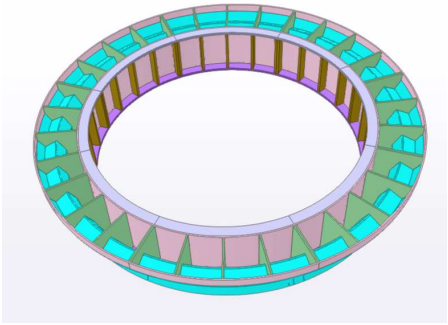
FORMWORK PREFABRICATION

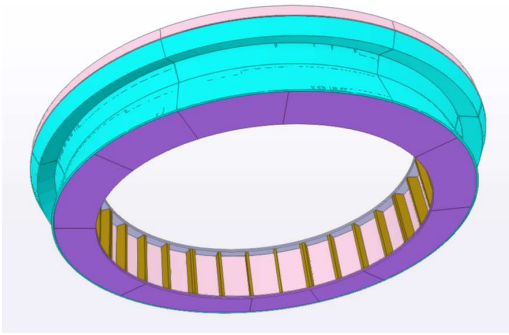


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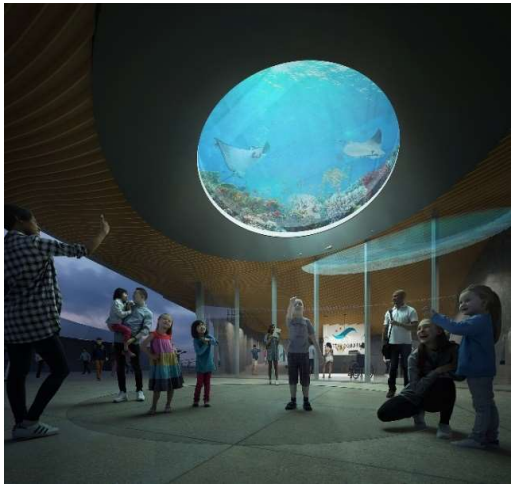






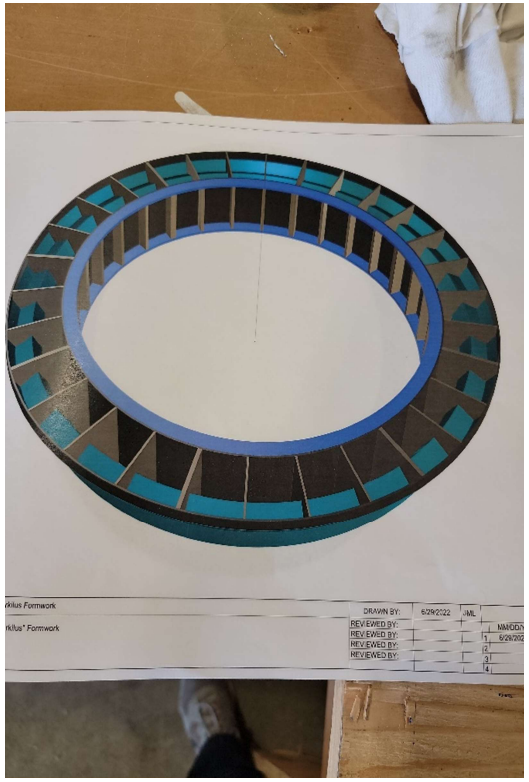


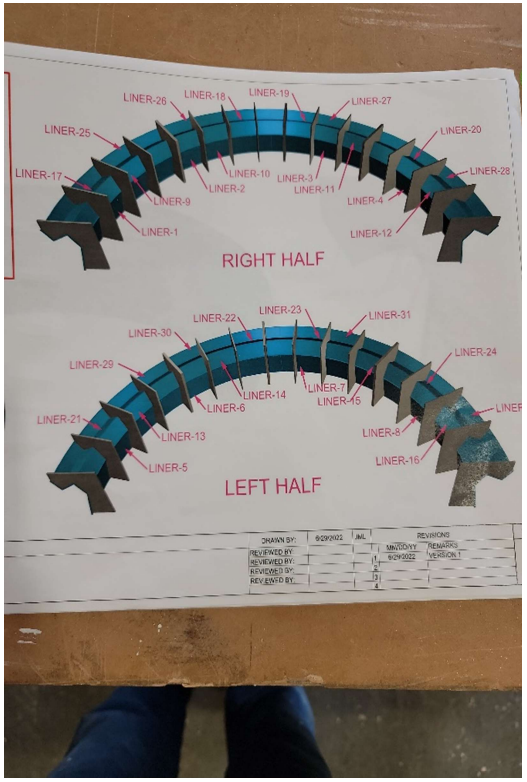


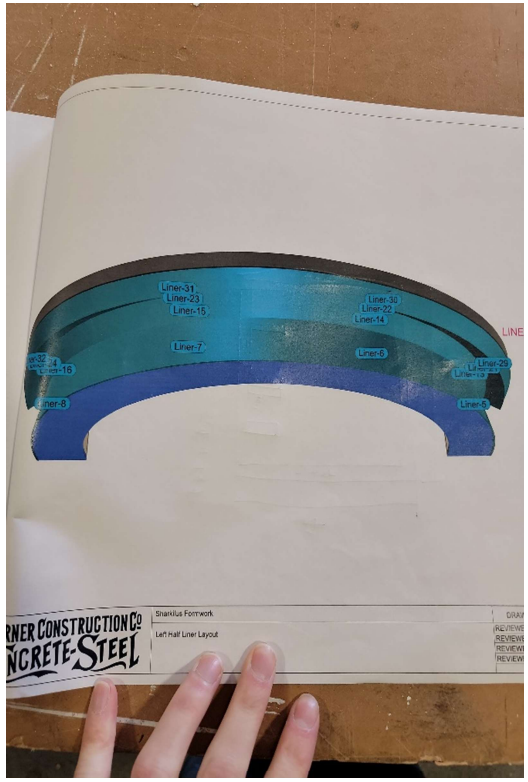


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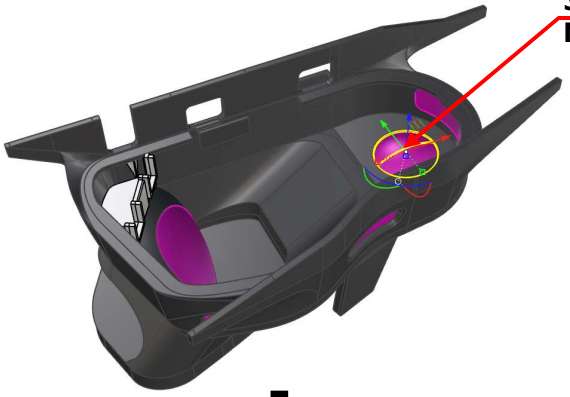
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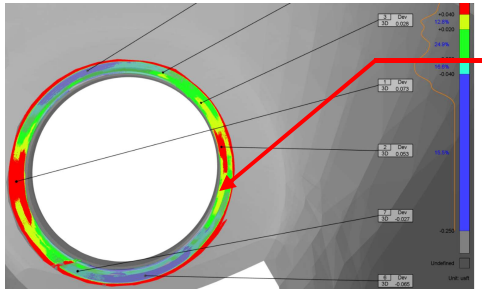
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ACRYLIC INSTALLATION

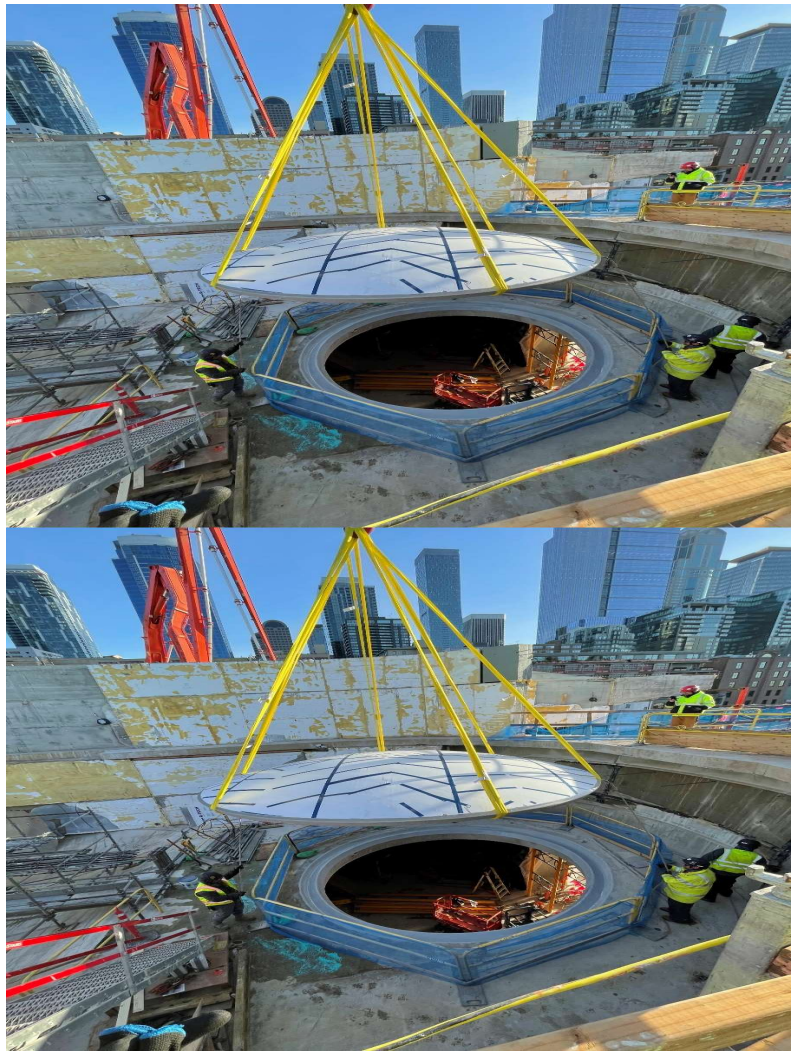


3D CONTRACTUAL MODEL

+

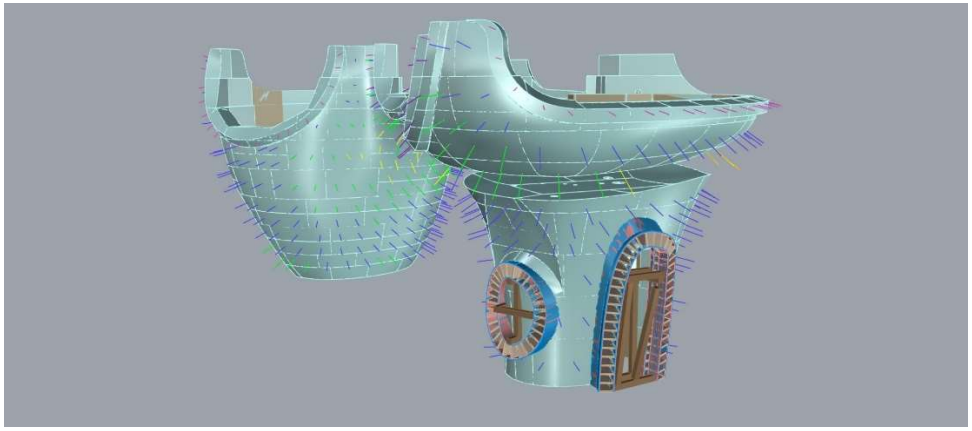


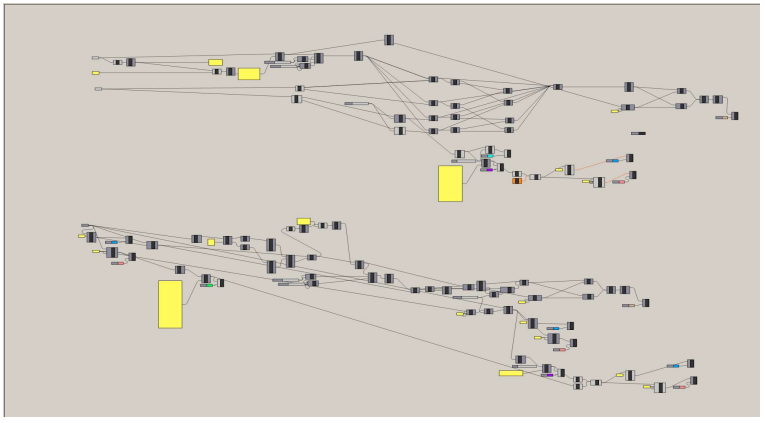
SCAN AS-BUILT REBATE / QC

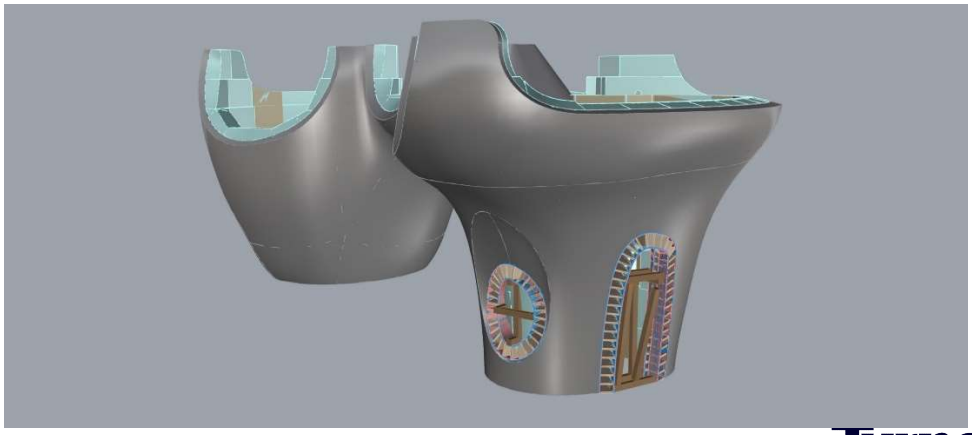


FORMWORK PREFABRICATION



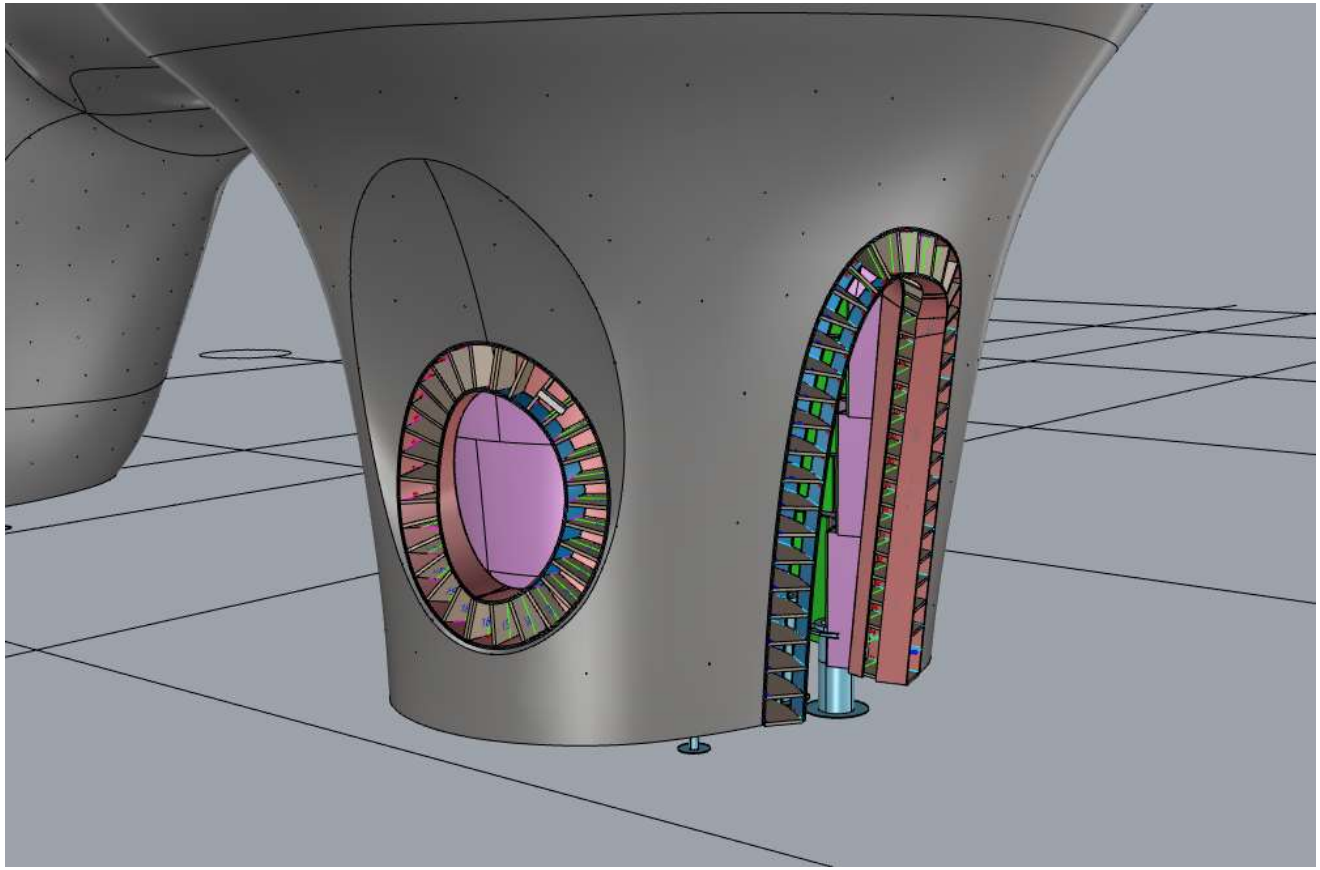






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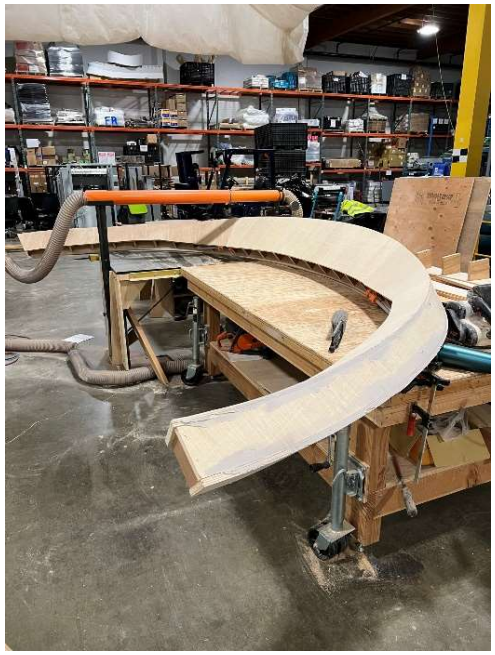
FORMWORK PREFABRICATION



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FORMWORK PREFABRICATION



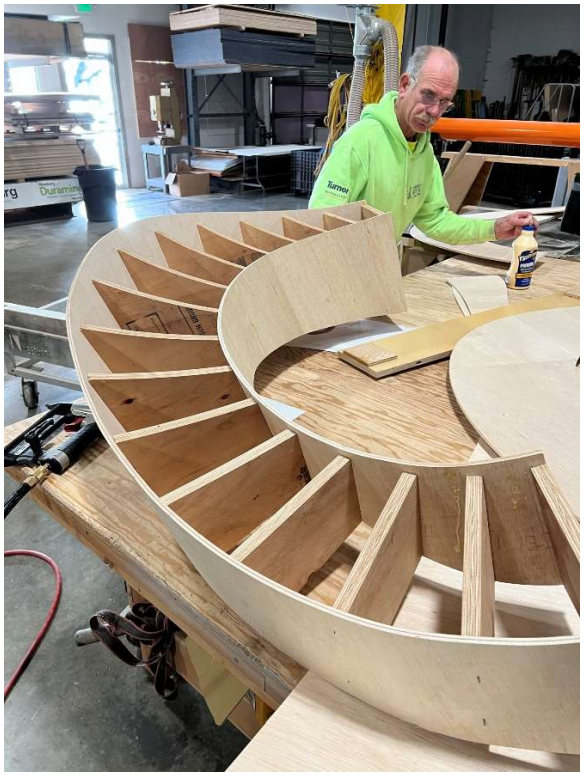




Turner

FORMWORK PREFABRICATION







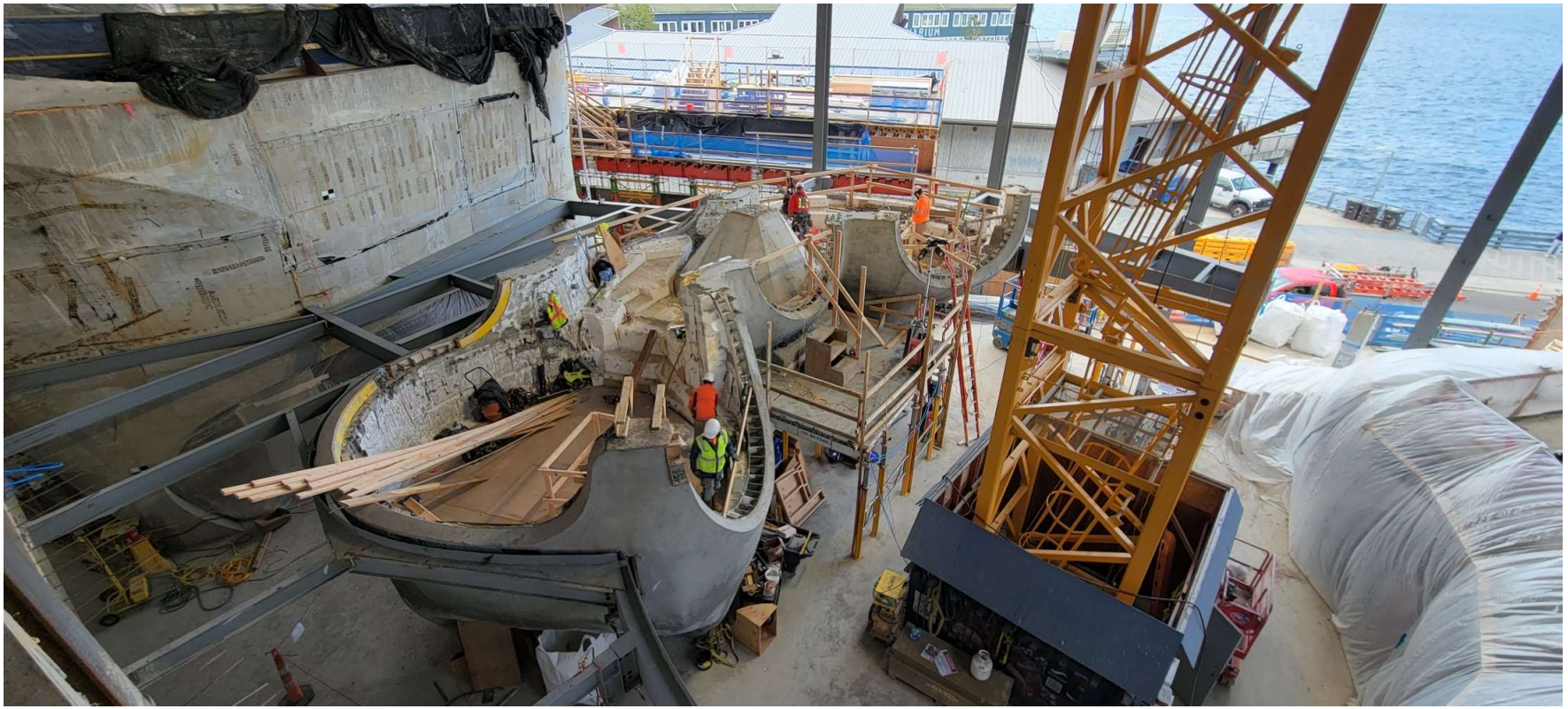
Turner

FORMWORK PREFABRICATION



Turner

FORMWORK PREFABRICATION



Turner

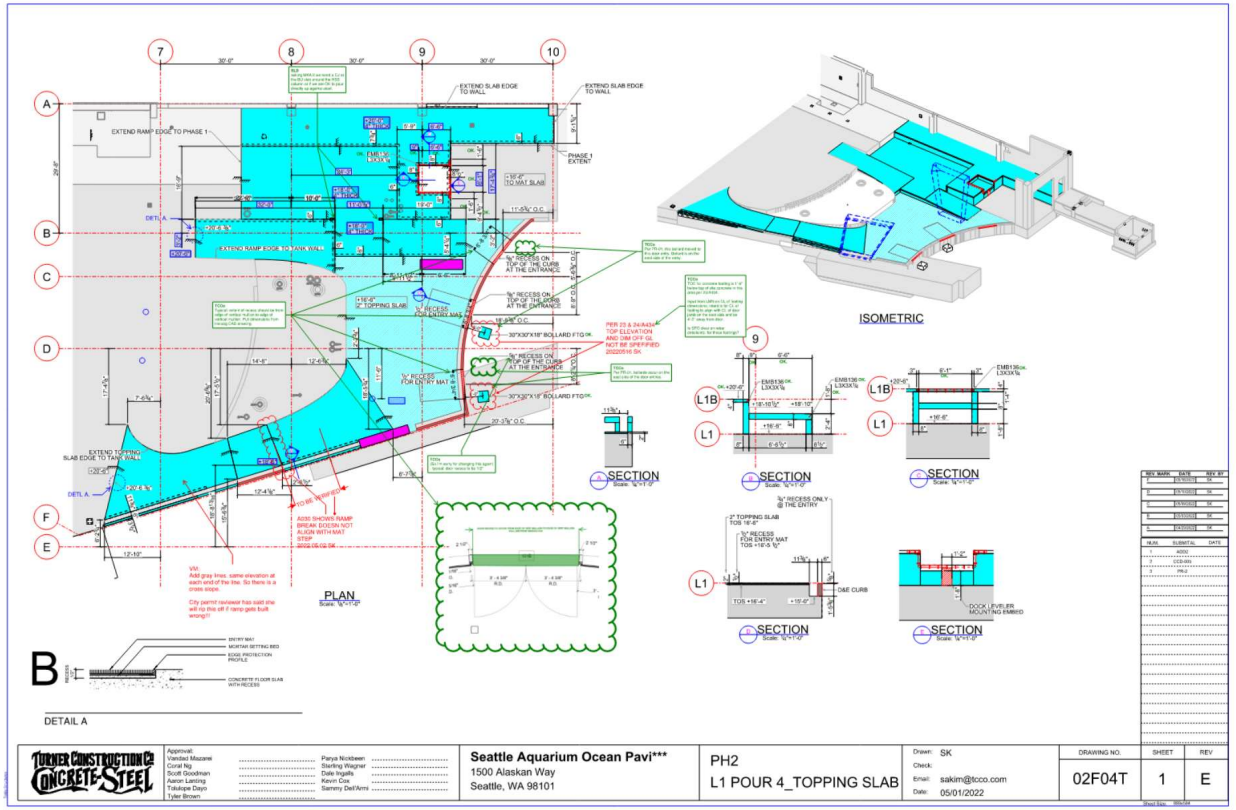
FORMWORK PREFABRICATION



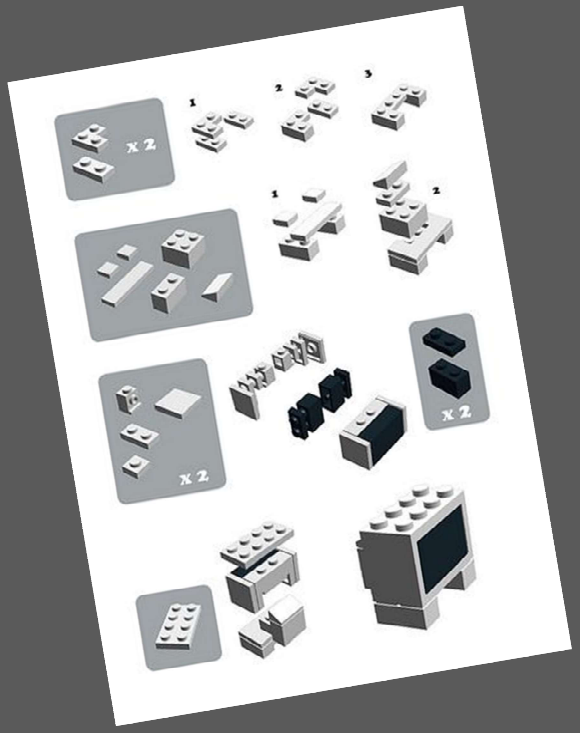
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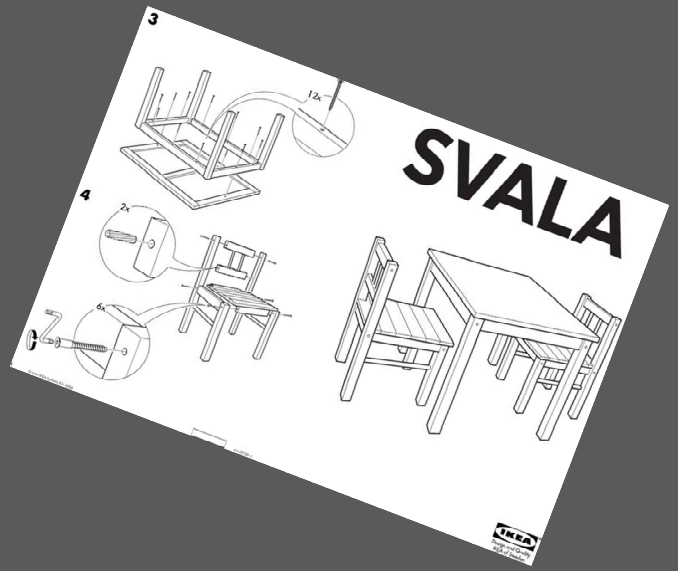
LIFT DRAWINGS

- De-Siloing
- Improved communication
- Everybody owns the data

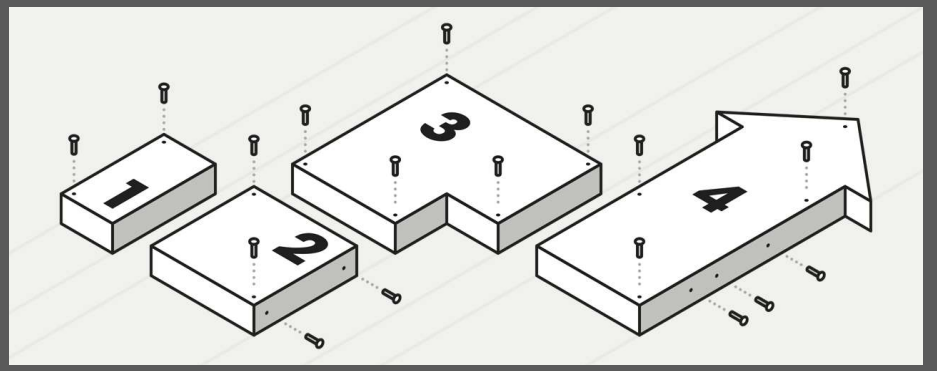


LEGO AND IKEA INSTRUCTION MANUAL



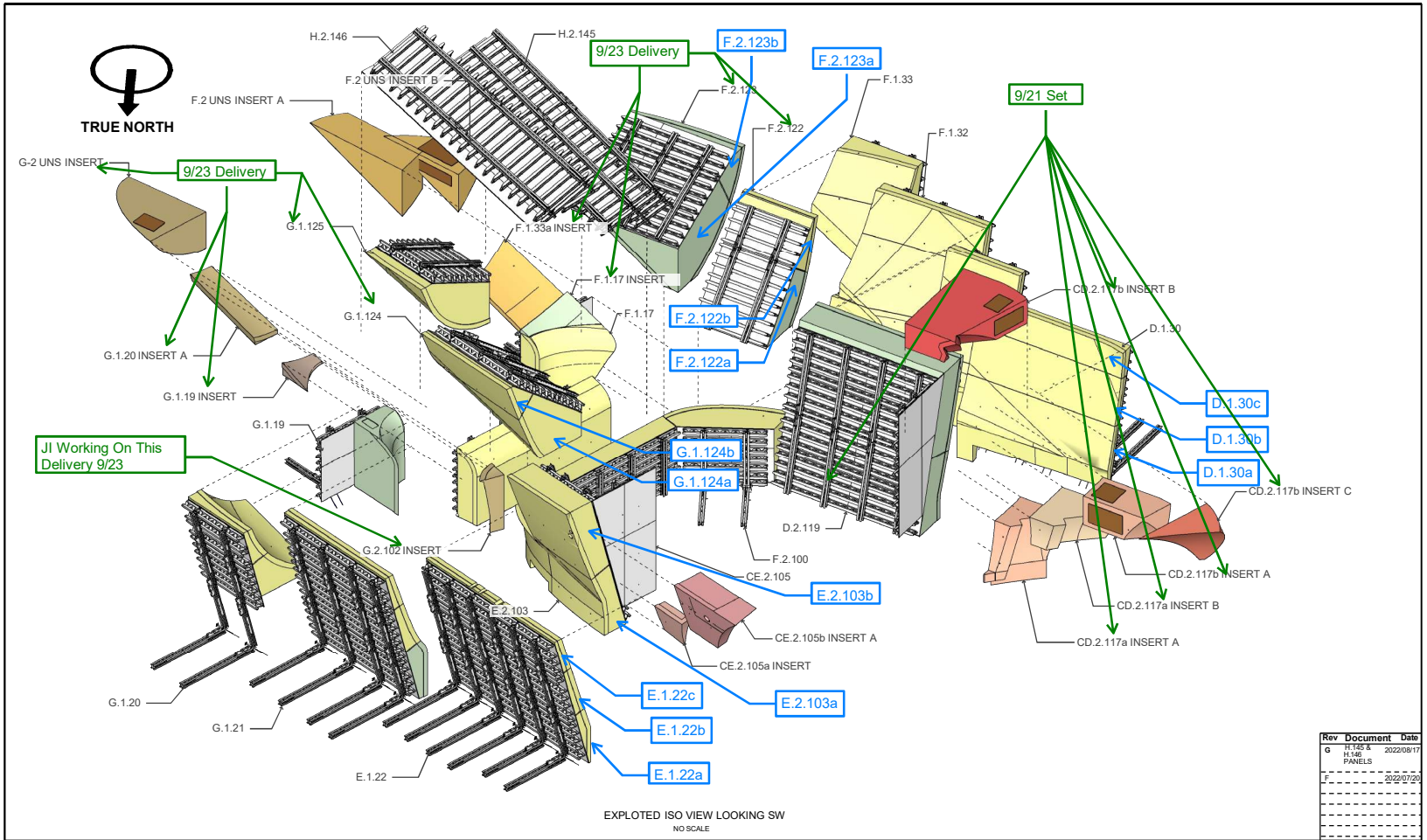


“LESS IS MORE”
MIES VAN DER ROHE



Turner

PANEL INSTALL



EXPLOTED ISO VIEW LOOKING SW
NO SCALE

Rev	Document	Date
G	H.145 & H.146 PANELS	2022/08/17
F		2022/07/20

Turner Construction Co. Concrete-Steel

Approval:
SPO Superintendent
SPO Foreman
SPO Engineer
Proj.
Misc Steel
Exterior
Other
Other
Other

SAOP
1483 Alaskan Way, Pier 59
Seattle, WA 98101

FORMWORK ZONE D-H

Drawn: SM
Phone:
email: smarticorena@tcco.com
Date: August 17, 2022

SHEET	REV
	G

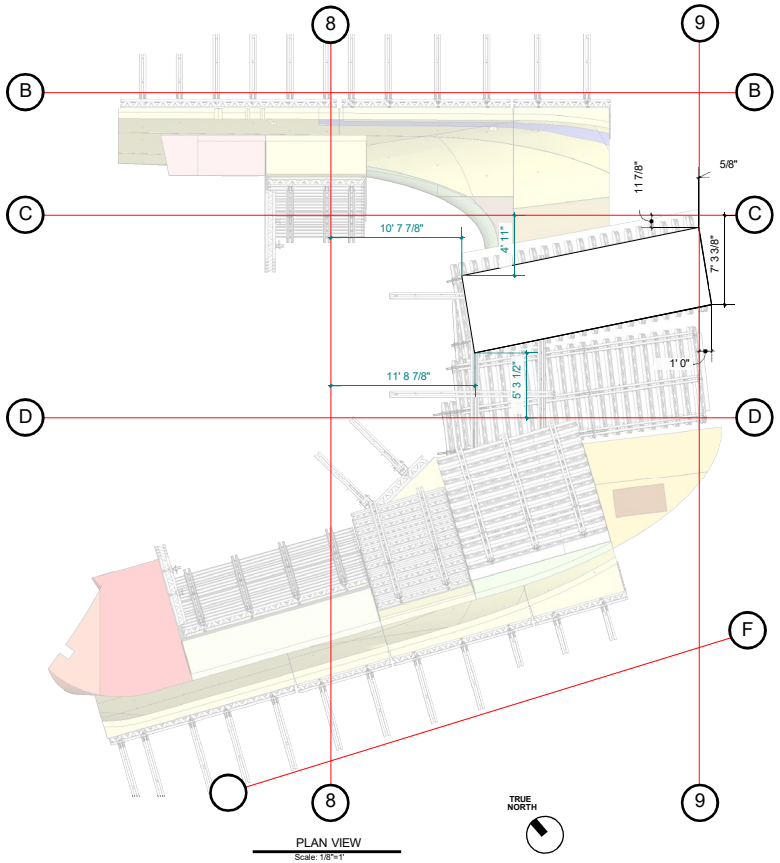
Turner

PANEL INSTALL

25 H.2.146 (6'-4 3/4" x 21'-8")

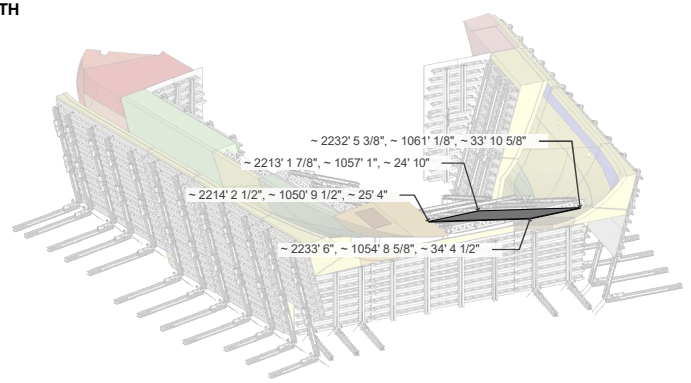
*ALL DIMENSIONS TO EXTERIOR FACE OF PLYWOOD
*TEAL DIMENSIONS TO PLYWOOD BOTTOM

*ALL ELEVATIONS TO TOP AND BOTTOM OF FOAM UNLESS OTHERWISE SPECIFIED

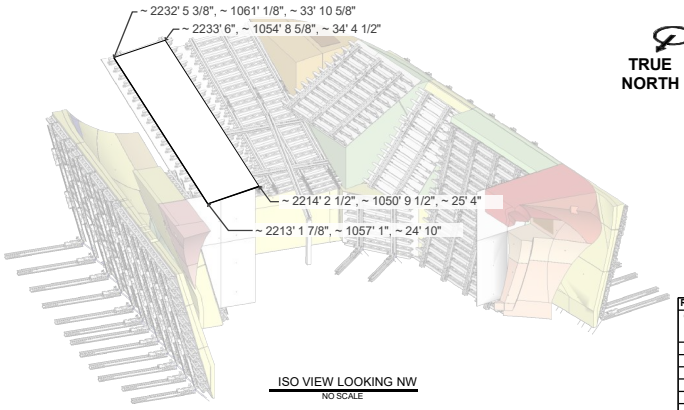


PLAN VIEW
Scale: 1/8"=1'

TRUE NORTH



ISO VIEW LOOKING SE
NO SCALE



TRUE NORTH

ISO VIEW LOOKING NW
NO SCALE

Rev	Document	Date
G	H.145 & H.146 PANELS	2022/08/17
F		2022/07/20

Turner Construction Co Concrete-Steel

Approval:
SPO Superintendent
SPO Foreman
SPO Engineer
Proj.
Misc Steel
Exterior
Other
Other
Other

SAOP
1483 Alaskan Way, Pier 59
Seattle, WA 98101

FORMWORK ZONE D-H

Drawn: SM
Phone:
email: smarticorena@tcco.com

Date: August 17, 2022

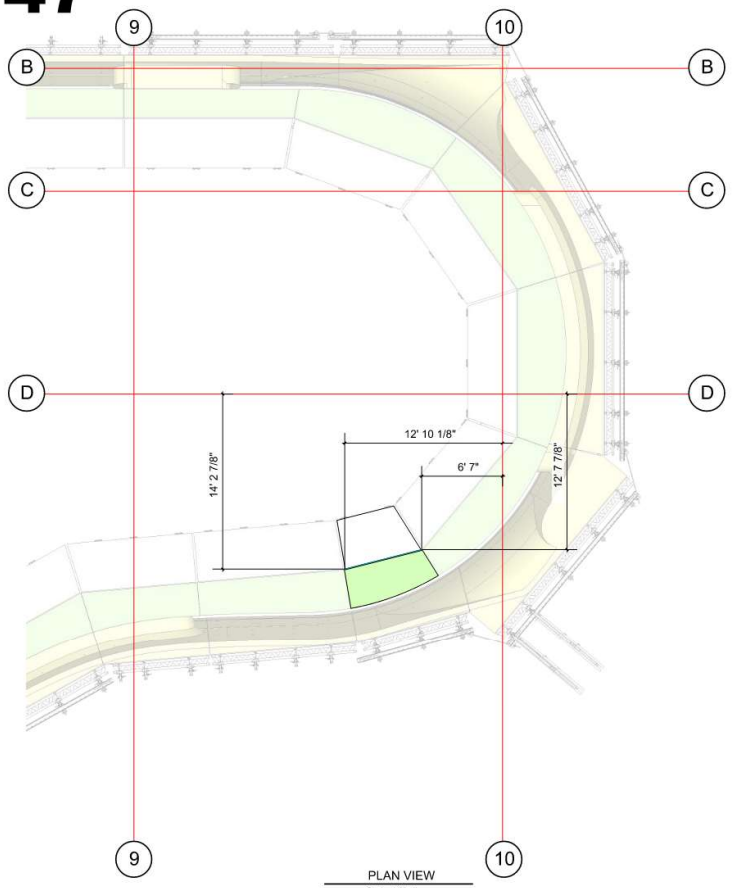
REV G

Turner

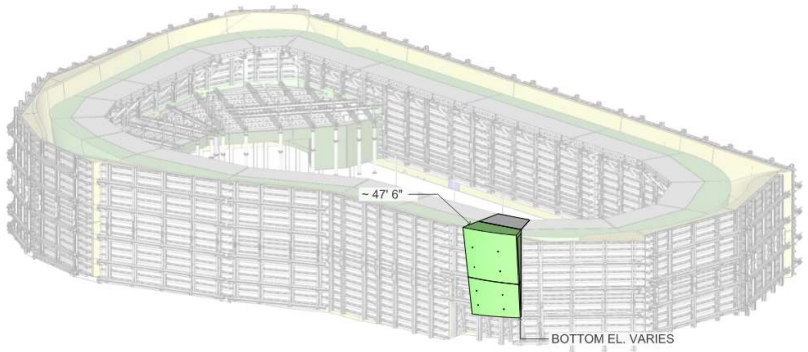
PANEL INSTALL

47 M.2.143

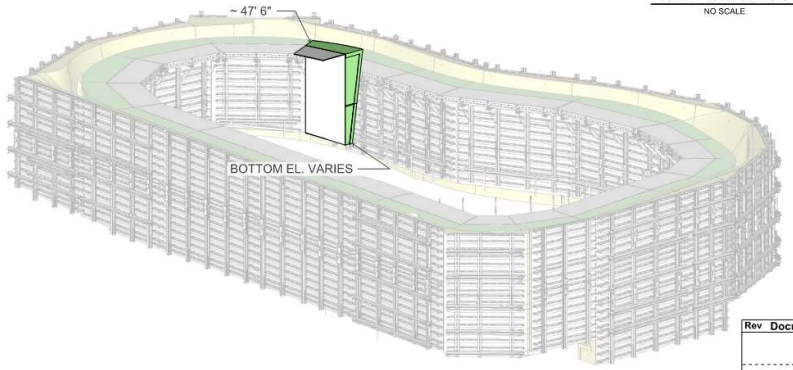
*ALL ELEVATIONS TO TOP AND BOTTOM OF FOAM UNLESS OTHERWISE SPECIFIED
*ALL DIMENSIONS TO EXTERIOR FACE OF PLYWOOD
*TEAL DIMENSIONS TO PLYWOOD BOTTOM
*EMBED DIMENSIONS TO OUTER FACE OF PLATE



PLAN VIEW
Scale: 1/8"=1'



ISO VIEW LOOKING SE
NO SCALE



ISO VIEW LOOKING NW
NO SCALE

Rev	Document	Date

Turner Construction Co Concrete-Steel

Approval:
SPO Superintendent
SPO Foreman
SPO Engineer
Proj.
Misc Steel
Exterior
Other
Other
Other

SAOP
1483 Alaskan Way, Pier 59
Seattle, WA 98101

FORMWORK ZONE J-M

Drawn: SM
Phone:
email: smarticorena@tcco.com
Date: July 14, 2022

SHEET	REV
47	A

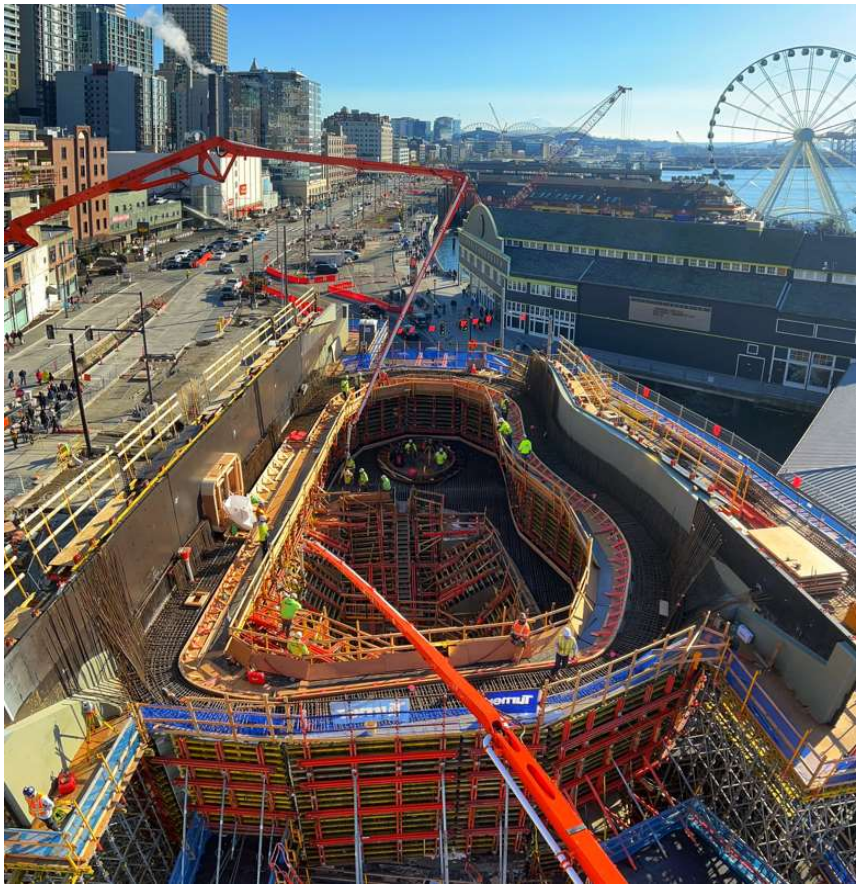
Sheet Size: 11x17

FORMWORK LIFT DRAWINGS IN THE FIELD



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MAIN TANK POUR SEQUENCE

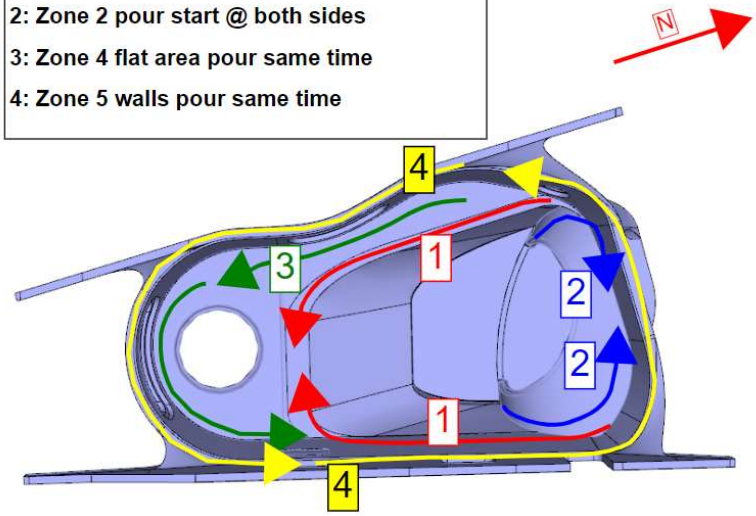


1: Zone 3 pour start @ both sides

2: Zone 2 pour start @ both sides

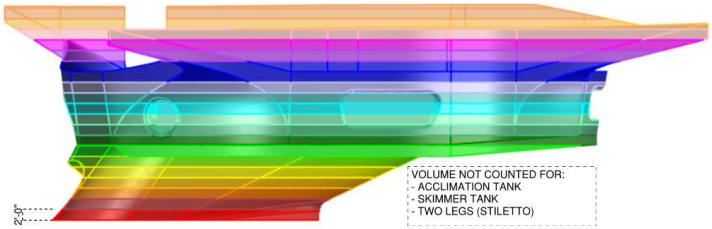
3: Zone 4 flat area pour same time

4: Zone 5 walls pour same time



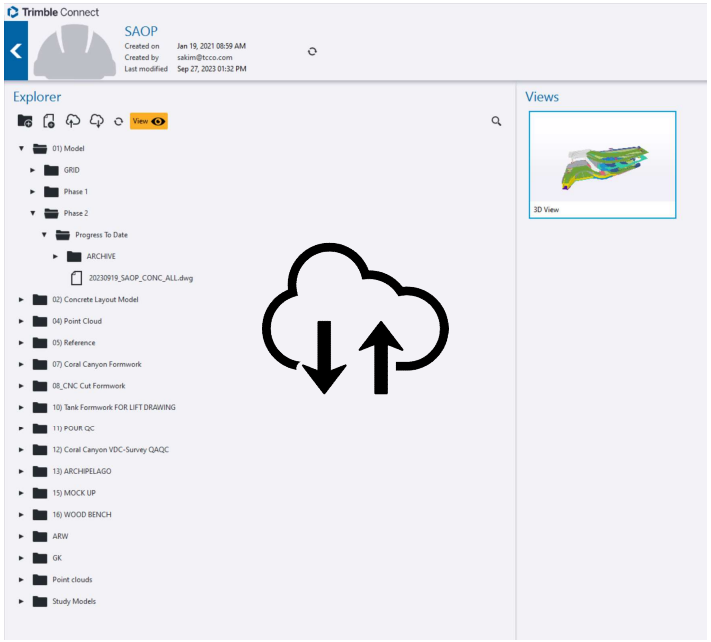
	POUR	CU YD
	19	14.4
	18	15.49
	17	26.15
	16	23.9
	15	22.27
	14	97.88
	13	43.61
	12	35.29
	11	33.55
	10	45.97
	9	56.41
	8	75.67
	7	120.15
	6	36.29
	5	31.89
	4	29.43
	3	27.7
	2	22.96
	1	21.26
	TOTAL	**780.27**

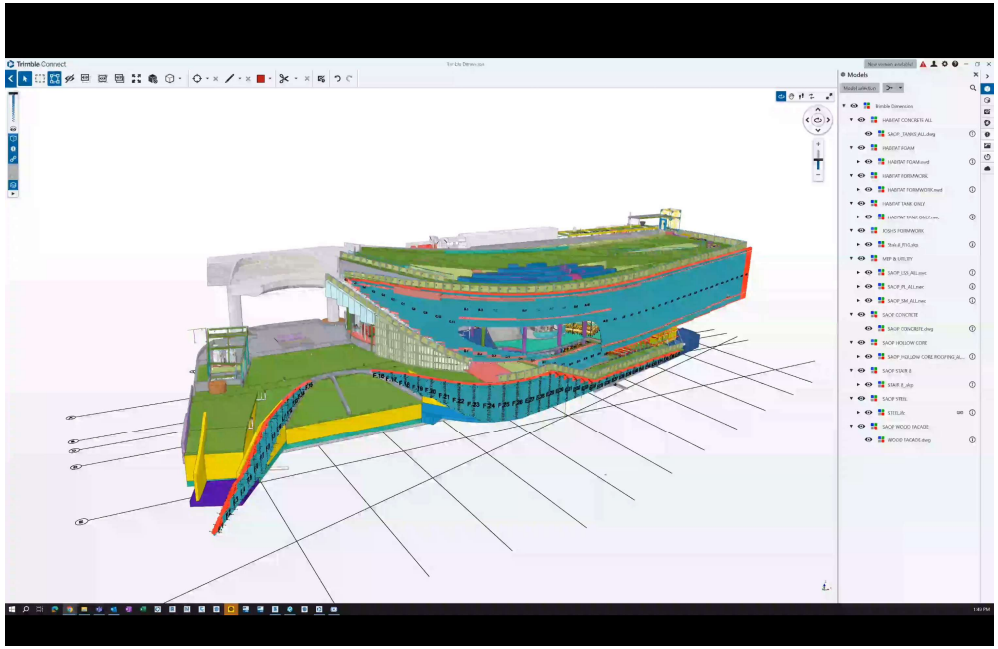
POUR 2'-0" INCREMENT



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TRIMBLE CONNECT – FILE SHARING





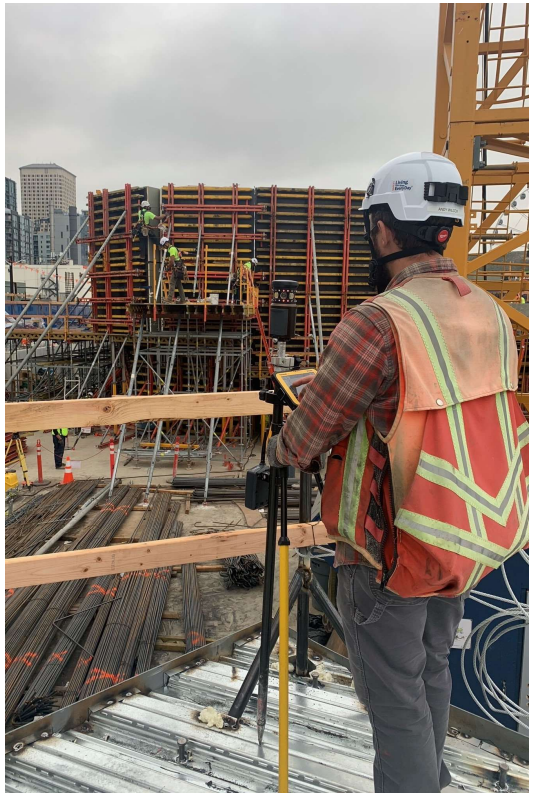
Turner

3D MODEL BASED LAYOUT



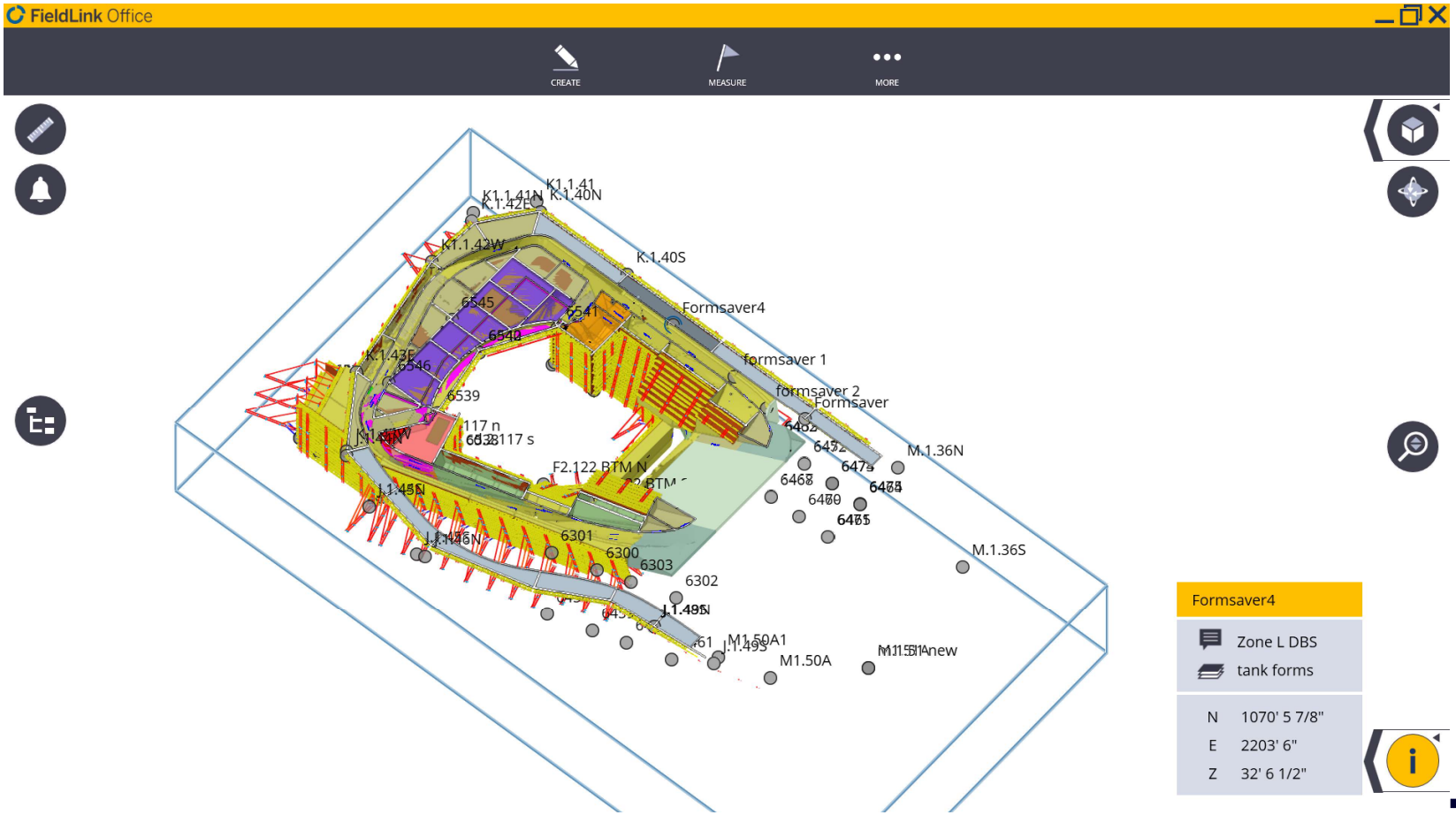




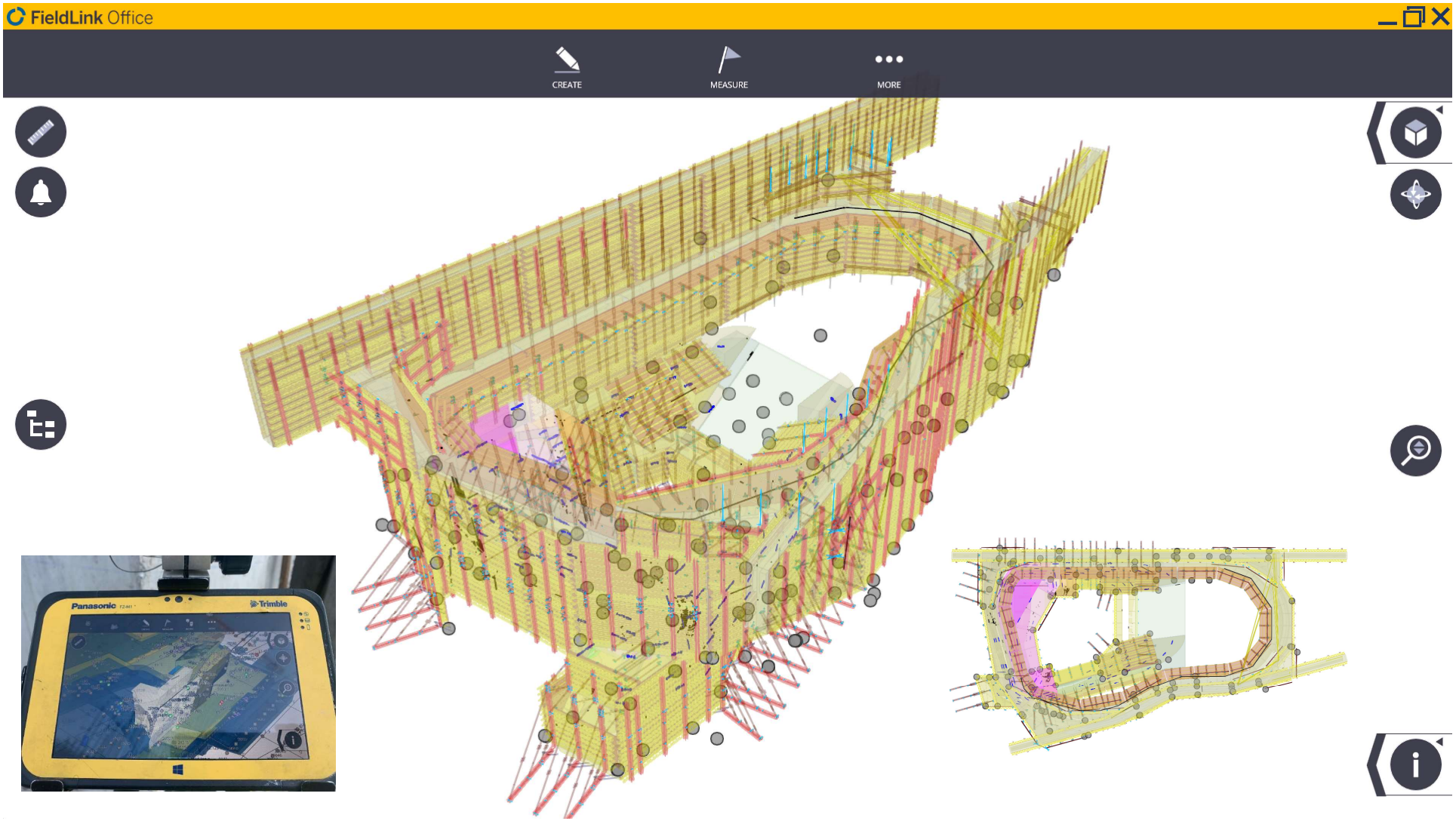


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3D MODEL BASED LAYOUT



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FieldLink Office
CREATE
MEASURE
MORE
Panasonic
Trimble

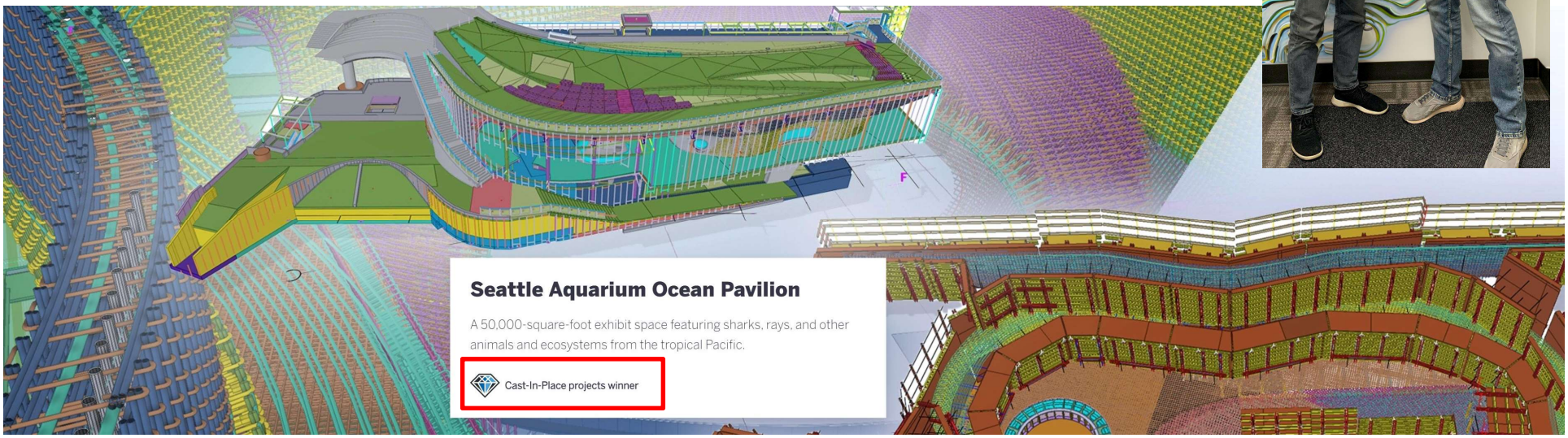
AWARDS AND PRESS











AWARDS AND PRESS

Inside the Construction of Seattle's New Aquarium
Trimble (SketchUp) Highlight on YouTube

https://www.youtube.com/watch?v=gmLQ8Bh4pmM



Inside the Complex Construction of Seattle's New Aquarium

4.1K views • 5 days ago

SketchUp

This time on Built in SketchUp, Aaron visits Turner **Construction** to tour their **Seattle Aquarium** Ocean Pavilion project.

New CC


QUESTIONS ?
sbeatty@tcco.com