The Rise of Modular Construction in the U.S.

Presented by Dean Dovolis

DJR

Dean Dovolis

CEO / OWNER / FOUNDER

Dean worked with Twin Cities and Boston firms before founding DJR Architecture in Minneapolis, MN in 1985. He has a vast range of experience in quickly recognizing significant planning and development opportunities. His expertise in international modular design and construction has proven invaluable to government agencies, developers and clients.

Modular Projects

MOD42

The Alvera

Public Housing Scattered Sites

Stinson Apartments

St. Michael Apartments

Glenwood Avenue Apartments

The Cove – Tuscaloosa, AL

UN World Bank - Africa

Benefits of Modular Construction

- Speed to Market
- Cost Savings
- Consistent Quality
- No Change Orders
- Less Disruption to Neighborhoods
- Healthy Work Environment
- Diverse Workforce

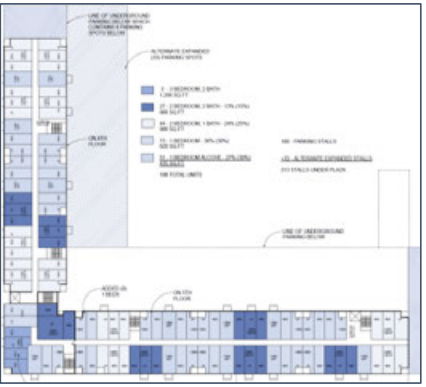
Why Developers & Builders Are Choosing Modular

ASSEMBLY LINE PROCESS IN CONTROLLED ENVIRONMENT			OFFSITE INSPECTIONS & QUALITY CONTROL		LONG-TERM END-USER BENEFITS	
QUALITY	**OVERSIGHT**	**SAFETY**	**CONCURRENT SCHEDULE**	**ENVIRONMENT**	**COST**	**SOUND**
Repeatable tasks and systematic quality ensuring consist ency and quality.	Facility-based 3rd party inspection streamlines the construction process guarantying quality control.	When compared to on-site-built projects, modular builds report 80% lower accident rates on average.[1]	Manufacturing occurs simultaneously in a controlled environment with sitework.	Less than 5% waste compared to 15% in typical construction for a more energy-efficient build.	In the right environment, modular construction can reduce costs by as much as 20%.	Modular built units feature enhanced acoustics due to double floor-ceilings and wall assemblies.

(1) Source: WSP – Modular Construction for Affordable Housing (February 2018)

Speed to Market

- Construction occurs simultaneously with the site work and foundation.
- Can result in up to 30-50% reduction of time in construction schedule.
- In the right environment, modular construction can cut costs by as much as 20%.



Project Is Designed Using Modern Digital Technology

Modular Units are Manufactured Inside Climate Controlled Factory

Modules Are Transported to the Construction Site

Modules Are Stacked and Assembled At The Construction Site

Multi-Family and Hospitality Buildings Are Finished Onsite

Speed to Market

Assumptions

# of Units	200
Gross Square Ft	200,000
Total Development Costs	$39,000,000
Cost/Ft	$195
Cost/Unit	$195,000
Debt	70%
Equity	30%
Rate	5.0%
Term (mths)	360

Stick Construction Period	18 months
Stick Built IRR	20.0%
Rent	$2.25 / SF
Net Margin	65%

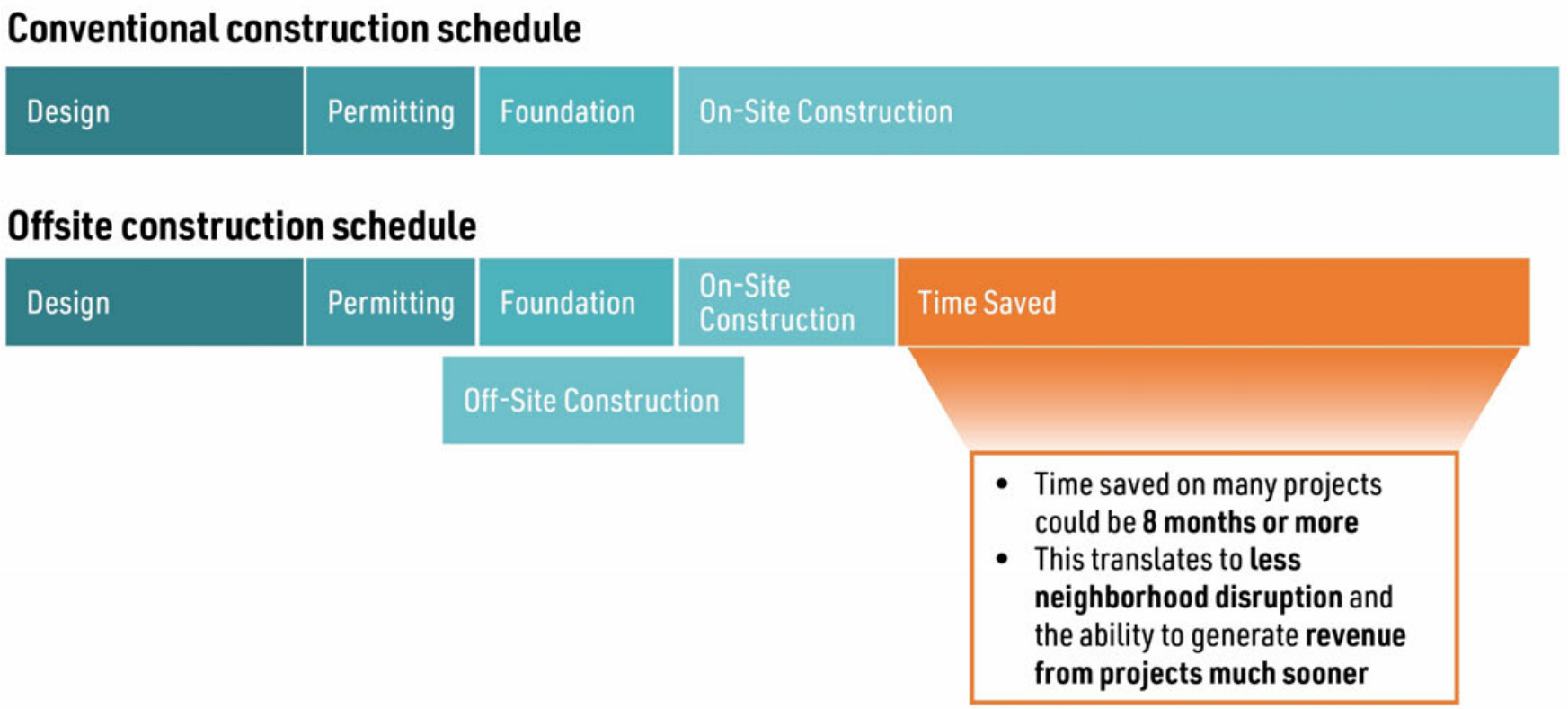
Exit 18 months after C.O.

IRR Impact of Faster Delivery and Cost Savings

Months	Cost Savings 0.0%	2.5%	5.0%	7.5%	10.0%
3	22.2%	24.2%	26.1%	28.0%	29.9%
4	23.0%	25.1%	27.1%	29.1%	31.0%
5	23.9%	26.0%	28.1%	30.2%	32.2%
6	24.9%	27.0%	29.2%	31.3%	33.4%
7	25.9%	28.2%	30.4%	32.6%	34.8%
8	27.0%	29.3%	31.7%	34.0%	36.2%
9	28.2%	30.6%	33.0%	35.4%	37.7%

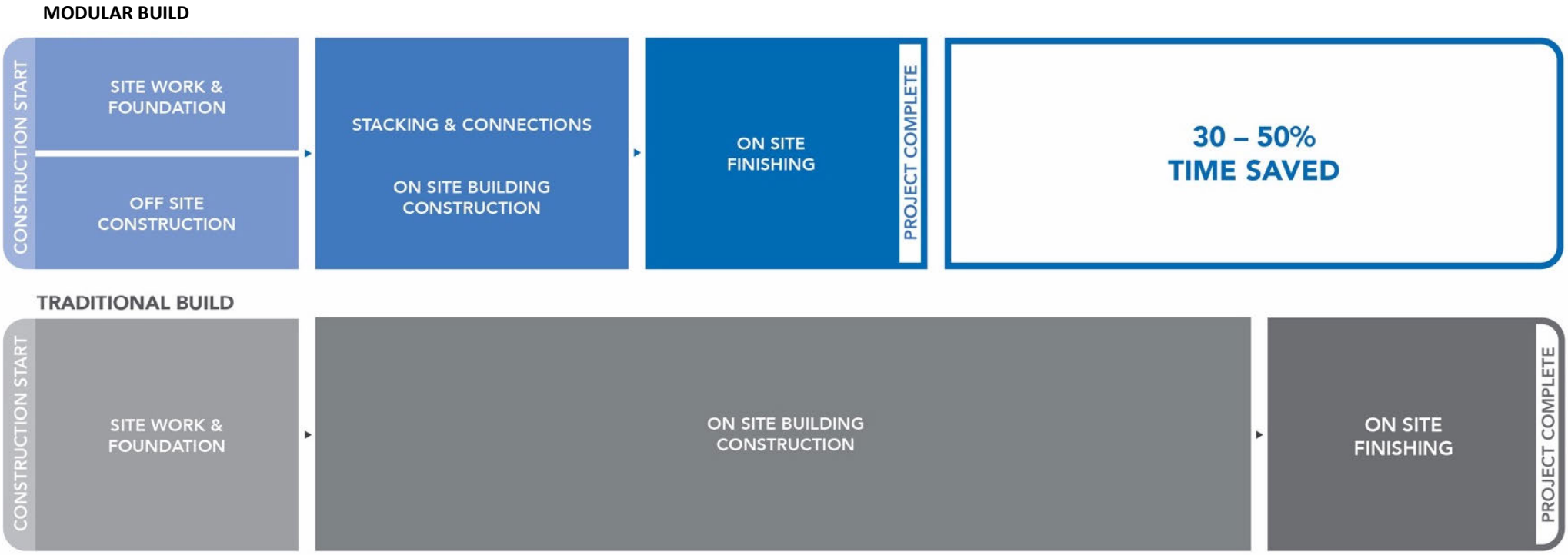
Speed to Market

Estimated Timeline Changes



Schedule Enhanced Solutions

Volumetric Modular Shortens Construction Timelines



Cost Savings

Assumptions

No. Of Units
200

Square Feet
200,000

Incremental Revenue

Time Savings (Months)	Total	Per Unit	Per SF
3	$1,000,350	$5,002	$5.00
4	$1,333,800	$6,669	$6.67
5	$1,667,250	$8,336	$8.34
6	$2,000,700	$10,004	$10.00
7	$2,334,150	$11,671	$11.67
8	$2,667,600	$13,338	$13.34
9	$3,001,050	$15,005	$15.01

Incremental Net Operating Income

Time Savings (Months)	Total	Per Unit	Per SF
3	$650,228	$3,251	$3.25
4	$866,970	$4,335	$4.33
5	$1,083,713	$5,419	$5.42
6	$1,300,455	$6,502	$6.50
7	$1,517,198	$7,586	$7.59
8	$1,733,940	$8,670	$8.67
9	$1,950,683	$9,753	$9.75

Construction Interest Savings

Time Savings (Months)	Total	Per Unit	Per SF
3	$119,665	$598	$0.60
4	$159,100	$796	$0.80
5	$198,695	$993	$0.99
6	$239,330	$1,197	$1.20
7	$279,123	$1,396	$1.40
8	$318,201	$1,591	$1.59
9	$358,996	$1,795	$1.79

Consistent Quality

- Indoor, controlled environment protects people and materials
- Repeat tasks ensures consistency and quality
- Systematic quality monitoring throughout manufacturing process
- Enhances structural integrity which minimizes damage during transportation
- Facility-based inspections streamlines construction process
- Precise manufacturing results in tighter tolerances

Inspections

- Rigorous certification ensures manufacturing to state requirements
- Communication critical for inspectors to research projects
- State inspectors visit manufacturing facility and inspect while being built
- Every project subject to inspection at any time



Inspections

- Stations have a tracking protocol - inspectors see what modules have been produced
- Plumbing and electrical inspections done at the manufacturing facility as well as on the job site
- City inspections occur once modules are delivered and being installed
- Inspectors are learning – where does their jurisdiction start and stop

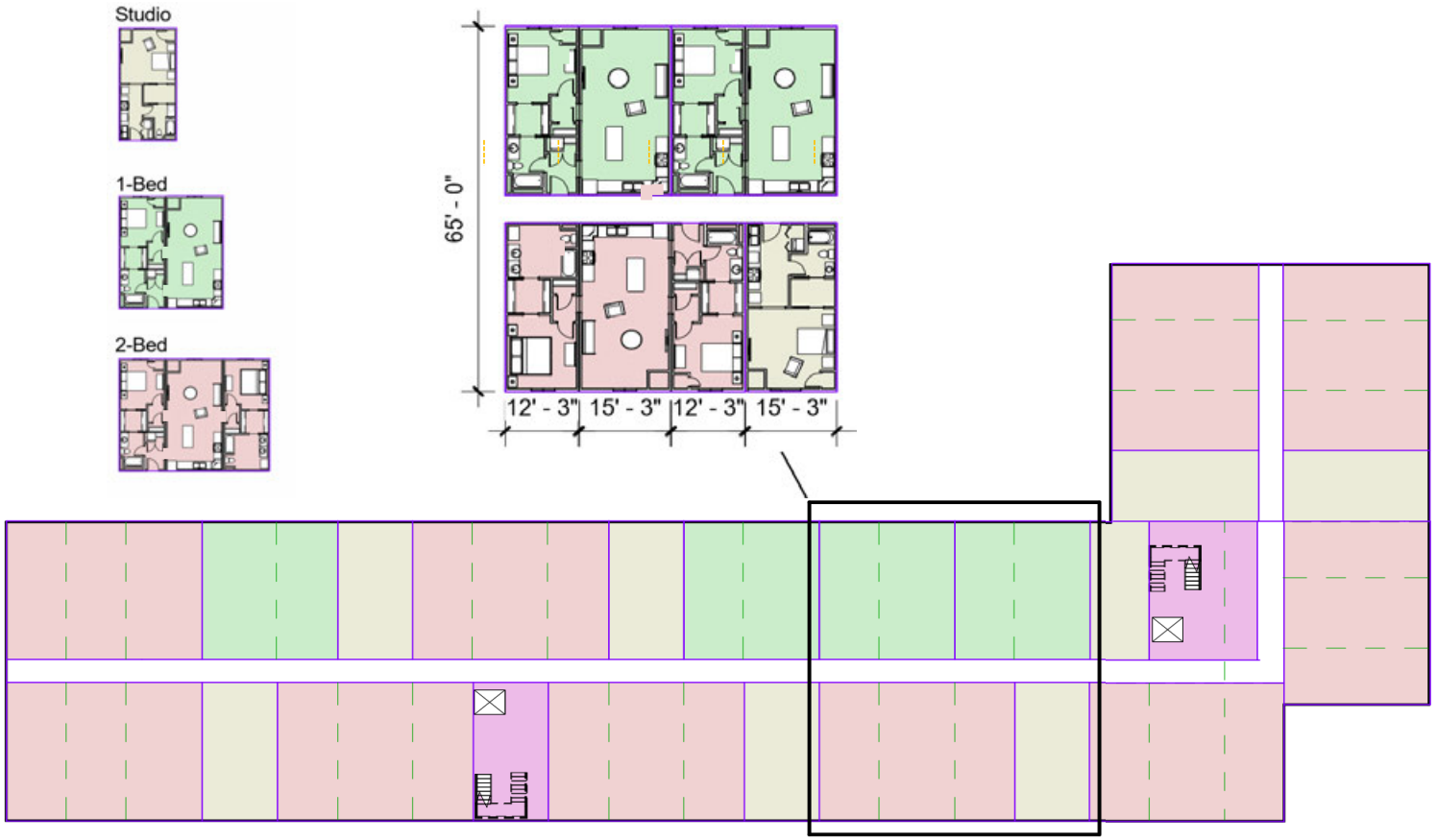
Barriers and Reactions

- Officials realize requirement to understand how to inspect modular
- Local officials cautious of new process
- Difficulty with plan reviewer and specialized on-site inspectors
- Officials see how modular simplifies their risk
- Eventually become a supporter of new technology

Design Considerations For Modular

- Requires Up-Front Considerations
- Supply Chain Can Create Barriers to Construction Timing
- Design Must Be Final Before Any Modular Units are Built
- Onus on Architects / Engineers / Developers to Develop Schedule

Sample Layout

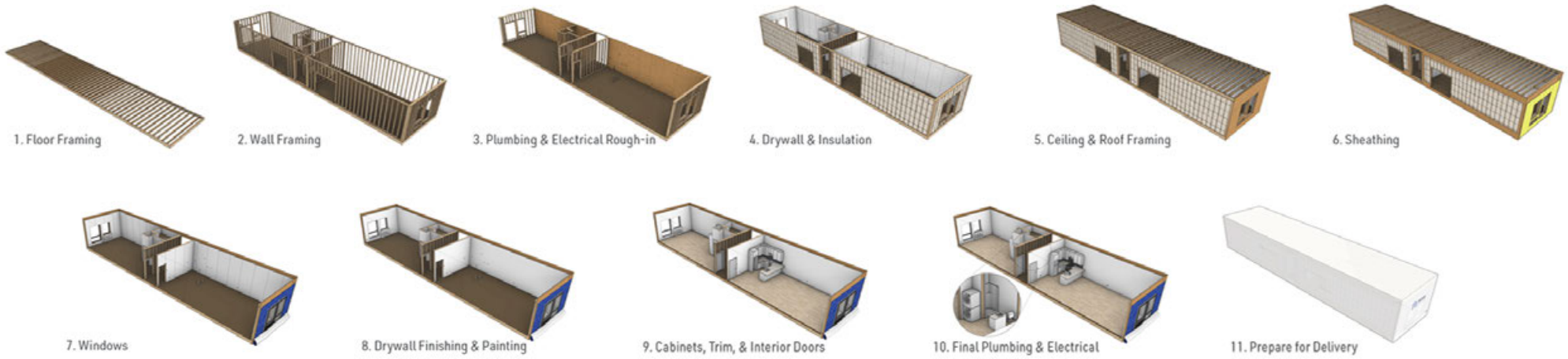


This illustration provides an example of the endless possibilities for design and layout.

Defining room types and organizing them by module size allows incredible flexibility in configuring space requirements that best meet programming intentions.

Design Considerations For Modular

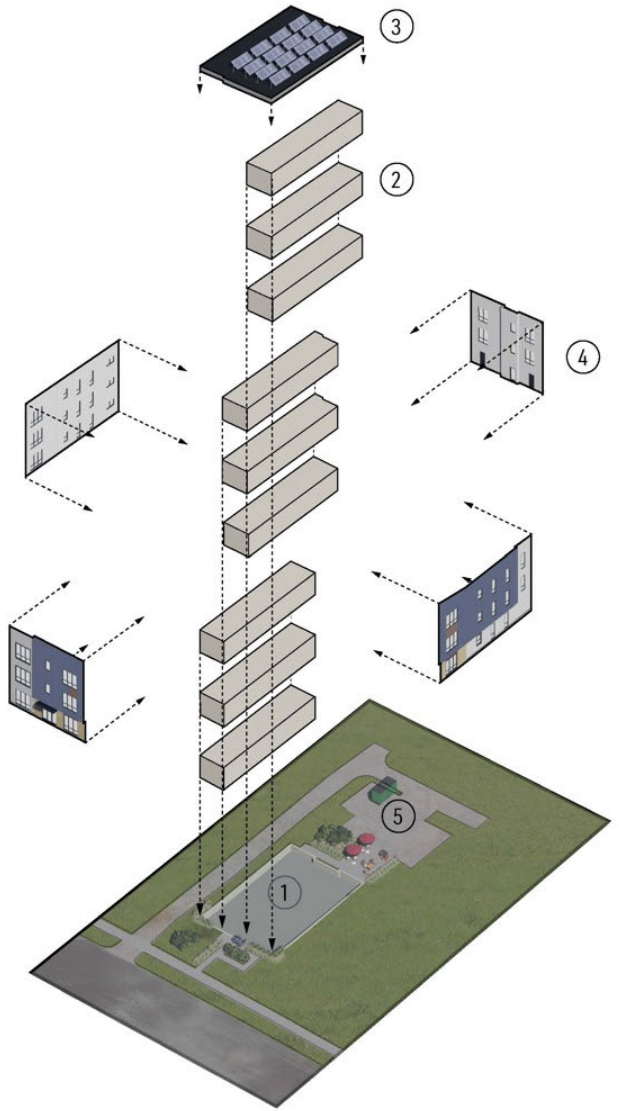
- Modular builder's factory timeline has a large impact on the timing of the project.



Mod Install

Mod Install

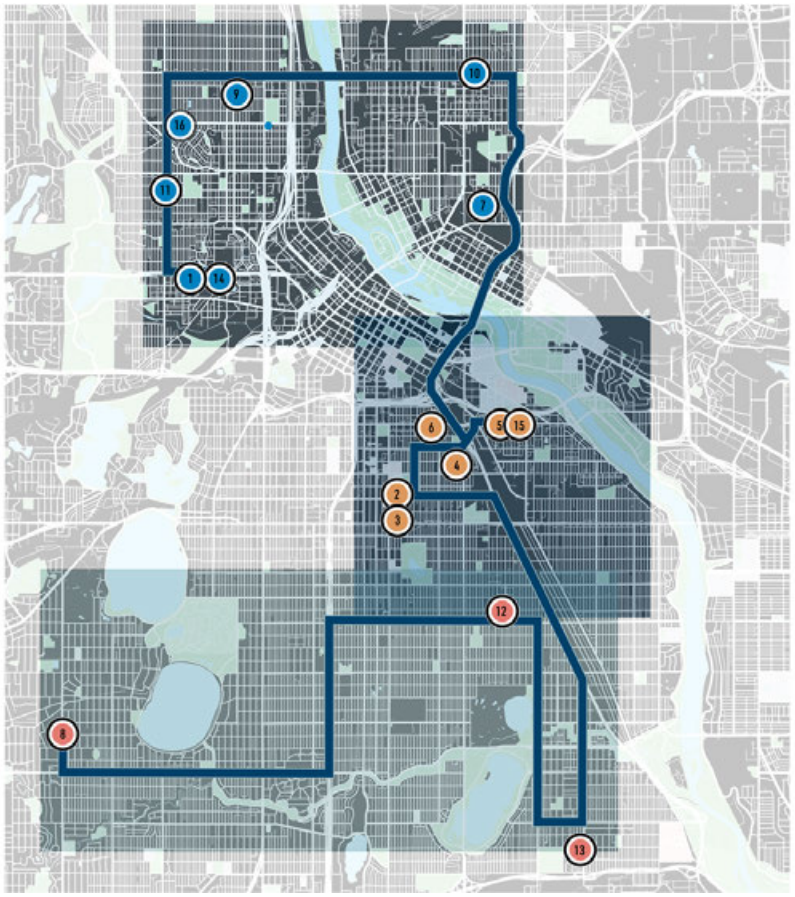
1. Site preparation, utility work
2. Stacking & connecting of mods
3. Roof application
4. Exterior façade materials applied
5. Final site work



Building Process

Minneapolis Public Housing Authority
Scattered Sites

- **TYPE:** Modular Multi-Family (4-Plex & 6-Plex)
- **LOCATION:** Minneapolis, MN
- **PROJECT TYPE:** Affordable
- **CONSTRUCTION DURATION:** 13 months
- **NUMBER OF MODS:** 126
- **NUMBER OF UNITS:** 84 units in 16 buildings
- **PROJECT STATUS:** First building completed September 2023

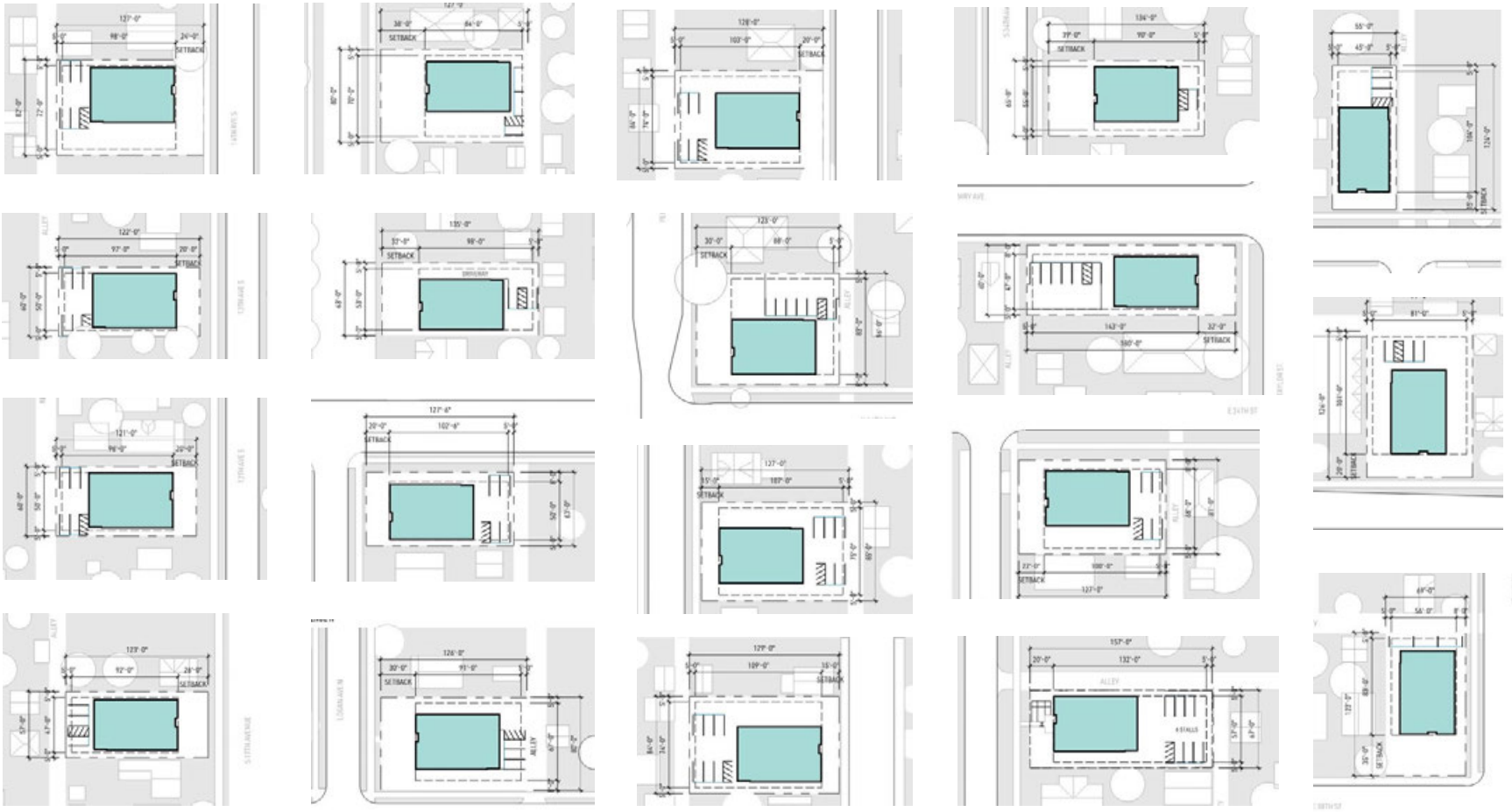


Minneapolis Public Housing Authority
Scattered Sites

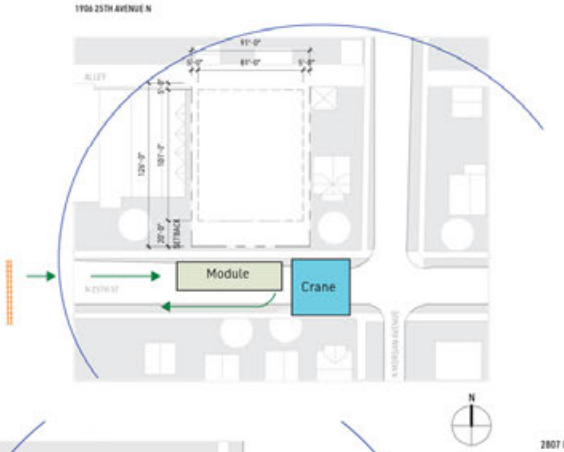
Minneapolis Public Housing Authority
Scattered Sites

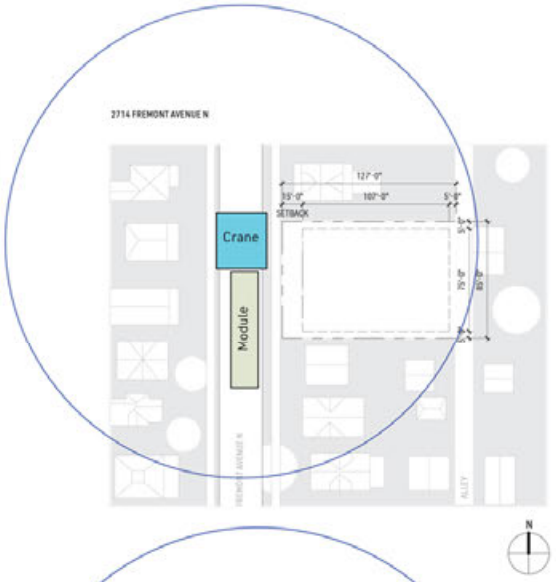
- RFP provided the opportunity to compare traditional and modular construction
- Modular significantly aligned with the scattered-site nature of the project
- Construction timeline was 33% faster than traditional
- Reduces impact on existing residents and neighbors and allows us to house new families sooner
- The modular approach provided a 13-21% cost reduction compared to traditional in a scattered site setting at the time of RFP
- As a long-term owner, the team was excited about the superior construction product modular construction provided
- Dramatically reduces impact to the neighborhood
- Less truck traffic for material delivery
- Fewer workers onsite means less construction worker traffic/parking
- Construction activities move inside much faster

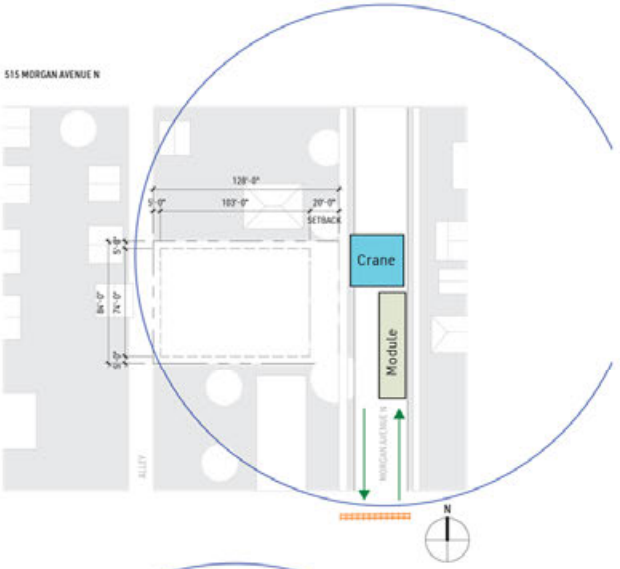
Site Analysis

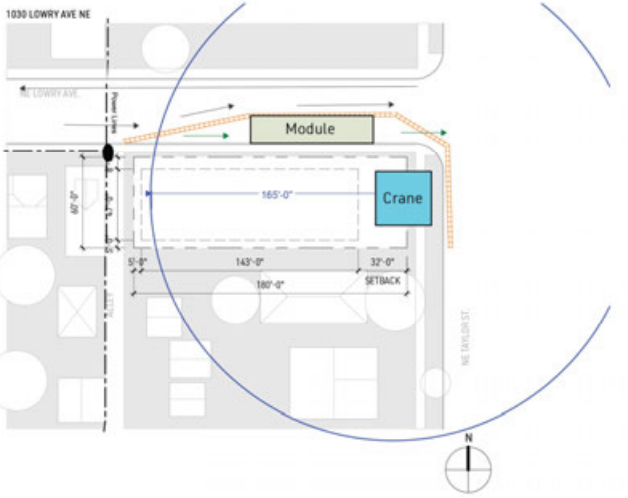


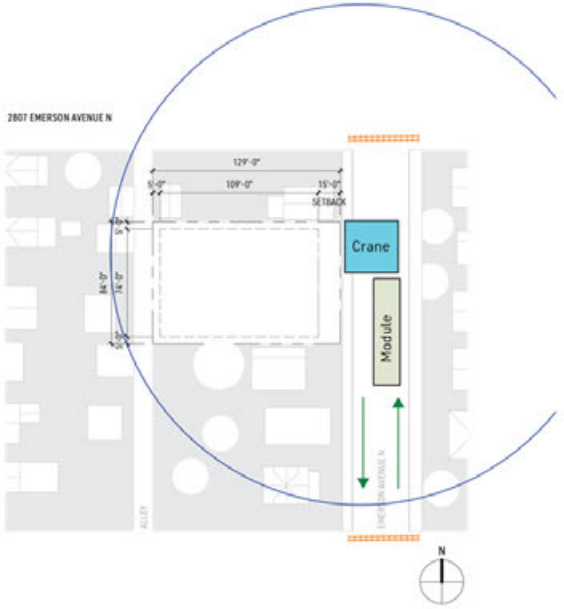
Crane Swing Analysis

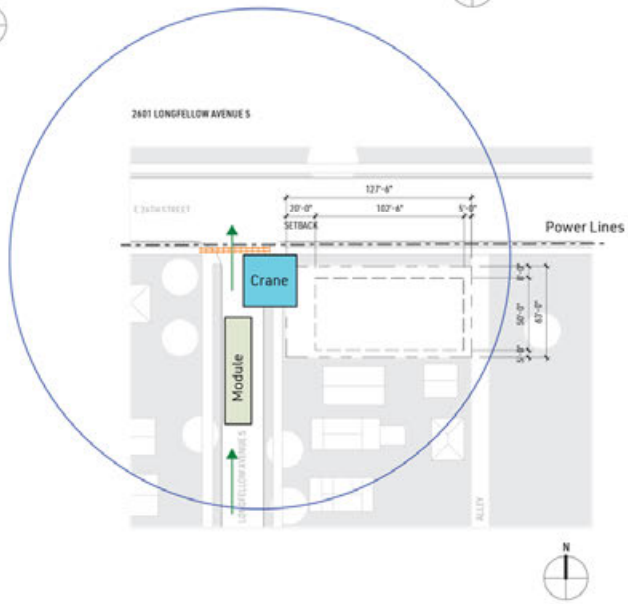












Minneapolis Public Housing Authority
Scattered Sites

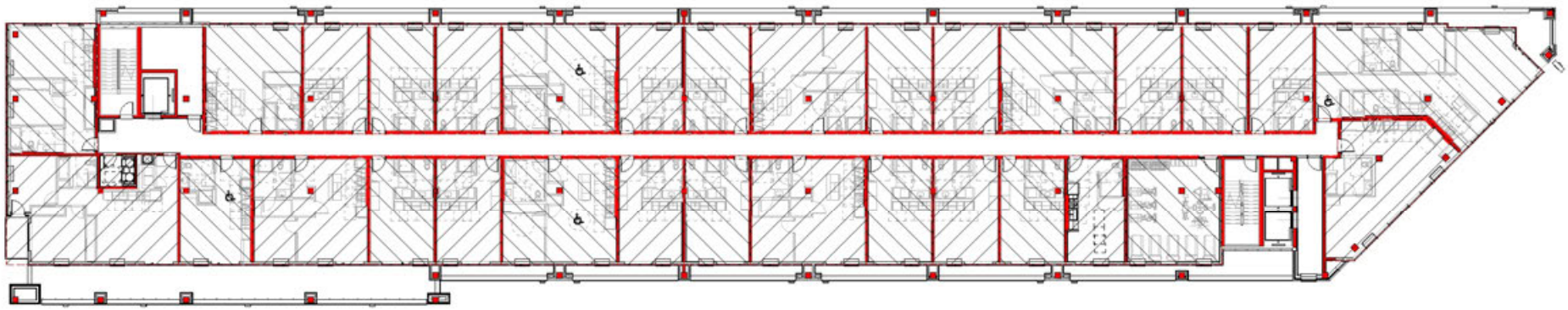
Alvera

- **TYPE:** Modular Multi-Family
- **LOCATION:** St. Paul, MN
- **PROJECT TYPE:** Market-Rate
- **CONSTRUCTION DURATION:** 12 months
- **NUMBER OF MODS:** 155
- **NUMBER OF UNITS:** 192
- **PROJECT STATUS:** Completed 2021

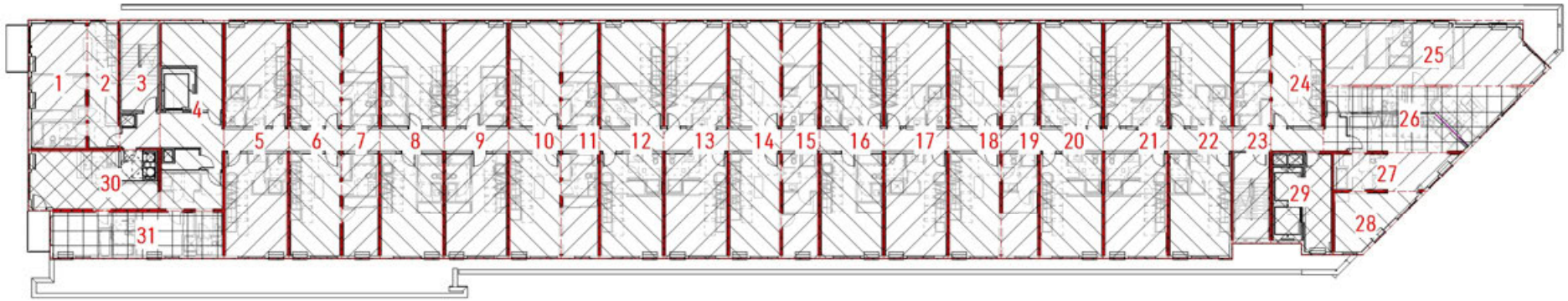

ALVERA
ALVERA

Barriers to On-Site Construction

- Budget – proforma did not work
- Schedule was 18-24 months
- Tight urban site – cranes and scaffolding would have been incredibly challenging
- Logistics – there wasn't an area near the site for staging or material storage
- Quality – onsite would have required shear walls and gypcrete
- Modular offered higher acoustical and insulation ratings



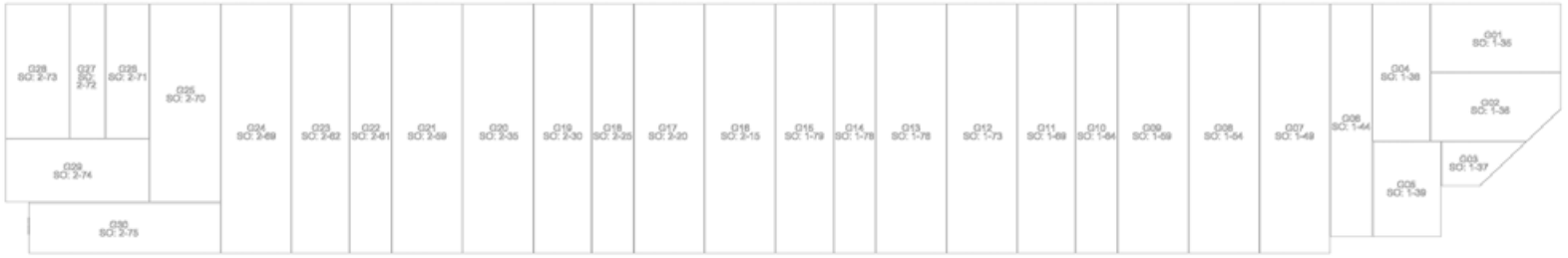
A **STICK FRAME FLOOR PLAN**
1" = 30'-0"



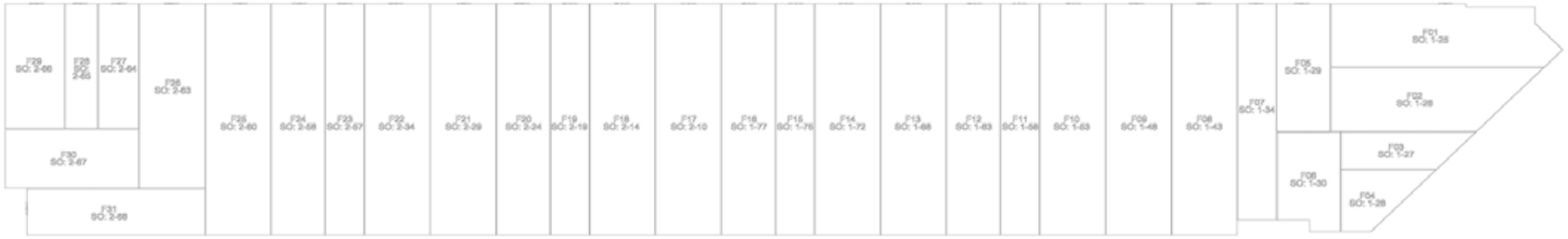
B **MODULAR FLOOR PLAN**
1" = 30'-0"

Alvera

Mod Layout and Setting Sequence



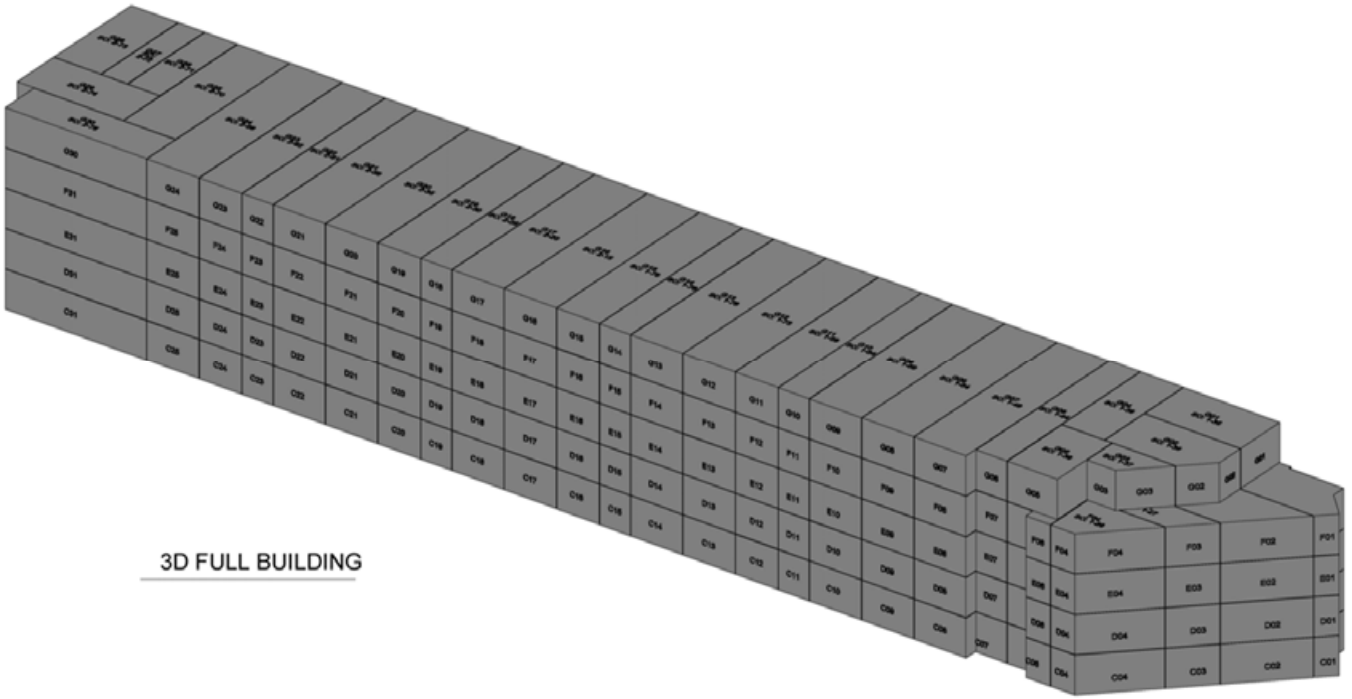
LEVEL 7



LEVELS 3-6

Alvera

Mod layout and setting sequence



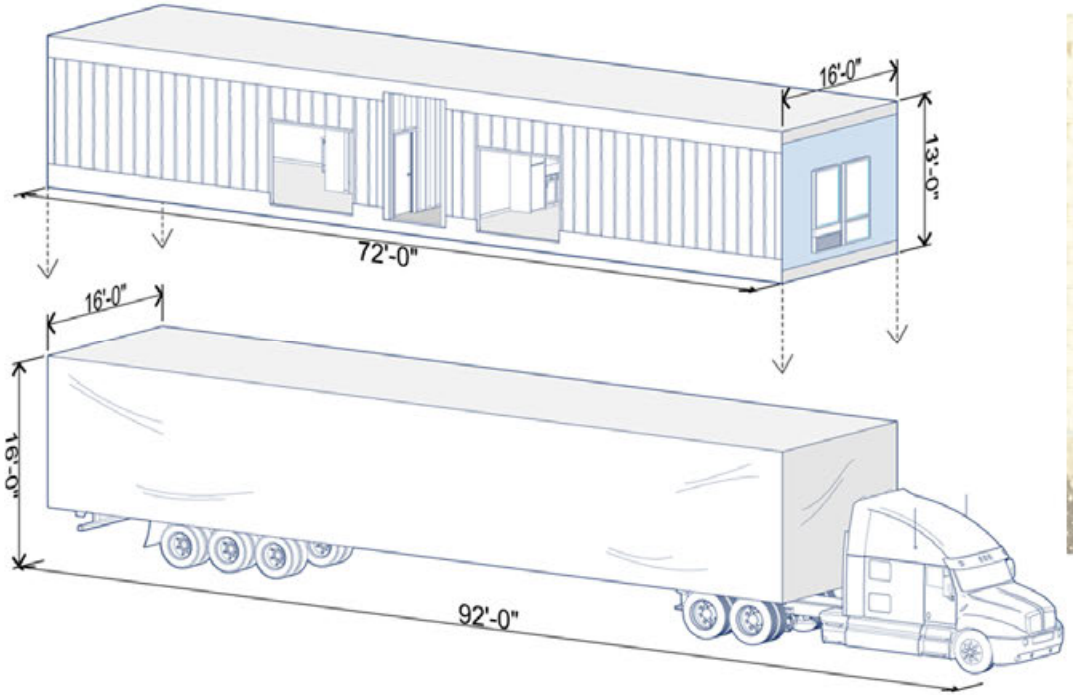
3D FULL BUILDING

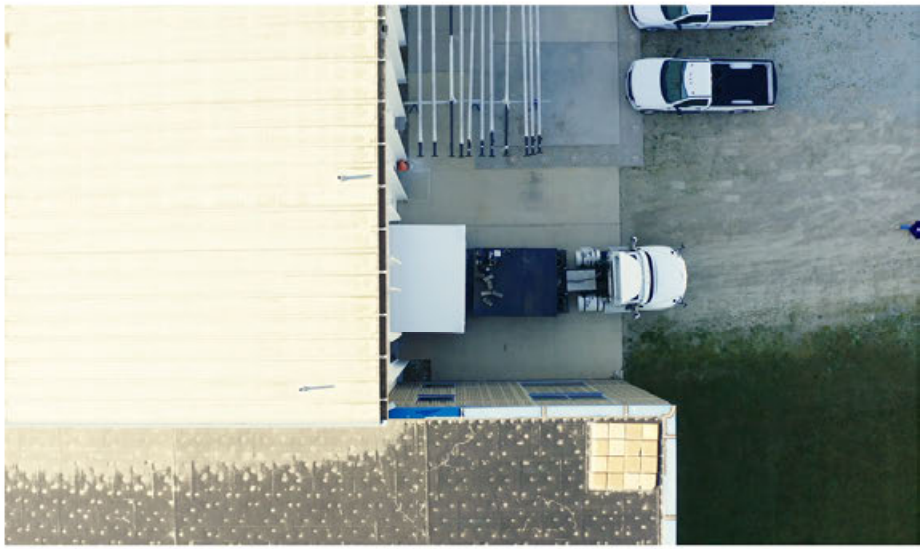
City Collaboration

- Invited city officials to tour modular plant to a quality control and inspections in action
- Also offered a 30, 60, 90-percent drawing review
- Invited inspectors to be onsite to witness the modules being set
- Once local inspectors and officials saw how a modular approach simplifies risk, they became more supportive of the process

Module Transport

Dimensional considerations





The Route – Leaving the Plant

The Route – Leaving the Plant

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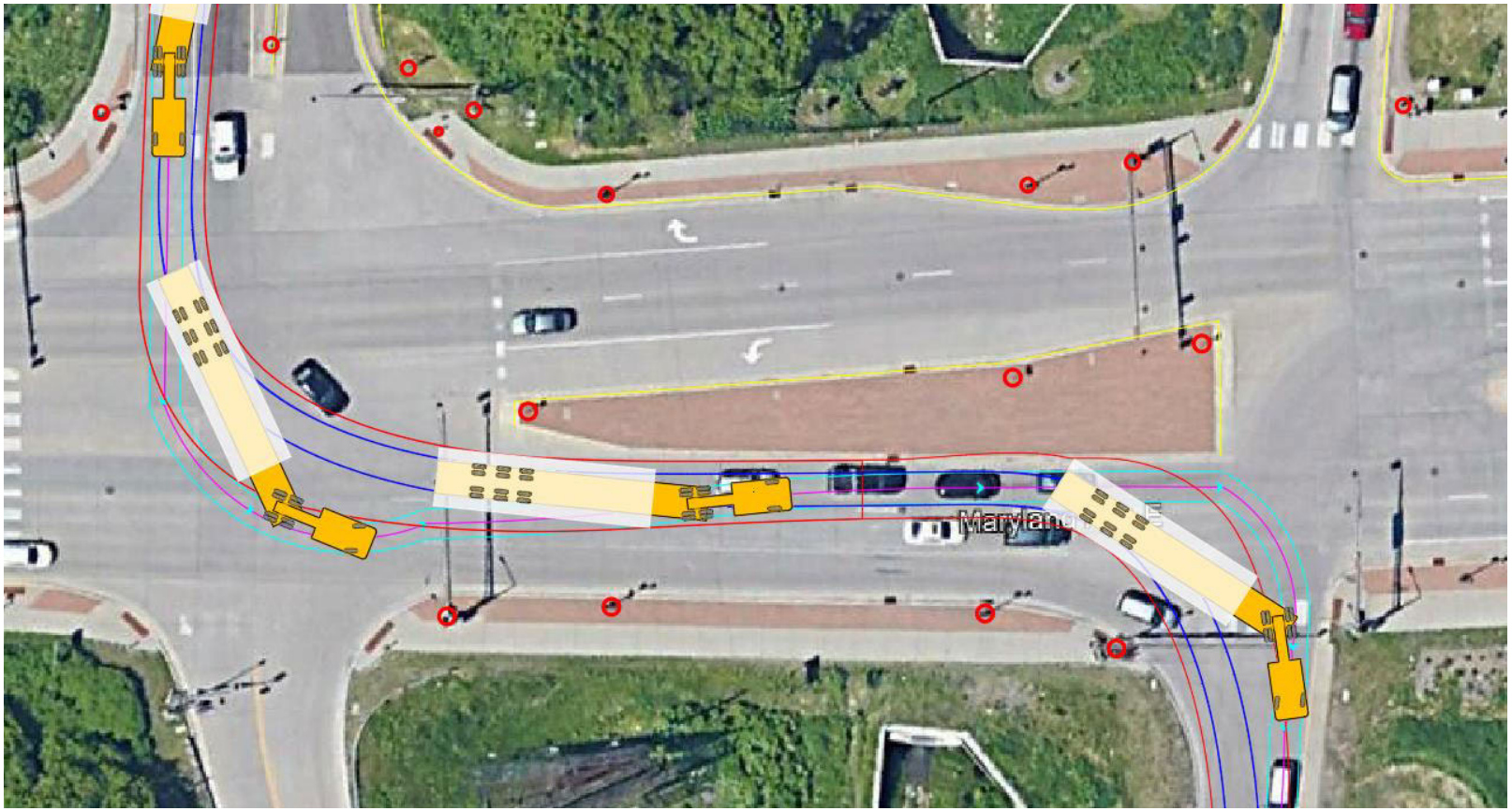
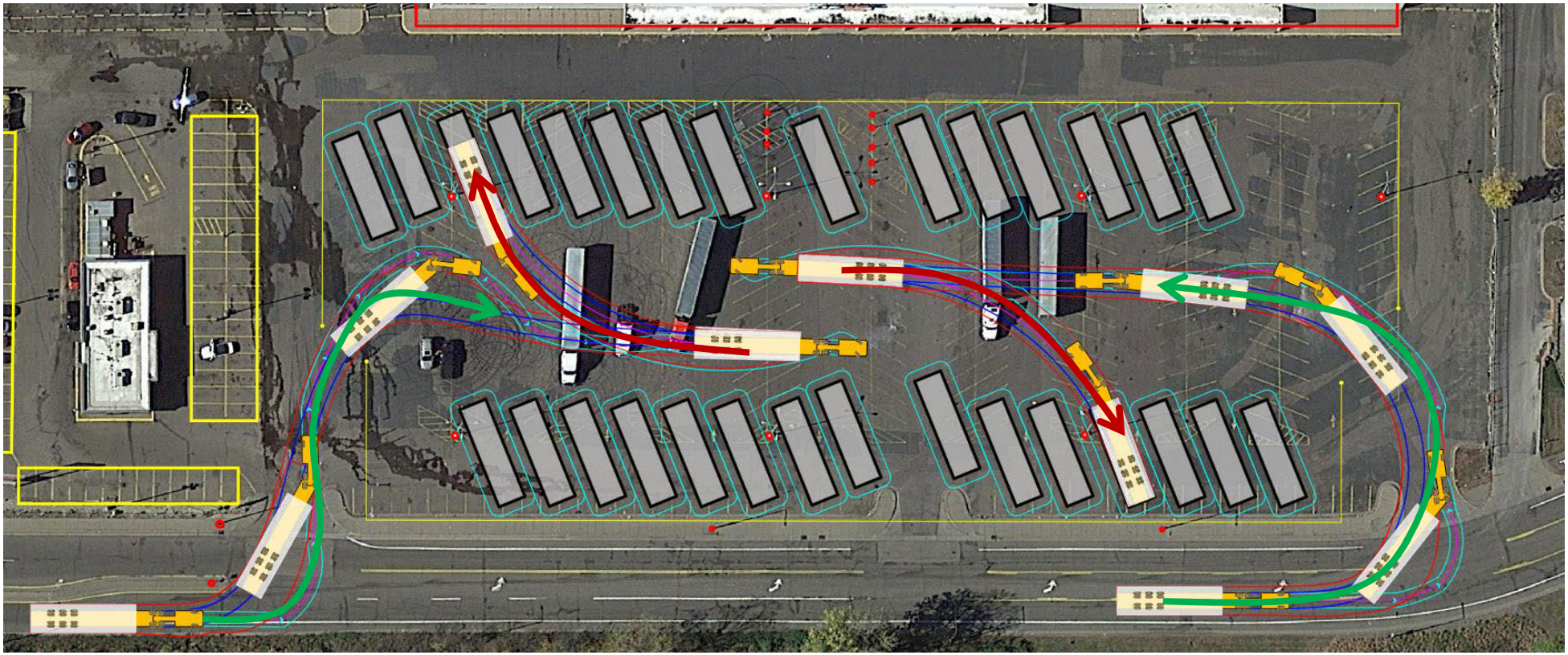
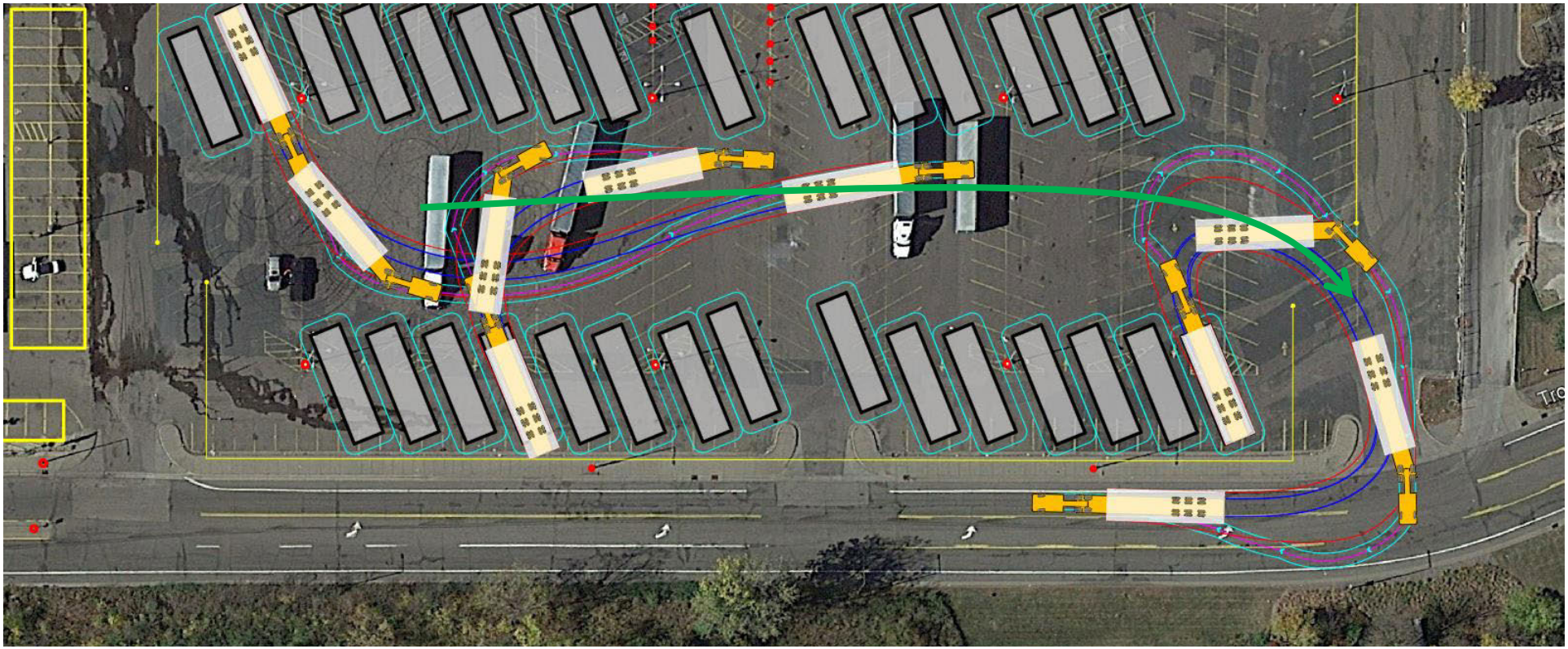


Module Staging - Entering



Module Staging – To Jobsite

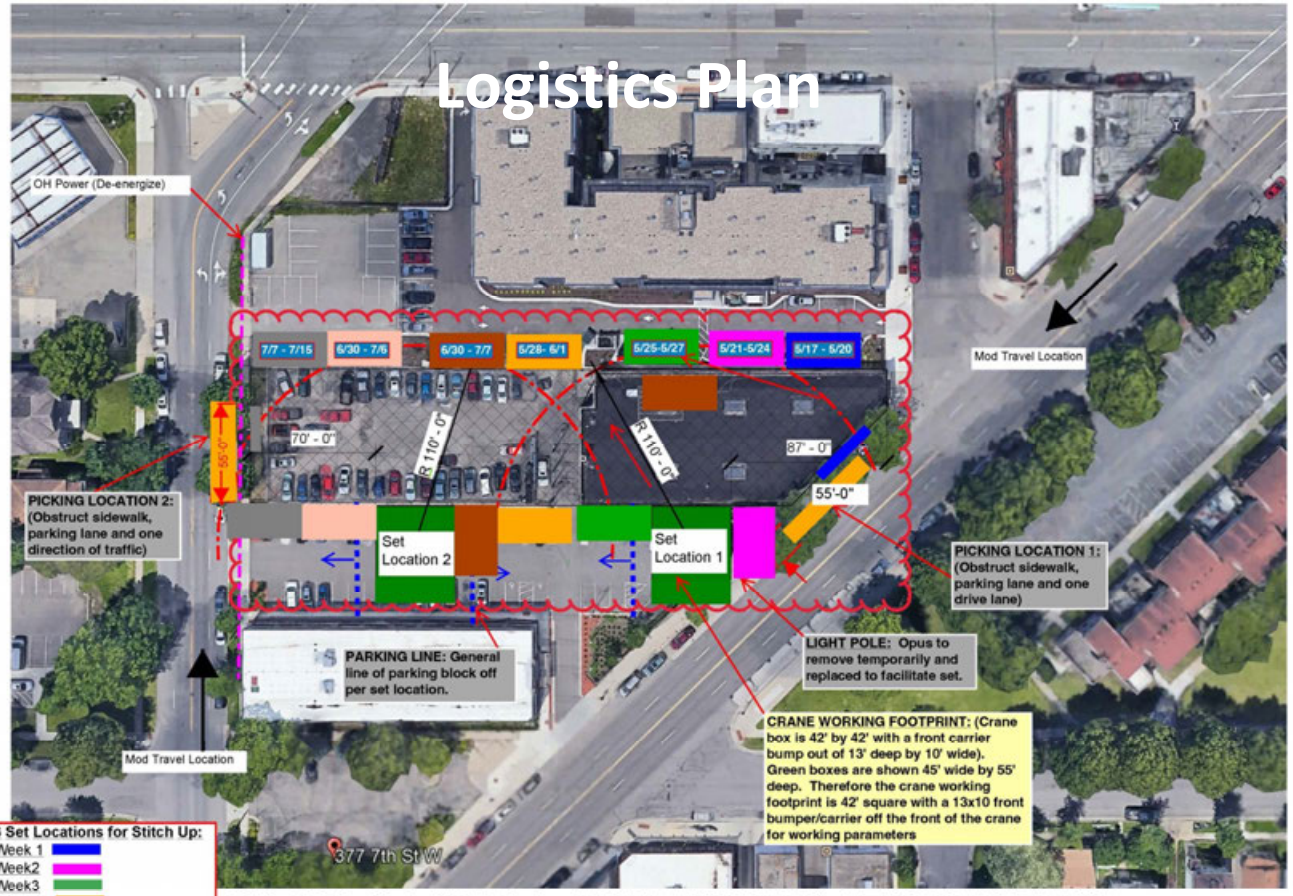


The Route – to Jobsite

EXHIBIT "D"

Two Set Plan Assuming the Following:
Crane set split at approximately building centerline

NOTES:
- 550 Ton Hydro Crane
- 34' face of building to Center Pivot of Crane
- Opus to de-energize Smith Street Power during west half of set
- 2 Sets, East first and West second
- Strip boxes at remote staging area

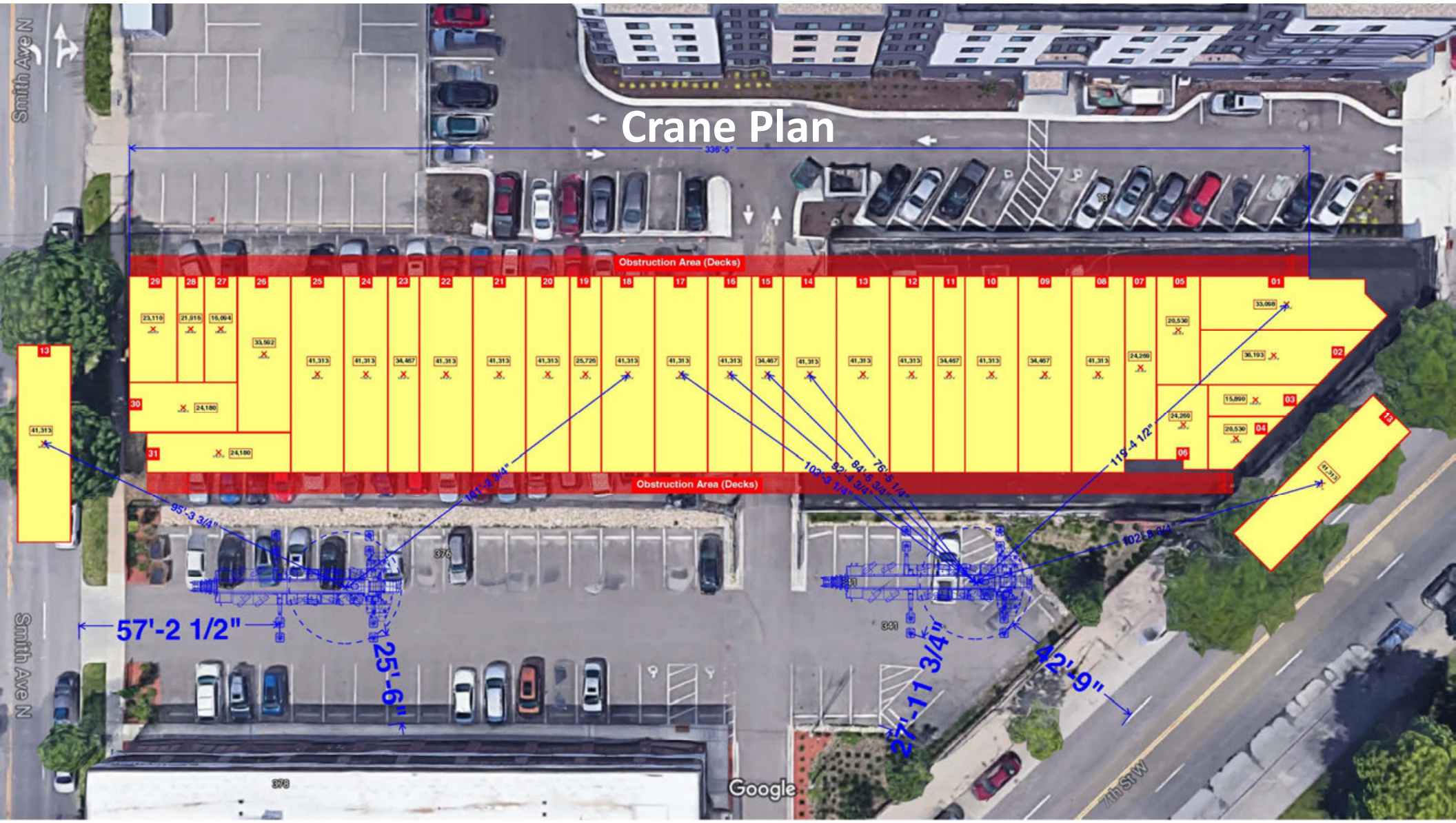


JLG Set Locations for Stitch Up:
- Week 1
- Week2
- Week3
- Week 4
- Week 5
- Week 6
- Week 7

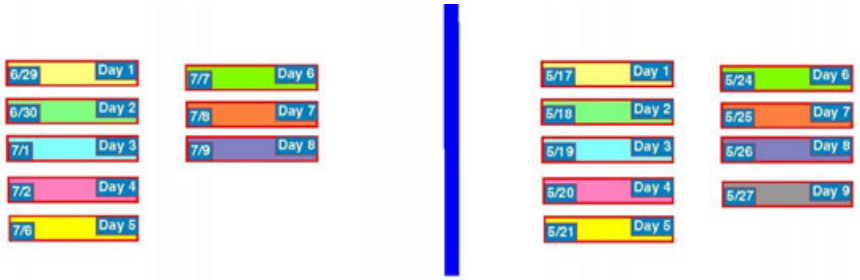
337 TH ST. WEST - PRELIMINARY STAGING PLAN

DENOTES OUTLINE OF INITIALLY ANTICIPATED SPACE REQUIREMENTS DURING THE COURSE OF MODULAR BOX SETTING. The actual area required is contingent on final Opus schedule, adjacent property owner feedback, actual site conditions and equipment availability/capabilities that may require adjustments and or deviations from this plan as necessary.

DrawingsAckerburg.rvt


Crane Plan
336'-5"
Obstruction Area (Decks)
Obstruction Area (Decks)
95'-3 3/4"
141'-2 3/4"
119'-4 1/2"
57'-2 1/2"
25'-6"
27'-11 3/4"
42'-9"
Smith Ave N
Smith Ave N
7th St W
Google

Set Order


6/29 Day 1
6/30 Day 2
7/1 Day 3
7/2 Day 4
7/6 Day 5
7/7 Day 6
7/8 Day 7
7/9 Day 8
5/17 Day 1
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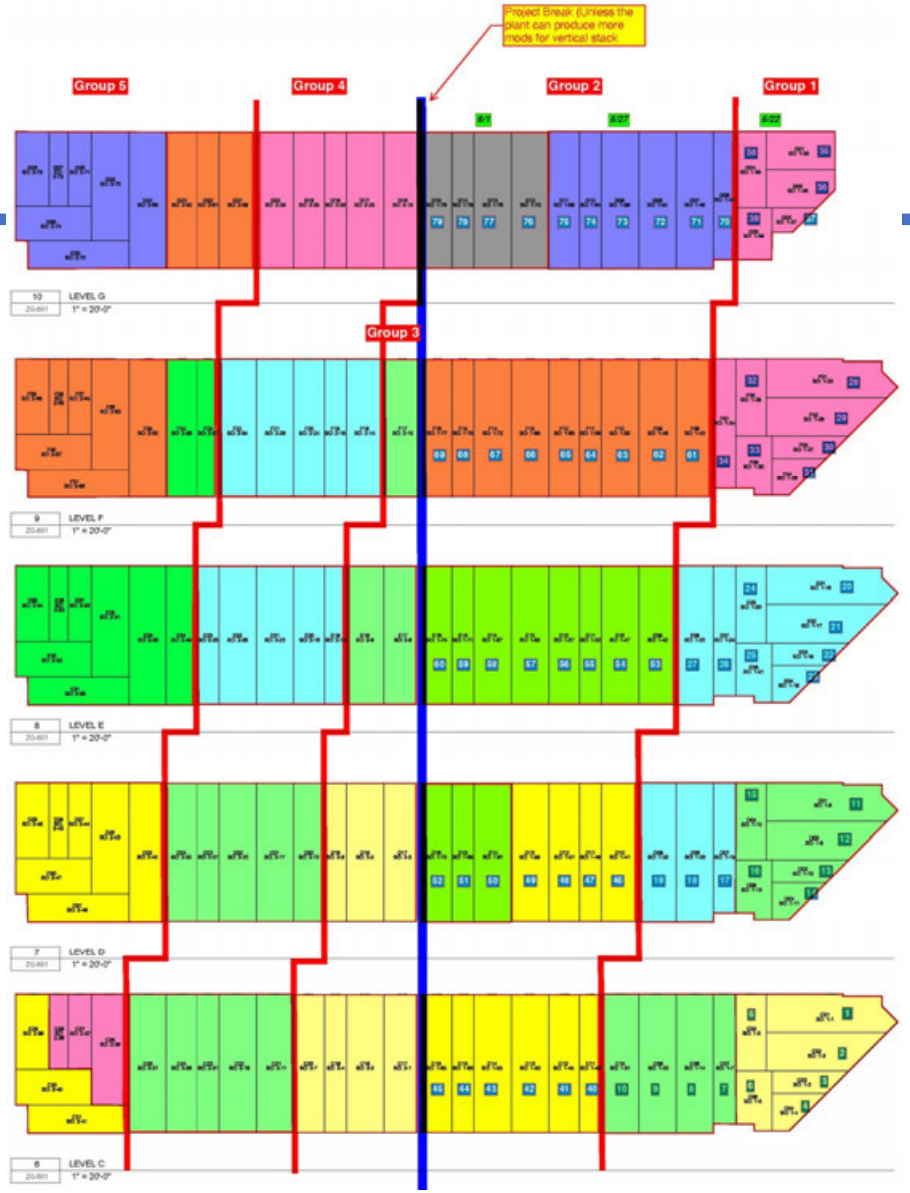
5/21 Day 5
5/24 Day 6
5/25 Day 7
5/26 Day 8
5/27 Day 9


Project Break (Unless the plant can produce more mods for vertical stack
Group 5
Group 4
Group 3
Group 2
Group 1
LEVEL G
LEVEL F
LEVEL E
LEVEL D
LEVEL C


OPUS

Alvera

- Alvera is the tallest and largest modular building in MN standing 85-feet tall
- Five stories of modular wood construction over two stories of concrete construction
- Gallery, artist-in-residence and WFH space
- Mechanized car-stacking system with 102 semi-automated stalls
- High-density - 192 units on 0.61 acres (316 units/acre)
- Project is significant in providing a solution to attainable housing as well as visually transforming and engaging the neighborhood

Alvera

- Modular maximized site to achieve unit count to make the project happen
- Timeline reduced from 24 to 14 months
- Modular worked with a tight site - developer did not have to invest in multiple staging sites
- Neighborhood impact less with a 22-day mod-set, less workers on site, less traffic and a significantly shorter construction timeline
- Quality of the project was improved - units have better noise and insulation
- Modular maintained high aesthetic of Alvera's design

QUESTIONS?

Speaker name: Dean Dovolis

Speaker organization: DJR Architecture & Design

Speaker email address: ddovolis@djr-inc.com