



## THE AMAZING RACE: VOLUMETRIC MODULAR VS KIT-OF-PARTS

*Sutter Health, Boulder Associates, The Boldt Company, and Mark III partnered to standardize and productize healthcare construction with the objective of increasing speed to market and quality.*

### OBJECTIVE

The project team launched a collaborative research and development initiative in late 2021 to compare a volumetric and kit-of-parts approach to healthcare construction. Leveraging standardization and productization, the project team worked together to develop a method that will increase speed to market without sacrificing quality.

To compare both delivery methods, volumetric modular and kit-of-parts, metrics were tracked and analyzed to determine the most effective process. This data can be used by other project teams to determine the best course of action on future projects.

### APPROACH

Over the course of six months, the project team worked together on room selection, building methodology, template creation, manufacturing, installation, and quality inspection.

### ROOM SELECTION

The project team strategically selected two common spaces within a typical medical building including an exam room and a patient/staff toilet. The data from Tables 1 and 2 illustrate that these rooms account for an average of 32% of the floor plan.

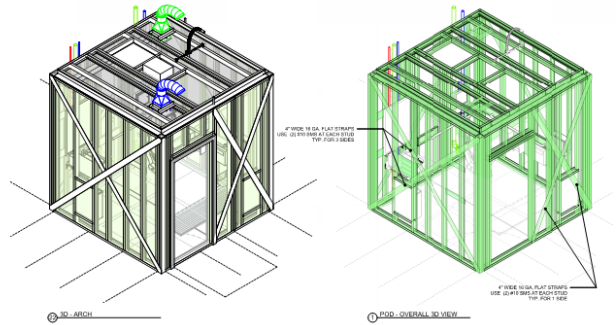


## BUILDING METHODOLOGY

The project team chose to test two delivery methods - volumetric modular (POD) and kit-of-parts (KOP).

### TEMPLATE CREATION

Utilizing owner feedback, needs analysis findings, and historical plans, the architect and manufacturing group collaborated to establish standards for the selected rooms. This included accessory layout, fixture, and trim selection. These agreed-upon standardizations made it possible to include in-wall scope and backing, making each template fully constructible as designed.



### MANUFACTURING

From the established templates, rooms were manufactured in Mark III's Sacramento-based MEP manufacturing facility. Each room was processed through the facility in two ways – volumetric modular pod and kit-of-parts.

### INSTALLATION

*Kit-of-Parts (KOP)* - Each KOP included wall panel assemblies, wall finish, fixtures, and trim. Units were flat-packed and organized into three deliveries. The Boldt Company received the KOPs for final on-site installation.

*Volumetric Modular (POD)* - Each POD was shipped to the site as a completed, turn-key room. PODs were unloaded and rolled into place using a proprietary low-profile roller system that requires zero exterior clearance. After setting both rooms, The Boldt Company installed floor-mounted fixtures and ceiling tiles.

### QUALITY INSPECTIONS

Quality inspections were completed by the project team. All groups reviewed and verified code and clearance requirements were met.

### ROLES AND RESPONSIBILITIES

	ROOM SELECTION	BUILDING METHODOLOGY	TEMPLATE CREATION	MANUFACTURING	INSTALLATION	QUALITY INSPECTIONS
Owner <i>Sutter Health</i>	X	X				X
Architect <i>Boulder Associates</i>			X			X
General Contractor <i>The Boldt Company</i>		X			X	X
Manufacturing Group <i>Mark III</i>	X	X	X	X	X	X



# DATA & ANALYTICS

## SPEED TO MARKET

To compare overall speed, both manufacturing and assembly time was tracked and reviewed for each unit for both delivery methods.

Mark III created standard room assemblies utilizing the owner requirements called out in the templates. These assemblies, or products, are cataloged as a Revit family within the room model. The completed catalog is 100% constructible and these products can be used by architects and owners for spatial layout and validation exercises. From the Revit model, fabrication documents were created and provided to the Mark III manufacturing team for production.

While the KOP took less time in the manufacturing facility, the on-site assembly took substantially more time. In contrast, manufacturing time for the POD was higher, while the site installation was lower. Overall the POD delivery method produced the largest time savings.

In conclusion, three major factors were identified as making substantial contributions to time savings:

- Standardization - Identifying repeatable units
- Manufacturing - Moving construction to a controlled environment
- Product Mindset - Delivering a product rather a traditional siloed construction approach

KOP DELIVERY METHOD - MANUFACTURING & INSTALLATION TIMES		
	EXAM KOP	TOILET KOP
Mfg. Time (Hours)	23 hours	15 hours
Install/Assembly Time (Hours)	66.7 hours	63.6 hours
<b>TOTAL HOURS</b>	<b>89.7 HOURS</b>	<b>78.6 HOURS</b>
Mft. Time (Man Days)	2.9 days	1.9 days
Install/Assembly Time (Man Days)	8.3 days	7.9 days
<b>TOTAL MAN DAYS</b>	<b>11.2 DAYS</b>	<b>9.8 DAYS</b>

VOLUMETRIC DELIVERY METHOD - MANUFACTURING & INSTALLATION TIMES		
	EXAM POD	TOILET POD
Mfg. Time (Hours)	71.9 hours	59.4 hours
Install/Assembly Time (Hours)	5 hours	5 hours
<b>TOTAL HOURS</b>	<b>76.9 HOURS</b>	<b>64.4 HOURS</b>
Mft. Time (Man Days)	8.9 days	7.4 days
Install/Assembly Time (Man Days)	.6 days	.6 days
<b>TOTAL MAN DAYS</b>	<b>9.5 DAYS</b>	<b>8 DAYS</b>



# DATA & ANALYTICS

## COMPARISON OF QUALITY

Quality was measured by the number of issues logged and QA/QC reports at the end of construction.

The crowdsourced issues and opportunities (I&O) log was put in place to capture data in a categorized and sortable fashion. By doing this, issues can be filtered and tracked back to the origination point. This simplifies and adds transparency to corrective action planning.

Entries are rated on a severity scale with green classified as an easy fix that did not impact production, yellow indicates issues that can be corrected in a day, and red is assigned to major issues that halted production, led to rework, and needed attention immediately. The I&O log allowed team members to monitor progress while also giving feedback about what areas still have issues, and if additional resources are needed.

Throughout the initial design efforts, every step in the assembly/ installation including speed bumps, defects and opportunities were captured. Project successes were highlighted and countermeasures were implemented for issues that came up to minimize repeat mistakes.

At the project completion, leaders from each organization walked the site to evaluate the overall quality and confirm code requirements were met. No issues were discovered and all parties were satisfied with the finished product.

## ISSUE & OPPORTUNITY LOG

- - DESIGN - 51%
- - MATERIAL - 26%
- - SHIPPING/LOGISTICS - 9%
- - MODEL/DETAILING - 7%
- - FAB - 5%
- - INSTALL - 2%

*A total of 43 issues were logged by the project team*

## AT A GLANCE

# 43

TOTAL ISSUES LOGGED

# 88%

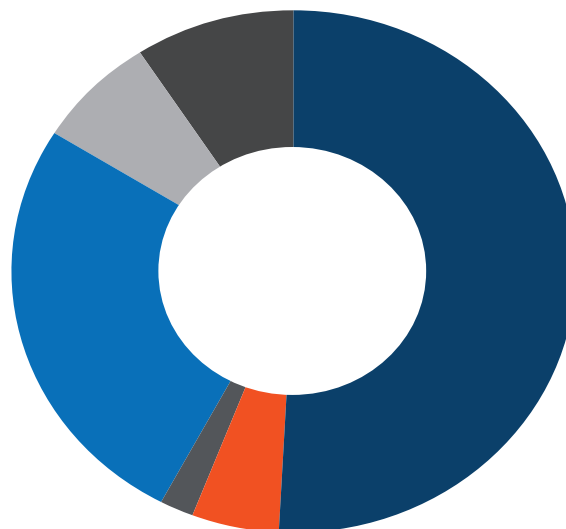
OF LOGGED ISSUES WERE CLASSIFIED AS SEVERITY LEVEL GREEN

# 30%

OF LOGGED ISSUES WERE RELATED TO FRAMING/BACKING

# 51%

OF LOGGED ISSUES WERE RELATED TO DESIGN



## CONCLUSION

*In summary, a volumetric modular delivery method produces the highest time savings, without sacrificing quality.*

Healthcare owners continue to report restricted budgets and rapidly growing markets, making it clear that the industry must adapt. The findings from this project prove that a modular approach to construction can significantly increase speed to market without impacting quality.

It is worth noting that while this study proves that a volumetric approach produces the highest schedule savings when compared to kit-of-parts, both of these methods are substantially more efficient than stick building. To learn more about our previous study, comparing a stick-built exam room to a kit-of-parts delivery method, visit this link.

Mark III continues to standardize and productize within the healthcare space, additional case studies will be published in the future as new data is collected.

### AT A GLANCE

# 16%

**FASTER TO UTILIZE  
VOLUMETRIC MODULAR  
DELIVERY METHOD**

\*Average, calculated by day



**SEE FOR YOURSELF, SCHEDULE  
A TOUR**

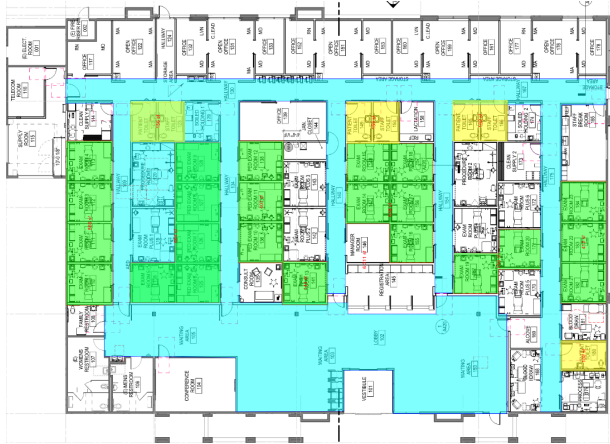
Scan the code to schedule a tour of Mark III's  
Sacramento-based MEP Manufacturing Tour





APPENDIX

TABLE 1



**MEDICAL OFFICE BUILDING 1**

**USABLE SPACE**

**11,800 SF**

Excluding waiting and corridor, represented in blue

**EXAM SPACE**

**3,080 SF | 26% of space**

Represented in green

**PATIENT/STAFF TOILET**

**580 SF | 5% of space**

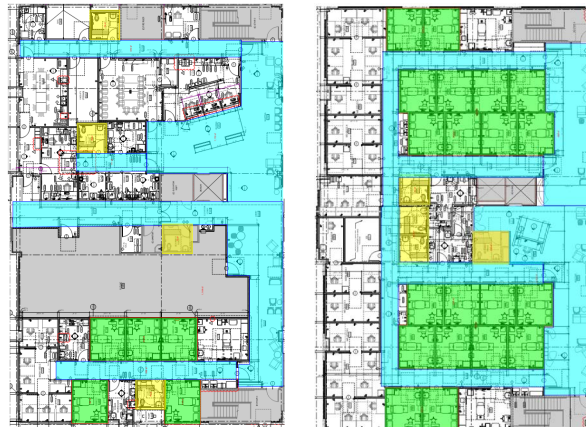
Represented in yellow

**TOTAL**

**31% of floor plan**

Is made up by exam space or patient/staff toilets

TABLE 2



**MEDICAL OFFICE BUILDING 2**

**USABLE SPACE**

**12,200 SF**

Excluding waiting and corridor, represented in blue

**EXAM SPACE**

**3,400 SF | 28% of space**

Represented in green

**PATIENT/STAFF TOILET**

**660 SF | 5% of space**

Represented in yellow

**TOTAL**

**33% of floor plan**

Is made up by exam space or patient/staff toilets

