MARK III CONSTRUCTION

TOPIC

THE FUTURE OF HEALTHCARE CONSTRUCTION: EXAM ROOM BUILT IN 6.5 DAYS

Case Study

PREPARED BY

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INTRODUCTION

Mark III Construction is transforming the way healthcare construction is approached. By utilizing Project Mountain as a change agent, Mark III has developed a process that streamlines workflow and increases productivity by standardizing building elements and moving production off-site to a controlled manufacturing environment. Rather than continuing to build projects as they did during the Industrial Revolution, Project Mountain is the automobile speeding past the horse and buggy.

KEY FIGURES AT A GLANCE

16-21%

SAVINGS ON MEP WALL FRAMING COSTS

20%

DECREASE IN OVERALL CONSTRUCTION SCHEDULE

6.5

DAYS TO BUILD 1 MEDICAL EXAM ROOM, COMPLETE WITH MEP SYSTEMS AND FINISH

In 2017, the company launched a series of internal research and development (R&D) projects, called Project Mountain. To date, Mark III has completed two projects within the series and have more on the horizon. To learn more about the series, follow this link to check out the videos on the company's website.

The goal for Project Mountain 2 (PM2) was to simplify the way complex projects are built. Traditionally – on a job site today – mechanical, electrical, and plumbing systems are installed using the "stick-build" method. This piece by piece methodology has been used by builders for centuries.

Fueled by their mission to lead the evolution of construction, the company has a vision to expose the world to a new way to build and it starts with Project Mountain.

The Lean Construction Institute (LCI) reported that up to 70 percent of projects are over budget and delivered late (Lean Construction Institute, 2020). In contrast, Mark III's preliminary findings estimate that standardization and modular building can save customers in the medical industry 16-21 percent on their MEP (mechanical, electrical, plumbing) wall framing costs and decrease the construction schedule by 20 percent.

Inspired by the belief that all owners should be able to build more with less, the company set out to build four (4) standardized medical exam rooms utilizing plans from a local Sutter Health medical office building. This case study will take a closer look at the project, methodology, and findings including:

- Objectives & Specifications
- Healthcare Construction
- Manufacturing
- Project Findings
- The Future of Construction

OBJECTIVES & SPECIFICATIONS

PROJECT OBJECTIVE

Mark III aimed to disrupt the traditional construction process by standardizing design, streamlining material procurement, and leveraging prefabrication and manufacturing to build a typical medical office building exam room.

PROJECT SPECIFICATIONS

- Focus remained solely on one type of exam room
- The exam room was built four (4) times, in three (3) different phases
- Two (2) non-trade specific mechanics were used to assemble the room
- The third phase included building two (2) exam rooms in tandem; for the purposes of this paper data from phase three has been divided in half for consistency and ability to compare results

HEALTHCARE CONSTRUCTION

INDUSTRY GROWTH

The healthcare industry is growing and this offers advantages for owners and contractors alike. According to Revista's construction report, "from June 2018 to June 2019 over 21 million square feet of medical office space have been delivered across the country" (Revista, Hilda Martin, 2019) and this is expected to continue to grow. They go on to report that "preliminary data shows $2.4 billion changed hands up through March 31 [2020], up from $1.7 billion in the first quarter of 2019" (Revista, Hilda Martin, 2020).

COMPLEXITY

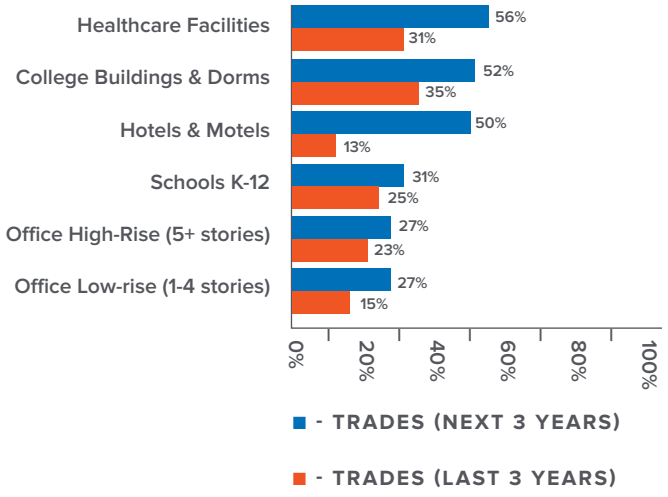
Hospitals, medical office buildings, and healthcare facilities are extremely labor intensive due to the high volume of MEP systems per square foot. While these systems are complex, they lend themselves to standardization and modular building because of the repeatability of common rooms, such as exam rooms, operating rooms, and restrooms.

It is estimated that healthcare facilities utilizing modular building will nearly double by 2023 and exceed all other industries, including hotels, dorms, and office buildings (Modular.org, 2020). Modular building and standardization offer healthcare end-users the opportunity for decreased build time and increased savings and quality.

TRADE CONTRACTORS' TOP 10 MOST FREQUENT BUILDING TYPES [FOR PERMANENT MODULAR BUILDING]

Forecast for the next 3 years compared with the history of the last 3 years

Source: Modular.org, 2020



HEALTHCARE CONSTRUCTION

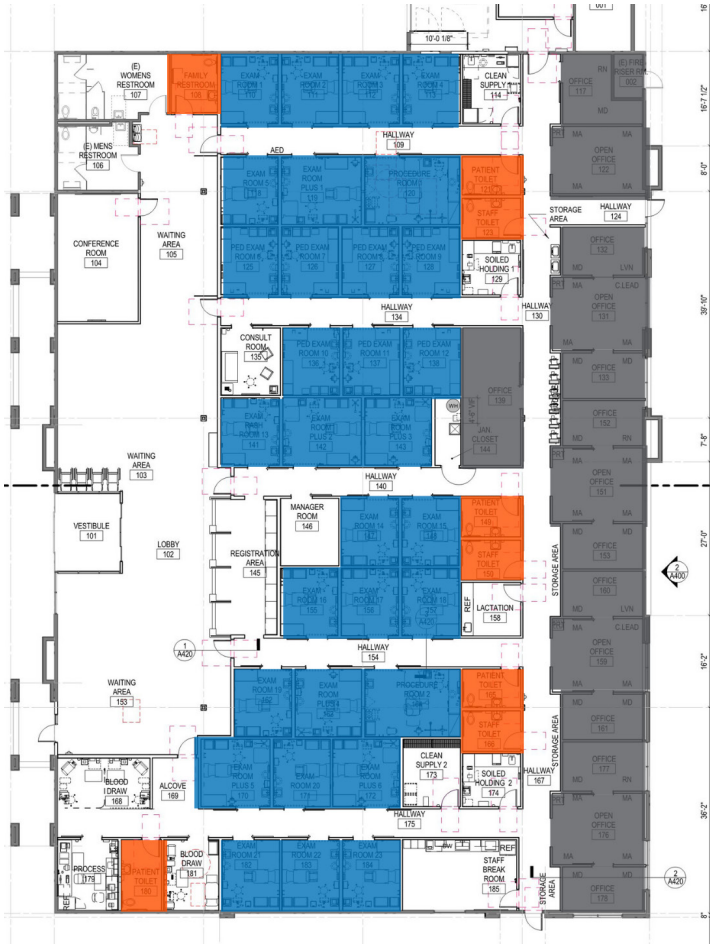
STANDARDIZATION AND REPEATABILITY

Medical office buildings are well suited to be standardized, manufactured, and modularly built in the field. Throughout our Project Mountain R&D efforts, we have proven that by embracing standardization and applying manufacturing and lean principles we can build MOB's in a fraction of the time. This methodology yields higher quality, accelerated schedules, reduction in waste, and optimized productivity.

For example, exam rooms account for 39% of the usable space* at the medical office building that PM2 was based upon. Once a build unit is created it can be utilized again on future projects, eliminating the need for redesign. Furthermore, if standardized design files were also created for the unisex restrooms and office areas of the same medical office building, over 65.5% of the usable space* would be designed and ready for manufacturing and assembly.

MEDICAL OFFICE BUILDING LAYOUT

The graphic below depicts the floor plan of the medical office building that PM2 was based upon. Offices, exam rooms, and unisex toilets are broken out to illustrate the impact standardization can have on the design and installation process.



15,971 total square feet

10,966 usable* square feet

**usable square feet excludes hallways, waiting areas, and storage*

Offices

2,408 SF of office

- 15% of overall space
- 22% of usable space

Exam Rooms

4,280 SF of office

- 26% of overall space
- 39% of usable space

Unisex Toilets

512 square feet

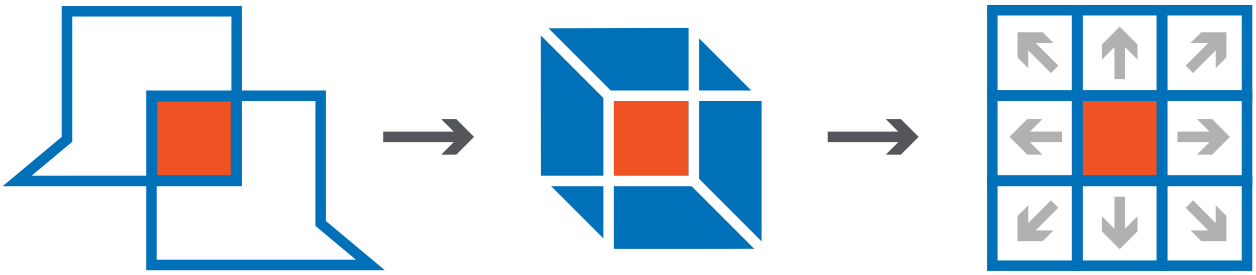
- 3% of overall space
- 4.5% of usable space

MANUFACTURING

Mark III Construction is transforming the way medical organizations approach design and construction. Contractors and owners are able to generate cost savings by building modularly and applying manufacturing methodologies to projects. These cost savings can be found in the reduction of waste, simplified design, expedited schedules, and increased predictability.

Projects built modularly have a consistent track record of accelerating project time lines by 20 to 50 percent (McKinsey & Company, 2019). By prefabricating assemblies for MEP trades at an off-site location, complete building systems can be installed into manufactured components prior to being delivered to a job site. This minimizes the disruption of day-to-day job functions and maximizes business operations during construction.

MODULAR BUILDING LIFECYCLE BREAKDOWN



COLLABORATION

A right-hand, left-hand partnership to ensure all stakeholder needs are met

STANDARDIZATION

Development of a repeatable build unit catalog and manufactured standardized kits (MSK's) to be manufactured and installed at any project site

ASSEMBLY

Installation of MSK's at the project site

BENEFITS OF MODULAR CONSTRUCTION

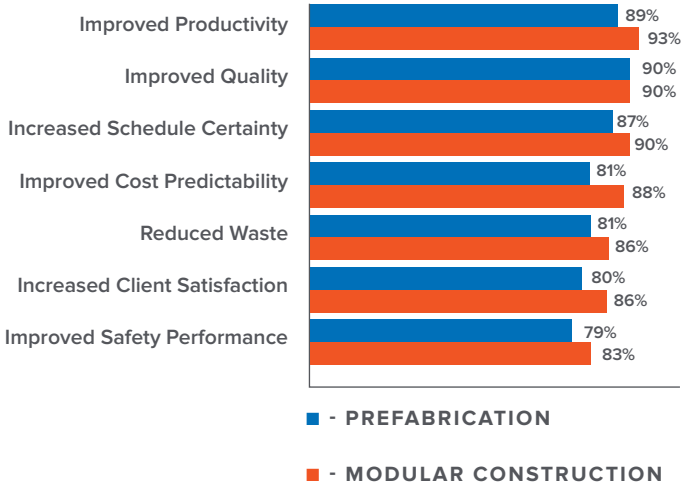
Developing standardized and repeatable units for construction projects allows for a reduction cost, wasted time and material, in addition to creating a safer work environment. By creating standardized room templates, virtual design files can be applied to subsequent projects. Additional benefits of prefabricated and modular construction include:

- Higher quality
- Accelerated schedules
- Optimized productivity

BENEFITS OF USING PREFABRICATED & MODULAR CONSTRUCTION

Users report receiving many important benefits from both prefabrication and from modular construction. The chart below shows the percentages reporting significant (medium, high, or very high level) positive impacts from the use of each on seven key metrics.

Source: Modular.org, 2020



PROJECT FINDINGS: PHASE 1

PROCESS

During the first phase a single medical exam room was built utilizing a fully kitted approach, with minimal prefabrication and manufacturing.

A 3-box process was developed to simplify the construction process:

1. **Configuration Box** - Spatial planning software that allows owners to plug & play cost-loaded building units for room layouts within a building footprint
2. **Virtual Box** - A compilation of design and engineering documents for a constructible and standardized build-unit developed with the intent of repeat use, including bill of material (BOM) and assembly drawings engineered using California jurisdiction standards
3. **Build Box** - A standardized set of tools, supplies, and instructional materials for a specific purpose, to maximize efficiency, eliminate waste, and simplify installation

Elements:

- One room
- Fully kitted approach
- Two (2) non-trade specific mechanics

The Project Mountain team began by virtually modeling the exam room for all trades – mechanical, electrical, plumbing, and wall framing. Once the first virtual box was created, detailed step-by-step instruction manuals were produced for every task required to build the exam room, from metal-stud framing to paint and finishes. A precise BOM was also produced to minimize material waste. A just-in-time schedule was implemented so that each day the crew would only receive the materials, tools, and instructions for that day's work.

ESTIMATED INSTALL HOURS

160 hours (10 days)
2 non-trade specific mechanics

LABOR BREAKDOWN

Virtual Box
393 hours

Build Box
322 hours
- 162 factory hours
- 160 installation hours

TOTAL PHASE HOURS

715 hours

Data collected by Mark III Project Executive

RESULTS

The first room installation was completed in **10 days**.

For each phase, all issues resulting in waste were captured in an issue log. In order to prevent repeat mistakes, countermeasures were created and implemented for each recorded issue on subsequent phases.

PHASE 1: ISSUE LOG

112 total issues were logged

- INSTRUCTIONS (43) - 38%
- MATERIALS (31) - 28%
- TOOLS (27) - 24%
- OTHER/MISC (11) - 10%

Issues were tracked and logged by all parties involved in the project, including the virtual construction dept, project executive, mechanics, MEP manufacturing facility fabricators etc.

PROJECT FINDINGS: PHASE 2

PROCESS

To build the second exam room, the team repeated the same process used for Phase 1, with countermeasures implemented into the kits based on issue log findings. This included improved instructions and corrected materials, tools, and logistics.

Elements that remained the same:

- One room
- Fully kitted approach, same level of prefabrication and manufacturing
- Two (2) non-trade specific mechanics

Elements that changed:

- Countermeasures were implemented into kits based off the Phase I issue log

ESTIMATED INSTALL HOURS

160 hours (10 days)
2 non-trade specific mechanics

LABOR BREAKDOWN

Virtual Box
141 hours

Build Box
237 hours
- 77 factory hours
- 160 installation hours

TOTAL PHASE HOURS

378 hours

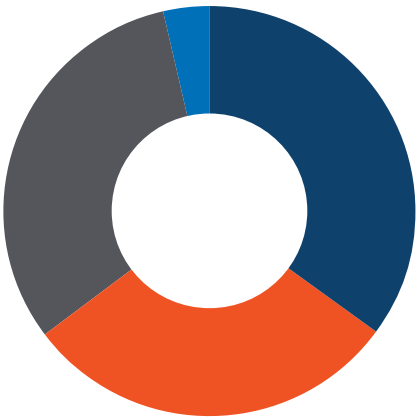
Data collected by Mark III Project Executive

UNCONTROLLABLE CHANGES

Phase 2 was affected by weather impacts; cold temperatures delayed the drywall mud and paint drying time. While the team did not see a reduction in install hours, they did see a reduction in overall hours, fabrication time, and issues.

RESULTS

Following the same processes from Phase 1, the second room installation was completed in **10 days**.



PHASE 2: ISSUE LOG

57 issues were tracked

- INSTRUCTIONS (20) - 35%
- MATERIALS (17) - 30%
- TOOLS (18) - 31%
- OTHER/MISC (2) - 4%

Issues were tracked and logged by all parties involved in the project, including the virtual construction dept, project executive, mechanics, MEP manufacturing facility fabricators etc.

PROJECT FINDINGS: PHASE 3

PROCESS

Two exam rooms were built during the third phase utilizing an enhanced process.

Elements that remained the same:

- The same countermeasures were implemented based off the Phase 1 & 2 issue logs

Elements that changed:

- Two (2) exam rooms were built in tandem
- Level of manufacturing increased:

  Rather than delivering kitted material to the (2) non-trade specific mechanics, a manufactured wall panel was delivered to site

  Each manufactured wall panel was complete with multi-trade utilities including prefabricated in-wall assemblies for electrical, low voltage, and plumbing systems
- A new team of (2) non-trade specific mechanics were utilized

  This insured that issues were not being overlooked due to a "seasoned team"

RESULTS

Utilizing a manufactured approach allowed the team to finish installation in just **6.5 days**, reducing the installation schedule by **35%** compared to Phase 1 and 2.

ESTIMATED INSTALL HOURS

160 hours (10 days*)
2 non-trade specific mechanics (new team)

ACTUAL INSTALL HOURS

6.5 days*

LABOR BREAKDOWN

Virtual Box
60* hours per room

Build Box
129.5* hours per room

- 25.5* factory hours per room
- 104* installation hours per room

TOTAL PHASE HOURS

189.5* hours per room

Data collected by Mark III Project Executive

** Indicates that hours were divided by 2 to account for hours per exam room*

PHASE 3: ISSUE LOG

87 issues were logged

- MATERIALS (25) - 29%
- TOOLS (21) - 24%
- OTHERS/MISC (21) - 24%
- INSTRUCTIONS (20) - 23%

The "fresh eyes" from new mechanics and shift in process were assumed to be responsible for the spike in issues.

Issues were tracked and logged by all parties involved in the project, including the virtual construction dept, project executive, mechanics, MEP manufacturing facility fabricators etc.

THE FUTURE OF CONSTRUCTION

By utilizing modular building and prefabrication, Mark III was able to complete the build of a medical office building exam room in just 6.5 days.

FINDINGS

By standardizing design and utilizing a manufactured approach to build a complex medical office building exam room, the Project Mountain team was able to reduce total hours spent by 71% from Phase 1 to Phase 3*. In addition, utilizing multi-trade manufactured wall panels during Phase 3 enabled the team to reduce on-site installation by 35%, thus illustrating that manufactured MEP wall panels are more efficient than a build box (fully kitted raw materials) for the metal-stud framing and in-wall utilities.

HOURLY RATE BREAKDOWN

	VIRTUAL CONSTRUCTION HOURS	FABRICATION & MANUFACTURING HOURS	ASSEMBLY & INSTALLATION HOURS	TOTAL HOURS BY PHASE
Phase 1	393	162	160	715
Phase 2	141	77	160	378
Phase 3*	60	25.5	104	189.5

**Phase 3 included the build of two exam rooms, figures are divided by 2 to allow for clear and fair comparisons between phases 1 and 2.*

While the team did experience schedule improvements for the manufactured MEP wall panels (complete with in-wall assemblies), there were no recorded improvements for other tasks required to complete the exam room such as, drywall, drywall taping, drywall mud, texture and paint. These specialized tasks proved to be the most challenging for the mechanics and did not yield any reduction in hours over the three phases. Moving forward, these specialty activities will be subcontracted in order to ensure that all possible cost and schedule savings are captured.

THE FUTURE

The company will continue to apply these practices and findings to projects in the field. This approach vertically integrates the full scope for all trades: mechanical, electrical, low voltage, plumbing, piping, and framing. MEP wall panels will be manufactured in Mark III's MEP Manufacturing Facility before being shipped to the job site which improves the quality of the product, simplifies project design, reduces waste, and increases project predictability for all stakeholders.

This year, Mark III has three healthcare projects under contract to be built utilizing MEP wall panels. Projects include: UC Davis Health New Campus Clinic, Sutter Health Natomas MOB, and Placerville CHC MOB.

To follow Mark III's progress on these projects, visit their website at mark-three.com

SOURCES

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