# Kaiser Permanente Largo Medical Office Building

*Largo, MD*


**Chris Pozza**
**Advisor: Dr. Rob Leicht**
**Construction Management**

# Kaiser Permanente Largo Medical Office Building

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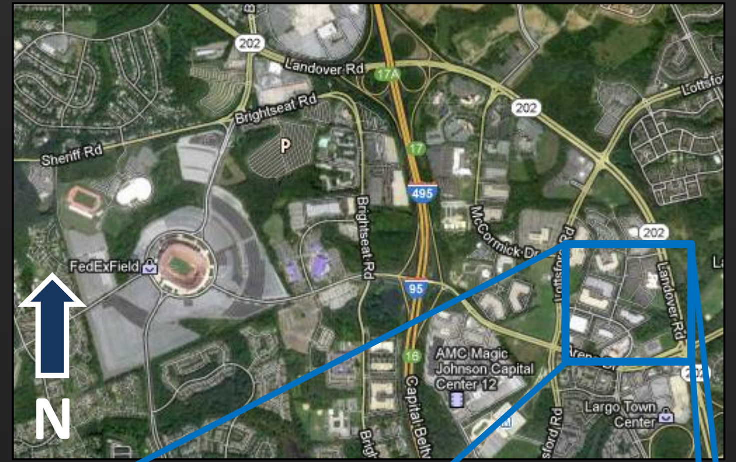
# Introduction

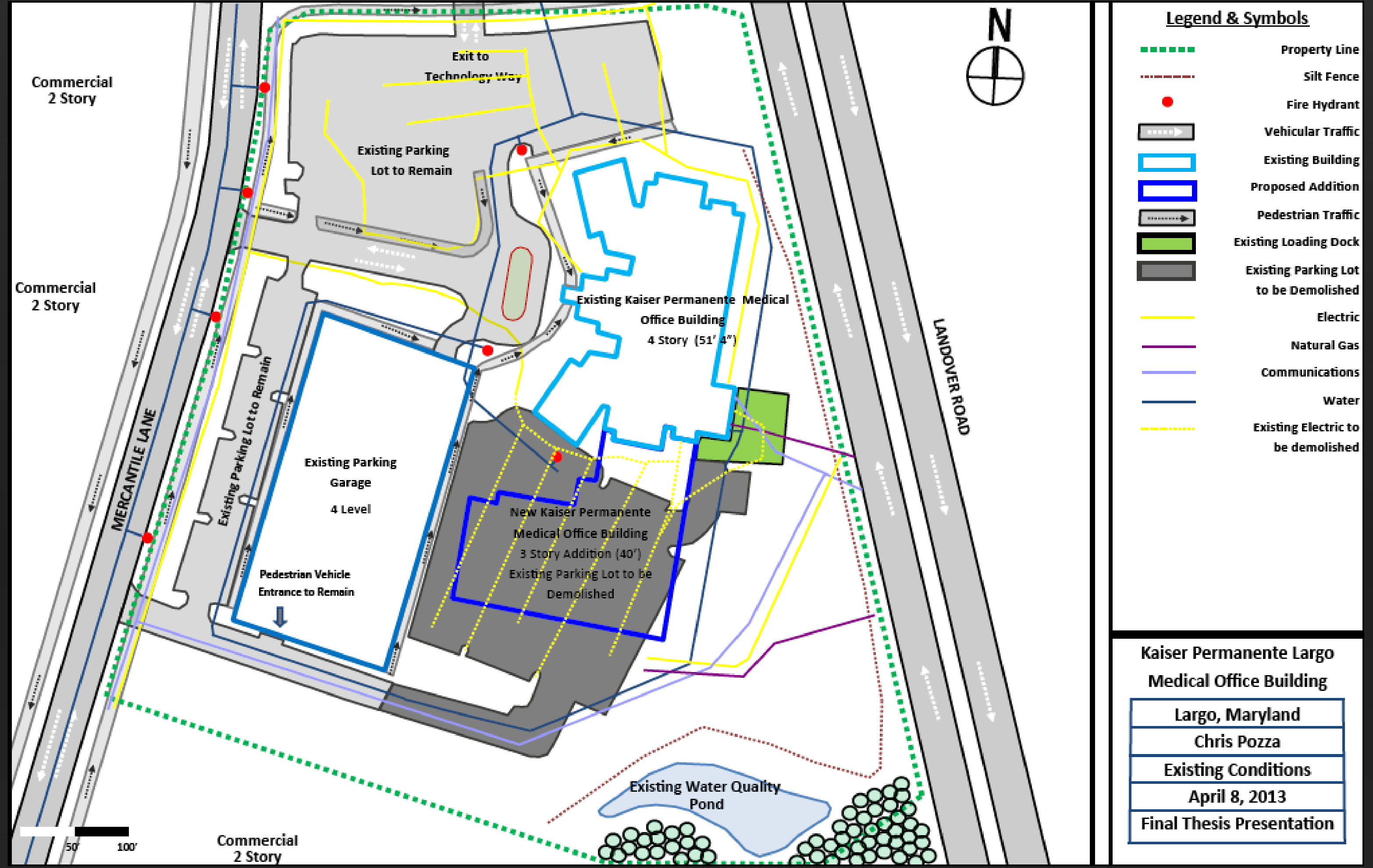


Project Cost: $39,558,519

Addition: $32,504,687

Addition Size: 106,700 SF





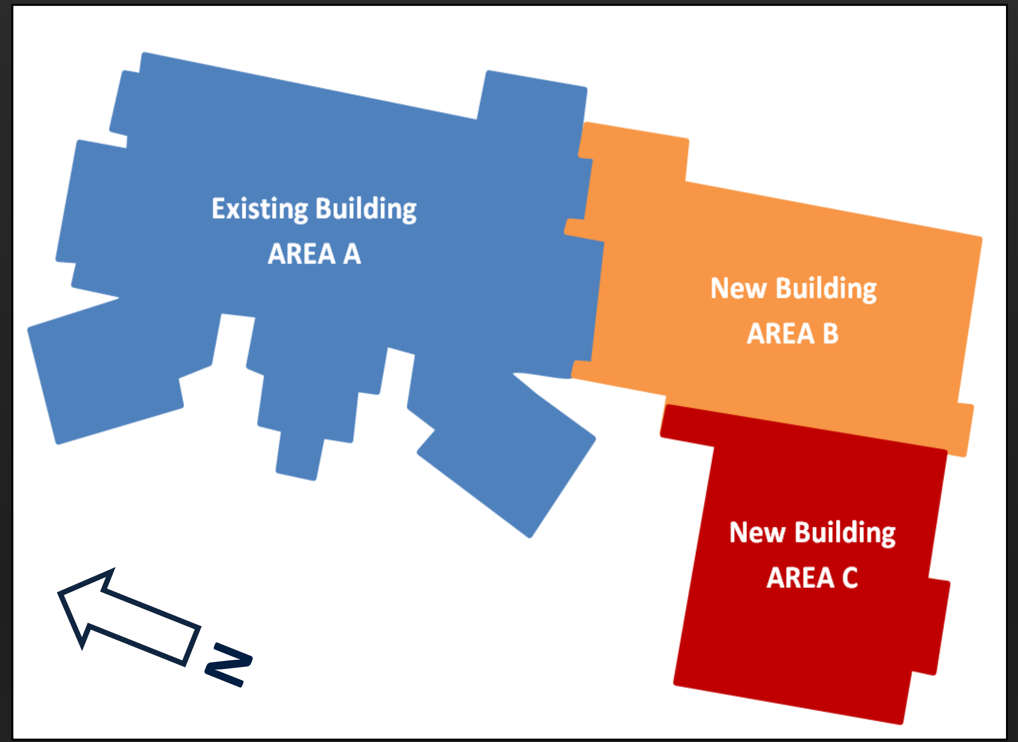
# Kaiser Permanente Largo Medical Office Building

*Largo, MD*

## Chris Pozza - Construction

# Introduction






DPR Awarded Contract: December 27, 2010

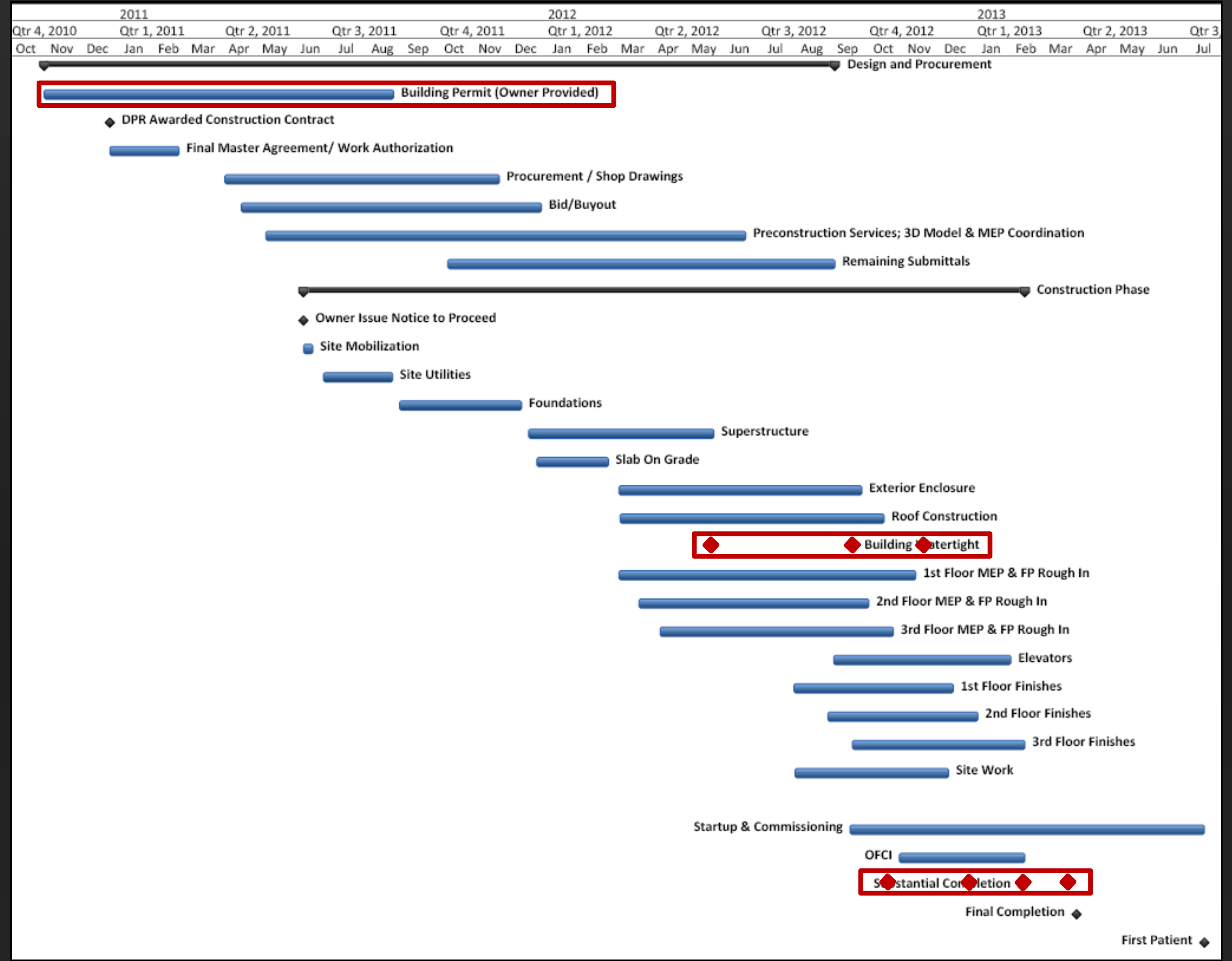
Building Permit (Owner Provided): ~~January 3, 2011~~
August 25, 2011

Notice to Proceed: June 10, 2011

Building Watertight: ~~April 25, 2012~~
~~September 27, 2012~~
October 18, 2012

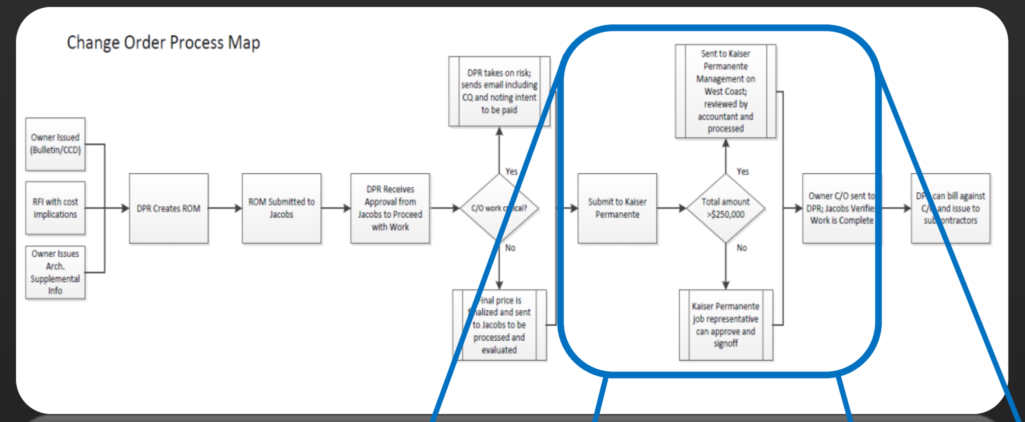
Substantial Completion: ~~October 2, 2012~~
~~December 6, 2012~~
~~February 11, 2013~~
March 1, 2013

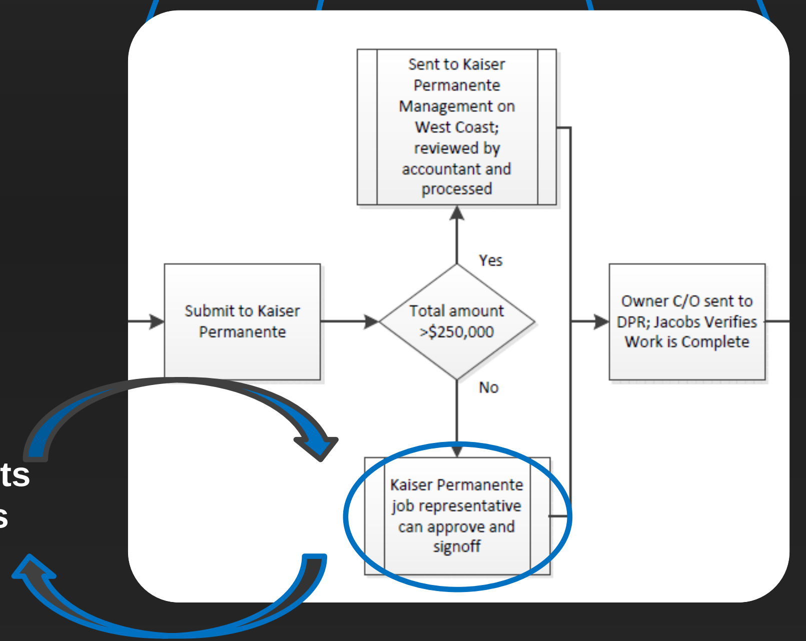
First Patient: July 8, 2013



# Analysis 1 – Change Order Management



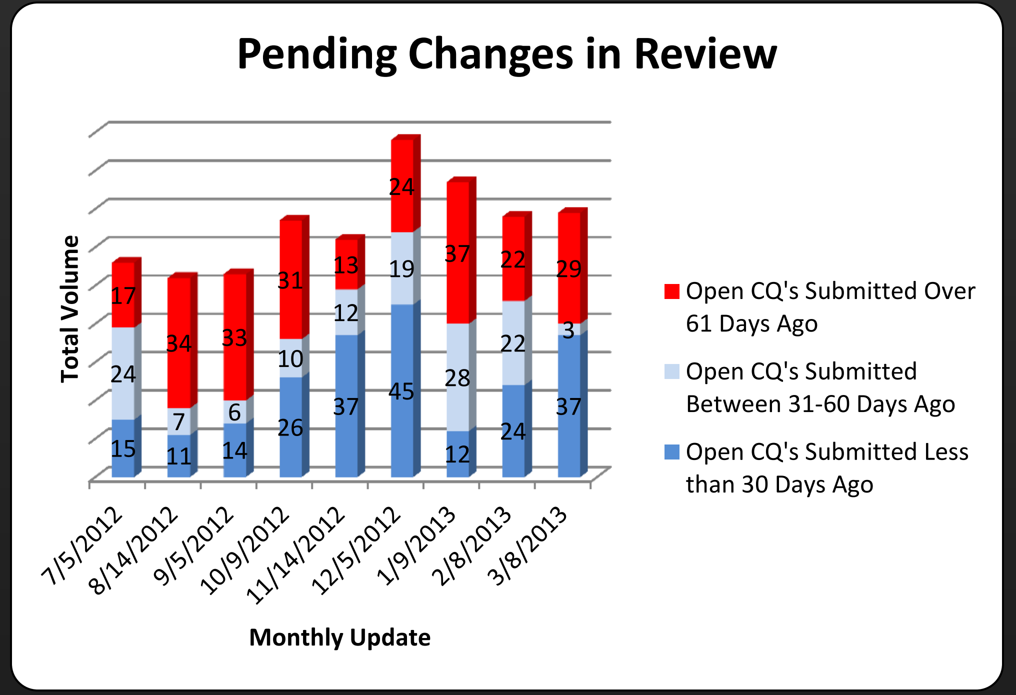



**3 Concurrent projects**
**400+ Change quotes**
***1 Representative***

## Problem:
## Current Process Costing Critical Time and Money

| Change Order Tracking Table | | | |
|---|---|---|---|
| **Description** | **Sum of Amount** | **Total** | **Average** |
| Approved | $6,249,917.07 | 148 | $42,229.17 |
| Pending Do Not Proceed | $498,568.82 | 8 | $62,321.10 |
| Pending Proceeding | $176,653.59 | 24 | $7,360.57 |
| Pending Proceeding with Authorization | $1,616,746.32 | 49 | $32,994.82 |
| ROM Do Not Forecast - Non-Proceeding | $593,500.00 | 5 | $118,700.00 |
| ROM Proceeding | $224,522.85 | 30 | $7,484.10 |
| ROM Proceeding with Authorization | $2,664,823.18 | 58 | $45,945.23 |
| ROM Do Not Proceed | $671,558.91 | 22 | $30,525.41 |
| In Dispute - Proceeding | $286,834.72 | 28 | $10,244.10 |
| **Total** | **$12,983,125.46** | **372** | |




## Factors Impacting Labor Productivity:

- Timing
- Intensity
- Type of Work
- Impact Type

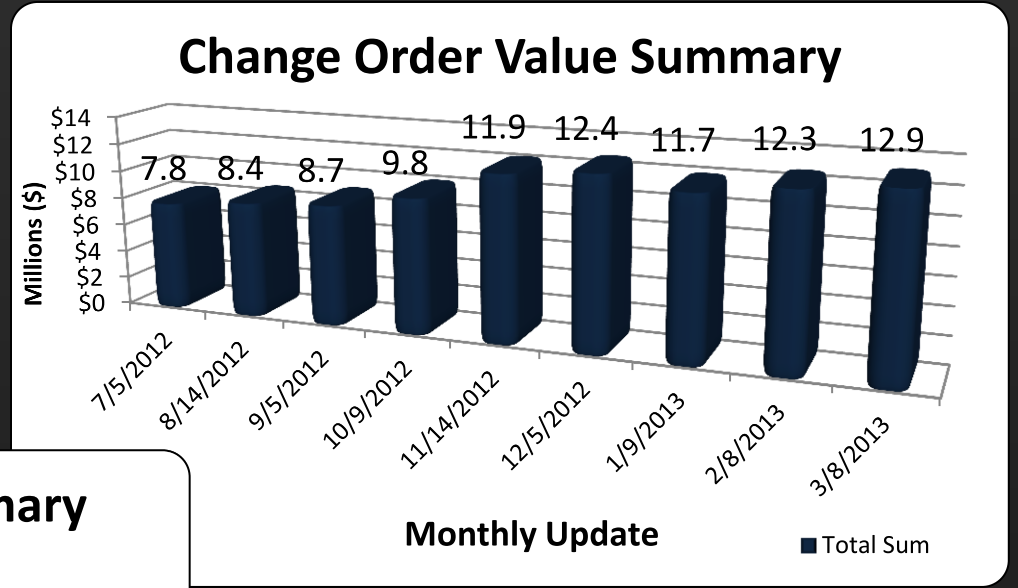
# Analysis 1 – Change Order Management

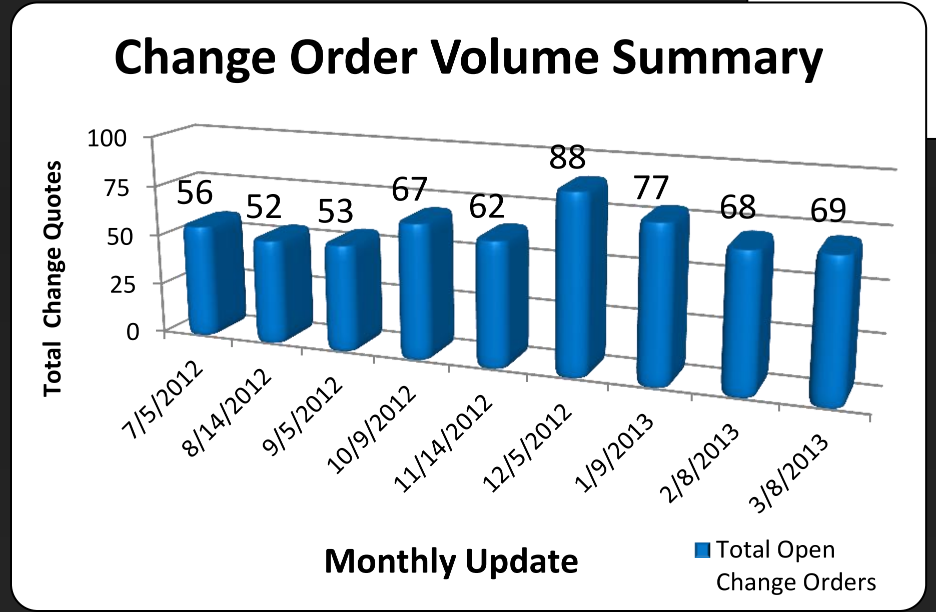


## Side Effects of Change Orders:

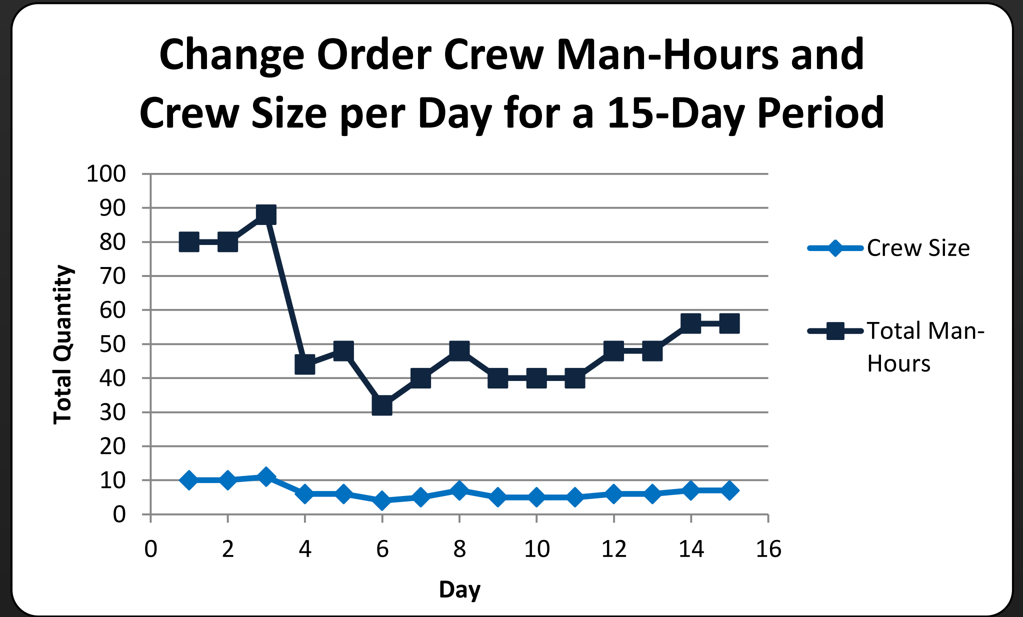
- Trade Stacking
- Schedule Compression
- Multiple-Shift Work
- Morale Issues

***Original Contract Value:***
**$32,504,687**




***Final Completion:***
***March 29, 2013***



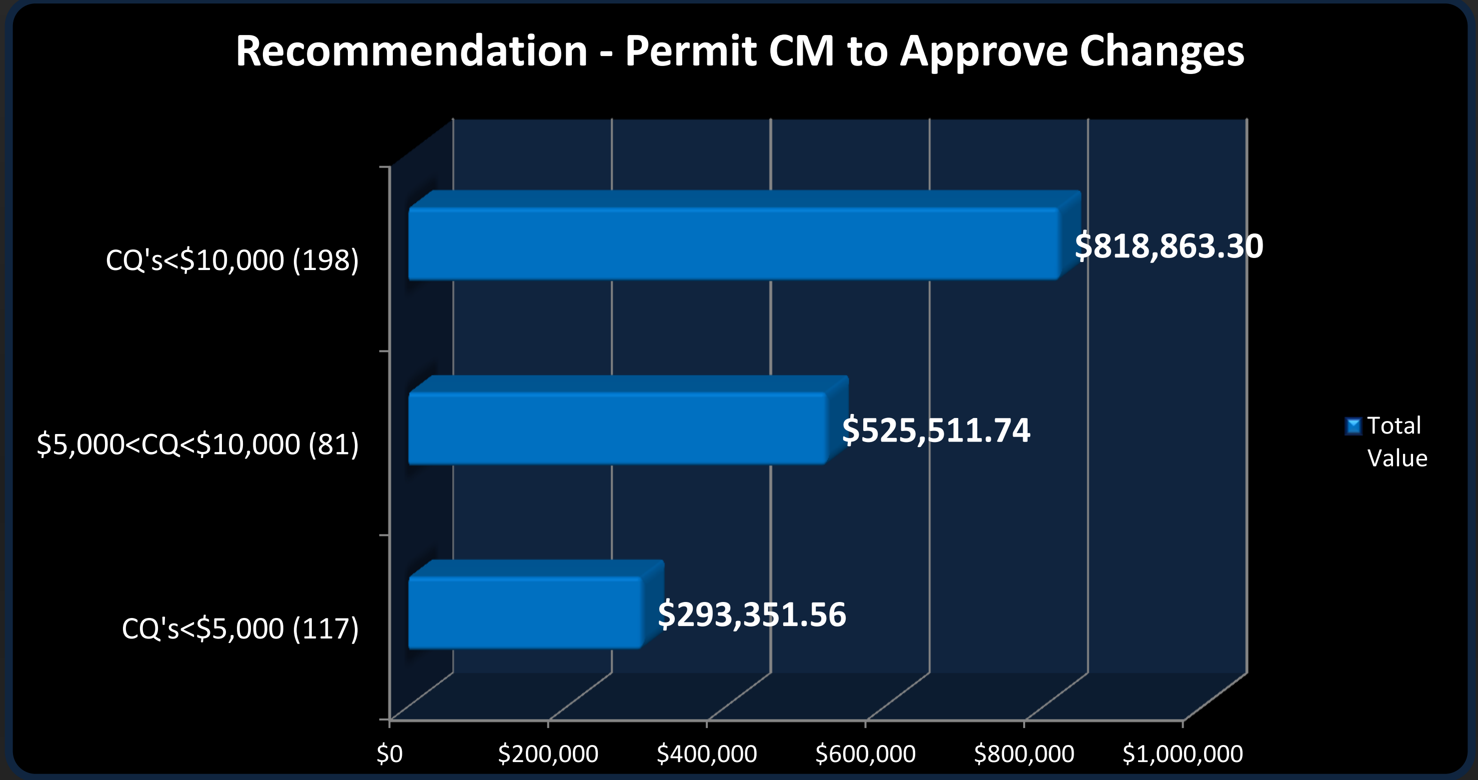

***788 Man-Hours***
***$58,000+ Purely Labor Cost***

# Analysis 1 – Final Recommendations



## 1. Give Authority to the CM to Approve Changes

- 446 Change Quotes Investigated
- 349 with Associated Costs
- 198 worth less than $10,000
- 1.5 Month Average Response Time




*+ Significantly reduce management time*
*+ Reduce turnaround time for large changes*
*+ Better cash flow for subcontractors*

## 2. Purchase Preconstruction Services

**Original Schedule:**

| | | | |
|---|---|---|---|
| BIM Coordination | 183 | 09-May-11 A | 07-Feb-12 |

**Actual Schedule:**

| | | | |
|---|---|---|---|
| BIM Coordination | 283 | 09-May-11 A | 20-Jun-12 A |

*+ Early trade involvement for intense MEP coordination*
*+ Utilize project team's healthcare experience*
*+ Improve design efficiency for all stakeholders*
*+ Reduction of rework*

## 3. Implement an Alternate Change Review Process

# Kaiser Permanente Largo Medical Office Building

*Largo, MD*

## Chris Pozza - Construction

# Analysis 2 – Precast Panel Implementation



| Precast Panel Comparison to Traditional Brick | |
|---|---|
| **Advantages** | **Disadvantages** |
| • Faster installation for schedule savings | • Higher upfront cost to fabricate panels |
| • Stronger and more durable than brick façade and tougher to penetrate | • Often requires heavier structural support members |
| • More favorable working conditions and no weather issues during fabrication | • Can be less aesthetically pleasing due to less imperfections and more joints |
| • Higher quality product produced off-site | • Customization of panels can significantly increases cost |
| • Panels typically have better insulation properties | • Can require multiple cranes depending on panel sizes |

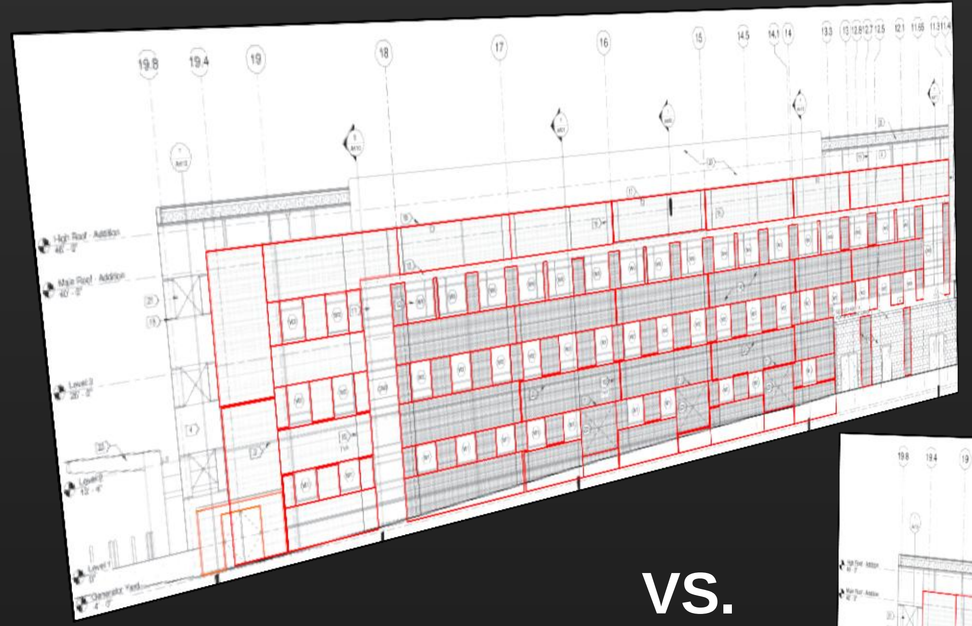
## Problem:
## Weather and Constructability Issues Impact Schedule

### Original:

| | | | |
|---|---|---|---|
| | 63 | 03-Apr-12 | 29-Jun-12 |
| Layout Exterior Walls | 6 | 03-Apr-12 | 10-Apr-12 |
| Install Top Track and Clips | 6 | 06-Apr-12 | 13-Apr-12 |
| Set Up Equipment & Fireproof Perimeter Steel | 5 | 16-Apr-12 | 20-Apr-12 |
| Frame Perimeter Walls | 15 | 23-Apr-12 | 11-May-12 |
| Install Exterior Wall Sheathing | 15 | 02-May-12 | 22-May-12 |
| Install Vapor Barrier and Wall Ties | 15 | 11-May-12 | 01-Jun-12 |
| Erect Exterior Brick and Precast Accent Band | 15 | 25-May-12 | 15-Jun-12 |
| Install Exterior Windows | 8 | 18-Jun-12 | 27-Jun-12 |
| Install Curtainwall | 8 | 18-Jun-12 | 27-Jun-12 |
| East Elevation - Caulking | 8 | 20-Jun-12 | 29-Jun-12 |

### Actual:

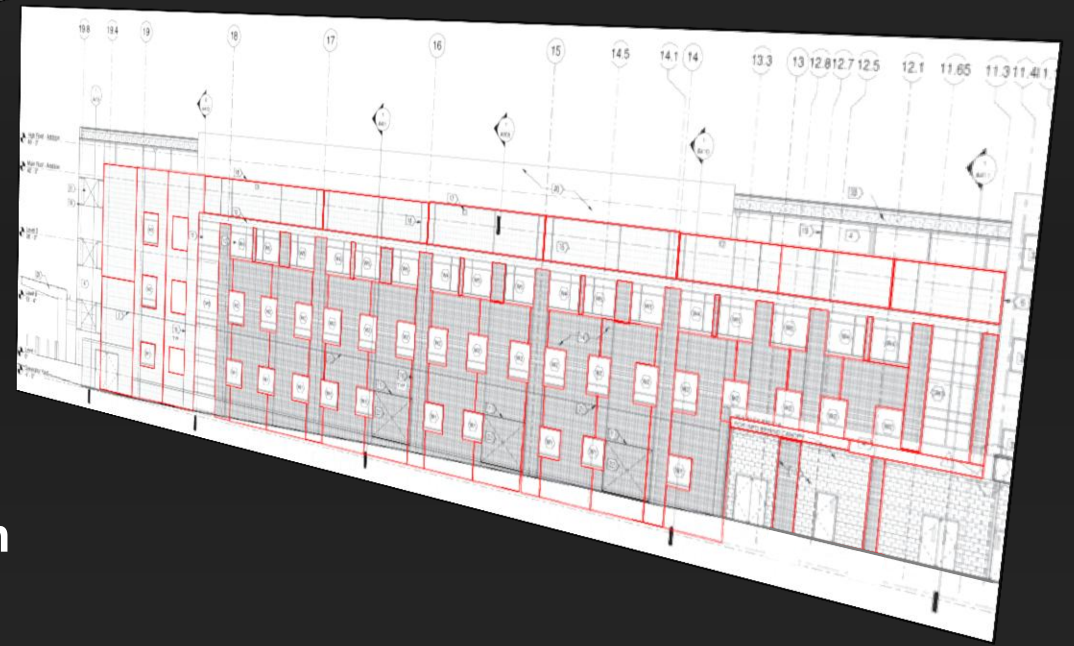
| | | | |
|---|---|---|---|
| | 138 | 05-Mar-12 A | 17-Sep-12 |
| Layout Exterior Walls East Elevation | 4 | 05-Mar-12 A | 08-Mar-12 A |
| Set Up Equipment & Fireproof Perimeter Steel | 17 | 09-Mar-12 A | 02-Apr-12 A |
| Install Top Track and Clips East Elevation | 3 | 19-Mar-12 A | 21-Mar-12 A |
| Frame Perimeter Walls East Elevation | 28 | 21-Mar-12 A | 30-Apr-12 A |
| Install Exterior Wall Sheathing East Elevation | 18 | 17-Apr-12 A | 11-May-12 A |
| Install Vapor Barrier and Wall Ties East Elevation | 26 | 25-May-12 A | 02-Jul-12 A |
| Erect Exterior Brick and Precast Accent Band East Elevation | 22 | 25-Jun-12 A | 26-Jul-12 A |
| Install Exterior Windows East Elevation | 17 | 13-Aug-12 A | 05-Sep-12 |
| Install Curtainwall East Elevation | 8 | 04-Sep-12 | 3-Sep-12 |
| East Elevation - Caulking | 8 | 06-Sep-12 | 17-Sep-12 |



## Horizontal

+ Easier to handle
+ More repetition
- Significant panel count

VS.



## Vertical

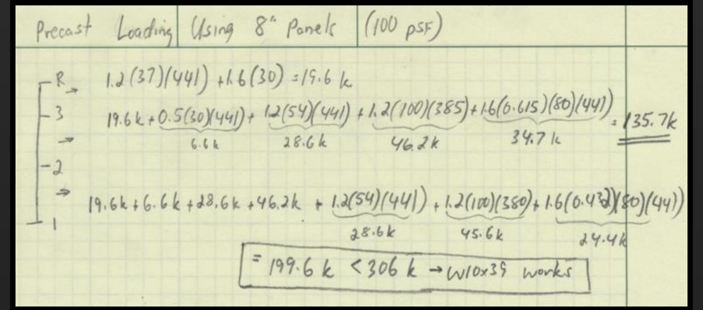
+ Lower panel count
+ Less connections
- High level of customization

# Kaiser Permanente Largo Medical Office Building
*Largo, MD*
## Chris Pozza - Construction

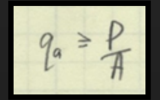
# Structural and Mechanical Breadth Studies



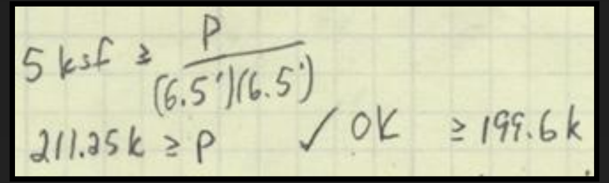
## Structural Steel:



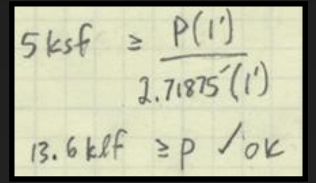

## Foundations:



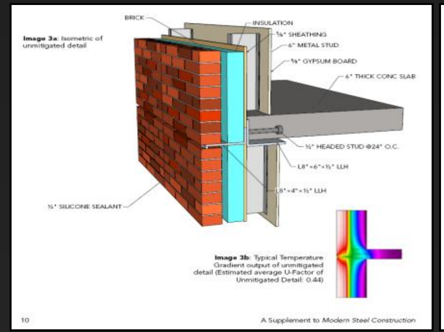

## Spread Footing:

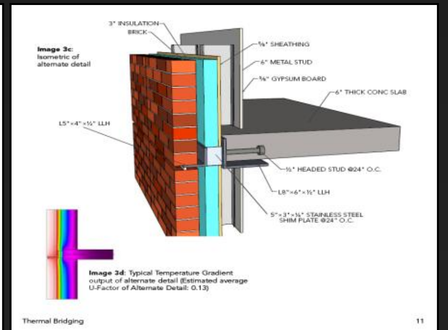



## Strip Footing:




| Wall R Values (Winter) | 3.5" Face Brick | 7" Precast Panels |
|---|---|---|
| $R_o$ - Outside Air Barrier | 0.17 | 0.17 |
| $R_1$ - 3 1/2" Face Brick (R=0.11 per inch)<br>Alternate $R_1$ - 7" Precast Panel with Thin Brick | 0.385 | 0.53 |
| $R_2$ - 1 7/8" Air Space | 1.23 | 1.23 |
| $R_3$ - 2" Rigid Insulation (R=5 per inch) | 10 | 10 |
| $R_4$ - Vapor Barrier | Negligible | Negligible |
| $R_5$ - 1/2" Gypsum Sheathing | 0.45 | 0.45 |
| $R_6$ - 6" Metal Stud / 6" Batt Insulation R-19 | 7.1 | 7.1 |
| $R_7$ - 5/8" Gypsum Sheathing – 51 | 0.56 | 0.56 |
| $R_i$ - Inside Air Film (Vertical Position, Horizontal Heat Flow) | 0.68 | 0.68 |
| Total R | 20.575 | 20.72 |
| $U_{avg}$ or Total U (1/R) | 0.0486 | 0.04826 |





## Conclusion

### Structure:

*Structural upgrades not required due to building size*

*Axial loading does not control structural design*

### Mechanical:

*Panels will provide slightly better thermal properties*

*Current system design is acceptable*

*Proper measures are required to prevent thermal bridging:*

- *Stainless Steel Shim Plates*
- *Plastic Shims*
- *Silicone Joint Sealant*

# Analysis 2 – Precast Panel Implementation



## Horizontal Panels

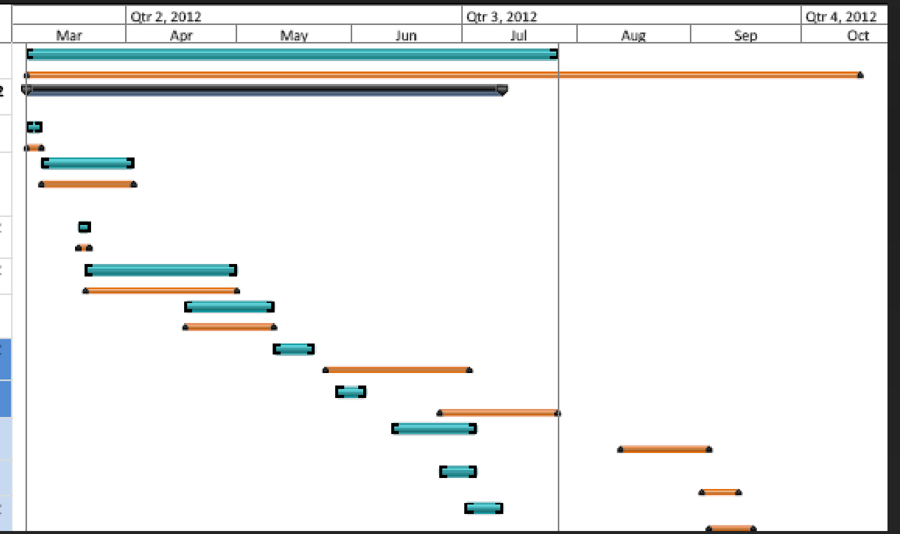
- *More practical*
- *High Unit Price*
- *244 total panels*

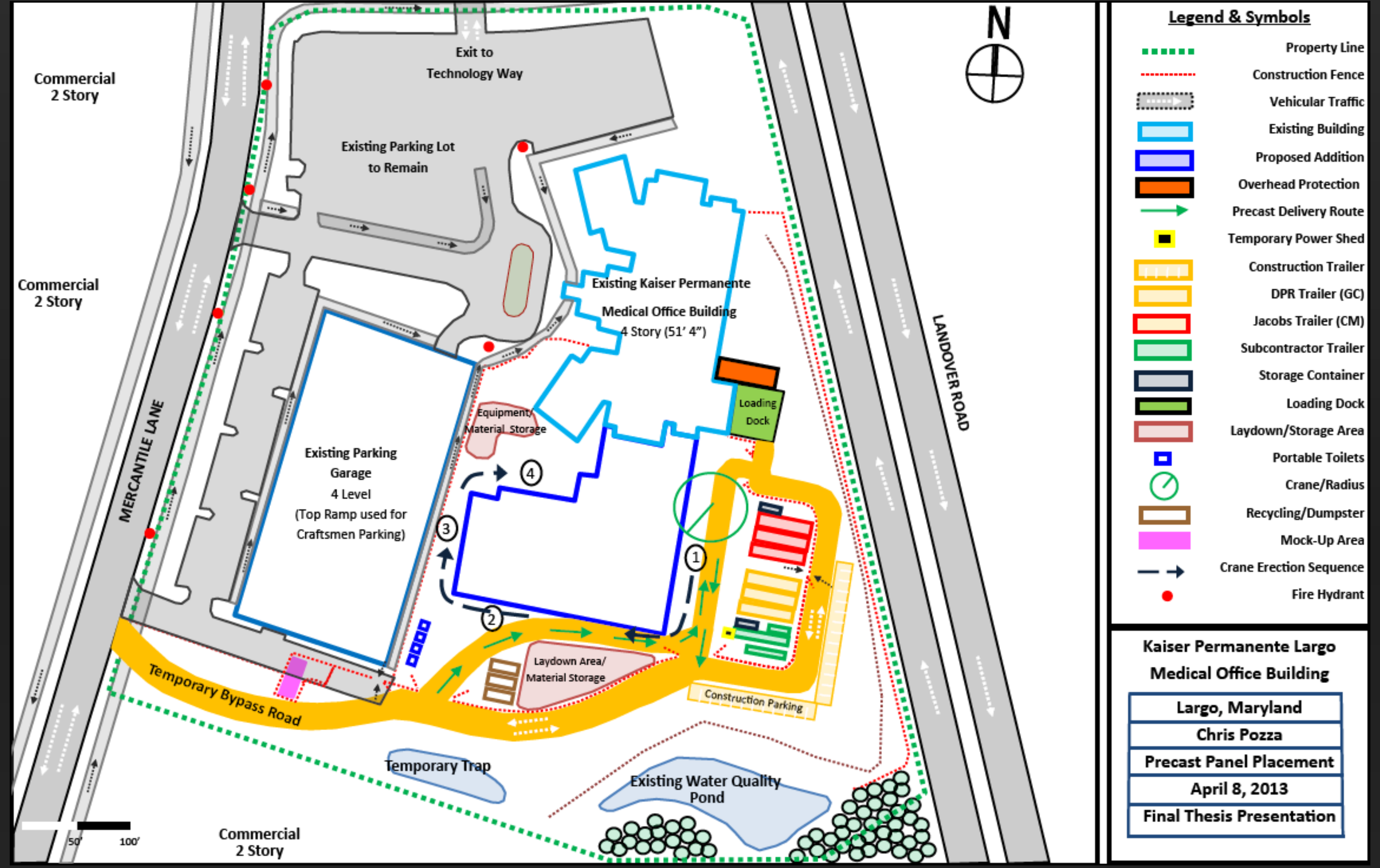
| System Cost Comparison | |
|---|---|
| Precast Panel System | $1,257,190.37 |
| Masonry Façade | $1,131,376.00 |
| Proposed Precast Additional Cost | $125,814.37 |

## Schedule Analysis

*15 panels per day*
*Eliminates Brick Ties*
*Easier vapor barrier installation*

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | Exterior Enclosure | 104 days | Mon 3/5/12 | Thu 7/26/12 |
| 2 | East Elevation | 93 days | Mon 3/5/12 | Wed 7/11/12 |
| 3 | Layout Exterior Walls | 4 days | Mon 3/5/12 | Thu 3/8/12 |
| 4 | Set up Equipment & Fireproof Perimeter Steel | 17 days | Fri 3/9/12 | Mon 4/2/12 |
| 5 | Install Top Track and Clips | 3 days | Mon 3/19/12 | Wed 3/21/12 |
| 6 | Frame Perimeter Walls | 29 days | Wed 3/21/12 | Mon 4/30/12 |
| 7 | Install Exterior Wall Sheathing | 18 days | Tue 4/17/12 | Thu 5/10/12 |
| 8 | Install Vapor Barrier & Insulation | 7 days | Fri 5/11/12 | Mon 5/21/12 |
| 9 | Erect Precast Panels | 6 days | Mon 5/28/12 | Mon 6/4/12 |
| 10 | Install Exterior Windows | 17 days | Tue 6/12/12 | Wed 7/4/12 |
| 11 | Install Curtain Wall | 8 days | Mon 6/25/12 | Wed 7/4/12 |
| 12 | Caulking | 8 days | Mon 7/2/12 | Wed 7/11/12 |



# Kaiser Permanente Largo Medical Office Building

*Largo, MD*

## Chris Pozza - Construction

# Analysis 2 – Final Recommendation

KAISER PERMANENTE

DPR Construction Inc.

ELLERBE BECKET

I. Introduction

II. Analysis 1 – Change Order Management

*III. Analysis 2 – Precast Panel Implementation*

A. Structural Breadth

B. Mechanical Breadth

IV. Analysis 3 – Use of Virtual Mock-Ups for SIPS

V. Analysis 4 – Modularization Comparison

VI. Conclusion & Recommendations

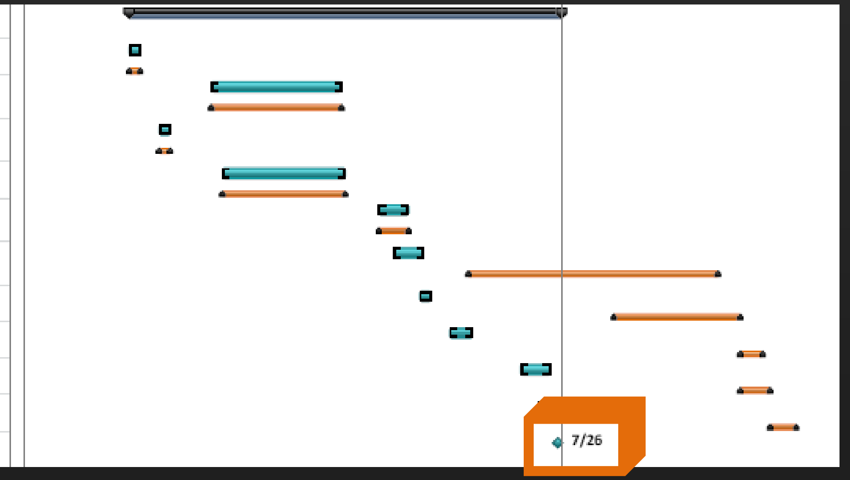
VII. Acknowledgements

## Schedule Savings

| Proposed Schedule Savings | | | |
|---|---|---|---|
| | Days | Weeks | Months |
| Activity Savings | 61 | 8.7 | 2.0 |
| **Schedule Savings** | **45** | **6.5** | **1.5** |

| General Conditions Costs | |
|---|---|
| Total Savings (1.5 Months) | $295,264.35 |
| Additional Crane Cost | $44,078.22 |
| **Total GC Cost Savings** | **$251,186.13** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 35 | **North Elevation** | **84 days** | **Mon 4/2/12** | **Thu 7/26/12** | **126 days** | **Mon 4/2/12** | **Thu 9/27/12** |
| 36 | Layout Exterior Walls | 3 days | Mon 4/2/12 | Wed 4/4/12 | 3 days | Mon 4/2/12 | Wed 4/4/12 |
| 37 | Install Top Track and Clips | 25 days | Tue 4/24/12 | Mon 5/28/12 | 25 days | Tue 4/24/12 | Mon 5/28/12 |
| 38 | Fireproof Perimeter Steel | 3 days | Tue 4/10/12 | Thu 4/12/12 | 3 days | Tue 4/10/12 | Thu 4/12/12 |
| 39 | Frame Perimeter Walls | 23 days | Fri 4/27/12 | Tue 5/29/12 | 23 days | Fri 4/27/12 | Tue 5/29/12 |
| 40 | Install Exterior Wall Sheathing | 6 days | Fri 6/8/12 | Fri 6/15/12 | 6 days | Fri 6/8/12 | Fri 6/15/12 |
| 41 | Install Vapor Barrier & Insulation | 6 days | Tue 6/12/12 | Tue 6/19/12 | 47 days | Mon 7/2/12 | Thu 9/6/12 |
| 42 | Erect Precast Panels | 3 days | Tue 6/19/12 | Thu 6/21/12 | 23 days | Fri 8/10/12 | Wed 9/12/12 |
| 43 | Install Exterior Windows | 4 days | Wed 6/27/12 | Mon 7/2/12 | 4 days | Thu 9/13/12 | Tue 9/18/12 |
| 44 | Install Curtain Wall | 6 days | Mon 7/16/12 | Mon 7/23/12 | 6 days | Thu 9/13/12 | Thu 9/20/12 |
| 45 | Caulking | 5 days | Sat 7/21/12 | Thu 7/26/12 | 5 days | Fri 9/21/12 | Thu 9/27/12 |
| 46 | **Building Watertight** | 0 days | Thu 7/26/12 | Thu 7/26/12 | 0 days | Thu 9/27/12 | Thu 9/27/12 |




## Final Recommendation

***Implement precast panels***

***Current systems won't be impacted***

| Final Cost Comparison Summary | |
|---|---|
| Proposed System Cost | $1,257,190.37 |
| Additional Crane Cost | $44,078.22 |
| Actual System Cost | $1,131,376 |
| General Conditions Savings | $295,264.35 |
| **Total Cost Savings** | **$125,371.76** |

***Schedule savings are greatest benefit!***

# Analysis 3 – Use of Virtual Mock-Ups for SIPS



**Original Schedule:**

| | | | |
|---|---|---|---|
| BIM Coordination | 183 | 09-May-11A | 07-Feb-12 |

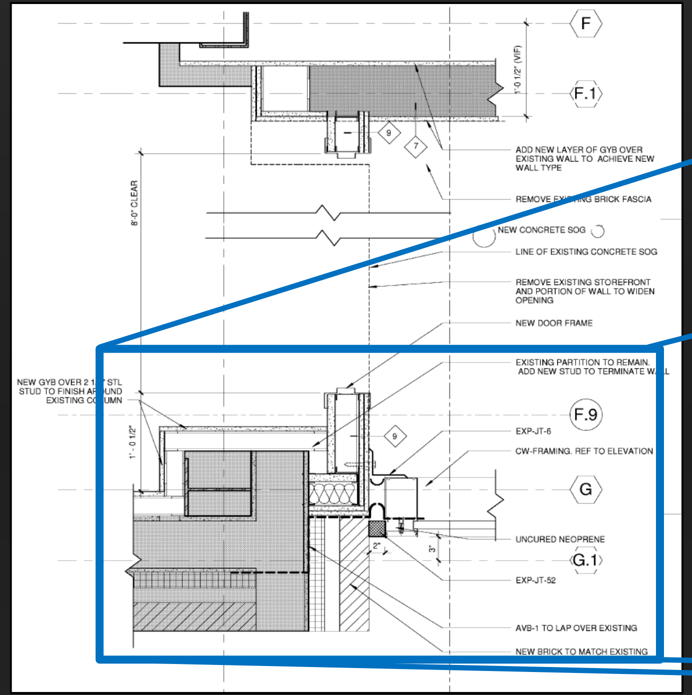
**Actual Schedule:**

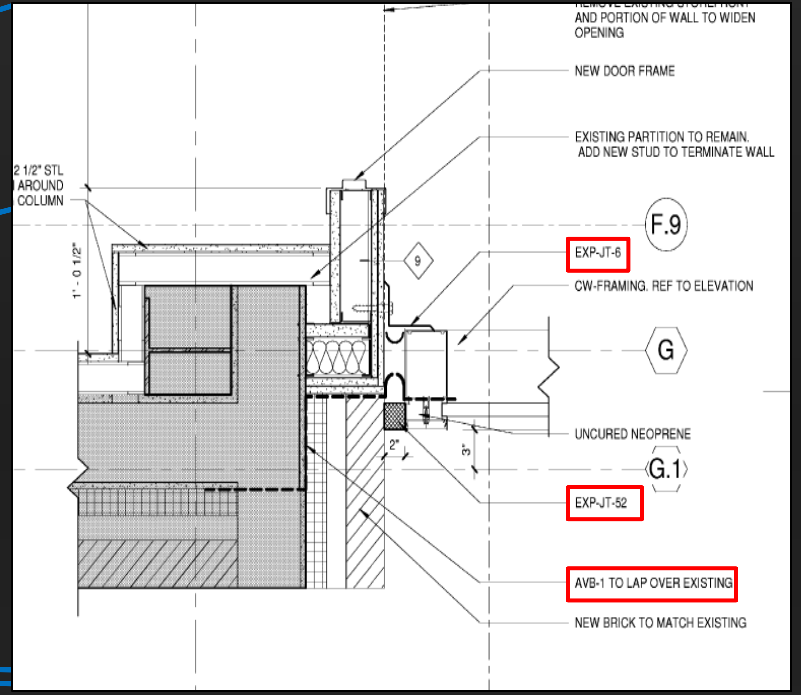
| | | | |
|---|---|---|---|
| BIM Coordination | 283 | 09-May-11A | 20-Jun-12 A |

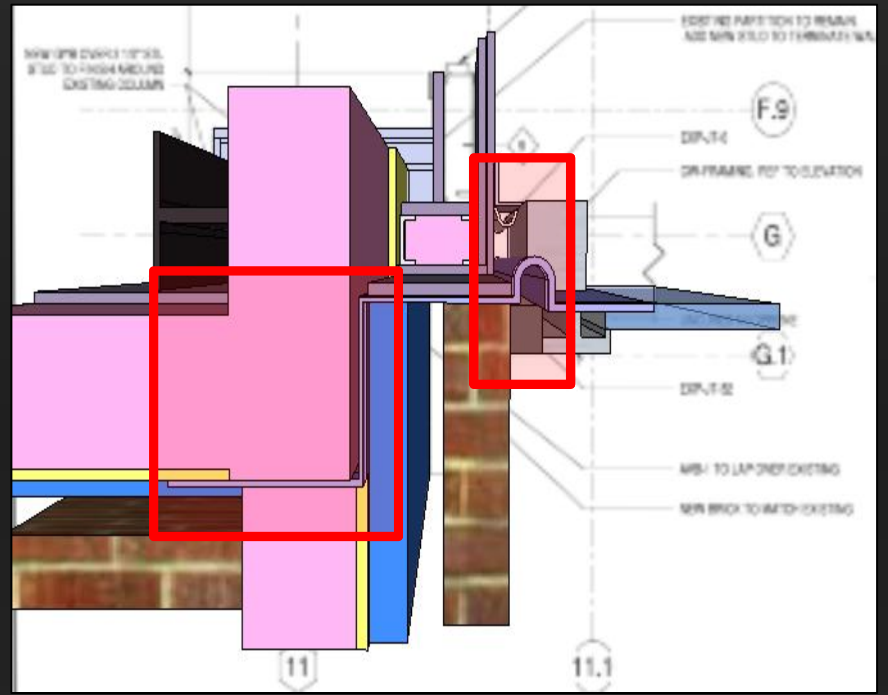
***Case Study: Tyson's Corner***

*32 Rooms*
*110 Changes*
*Total cost: $38,000*
*<u>Owner benefit only</u>*

## Problem:
## Building Connection Constructability Issues







***Solution: EMSEAL***

# Kaiser Permanente Largo Medical Office Building

*Largo, MD*

**Chris Pozza - Construction**

# Analysis 3 – Use of Virtual Mock-Ups for SIPS



## Traditional SIPS

- One specific operation is analyzed
- A much higher level of detail is needed
- Personnel input and commitment is required from all

*Project:* Kaiser Permanente Largo Medical Office Building  *Zone:* Northwest Building Connection

| Activity | Quanity | Unit | Budget Production (Units / MHR) | Total Budget Time (MHR) | Crew Size (People) | Activity Duration (HR) | Activity Duration (Days) | Notes |
|---|---|---|---|---|---|---|---|---|
| Construct Temporary Partition | 1 | EA | 0.25 | 4 | 2 | 2.0 | 0.3 | Wood Studs/Drywall Enclosure - Off-hours (OH) |
| Remove Drywall/Insulation | 75 | SF | 18.75 | 4 | 2 | 2.0 | 0.3 | Tear Down / Clean Up - (OH) |
| Relocate Electric Conduit | 15 | LF | 5.00 | 3 | 1 | 3.0 | 0.4 | Determine source location if needed |
| Saw Cut Brick/Remove Studs | 75 | SF | 4.70 | 32 | 4 | 8.0 | 1.0 | Including 3 courses below finished floor - (OH) |
| Insert 5/16" Bent Plate | 8 | LF | 2.00 | 8 | 4 | 2.0 | 0.3 | 1/2" Diameter 6" Imbeds, 24" O.C. - (OH) |
| Place Concrete/Expansion Joint | 1 | CY | 0.50 | 4 | 2 | 2.0 | 0.3 | Joint depressed 3/4" for cover |
| Set Door Frame | 1 | EA | 0.33 | 3 | 1 | 3.0 | 0.4 | |
| Frame Opening/Header & Studs | 1 | EA | 0.13 | 8 | 2 | 4.0 | 0.5 | |
| Drywall & Spackle | 75 | SF | 25.00 | 3 | 1 | 3.0 | 0.4 | Both sides, assume half the total area each side |
| Hang Doors/Install Hardware | 1 | EA | 0.20 | 5 | 1 | 5.0 | 0.6 | Double Set with Panic Hardware |
| Prime/Paint | 75 | SF | 25.00 | 3 | 1 | 3.0 | 0.4 | Both sides, assume half the total area each side |
| Remove Parition/Cleanup | 1 | EA | 0.25 | 4 | 2 | 2.0 | 0.3 | Off-hours (OH) |
| TOTALS | | | | 77 | 21.0 | 37.0 | 4.6 | |

***+ Reach level of detail necessary to maximize efficiency***

### Additional Man-Hours for Building Tie-In

| Activity | Time (hr.) | Crew Size | Man-hours |
|---|---|---|---|
| Insert 5/16" Bent Plate | 3 | 4 | 12 |
| Place Concrete/Expansion Joint | 4 | 2 | 8 |
| Total Man-Hours | | | 20 |

# Analysis 3 – Final Recommendation

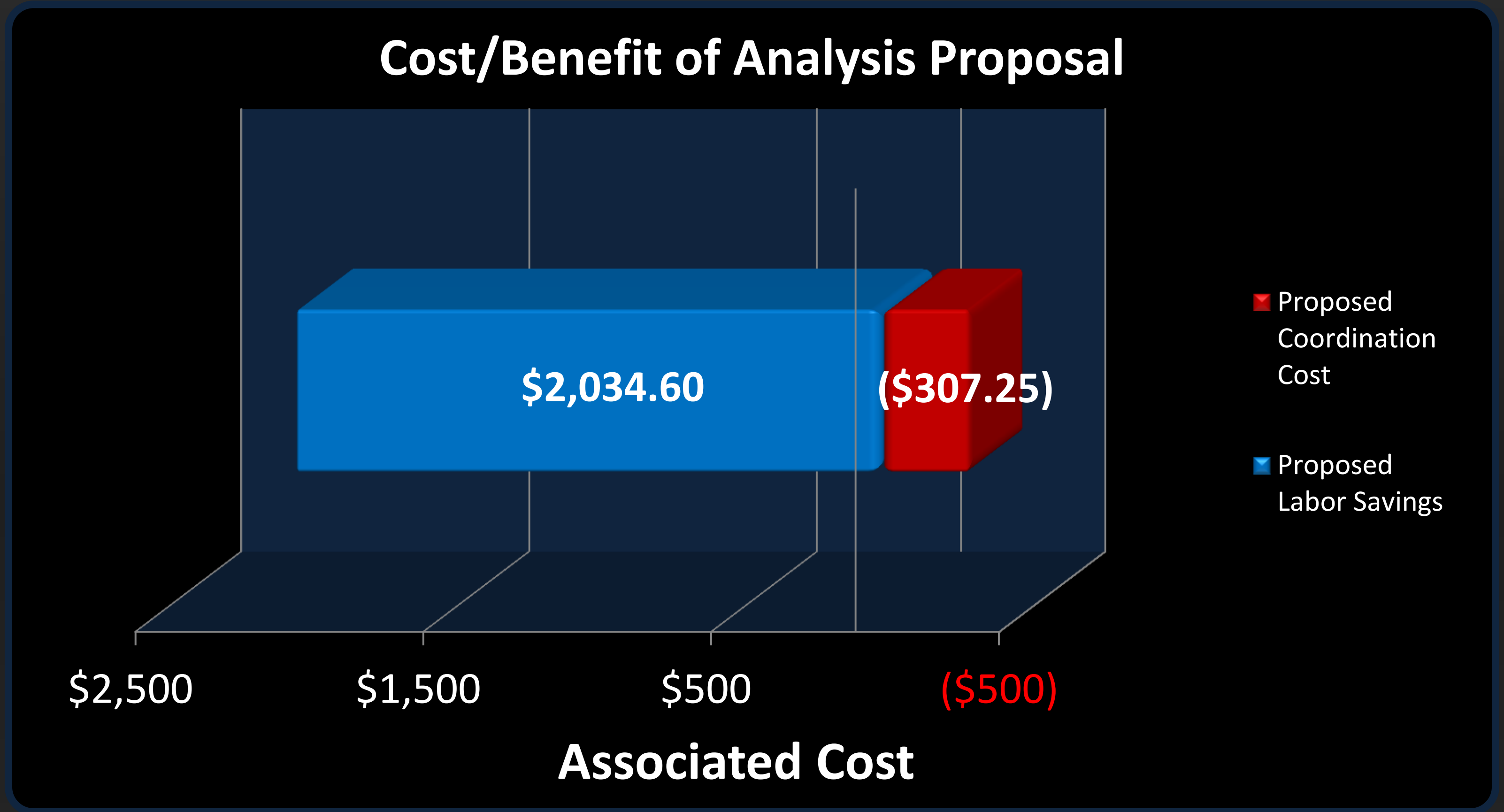
KAISER PERMANENTE

DPR Construction Inc.

ELLERBE BECKET



**2.5 Hrs. BIM Champ**
**1 Hr. Superintendent**
**20 Man-Hrs. Saved**
**$1,700 - Potential savings**




## Potential Value Added:

- Strong visualization and communication tool for all parties
- Subcontractor feedback and proper preparation
- Eliminate coordination issues
- Show end users how existing building will be impacted
- Perform premium-rate work the most efficient way possible
- Cause as little disturbance for building occupants

# Analysis 4 – Modularization Comparison



| | | | | | |
|---|---|---|---|---|---|
| Interior Construction | | 245 | 243 | 05-Mar-12 A | 20-Feb-13 |
| M/E/P & FP Rough Ins | | 180 | 178 | 05-Mar-12 A | 12-Nov-12 |
| Level 1 | | 180 | 178 | 05-Mar-12 A | 12-Nov-12 |
| RI.01.1000 | Fireproof Structure | 15 | 14 | 09-Mar-12 A | 29-Mar-12 A |
| Area "B" | | 133 | 131 | 05-Mar-12 A | 06-Sep-12 |
| RI.1B.1000 | 1B1 - Lay Out Walls | 10 | 8 | 05-Mar-12 A | 15-Mar-12 A |
| RI.1B.1020 | 1B1 - OH Plbg Rough In | 10 | 77 | 13-Mar-12 A | 29-Jun-12 A |
| RI.1B.1030 | 1B1 - OH Elec & Tele/Data Rough In | 10 | 91 | 13-Mar-12 A | 20-Jul-12 A |
| RI.1B.1010 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| RI.1B.1070 | 1B1 - Frame Walls | 10 | 61 | 26-Mar-12 A | 20-Jun-12 A |
| RI.1B.1120 | 1B1 - In Wall Elec Rough In | 10 | 51 | 04-Apr-12 A | 15-Jun-12 A |
| RI.1B.1050 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| RI.1B.1040 | 1B1 - OH F.A. Rough In | 10 | 66 | 09-Apr-12 A | 12-Jul-12 A |
| RI.1B.1100 | 1B1 - In Wall Mech Rough In | 10 | 40 | 18-Apr-12 A | 14-Jun-12 A |
| RI.1B.1110 | 1B1 - In Wall Plbg Rough In | 10 | 50 | 18-Apr-12 A | 28-Jun-12 A |
| RI.1B.1080 | 1B1 - Set Door Frames | 5 | 24 | 20-Apr-12 A | 23-May-12 A |
| RI.1B.1150 | 1B1 - Pipe and Duct Testing | 5 | 46 | 02-May-12 A | 09-Jul-12 A |
| RI.1B.1160 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| RI.1B.1130 | 1B1 - In Wall Med Gas Rough In | 10 | 40 | 16-May-12 A | 13-Jul-12 A |
| RI.1B.1140 | 1B1 - In Wall Tele / Data Rough In | 10 | 19 | 24-May-12 A | 21-Jun-12 A |
| RI.1B.1090 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| RI.1B.1185 | 1B1 - Install Blocking | 10 | 11 | 16-Jul-12 A | 31-Jul-12 A |
| RI.1B.1170 | 1B1 - Wall Close In Inspection | 2 | 15 | 26-Jul-12 A | 15-Aug-12 A |
| RI.1B.1060 | 1B1 - OH Sprinkler Rough In | 10 | 20 | 07-Aug-12 A | 04-Sep-12 |
| RI.1B.1180 | 1B1 - MEP OH Inspection | 2 | 2 | 05-Sep-12 | 06-Sep-12 |
| RI.1B.1190 | 1B1 - Sprinkler Hydro Test | 1 | 1 | 05-Sep-12 | 05-Sep-12 |

## Problem:
## Modular headwall units used were very labor intensive

vs.

## Labor Savings (Man-Hours)

| Activity | Average Unit Durations (hr.) | L1 - Area B | L1 - Area C | L3 - Area B | Total |
|---|---|---|---|---|---|
| Frame Walls | 2 | 32 | 16 | 50 | 98 |
| In-Wall Electric Rough-Ins | 3 | 48 | 24 | 75 | 147 |
| In-Wall Med Gas Rough-Ins | 5 | 80 | 40 | 125 | 245 |
| In-Wall Tele/Data Rough-Ins | 1.5 | 24 | 12 | 37.5 | 73.5 |
| | | | | Total | 563.5 |

## Schedule Savings (Days)

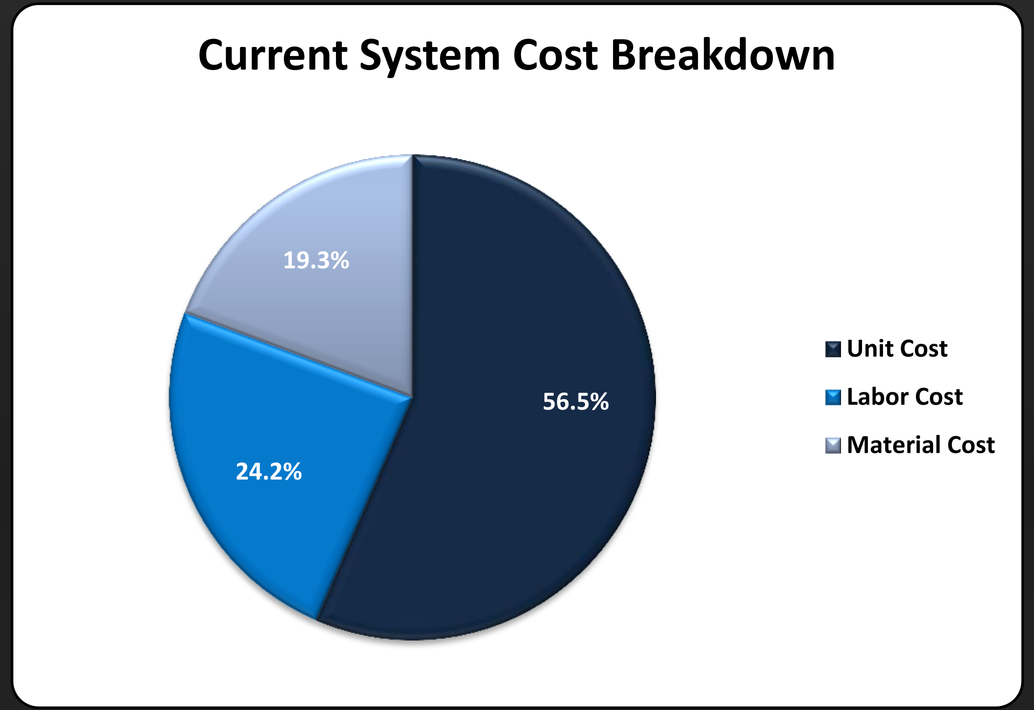
| Activity | Average Unit Durations (hr.) | L1 - Area B | L1 - Area C | L3 - Area B | Total |
|---|---|---|---|---|---|
| Frame Walls | 2 | 4 | 2 | 6.3 | 12.3 |
| In-Wall Electric Rough-Ins | 3 | 6 | 3 | 9.4 | 18.4 |
| In-Wall Med Gas Rough-Ins | 5 | 10 | 5 | 15.6 | 30.6 |
| In-Wall Tele/Data Rough-Ins | 1.5 | 3 | 1.5 | 4.7 | 9.2 |
| | | | | Total | 70.4 |

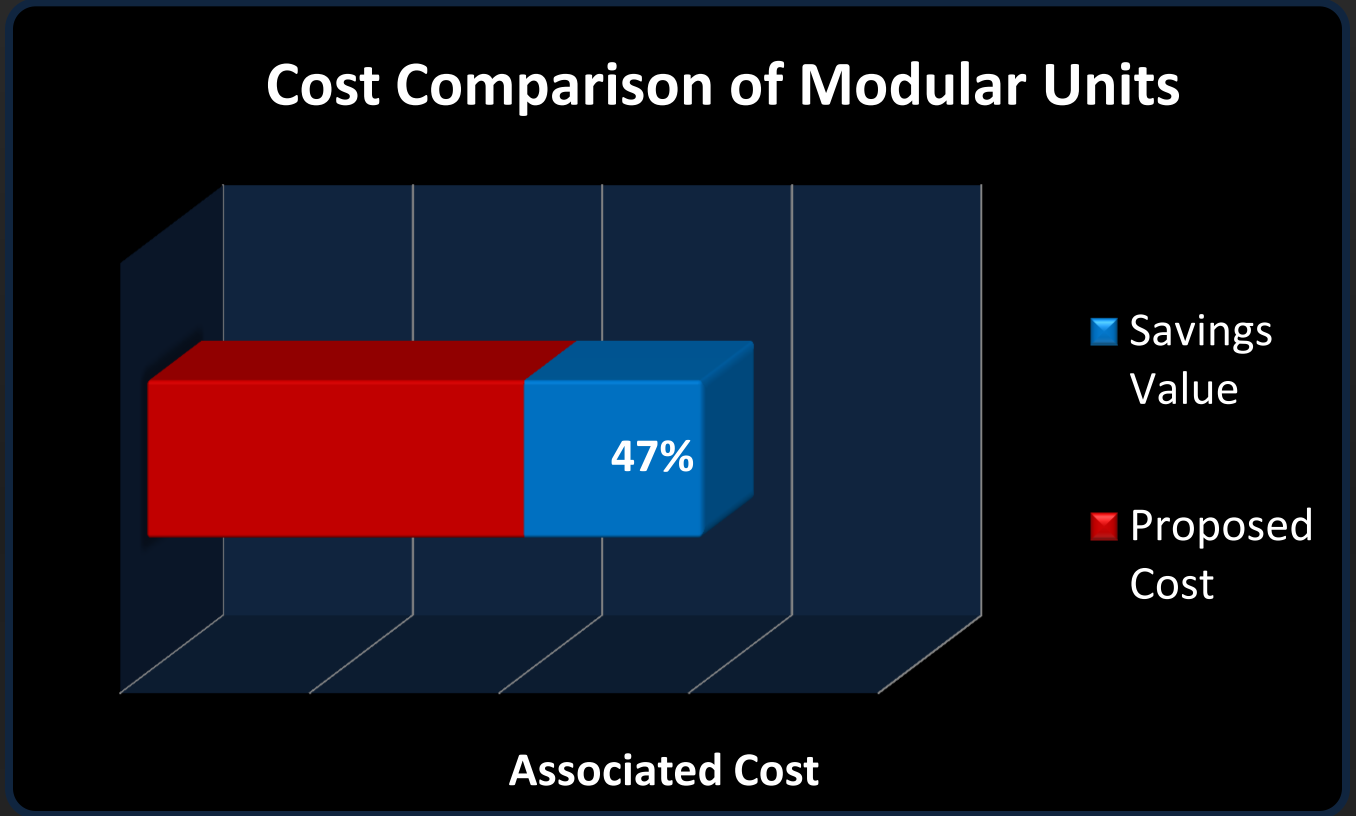
***Does not affect critical path for this project***

# Kaiser Permanente Largo Medical Office Building
*Largo, MD*
## Chris Pozza - Construction

# Analysis 4 – Modularization Comparison






## Final Recommendation

**With chosen design, modules can only benefit the project**

**Recommend for future projects**

- ***Reduces labor***
- ***Improving quality***
- ***Streamlines MEP rough-ins***

**If half the time saved shortened critical path, general conditions savings would greatly offset cost**

# Kaiser Permanente Largo Medical Office Building
*Largo, MD*
## Chris Pozza - Construction

# Conclusion & Recommendations



- Shortens Schedule
- Improves Efficiency
- Increases Collaboration
- Streamlines Processes

## Analysis 1 – Change Order Management

1. Give Authority to the CM to Approve Changes
2. Purchase Preconstruction Services
3. Implement an Alternate Change Review Process

*+ Early trade involvement for intense MEP coordination*

*+ Significantly reduce management time*

*+ Better cash flow for subcontractors*

## Analysis 2 – Precast Panel Implementation

| Proposed Schedule Savings | | | |
|---|---|---|---|
| | Days | Weeks | Months |
| Activity Savings | 61 | 8.7 | 2.0 |
| Schedule Savings | 45 | 6.5 | 1.5 |

| General Conditions Costs | |
|---|---|
| Total Savings (1.5 Months) | $295,264.35 |
| Additional Crane Cost | $44,078.22 |
| Total GC Cost Savings | $251,186.13 |

*+ Total cost savings: $125,371.76*

*+ Structural upgrades not required*

*+ Panels have better thermal characteristics*

*+ Current mechanical system is acceptable*

## Analysis 3 – Use of Virtual Mock-Ups for SIPS

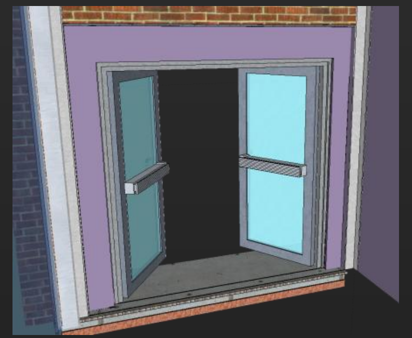
*+ Potential savings of $1,700*

*+ Strong visualization and communication tool*

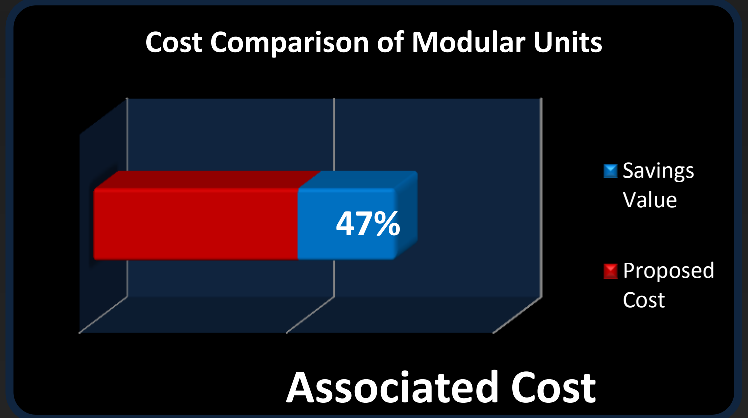
*+ Subcontractor feedback*

*+ Show end users how existing building will be impacted*

*+ Perform premium-rate work the most efficient way possible*



## Analysis 4 – Modularization Comparison




### Recommend for future projects

*+ Reduces labor*

*+ Improving quality*

*+ Streamlines MEP rough-ins*

# Acknowledgements



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PENNSTATE
1855

PENNSTATE
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Architectural Engineering

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MODULAR SERVICES COMPANY
Hill-Rom
Southland Industries Design Build Maintain
Tindall

**Kaiser Permanente Largo Medical Office Building**

*Largo, MD*

**Chris Pozza - Construction**

# Thank you! Any questions?

KAISER PERMANENTE

DPR Construction Inc.

ELLERBE BECKET

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# Appendix – Change Order Management

**Owner Change Order 10**

| CQ Included | Date Initiated | Date ROM Submitted | Calendar Days from Initiation until ROM Submitted | Date Final Pricing Submitted | Calendar Days from ROM Submitted until Final Pricing Submission | Total Price | Date Closed | Calendar Days from Final Pricing Submission until KP Approval | Total Weeks | Total Months |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.1 | 7/28/2011 | 3/12/2012 | 163 | 3/12/2012 | 1 | 9,520.28 | 6/28/2012 | 79 | 11.3 | 2.6 |
| 42 | 2/13/2012 | 5/2/2012 | 58 | 5/2/2012 | 1 | -42,077.08 | 6/28/2012 | 42 | 6.0 | 1.4 |
| 58 | 11/2/2011 | 1/16/2012 | 54 | 1/16/2012 | 1 | 30,630.51 | 6/28/2012 | 119 | 17.0 | 3.9 |
| 133 | 3/21/2012 | 4/25/2012 | 26 | 5/10/2012 | 12 | 1,711.10 | 6/28/2012 | 36 | 5.1 | 1.2 |
| 155 | 4/30/2012 | 5/2/2012 | 3 | 5/2/2012 | 1 | 2,050.78 | 6/28/2012 | 42 | 6.0 | 1.4 |
| | | Average | 61 | Average | 3 | | Average | 63.6 | 9.1 | 2.1 |
| | | | | | Total Cost | $1,835.59 | | | | |

**Owner Change Order 24**

| CQ Included | Date Initiated | Date ROM Submitted | Calendar Days from Initiation until ROM Submitted | Date Final Pricing Submitted | Calendar Days from ROM Submitted until Final Pricing Submission | Total Price | Date Closed | Calendar Days from Final Pricing Submission until KP Approval | Total Weeks | Total Months |
|---|---|---|---|---|---|---|---|---|---|---|
| 099Rev | 10/9/2012 | 10/17/2012 | 7 | 10/17/2012 | 1 | 7,498.99 | 2/5/2013 | 80 | 11.4 | 2.6 |
| 127 | 3/8/2012 | 11/6/2012 | 174 | 11/7/2012 | 2 | 4,654.44 | 2/5/2013 | 65 | 9.3 | 2.1 |
| 157 | 5/1/2012 | 10/12/2012 | 119 | 10/12/2012 | 1 | 5,863.40 | 2/5/2013 | 83 | 11.9 | 2.7 |
| 182 | 6/11/2012 | 6/11/2012 | 1 | 11/5/2012 | 106 | 36,182.22 | 2/5/2013 | 67 | 9.6 | 2.2 |
| 188 | 6/15/2012 | 11/2/2012 | 101 | 11/2/2012 | 1 | 4,232.14 | 2/5/2013 | 68 | 9.7 | 2.2 |
| 196 | 7/9/2012 | 10/15/2012 | 71 | 10/15/2012 | 1 | 14,529.92 | 2/5/2013 | 82 | 11.7 | 2.7 |
| 203 | 7/25/2012 | 11/2/2012 | 73 | 11/2/2012 | 1 | 2,229.03 | 2/5/2013 | 68 | 9.7 | 2.2 |
| 240 | 8/22/2012 | 9/20/2012 | 22 | 9/20/2012 | 1 | 3,922.45 | 2/5/2013 | 99 | 14.1 | 3.3 |
| 261 | 9/19/2012 | 10/11/2012 | 17 | 11/20/2012 | 29 | 9,466.81 | 2/5/2013 | 56 | 8.0 | 1.8 |
| 276 | 10/12/2012 | 11/14/2012 | 24 | 11/14/2012 | 1 | 2,578.74 | 2/5/2013 | 60 | 8.6 | 2.0 |
| 298 | 11/13/2012 | 11/20/2012 | 6 | 11/20/2012 | 1 | 12,668.06 | 2/5/2013 | 56 | 8.0 | 1.8 |
| | | Average | 56 | Average | 13 | | Average | 71.3 | 10.2 | 2.4 |
| | | | | | Total Cost | $103,826.20 | | | | |

**Owner Change Order 21**

| CQ Included | Date Initiated | Date ROM Submitted | Calendar Days from Initiation until ROM Submitted | Date Final Pricing Submitted | Calendar Days from ROM Submitted until Final Pricing Submission | Total Price | Date Closed | Calendar Days from Final Pricing Submission until KP Approval | Total Weeks | Total Months |
|---|---|---|---|---|---|---|---|---|---|---|
| 105 | 2/29/2012 | 4/24/2012 | 40 | 5/16/2012 | 17 | 108,713.45 | 1/29/2013 | 185 | 26.4 | 6.1 |
| 236 | 8/22/2012 | 11/5/2012 | 54 | 11/5/2012 | 1 | 7,407.97 | 1/29/2013 | 62 | 8.9 | 2.0 |
| 247 | 8/31/2012 | 10/17/2012 | 34 | 10/17/2012 | 1 | 553.23 | 1/29/2013 | 75 | 10.7 | 2.5 |
| 248 | 8/31/2012 | 10/17/2012 | 34 | 10/17/2012 | 1 | 553.23 | 1/29/2013 | 75 | 10.7 | 2.5 |
| 251 | 9/10/2012 | 10/17/2012 | 28 | 10/17/2012 | 1 | 1,758.05 | 1/29/2013 | 75 | 10.7 | 2.5 |
| | | Average | 38 | Average | 4 | | Average | 94.4 | 13.5 | 3.1 |
| | | | | | Total Cost | $118,985.93 | | | | |

**Owner Change Order 012**

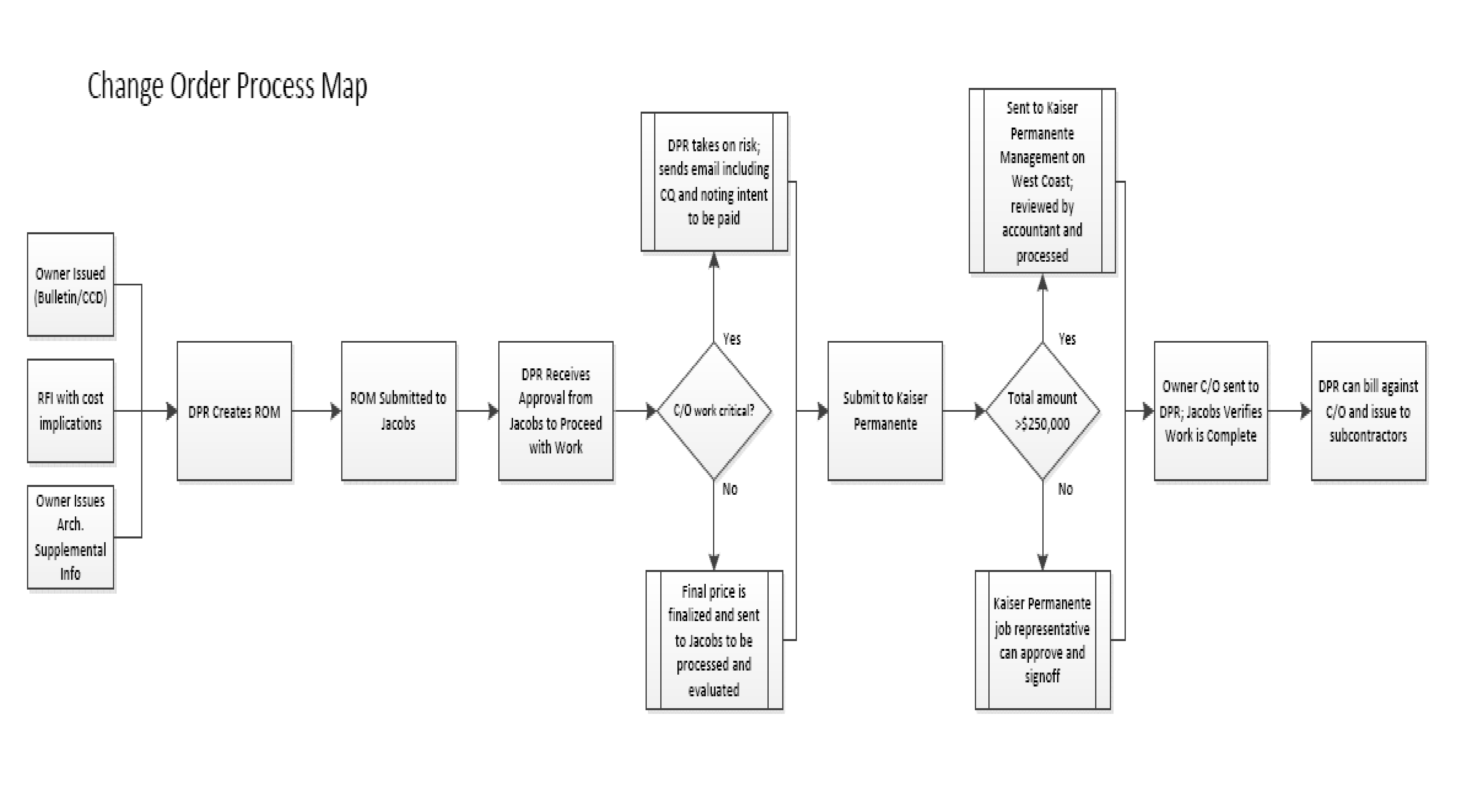
| CQ Included | Date Initiated | Date ROM Submitted | Calendar Days from Initiation until ROM Submitted | Date Final Pricing Submitted | Calendar Days from ROM Submitted until Final Pricing Submission | Total Price | Date Closed | Calendar Days from Final Pricing Submission until KP Approval | Total Weeks | Total Months |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.1 | 5/6/2011 | 3/12/2012 | 222 | 3/12/2012 | 1 | 43,523.06 | 8/6/2012 | 106 | 15.1 | 3.5 |
| 17 | 6/12/2012 | 6/22/2012 | 9 | 6/22/2012 | 1 | 199,054.24 | 8/6/2012 | 32 | 4.6 | 1.1 |
| 103 | 2/1/2012 | 3/12/2012 | 29 | 3/12/2012 | 1 | 807.48 | 8/6/2012 | 106 | 15.1 | 3.5 |
| 115 | 2/27/2012 | 3/12/2012 | 11 | 3/12/2012 | 1 | 2,317.61 | 8/6/2012 | 106 | 15.1 | 3.5 |
| 156 | 4/30/2012 | 6/11/2012 | 31 | 6/11/2012 | 1 | 6,387.01 | 8/6/2012 | 41 | 5.9 | 1.4 |
| 170 | 5/15/2012 | 5/21/2012 | 5 | 5/21/2012 | 1 | 5,253.11 | 8/6/2012 | 56 | 8.0 | 1.8 |
| | | Average | 51 | Average | 1 | | Average | 74.5 | 10.6 | 2.5 |
| | | | | | Total Cost | $257,342.51 | | | | |

**Labor Tracking of Change Order (Blue Vest) Crew**

| Day | Date | VarcoMac | Hours | Daily Hours | Pro-Air | Hours | Daily Hours | Metro Painters | Hours | Daily Hours | Total Labor | Total Man-Hours |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 12/11/12 | 8 | 8 | 64 | 2 | 8 | 16 | | | 0 | 10 | 80 |
| 2 | 12/12/12 | 8 | 8 | 64 | 2 | 8 | 16 | | | 0 | 10 | 80 |
| 3 | 12/13/12 | 10 | 8 | 80 | 1 | 8 | 8 | | | 0 | 11 | 88 |
| 4 | 12/14/12 | 5 | 8 | 40 | 1 | 4 | 4 | | | 0 | 6 | 44 |
| 5 | 12/17/12 | 4 | 8 | 32 | 2 | 8 | 16 | | | 0 | 6 | 48 |
| 6 | 12/18/12 | 3 | 8 | 24 | 1 | 8 | 8 | | | 0 | 4 | 32 |
| 7 | 12/19/12 | 3 | 8 | 24 | 2 | 8 | 16 | | | 0 | 5 | 40 |
| 8 | 12/20/12 | 5 | 8 | 40 | 2 | 4 | 8 | | | 0 | 7 | 48 |
| 9 | 12/21/12 | 5 | 8 | 40 | | | 0 | | | 0 | 5 | 40 |
| 10 | 12/26/12 | 5 | 8 | 40 | | | 0 | | | 0 | 5 | 40 |
| 11 | 1/4/2013 | 5 | 8 | 40 | | | 0 | | | 0 | 5 | 40 |
| 12 | 1/7/2013 | 5 | 8 | 40 | | | 0 | 1 | 8 | 8 | 6 | 48 |
| 13 | 1/8/2013 | 5 | 8 | 40 | | | 0 | 1 | 8 | 8 | 6 | 48 |
| 14 | 1/9/2012 | 5 | 8 | 40 | 1 | 8 | 8 | 1 | 8 | 8 | 7 | 56 |
| 15 | 1/10/2012 | 5 | 8 | 40 | 1 | 8 | 8 | 1 | 8 | 8 | 7 | 56 |
| | **Totals** | | | **648** | | | **108** | | | **32** | | **788** |

**Blue Vest Labor Cost**

| Trade | RSMeans Hourly Wage | Total Man-Hours | Total Labor Cost |
|---|---|---|---|
| VarcoMac | 73.14 | 648 | $47,394.72 |
| Pro-Air | 78.38 | 108 | $8,465.04 |
| MetroPainter | 67.82 | 32 | $2,170.24 |
| Total | | 788 | $58,030.00 |

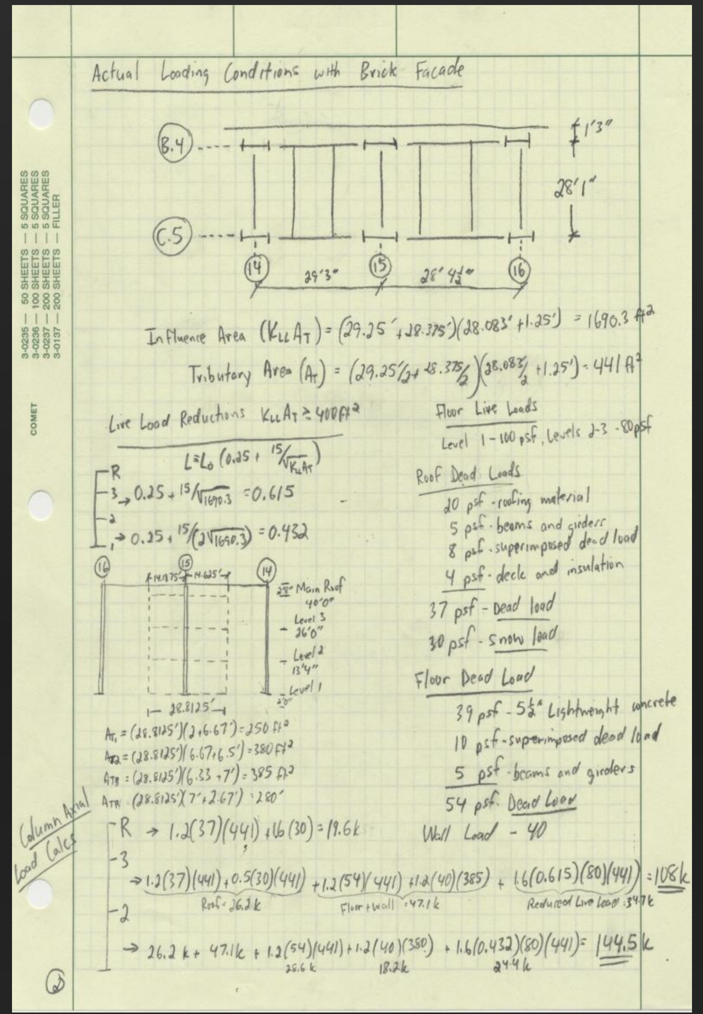


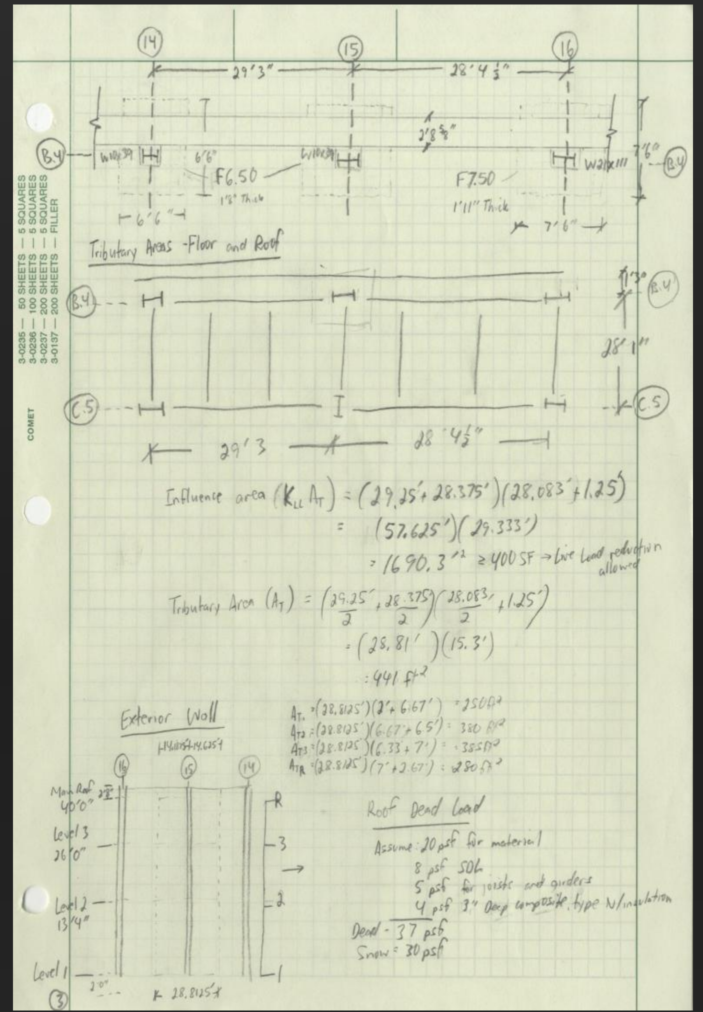
# Kaiser Permanente Largo Medical Office Building

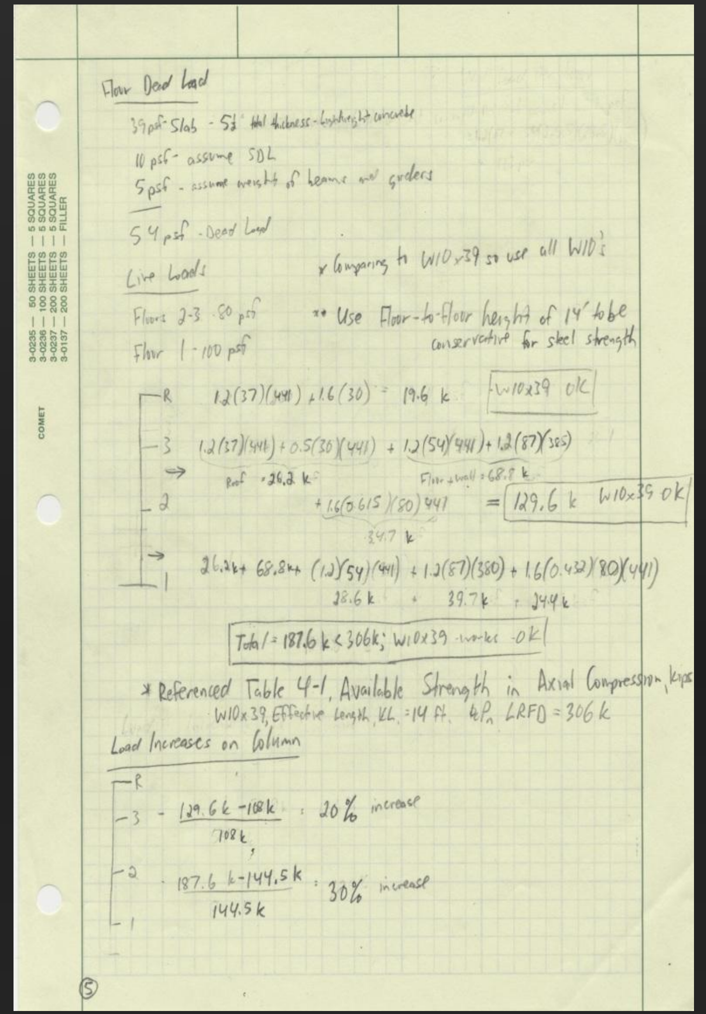
*Largo, MD*

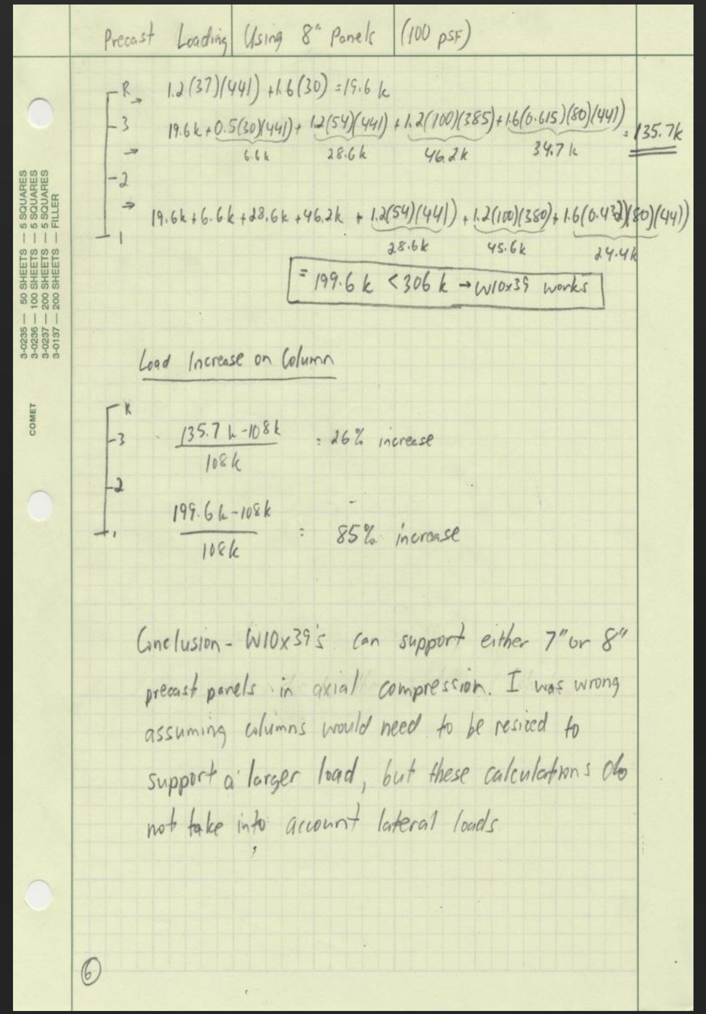
## Chris Pozza - Construction

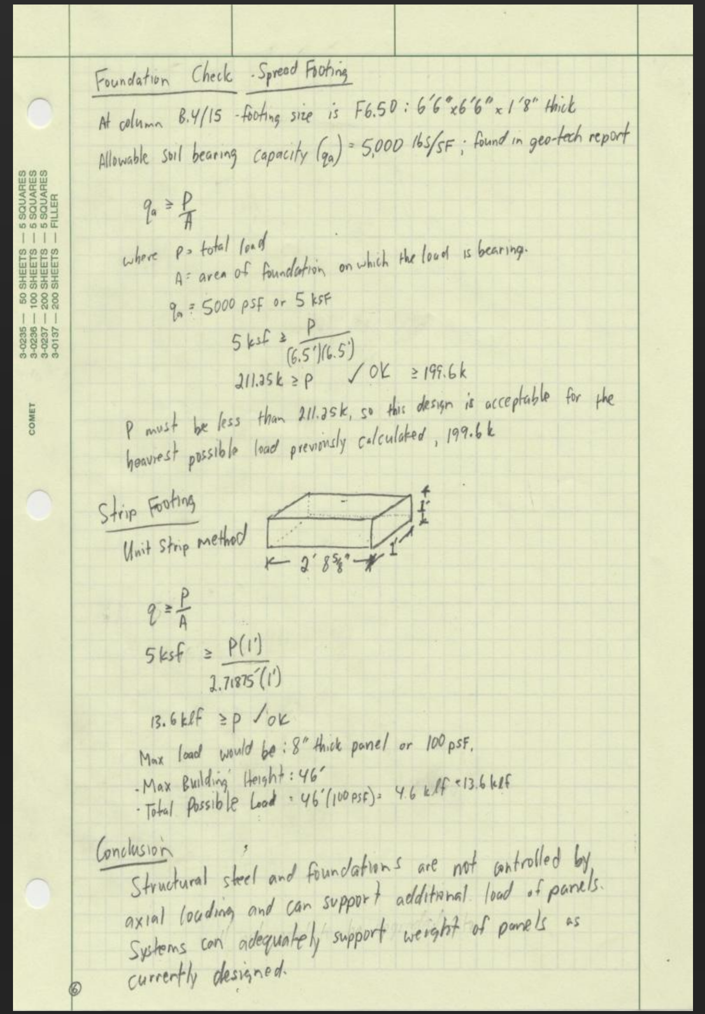
# Appendix – Structural Breadth











element factor $K_{LL} = 4$ (IBC Table 1607.9.1).

Reduced live load $L$ is determined by Eq. 16-24:

$$L = L_o\left(0.25 + \frac{15}{\sqrt{K_{LL}A_T}}\right)$$

$\geq 0.50L_o$ for members supporting one floor

$\geq 0.40L_o$ for members supporting two or more floors

*Table 2.2 Summary of Load Combinations Using Strength Design or Load and Resistance Factor Design (2006 IBC)*

| Equation No. | Load Combination |
|---|---|
| 16-1 | $1.4(D+F)$ |
| 16-2 | $1.2(D+F+T)+1.6(L+H)+0.5(L_r \text{ or } S \text{ or } R)$ |
| 16-3 | $1.2D+1.6(L_r \text{ or } S \text{ or } R)+(f_1L \text{ or } 0.8W)$ |
| 16-4 | $1.2D+1.6W+f_1L+0.5(L_r \text{ or } S \text{ or } R)$ |
| 16-5 | $1.2D+1.0E+f_1L+f_2S$ |
| 16-6 | $0.9D+1.6W+1.6H$ |
| 16-7 | $0.9D+1.0E+1.6H$ |

$f_1$ = 1 for floors in places of public assembly, for live loads in excess

**Table 4-1 (continued)**
**Available Strength in Axial Compression, kips**
**W-Shapes**

W10 $F_y$

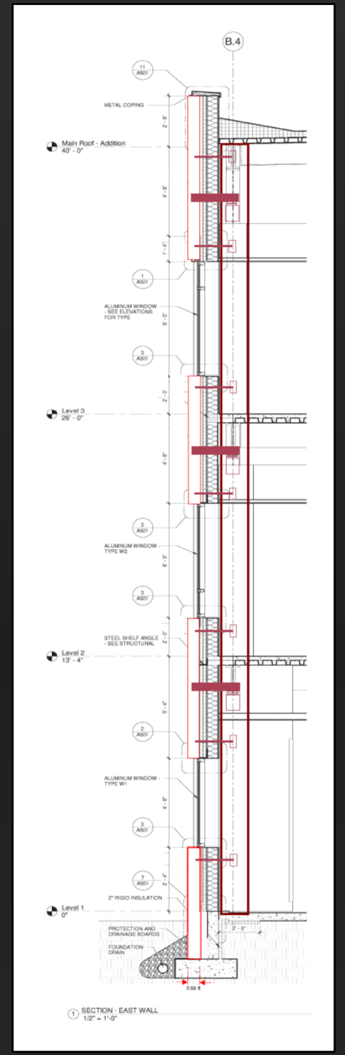
| Shape | W10× | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| lb/ft | 54 | | 49 | | 45 | | 39 | |
| Design | $P_n/\Omega_c$ ASD | $\phi_cP_n$ LRFD | $P_n/\Omega_c$ ASD | $\phi_cP_n$ LRFD | $P_n/\Omega_c$ ASD | $\phi_cP_n$ LRFD | $P_n/\Omega_c$ ASD | $\phi_cP_n$ LRFD |
| 0 | 473 | 711 | 431 | 648 | 398 | 598 | 344 | 517 |
| 6 | 446 | 671 | 407 | 611 | 363 | 545 | 313 | 470 |
| 7 | 437 | 657 | 398 | 598 | 350 | 527 | 302 | 454 |
| 8 | 427 | 642 | 388 | 584 | 337 | 507 | 290 | 436 |
| 9 | 415 | 624 | 378 | 568 | 322 | 485 | 277 | 416 |
| 10 | 403 | 605 | 366 | 550 | 307 | 461 | 263 | 396 |
| 11 | 389 | 585 | 354 | 532 | 291 | 437 | 249 | 374 |
| 12 | 375 | 564 | 341 | 512 | 274 | 411 | 234 | 352 |
| 13 | 361 | 542 | 327 | 492 | 256 | 385 | 219 | 329 |
| 14 | 345 | 519 | 313 | 471 | 239 | 359 | 203 | 306 |
| 15 | 330 | 495 | 299 | 449 | 222 | 333 | 188 | 283 |

least radius of gyration, $r_y$

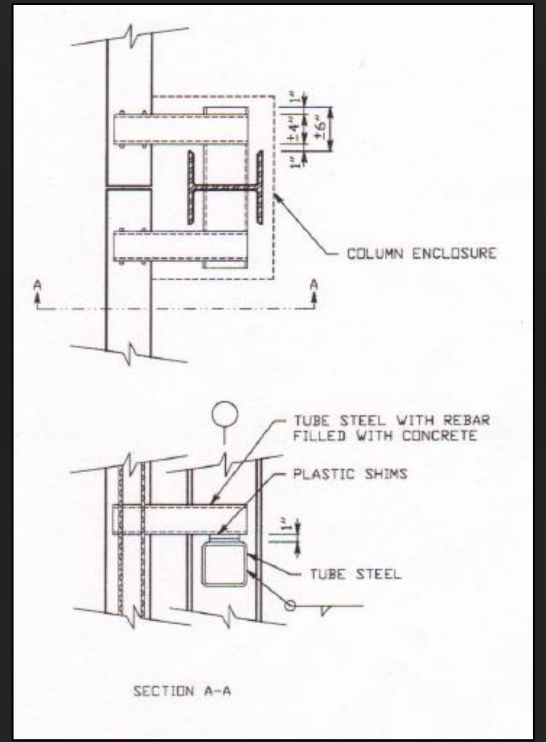
# Appendix – Mechanical Breadth

| Wall U Value (Summer) | Combined |
|---|---|
| $R_o$ - Outside Air Barrier | 0.25 |
| $R_1$ - 3 1/2" Face Brick (R=0.11 per inch) | 0.385 |
| $R_2$ - 1 7/8" Air Space | 1.23 |
| $R_3$ - 2" Rigid Insulation (R=5 per inch) | 10 |
| $R_4$ - Vapor Barrier | Negligible |
| $R_5$ - 1/2" Gypsum Sheathing | 0.45 |
| $R_6$ - 6" Metal Stud / 6" Batt Insulation R-19 | 7.1 |
| $R_7$ - 5/8" Gypsum Sheating - 51 | 0.56 |
| $R_i$ - Inside Air Film (Vertical Position, Horizontal Heat Flow) | 0.68 |
| Total R | 20.655 |
| u (1/R) | 0.0484 |
| % | 100% |
| u | 0.0484 |
| %*u | 0.0484 |
| $U_{avg}=U_{avg}*0.15 + 0.85*U_{insul}$ | 0.0484 |

| Wall U Value (Summer) | Combined |
|---|---|
| $R_o$ - Outside Air Barrier | 0.25 |
| $R_1$ - 7" Precast Panel with Thin Brick (assume all concrete) | 0.53 |
| $R_2$ - 1 7/8" Air Space | 1.23 |
| $R_3$ - 2" Rigid Insulation (R=5 per inch) | 10 |
| $R_4$ - Vapor Barrier | Negligible |
| $R_5$ - 1/2" Gypsum Sheathing | 0.45 |
| $R_6$ - 6" Metal Stud / 6" Batt Insulation R-19 | 7.1 |
| $R_7$ - 5/8" Gypsum Sheating - 51 | 0.56 |
| $R_i$ - Inside Air Film (Vertical Position, Horizontal Heat Flow) | 0.68 |
| Total R | 20.8 |
| u (1/R) | 0.04808 |
| % | 100% |
| u | 0.04808 |
| %*u | 0.04808 |
| $U_{avg}=U_{avg}*0.15 + 0.85*U_{insul}$ | 0.04808 |



| Air Space R-Value (from Table E.4) | |
|---|---|
| Direction of Heat Flow | Horizontal |
| Mean Temperature | 0° |
| Temperature Difference | 10° |
| Thickness | 1 7/8" |
| E (Table E.4, Page 1614) | 0.82 |
| R (1.5"-3.5" with Emittance=0.82) | 1.23 |

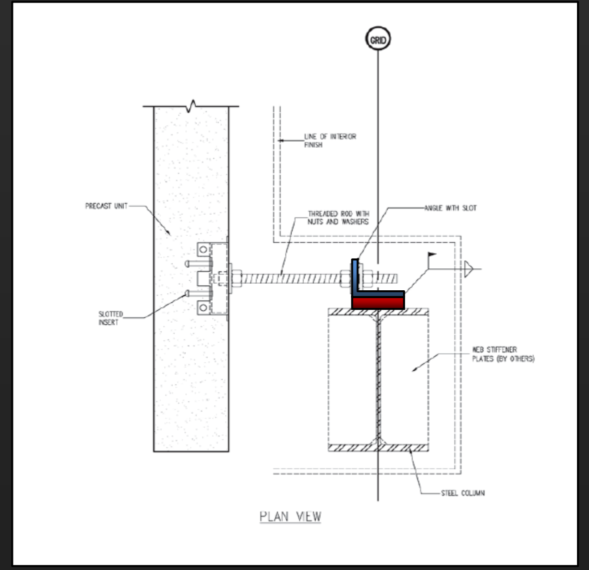


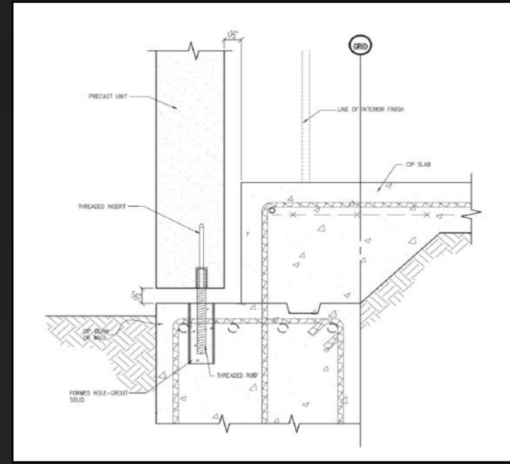

1596 APPENDIX E

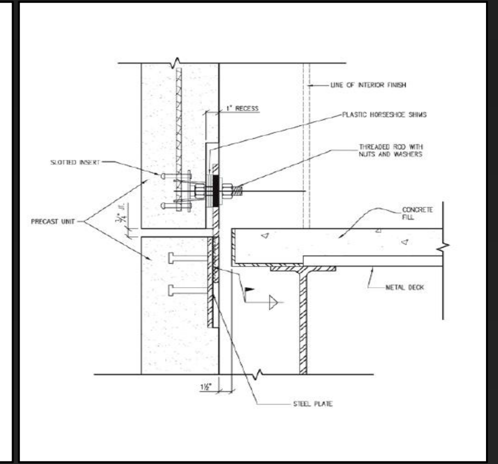
**TABLE E.1 Thermal Properties of Conventional Building and Insulating Materials[a] (*Continued*)**

Part A. I-P Units

| Description | | Density lb/ft³ | Conductivity[b] (k) Btu-in./h ft² °F | Conductance (C) Btu h/ft² °F | I-P Resistance[c] (R) Per Inch Thickness (1/k) °F ft² h Btu-in. | I-P Resistance[c] (R) For Thickness Listed (1/C) °F ft² h Btu | Specific Heat Btu/lb °F |
|---|---|---|---|---|---|---|---|
| Perlite, expanded | | 2.0–4.1 | 0.27–0.31 | — | 3.7–3.3 | — | 0.26 |
| | | 4.1–7.4 | 0.31–0.36 | — | 3.3–2.8 | — | — |
| | | 7.4–11.0 | 0.36–0.42 | — | 2.8–2.4 | — | — |
| Mineral fiber (rock, slag, or glass)[g] | | | | | | | |
| Approx. 3.75–5 in. | | 0.6–2.0 | — | — | — | 11.0 | 0.17 |
| Mineral fiber (rock, slag, or glass)[g] | | | | | | | |
| Approx. 6.5–8.75 in. | | 0.6–2.0 | — | — | — | 19.0 | — |
| Approx. 7.5–10 in. | | 0.6–2.0 | — | — | — | 22.0 | — |
| Approx. 10.3–13.7 in. | | 0.6–2.0 | — | — | — | 30.0 | — |
| Mineral fiber (rock, slag, or glass)[g] Approx. 3.5 in. (closed sidewall application) | | 2.0–3.5 | — | — | — | 12.0–14.0 | — |
| Vermiculite, exfoliated | | 7.0–8.2 | 0.47 | — | 2.13 | — | 0.32 |
| | | 4.0–6.0 | 0.44 | — | 2.27 | — | — |
| *Spray Applied* | | | | | | | |
| Polyurethane foam | | 1.5–2.5 | 0.16–0.18 | — | 6.25–5.56 | — | — |
| Ureaformaldehyde foam | | 0.7–1.6 | 0.22–0.28 | — | 4.55–3.57 | — | — |
| Cellulosic fiber | | 3.5–6.0 | 0.29–0.34 | — | 3.45–2.94 | — | — |
| Glass fiber | | 3.5–4.5 | 0.26–0.27 | — | 3.85–3.70 | — | — |
| *Reflective Insulation* | | | | | | | |
| Reflective material (ε < 0.5) in center of ¾-in. cavity forms two ⅜-in. vertical air spaces[m] | | — | — | 0.31 | — | 3.2 | — |
| **Metals** | | | | | | | |
| (See *ASHRAE Handbook—Fundamentals*) | | | | | | | |
| **Roofing** | | | | | | | |
| Asbestos–cement shingles | | 120 | — | 4.76 | — | 0.21 | 0.24 |
| Asphalt roll roofing | | 70 | — | 6.50 | — | 0.15 | 0.36 |
| Asphalt shingles | | 70 | — | 2.27 | — | 0.44 | 0.30 |
| Built-up roofing | 0.375 in. | 70 | — | 3.00 | — | 0.33 | 0.35 |
| Slate | 0.5 in. | — | — | 20.00 | — | 0.05 | 0.30 |
| Wood shingles, plain and plastic film faced | | — | — | 1.06 | — | 0.94 | 0.31 |
| **Plastering Materials** | | | | | | | |
| Cement plaster, sand aggregate | | 116 | 5.0 | — | 0.20 | — | 0.20 |
| Sand aggregate | 0.375 in. | — | — | 13.3 | — | 0.08 | 0.20 |
| Sand aggregate | 0.75 in. | — | — | 6.66 | — | 0.15 | 0.20 |
| Gypsum plaster | | | | | | | |
| Lightweight aggregate | 0.5 in. | 45 | — | 3.12 | — | 0.32 | — |
| Lightweight aggregate | 0.625 in. | 45 | — | 2.67 | — | 0.39 | — |
| Lightweight aggregate on metal lath | 0.75 in. | — | | 2.13 | — | 0.47 | — |



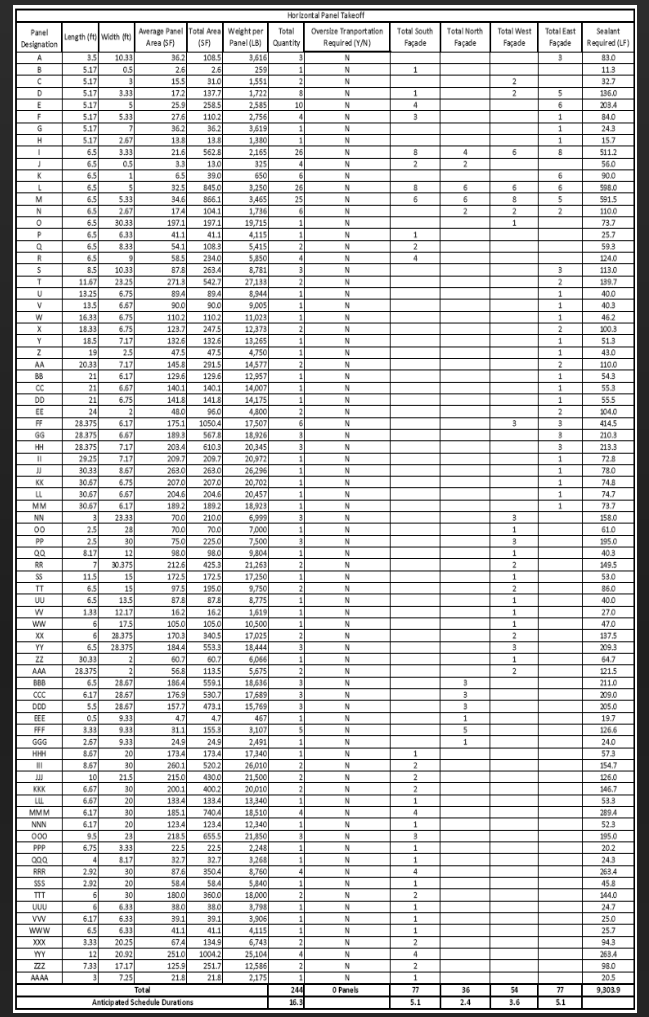


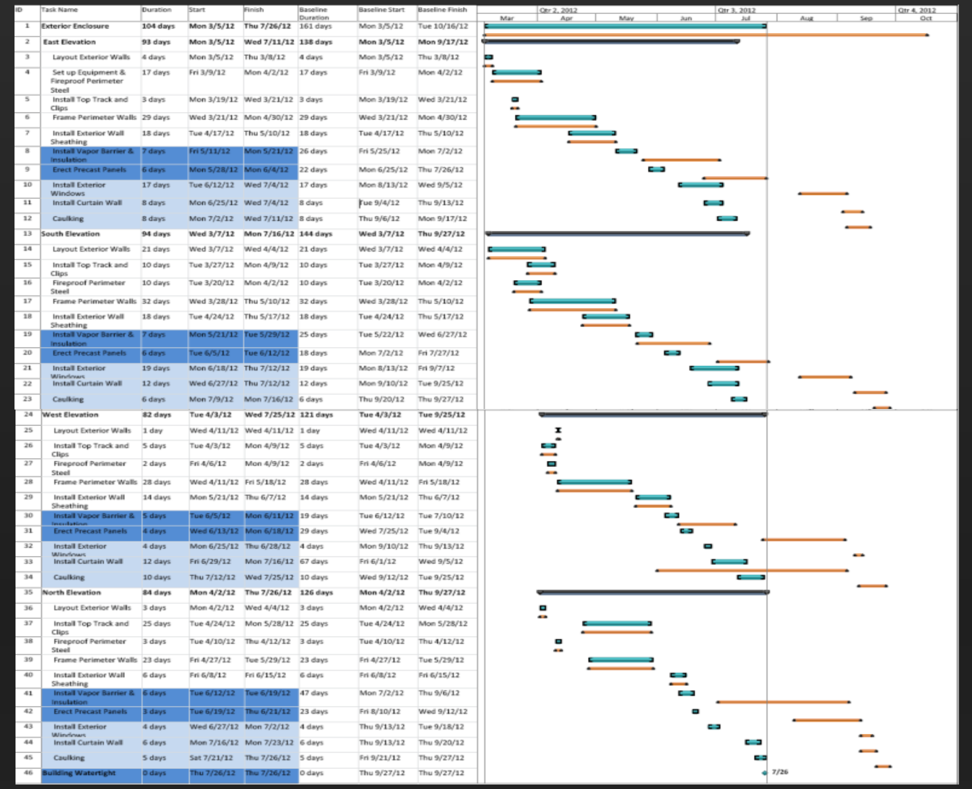
# Kaiser Permanente Largo Medical Office Building

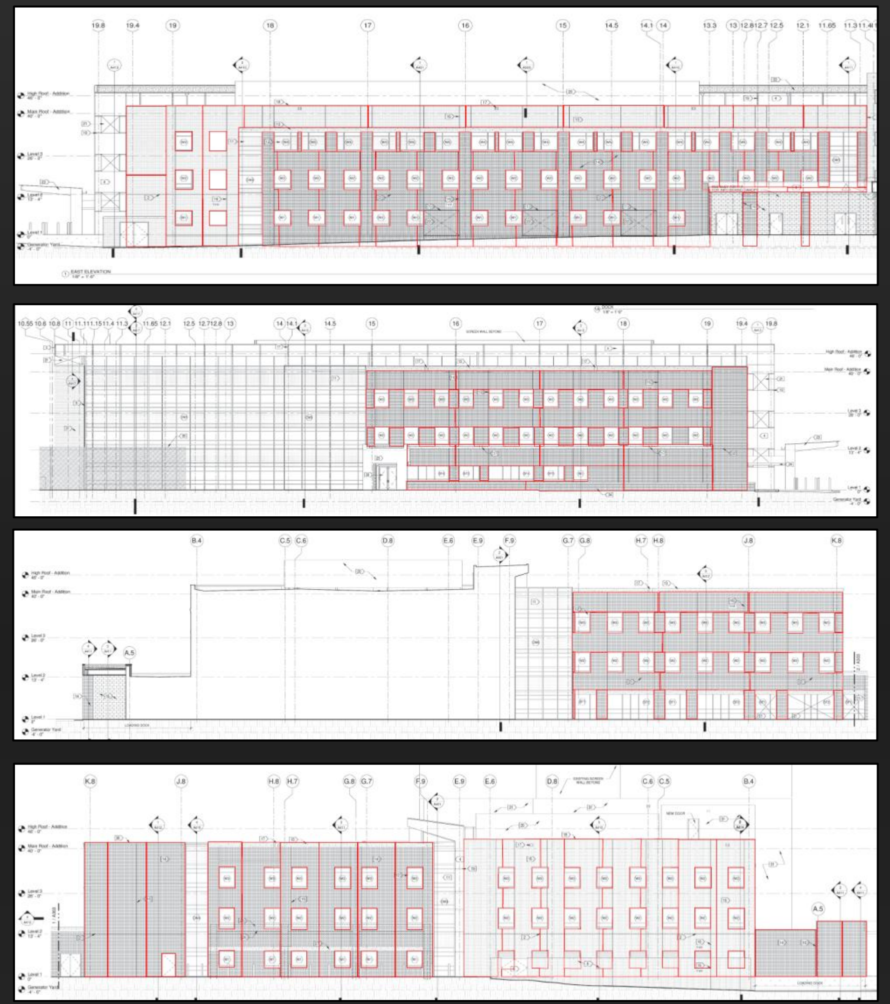
*Largo, MD*

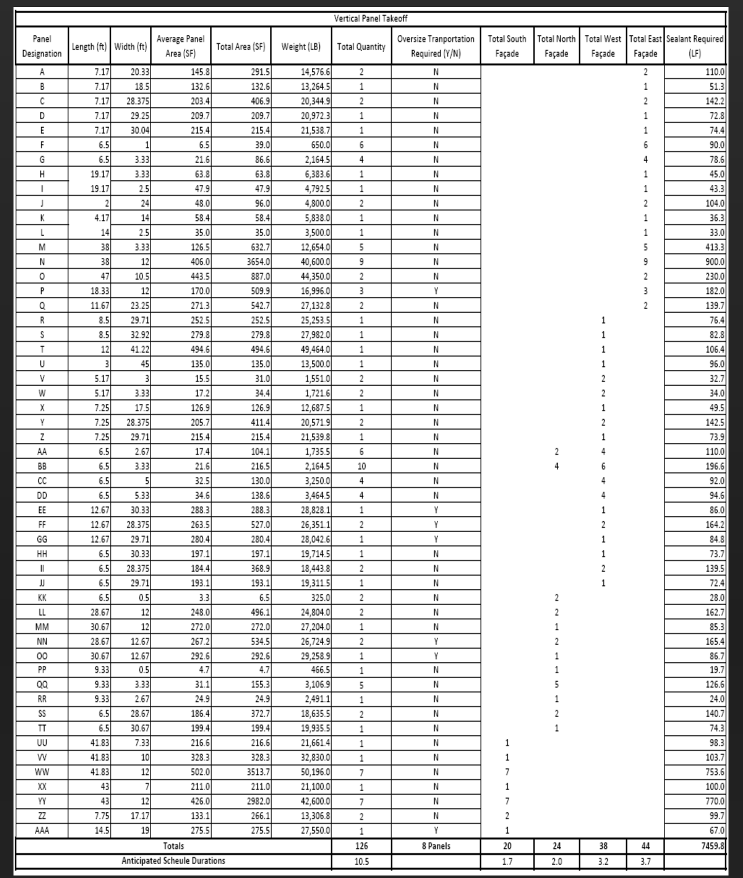
## Chris Pozza - Construction

# Appendix – Precast Panels

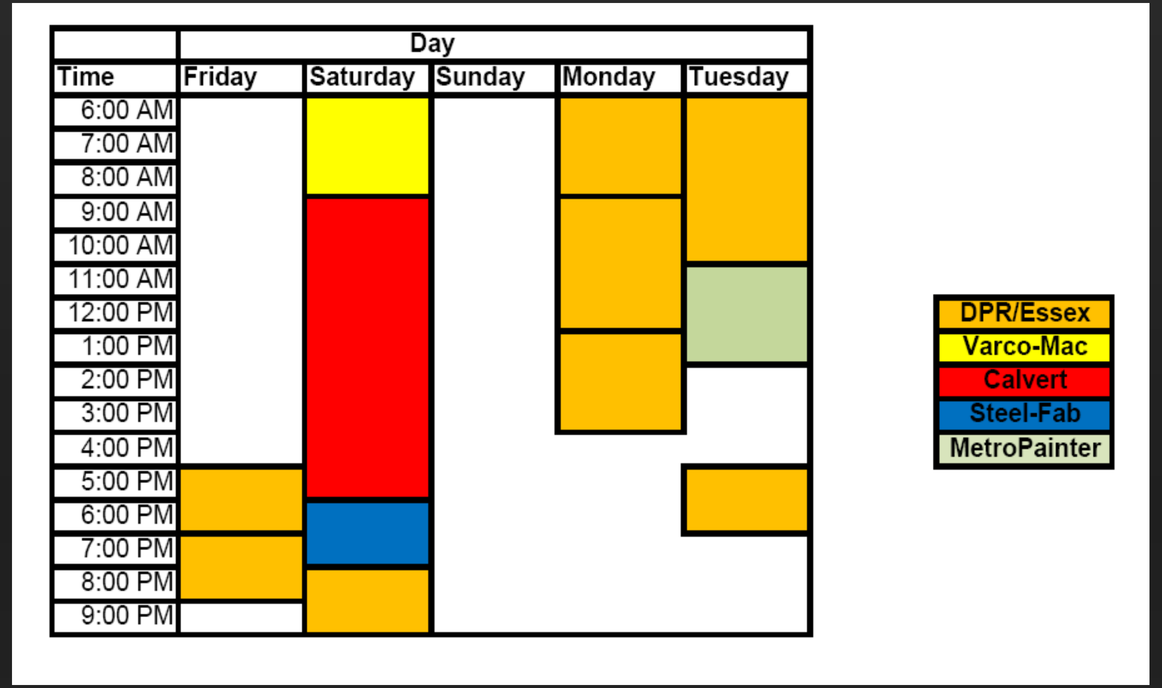






# Appendix – Virtual Mock-Ups and SIPS




*Project:* Kaiser Permanente Largo Medical Office Building *Zone:* Northwest Building Connection

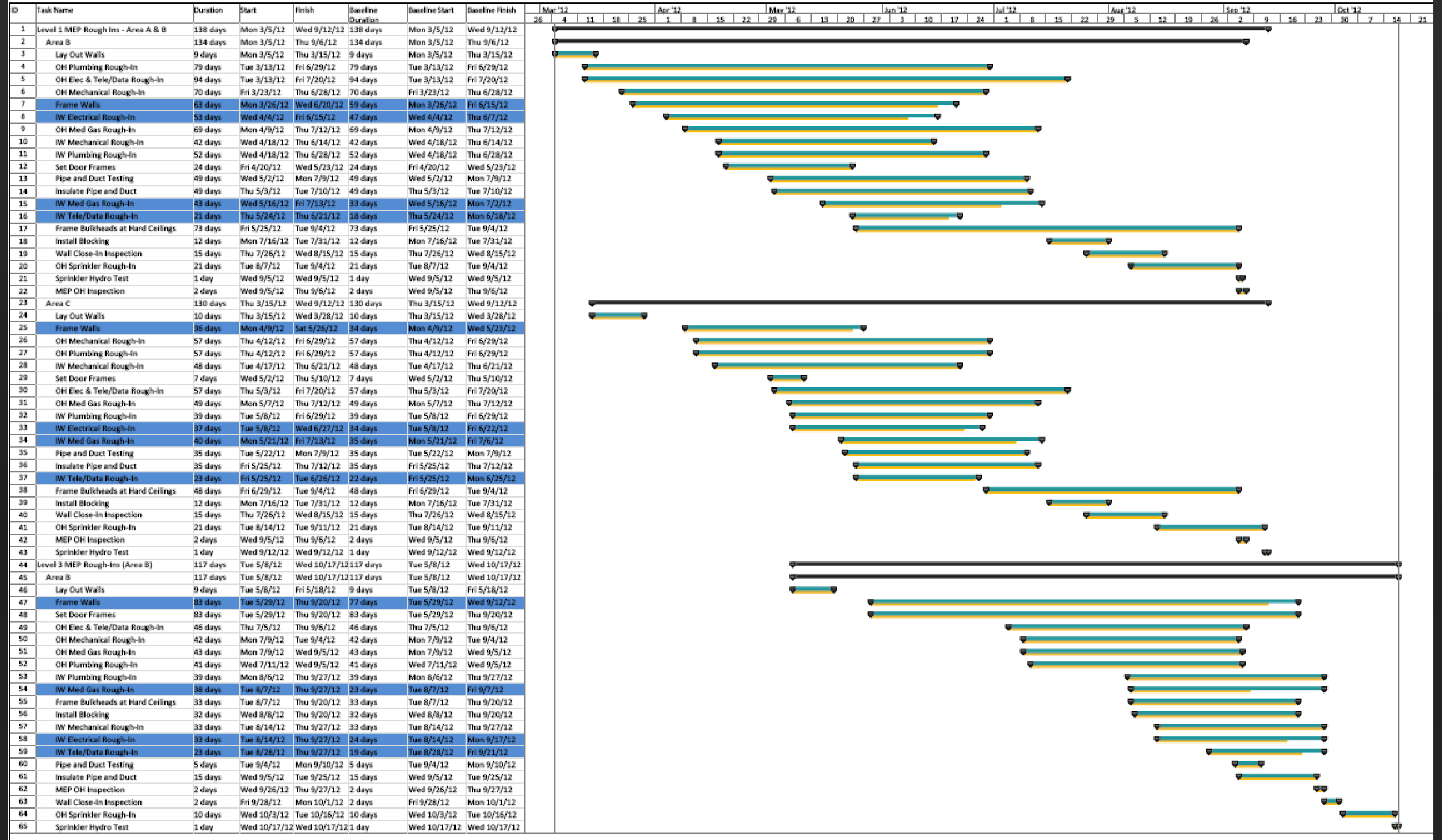
| Activity | Quanity | Unit | Budget Production (Units / MHR) | Total Budget Time (MHR) | Crew Size (People) | Activity Duration (HR) | Activity Duration (Days) | Notes |
|---|---|---|---|---|---|---|---|---|
| Construct Temporary Partition | 1 | EA | 0.25 | 4 | 2 | 2.0 | 0.3 | Wood Studs/Drywall Enclosure - Off-hours (OH) |
| Remove Drywall/Insulation | 75 | SF | 18.75 | 4 | 2 | 2.0 | 0.3 | Tear Down / Clean Up - (OH) |
| Relocate Electric Conduit | 15 | LF | 5.00 | 3 | 1 | 3.0 | 0.4 | Determine source location if needed |
| Saw Cut Brick/Remove Studs | 75 | SF | 4.70 | 32 | 4 | 8.0 | 1.0 | Including 3 courses below finished floor - (OH) |
| Insert 5/16" Bent Plate | 8 | LF | 2.00 | 8 | 4 | 2.0 | 0.3 | 1/2" Diameter 6" Imbeds, 24" O.C. - (OH) |
| Place Concrete/Expansion Joint | 1 | CY | 0.50 | 4 | 2 | 2.0 | 0.3 | Joint depressed 3/4" for cover |
| Set Door Frame | 1 | EA | 0.33 | 3 | 1 | 3.0 | 0.4 | |
| Frame Opening/Header & Studs | 1 | EA | 0.13 | 8 | 2 | 4.0 | 0.5 | |
| Drywall & Spackle | 75 | SF | 25.00 | 3 | 1 | 3.0 | 0.4 | Both sides, assume half the total area each side |
| Hang Doors/Install Hardware | 1 | EA | 0.20 | 5 | 1 | 5.0 | 0.6 | Double Set with Panic Hardware |
| Prime/Paint | 75 | SF | 25.00 | 3 | 1 | 3.0 | 0.4 | Both sides, assume half the total area each side |
| Remove Parition/Cleanup | 1 | EA | 0.25 | 4 | 2 | 2.0 | 0.3 | Off-hours (OH) |
| TOTALS | | | | 77 | 21.0 | 37.0 | 4.6 | |

| 2013 RSMeans Facilities Construction Cost Data - Trade Hourly Durations | | | | |
|---|---|---|---|---|
| Description | Hourly Rate including O & P | Location Factor | Adjusted Rate including O & P | Adjusted Premium Rate |
| **Skilled Worker Average** | $75.10 | 90.3 | $67.82 | $101.72 |
| **Electricians** | $81.00 | 90.3 | $73.14 | $109.71 |
| **Plumbers** | $86.80 | 90.3 | $78.38 | $117.57 |
| **Truck Drivers, Heavy** | $59.70 | 90.3 | $53.91 | $80.86 |

# Appendix – Modularization

| Headwall Labor Costs | | | | | |
|---|---|---|---|---|---|
| Activity | Adjusted Hourly Rate | Hours Per Unit | Cost Per Unit | Total Man-Hours | Total Cost |
| **Frame Walls** | $67.82 | 2.0 | $135.64 | 98 | $6,646.36 |
| **In-Wall Electric Rough-Ins** | $73.14 | 3.0 | $219.42 | 147 | $10,751.58 |
| **In-Wall Med Gas Rough-Ins** | $78.38 | 5.0 | $391.90 | 245 | $19,203.10 |
| **In-Wall Tele/Data Rough-Ins** | $73.14 | 1.5 | $109.71 | 73.5 | $5,375.79 |
| **Totals** | | 11.5 | $856.67 | 563.5 | $41,976.83 |

| Module Costs | | | | | |
|---|---|---|---|---|---|
| Description | Unit Cost | Additional Cost | Total Unit Cost | Total Units | Total Project Cost |
| Current Unit Cost | --- | $1,540.65 | --- | 49 | --- |
| Proposed System Cost | --- | - | --- | 49 | --- |
| Difference | | | | | --- |



Headwall Takeoff
Data Release : Year 2013 Quarter 1
**Unit Cost Estimate**

| Quantity | LineNumber | Description | Crew | Unit | Material | Ext. Mat. | Mat. O&P | Ext. Mat. O&P |
|---|---|---|---|---|---|---|---|---|
| 9 | 054113304370 | Partition, galv LB studs, 16 ga x 4" W studs 16" O.C. x 8' H, incl galv top & bottom track, excl openings, headers, beams, bracing & bridging | 2 Carp | L.F. | $ 9.37 | $ 84.33 | $ 10.31 | $ 92.79 |
| 14 | 221113232140 | Pipe, copper, tubing, solder, 1/2" diameter, type L, includes coupling & clevis hanger assembly 10' O.C. | 1 Plum | L.F. | $ 3.94 | $ 55.16 | $ 4.33 | $ 60.62 |
| 7 | 221113232180 | Pipe, copper, tubing, solder, 3/4" diameter, type L, includes coupling & clevis hanger assembly 10' O.C. | 1 Plum | L.F. | $ 6.04 | $ 42.28 | $ 6.69 | $ 46.83 |
| 4 | 221113257110 | Elbow, 90 Deg., tube connector fittings, brass/copper, insert type, C x CTS, 100 psi @ 180Deg.F, 1/2" | 1 Plum | Ea. | $ 1.88 | $ 7.52 | $ 2.06 | $ 8.24 |
| 1 | 221113257120 | Elbow, 90 Deg., tube connector fittings, brass/copper, insert type, C x CTS, 100 psi @ 180Deg.F, 3/4" | 1 Plum | Ea. | $ 2.29 | $ 2.29 | $ 2.52 | $ 2.52 |
| 2 | 221113257140 | Tee, tube connector fittings, brass/copper, insert type, C x CTS, 100 psi @ 180Deg.F, 1/2" | 1 Plum | Ea. | $ 2.40 | $ 4.80 | $ 2.64 | $ 5.28 |
| 1 | 221113257150 | Tee, tube connector fittings, brass/copper, insert type, C x CTS, 100 psi @ 180Deg.F, 3/4" | 1 Plum | Ea. | $ 3.68 | $ 3.68 | $ 4.05 | $ 4.05 |
| 4 | 260519131000 | Underecarpet, cable flat, boxes, wall, surface, w/cover, #12, 3 conductor | 1 Elec | Ea. | $ 58.85 | $ 235.40 | $ 64.29 | $ 257.16 |
| 8 | 260529201950 | Riser clamps, steel, conduit, 3/4" diameter | 1 Elec | Ea. | $ 11.77 | $ 94.16 | $ 12.96 | $ 103.68 |
| 28 | 260533131770 | Rigid galvanized steel conduit, 3/4" diameter, to 15' H, incl 2 terminations, 2 elbows, 11 beam clamps, and 11 couplings per 100 LF | 1 Elec | L.F. | $ 2.66 | $ 74.48 | $ 2.93 | $ 82.04 |
| 1 | 260526800340 | Ground wire, copper wire, bare solid, #10 | 1 Elec | C.L.F. | $ 18.94 | $ 18.94 | $ 20.77 | $ 20.77 |
| | | | | **Total** | | **$623.04** | **Total with O&P** | **$683.98** |