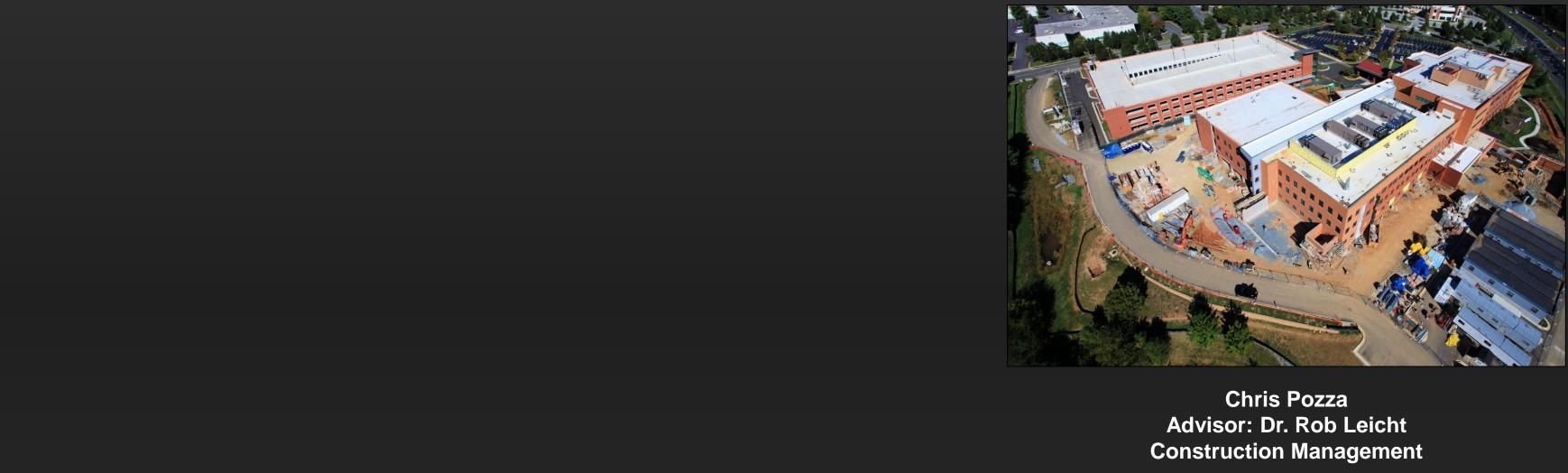
# Kaiser Permanente Largo Medical Office Building



# Kaiser Permanente Largo Medical Office Building

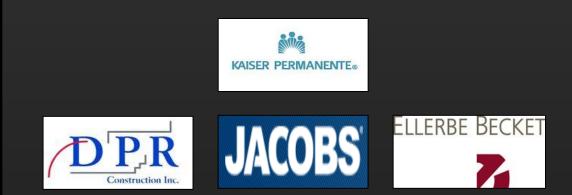
I. Introduction	
II. Analysis 1 – Change Order Management	
III. Analysis 2 – Precast Panel Implementation	
A. Structural Breadth B. Mechanical Breadth	
IV. Analysis 3 – Use of Virtual Mock-Ups for SIPS	
V. Analysis 4 – Modularization Comparison	
VI. Conclusion & Recommendations	
VII. Acknowledgements	



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



- I. Introduction
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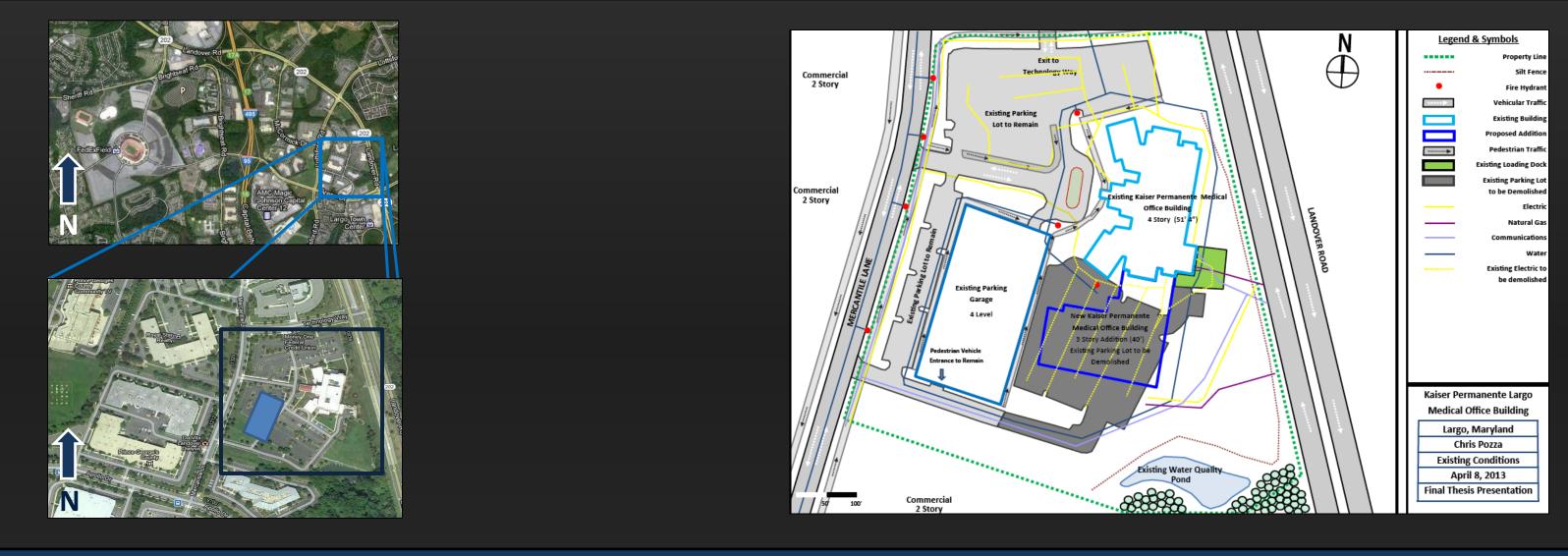
Project Cost: \$39,558,519 Addition: \$32,504,687

Addition Size: 106,700 SF

## Introduction







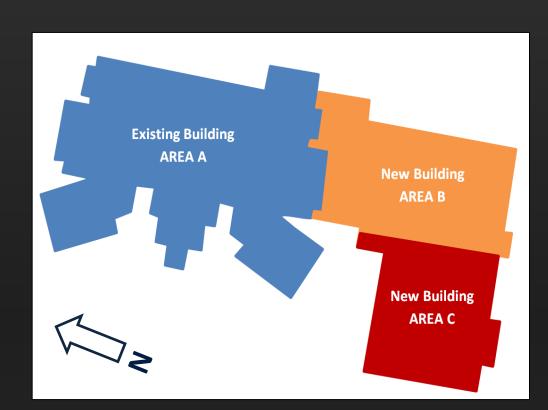
## Ellerbe Becket

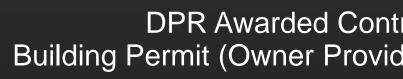




### Introduction

- II. Analysis 1 Change Order Management
- III. Analysis 2 Precast Panel Implementation
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  - B. Mechanical Breadth
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## Introduction



		Qtr 4, 2010 Oct Nov De	2011 Qtr 1, 2011 c Jan Feb Ma	Qtr 2, 2011 ar Apr May Jun	Qtr 3, 2011 n Jul Aug Sep	Qtr 4, 2011 Oct Nov De	2012 Qtr 1, 2012 ec Jan Feb I
			DPR Awarded	Construction Contra		ling Permit (Owne	r Provided)
PR Awarded Contract:	December 27, 2010		Fina	al Master Agreemer	nt/ Work Authoriza		curement / Shop
mit (Owner Provided):	January 3, 2011			_			Bid/Buyout
	August 25, 2011			-			
Notice to Proceed:	June 10, 2011			•	Owner Issue Notice Site Mobilization		
Building Watertight:					Site	Jtilities	Foundations
	September 27, 2012						si si
	October 18, 2012						
Ibstantial Completion:	October 2, 2012						
·	December 6, 2012						
	February 11, 2013						
	March 1, 2013						

First Patient: July 8, 2013





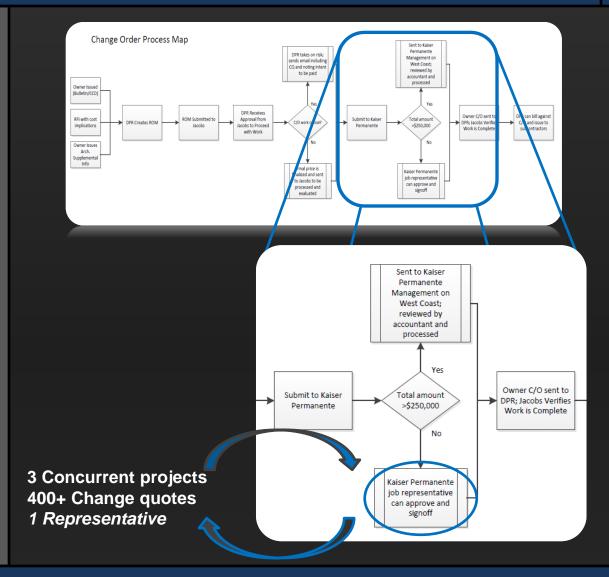




## Analysis 1 – Change Order Management

### Introduction

- Analysis 1 Change Order Management
- II. Analysis 2 Precast Panel Implementation
  - A. Structural Breadth
  - B. Mechanical Breadth
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## Problem: **Current Process Costing Critical Time and Money**

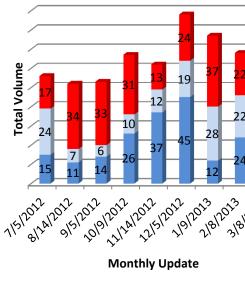
Desc
Арр
Pene
Pene
Pene
RON
RON
RON
RON
In D

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





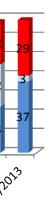
### Pending Changes in Review



Factors Impacting Labor Productivity:

- Timing
- Intensity
- Type of Work
- Impact Type





- Open CQ's Submitted Over 61 Days Ago
- **Open CQ's Submitted** Between 31-60 Days Ago
- Open CQ's Submitted Less than 30 Days Ago



## Analysis 1 – Change Order Management

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- Analysis 1 Change Order Management
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## Side Effects of Change Orders:



## Trade Stacking



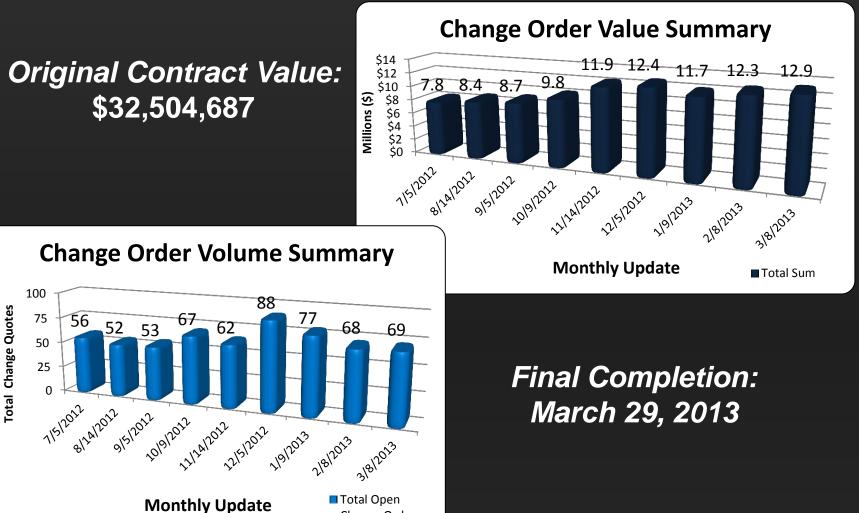
## Schedule Compression



## Multiple-Shift Work



### Morale Issues

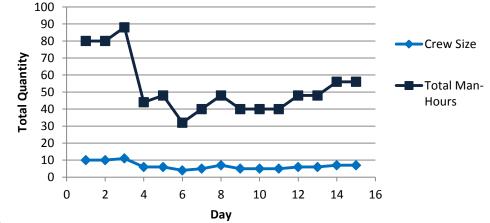


Change Orders











### Change Order Crew Man-Hours and Crew Size per Day for a 15-Day Period

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



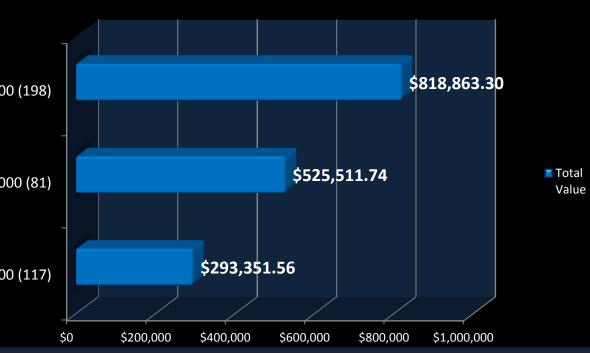
## Analysis 1 – Final Recommendations

Introduction Analysis 1 – Change Order Management 446 Change Quotes Investigated II. Analysis 2 – Precast Panel Implementation A. Structural Breadth 349 with Associated Costs B. Mechanical Breadth CQ's<\$10,000 (198) IV. Analysis 3 – Use of Virtual Mock-Ups for SIPS 198 worth less than \$10,000 V. Analysis 4 – Modularization Comparison \$5,000<CQ<\$10,000 (81) 1.5 Month Average Response Time VI. Conclusion & Recommendations VII. Acknowledgements CQ's<\$5,000 (117) + Significantly reduce management time + Reduce turnaround time for large changes + Better cash flow for subcontractors





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



**Recommendation - Permit CM to Approve Changes** 

## 2. Purchase Preconstruction Services





- + Utilize project team's healthcare experience
- + Improve design efficiency for all stakeholders
- + Reduction of rework
- 3. Implement an Alternate Change Review Process



# + Early trade involvement for intense MEP coordination



## **Analysis 2 – Precast Panel Implementation**

## Problem: Weather and Constructability Issues Impact Schedule

### Original:

- . Introduction
- II. Analysis 1 Change Order Management
- II. Analysis 2 Precast Panel Implementation
  - A. Structural Breadth
  - B. Mechanical Breadth
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Precast Panel Comparison to Traditional Brick				
Advantages	Disadvantages			
<ul> <li>Faster installation for schedule savings</li> <li>Stronger and more durable than brick façade and tougher to penetrate</li> <li>More favorable working conditions and no weather issues during fabrication</li> <li>Higher quality product produced off-site</li> <li>Panels typically have better insulation properties</li> </ul>	<ul> <li>Higher upfront cost to fabricate panels</li> <li>Often requires heavier structural support members</li> <li>Can be less aesthetically pleasing due to less imperfections and more joints</li> <li>Customization of panels can significantly increases cost</li> <li>Can require multiple cranes depending on panel sizes</li> </ul>			

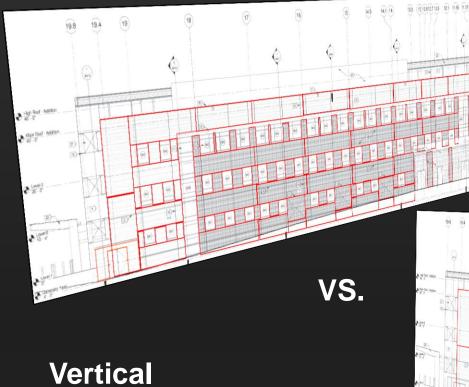




	63	03-Apr-12	29-Jun-12
out Exterior Walls	6	03-Apr-12	10-Apr-12
tall Top Track and Clips	6	06-Apr-12	13-Apr-12
Up Equipment & Fireproof Perimeter Steel	5	16-Apr-12	20-Apr-12
me Perimeter Walls	15	23-Apr-12	11-May-12
tall Exterior Wall Sheathing	15	02-May-12	22-May-12
tall Vap or Barrier and Wall Ties	15	11-May-12	01-Jun-12
ct Exterior Brick and Precast Accent Band	15	25-May-12	15-Jun-12
tall Exterior Windows	8	18-Jun-12	27-Jun-12
tall Curtain wall	8	18-Jun-12	27-Jun-12
st Elevation - Caulking	8	20-Jun-12	29-Jun-12

### Actual:

	138	05-Mar-12A	17-Sep-12
Layout Exterior Walls East Elevation	4	05-Mar-12A	08-Mar-12 A
Set Up Equipment & Fireproof Perimeter Steel	17	09-Mar-12A	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-12A	30-Apr-12 A
Install Exterior Wall Sheathin g East Elevation	18	17-Apr-12A	11-May-12A
Install Vap or Barrier and Wall Ties East Elevation	26	25-May-12A	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 Curtain wall East Elevation	8	04-Sep-12	3-Sep-12
East Elevation - Caulking	8	06-Sep-12	17-Sep-12

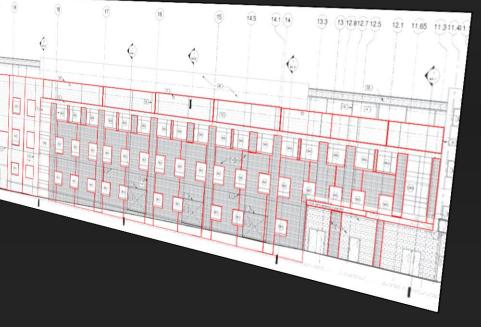


- + Lower panel count
- + Less connections
- High level of customization



## Horizontal

- + Easier to handle
- + More repetition
- Significant panel count

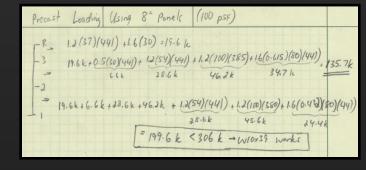




## Structural and Mechanical Breadth Studies

- I. Introduction
- II. Analysis 1 Change Order Management
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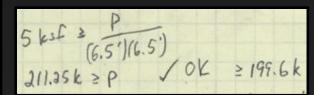
### Structural Steel:



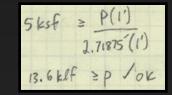
Foundations:



### Spread Footing:



### Strip Footing:



R <sub>o</sub> - Οι
R <sub>1</sub> - 3 1
Altern
R <sub>2</sub> - 17
R <sub>3</sub> - 2"
R <sub>4</sub> - Va
R <sub>5</sub> - 1/
R <sub>6</sub> - 6"
R <sub>7</sub> - 5/

<b>***</b>	
KAISER PERMANENTE®	



Conclusion

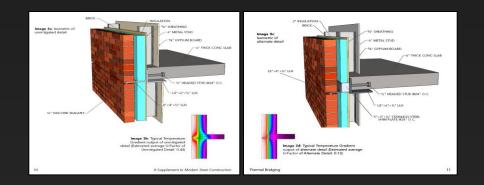
Structure:

Structural upgrades not required due to building size

Axial loading does not control structural design



Wall R Values (Wir	iter)	3.5" Face Brick	7" Precast Panels
utside Air Barrier		0.17	0.17
1/2" Face Brick (R=0.11 per inch) ate R <sub>1</sub> - 7" Precast Panel with Thi	n Brick	0.385	0.53
7/8" Air Space		1.23	1.23
Rigid Insulation (R=5 per inch)		10	10
por Barrier		Negligible	Negligible
2" Gypsum Sheathing		0.45	0.45
Metal Stud / 6" Batt Insulation R-19		7.1	7.1
8" Gypsum Sheathing – 51		0.56	0.56
ide Air Film (Vertical Position, Ho	rizontal Heat Flow)	0.68	0.68
	Total R	20.575	20.72
	Uavg or Total U (1/R)	0.0486	0.04826







### 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**

- Introduction
- II. Analysis 1 Change Order Management
- II. Analysis 2 Precast Panel Implementation
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## **Horizontal Panels**

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

System Cost Comparis	on
Precast Panel System	\$1,257,190.37
Masonry Façade	\$1,131,376.00
Proposed Precast Additional Cost	\$125,814.37

# 15 panels per day

ID	Task Name
1	Exterior Enclosure
2	East Elevation
3	Layout Exterior Walls
4	Set up Equipment & Fireproof Perimeter Steel
5	Install Top Track and Clips
6	Frame Perimeter Wa
7	Install Exterior Wall Sheathing
8	Install Vapor Barrier 8 Insulation
9	Erect Precast Panels
10	Install Exterior Windows
11	Install Curtain Wall
12	Caulking

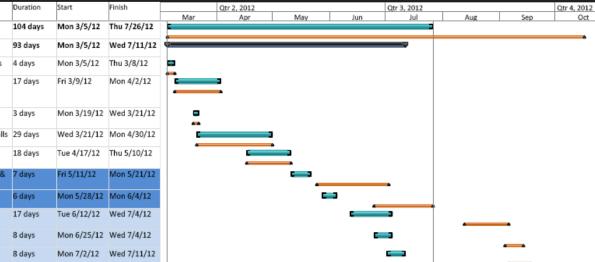


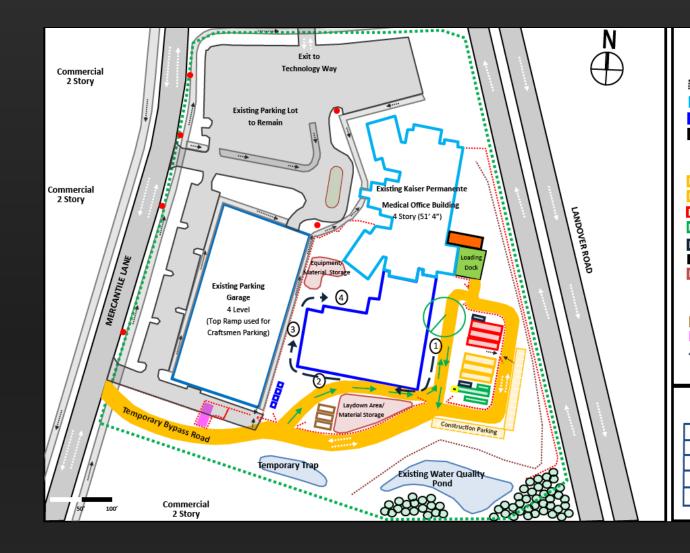


## Schedule Analysis

Eliminates Brick Ties Easier vapor barrier installation









Legend & Symbols Property Lin Construction Fence Vehicular Traffic Existing Building Proposed Addition Overhead Protection recast Delivery Rout  $\rightarrow$ porary Power She Construction Traile DPR Trailer (GC) Jacobs Trailer (CM) Subcontractor Traile Storage Containe Loading Dock aydown/Storage Are Portable Toilet Crane/Radiu Recycling/Dumpster Mock-Up Are ne Erection Sequenc Fire Hydra

### Kaiser Permanente Largo Medical Office Building

Largo, Maryland Chris Pozza Precast Panel Placemen April 8, 2013 Final Thesis Presentation



## Analysis 2 – Final Recommendation

- I. Introduction
- II. Analysis 1 Change Order Management
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## 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
		04 0095			-		
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		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		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 E	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

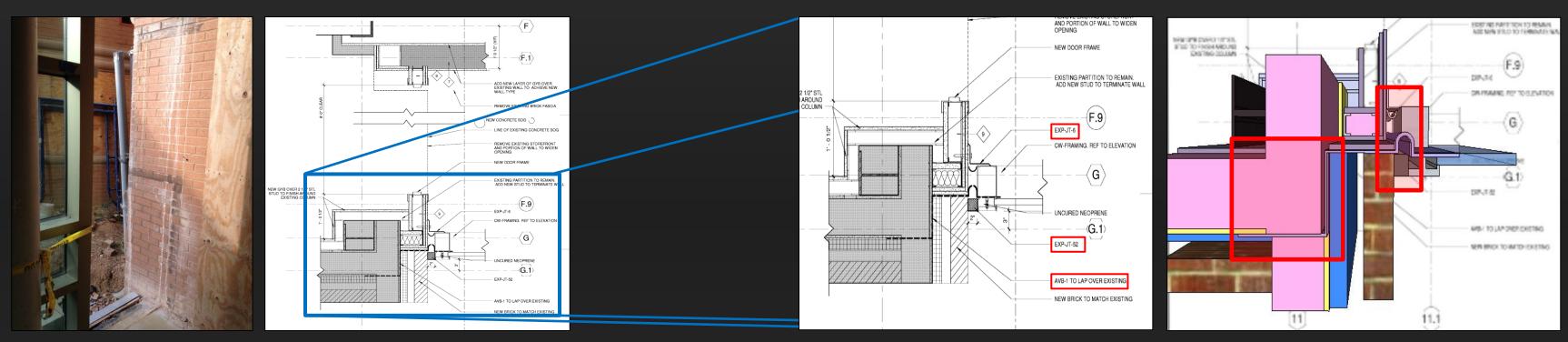
Final Cost Comparison Summary			
Proposed System Cost	\$1,257,190.37		
Additional Crane Cost	\$44,078.22		
Actual System Cost	\$1,131,376		
General Conditions Savings	\$295,264.35		
Total Cost Savings	\$125,371.76		
	Proposed System Cost Additional Crane Cost Actual System Cost General Conditions Savings		

## Schedule savings are greatest benefit!





## Problem: **Building Connection Constructability Issues**



- I. Introduction
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### **Original Schedule:**



### Case Study: Tyson's Corner

32 Rooms 110 Changes Total cost: \$38,000 Owner benefit only



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









### Solution: EMSEAL



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

- Introduction
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Project:
Activity
Construct Temporary Parti
Remove Drywall/Insulation
Relocate Electric Condu
Saw Cut Brick/Remove Stu
Insert 5/16" Bent Plate
Place Concrete/Expansion
Set Door Frame
Frame Opening/Header & S
Drywall & Spackle
Hang Doors/Install Hardwa
Prime/Paint
Remove Parition/Cleanu
TOTALS



## **Traditional SIPS**

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

	Kaiser Permanente Largo Medical Office Building						Zone:	Northwest Building Connection
	Quanity	Unit	Budget Production (Units / MHR)	Total Budget Time (MHR)	1 1	Activity Duration (HR)	Activity Duration (Days)	Notes
tion	1	EA	0.25	4	2	2.0	0.3	Wood Studs/Drywall Enclosure - Off-hours (OH)
on	75	SF	18.75	4	2	2.0	0.3	Tear Down / Clean Up - (OH)
it	15	LF	5.00	3	1	3.0	0.4	Determine source location if needed
uds	75	SF	4.70	32	4	8.0	1.0	Including 3 courses below finished floor - (OH)
	8	LF	2.00	8	4	2.0	0.3	1/2" Diameter 6" Imbeds, 24" O.C (OH)
Joint	1	CY	0.50	4	2	2.0	0.3	Joint depressed 3/4" for cover
	1	EA	0.33	3	1	3.0	0.4	
Studs	1	EA	0.13	8	2	4.0	0.5	
	75	SF	25.00	3	1	3.0	0.4	Both sides, assume half the total area each side
are	1	EA	0.20	5	1	5.0	0.6	Double Set with Panic Hardware
	75	SF	25.00	3	1	3.0	0.4	Both sides, assume half the total area each side
ıр	1	EA	0.25	4	2	2.0	0.3	Off-hours (OH)
				77	21.0	37.0	4.6	
			/	4	·			

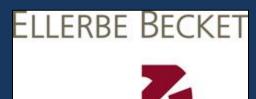
+ Reach level of detail necessary to maximize efficiency







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		
	20				





## Analysis 3 – Final Recommendation

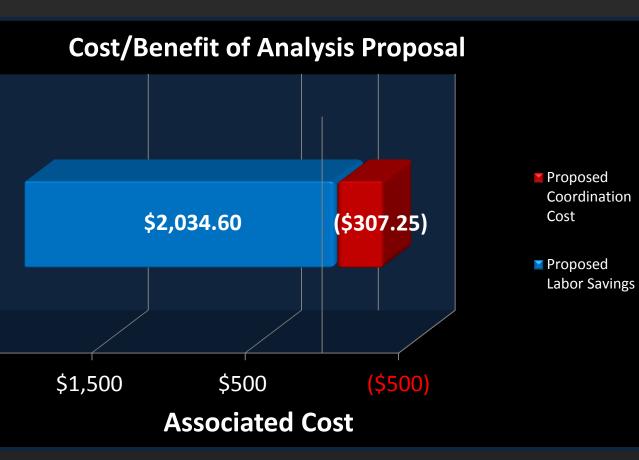
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2.5 Hrs. BIM Champ 1 Hr. Superintendent 20 Man-Hrs. Saved \$1,700 - Potential savings









## **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

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



### Introduction

- II. Analysis 1 Change Order Management
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Interior Construc		245		05-Mar-12A	20-Feb-13
M/E/P&FPR	ough Ins	180		05-Mar-12A	12-Nov-12
Level 1		180	178	05-Mar-12A	12-Nov-12
RI.01.10	00 Fireproof Structure	15	14	09-Mar-12 A	29-Mar-12 A
Area "B"		133	131	05-Mar-12A	06-Sep-12
RI.1B.	1000 1B1 - Lay Out Walls	10	8	05-Mar-12A	15-Mar-12 A
RI.1B	1020 1B1 - OH Plbg Rough In	10	77	13-Mar-12A	29-Jun-12 A
RI.1B	1030 1B1 - OH Elec & Tele/Data Rough In	10	91	13-Mar-12A	20-Jul-12 A
RI.1B	1010 101 on meen nough in	10		20 1001 120	20 3011 22 7
RI.1B	1070 1B1 - Frame Walls	10	61	26-Mar-12A	20-Jun-12 A
RI.1B	1120 1B1 - In Wall Elec Rough In	10	51	04-Apr-12A	15-Jun-12 A
RI.1B	1050 101 on med cus system no ugn m	Ū		00 Apr 12A	
RI.1B	1040 1B1 - OH F.A. Rough In	10	66	09-Apr-12A	12-Jul-12 A
RI.1B	1100 1B1 - In Wall Mech Rough In	10	40	18-Apr-12A	14-Jun-12 A
RI.1B	1110 1B1 - In Wall Plbg R ough In	10	50	18-Apr-12A	28-Jun-12 A
RI.1B	1080 1B1 - Set Door Frames	5	24	20-Apr-12A	23-May-12A
RI.1B	1150 1B1 - Pipe and Duct Testing	5	46	02-May-12A	09-Jul-12 A
RI.1B	1160 102 moder Tipe and Date	10		,	
RI.1B	1130 1B1 - In Wall Med GasRough In	10	40	16-May-12A	13-Jul-12 A
RI.1B	1140 1B1 - In Wall Tele / Data Rough In	10	19	24-May-12A	21-Jun-12 A
RI.1B	1090 102 Traine builtineads and hand ceiling Areas	10		20 7011 227	01 Jup 12
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 - MEPOH Inspection	2	2	05-Sep-12	06-Sep-12
RI.1B	1190 1B1 - Sprinkler Hydro Test	1	1	05-Sep-12	05-Sep-12

# KAISER PERMANENTE®



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

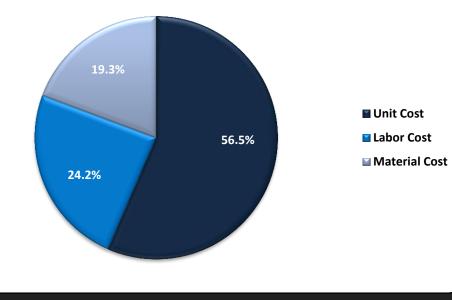




## Analysis 4 – Modularization Comparison

- Introduction
- II. Analysis 1 Change Order Management
- II. 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

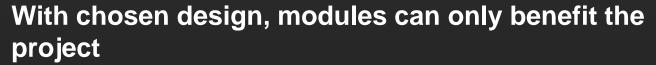








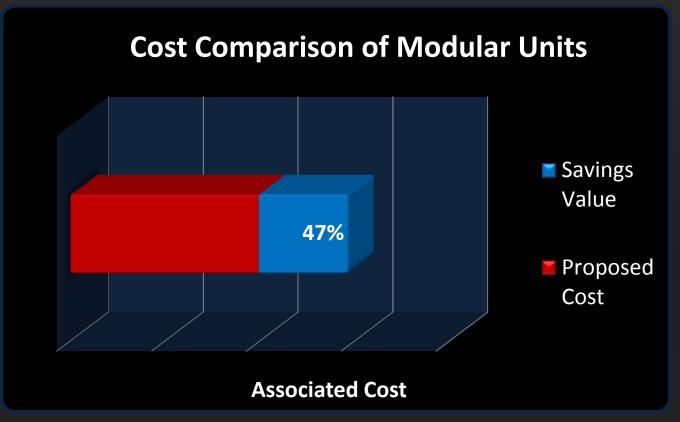
**Final Recommendation** 



### **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





. Introduction		Analys
I. Analysis 1 – Change Order Management		1. Gi 2. Pu
II. Analysis 2 – Precast Panel Implementation A. Structural Breadth	Shortens Schedule	3. Im +
B. Mechanical Breadth	Improves Efficiency	+ +
V. Analysis 3 – Use of Virtual Mock-Ups for SIPS	Increases Collaboration	Analys
<ul> <li>Analysis 4 – Modularization Comparison</li> <li>VI. Conclusion &amp; Recommendations</li> </ul>		Propos
/II. Acknowledgements	Streamlines Processes	Activity Saving Schedule Savi
		Gene
		Total Savings (1.5 Additional Crane
		Total GC Cost S

## **Conclusion & Recommendations**

## sis 1 – Change Order Management

- ive Authority to the CM to Approve Changes urchase Preconstruction Services plement an Alternate Change Review Process
- Early trade involvement for intense MEP coordination
- Significantly reduce management time
- Better cash flow for subcontractors

## sis 2 – Precast Panel Implementation

sed Schedule Savings							
Days Weeks Months							
ngs	61	8.7	2.0				
vings	45	6.5	1.5				

eral Conditions Costs					
.5 Months) \$295,264.35					
e Cost	\$44,078.22				
Savings \$251,186.13					

- + Total cost savings: \$125,371.76
- + Structural upgrades not required
- + Panels have better thermal characteristics
- + Current mechanical system is acceptable

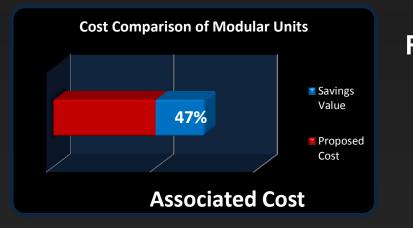




## Analysis 3 – Use of Virtual Mock-Ups for SIPS

- + 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



### . Introduction

- I. Analysis 1 Change Order Management
- II. 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

## Academic Acknowledgements

Architectural Engineering Faculty Dr. Robert Leicht (Advisor)



John Stull, Bob Nimorwicz, Matt Hedrick, Shane Goodman, & DPR's Project Team

PENNSTATE Department of Architectural Engineering

## Acknowledgements

## Special Thanks to:

My Family & Friends

Patrick Farrell of Kaiser Permanente

Steve Willey & Mark Zuidema of Ellerbe Beckett, now practicing as AECOM

Cy Zinn of Jacobs

Mark Taylor of Nitterhouse

Chuck Wynings & John Varga of Tindall Corporation

Andy Rhodes & Nate Patrick of Southland Industries

Cory Trent of Modular Services

Alex White & Dennis Gallant of Hill-Rom

**PACE Industry Members** 





## Industry Acknowledgements





















## Thank you! Any questions?











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## **Appendix – Change Order Management**

Owner Change Order 10										
Date Date ROM Calendar Dave from Initiation until Date Signal Pricing Calendar Dave from ROM Submitted until Total Date Calendar Dave from Signal Pricing Total Total										
CQ Included	Initiated	Submitted	ROM Submitted	Submitted	Final Pricing Submission	Price	Closed	Submission until KP Approval	Weeks	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										
CO Included	Date	Date ROM	Calendar Days from Initiation until		Calendar Days from ROM Submitted until	Total	Date	Calendar Days from Final Pricing	Total	Total
CQIIIciudea	Initiated	Submitted	ROM Submitted	Submitted	Final Pricing Submission	Price	Closed	Submission until KP Approval	Weeks	Months
099Rev	10/9/2012	10/17/2012	7	10/17/2012		7,498.99		80	11.4	2.6
127	3/8/2012	11/6/2012	174	11/7/2012		4,654.44		65	9.3	2.1
157	5/1/2012	10/12/2012	119	10/12/2012		5,863.40		83	11.9	2.7
182	6/11/2012	6/11/2012	1	11/5/2012		36,182.22		67	9.6	2.2
188	6/15/2012	11/2/2012	101	11/2/2012		4,232.14		68	9.7	2.2
196	7/9/2012	10/15/2012	71	10/15/2012		14,529.92		82	11.7	2.7
203	7/25/2012	11/2/2012	73	11/2/2012		2,229.03		68	9.7	2.2
240	8/22/2012	9/20/2012	22	9/20/2012		3,922.45	2/5/2013	99	14.1	3.3
261	9/19/2012	10/11/2012	17	11/20/2012		9,466.81	2/5/2013	56	8.0	1.8
276	10/12/2012	11/14/2012	24	11/14/2012		2,578.74	2/5/2013	60	8.6	2.0
298	11/13/2012	11/20/2012	6	11/20/2012		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				
				Owne	r 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		43,523.06		106	15.1	3.5
17	6/12/2012	6/22/2012	9	6/22/2012		199,054.24		32	4.6	1.1
103	2/1/2012	3/12/2012	29	3/12/2012		807.48		106	15.1	3.5
115	2/27/2012	3/12/2012	11	3/12/2012		2,317.61		106	15.1	3.5
156	4/30/2012	6/11/2012	31	6/11/2012		6,387.01		41	5.9	1.4
170	5/15/2012	5/21/2012	5	5/21/2012		5,253.11		56	8.0	1.8
1.0	5, 15, 2012	Average	51	Average	1	5,255.11	Average	74.5	10.6	2.5
		. werage	51	Average	-	\$257,342.51	weruge	77.5	10.0	2.5

Day	Date
1	12/11/
2	12/12/
3	12/13/
4	12/14/
5	12/17/
6	12/18/
7	12/19/
8	12/20/
9	12/21/
10	12/26/
11	1/4/20
12	1/7/20
13	1/8/20
14	1/9/20
15	1/10/20
	Totals

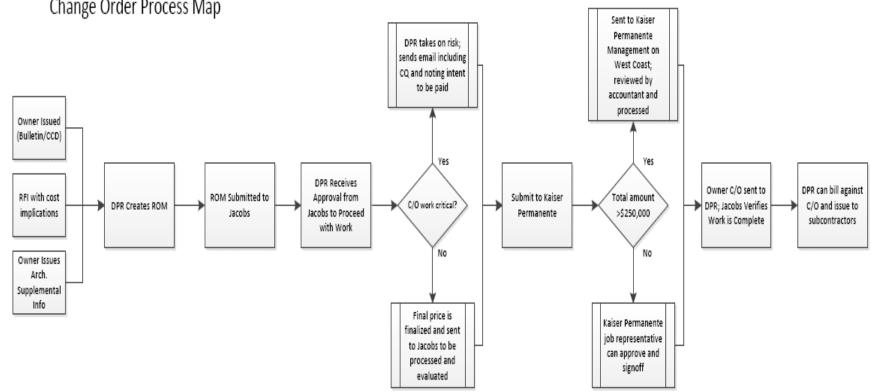




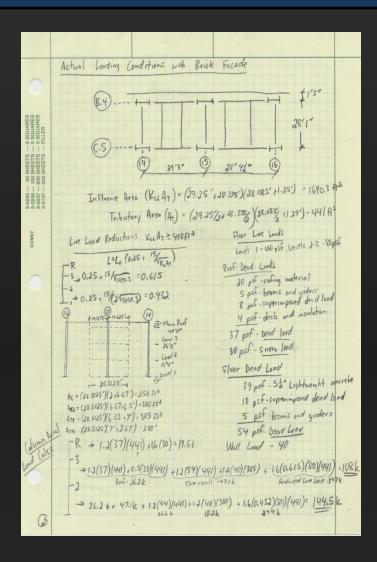
	Labor Tracking of Change Order (Blue Vest) Crew										
	VarcoMac	Hours	Daily	Pro-Air	Hours	Daily	Metro Painters	Hours	Daily	Total	Total
			Hours			Hours			Hours	Labor	Man-Hours
12	8	8	64	2	8	16			0	10	80
12	8	8	64	2	8	16			0	10	80
12	10	8	80	1	8	8			0	11	88
12	5	8	40	1	4	4			0	6	44
12	4	8	32	2	8	16			0	6	48
12	3	8	24	1	8	8			0	4	32
12	3	8	24	2	8	16			0	5	40
12	5	8	40	2	4	8			0	7	48
12	5	8	40			0			0	5	40
12	5	8	40			0			0	5	40
13	5	8	40			0			0	5	40
13	5	8	40			0	1	8	8	6	48
13	5	8	40			0	1	8	8	6	48
12	5	8	40	1	8	8	1	8	8	7	56
12	5	8	40	1	8	8	1	8	8	7	56
			648			108			32		788

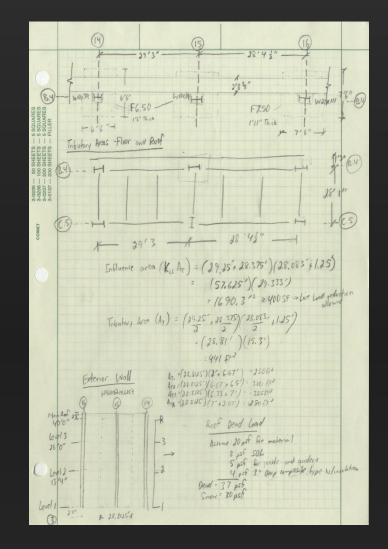
Blue Vest Labor Cost									
	RSI/Ieans Total Total								
Trade	Hourly Wage	Man-Hours	Labor Cost						
VarcoMac	73.14	648	\$47,394.72						
Pro-Air	78.38	108	\$8,465.04						
MetroPainter	67.82	32	\$2,170.24						
Tot	al	788	\$58,030.00						

Change Order Process Map











## Appendix – Structural Breadth





	Precast Loading Using 8" Ponels (100 psf)
SHEETS - FILLER	$\begin{bmatrix} 8 & 1.3 (37) (441) + 1.6 (30) = 15.6 \ l_{c} \\ -3 & 19.6 \ k + 0.5 (50) (441) + 1.2 (54) (441) + 1.2 (100) (385) + 1.6 (6.615) (80) (441) \\ -3 & 28.6 \ k & 46.2 \ k & 34.7 \ k \\ -2 & -2 \\ -3 & -2 \\ -3 & -2 \\ -3 & -2 \\ -3 & -2 \\ -3 & -2 \\ -3 & -2 \\ -3 & -2 \\ -3 & -2 \\ -3 & -2 \\ -3 & -2 \\ -3 & -2 \\ -3 & -2 \\ -4 & -2 \\ -4 & -2 \\ -3 & -2 \\ -3 & -2 \\ -4 & -2 \\ -4 & -2 \\ -2 & -2 \\ -3 & -2 \\ -3 & -2 \\ -3 & -2 \\ -4 & -2 \\ -2 & -2 \\ -3 &$
3-0137 - 200	$\frac{lood   ncrease on (olumn)}{[-3] - \frac{135.7 \ L - 10.8 \ k}{10.8 \ k}} = 26\% \text{ increase}$ $\frac{1}{10.8 \ k} = \frac{199.6 \ L - 10.8 \ k}{10.8 \ k} = 85\% \text{ increase}$
	Conclusion - WIOX39's can support either 7"or 8" preast panels in axial compression. I was wrong assuming culumns would need to be resized to support a larger load, but these calculations obo not take into account lateral loads

Foundation Check - Spread Franking At column B.4/15 -footing size is F6.50: 6'6 x6'6" x 1'8" thick Allowable soil bearing capacity (ga) = 5,000 165/5F; found in geo-tech report where p= total land At area of foundation, on which the load is bearing. 9. = 5000 psf or 5 ksf 5 ksf = P (6.5')(6.5') 211.35k 2 p / 0K 2199.6k P must be less than 211.35k, so this design is acceptable for the hownest possible load previously calculated, 199.6 k Strip Footing Unit strip method - 2'88" # I'm 2=A  $5 ksf \ge P(1')$ 1,71875 (1) 13.6 klf = p /ok Max load would be: 8" thick panel or 100 psf. -Max Building Height: 46" Total Possible Lood : 46 (100 psf) = 4.6 KAF = 13.6 KAF Conclusion ; Structural steel and foundations are not controlled by axial louding and can support additional load of purels Systems can adequately support weight of ponels as currently designed.



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)

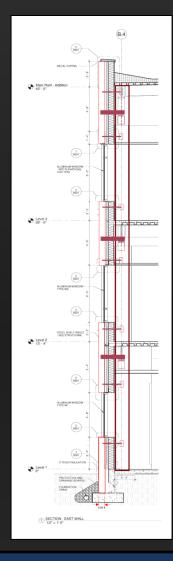
Equation No.	Load Combination
16-1	1.4(D + F)
16-2	$1.2(D + F + T) + 1.6(L + H) + 0.5(L_r \text{ or } S \text{ or } R)$
16-3	$1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (f_1L \text{ or } 0.8W)$
16-4	$1.2D + 1.6W + f_1L + 0.5(L_p \text{ or } S \text{ or } R)$
16-5	$1.2D + 1.0E + f_1L + f_2S$
16-6	0.9D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

w	10	A	Ava	ailat Co	mpr	conti Strei ess apes	ngth ion,	n in	s <sup>F</sup>	-y -
Sh	nape	1		-	1810	W	10×	-	170	
lb/ft Design		5	54		49		45		39	
		Pn/Qc	ocPn	$P_n/\Omega_c$	¢cPn	$P_n/\Omega_c$	ocPn	$P_n/\Omega_c$	ocPn	1
De	sign	ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD	
1000	0	473	711	431	648	398	598	344	517	1
gyration, ry	6 7 8 9 10	446 437 427 415 403	671 657 642 624 605	407 398 388 378 366	611 598 584 568 550	363 350 337 322 307	545 527 507 485 461	313 302 290 277 263	470 454 436 416 396	
least radius of gyration, ry	11 12 13 14 - 15	389 375 361 345 330	585 564 542 519 495	354 341 327 313 299	532 512 492 471 449	291 274 256 239 222	437 411 385 359 333	249 234 219 203 188	374 352 329 306 283	



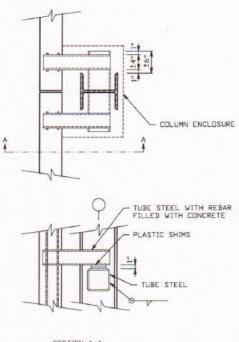
Wall U Value (Summer)	Combined
R <sub>o</sub> - Outside Air Barrier	0.25
R <sub>1</sub> - 3 1/2" Face Brick (R=0.11 per inch)	0.385
R <sub>2</sub> - 1 7/8" Air Space	1.23
R <sub>3</sub> - 2" Rigid Insulation (R=5 per inch)	10
R <sub>4</sub> - Vapor Barrier	Negligible
R <sub>5</sub> - 1/2" Gypsum Sheathing	0.45
R <sub>6</sub> - 6" Metal Stud / 6" Batt Insulation R-19	7.1
R <sub>7</sub> - 5/8" Gypsum Sheating - 51	0.56
R <sub>i</sub> - 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 <sub>avg</sub> =U <sub>avg</sub> *0.15 + 0.85*U <sub>insul</sub>	0.0484

Wall U Value (Summer)	Combined
R <sub>o</sub> - Outside Air Barrier	0.25
R <sub>1</sub> - 7" Precast Panel with Thin Brick (assume all concrete)	0.53
R <sub>2</sub> - 1 7/8" Air Space	1.23
R <sub>3</sub> - 2" Rigid Insulation (R=5 per inch)	10
R <sub>4</sub> - Vapor Barrier	Negligible
R <sub>5</sub> - 1/2" Gypsum Sheathing	0.45
R <sub>6</sub> - 6" Metal Stud / 6" Batt Insulation R-19	7.1
R <sub>7</sub> - 5/8" Gypsum Sheating - 51	0.56
R <sub>i</sub> - Inside Air Film (Vertical Position, Horizontal Heat Flow)	0.68
Total F	R 20.8
u (1/R	) 0.04808
%	i 100%
L	u 0.04808
<u>%*۱</u>	u 0.04808
U <sub>avg</sub> =U <sub>avg</sub> *0.15 + 0.85*U <sub>insul</sub>	0.04808



## Appendix – Mechanical Breadth

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



Š. KAISER PERMANENTE®



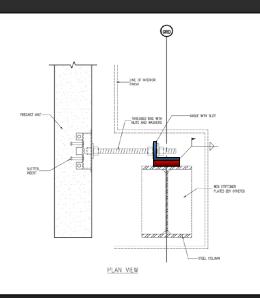
TABLE E.1 Thermal Properties of Conventional Building and Insulating Materials' (Continued)

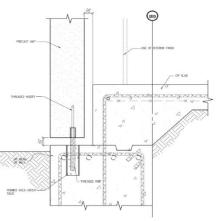
			Part A. I-P Units				
	10				I-P Resist	and the second se	
Description		Density lb/ft <sup>3</sup>	Conductivity <sup>®</sup> (k) Btu-in./h ft <sup>2</sup> °F	Conductance (C) Btu h/ ft <sup>2</sup> °F	Per Inch Thickness (1/k) °F ft <sup>2</sup> h Btu-in.	For Thickness Listed (1/C) °F ft <sup>2</sup> h Btu	Specifi Heat Btu/ Ib °F
Perlite, expanded		2.0-4.1	0.27-0.31	-	3.7-3.3		0.26
Penite, expanded		4.1-7.4	0.31-0.36	-	3.3-2.8	A	-
		7.4-11.0	0.36-0.42	-	2.8-2.4	-	-
Mineral fiber (rock, slag, or glass) <sup>o</sup>							
Approx. 3.75-5 in.		0.6-2.0	-	-	-	11.0	0.17
Mineral fiber (rock, slag, or glass) <sup>g</sup>							
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	al online		-	30.0	-
Mineral fiber (rock, slag, or glass) <sup>g</sup>		2.0-3.5		-	-	12.0-14.0	101
Approx. 3.5 in. (closed sidewall application)							
Vermiculite, exfoliated		7.0-8.2	0.47	6827	2.13	-	0.3
		4.0-6.0	0.44		2.27	000	
Spray Applied					6.25-5.56		
Polyurethane foam		1.5-2.5	0.16-0.18	-	4.55-3.57	2017	- 3
Ureaformaldehyde foam		0.7-1.6	0.22-0.28	55.87	3.45-2.94	and the second	
Cellulosic fiber		3.5-6.0	0.29-0.34	9.8977	3.45-2.94		
Glass fiber		3.5-4.5	0.26-0.27	-	3.65-3.70		
Reflective Insulation				0.31		3.2	
Reflective material (ε < 0.5) in center of ¾-in. cavity forms two ¾-in. vertical air spaces <sup>m</sup>			20	0.31		5.2	
Metals		1					
(See ASHRAE Handbook—Fund	lamentals)						
Roofing							
Asbestos-cement shingles		120	-	4.76	-	0.21	0.
Asphalt roll roofing		70	-	6.50	20	0.15	0.
Asphalt shingles		70	-	2.27	80 -	0.44	0.
Built-up roofing	0.375 in.	70	1	3.00	-	0.33	0.
Slate	0.5 in.	-	100	20.00	belo	0.05	0.
Wood shingles, plain and plastic film faced		-		1.06	100	0.94	0.
Plastering Materials		1999.0			0.20		0.
Cement plaster, sand aggregate		116	5.0	12.2	0.20	0.08	0.
Sand aggregate	0.375 in.	-	-	13.3		0.08	0.
Sand aggregate	0.75 in.	-	10 - C	0.00		0.15	
Gypsum plaster				3.12		0.32	
Lightweight aggregate	0.5 in.	45	-	2.67		0.32	-
Lightweight aggregate Lightweight aggregate on metal lath	0.625 in. 0.75 in.	45		2.13	-	0.47	-

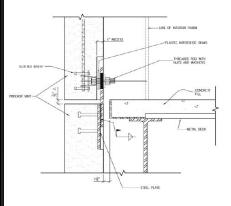
SECTION A-A













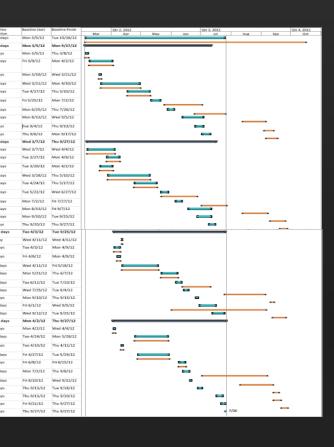
						Horiz	ontal Panel Takeoff					
Panel Designation	Length (ft)	Width (ft)	Average Panel Area (SF)	Total Area (SF)	Weight per Panel (LB)	Total Quantity	Oversize Tranportation Required (Y/N)	Total South Façade	Total North Façade	Total West Façade	Total East Façade	Sealant Required (LF)
A	3.5	10,33	36.2	108.5	3,616	3	N				3	83.0
B	5.17	0.5	2.6 15.5	2.6 31.0	259	2	N	1		2		11.3 32.7
D	5.17	3.33	15.5	137.7	1,551		N	1		2	5	135.0
E	5.17	5	25.9	258.5	2,585	10	N	4		-	6	203.4
F	5.17	5.33	27.5	110.2	2,756	4	N	3			1	84.0
G	5.17	7	36.2	36.2	3,619	1	N				1	24.3 15.7
	5.17	3.33	21.6	562.8	2,165	26	N	8	4	6	8	511.2
j.	6.5	0.5	3.3	13.0	325	4	N	2	2			56.0
K	6.5	1	6.5	39.0	650	6	N				6	90.0
M	6.5 6.5	5.33	32.5 34.6	845.0 866.1	3,250 3,465	26	N	8	6	6	6 5	598.0 591.5
N	6.5	2.67	17.4	104.1	1,736	6	N	v	2	2	2	110.0
0	6.5	30.33	197.1	197.1	19,715	1	N			1		73.7
P	6.5	6,33	41.1	41.1	4,115	1	N	1				25.7
Q	6.5 6.5	8.33	54.1 58.5	108.3 234.0	5,415 5,850	2	N	2 4				59.3 124.0
S	8.5	10.33	87.8	263.4	8,781	3	N				3	113.0
т	11.67	23.25	271.3	542.7	27,133	2	N				2	139.7
V	13.25	6.75	89.4	89.4	8,944	1	N				1	40.0
v w	13.5 16.33	6.67	90.0 110.2	90.0 110.2	9,005	1	N				1	40.3 46.2
X	18.33	6.75	110.2	247.5	12,373	2	N				2	40.2
Y	18.5	7.17	132.6	132.6	13,265	1	N				1	51.3
Z	19	2.5	47.5	47.5	4,750	1	N				1	43.0
AA BB	20.33	7.17	145.8 129.6	291.5 129.6	14,577 12,957	2	N				2	110.0 54.3
CC	21	6.17	129.5	129.6	12,957	1	N				1	55.3
DD	21	6.75	141.8	141.8	14,175	1	N				1	55.5
EE	24	2	48.0	96.0	4,800	2	N				2	104.0
FF GG	28.375	6.17	175.1	1050.4	17,507	6	N			3	3	414.5
HH	28.375	7.17	203.4	610.3	20,345	3	N				3	210.5
11	29.25	7.17	209.7	209.7	20,972	1	N				1	72.8
11	30.33	8.67	263.0	263.0	26,296	1	N				1	78.0
KK LL	30.67 30.67	6.75	207.0 204.6	207.0 204.6	20,702 20,457	1	N				1	74.8
MM	30.67	6.17	189.2	189.2	18,923	1	N				1	73.7
NN	3	23.33	70.0	210.0	6,999	3	N			3		158.0
00	2.5	28	70.0	70.0	7,000	1	N			1		61.0
PP	2.5 8.17	30	75.0	225.0 98.0	7,500	3	N			3		195.0 40.3
RR	7	30.375	212.6	425.3	21,263	2	N			2		149.5
SS	11.5	15	172.5	172.5	17,250	1	N			1		53.0
TT	6.5 6.5	15	97.5 87.8	195.0 87.8	9,750	2	N			2		86.0 40.0
W	1.33	13.5	87.8	87.8	8,775	1	N			1		27.0
ww	6	17.5	105.0	105.0	10,500	1	N			1		47.0
XX	6	28.375	170.3	340.5	17,025	2	N			2		137.5
YY	6.5	28.375	184.4	553.3	18,444	3	N			3		209.3 64.7
ZZ	30.33 28.375	2	60.7 56.8	60.7 113.5	6,066	2	N			2		64.7 121.5
B88	6.5	28.67	185.4	559.1	18,636	3	N		3			211.0
CCC	6.17	28.67	176.9	530.7	17,689	3	N		3			209.0
DDD EEE	5.5	28.67	157.7	473.1	15,769	3	N		3			205.0
FFF	3.33	9,33	4./	4./	467	5	N		5			19.7
GGG	2.67	9.33	24.9	24.9	2,491	1	N		1			24.0
HHH	8.67	20	173.4	173.4	17,340	1	N	1				57.3
111	8.67	30 21.5	260.1 215.0	520.2 430.0	26,010 21,500	2	N	2				154.7 126.0
KKK	10 6.67	21.5	215.0	430.0	21,500	2	N	2				126.0
LLL	6.67	20	133.4	133.4	13,340	1	N	1				53.3
MMM	6.17	30	185.1	740.4	18,510	4	N	4				289.4
NNN 000	6.17 9.5	20	123.4 218.5	123.4 655.5	12,340 21,850	1	N	1 3				52.3 195.0
PPP	6.75	3.33	218.5	22.5	2,248	1	N	1				20.2
QQQ	4	8.17	32.7	32.7	3,268	1	N	1				24.3
RRR	2.92	30	87.6	350.4	8,760	4	N	4				263.4
SSS TIT	2.92	20	58.4	58.4 360.0	5,840	2	N	1 2				45.8 144.0
UUU	6	6.33	38.0	360.0	3,798	1	N	1				244.0
VW	6.17	6.33	39.1	39.1	3,906	1	N	1				25.0
WWW	6.5	6.33	41.1	41.1	4,115	1	N	1				25.7
XXX YYY	3.33	20.25 20.92	67.4 251.0	134.9 1004.2	6,743 25,104	2	N	2 4				94.3 263.4
ZZZ	7.33	17.17	1251.0	251.7	12,586	2	N	2				98.0
AAAA	3	7.25	21.8	21.8	2,175	1	N	1				20.5
			Total			244	0 Panels	77	36	54	77	9,303.9
	A	nucipated S	chedule Duratio	กร		16.3		5.1	2.4	3.6	5.1	



Unit Detail Repo	ort							
LineNumber	-	Ø	T	Description	Quantity	Unit	Total Incl.	Ext. Total Incl.
							O&P	O&P
Division 07 There	nal and	Moistur	e Prote	ction				
079213200085			•	Joint sealants, caulking and sealants, bulk acrylic latex, 3/8" x 5/8", in place	7,459.80	L.F.	\$2.16	\$16,113.17
Division 07 Thern	al and l	Voisture	Protec					\$16,113.17
Division of Thern	iai anti i	storsture	TIOLE	choir Subiotai				510,115.17
LineNumber		Ø	Т	Description	Quantity	Unit	Total Incl.	Ext. Total Incl.
							O&P	O&P
Division 01 Gene	ral Requ	irement	s					
015433601200			<b>1</b> 11	Rent crawler mounted, lattice boom	17.00	Day	\$2,510.73	\$42,682.38
				crane, 100 ton, 60' boom, Incl. Hourly				
				Oper. Cost.				
015436502300				Mobilization or demobilization,	1.00	Ea.	\$1,395.84	\$1,395.84
				crane, crawler-mounted, over 75 ton				
Division 01 Gener	al Requ	irements	Subto	otal				\$44,078.22
LineNumber		1	T	Description	Ouantity	Unit	Total Incl.	Ext. Total Incl.
Linerandoer		<i>w</i>	1	Description	Quantity	Calt	O&P	Ext. 1 otal Inci. O&P
Division 07 There		M-1-4	Dente				our	041
	nai and	Moistur	e rrote		22 200 00	0 F		6.00 222 00
072113100030	*			Fiberboard insulation, rigid, for walls, 2" thick, R5.26	33,780.00	S.F.	\$1.74	\$58,777.20
Division 07 Thern	al and !	Moisture	Protee					\$58,777.20

ID	Task Name	Duration	Start	Finish	Baseline Duration
1	Exterior Enclosure	104 days	Mon 3/5/12	Thu 7/26/12	161 day
2	East Elevation	93 days	Mon 3/5/12		138 day
3	Layout Exterior Walls	4 days	Mon 3/5/12	Thu 3/8/12	4 days
4	Set up Equipment & Fireproof Perimeter Steel	17 days	Fri 3/9/12	Mon 4/2/12	17 days
5	Install Top Track and Clips	3 days	Mon 3/19/12	Wed 3/21/12	3 days
6	Frame Perimeter Walls	29 days	Wed 3/21/12	Mon 4/30/12	29 days
7	Install Exterior Wall Sheathing	18 days	Tue 4/17/12	Thu 5/10/12	18 days
8	Install Vapor Barrier & Insulation	7 days	Fri 5/11/12	Mon 5/21/12	26 days
9	Erect Precast Panels	6 days	Mon 5/28/12	Mon 6/4/12	22 days
10	Install Exterior Windows	17 days	Tue 6/12/12	Wed 7/4/12	17 days
11	Install Curtain Wall	8 days	Mon 6/25/12	Wed 7/4/12	8 days
12	Caulking	8 days	Mon 7/2/12	Wed 7/11/12	8 days
13	South Elevation	94 days	Wed 3/7/12	Mon 7/16/12	144 day
14	Layout Exterior Walls	21 days	Wed 3/7/12	Wed 4/4/12	21 days
15	Install Top Track and Clips	10 days	Tue 3/27/12	Mon 4/9/12	10 days
16	Fireproof Perimeter Steel	10 days	Tue 3/20/12	Mon 4/2/12	10 days
17	Frame Perimeter Walls	32 days	Wed 3/28/12	Thu 5/10/12	32 days
18	Install Exterior Wall Sheathing	18 days	Tue 4/24/12	Thu 5/17/12	18 days
19	Install Vapor Barrier & Insulation	7 days	Mon 5/21/12	Tue 5/29/12	25 days
20	Erect Precast Panels	6 days	Tue 6/5/12	Tue 6/12/12	18 days
21	Install Exterior Windows	19 days	Mon 6/18/12	Thu 7/12/12	19 days
22	Install Curtain Wall	12 days	Wed 6/27/12	Thu 7/12/12	12 days
23	Caulking	6 days	Mon 7/9/12	Mon 7/16/12	6 days
24	West Elevation	82 days	Tue 4/3/12	Wed 7/25/12	121 day
25	Layout Exterior Walls Install Top Track and	1 day 5 days	Wed 4/11/12 Tue 4/3/12	Wed 4/11/12 Mon 4/9/12	1 day 5 days
26	Clips		Tue 4/5/12		
	Fireproof Perimeter Steel	2 days		Mon 4/9/12	2 days
28	Frame Perimeter Walls	28 days	Wed 4/11/12	Fri 5/18/12	28 days
~	Install Exterior Wall Sheathing	14 days	Mon 5/21/12	Thu 6/7/12	14 days
30	Install Vapor Barrier & Insulation	5 days	Tue 6/5/12	Mon 6/11/12	19 days
31	Erect Precast Panels	4 days 4 days	Wed 6/13/12	Mon 6/18/12	29 days
32	Install Exterior Windows Install Curtain Wall	4 days 12 days	Mon 6/25/12 Fri 6/29/12	Thu 6/28/12 Mon 7/16/12	4 days 67 days
33	Caulking	12 days	Thu 7/12/12	Wed 7/25/12	67 days
35	North Elevation	84 days	Mon 4/2/12	Thu 7/26/12	126 day
36	Layout Exterior Walls	3 days	Mon 4/2/12	Wed 4/4/12	3 days
37	Install Top Track and	25 days	Tue 4/24/12	Mon 5/28/12	25 days
38	Clips Fireproof Perimeter	3 days	Tue 4/10/12	Thu 4/12/12	3 days
39	Steel Frame Perimeter Walls	23 days	Fri 4/27/12	Tue 5/29/12	23 days
40	Install Exterior Wall	6 days	Fri 6/8/12	Fri 6/15/12	6 days
41	Sheathing Install Vapor Barrier &	6 days	Tue 6/12/12	Tue 6/19/12	47 days
42	Insulation Erect Precast Panels	3 days	Tue 6/19/12	Thu 6/21/12	23 days
43	Install Exterior	4 days	Wed 6/27/12	Mon 7/2/12	4 days
44	Windows Install Curtain Wall	6 days	Mon 7/16/12	Mon 7/23/12	6 days
45	Caulking	5 days	Sat 7/21/12	Thu 7/26/12	S days
46	Building Watertight	0 days	Thu 7/26/12	Thu 7/26/12	0 days

## Appendix – Precast Panels



	Activity Name	Original Duration	At Completion Duration	Start	Finish
cterior		161	159	05-Mar-12 A	16-0ct-12
EastElevation		138	138	05-Mar-12 A	17-Sep-12
EE.00.1000	Layout Exterior Walls East Elevation	6	4	05-Mar-12 A	08-Mar-12 A
EE.00.1020	Set Up Equipment & Fireproof Perimeter Steel	5	17	09-Mar-12 A	02-Apr-12 A
EE.00.1010	Install Top Track and Clips East Elevation	6	3	19-Mar-12 A	21-Mar-12A
EE.00.1030	Frame Perimeter Walls East Elevation	15	28	21-Mar-12A	30-Apr-12A
EE.00.1040	Install Exterior Wall Sheathing East Elevation	15	18	17-Apr-12 A	11-May-12A
EE.00.1050	Install Vapor Barrier and Wall Ties East Elevation	15	26	25-May- 12 A	02-Jul-12 A
EE.00.1060	Erect Exterior Brick and Precast Accent Band East Elevation	15	22	25-Jun-12 A	26-Jul-12 A
EE.00.1070	Install Exterior Windows East Elevation	8	17	13-Aug-12 A	05-Sep-12
EE.00.1080	Install Curtain wall East Elevation	8	8	04-Sep-12	13-Sep-12
EE.00.1090	East Elevation - Caulking	8	8	06-Sep-12	17-Sep-12
South Elevation		148	144	07-Mar-12A	27-Sep-12
SE.00.1000	Layout Exterior Walls South Elevation	6	21	07-Mar-12A	04-Apr-12A
SE.00.1020	Fireproof Perimeter Steel South Elevation	5	10	20-Mar-12 A	02-Apr-12 A
SE.00.1010	Install Top Track and Clips South Elevation	6	10	27-Mar-12A	09-Apr-12A
SE.00.1030	Frame Perimeter Walls South Elevation	15	32	28-Mar-12 A	11-May-12A
SE.00.1040	Install Exterior Wall Sheathing South Elevation	15	17	24-Apr-12A	17-May-12A
SE.00.1050	Install Vapor Barrier and Wall Ties South Elevation	15	25	22-May- 12 A	27-Jun-12 A
SE.00.1060	Erect Exterior Brick and Precast Accent Band South Elevation	15	18	02-Jul-12 A	27-Jul-12 A
SE.00.1070	Install Exterior Windows South Elevation	6	19	13-Aug-12 A	07-Sep-12
SE.00.1080	Install Curtain wall South Elevation	12	12	10-Sep-12	25-Sep-12
SE.00.1090	South Elevation - Caulking	6	6	20-Sep-12	27-Sep-12
West Elevation		121	123	03-Apr-12A	25-Sep-12
WE.00.1010	Install Top Track and Clips West Elevation	6	5	03-Apr-12 A	10-Apr-12 A
WE.00.1020	Fireproof Perimeter Steel West Elevation	5	2	06-Apr-12 A	09-Apr-12 A
WE.00.1000	Layout Exterior Walls West Elevation	6	1	11-Apr-12A	12-Apr-12 A
WE.00.1030	Frame Perimeter Walls West Elevation	9	28	11-Apr-12A	21-May-12 A
WE.00.1040	Install Exterior Wall Sheathing West Elevation	9	14	21-May- 12 A	11-Jun-12 A
WE.00.1080	Install Curtain wall West Elevation	12	67	01-Jun-12 A	05-Sep-12
WE.00.1050	Install Vapor Barrier and Wall Ties West Elevation	9	19	12-Jun-12 A	10-Jul-12 A
WE.00.1060	Erect Exterior Brick and Precast Accent Band West Elevation	9	29	25-Jul-12 A	04-Sep-12
WE.00.1070	Install Exterior Windows West Elevation	4	4	10-Sep-12	13-Sep-12
WE.00.1090	West Elevation - Caulking	10	10	12-Sep-12	25-Sep-12
North Elevation		119	126	02-Apr-12 A	27-Sep-12
NE.00.1000	Layout Exterior Walls North Elevation	6		02-Apr-12A	05-Apr-12A
NE.00.1020	Fireproof Perimeter Steel North Elevation	5		10-Apr-12A	13-Apr-12 A
NE.00.1010	Install Top Track and Clips North Elevation	6		24-Apr-12A	29-May-12 A
NE.00.1030	Frame Perimeter WallsN orth Elevation	6		27-Apr-12A	31-May-12A
NE.00.1040	Install Exterior Wall Sheathing North Elevation	6		02-Jul-12 A	10-Jul-12 A
NE.00.1050	Install Vapor Barrier and Wall Ties North Elevation	6		02-Jul-12 A	06-Sep-12
NE.00.1060	Erect Exterior Brick and Precast Accent Band North Elevation	6		10-Aug-12 A	12-Sep-12
NE.00.1070	Install Exterior Windows North Elevation	4		13-Sep-12	18-Sep-12
NE.00.1080	Install Curtain wall North Elevation	6		13-Sep-12	20-Sep-12
NE.00.1090	North Elevation - Caulking	5	5	21-Sep-12	27-Sep-12



















						Vertical Panel Ta	keoff					
Panel Designation	Length (ft)	Width (ft)	Average Panel Area (SF)	Total Area (SF)	Weight (LB)	Total Quantity	Oversize Tranportation Required (Y/N)	Total South Façade	Total North Façade	Total West Façade	Total East Façade	Sealant Required (LF)
A	7.17	20.33	145.8	291.5	14,576.6	2	N				2	110.0
В	7.17	18.5	132.6	132.6	13,264.5	1	N				1	51.3
с	7.17	28.375	203.4	406.9	20,344.9	2	N				2	142.2
D E	7.17	29.25 30.04	209.7 215.4	209.7 215.4	20,972.3 21,538.7	1	N	-			1	72.8
F	6.5	30.04	215.4	215.4	21,538.7	6	N				6	90.0
G	6.5	3.33	21.6	86.6	2,164.5	4	N	1			4	78.6
н	19.17	3.33	63.8	63.8	6,383.6	1	N				1	45.0
1	19.17	2.5	47.9	47.9	4,792.5	1	N	1			1	43.3
J	2	24	48.0	96.0	4,800.0	2	N				2	104.0
K	4.17	14	58.4	58.4	5,838.0	1	N				1	36.3
L	14	2.5	35.0	35.0	3,500.0	1	N				1	33.0
M	38	3.33	126.5	632.7 3654.0	12,654.0	5	N	-			5	413.3
N	38 47	12	406.0 443.5	3654.0	40,600.0	2	N	1			9	900.0
P	18.33	10.5	445.5	509.9	16,996.0	3	Y	1			3	182.0
Q	11.67	23.25	271.3	542.7	27,132.8	2	N	1			2	139.7
R	8.5	29.71	252.5	252.5	25,253.5	1	N	1		1		76.4
S	8.5	32.92	279.8	279.8	27,982.0	1	N	1		1		82.8
T	12	41.22	494.6	494.6	49,464.0	1	N	]		1		106.4
U	3	45	135.0	135.0	13,500.0	1	N			1		96.0
V	5.17	3	15.5	31.0	1,551.0	2	N			2		32.7
W	5.17	3.33	17.2	34.4	1,721.6	2	N			2		34.0
X Y	7.25	17.5 28.375	126.9 205.7	126.9 411.4	12,687.5 20,571.9	2	N	-		1		49.5
Z	7.25	20.5/5	205.7	215.4	20,571.5 21,539.8	1	N	1		1		73.9
AA	6.5	2.67	17.4	104.1	1,735.5	6	N		2	4		110.0
88	6.5	3.33	21.6	216.5	2,164.5	10	N	1	4	6		196.6
CC	6.5	5	32.5	130.0	3,250.0	4	N	1		4		92.0
DD	6.5	5.33	34.6	138.6	3,464.5	4	N			4		94.6
EE	12.67	30.33	288.3	288.3	28,828.1	1	Ŷ			1		86.0
FF	12.67	28.375	263.5	527.0	26,351.1	2	Ŷ	-		2		164.2
GG HH	12.67	29.71 30.33	280.4	280.4	28,042.6	1	Y N	-		1		84.8
II II	6.5	28.375	197.1	368.9	19,/14.5	2	N	1		2		139.5
, L	6.5	29.71	193.1	193.1	19,311.5	1	N	1		1		72.4
KK	6.5	0.5	3.3	6.5	325.0	2	N	1	2	-		28.0
ш	28.67	12	248.0	496.1	24,804.0	2	N	1	2			162.7
MM	30.67	12	272.0	272.0	27,204.0	1	N	]	1			85.3
NN	28.67	12.67	267.2	534.5	26,724.9	2	Ŷ		2			165.4
00	30.67	12.67	292.6	292.6	29,258.9	1	Ŷ	-	1			86.7
PP QQ	9.33 9.33	0.5	4.7	4.7	466.5	1	N	-	1			19.7
RR	9.33	2.67	24.9	24.9	2,491.1	5	N	-	1			24.0
SS	5.35	28.67	186.4	372.7	18,635.5	2	N	1	2			140.7
TT	6.5	30.67	199.4	199.4	19,935.5		N	1	1			74.3
UU	41.83	7.33	216.6	216.6	21,661.4	1	N	1				98.3
VV	41.83	10	328.3	328.3	32,830.0	1	N	1				103.7
WW	41.83	12	502.0	3513.7	50,196.0	7	N	7				753.6
XX	43	7	211.0	211.0	21,100.0	1	N	1				100.0
ΥY	43	12	426.0	2982.0	42,600.0	7	N	7				770.0
ZZ	7.75	17.17	133.1	266.1	13,306.8	2	N Y	2				99.7
AAA	14.5	19	275.5 Tatala	275.5	27,550.0	1 126		20	24	30	44	67.0 7459.8
		Anticipat	Totals ted Scheule Durat	ions		125	8 Panels	20	24	38	3.7	/459.8
		ninsipa	ee sensore offici			10.5		4.7	2.0	3.2	2.1	<u> </u>

 Time
 Friday

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## Appendix – Virtual Mock-Ups and SIPS

			 Project:	Kaiser Permanente Largo Medical Office Building					Zone:	Northwest Building Connection	
Day			Activity	Quanity	Unit	Budget Production	Total Budget Time (MHR)	Crew Size (People)	Activity Duration (HR)	Activity Duration (Days)	Notes
y Saturday Sunday M	londay Tuesday			Quanty				(People)			
			Construct Temporary Partition	1	ΕA	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
		DPR/Essex	Saw Cut Brick/Remove Studs	75	SF	4.70	32	4	8.0	1.0	Including 3 courses below finished floor - (OH)
		Varco-Mac	Insert 5/16" Bent Plate	8	LF	2.00	8	4	2.0	0.3	1/2" Diameter 6" Imbeds, 24" O.C (OH)
		Calvert Steel-Fab	Place Concrete/Expansion Joint	1	СҮ	0.50	4	2	2.0	0.3	Joint depressed 3/4" for cover
		MetroPainter	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										
	Hourly Rate	Hourly Rate Location Adjusted Rate Adjuste								
Description	including O & P	Factor	including O & P	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						







2	Area B	134 days	Mon 3/5/12	Thu 9/6/12	134 days
3	Lay Out Walls	9 days	Mon 3/5/12	Thu 3/15/12	9 days
4	OH Plumbing Rough-In	79 days	Tue 3/13/12	Fri 6/29/12	79 days
5	OH Flanding Rough-In OH Elec & Tele/Data Rough-In	94 days	Tue 3/13/12	Fri 7/20/12	94 days
6	OH Mechanical Rough-In	70 days	Fri 3/23/12	Thu 6/28/12	70 days
7	Frame Walls	63 days	Mon 3/26/12	Wed 6/20/12	59 days
8	IW Electrical Rough-In	53 days	Wed 4/4/12	Fri 6/15/12	47 days
9	OH Med Gas Rough-In	69 days	Mon 4/9/12	Thu 7/12/12	69 days
10	W Mechanical Rough-In	42 days	Wed 4/18/12	Thu 6/14/12	42 days
11	W Plumbing Rough-In	52 days	Wed 4/18/12 Wed 4/18/12	Thu 6/28/12	52 days
12	Set Door Frames	52 days 24 days	Fri 4/20/12	Wed 5/23/12	52 days 24 days
13	Pipe and Duct Testing	24 days 49 days	Wed 5/2/12	Mon 7/9/12	49 days
14	Insulate Pipe and Duct	49 days	Thu 5/3/12	Tue 7/10/12	49 days
15	IW Med Gas Rough-In	43 days	Wed 5/16/12	Fri 7/13/12	33 days
16	IW Tele/Data Rough-In	21 days	Thu 5/24/12	Thu 6/21/12	18 days
17	Frame Bulkheads at Hard Ceilings	73 days	Fri 5/25/12	Tue 9/4/12	73 days
18	Install Blocking	12 days	Mon 7/16/12	Tue 7/31/12	12 days
19	Wall Close-In Inspection	15 days	Thu 7/26/12	Wed 8/15/12	15 days
20	OH Sprinkler Rough-In	21 days	Tue 8/7/12	Tue 9/4/12	21 days
21	Sprinkler Hydro Test	1 day	Wed 9/5/12	Wed 9/5/12	1 day
22	MEP OH Inspection	2 days	Wed 9/5/12	Thu 9/6/12	2 days
23	Area C	130 days	Thu 3/15/12	Wed 9/12/12	
24	Lay Out Walls	10 days	Thu 3/15/12	Wed 3/28/12	10 days
25	Frame Walls	36 days	Mon 4/9/12	Sat 5/26/12	34 days
26	OH Mechanical Rough-In	57 days	Thu 4/12/12	Fri 6/29/12	57 days
27	OH Plumbing Rough-In	57 days	Thu 4/12/12	Fri 6/29/12	57 days
28	IW Mechanical Rough-In	48 days	Tue 4/17/12	Thu 6/21/12	48 days
29	Set Door Frames	7 days	Wed 5/2/12	Thu 5/10/12	7 days
30	OH Elec & Tele/Data Rough-In	57 days	Thu 5/3/12	Fri 7/20/12	57 days
31	OH Med Gas Rough-In	49 days	Mon 5/7/12	Thu 7/12/12	49 days
32	IW Plumbing Rough-In	39 days	Tue 5/8/12	Fri 6/29/12	39 days
33	IW Electrical Rough-In	37 days	Tue 5/8/12	Wed 6/27/12	
34	IW Med Gas Rough-In	40 days	Mon 5/21/12	Fri 7/13/12	35 days
35	Pipe and Duct Testing	35 days	Tue 5/22/12	Mon 7/9/12	35 days
36	Insulate Pipe and Duct	35 days	Fri 5/25/12	Thu 7/12/12	35 days
37	IW Tele/Data Rough-In	23 days	Fri 5/25/12	Tue 6/26/12	22 days
38	Frame Bulkheads at Hard Ceilings	48 days	Fri 6/29/12	Tue 9/4/12	48 days
39	Install Blocking	12 days	Mon 7/16/12	Tue 7/31/12	12 days
40	Wall Close-In Inspection	15 days	Thu 7/26/12	Wed 8/15/12	15 days
41	OH Sprinkler Rough-In	21 days	Tue 8/14/12	Tue 9/11/12	21 days
42	MEP OH Inspection	2 days	Wed 9/5/12	Thu 9/6/12	2 days
43	Sprinkler Hydro Test	1 day	Wed 9/12/12	Wed 9/12/12	
44	Level 3 MEP Rough-Ins (Area B)	117 days	Tue 5/8/12	Wed 10/17/12	
45	Area B	117 days	Tue 5/8/12	Wed 10/17/12	
46	Lay Out Walls	9 days	Tue 5/8/12	Fri 5/18/12	9 days
47	Frame Walls	83 days	Tue 5/29/12	Thu 9/20/12	
48	Set Door Frames	83 days	Tue 5/29/12	Thu 9/20/12	83 days
49	OH Elec & Tele/Data Rough-In	45 days	Thu 7/5/12	Thu 9/6/12	46 days
50	OH Mechanical Rough-In	42 days	Mon 7/9/12	Tue 9/4/12	42 days
51	OH Med Gas Rough-In	43 days	Mon 7/9/12	Wed 9/5/12	43 days
52	OH Plumbing Rough-In	41 days	Wed 7/11/12	Wed 9/5/12	41 days
53	IW Plumbing Bough-In	39 days	Mon 8/6/12	Thu 9/27/12	39 days
54	IW Med Gas Rough-In	38 days	Tue 8/7/12	Thu 9/27/12	23 days
55	Frame Bulkheads at Hard Ceilings	33 days	Tue 8/7/12	Thu 9/20/12	33 days
56	Install Blocking	32 days	Wed 8/8/12	Thu 9/20/12	32 days
57	IW Mechanical Bough-In	33 days	Tue 8/14/12	Thu 9/27/12	33 days
58	IW Electrical Rough-In	33 days	Tue 8/14/12	Thu 9/27/12	24 days
59	IW Tele/Data Rough-In	23 days	Tue 8/28/12	Thu 9/27/12	19 days
60	Pipe and Duct Testing	5 days	Tue 9/4/12	Mon 9/10/12	
61	Insulate Pipe and Duct	15 days	Wed 9/5/12	Tue 9/25/12	15 days
62	MEP OH Inspection	2 days	Wed 9/26/12	Thu 9/27/12	2 days
63	Wall Close-In Inspection	2 days	Fri 9/28/12	Mon 10/1/12	
64	OH Sprinkler Rough-In	10 days		Tue 10/16/12	
65	Sprinkler Hydro Test	1 day		Wed 10/17/12	

Task Nam

Level 1 MEP Rough Ins - Area A & B

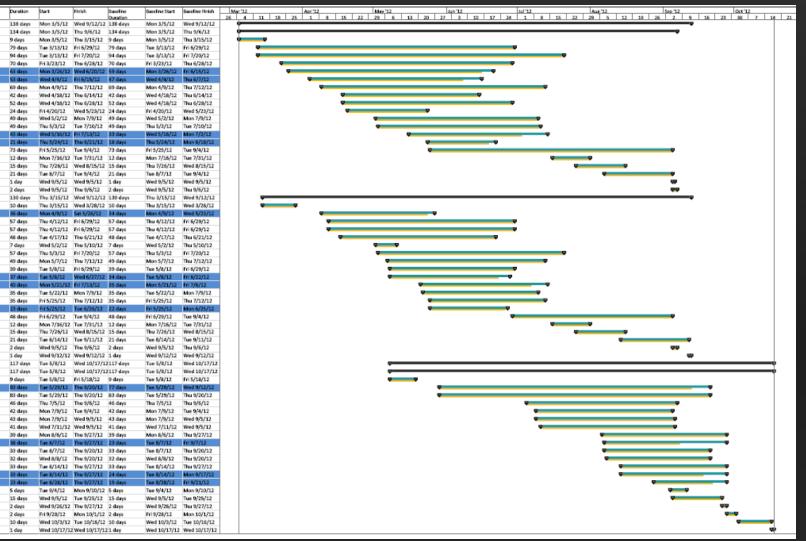
Headwall Labor Costs											
Activity	Adjusted	Hours Per	Cost Per	Total	Total Cost						
Activity	Hourly Rate	Unit	Unit	Man-Hours	Total Cost						
Frame Walls	\$67.82	2.0	\$135.64	98	\$6,646.36						
In-Wall Electric Rough-Ins	\$73.14	3.0	\$219.42	147	\$10,751.58						
In-Wall Med Gas Rough-Ins	\$78.38	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	Total Unit Cost	Total Units	Total Project					
Description	Onit Cost	Cost	Total Onit Cost	Total Offics	Cost					
Current Unit Cost		\$1,540.65		49						
Proposed System Cost 49										
Difference										

## **Appendix – Modularization**







Headwall Takeoff Data Release : Year 2013 Quarter 1 Unit Cost Estimate													
Quantity	LineNumber	Description	Crew	Unit	Ma	Material		Ext. Mat.		Mat. O&P		Ext. Mat. O&P	
		Partition, galv LB studs, 16 ga x 4" W											
		studs 16" O.C. x 8' H, incl galv top & bottom track, excl openings, headers,											
9	054113304370	beams, bracing & bridging	2 Carp	L.F.	s	9.37	c	84.33	c	10.31	s	92.79	
9	054115504570	Pipe, copper, tubing, solder, 1/2"	2 Carp	L.F.	2	9.31	Ф	04.33	Ð	10.51	3	92.19	
		diameter, type L, includes coupling &											
14	221113232140	clevis hanger assembly 10' O.C.	1 Plum	L.F.	s	3.94	\$	55.16	s	4.33	s	60.62	
14	221110202140	Pipe, copper, tubing, solder, 3/4"	TTMIT		Ť	5.54	Ψ	55.10	Ű	4.55	Ť	55.02	
		diameter, type L, includes coupling &											
7	221113232180	clevis hanger assembly 10' O.C.	1 Plum	L.F.	\$	6.04	\$	42.28	\$	6.69	s	46.83	
		Elbow, 90 Deg., tube connector fittings,											
		brass/copper, insert type, C x CTS, 100											
4	221113257110	psi @ 180Deg.F, 1/2"	1 Plum	Ea.	\$	1.88	\$	7.52	\$	2.06	s	8.24	
		Elbow, 90 Deg., tube connector fittings,											
		brass/copper, insert type, C x CTS, 100											
1	221113257120	psi @ 180Deg.F, 3/4"	1 Plum	Ea.	\$	2.29	\$	2.29	\$	2.52	\$	2.52	
		Tee, tube connector fittings,											
~	224442257440	brass/copper, insert type, C x CTS, 100	4.0	<b>F</b> -		o 40	_		_		_	5.00	
2	221113257140	psi @ 180Deg.F, 1/2"	1 Plum	Ea.	\$	2.40	\$	4.80	\$	2.64	s	5.28	
		Tee, tube connector fittings, brass/copper, insert type, C x CTS, 100											
1	221113257150	psi @ 180Deg.F. 3/4"	1 Plum	Ea.	s	3.68	\$	3.68	¢	4.05	s	4.05	
1	221113237130	Underecarpet, cable flat, boxes, wall,	TFIUIT	∟a.	Ŷ	5.00	φ	5.00	Ŷ	4.05	9	4.05	
4	260519131000	surface, w/cover, #12, 3 conductor	1 Elec	Ea.	s	58.85	\$	235.40	s	64.29	s	257.16	
	200010101000	Riser clamps, steel, conduit, 3/4"	1 2.00		Ť		÷	200.40	Ť	04.20	Ť	201.10	
8	260529201950	diameter	1 Elec	Ea.	s	11.77	\$	94.16	\$	12.96	s	103.68	
		Rigid galvanized steel conduit, 3/4"			-		-		Ť				
		diameter, to 15' H, incl 2 terminations, 2											
		elbows, 11 beam clamps, and 11											
28	260533131770	couplings per 100 LF	1 Elec	L.F.	\$	2.66	\$	74.48	\$	2.93	\$	82.04	
		Ground wire, copper wire, bare solid,											
1	260526800340	#10	1 Elec	C.L.F.	\$	18.94	\$	18.94	\$	20.77	s	20.77	
				Total			<b>*</b> ****	4 Total with O&P			\$683.98		

