

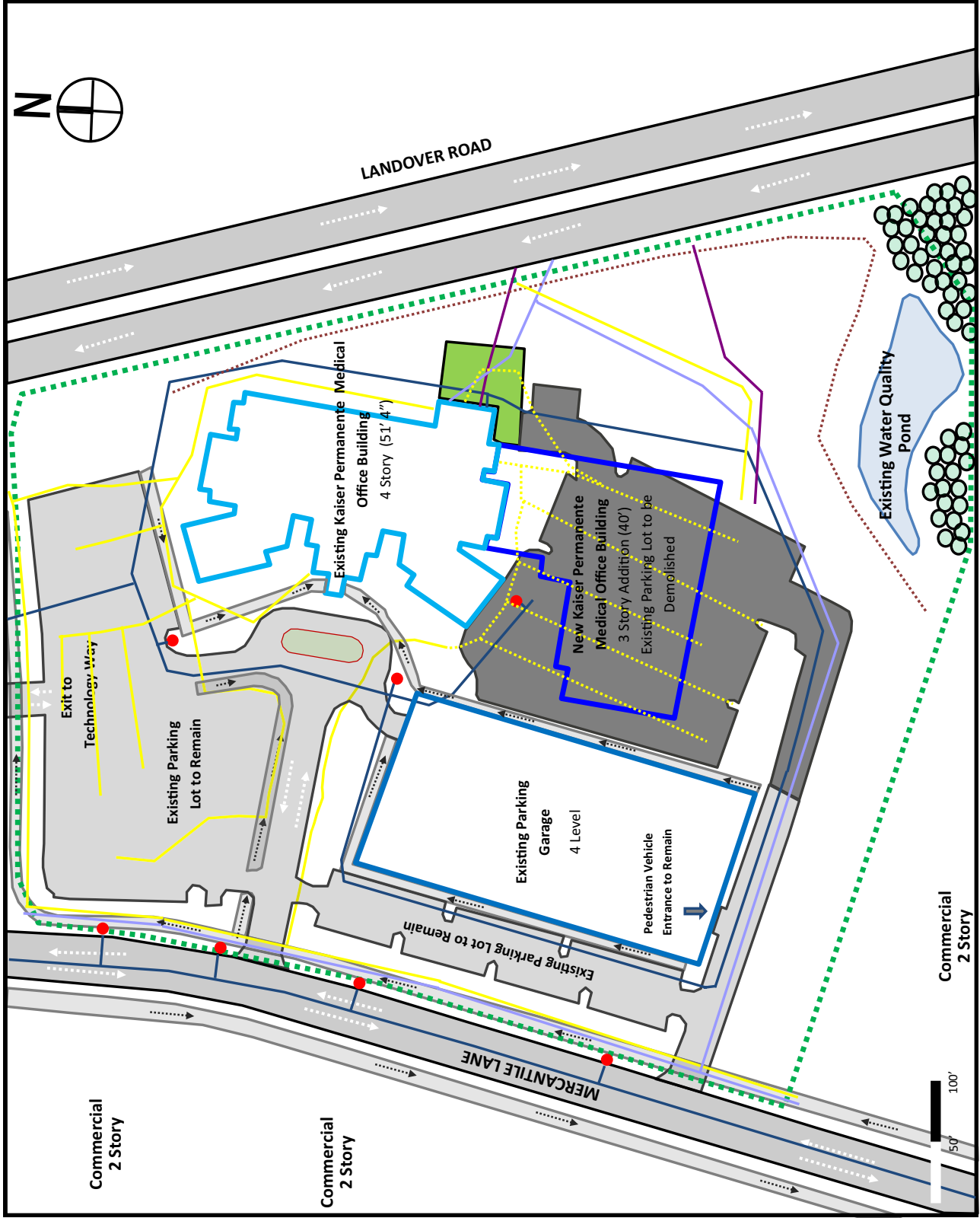
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Appendix A - Existing Conditions





Legend & Symbols

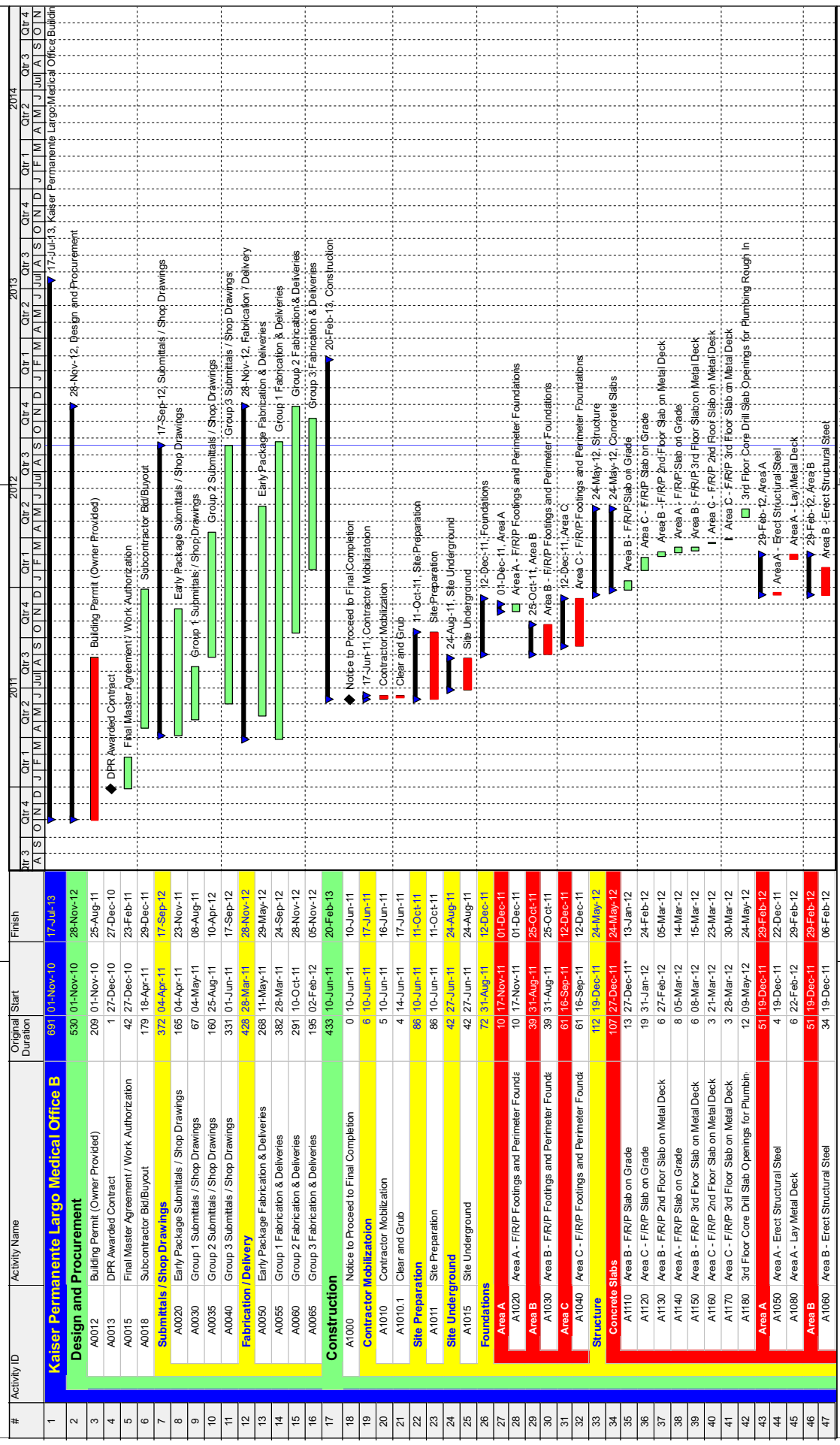
- Property Line
- Silt Fence
- Fire Hydrant
- Vehicular Traffic
- Existing Building
- Proposed Addition
- Pedestrian Traffic
- Existing Loading Dock
- Existing Parking Lot to be Demolished
- Electric
- Natural Gas
- Communications
- Water
- Existing Electric to be demolished

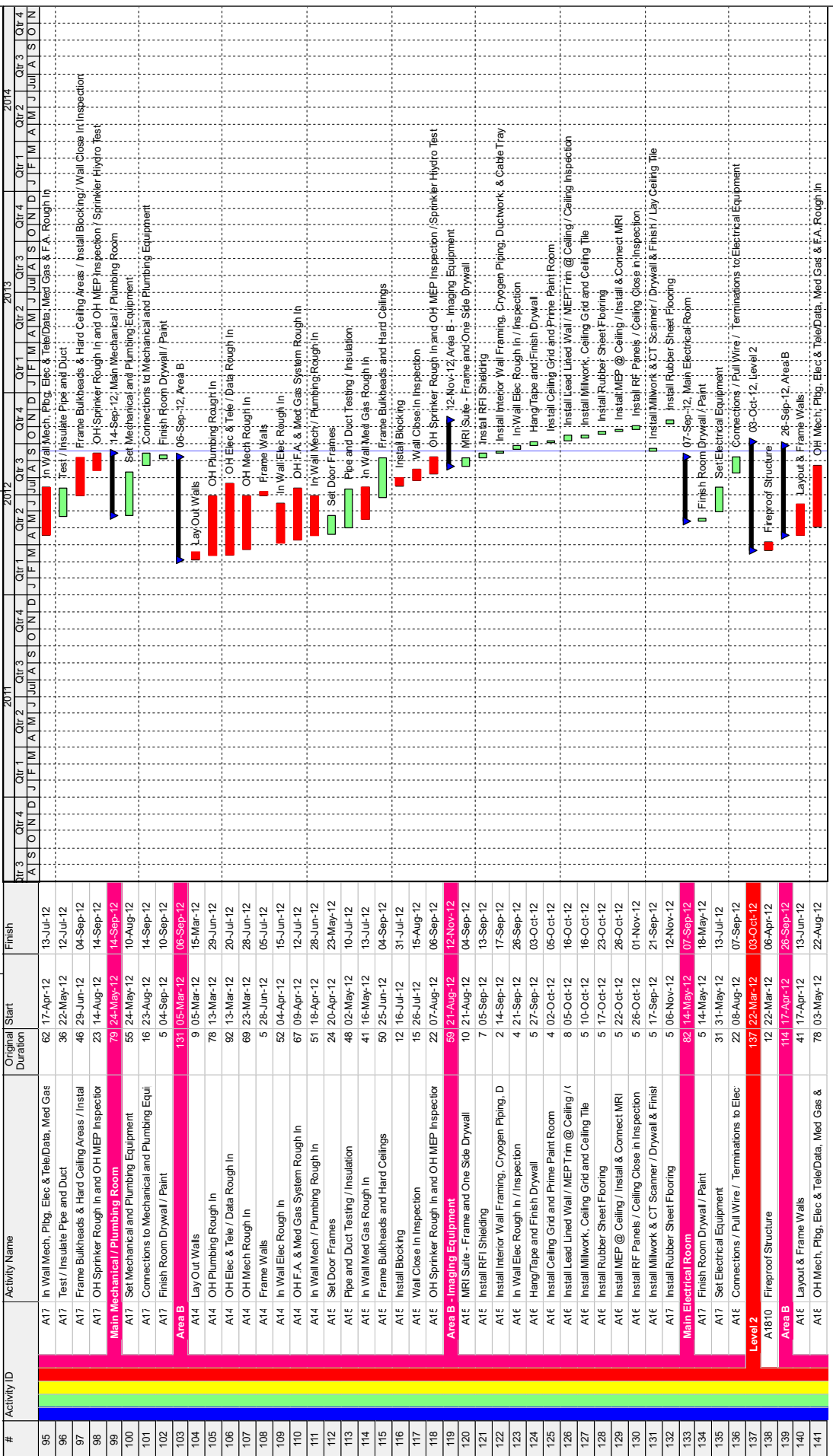
Kaiser Permanente Largo Medical Office Building

Largo, Maryland
Chris Pozza
Existing Conditions
April 3, 2013
Final Thesis Report

Appendix B – Detailed Project Schedule







Actual Work █ Remaining Work █ Critical Remaining Work █ Milestone ◆

TASK filter: All Activities

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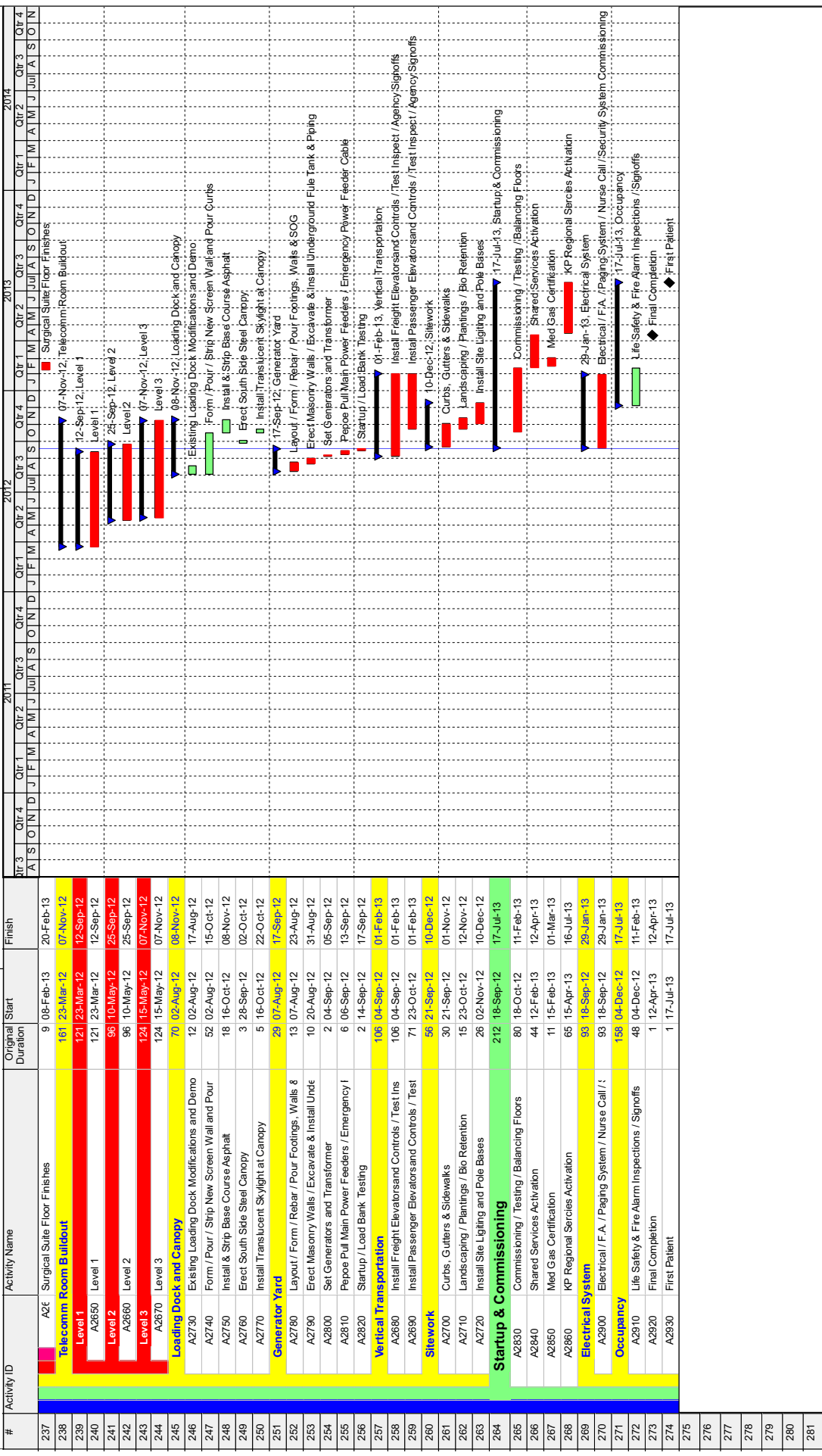
#	Activity ID	Activity Name	Original Duration	Start	Finish	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4
142	A1E	In Wall Mech, Plbg, Elec & Tele/Data, Med Gas	44	02-Jul-12	31-Aug-12														
143	A1E	Test/ Insulate Pipe and Duct	26	03-Jul-12	08-Aug-12														
144	A1E	Frame Bulkheads & Hard Ceiling Areas / Instal	43	05-Jul-12	04-Sep-12														
145	A1E	OH Sprinkler Rough In and OH MEP Inspector	16	05-Sep-12	26-Sep-12														
146	Area C		108	02-May-12	03-Oct-12														
147	A1E	Layout & Frame Walls	29	02-May-12	12-Jun-12														
148	A1E	OH Mech, Plbg, Elec & Tele/Data, Med Gas &	47	24-May-12	31-Jul-12														
149	A1E	In Wall Mech, Plbg, Elec & Tele/Data, Med Gas	43	03-Jul-12	31-Aug-12														
150	A1E	Test/ Insulate Pipe and Duct	24	18-Jul-12	20-Aug-12														
151	A1E	Frame Bulkheads & Hard Ceiling Areas / Instal	43	10-Jul-12	07-Sep-12														
152	A1E	OH Sprinkler Rough In and OH MEP Inspector	18	10-Sep-12	08-Oct-12														
153	Level 3		119	08-May-12	24-Oct-12														
154	A1940	Fireproof Structure	5	08-May-12	22-May-12														
155	Area B		114	08-May-12	17-Oct-12														
156	A1E	Layout & Frame Walls	95	08-May-12	20-Sep-12														
157	A1E	OH Mech, Plbg, Elec & Tele/Data, Med Gas &	60	05-Jul-12	27-Sep-12														
158	A1E	In Wall Mech, Plbg, Elec & Tele/Data, Med Gas	38	06-Aug-12	27-Sep-12														
159	A1E	Test/ Insulate Pipe and Duct	16	04-Sep-12	25-Sep-12														
160	A1E	Frame Bulkheads & Hard Ceiling Areas / Instal	39	07-Aug-12	01-Oct-12														
161	A2C	OH Sprinkler Rough In and OH MEP Inspector	16	26-Sep-12	17-Oct-12														
162	Area C		119	08-May-12	24-Oct-12														
163	A2C	Layout & Frame Walls	97	08-May-12	24-Sep-12														
164	A2C	OH Mech, Plbg, Elec & Tele/Data, Med Gas &	54	02-Jul-12	17-Sep-12														
165	A2C	In Wall Mech, Plbg, Elec & Tele/Data, Med Gas	42	14-Aug-12	11-Oct-12														
166	A2C	Test/ Insulate Pipe and Duct	25	29-Aug-12	26-Sep-12														
167	A2C	Frame Bulkheads & Hard Ceiling Areas / Instal	45	13-Aug-12	15-Oct-12														
168	A2C	OH Sprinkler Rough In and OH MEP Inspector	11	10-Oct-12	24-Oct-12														
169	Building Finishes		142	01-Aug-12	20-Feb-13														
170	Level 1		36	01-Aug-12	14-Dec-12														
171	Area B		36	01-Aug-12	14-Dec-12														
172	A2C	Insulate and Hang One-Side Drywall	14	01-Aug-12	14-Aug-12														
173	A2C	Hang Drywall	14	15-Aug-12	04-Sep-12														
174	A2C	Tape & Finish Drywall	14	20-Aug-12	07-Sep-12														
175	A21	Prime & 1st Coat Paint	5	10-Sep-12	14-Sep-12														
176	A21	Install Ceiling Grid	10	17-Sep-12	28-Sep-12														
177	A21	Install Light Fixtures, Sprinkler Heads, and G/F	10	25-Sep-12	08-Oct-12														
178	A21	Final Paint and Ceiling Close in Inspection	5	09-Oct-12	15-Oct-12														
179	A21	Lay In Ceiling Tile	5	11-Oct-12	17-Oct-12														
180	A21	Base Cabinets & Countertops	5	30-Oct-12	06-Nov-12														
181	A21	OFC On Site	1	30-Oct-12	30-Oct-12														
182	A21	Mech / Plumbing and Electrical Trim Out	5	05-Nov-12	09-Nov-12														
183	A21	Hang Wall Cabinets / Accessories	4	13-Nov-12	16-Nov-12														
184	A21	Install Flooring	6	19-Nov-12	27-Nov-12														
185	A22	Hang Doors & Hardware	5	29-Nov-12	05-Dec-12														
186	A22	Construction Clean & Final Clean	4	06-Dec-12	11-Dec-12														
187	A22	Rolling Completion List Walk Through & Signoff	3	12-Dec-12	14-Dec-12														
188	A22	Area Ready	1	14-Dec-12	14-Dec-12														

Actual Work Remaining Work Critical Remaining Work Milestones

TASK Filter: All Activities

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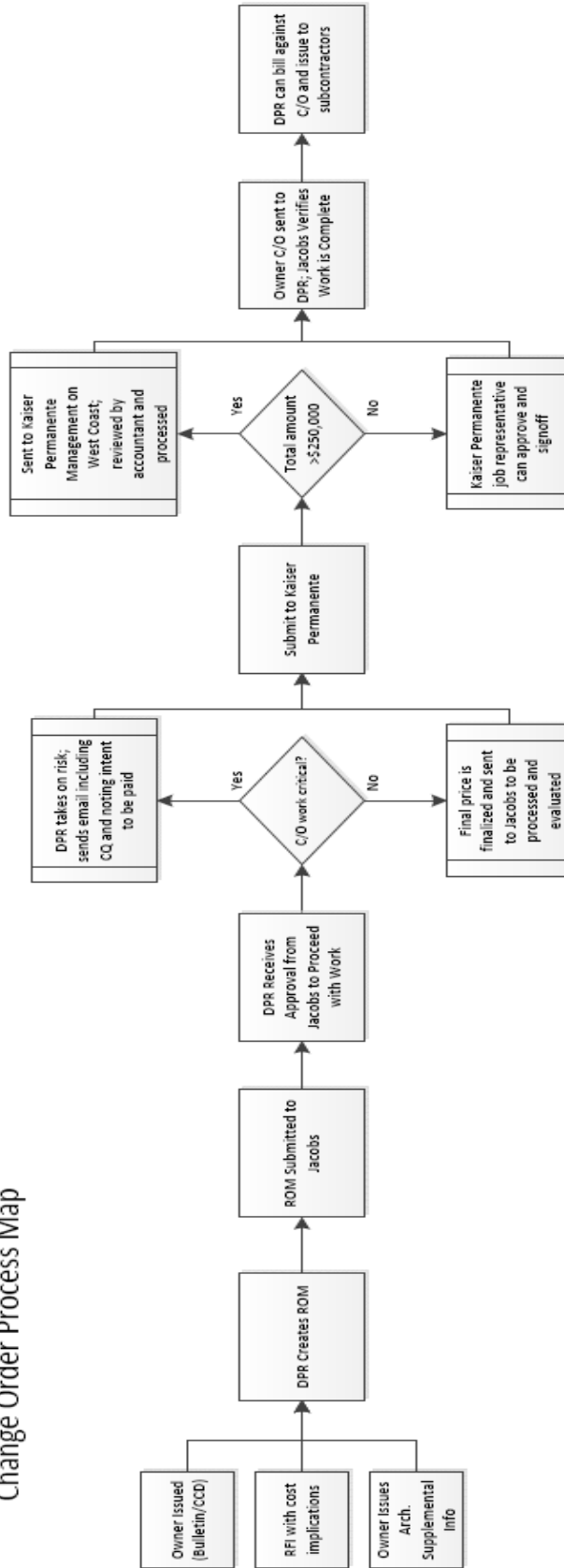
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Appendix C – Change Order Process Map



Change Order Process Map



Appendix D – Change Order Crew Tracking



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



Appendix E – Structural Breadth Calculations



Design Live Loads

Medical offices at Ground Floor = 100 psf

Lobby and corridors at Ground Floor = 100 psf

Medical offices, lobby, and corridors at Elevated Floors ** = 80 psf

Roof areas * = 30 psf

* Plus Drifting and/or sliding snow

** Includes 20 psf for partition loads

Snow Load

Ground snow Load, $P_g = 25$ psf

Flat-Roof Snow Load, $P_f = 17.5$ psf

Snow Exposure Factor, $C_e = 1.0$

Snow Importance Factor, $I_s = 1.0$

Thermal Factor, $C_t = 1.0$

Wind Load

Wind Loads shall be applied to the building main wind-force resisting system and components and cladding in accordance with the code - International Building Code 2009

Basic Wind Speed, $V = 90$ mph

Wind Importance Factor, $I_w = 1.0$

Building Category = I

Wind Exposure Category = C

Enclosure Classification = Enclosed Building

Internal Pressure Coefficient = ± 0.18

3-0235 — 50 SHEETS — 5 SQUARES
3-0236 — 100 SHEETS — 5 SQUARES
3-0237 — 200 SHEETS — 5 SQUARES
3-0137 — 200 SHEETS — FILLER

COMET

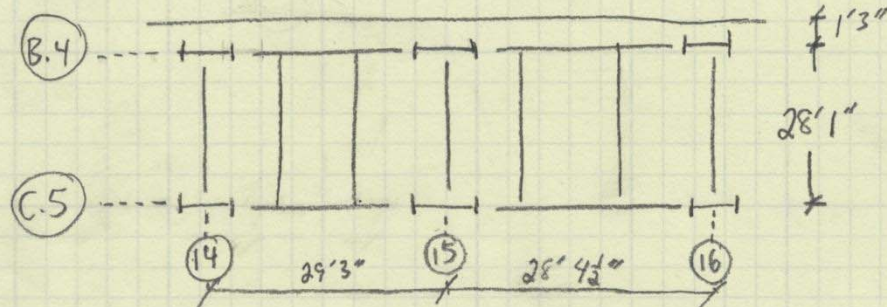
①



3-0235 — 50 SHEETS — 5 SQUARES
 3-0236 — 100 SHEETS — 5 SQUARES
 3-0237 — 200 SHEETS — 5 SQUARES
 3-0137 — 200 SHEETS — FILLER

COMET

Actual Loading Conditions with Brick Facade



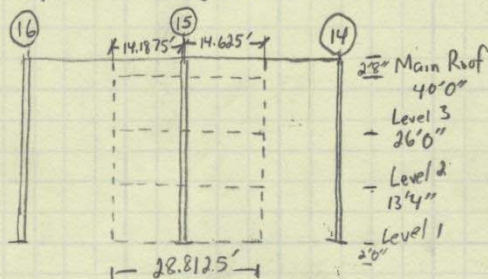
$$\text{Influence Area } (K_{LL} A_T) = (29.25' + 28.375') (28.083' + 1.25') = 1690.3 \text{ ft}^2$$

$$\text{Tributary Area } (A_T) = (29.25'/2 + 28.375'/2) (28.083'/2 + 1.25') = 441 \text{ ft}^2$$

Live Load Reductions $K_{LL} A_T \geq 400 \text{ ft}^2$

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

R
 3 → $0.25 + \frac{15}{\sqrt{1690.3}} = 0.615$
 2
 1 → $0.25 + \frac{15}{\sqrt{2(1690.3)}} = 0.432$



$$A_{T1} = (28.8125') (2 + 6.67') = 250 \text{ ft}^2$$

$$A_{T2} = (28.8125') (6.67' + 6.5') = 380 \text{ ft}^2$$

$$A_{T3} = (28.8125') (6.33' + 7') = 385 \text{ ft}^2$$

$$A_{TR} = (28.8125') (7' + 2.67') = 280'$$

Column Axial Load Calc

R → $1.2(37)(441) + 16(30) = 19.6 \text{ k}$

3 → $1.2(37)(441) + 0.5(30)(441) + 1.2(54)(441) + 1.2(40)(385) + 1.6(0.615)(80)(441) = 108 \text{ k}$
 Roof = 26.2 k Floor + Wall = 47.1 k Reduced Live Load = 34.7 k

2 → $26.2 \text{ k} + 47.1 \text{ k} + 1.2(54)(441) + 1.2(40)(385) + 1.6(0.432)(80)(441) = 144.5 \text{ k}$
 28.6 k 18.2 k 24.4 k

Floor Live Loads

Level 1 - 100 psf, Levels 2-3 - 80 psf

Roof Dead Loads

- 20 psf - roofing material
- 5 psf - beams and girders
- 8 psf - superimposed dead load
- 4 psf - deck and insulation

37 psf - Dead load

30 psf - snow load

Floor Dead Load

39 psf - 5 1/2" Lightweight concrete

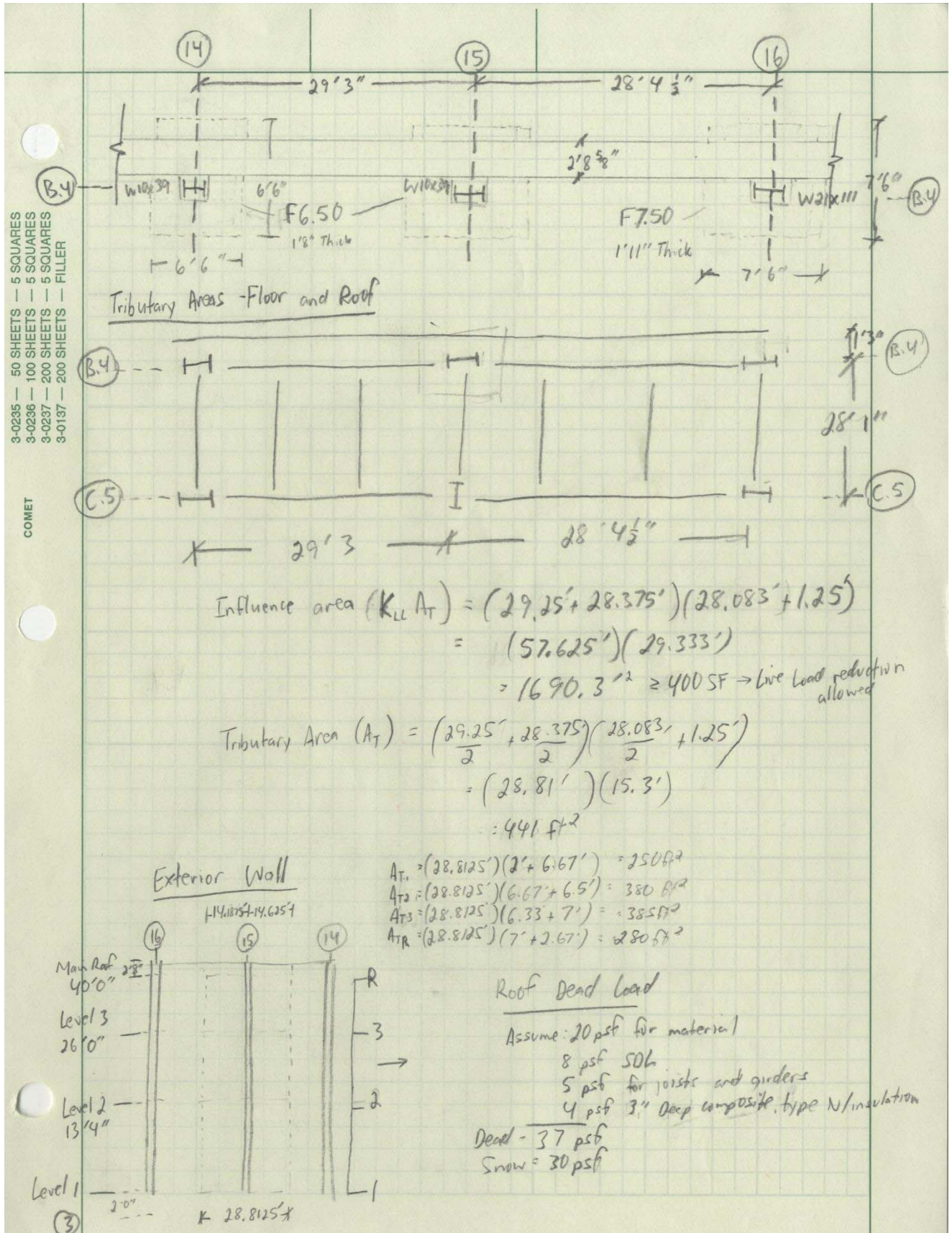
10 psf - superimposed dead load

5 psf - beams and girders

54 psf - Dead Load

Wall Load - 40





Live Load Reductions

$$\begin{array}{l}
 R \\
 \hline
 3 \\
 \rightarrow 0.25 + \frac{15}{\sqrt{1690.3}} = 0.615 \\
 \hline
 2 \\
 \rightarrow 0.25 + \frac{15}{\sqrt{2(1690.3)}} = 0.432 \\
 \hline
 1
 \end{array}$$

Wall Load Per Floor

$$7'' \text{ precast panel} = 87 \text{ psf}$$

Use 14' floor-to-floor height - largest floor-to-floor height is 14'

* Larger floor-to-floor height = less amount of axial compression allowed

$$\text{Wall Load/Floor} = 87 \text{ psf} \times 14' = 1218 \text{ plf}$$
Conservative Assumptions:

1. Entire wall is precast panels, so actual loads would be reduced significantly due to windows
2. Focus is on W10x39 column, the smallest column used consistently around perimeter of the building.
 - Other columns are W21x111 so W10x39 columns would be limiting factor for axial loading
 - (All W21x111 columns include at least one moment connection \rightarrow beyond capability to do full lateral analysis with SidePlate Moment connections)

④



3-0235 — 50 SHEETS — 5 SQUARES
 3-0236 — 100 SHEETS — 5 SQUARES
 3-0237 — 200 SHEETS — 5 SQUARES
 3-0137 — 200 SHEETS — FILLER

COMET

Flour Dead Load

39 psf Slab - 5 1/2" total thickness - lightweight concrete

10 psf - assume SDL

5 psf - assume weight of beams and girders

54 psf - Dead Load

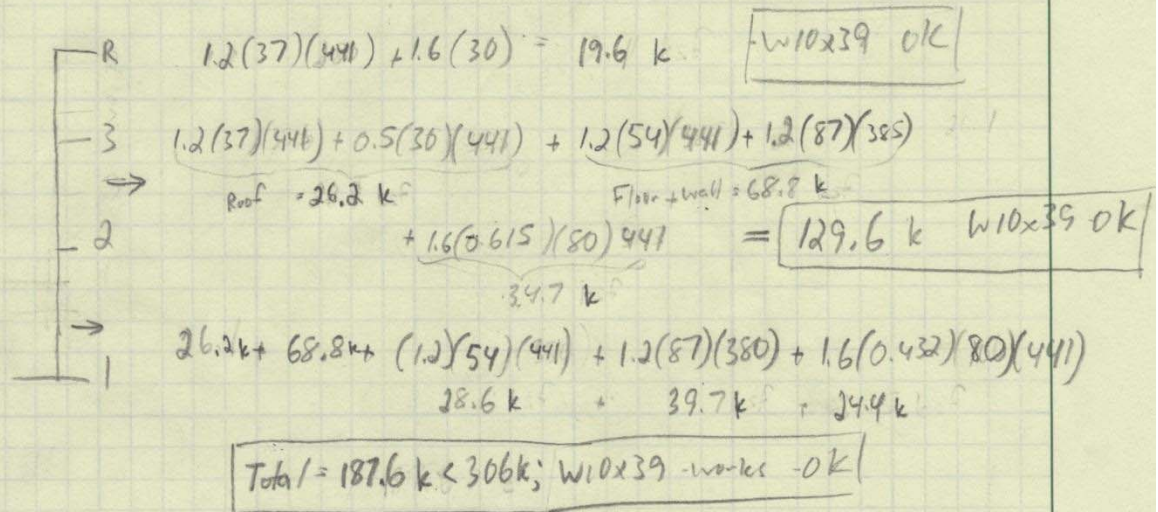
Live Loads

Floors 2-3 - 80 psf

Floor 1 - 100 psf

* Comparing to W10x39 so use all W10's

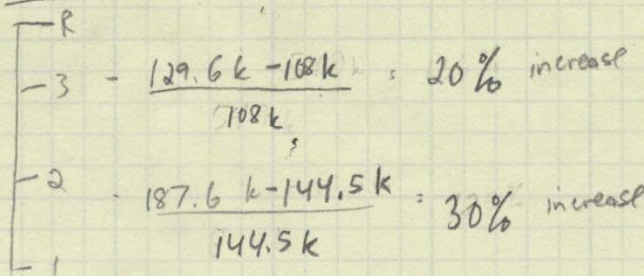
** Use Floor-to-floor height of 14' to be conservative for steel strength



* Referenced Table 4-1, Available Strength in Axial Compression, kips

W10x39, Effective length, KL = 14 ft. ϕP_n LRFD = 306 k

Load Increases on Column



5



Precast Loading (Using 8" Panels) (100 psf)

3-0235 — 50 SHEETS — 5 SQUARES
 3-0236 — 100 SHEETS — 5 SQUARES
 3-0237 — 200 SHEETS — 5 SQUARES
 3-0137 — 200 SHEETS — FILLER

R		$1.2(37)(441) + 1.6(30) = 19.6\text{ k}$
3	→	$19.6\text{ k} + \underbrace{0.5(30)(441)}_{6.6\text{ k}} + \underbrace{1.2(54)(441)}_{28.6\text{ k}} + \underbrace{1.2(100)(385)}_{46.2\text{ k}} + \underbrace{1.6(6.615)(80)(441)}_{34.7\text{ k}} = \underline{\underline{135.7\text{ k}}}$
2	→	
1	→	$19.6\text{ k} + 6.6\text{ k} + 28.6\text{ k} + 46.2\text{ k} + \underbrace{1.2(54)(441)}_{28.6\text{ k}} + \underbrace{1.2(100)(380)}_{45.6\text{ k}} + \underbrace{1.6(0.432)(80)(441)}_{24.4\text{ k}}$
$= 199.6\text{ k} < 306\text{ k} \rightarrow \text{W10x39 works}$		

Load Increase on Column

COMET

R		
3	→	$\frac{135.7\text{ k} - 108\text{ k}}{108\text{ k}} = 26\% \text{ increase}$
2	→	
1	→	$\frac{199.6\text{ k} - 108\text{ k}}{108\text{ k}} = 85\% \text{ increase}$

Conclusion - W10x39's can support either 7" or 8" precast panels in axial compression. I was wrong assuming columns would need to be resized to support a larger load, but these calculations do not take into account lateral loads.

⑥



Foundation Check - Spread Footing

At column B.4/15 - footing size is F6.50: 6'6" x 6'6" x 1'8" thick

Allowable soil bearing capacity (q_a) = 5,000 lb/SF; found in geo-tech report

$$q_a \geq \frac{P}{A}$$

where P = total load

A = area of foundation on which the load is bearing.

$$q_a = 5000 \text{ psf or } 5 \text{ ksf}$$

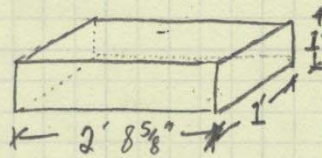
$$5 \text{ ksf} \geq \frac{P}{(6.5')(6.5')}$$

$$211.25 \text{ k} \geq P \quad \checkmark \text{ OK } \geq 199.6 \text{ k}$$

P must be less than 211.25k, so this design is acceptable for the heaviest possible load previously calculated, 199.6k

Strip Footing

Unit Strip method



$$q \geq \frac{P}{A}$$

$$5 \text{ ksf} \geq \frac{P(1')}{2.71875(1')}$$

$$13.6 \text{ klf} \geq P \quad \checkmark \text{ OK}$$

Max load would be: 8" thick panel or 100 psf.

- Max Building Height: 46'

- Total Possible Load = 46'(100 psf) = 4.6 klf < 13.6 klf

Conclusion

Structural steel and foundations are not controlled by axial loading and can support additional load of panels. Systems can adequately support weight of panels as currently designed.

3-0235 — 50 SHEETS — 5 SQUARES
3-0236 — 100 SHEETS — 5 SQUARES
3-0237 — 200 SHEETS — 5 SQUARES
3-0137 — 200 SHEETS — FILLER

COMET

Appendix F – Structural References



Since $200 \text{ sq ft} < A_t < 600 \text{ sq ft}$, R_1 is determined by Eq. 16-29:

$$R_1 = 1.2 - 0.001A_t = 1.2 - (0.001 \times 315) = 0.89$$

Since $F = 1/2 < 4$, $R_2 = 1$ (Eq. 16-31)

Thus, $L_r = 20 \times 0.89 \times 1 = 17.8 \text{ psf}$

Axial load = $17.8 \times 315 / 1,000 = 5.6 \text{ kips}$

- Ninth floor

Since the ninth floor is storage with a live load of 125 psf, which exceeds 100 psf, the live load is not permitted to be reduced (IBC 1607.9.1.1).

Axial load = $125 \times 315 / 1,000 = 39.4 \text{ kips}$

- Typical floors

Reducible nominal live load = 50 psf

Since column A3 is an exterior column without a cantilever slab, the live load element factor $K_{LL} = 4$ (IBC Table 1607.9.1).⁶

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

The reduction multiplier is equal to 0.40 where $K_{LL} A_T \geq 10,000 \text{ sq ft}$ (see Figure 3.1).

Axial load = $(L + 15)A_T = 315(L + 15)$

Part 2: Determine reduced live load for column B3

A summary of the reduced live loads is given in Table 3.2. Detailed calculations for various floor levels follow the table.

⁶ $K_{LL} = \text{influence area/tributary area} = 28(25 + 20)/315 = 4.$



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 of 100 psf, and for parking garage live load
 $= 0.5$ for other live loads
- $f_2 = 0.7$ for roof configurations (such as sawtooth) that do not shed snow off the structure
 $= 0.2$ for other roof configurations

Load combinations are constructed by adding to the dead load one or more of the variable loads at its maximum value, which is typically indicated by a load factor of 1.6. Also included are other variable loads with load factors less than 1.0; these are companion loads which represent arbitrary point-in-time values for those loads. Certain types of variable loads, such as wind and earthquake loads, act in more than one direction on a building or structure, and the appropriate sign of the variable load must be considered in the load combinations.

According to the exception to this section, factored load combinations that are specified in other provisions of the IBC take precedence to those listed in IBC 1605.2.

The load combinations given in IBC 1605.2.1 are the same as those in ASCE/SEI 2.3.2 with the following exceptions:

- The variable f_1 that is present in IBC Eqs. 16-3, 16-4, and 16-5 is not found in ASCE/SEI combinations 3, 4, and 5. Instead, the load factor on the live load L in the ASCE/SEI combinations is equal to 1.0 with the exception that the load factor on L is permitted to equal 0.5 for all occupancies where the live load is less than or equal to 100 psf, except for parking garages or areas occupied as places of public assembly (see exception 1 in ASCE/SEI 2.3.2). This exception makes these load combinations the same in ASCE/SEI 7 and the IBC.
- The variable f_2 that is present in IBC Eq. 16-5 is not found in ASCE/SEI combination 5. Instead, a load factor of 0.2 is applied to S in the ASCE/SEI combination. The third exception in ASCE/SEI 2.3.2 states that in combinations



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DESIGN OF COMPRESSION MEMBERS




Table 4-1 (continued)
Available Strength in Axial Compression, kips $F_y = 50$ ksi
W-Shapes

Shape		W10x									
lb/ft		54		49		45		39		33	
Design		P_n/Ω_c	$\phi_c P_n$	P_n/Ω_c	$\phi_c P_n$	P_n/Ω_c	$\phi_c P_n$	P_n/Ω_c	$\phi_c P_n$	P_n/Ω_c	$\phi_c P_n$
		ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD
Effective length, KL (ft), with respect to least radius of gyration, r_y	0	473	711	431	648	398	598	344	517	291	437
	6	446	671	407	611	363	545	313	470	263	395
	7	437	657	398	598	350	527	302	454	253	381
	8	427	642	388	584	337	507	290	436	243	365
	9	415	624	378	568	322	485	277	416	232	348
	10	403	605	366	550	307	461	263	396	220	330
	11	389	585	354	532	291	437	249	374	207	311
	12	375	564	341	512	274	411	234	352	194	292
	13	361	542	327	492	256	385	219	329	181	272
	14	345	519	313	471	239	359	203	306	168	253
	15	330	495	299	449	222	333	188	283	155	233
	16	314	471	284	427	204	307	173	260	142	214
	17	297	447	269	404	188	282	158	238	130	195
	18	281	422	254	382	171	257	144	217	117	177
	19	265	398	239	360	155	234	130	196	106	159
	20	249	374	224	337	140	211	118	177	95.4	143
	22	217	327	196	294	116	174	97.2	146	78.8	118
	24	188	282	168	253	97.4	146	81.7	123	66.2	99.5
	26	160	240	143	216	83.0	125	69.6	105	56.4	84.8
	28	138	207	124	186	71.5	108	60.0	90.2	48.7	73.1
30	120	180	108	162	62.3	93.7	52.3	78.6	42.4	63.7	
32	106	159	94.7	142	54.8	82.3	46.0	69.1	37.3	56.0	
34	93.5	141	83.9	126							
36	83.4	125	74.8	112							
38	74.8	112	67.2	101							
40	67.6	102	60.6	91.1							
Properties											
P_{no} , kips	69.1	104	60.1	90.1	65.3	98.0	54.1	81.1	45.2	67.8	
P_{ni} , kips/in.	12.3	18.5	11.3	17.0	11.7	17.5	10.5	15.8	9.67	14.5	
P_{nb} , kips	112	168	86.6	130	94.2	142	68.7	103	53.7	80.7	
P_{nb} , kips	70.8	106	58.7	88.2	71.9	108	52.6	79.0	35.4	53.2	
L_p , ft	9.04		8.97		7.10		6.99		6.85		
L_r , ft	33.6		31.6		26.9		24.2		21.8		
A_g , in. ²	15.8		14.4		13.3		11.5		9.71		
I_x , in. ⁴	303		272		248		209		171		
I_y , in. ⁴	103		93.4		53.4		45.0		36.6		
r_y , in.	2.56		2.54		2.01		1.98		1.94		
r_x/r_y	1.71		1.71		2.15		2.16		2.16		
$P_{nx}(KL)^2/10^4$, k-in. ²	8670		7790		7100		5980		4890		
$P_{ny}(KL)^2/10^4$, k-in. ²	2950		2670		1530		1290		1050		
ASD	LRFD		Note: Heavy line indicates KL/r_y equal to or greater than 200.								
$\Omega_c = 1.67$	$\phi_c = 0.90$										



Appendix G – Mechanical Breadth Calculations



Wall U Value (Winter)	Combined
R ₀ - Outside Air Barrier	0.17
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 Sheathing - 51	0.56
R _i - Inside Air Film (Vertical Position, Horizontal Heat Flow)	0.68

Total R	20.575
U _{avg} or Total U (1/R)	0.0486

%	100%
u	0.0486
%*u	0.0486
$U_{avg} = U_{avg} * 0.15 + 0.85 * U_{insul}$	0.0486

Wall U Value (Winter)	Combined
R ₀ - Outside Air Barrier	0.17
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 Sheathing - 51	0.56
R _i - Inside Air Film (Vertical Position, Horizontal Heat Flow)	0.68

Total R	20.72
U _{avg} or Total U (1/R)	0.04826

%	100%
u	0.04826
%*u	0.04826
$U_{avg} = U_{avg} * 0.15 + 0.85 * U_{insul}$	0.04826

Wall U Value (Summer)	Combined
R ₀ - 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 Sheathing - 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 ₀ - 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 Sheathing - 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
Find R (1.5"-3.5" with Emittance=0.82)	1.23



Appendix H - Mechanical Breadth References

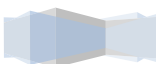


TABLE E.1 Thermal Properties of Conventional Building and Insulating Materials*

Description	Density lb/ft ³	Conductivity ^b Btu-in./h ft ² ·°F	Conductance (C) Btu h/ ft ² ·°F	I-P Resistance (R)		Specific Heat Btu/ lb·°F
				Per Inch Thickness (1/R)·°F ft ² / h Btu-in.	For Thickness Listed (1/C)·°F ft ² / h Btu	
Building Board						
Asbestos-cement board	120	4.0	—	0.25	—	0.24
Asbestos-cement board	120	—	33.00	—	0.03	—
Asbestos-cement board	120	—	16.50	—	0.06	—
Gypsum or plaster board	50	—	3.10	—	0.32	0.26
Gypsum or plaster board	50	—	2.22	—	0.45	—
Gypsum or plaster board	50	—	1.78	—	0.56	—
Gypsum or plaster board	50	—	—	1.25	—	0.29
Plywood (Douglas fir) ^c	34	0.80	—	—	0.31	—
Plywood (Douglas fir)	34	—	3.20	—	0.47	—
Plywood (Douglas fir)	34	—	2.13	—	0.77	—
Plywood (Douglas fir)	34	—	1.60	—	0.62	—
Plywood (Douglas fir)	34	—	1.29	—	0.77	—
Plywood (Douglas fir)	34	—	1.07	—	0.93	0.29
Plywood or wood panels	34	—	—	—	—	—
Vegetable fiber board	18	—	0.76	—	1.32	0.31
Sheathing, regular density ^d	18	—	0.49	—	2.06	0.31
Sheathing intermediate density ^d	18	—	0.92	—	1.09	—
Sheathing intermediate density ^d	18	—	—	—	—	—
Nail-base sheathing ^e	25	—	0.94	—	1.06	0.31
Shingle backer	18	—	1.06	—	0.94	0.31
Shingle backer	18	—	1.28	—	0.78	—
Sound-deadening board	15	—	0.74	—	1.35	0.30
Tile and lay-in panels, plain or acoustic	18	0.40	—	2.50	—	0.14
				(17.0)		
Laminated paperboard	30	0.50	—	2.00	—	0.33
				(13.9)		
Homogeneous board from repulped paper	30	0.50	—	2.00	—	0.28
				(13.9)		
Hardboard ^d	50	0.73	—	1.37	—	0.31
Medium density	55	0.82	—	1.22	—	0.32
High-density, service-tempered grade and service grade	63	1.00	—	1.00	—	0.32
High-density, standard-tempered grade	37	0.71	—	1.41	—	0.31
Particle board ^d	50	0.94	—	1.06	—	0.31
Low density	62	0.5	—	1.18	—	0.85
Medium density	40	—	1.22	—	—	1.30
High density	40	—	1.22	—	—	0.29
Underlayment	40	—	1.22	—	—	0.82

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

Description	Density lb/ft ³	Conductivity ^b Btu-in./h ft ² ·°F	Conductance (C) Btu h/ ft ² ·°F	I-P Resistance (R)		Specific Heat Btu/ lb·°F
				Per Inch Thickness (1/R)·°F ft ² / h Btu-in.	For Thickness Listed (1/C)·°F ft ² / h Btu	
Waterboard	37	0.63	—	1.59	—	—
Wood subfloor	—	—	1.06	—	0.94	0.33
	—	6.0	—	—	—	—
Building Membrane						
Vapor—permeable felt	—	16.70	—	0.06	—	—
Vapor—seal, 2 layers of mopped 15-lb felt	—	8.35	—	0.12	—	—
Vapor—seal, plastic film	—	47.4	—	Neg.	—	—
Finish Flooring Materials						
Carpet and fibrous pad	—	0.48	—	2.08	0.34	—
Carpet and rubber pad	—	0.81	—	1.23	0.33	—
Cork tile	0.125 in.	—	3.60	—	0.28	0.48
Terrazzo	1 in.	—	12.50	—	0.08	0.19
Tile—asphalt, linoleum, vinyl, rubber	—	—	20.00	—	0.05	0.30
Vinyl asbestos	—	—	—	—	—	0.24
Ceramic	—	—	—	—	—	0.19
Wood, hardwood finish	0.75 in.	—	1.47	—	0.68	—
Insulating Materials						
Blanket and Batt ^g						
Mineral fiber, fibrous form processed from rock, slag, or glass						
Approx. 3-4 in.	0.4-2.0	—	0.091	—	11	—
Approx. 3.5 in.	0.4-2.0	—	0.077	—	13	—
Approx. 3.5 in.	1.2-1.6	—	0.067	—	15	—
Approx. 5.5-6.5 in.	0.4-2.0	—	0.053	—	19	—
Approx. 5.5 in.	0.6-1.0	—	0.048	—	21	—
Approx. 6-7.5 in.	0.4-2.0	—	0.045	—	22	—
Approx. 8.25-10 in.	0.4-2.0	—	0.033	—	30	—
Approx. 10-13 in.	0.4-2.0	—	0.026	—	38	—
Board and Slabs						
Cellular glass	8.0	0.33	—	3.03	—	0.18
Glass fiber, organic bonded	4.0-9.0	0.25	—	4.00	—	0.23
Expanded perlite, organic bonded	1.0	0.36	—	2.78	—	0.30
Expanded rubber (rigid)	4.5	0.22	—	4.55	—	0.40
Expanded polystyrene, extruded (smooth skin surface) (CFC-12 exp.)	1.8-3.5	0.20	—	5.00	—	0.29



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

Description	Part A. I.P. Units				I-P Resistance* (R)		Specific Heat Btu/lb·°F
	Density lb/ft ³	Conductivity ^b (k) Btu-in./h ft ² ·°F	Conductance (C) Btu h/ft ² ·°F	Per Inch Thickness (1/K) °F ft ² /h Btu-in.	For Thickness Listed (1/C) °F ft ² /h Btu		
Perlite, expanded	2.0-4.1	0.27-0.31	—	3.7-3.3	—	0.26	
Mineral fiber (rock, slag, or glass) ^c	4.1-7.4	0.31-0.36	—	3.3-2.8	—	—	
Approx. 3.75-5 in. glass ^d	7.4-11.0	0.36-0.42	—	2.8-2.4	—	—	
Mineral fiber (rock, slag, or glass) ^e	0.6-2.0	—	—	—	11.0	0.17	
Approx. 6.5-8.75 in. glass ^f	0.6-2.0	—	—	—	19.0	—	
Approx. 7.5-10 in. glass ^g	0.6-2.0	—	—	—	22.0	—	
Approx. 10.3-13.7 in. glass ^h	0.6-2.0	—	—	—	30.0	—	
Mineral fiber (rock, slag, or glass) ⁱ	2.0-3.5	—	—	—	12.0-14.0	—	
Approx. 3.5 in. (closed sidewall application)	7.0-8.2	0.47	—	2.13	—	0.32	
Vermiculite, exfoliated	4.0-6.0	0.44	—	2.27	—	—	
Spray Applied	1.5-2.5	0.16-0.18	—	6.25-5.56	—	—	
Polyurethane foam	0.7-1.6	0.22-0.28	—	4.55-3.57	—	—	
Urethane formaldehyde foam	3.5-6.0	0.29-0.34	—	3.45-2.94	—	—	
Cellulosic fiber	3.5-4.5	0.26-0.27	—	3.85-3.70	—	—	
Glass fiber	—	—	0.31	—	3.2	—	
Reflective insulation (ε < 0.5) in center of 1/8-in. cavity forms two 1/8-in. vertical air spaces ^o	—	—	—	—	—	—	
Metals	(See ASHRAE Handbook—Fundamentals)						
Roofing	120	—	4.76	—	0.21	0.24	
Asbestos-cement shingles	70	—	6.50	—	0.15	0.36	
Asphalt roll roofing	70	—	2.27	—	0.44	0.30	
Asphalt shingles	70	—	3.00	—	0.33	0.35	
Built-up roofing	0.375 in. 0.5 in.	—	20.00 1.06	—	0.05 0.94	0.30 0.31	
Slate	—	—	—	—	—	—	
Wood shingles, plain and plastic film faced	—	—	—	—	—	—	
Plastering Materials	116	5.0	—	0.20	—	0.20	
Cement plaster, sand aggregate	0.375 in. 0.75 in.	—	13.3 6.66	—	0.08 0.15	0.20 0.20	
Sand aggregate	—	—	—	—	—	—	
Gypsum plaster	0.5 in. 0.625 in.	—	3.12 2.67	—	0.32 0.39	—	
Lightweight aggregate	0.5 in. 0.625 in.	—	2.67 2.13	—	0.39 0.47	—	
Lightweight aggregate on metal lath	0.75 in.	—	—	—	—	—	

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

Description	Part A. I.P. Units				I-P Resistance* (R)		Specific Heat Btu/lb·°F
	Density lb/ft ³	Conductivity ^b (k) Btu-in./h ft ² ·°F	Conductance (C) Btu h/ft ² ·°F	Per Inch Thickness (1/K) °F ft ² /h Btu-in.	For Thickness Listed (1/C) °F ft ² /h Btu		
Perlite aggregate	45	1.5	—	0.67	—	0.32	
Sand aggregate	105	5.6	—	0.18	—	0.20	
Sand aggregate	105	—	11.10	—	0.09	—	
Sand aggregate	105	—	9.10	—	0.11	—	
Sand aggregate on metal lath	—	—	7.70	—	0.13	—	
Vermiculite aggregate	45	1.7	—	0.59	—	—	
Masonry Materials							
Masonry Units							
Brick, fired clay	150	8.4-10.2	—	0.12-0.10	—	—	
—	140	7.4-9.0	—	0.14-0.11	—	—	
—	130	6.4-7.8	—	0.16-0.12	—	—	
—	120	5.6-6.8	—	0.18-0.15	—	0.19	
—	110	4.9-5.9	—	0.20-0.17	—	—	
—	100	4.2-5.1	—	0.24-0.20	—	—	
—	90	3.6-4.3	—	0.28-0.24	—	—	
—	80	3.0-3.7	—	0.33-0.27	—	—	
—	70	2.5-3.1	—	0.40-0.33	—	—	
Clay tile, hollow	—	—	1.25	—	0.80	0.21	
1 cell deep	—	—	0.90	—	1.11	—	
1 cell deep	—	—	0.66	—	1.52	—	
2 cells deep	—	—	0.54	—	1.85	—	
2 cells deep	—	—	0.45	—	2.22	—	
2 cells deep	—	—	0.40	—	2.50	—	
3 cells deep	—	—	—	—	—	—	
Concrete blocks ^e							
Limestone aggregate	—	—	—	—	—	—	
8 in., 36 lb, 138 lb/ft ³ concrete, 2 cores	—	—	0.48	—	2.1	—	
Same with perlite-filled cores	—	—	—	—	—	—	
Limestone aggregate	—	—	—	—	—	—	
12 in., 55 lb, 138 lb/ft ³ concrete, 2 cores	—	—	—	—	—	—	
Same with perlite-filled cores	—	—	0.27	—	3.7	—	
Normal weight aggregate (sand and gravel)	—	—	0.90-1.03	—	1.11-0.97	0.22	
8 in., 33-36 lb, 126-136 lb/ft ³ concrete, 2 or 3 cores	—	—	0.50	—	2.0	—	
Same with perlite-filled cores	—	—	0.52-0.73	—	1.92-1.37	—	
Same with vermiculite-filled cores	—	—	0.81	—	1.23	0.22	
12 in., 50 lb, 125 lb/ft ³ concrete, 2 cores	—	—	—	—	—	—	



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TABLE E.3 Thermal Properties of Surface Air Films and Air Spaces

Part A. Surface Conductances and Resistances^a for Surface Air Films

Position of Surface	Direction of Heat Flow	I-P Units ^b						SI Units ^c					
		Nonreflective $\epsilon = 0.90$			Reflective $\epsilon = 0.20$			Nonreflective $\epsilon = 0.90$			Reflective $\epsilon = 0.20$		
		h_c	R	h_c	R	h_c	R	h_c	R	h_c	R	h_c	R
Still Air	Horizontal	1.63	0.61	0.91	1.10	0.76	1.32	9.26	0.11	5.17	0.19	4.32	0.23
	Sloping-45°	1.60	0.62	0.88	1.14	0.73	1.37	9.09	0.11	5.00	0.20	4.15	0.24
	Vertical	1.46	0.68	0.74	1.35	0.59	1.70	8.29	0.12	4.20	0.24	3.35	0.30
	Sloping-45°	1.32	0.76	0.60	1.67	0.45	2.22	7.50	0.13	3.41	0.29	2.56	0.39
	Horizontal	1.08	0.92	0.37	2.70	0.22	4.55	6.13	0.16	2.10	0.48	1.25	0.80
Moving Air (any position)		h_c	R					h_c	R				
	Winter Wind			6.00	0.17			34.0	0.030				
	15 mph (6.7 m/s)												
	Summer Wind												
	7.5 mph (3.4 m/s)			4.00	0.25			22.7	0.044				

Part B. Emission Values of Various Surfaces and Effective Emission Values of Air Spaces

Material	Average Emission ϵ	Effective Emission ϵ_{eff} of Air Space	
		One Surface Emission ϵ	Both Surfaces Emission ϵ
Aluminum foil, bright	0.05	0.05	0.03
Aluminum foil with condensate just visible	0.30	0.29	—
Aluminum foil with condensate clearly visible	0.70	0.65	—
Aluminum sheet	0.12	0.12	0.06
Aluminum-coated paper, polished	0.20	0.20	0.11
Steel, galvanized, bright	0.25	0.24	0.15
Aluminum paint	0.50	0.47	0.35
Building materials: wood, paper, masonry, nonmetallic paints	0.90	0.82	0.82
Regular glass	0.84	0.77	0.72

Source: Reprinted with permission of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. from the 2001 ASHRAE Handbook—Fundamentals. Conductances are for surfaces of the stated emittance facing virtual blackbody surroundings at the same temperature as the ambient air. Values are based on a surface-air temperature difference of 10°F (5.5°C) and for surface temperatures of 10°F (21°C). We used an air space resistance value and a surface resistance value. I-P units: surface conductance h_c and ϵ , measured in Btu h⁻¹ ft²; resistance R measured in h ft²/Btu. SI units: surface conductance h_c and ϵ , measured in W/m² K; resistance R measured in m²/Kw.

TABLE E.4 Thermal Resistances of Plane^a Air Spaces (I-P Units) (Continued)

Position of Air Space	Direction of Heat Flow	Mean Temp. ^b °F	Temp Diff. ^b °F	0.5-in. Air Space ^c			0.75-in. Air Space ^c			1.5-in. Air Space ^c			3.5-in. Air Space ^c					
				Value of $R_{s,c}$	0.2	0.5	0.82	0.03	0.05	0.2	0.5	0.82	0.03	0.05	0.2	0.5	0.82	
Horizontal	Down	90	10	2.48	2.34	1.67	1.06	0.77	3.55	3.29	2.10	1.22	0.85	4.71	4.51	3.42	2.30	1.71
		50	30	2.66	2.54	1.88	1.24	0.91	3.77	3.52	2.38	1.44	1.02	4.71	4.51	3.42	2.30	1.71
		50	10	2.67	2.55	1.89	1.25	0.92	3.84	3.59	2.41	1.45	1.02	4.71	4.51	3.42	2.30	1.71
		0	20	2.94	2.83	2.20	1.53	1.15	4.18	3.96	2.83	1.81	1.30	4.71	4.51	3.42	2.30	1.71
		0	10	2.96	2.85	2.22	1.53	1.16	4.25	4.02	2.87	1.82	1.31	4.71	4.51	3.42	2.30	1.71
		-50	20	3.25	3.15	2.58	1.89	1.47	4.60	4.41	3.36	2.28	1.69	4.71	4.51	3.42	2.30	1.71
45° Slope	Up	90	10	2.55	2.41	1.71	1.08	0.77	2.84	2.66	1.83	1.13	0.80	4.71	4.51	3.42	2.30	1.71
		50	30	1.87	1.81	1.45	1.04	0.80	2.09	2.01	1.58	1.10	0.84	4.71	4.51	3.42	2.30	1.71
		50	10	2.50	2.40	1.81	1.21	0.89	2.80	2.66	1.95	1.28	0.93	4.71	4.51	3.42	2.30	1.71
		0	20	2.01	1.95	1.63	1.23	0.97	2.25	2.18	1.79	1.32	1.03	4.71	4.51	3.42	2.30	1.71
		0	10	2.43	2.35	1.90	1.38	1.06	2.71	2.62	2.07	1.47	1.12	4.71	4.51	3.42	2.30	1.71
		-50	20	1.94	1.91	1.68	1.36	1.13	2.19	2.14	1.86	1.47	1.20	4.71	4.51	3.42	2.30	1.71

Table 1. Effective R-Value of Fiberglass in Standard Steel Stud Wall Assemblies

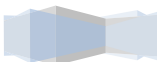
Depth of Cavity (in)	Rated Fiberglass R-Value	Effective R-Value (16" OC)	Effective R-Value (24" OC)
3.5	R-11	5.5	6.6
3.5	R-13	6.0	7.2
3.5	R-15	6.4	7.8
6.0	R-19	7.1	8.6
6.0	R-21	7.4	9.0
8.0	R-25	7.8	9.6



Appendix I - Horizontal Precast Panel Takeoff

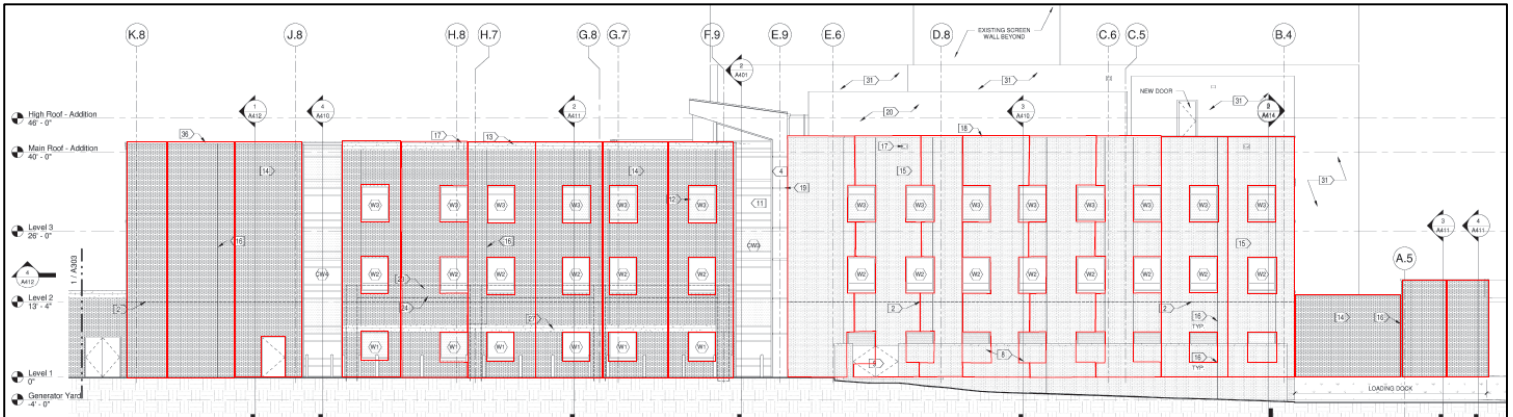
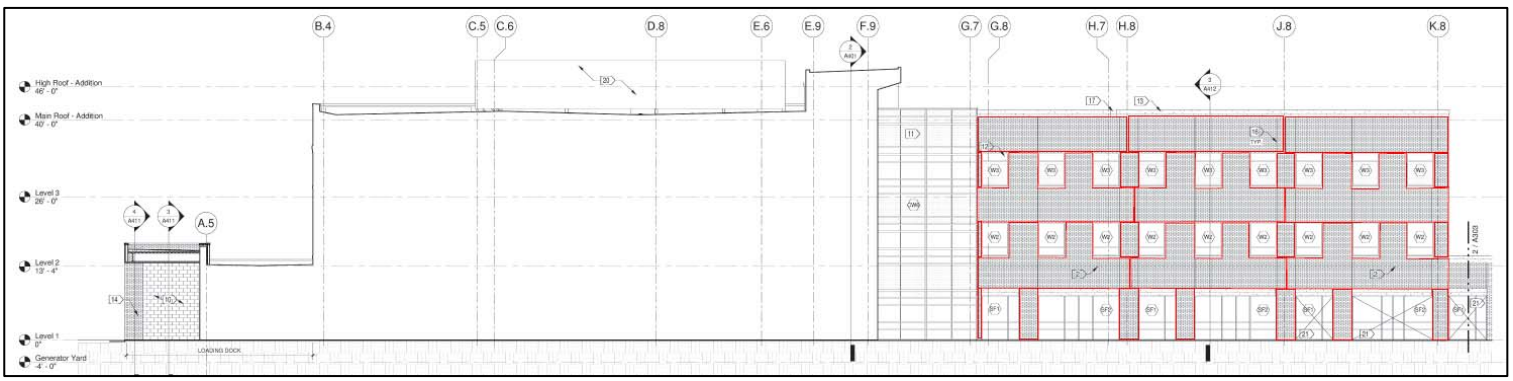
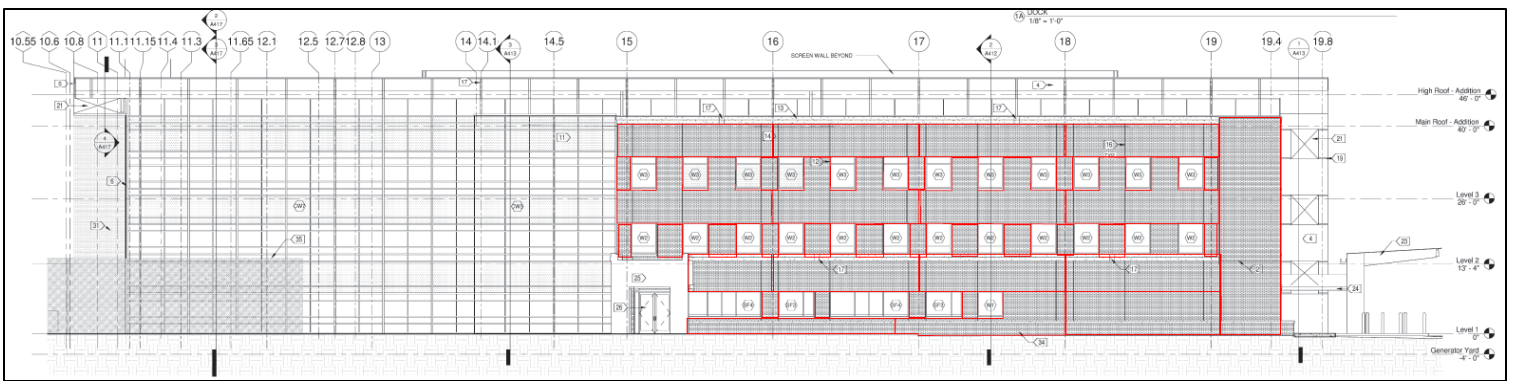
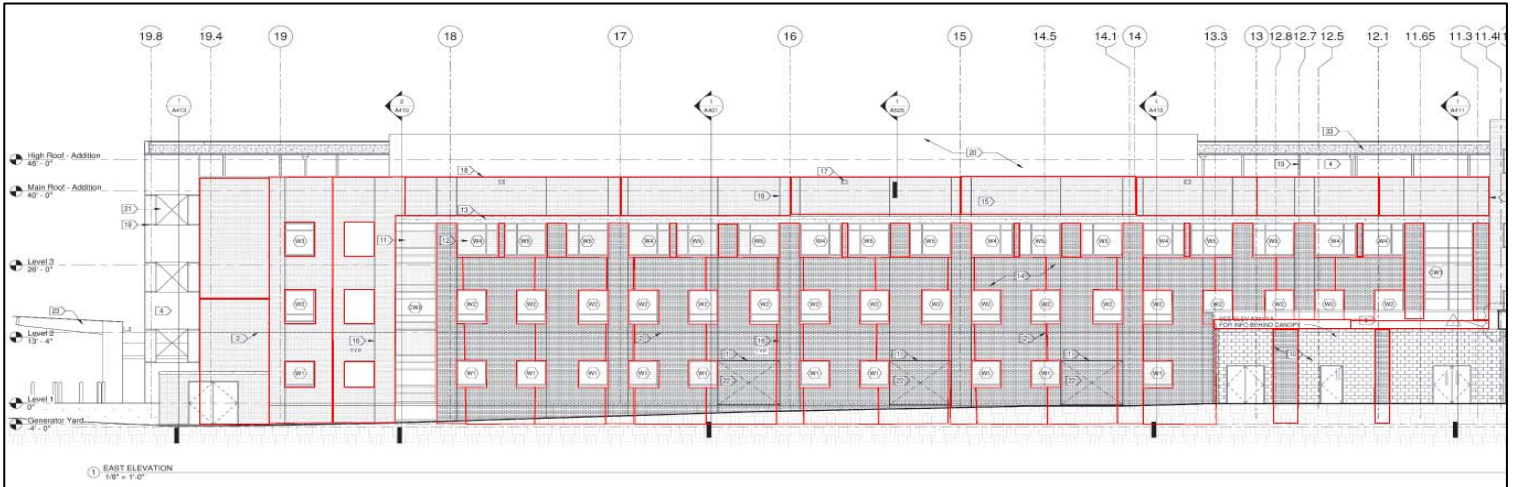


Horizontal Panel Takeoff												
Panel Designation	Length (ft)	Width (ft)	Average Panel Area (SF)	Total Area (SF)	Weight per Panel (LB)	Total Quantity	Oversize Transportation Required (Y/N)	Total South Façade	Total North Façade	Total West Façade	Total East Façade	Sealant Required (LF)
A	3.5	10.33	36.2	108.5	3,616	3	N				3	83.0
B	5.17	0.5	2.6	2.6	259	1	N	1				11.3
C	5.17	3	15.5	31.0	1,551	2	N			2		32.7
D	5.17	3.33	17.2	137.7	1,722	8	N	1		2		136.0
E	5.17	5	25.9	258.5	2,585	10	N	4			6	203.4
F	5.17	5.33	27.6	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
H	5.17	2.67	13.8	13.8	1,380	1	N				1	15.7
I	6.5	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
L	6.5	5	32.5	845.0	3,250	26	N	8	6	6	6	598.0
M	6.5	5.33	34.6	866.1	3,465	25	N	6	6	8	5	591.5
N	6.5	2.67	17.4	104.1	1,736	6	N		2	2	2	110.0
O	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	8.33	54.1	108.3	5,415	2	N	2				59.3
R	6.5	9	58.5	234.0	5,850	4	N	4				124.0
S	8.5	10.33	87.8	263.4	8,781	3	N				3	113.0
T	11.67	23.25	271.3	542.7	27,133	2	N				2	139.7
U	13.25	6.75	89.4	89.4	8,944	1	N				1	40.0
V	13.5	6.67	90.0	90.0	9,005	1	N				1	40.3
W	16.33	6.75	110.2	110.2	11,023	1	N				1	46.2
X	18.33	6.75	123.7	247.5	12,373	2	N				2	100.3
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	20.33	7.17	145.8	291.5	14,577	2	N				2	110.0
BB	21	6.17	129.6	129.6	12,957	1	N				1	54.3
CC	21	6.67	140.1	140.1	14,007	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	28.375	6.17	175.1	1050.4	17,507	6	N			3	3	414.5
GG	28.375	6.67	189.3	567.8	18,926	3	N				3	210.3
HH	28.375	7.17	203.4	610.3	20,345	3	N				3	213.3
II	29.25	7.17	209.7	209.7	20,972	1	N				1	72.8
JJ	30.33	8.67	263.0	263.0	26,296	1	N				1	78.0
KK	30.67	6.75	207.0	207.0	20,702	1	N				1	74.8
LL	30.67	6.67	204.6	204.6	20,457	1	N				1	74.7
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
OO	2.5	28	70.0	70.0	7,000	1	N			1		61.0
PP	2.5	30	75.0	225.0	7,500	3	N			3		195.0
QQ	8.17	12	98.0	98.0	9,804	1	N			1		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	15	97.5	195.0	9,750	2	N			2		86.0
UU	6.5	13.5	87.8	87.8	8,775	1	N			1		40.0
VV	1.33	12.17	16.2	16.2	1,619	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
ZZ	30.33	2	60.7	60.7	6,066	1	N			1		64.7
AAA	28.375	2	56.8	113.5	5,675	2	N			2		121.5
BBB	6.5	28.67	186.4	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	5.5	28.67	157.7	473.1	15,769	3	N			3		205.0
EEE	0.5	9.33	4.7	4.7	467	1	N			1		19.7
FFF	3.33	9.33	31.1	155.3	3,107	5	N			5		126.6
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
III	8.67	30	260.1	520.2	26,010	2	N	2				154.7
JJJ	10	21.5	215.0	430.0	21,500	2	N	2				126.0
KKK	6.67	30	200.1	400.2	20,010	2	N	2				146.7
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	6.17	20	123.4	123.4	12,340	1	N	1				52.3
OOO	9.5	23	218.5	655.5	21,850	3	N	3				195.0
PPP	6.75	3.33	22.5	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	2.92	20	58.4	58.4	5,840	1	N	1				45.8
TTT	6	30	180.0	360.0	18,000	2	N	2				144.0
UUU	6	6.33	38.0	38.0	3,798	1	N	1				24.7
VVV	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	3.33	20.25	67.4	134.9	6,743	2	N	2				94.3
YYY	12	20.92	251.0	1004.2	25,104	4	N	4				263.4
ZZZ	7.33	17.17	125.9	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
Anticipated Schedule Durations						16.3		5.1	2.4	3.6	5.1	



Appendix J – Vertical Precast Panel Design





Appendix K – Vertical Precast Panel Takeoff

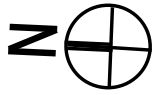


Vertical Panel Takeoff												
Panel Designation	Length (ft)	Width (ft)	Average Panel Area (SF)	Total Area (SF)	Weight (LB)	Total Quantity	Oversize Transportation Required (Y/N)	Total South Façade	Total North Façade	Total West Façade	Total East Façade	Sealant Required (LF)
A	7.17	20.33	145.8	291.5	14,576.6	2	N				2	110.0
B	7.17	18.5	132.6	132.6	13,264.5	1	N				1	51.3
C	7.17	28.375	203.4	406.9	20,344.9	2	N				2	142.2
D	7.17	29.25	209.7	209.7	20,972.3	1	N				1	72.8
E	7.17	30.04	215.4	215.4	21,538.7	1	N				1	74.4
F	6.5	1	6.5	39.0	650.0	6	N				6	90.0
G	6.5	3.33	21.6	86.6	2,164.5	4	N				4	78.6
H	19.17	3.33	63.8	63.8	6,383.6	1	N				1	45.0
I	19.17	2.5	47.9	47.9	4,792.5	1	N				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	12,654.0	5	N				5	413.3
N	38	12	406.0	3654.0	40,600.0	9	N				9	900.0
O	47	10.5	443.5	887.0	44,350.0	2	N				2	230.0
P	18.33	12	170.0	509.9	16,996.0	3	Y				3	182.0
Q	11.67	23.25	271.3	542.7	27,132.8	2	N				2	139.7
R	8.5	29.71	252.5	252.5	25,253.5	1	N			1		76.4
S	8.5	32.92	279.8	279.8	27,982.0	1	N			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	7.25	17.5	126.9	126.9	12,687.5	1	N			1		49.5
Y	7.25	28.375	205.7	411.4	20,571.9	2	N			2		142.5
Z	7.25	29.71	215.4	215.4	21,539.8	1	N			1		73.9
AA	6.5	2.67	17.4	104.1	1,735.5	6	N		2	4		110.0
BB	6.5	3.33	21.6	216.5	2,164.5	10	N		4	6		196.6
CC	6.5	5	32.5	130.0	3,250.0	4	N			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	Y			1		86.0
FF	12.67	28.375	263.5	527.0	26,351.1	2	Y			2		164.2
GG	12.67	29.71	280.4	280.4	28,042.6	1	Y			1		84.8
HH	6.5	30.33	197.1	197.1	19,714.5	1	N			1		73.7
II	6.5	28.375	184.4	368.9	18,443.8	2	N			2		139.5
JJ	6.5	29.71	193.1	193.1	19,311.5	1	N			1		72.4
KK	6.5	0.5	3.3	6.5	325.0	2	N		2			28.0
LL	28.67	12	248.0	496.1	24,804.0	2	N		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	Y		2			165.4
OO	30.67	12.67	292.6	292.6	29,258.9	1	Y		1			86.7
PP	9.33	0.5	4.7	4.7	466.5	1	N		1			19.7
QQ	9.33	3.33	31.1	155.3	3,106.9	5	N		5			126.6
RR	9.33	2.67	24.9	24.9	2,491.1	1	N		1			24.0
SS	6.5	28.67	186.4	372.7	18,635.5	2	N		2			140.7
TT	6.5	30.67	199.4	199.4	19,935.5	1	N		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
YY	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	2				99.7
AAA	14.5	19	275.5	275.5	27,550.0	1	Y	1				67.0
Totals						126	8 Panels	20	24	38	44	7459.8
Anticipated Schedule Durations						10.5		1.7	2.0	3.2	3.7	



Appendix L – Panel Placement Logistics Plan



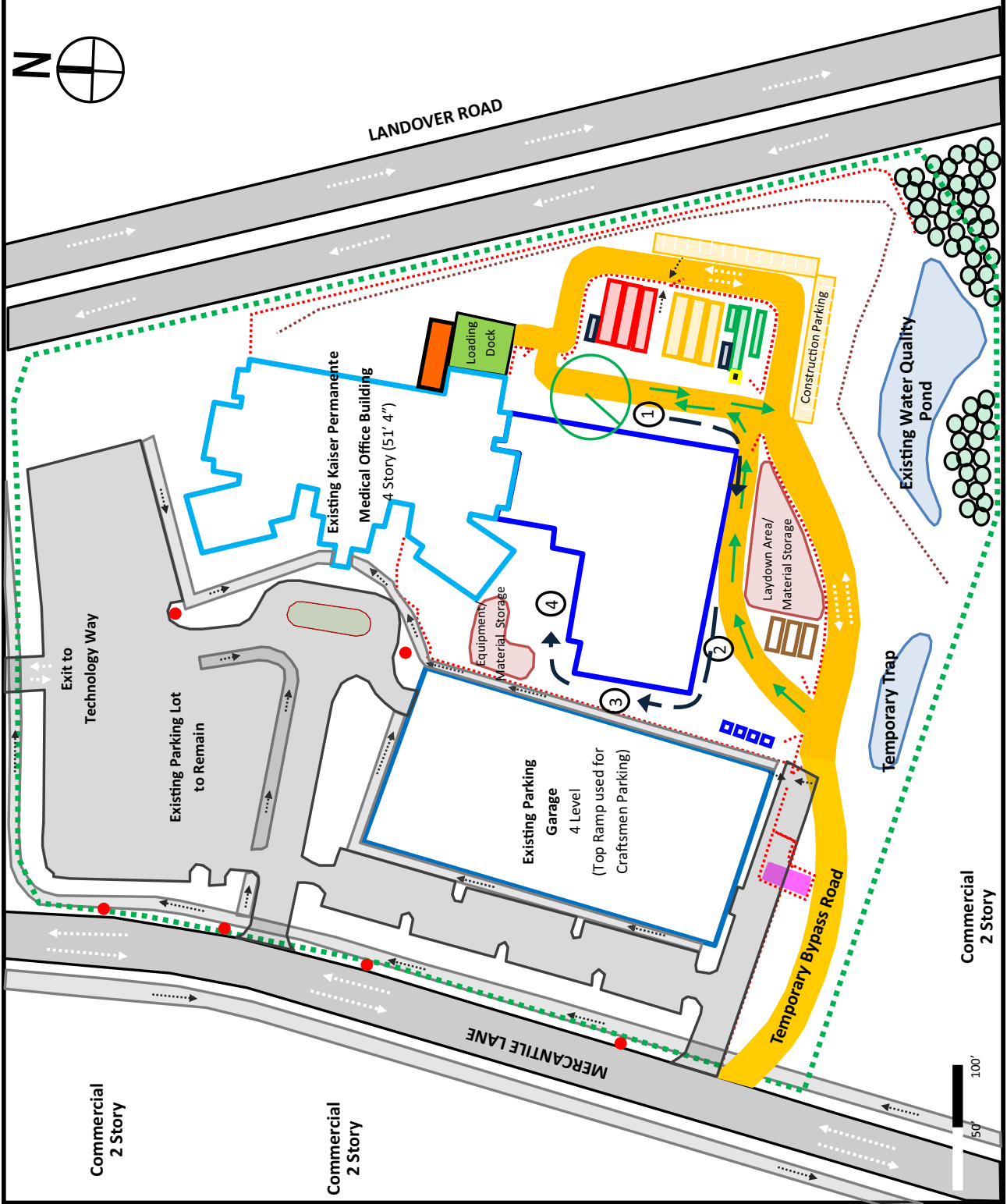


Legend & Symbols

	Property Line
	Construction Fence
	Vehicular Traffic
	Existing Building
	Proposed Addition
	Overhead Protection
	Precast Delivery Route
	Temporary Power Shed
	Construction Trailer
	DPR Trailer (GC)
	Jacobs Trailer (CM)
	Subcontractor Trailer
	Storage Container
	Loading Dock
	Laydown/Storage Area
	Portable Toilets
	Crane/Radius
	Recycling/Dumpster
	Mock-Up Area
	Crane Erection Sequence
	Fire Hydrant

**Kaiser Permanente Largo
Medical Office Building**

Largo, Maryland
Chris Pozza
Precast Panel Placement April 3, 2013
Final Thesis Report



Commercial
2 Story

Commercial
2 Story

Commercial
2 Story



Appendix M – Actual Exterior Enclosure Project Schedule



Activity ID	Activity Name	Original Duration	At Completion Duration	Start	Finish
Exterior		161	159	05-Mar-12 A	16-Oct-12
East Elevation		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-12 A
EE.00.1030	Frame Perimeter Walls East Elevation	15	28	21-Mar-12 A	30-Apr-12 A
EE.00.1040	Install Exterior Wall Sheathing East Elevation	15	18	17-Apr-12 A	11-May-12 A
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-12 A	27-Sep-12
SE.00.1000	Layout Exterior Walls South Elevation	6	21	07-Mar-12 A	04-Apr-12 A
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-12 A	09-Apr-12 A
SE.00.1030	Frame Perimeter Walls South Elevation	15	32	28-Mar-12 A	11-May-12 A
SE.00.1040	Install Exterior Wall Sheathing South Elevation	15	17	24-Apr-12 A	17-May-12 A
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-12 A	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-12 A	12-Apr-12 A
WE.00.1030	Frame Perimeter Walls West Elevation	9	28	11-Apr-12 A	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	3	02-Apr-12 A	05-Apr-12 A
NE.00.1020	Fireproof Perimeter Steel North Elevation	5	3	10-Apr-12 A	13-Apr-12 A
NE.00.1010	Install Top Track and Clips North Elevation	6	25	24-Apr-12 A	29-May-12 A
NE.00.1030	Frame Perimeter Walls North Elevation	6	23	27-Apr-12 A	31-May-12 A
NE.00.1040	Install Exterior Wall Sheathing North Elevation	6	6	02-Jul-12 A	10-Jul-12 A
NE.00.1050	Install Vapor Barrier and Wall Ties North Elevation	6	47	02-Jul-12 A	06-Sep-12
NE.00.1060	Erect Exterior Brick and Precast Accent Band North Elevation	6	23	10-Aug-12 A	12-Sep-12
NE.00.1070	Install Exterior Windows North Elevation	4	4	13-Sep-12	18-Sep-12
NE.00.1080	Install Curtain wall North Elevation	6	6	13-Sep-12	20-Sep-12
NE.00.1090	North Elevation - Caulking	5	5	21-Sep-12	27-Sep-12



Appendix N – Proposed Detailed Exterior Enclosure Schedule



ID	Task Name	Duration	Start	Finish	Baseline Duration	Baseline Start	Baseline Finish	Qtr 2, 2012			Qtr 3, 2012			Qtr 4, 2012		
								Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
24	West Elevation	82 days	Tue 4/3/12	Wed 7/25/12	121 days	Tue 4/3/12	Tue 9/25/12									
25	Layout Exterior Walls	1 day	Wed 4/11/12	Wed 4/11/12	1 day	Wed 4/11/12	Wed 4/11/12									
26	Install Top Track and Clips	5 days	Tue 4/3/12	Mon 4/9/12	5 days	Tue 4/3/12	Mon 4/9/12									
27	Fireproof Perimeter Steel	2 days	Fri 4/6/12	Mon 4/9/12	2 days	Fri 4/6/12	Mon 4/9/12									
28	Frame Perimeter Walls	28 days	Wed 4/11/12	Fri 5/18/12	28 days	Wed 4/11/12	Fri 5/18/12									
29	Install Exterior Wall Sheathing	14 days	Mon 5/21/12	Thu 6/7/12	14 days	Mon 5/21/12	Thu 6/7/12									
30	Install Vapor Barrier & Insulation	5 days	Tue 6/5/12	Mon 6/11/12	19 days	Tue 6/12/12	Tue 7/10/12									
31	Erect Precast Panels	4 days	Wed 6/13/12	Mon 6/18/12	29 days	Wed 7/25/12	Tue 9/4/12									
32	Install Exterior Windows	4 days	Mon 6/25/12	Thu 6/28/12	4 days	Mon 9/10/12	Thu 9/13/12									
33	Install Curtain Wall	12 days	Fri 6/29/12	Mon 7/16/12	67 days	Fri 6/1/12	Wed 9/5/12									
34	Caulking	10 days	Thu 7/12/12	Wed 7/25/12	10 days	Wed 9/12/12	Tue 9/25/12									
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									

Project: Horizontal Panel Schedul
Date: Tue 3/26/13

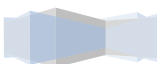
Task		Summary		Inactive Task		Duration-only		Finish-only	
Split		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline	
Milestone		External Tasks		Inactive Summary		Manual Summary		Progress	
Baseline		External Milestone		Manual Task		Start-only			

ID	Task Name	Duration	Start	Finish	Baseline Duration	Baseline Start	Baseline Finish	Qtr 2, 2012			Qtr 3, 2012			Qtr 4, 2012		
								Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
1	Exterior Enclosure	104 days	Mon 3/5/12	Thu 7/26/12	161 days	Mon 3/5/12	Tue 10/16/12									
2	East Elevation	93 days	Mon 3/5/12	Wed 7/11/12	138 days	Mon 3/5/12	Mon 9/17/12									
3	Layout Exterior Walls	4 days	Mon 3/5/12	Thu 3/8/12	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	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	3 days	Mon 3/19/12	Wed 3/21/12									
6	Frame Perimeter Walls	29 days	Wed 3/21/12	Mon 4/30/12	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	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	26 days	Fri 5/25/12	Mon 7/2/12									
9	Erect Precast Panels	6 days	Mon 5/28/12	Mon 6/4/12	22 days	Mon 6/25/12	Thu 7/26/12									
10	Install Exterior Windows	17 days	Tue 6/12/12	Wed 7/4/12	17 days	Mon 8/13/12	Wed 9/5/12									
11	Install Curtain Wall	8 days	Mon 6/25/12	Wed 7/4/12	8 days	Tue 9/4/12	Thu 9/13/12									
12	Caulking	8 days	Mon 7/2/12	Wed 7/11/12	8 days	Thu 9/6/12	Mon 9/17/12									
13	South Elevation	94 days	Wed 3/7/12	Mon 7/16/12	144 days	Wed 3/7/12	Thu 9/27/12									
14	Layout Exterior Walls	21 days	Wed 3/7/12	Wed 4/4/12	21 days	Wed 3/7/12	Wed 4/4/12									
15	Install Top Track and Clips	10 days	Tue 3/27/12	Mon 4/9/12	10 days	Tue 3/27/12	Mon 4/9/12									
16	Fireproof Perimeter Steel	10 days	Tue 3/20/12	Mon 4/2/12	10 days	Tue 3/20/12	Mon 4/2/12									
17	Frame Perimeter Walls	32 days	Wed 3/28/12	Thu 5/10/12	32 days	Wed 3/28/12	Thu 5/10/12									
18	Install Exterior Wall Sheathing	18 days	Tue 4/24/12	Thu 5/17/12	18 days	Tue 4/24/12	Thu 5/17/12									
19	Install Vapor Barrier & Insulation	7 days	Mon 5/21/12	Tue 5/29/12	25 days	Tue 5/22/12	Wed 6/27/12									
20	Erect Precast Panels	6 days	Tue 6/5/12	Tue 6/12/12	18 days	Mon 7/2/12	Fri 7/27/12									
21	Install Exterior Windows	19 days	Mon 6/18/12	Thu 7/12/12	19 days	Mon 8/13/12	Fri 9/7/12									
22	Install Curtain Wall	12 days	Wed 6/27/12	Thu 7/12/12	12 days	Mon 9/10/12	Tue 9/25/12									
23	Caulking	6 days	Mon 7/9/12	Mon 7/16/12	6 days	Thu 9/20/12	Thu 9/27/12									

Project: Horizontal Panel Schedul
Date: Tue 3/26/13

Task	Summary	Inactive Task	Duration-only	Finish-only
Split	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline
Milestone	External Tasks	Inactive Summary	Manual Summary	Progress
Baseline	External Milestone	Manual Task	Start-only	

Appendix O – General Conditions Estimate



General Condition Estimate

Date: 10-Oct-12

Line Number		Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
Division 01 General Requirements						
013113200020		Field Personnel, clerk, average	80	Week	\$650.00	\$52,000.00
013113200140		Field personnel, field engineer, maximum	95	Week	\$2,275.00	\$216,125.00
013113200140		Field personnel, field engineer, maximum	95	Week	\$2,275.00	\$216,125.00
013113200140		Field personnel, field engineer, maximum	60	Week	\$2,275.00	\$136,500.00
013113200200		Field personnel, project manager, average	70	Week	\$3,275.00	\$229,250.00
013113200220		Field personnel, project manager, maximum	100	Week	\$3,750.00	\$375,000.00
013113200240		Field personnel, superintendent, minimum	25	Week	\$2,775.00	\$69,375.00
013113200280		Field personnel, superintendent, maximum	95	Week	\$3,475.00	\$330,125.00
013113200280		Field personnel, superintendent, maximum	91	Week	\$3,475.00	\$316,225.00
013113200280		Field personnel, superintendent, maximum	91	Week	\$3,475.00	\$316,225.00
013113200280		Field personnel, superintendent, maximum	20	Week	\$3,475.00	\$69,500.00
Division 01 General Requirements Subtotal						\$2,326,450.00

Temporary Facilities

Date: 10-Oct-12

Line Number		Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
Division 01 General Requirements						
015212400122	U	Large Trailer Setup	1	Each	\$25,000.00	\$25,000.00
015212400132	U	Jobsite Setup/Tear Down	1	Each	\$15,000.00	\$15,000.00
015213200300		Office Trailer, furnished, buy, 32' x 8', excl. hookups	2	Ea.	\$15,971.80	\$31,943.60
015213200500		Office Trailer, furnished, buy, 50' x 12', excl. hookups	1	Ea.	\$30,868.65	\$30,868.65
015523000010	U	Offsite Parking	20	Month	\$2,000.00	\$40,000.00
015523000020	U	Jobsite Vehicles	70	Month	\$800.00	\$56,000.00
015523000030	U	Fuel	91	Month	\$500.00	\$45,500.00
Division 01 General Requirements Subtotal						\$244,312.25



Temporary Utilities Estimate

Date: 10-Oct-12

Line Number		Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
Division 01 General Requirements						
012123111000	U	Temporary Toilets (Building)	20	Month	\$800.00	\$16,000.00
012311111110	U	Water Consumption	20	Month	\$400.00	\$8,000.00
012312111110	U	Water Meter	1	Each	\$15,000.00	\$15,000.00
012354100000	U	Power Consumption	13	Month	\$32,282.00	\$419,666.00
015113100000	U	Temporary Generators	4	Month	\$13,260.00	\$53,040.00
015433110000	U	Temporary Toilets (Trailers)	20	Month	\$400.00	\$8,000.00
Division 01 General Requirements Subtotal						\$519,706.00

Safety and Protection Estimate

Date: 10-Oct-12

Line Number		Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
Division 01 General Requirements						
013113200160		Field personnel, general purpose laborer, average	84	Week	\$2,125.00	\$178,500.00
014523505900		Vibration monitoring, seismograph and technician	40	Day	\$449.96	\$17,998.40
015409500005	U	Safety Supplies and First Aid	20	Month	\$500.00	\$10,000.00
015423700005	U	Scaffold Stair Tower	16	Month	\$750.00	\$12,000.00
015616000005	U	Temporary Walkway Protection	300	LF	\$125.00	\$37,500.00
015626500015	U	Temporary Fence Installation	1	Each	\$7,500.00	\$7,500.00
015626500025	U	Site Signage	1	Each	\$7,500.00	\$7,500.00
Division 01 General Requirements Subtotal						\$270,998.40
Division 10 Specialties						
104416131100		Fire extinguishers, dry chemical, pressurized, standard type, portable, painted, 20 lb	35	Ea.	\$138.00	\$4,830.00
Division 10 Specialties Subtotal						\$4,830.00
Division 32 Exterior Improvements						
320130200420		Snow removal, sidewalks and drives, double driveway (20' x 50'), 10" - 15" deep, 24" power blower	188	Ea.	\$190.11	\$35,740.68
Division 32 Exterior Improvements Subtotal						\$35,740.68



Cleaning Estimate

Date: 10-Oct-12

Line Number		Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
Division 01 General Requirements						
013113200160		Field personnel, general purpose laborer, average	110	Week	\$2,125.00	\$233,750.00
015409600205	U	Debris Boxes	130	Each	\$550.00	\$71,500.00
017413200105	U	Final Clean	106700	SF	\$0.51	\$54,417.00
Division 01 General Requirements Subtotal						\$359,667.00
Division 14 Conveying Equipment						
149182103000		Chutes, package, spiral type, max	2	Floor	\$7,652.45	\$15,304.90
Division 14 Conveying Equipment Subtotal						\$15,304.90

General Expense Estimate

Date: 11-Oct-12





Line Number		Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
Division 01 General Requirements						
011131110105	U	Blueprints throughout construction	10	Month	\$1,500.00	\$15,000.00
013233500600		Construction photographs, aerial photos, initial fly-over, 6 shots, 1 print ea., 16" x 20" prints	2	Set	\$1,294.53	\$2,589.06
015213200010	U	Office Furniture (all Trailers)	1	Each	\$3,000.00	\$3,000.00
015213200020	U	Network and Server	20	Month	\$800.00	\$16,000.00
015213200030	U	DSL Line Setup and Charges	1	Each	\$5,000.00	\$5,000.00
015213200040	U	Printer/Fax/Copy Machine	20	Month	\$350.00	\$7,000.00
015213200050	U	Jobsite Telephones	20	20	\$250.00	\$5,000.00
015213200060	U	Jobsite Telephones Service Setup	1	Each	\$2,000.00	\$2,000.00
015213200070	U	Postage/Federal Express	20	Month	\$250.00	\$5,000.00
015213200080	U	Meeting Supplies/Snacks/Coffee	20	Month	\$300.00	\$6,000.00
015213200090	U	Survey	1	Each	\$40,000.00	\$40,000.00
015213400100		Field Office Expense, office equipment rental, average	40	Month	\$214.94	\$8,597.60
Division 01 General Requirements Subtotal						\$115,186.66













Appendix P – Precast Analysis RSMeans Estimates



Unit Detail Report

LineNumber				Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
Division 07 Thermal and Moisture Protection								
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 Thermal and Moisture Protection Subtotal								\$16,113.17

LineNumber				Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
Division 01 General Requirements								
015433601200				Rent crawler mounted, lattice boom crane, 100 ton, 60' boom, Incl. Hourly Oper. Cost.	17.00	Day	\$2,510.73	\$42,682.38
015436502300				Mobilization or demobilization, crane, crawler-mounted, over 75 ton	1.00	Ea.	\$1,395.84	\$1,395.84
Division 01 General Requirements Subtotal								\$44,078.22

LineNumber				Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
Division 07 Thermal and Moisture Protection								
072113100030				Fiberboard insulation, rigid, for walls, 2" thick, R5.26	33,780.00	S.F.	\$1.74	\$58,777.20
Division 07 Thermal and Moisture Protection Subtotal								\$58,777.20



Appendix Q – Building Tie-In Short Interval Production Schedule



Project:	Kaiser Permanente Largo Medical Office Building						Zone:	Northwest Building Connection
Activity	Quantity	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 Partition/Cleanup	1	EA	0.25	4	2	2.0	0.3	Off-hours (OH)
TOTALS				77	210	37.0	4.6	



Appendix R – Actual Interior MEP Rough-In Schedule

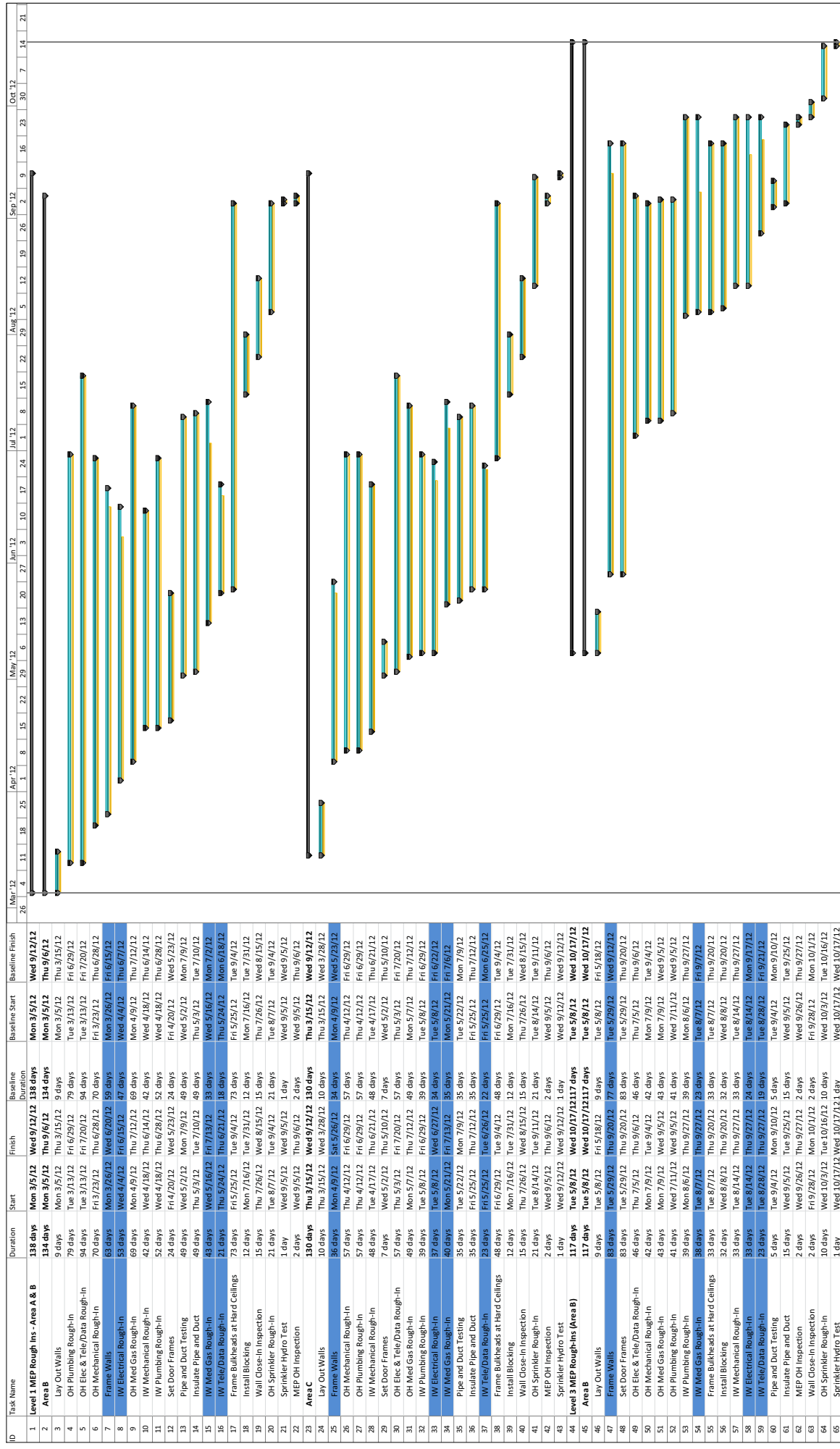


Interior Construction		245	243	05-Mar-12A	20-Feb-13
M/E/P & FP Rough Ins		180	178	05-Mar-12A	12-Nov-12
Level 1		180	178	05-Mar-12A	12-Nov-12
RI.01.1000	Fireproof Structure	15	14	09-Mar-12A	29-Mar-12A
Area "B"		133	131	05-Mar-12A	06-Sep-12
RI.1B.1000	1B1 - Lay Out Walls	10	8	05-Mar-12A	15-Mar-12A
RI.1B.1020	1B1 - OH Plbg Rough In	10	77	13-Mar-12A	29-Jun-12A
RI.1B.1030	1B1 - OH Elec & Tele/Data Rough In	10	91	13-Mar-12A	20-Jul-12A
RI.1B.1010	1B1 - OH Mech Rough In	10	68	23-Mar-12A	28-Jun-12A
RI.1B.1070	1B1 - Frame Walls	10	61	26-Mar-12A	20-Jun-12A
RI.1B.1120	1B1 - In Wall Elec Rough In	10	51	04-Apr-12A	15-Jun-12A
RI.1B.1050	1B1 - OH Med Gas System Rough In	6	66	09-Apr-12A	12-Jul-12A
RI.1B.1040	1B1 - OH F.A. Rough In	10	66	09-Apr-12A	12-Jul-12A
RI.1B.1100	1B1 - In Wall Mech Rough In	10	40	18-Apr-12A	14-Jun-12A
RI.1B.1110	1B1 - In Wall Plbg Rough In	10	50	18-Apr-12A	28-Jun-12A
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-12A
RI.1B.1160	1B1 - Insulate Pipe and Duct	15	46	03-May-12A	10-Jul-12A
RI.1B.1130	1B1 - In Wall Med Gas Rough In	10	40	16-May-12A	13-Jul-12A
RI.1B.1140	1B1 - In Wall Tele / Data Rough In	10	19	24-May-12A	21-Jun-12A
RI.1B.1090	1B1 - Frame Bulkheads and Hard Ceiling Areas	10	50	25-Jun-12A	04-Sep-12
RI.1B.1185	1B1 - Install Blocking	10	11	16-Jul-12A	31-Jul-12A
RI.1B.1170	1B1 - Wall Close In Inspection	2	15	26-Jul-12A	15-Aug-12A
RI.1B.1060	1B1 - OH Sprinkler Rough In	10	20	07-Aug-12A	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
Area "C"		132	129	15-Mar-12A	14-Sep-12
RI.1C.1000	1C1 - Lay Out Walls	10	10	15-Mar-12A	28-Mar-12A
RI.1C.1070	1C1 - Frame Walls	10	35	09-Apr-12A	26-May-12A
RI.1C.1010	1C1 - OH Mech Rough In	10	55	12-Apr-12A	29-Jun-12A
RI.1C.1020	1C1 - OH Plbg Rough In	10	55	12-Apr-12A	29-Jun-12A
RI.1C.1040	1C1 - OH F.A. Rough In	10	62	16-Apr-12A	13-Jul-12A
RI.1C.1100	1C1 - In Wall Mech Rough In	10	46	17-Apr-12A	21-Jun-12A
RI.1C.1080	1C1 - Set Door Frames	5	6	02-May-12A	10-May-12A
RI.1C.1030	1C1 - OH Elec & Tele/Data Rough In	10	54	03-May-12A	20-Jul-12A
RI.1C.1050	1C1 - OH Med Gas System Rough In	10	46	07-May-12A	12-Jul-12A
RI.1C.1110	1C1 - In Wall Plbg Rough In	10	38	08-May-12A	29-Jun-12A
RI.1C.1120	1C1 - In Wall Elec Rough In	10	35	08-May-12A	27-Jun-12A
RI.1C.1130	1C1 - In Wall Med Gas Rough In	10	37	21-May-12A	13-Jul-12A
RI.1C.1150	1C1 - Pipe and Duct Testing	5	32	22-May-12A	09-Jul-12A
RI.1C.1160	1C1 - Insulate Pipe and Duct	15	32	25-May-12A	12-Jul-12A
RI.1C.1140	1C1 - In Wall Tele / Data Rough In	10	21	25-May-12A	26-Jun-12A
RI.1C.1090	1C1 - Frame Bulkheads and Hard Ceilings Areas	10	46	29-Jun-12A	04-Sep-12
RI.1C.1185	1C1 - Install Blocking	10	11	16-Jul-12A	31-Jul-12A
RI.1C.1170	1C1 - Wall Close In Inspection	2	15	26-Jul-12A	15-Aug-12A
RI.1C.1060	1C1 - OH Sprinkler Rough In	10	20	14-Aug-12A	11-Sep-12
RI.1C.1180	1C1 - MEPOH Inspection	2	2	05-Sep-12	06-Sep-12
Level 3		129	140	09-Apr-12A	24-Oct-12
RI.03.1000	Fireproof Structure	15	31	09-Apr-12A	22-May-12A
Area "B"		114	114	08-May-12A	17-Oct-12
RI.3B.1000	3B1 - Lay Out Walls	10	8	08-May-12A	18-May-12A
RI.3B.1070	3B1 - Frame Walls	10	81	29-May-12A	20-Sep-12
RI.3B.1080	3B1 - Set Door Frames	5	81	29-May-12A	20-Sep-12
RI.3B.1030	3B1 - OH Elec & Tele/Data Rough In	10	45	05-Jul-12A	06-Sep-12
RI.3B.1010	3B1 - OH Mech Rough In	10	41	09-Jul-12A	04-Sep-12
RI.3B.1050	3B1 - OH Med Gas System Rough In	10	42	09-Jul-12A	05-Sep-12
RI.3B.1020	3B1 - OH Plbg Rough In	10	40	11-Jul-12A	05-Sep-12
RI.3B.1110	3B1 - In Wall Plbg Rough In	10	38	06-Aug-12A	27-Sep-12
RI.3B.1130	3B1 - In Wall Med Gas Rough In	10	37	07-Aug-12A	27-Sep-12
RI.3B.1090	3B1 - Frame Bulkheads and Hard Ceiling Areas	10	32	07-Aug-12A	20-Sep-12
RI.3B.1185	3B1 - Install Blocking	10	31	08-Aug-12A	20-Sep-12
RI.3B.0990	3B1 - CAV Delivery to Site	0	0		10-Aug-12A
RI.3B.0995	3B1 - Install CAV sand Down Stream Spiral Duct	8	17	13-Aug-12A	05-Sep-12
RI.3B.1100	3B1 - In Wall Mech Rough In	10	32	14-Aug-12A	27-Sep-12
RI.3B.1120	3B1 - In Wall Elec Rough In	10	32	14-Aug-12A	27-Sep-12
RI.3B.1040	3B1 - OH F.A. Rough In	10	21	15-Aug-12A	13-Sep-12
RI.3B.1140	3B1 - In Wall Tele / Data Rough In	10	22	28-Aug-12A	27-Sep-12
RI.3B.1150	3B1 - Pipe and Duct Testing	5	5	04-Sep-12	10-Sep-12
RI.3B.1160	3B1 - Insulate Pipe and Duct	15	15	05-Sep-12	25-Sep-12
RI.3B.1180	3B1 - MEPOH Inspection	2	2	26-Sep-12	27-Sep-12
RI.3B.1170	3B1 - Wall Close In Inspection	2	2	28-Sep-12	01-Oct-12
RI.3B.1060	3B1 - OH Sprinkler Rough In	10	10	03-Oct-12	16-Oct-12
RI.3B.1190	3B1 - Sprinkler Hydro Test	1	1	17-Oct-12	17-Oct-12



Appendix S- Proposed Headwall Interior MEP Rough-In Schedule





Appendix T – Headwall Labor and Material Takeoffs



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	Undercarpet, 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



Appendix U – RSMeans Labor Costs



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

