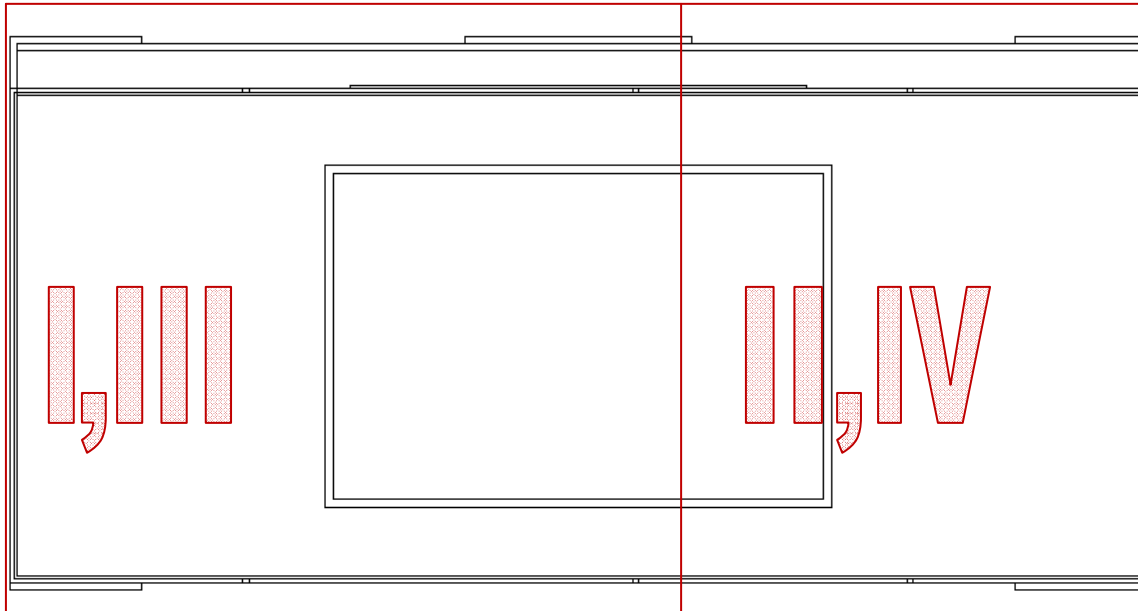




**Appendix A**  
**Building Sequencing**



BUILDING PLAN



## Appendix B

### Existing Condition Site Plan

Kristen  
Hlopick

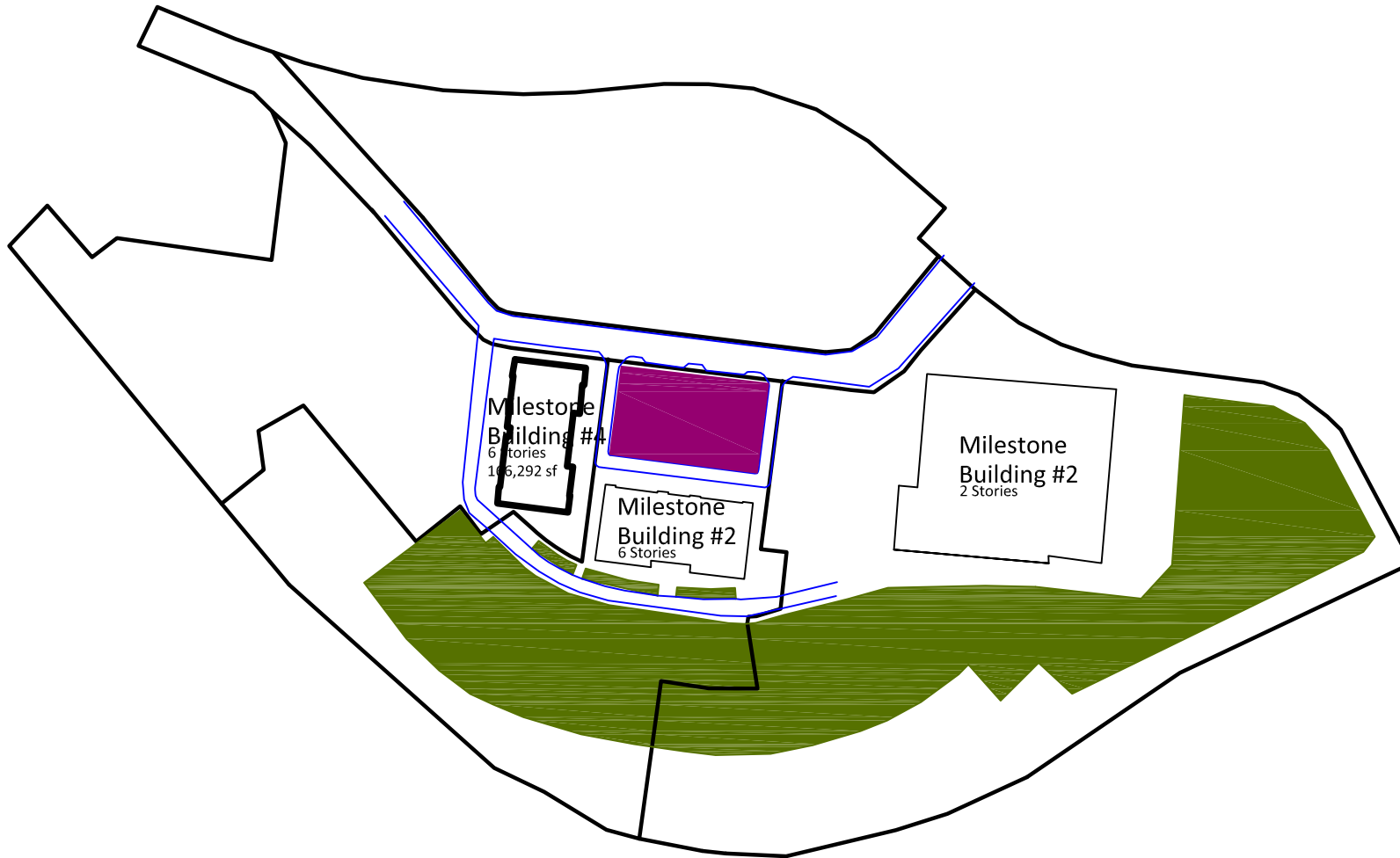
October 5, 2007

Milestone Buisness Park  
Building #4  
Germantown, MD

Revisions

Site Plan  
Existing Condition

Civil-001  
Page 54 of 117



Legend

Courtyard	—	Roads	—
Electric	—	Sanatary Sewer	—
Fence	—	Storm Drain	—
Parking	—	Water Pipe/Struc.	—
Property Line	—		



Kristen Hlopick

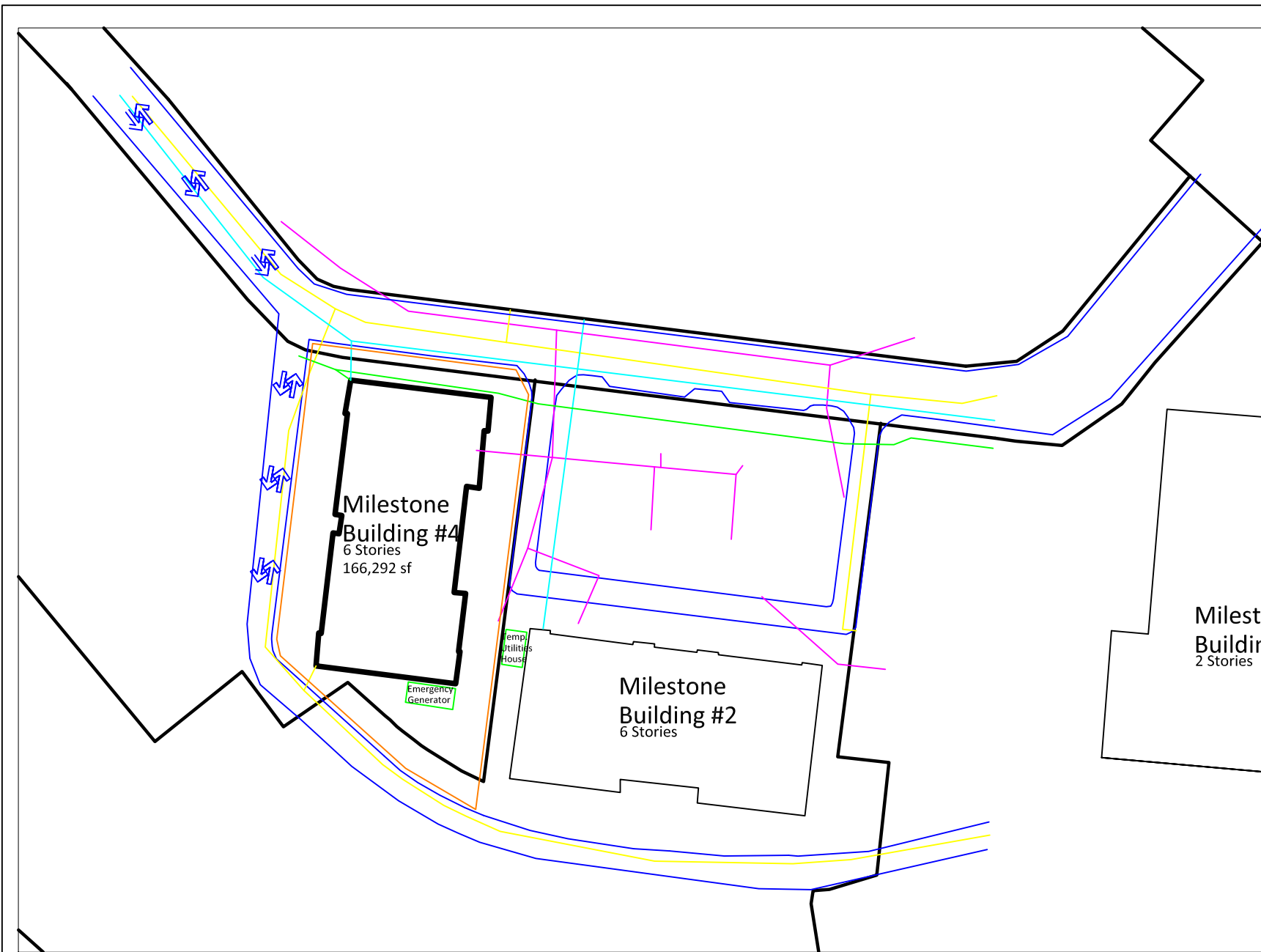
October 5, 2007

Milestone Buisness Park  
Building #4  
Germantown, MD

Revisions

Site Plan  
Existing Condition

Civil-002  
Page 55 of 117



Legend

Courtyard	—	Roads	—
Electric	—	Sanatary Sewer	—
Fence	—	Storm Drain	—
Parking	—	Water Pipe/Struc.	—
Property Line	—		

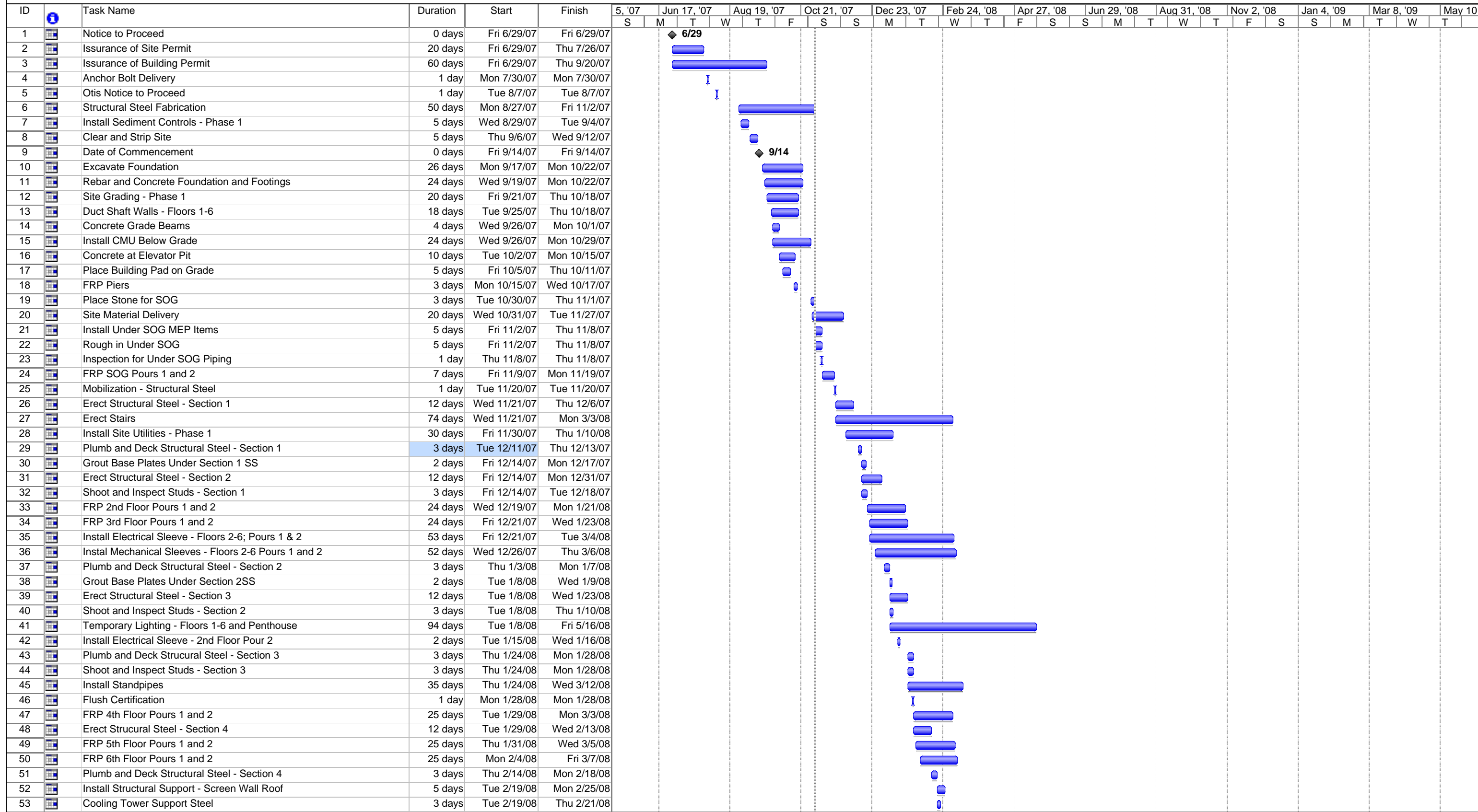




## Appendix C

### Detailed Project Schedule

# Milestone Building #4



Project: Project1 Date: Fri 11/2/07  
Task Progress Summary External Tasks Deadline  
Split Milestone Project Summary External Milestone

## Milestone Building #4

ID	Task Name	Duration	Start	Finish	'07							'08							'09								
					S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T						
54	Shoot and Inspect Studs - Section 4	3 days	Tue 2/19/08	Thu 2/21/08																							
55	Set Elev. Equipment into Mechanical Room	1 day	Tue 2/19/08	Tue 2/19/08																							
56	Set Roof Drain Bodies	4 days	Tue 2/19/08	Fri 2/22/08																							
57	Install Roof Curbs - Mechanical	3 days	Tue 2/19/08	Thu 2/21/08																							
58	Set Cooling Tower	2 days	Fri 2/22/08	Mon 2/25/08																							
59	Install Tieback Supports - Roof	5 days	Tue 2/26/08	Mon 3/3/08																							
60	Frame, Sheath - Screen Wall Roof	10 days	Tue 2/26/08	Mon 3/10/08																							
61	FRP Penthouse	4 days	Mon 3/10/08	Thu 3/13/08																							
62	Erect Material Hoist	3 days	Mon 3/10/08	Wed 3/12/08																							
63	Mobilization - Drywall	1 day	Mon 3/10/08	Mon 3/10/08																							
64	Install EIFS - Screen Wall Roof and Penthouse	26 days	Tue 3/11/08	Tue 4/15/08																							
65	Layout Walls - Floors 1-6 and Penthouse	49 days	Tue 3/11/08	Fri 5/16/08																							
66	Layout Equipment Pads and Curbs	1 day	Thu 3/13/08	Thu 3/13/08																							
67	Install Temporary Power for Material Hoist	1 day	Thu 3/13/08	Thu 3/13/08																							
68	Layout Equipment Pad and Curbs	1 day	Thu 3/13/08	Thu 3/13/08																							
69	Frame, Sheath, Moisture Barrier, Masonry Walls - South	8 days	Fri 3/14/08	Tue 3/25/08																							
70	Set SCU's - Floors 1-6 and Penthouse	1 day	Mon 3/17/08	Mon 3/17/08																							
71	Spray Fireproofing - Floors 1-6 and Penthouse	48 days	Tue 3/18/08	Thu 5/22/08																							
72	Set Penthouse Pumps	2 days	Thu 3/20/08	Fri 3/21/08																							
73	Ductwork - Floors 1-6	46 days	Thu 3/20/08	Thu 5/22/08																							
74	Install Duct - Floors 1-6 and Penthouse	54 days	Mon 3/24/08	Thu 6/5/08																							
75	Penthouse Piping	10 days	Mon 3/24/08	Fri 4/4/08																							
76	Frame, Sheath, Moisture Barrier, Masonry Walls - West	13 days	Wed 3/26/08	Fri 4/11/08																							
77	Layout - Masonry	2 days	Thu 3/27/08	Fri 3/28/08																							
78	Install Carriers and Plumbing Rough In - Floors 1-6	46 days	Thu 3/27/08	Thu 5/29/08																							
79	Install and Washdown Masonry - South	18 days	Mon 3/31/08	Wed 4/23/08																							
80	Install Sprinkler System	61 days	Tue 4/1/08	Tue 6/24/08																							
81	Install CMU Loading Dock/General Area	5 days	Thu 4/3/08	Wed 4/9/08																							
82	Install Roof - Main Roof	10 days	Fri 4/4/08	Thu 4/17/08																							
83	Install and Washdown Masonry - West	25 days	Mon 4/14/08	Fri 5/16/08																							
84	Frame, Sheath, Moisture Barrier, Masonry Walls - North	8 days	Mon 4/14/08	Wed 4/23/08																							
85	Install and Washdown Masonry - East	25 days	Fri 4/18/08	Thu 5/22/08																							
86	Install Wood Blocking at Exterior Wall -South	3 days	Mon 4/21/08	Wed 4/23/08																							
87	Install Metal Flashing and Caps - South	3 days	Thu 4/24/08	Mon 4/28/08																							
88	Mobilization - Windows	1 day	Thu 4/24/08	Thu 4/24/08																							
89	Caulk Masonry Joints - South	3 days	Thu 4/24/08	Mon 4/28/08																							
90	Frame, Sheath, Moisture Barrier, Masonry Walls - East	13 days	Thu 4/24/08	Mon 5/12/08																							
91	Install and Caulk Windows - South	20 days	Fri 4/25/08	Thu 5/22/08																							
92	Install and Washdown Masonry - North	18 days	Mon 5/5/08	Wed 5/28/08																							
93	Install Brick Loading Dock/General Area	6 days	Tue 5/6/08	Tue 5/13/08																							
94	Install Roof - Penthouse	5 days	Thu 5/8/08	Wed 5/14/08																							
95	Set Fire Pump and Jockey Pump	2 days	Thu 5/8/08	Fri 5/9/08																							
96	Install Wood Blocking at Exterior Wall - West	3 days	Mon 5/12/08	Wed 5/14/08																							
97	Power to Fire Pump and Jockey Pump	3 days	Mon 5/12/08	Wed 5/14/08																							
98	Loading Dock Ramp Concrete	5 days	Wed 5/14/08	Tue 5/20/08																							
99	Washdown Loading Dock/General Area	2 days	Wed 5/14/08	Thu 5/15/08																							
100	Install Metal Flashing and Caps - West	3 days	Thu 5/15/08	Mon 5/19/08																							
101	Frame and Install GWB Elevator Shaft 3 Sides	20 days	Thu 5/15/08	Wed 6/11/08																							
102	Fire Pump Flow Test	1 day	Thu 5/15/08	Thu 5/15/08																							
103	Sprinkler Final Inspection	1 day	Fri 5/16/08	Fri 5/16/08																							
104	Install and Caulk Windows - West	25 days	Mon 5/19/08	Fri 6/20/08																							
105	Caulk Masonry Joints - West	3 days	Mon 5/19/08	Wed 5/21/08																							
106	Vanity and Toilet Partition Support Steel - Floors 1-6	44 days	Tue 5/20/08	Fri 7/18/08																							

Project: Project1     Task Progress Summary External Tasks Deadline

Date: Fri 11/2/07     Split Milestone Project Summary External Milestone



### Milestone Building #4

ID	Task Name	Duration	Start	Finish	5, '07		Jun 17, '07		Aug 19, '07		Oct 21, '07		Dec 23, '07		Feb 24, '08		Apr 27, '08		Jun 29, '08		Aug 31, '08		Nov 2, '08		Jan 4, '09		Mar 8, '09		May 10	
					S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T
107	Frame Walls and Ceiling - Floors 1-6 and Penthouse	66 days	Tue 5/20/08	Tue 8/19/08																										
108	Plumbing Rough In - Penthouse	5 days	Wed 5/21/08	Tue 5/27/08																										
109	Install Ceramic Tile in RR - Floors 1-6	10 days	Thu 5/22/08	Wed 6/4/08																										
110	Rough In Electrical - Floors 1-6 and Penthouse	61 days	Thu 5/22/08	Thu 8/14/08																										
111	Set Generator	1 day	Fri 5/23/08	Fri 5/23/08																										
112	Install Wood Blocking at Exterior Wall - North	3 days	Mon 5/26/08	Wed 5/28/08																										
113	Set Switchgear	5 days	Tue 5/27/08	Mon 6/2/08																										
114	Electrical Close In Inspection - Penthouse	1 day	Wed 5/28/08	Wed 5/28/08																										
115	FRP Stairs Near B-1 ext	3 days	Thu 5/29/08	Mon 6/2/08																										
116	Install Metal Flashing and Caps - North	3 days	Thu 5/29/08	Mon 6/2/08																										
117	Install and Caulk Windows - North	20 days	Thu 5/29/08	Wed 6/25/08																										
118	Caulk Masonry Joints - North	3 days	Thu 5/29/08	Mon 6/2/08																										
119	Framing Close-in Inspection - Penthouse	1 day	Thu 5/29/08	Thu 5/29/08																										
120	Electrical Close In Inspection - 1st Floor	1 day	Thu 5/29/08	Thu 5/29/08																										
121	Plumbing Wall Close-in Inspection - Floors 1-6	3 days	Fri 5/30/08	Tue 6/3/08																										
122	Install Mirrors - Floors 1-6	58 days	Mon 6/2/08	Wed 8/20/08																										
123	Vanity Tops - Floors 1-6	44 days	Tue 6/3/08	Fri 8/1/08																										
124	TPF Inspection	1 day	Tue 6/3/08	Tue 6/3/08																										
125	Power to Elevator Equipment	3 days	Wed 6/4/08	Fri 6/6/08																										
126	Install Sprinkler Mains - Penthouse	6 days	Fri 6/6/08	Fri 6/13/08																										
127	Plumbing Fixtures - Floors 1-6	47 days	Fri 6/6/08	Mon 8/11/08																										
128	Mobilization - Elevator	2 days	Tue 6/10/08	Wed 6/11/08																										
129	Set Elev. Mechanical Room Equipment for Installation	10 days	Tue 6/10/08	Mon 6/23/08																										
130	Set and Pipe In House Pump	3 days	Tue 6/10/08	Thu 6/12/08																										
131	Framing Close-in Inspection - 1st Floor	1 day	Thu 6/12/08	Thu 6/12/08																										
132	Pipe Out Sprinkler Room	1 day	Fri 6/13/08	Fri 6/13/08																										
133	HVAC Systems Operational	0 days	Fri 6/13/08	Fri 6/13/08																										
134	Install Wood Blocking at Exterior Wall - East	3 days	Mon 6/16/08	Wed 6/18/08																										
135	Install Sprinkler Branch and Heads - Penthouse	6 days	Mon 6/16/08	Mon 6/23/08																										
136	Install Decorated Painted Steel Rails	10 days	Thu 6/19/08	Wed 7/2/08																										
137	Electrical Close In Inspection - 2nd Floor	1 day	Thu 6/19/08	Thu 6/19/08																										
138	Grilles and Diffusers - Floors 1-6	50 days	Thu 6/19/08	Wed 8/27/08																										
139	Framing Close-in Inspection - 2nd Floor	1 day	Fri 6/20/08	Fri 6/20/08																										
140	Install and Caulk Windows - East	25 days	Mon 6/23/08	Fri 7/25/08																										
141	Caulk Masonry Joints - East	3 days	Mon 6/23/08	Wed 6/25/08																										
142	Install Aluminum Louvers	5 days	Mon 6/23/08	Fri 6/27/08																										
143	Rough In Electrical - Lobby	19 days	Mon 6/23/08	Thu 7/17/08																										
144	Install Rails and Shaft - Elevator	20 days	Tue 6/24/08	Mon 7/21/08																										
145	Blinds - Floors 1-6	59 days	Fri 6/27/08	Wed 9/17/08																										
146	Install Electrical Trim -Floors 1-6 and Penthouse	59 days	Fri 6/27/08	Wed 9/17/08																										
147	Install Doors Frames and Hardware - Floors 1-6	37 days	Fri 6/27/08	Mon 8/18/08																										
148	Caulk Louvers	2 days	Mon 6/30/08	Tue 7/1/08																										
149	Set Fixtures/Trim/Connect - Floors 1-6	45 days	Tue 7/1/08	Mon 9/1/08																										
150	Install Metal Flashing and Caps - East	3 days	Thu 7/3/08	Mon 7/7/08																										
151	Electrical Close In Inspection - 3rd Floor	1 day	Thu 7/3/08	Thu 7/3/08																										
152	Framing Close-in Inspection - 3rd Floor	1 day	Mon 7/7/08	Mon 7/7/08																										
153	Final Cleaning - All Floors, Penthouse and Lobby	69 days	Tue 7/8/08	Fri 10/10/08																										
154	Install Metal Flashing and Caps - Penthouse	1 day	Wed 7/9/08	Wed 7/9/08																										
155	Hang and Finish GWB - Floors 1-6	30 days	Wed 7/9/08	Tue 8/19/08																										
156	Install Platforms - Elevator	20 days	Wed 7/9/08	Tue 8/5/08																										
157	Install Millwork	25 days	Thu 7/10/08	Wed 8/13/08																										
158	Wall and Ceiling Inspection - Lobby	2 days	Thu 7/10/08	Fri 7/11/08																										
159	Electrical Close In Inspection - 4th Floor	1 day	Fri 7/18/08	Fri 7/18/08																										

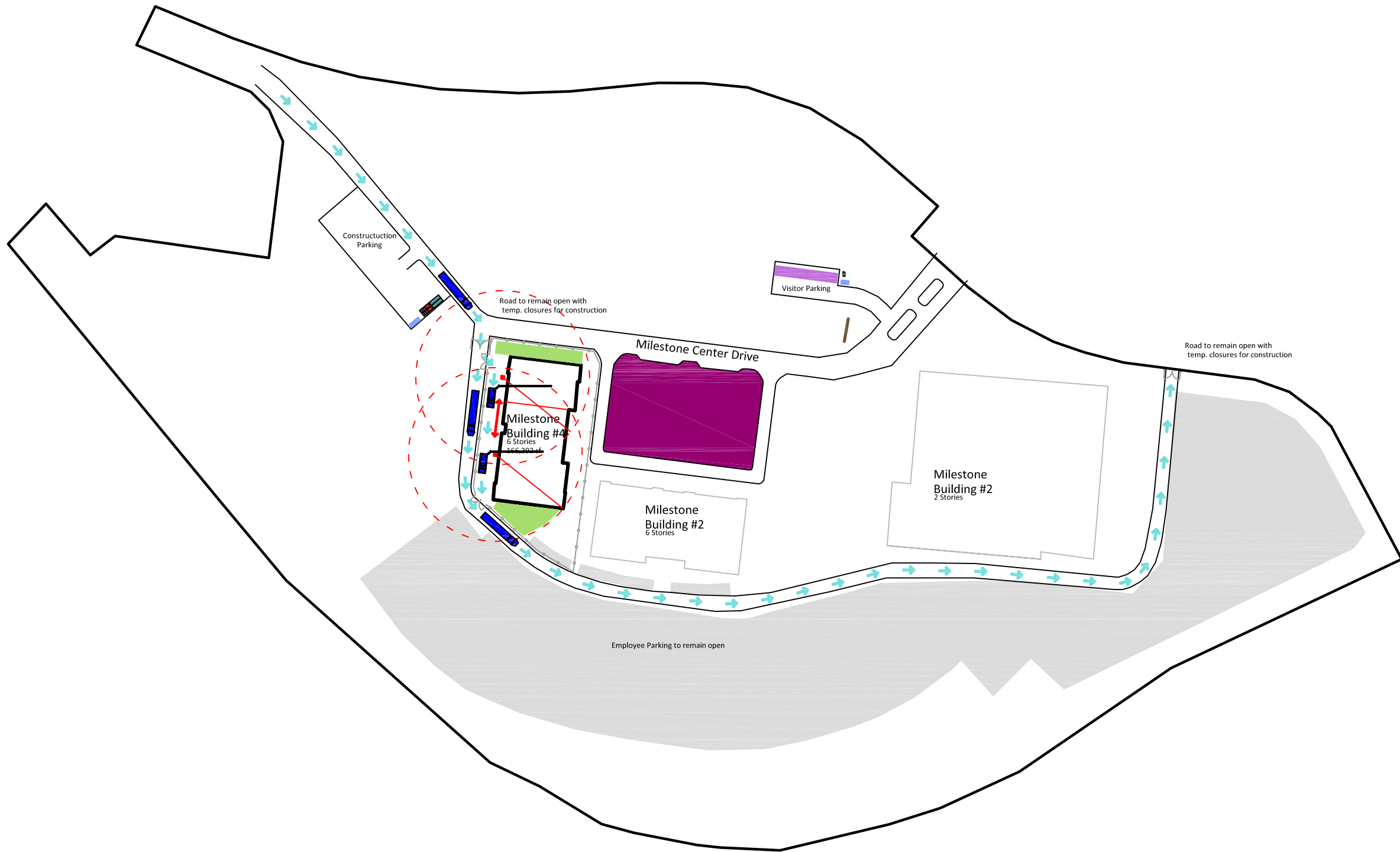
Project: Project1 Date: Fri 11/2/07	Task	Progress	Summary	External Tasks	Deadline
	Split	Milestone	Project Summary	External Milestone	





**Appendix D**  
**Site Utilization Plan**

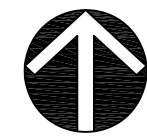
Milestone Buisness Park  
 Building #4  
 Germantown, MD



Revisions


Site Utilization

Steel Erection



Legend

Concrete Trucks	Delivery Path	Portable Toilets
Construction Parking	Delivery Trucks	Property Line
Courtyard	Dumpsters	Recycle Bins
Crane	Fence	SEA Trailers
Crane Path	Parking	Steel Staging

Constructuon Parking

Road to remain open with temp. closures for construction

Crane; II, IV

Milestone Building #4

Crane; I, III

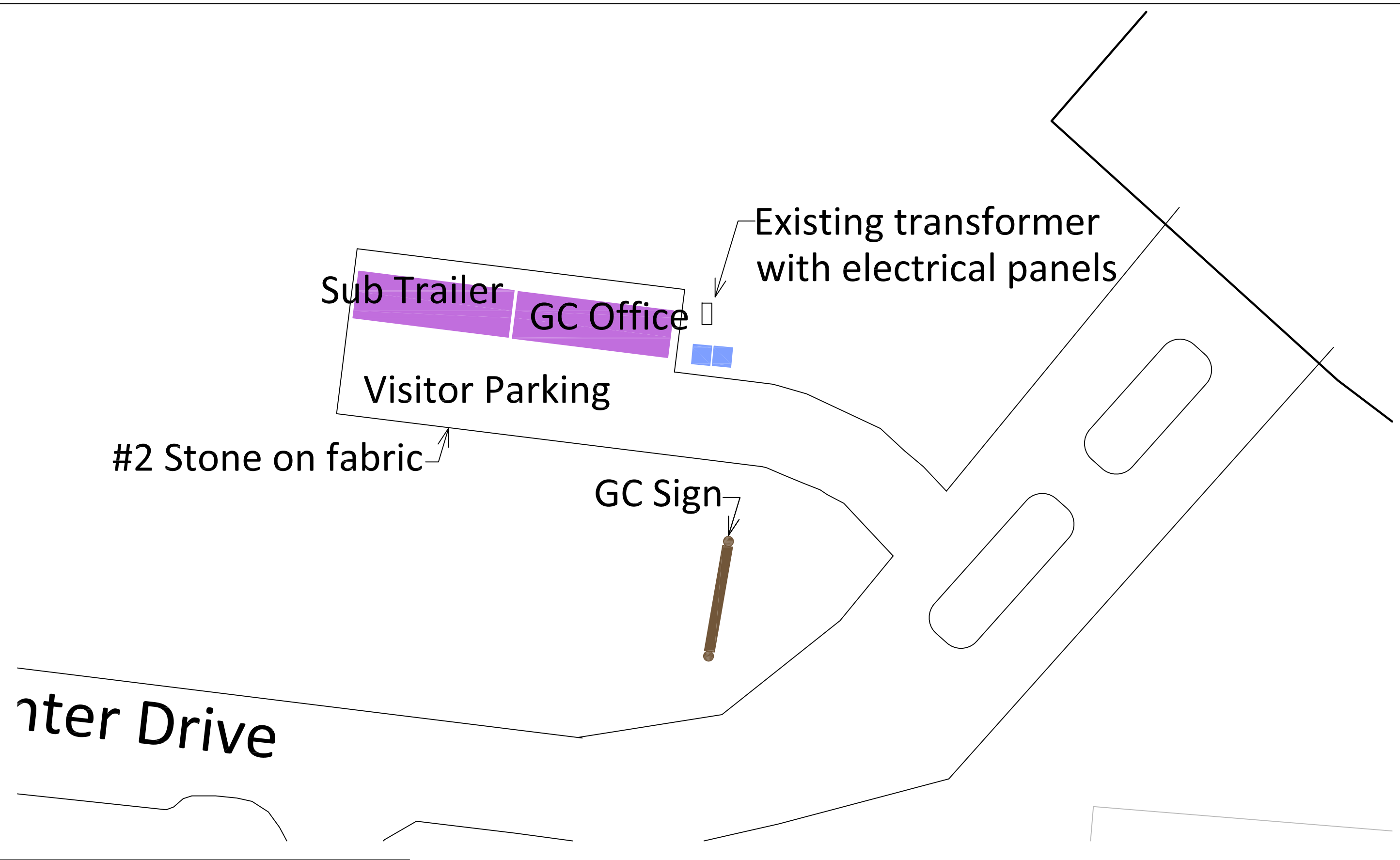
Milestone Center Dr

Milestone Building #2  
6 Stories

Legend

Concrete Trucks	Delivery Path	Portable Toilets
Construction Parking	Delivery Trucks	Property Line
Courtyard	Dumpsters	Recycle Bins
Crane	Fence	SEA Trailers
Crane Path	Parking	Steel Staging





Legend			
Concrete Trucks		Delivery Path	
Construction Parking		Delivery Trucks	
Courtyard		Dumpsters	
Crane		Fence	
Crane Path		Parking	
		Portable Toilets	
		Property Line	
		Recycle Bins	
		SEA Trailers	
		Steel Staging	



**Appendix E**  
**Survey Consultant Package**



## **Appendix E.1**

### **Introduction Letter**





Construction Management | Dr. Riley | Germantown, Maryland | April 9, 2008

Dear Sir or Madam;

I am currently a senior at The Pennsylvania State University majoring in Architectural Engineering with an emphasis in Construction Management. As I approach graduation, one requirement is to write a thesis. Through my studies and experience, I have found that some projects had to take away LEED points early during construction because of cost, availability of materials, trades, and knowledge deficit within the construction industry. After speaking with industry members, I found that many other companies, when implementing LEED design into a project for the first time, have experienced similar problems.

My research looks into creating a LEED guide for trade contractors that will allow for an easy implementation process for inexperienced industry members on preselected Materials and Resources points. An information pamphlet and LEED guidelines will be developed for them. The goal of my research is to enable companies to prepare a proficient project team early on.

LEED design is a hot topic in today's industry and you can't go a day without hearing about green, sustainability or energy efficient. After graduation, I will be working with construction teams in and around the nation's capital. The city's master plan calls for all new construction to be LEED certified. With this in mind, I developed my research topic. To achieve this goal, trade contractors must be prepared to implement LEED changes into their projects. Once proficient with LEED concepts, contractors will benefit by being called back for future jobs.

I have enclosed three documents. The first is a LEED information sheet. This sheet focuses on three Materials and Resource credits (MR2, MR4 and MR5) and provides background and highlights for each of the credits. The second document is a survey. The intention of this survey is to provide feedback on your feelings about the situation, any additional advice, and most importantly to help narrow down my research to a more specific topic. The third document is a LEED guideline for trade contractors that provides the documents needed for common specification sections.

I would greatly appreciate your input and feedback on LEED design and construction to support my senior thesis research. Due to deadlines my professors have set, I would like to receive feedback by **Friday March 28, 2008**. Should you have any questions or concerns, please feel free to contact me at your convenience.

Sincerely,  
Kristen M Hlopick



**Appendix F.2**  
**Opinion Survey**



Construction Management | Dr. Riley | Germantown, Maryland | April 9, 2008

**SECTION 1**

What kind of company do you work for?

- Owner
- Architect
- Construction Manager
- General Contractor
- Trade Contractor
- Supplier
- Manufacturer
- Other: \_\_\_\_\_

Have you participated in the design or construction of a LEED certified building?

- Yes. Please proceed to SECTION 2
- No. Please proceed to SECTION 3

**SECTION 2**

How many LEED certified building did you take part in?

What were the ratings?

- Certified
- Silver
- Gold
- Platinum

If you are a trade partner, supplier or manufacturer, did you have any problems implementing the needed requirements for the anticipated LEED points: MR 2 (Construction Waste Management), MR 4(Recycled Content), MR 5(Local/Regional Materials)?

- Yes
- No

If yes, please provide explanation.

Was there any trouble obtaining verification information needed for submittals?

- Yes
- No

If yes, please provide explanation.

When fulfilling requirements for MR 2 Construction Waste Management, what method was used?

- third party to separate co-mingled trash
  - separate recycling bins on site for different materials
- Why did you choose this method?



Where there any complications?

Did you have any trouble finding products with the noted recycled content in MR4 Recycled Content?

Yes

No

If yes, please provide explanation.

Was there any trouble finding local materials, suppliers and/or manufacturers for MR 5 Local Materials?

Yes

No

If yes, please provide explanation.

### SECTION 3

Would your company be interested in pursuing a LEED project?

Yes

No

If yes, are you looking to start a LEED project?

If no, please provide explanation.

Do you feel that you have adequate knowledge of the LEED design and construction?

Yes

No

Please provide explanation.

What factors do you feel that have preventing your company from taking part in a LEED project?

### SECTION 4

Was the LEED implementation process successful?

Yes

No

Please provide explanation.



For trade contractors, was this your first LEED project?

Yes

No

If yes, did you find that when implementing the LEED process for the first time, that you had trouble with any of the requirements?

Do you feel that a LEED guide made for trade contractors would be beneficial when implementing LEED into a construction project?

Yes

No

Do you have any suggestions for what can make this process smoother?

As a trade contractor, do you have your own thoughts about recycling materials that is not mentioned in the LEED guidelines?

What benefits have you seen in the LEED projects? Are you happy with your decision in taking part of a LEED project?

Please feel free to add any additional comments.

Thank you for your time and input. Your participation in my senior thesis research is greatly appreciated. Should you have any questions, feel free to contact me.

Kristen M Hlopick  
825 South Allen Street, #8  
State College, PA 16801  
[kmh326@psu.edu](mailto:kmh326@psu.edu)  
[khlopick@buchconstruction.com](mailto:khlopick@buchconstruction.com)  
814.282.5431



### **Appendix E.3**

#### **LEED Information Pamphlet**



## **MR 2 – Construction Waste Management**

### Requirements:

- Recycle or salvage 50% of non-hazardous construction and demolition debris
- Develop and implement a construction waste management plan
- Determine whether the materials will be sorted on site or comingled

### Strategies:

- Cardboard, metal brick, acoustical ceiling tile, concrete, plastic, clean wood, glass, drywall, carpet and insulation
- Designate area on site for recycling and track construction process
- Identify construction handlers and haulers

### Calculations:

None

### Pre Certification Submittal Documentation:

- Narrative describing how the project intends to accomplish the credit requirements
- Confirmation of this intent from both the design professional and the owner/developer

### Certification Submittal Documentation:

- Complete the construction waste calculation tables in the submittal template
  - General description of each type of waste generated
  - Location of receiving agent (recycler or landfiller) for waste
  - Quantity of waste diverted (by category) in tons or cubic yards
- Narrative describing the project construction waste management approach
  - Construction waste management plan
  - Addition comments/note for special circumstances



**MR 2 Construction Waste Management – Sample Tables**

Sample Construction Waste Management Diversion Summary

<b>Diverted/Recycled Materials Description</b>	<b>Diversion/Recycling Hauler or Location</b>	<b>Quantity of Diverted/ Recycled Waste</b>	<b>Units (tons/cy)</b>
Concrete	ABC Recycling	138.0	Tons
Wood	Z-Construction Reuse	10.2	Tons
Gypsum Wallboard	ABC Recycling	6.3	Tons
Steel	Re-Cycle Steel Collectors	1.1	Tons
Crushed Asphalt	On-Site Reuse	98.2	Tons
Masonry	ABC Recycling	6.8	Tons
Cardboard	ABC Recycling	1.6	Tons
<b>TOTAL CONSTRUCTION WASTE DIVERTED</b>		<b>262.2</b>	<b>Tons</b>
<b>Landfill Materials Description</b>	<b>Landfill Hauler or Location</b>	<b>Quantity of Diverted/ Recycled Waste</b>	<b>Units (tons/cy)</b>
General Mixed Waste	XYZ Landfill	52.3	Tons
<b>TOTAL CONSTRUCTION WASTE SENT TO LANDFILL</b>		<b>52.3</b>	<b>Tons</b>
<b>TOTAL OF ALL CONSTRUCTION WASTE</b>		<b>314.5</b>	<b>Tons</b>
<b>PERCENTAGE OF CONSTRUCTION WASTE DIVERTED FROM LANDFILL</b>		<b>83.40%</b>	

Solid Waste Conversion Factors

<b>Material</b>	<b>Density (lbs/cy)</b>
Cardboard	100
Gypsum Wallboard	500
Mixed Waste	350
Rubble	1400
Steel	1000
Wood	300





## MR 4 – Recycled Content

### Requirements:

Use materials such that the sum of post-consumer recycled content plus one half of the pre-consumer content constitutes at least 10% of the total value of materials (base on cost).

### Strategies:

- Identify material suppliers that can achieve predetermined goal
- During construction, ensure correct products are being installed
- Consider range of environmental, economic and performance attributes when selecting products and materials
- Metals, concrete, masonry, acoustical ceiling tile, carpet, ceramic tile, insulation

### Calculations:

Recycled content value =

(% post consumer\*material cost) + 0.5(% pre construction\*material cost)

% recycled content =  $\frac{\text{total recycled content material value (\$)}}{\text{total material cost (\$)}}$

Total material costs = actual costs in CSI Divisions 2-10

= total material cost\*45% (default)

Steel:

- Assume 25% post consumer, but actual may be much higher

Assemblies:

- Consider % by weight for pre and post consumer products
- When there are subcomponents, the final two percentages must be determined by using the weights of the small subcomponent element

Supplementary Cementitious Material:

- Calculate recycled content value on the mass of the cementitious material only, not the entire concrete mix.
- Amount of cementitious material can be obtained from supplier

### Pre Certification Submittal Documentation:

- Narrative describing how project intends to accomplish credit
- Confirmation of this intent from both the design professional and the owner/developer



**Certification Submittal Documentation:**

- Provide total materials cost (CSI Division 2-10) or 45% of the total project material cost (CSI Division 2-10)
- Provide tabulation of each material used on the project that is being tracked for recycled content
  - Material
  - Manufacturer
  - Product cost
  - Pre/Post consumer amount
  - Source of recycled content data
- Narrative for any special circumstances

**MR 4 Recycled Content – Sample Tables**

Sample Supplementary Cementitious Material Calculations

Mix #	Mass of Portland cement* (lbs)	Mass of recycled SCMs (lbs)	Mass of total cementitious materials (lbs)	SCMs as a percentage of total cementitious materials (%)	Dollar value of all cementitious materials (from concrete supplier)	Recycled content value per yard [(SCM/2)x dollar value]
2	200	50	250	20%	\$35	\$3.50
3	300	100	400	25%	\$45	\$5.63

*\*This column also includes any other cementitious ingredients that are not recycled.*



## MR 5 – Regional Materials

### Requirements:

Use building material that have been extracted, harvested or recovered, as well as manufactured within 500 miles from project site. If only a fraction of the material is extracted, harvested or manufactured, only use that fraction in the calculations.

### Strategies:

- Research early in design process. Select feasible materials.
- Establish a goal and only specify materials that can be found locally
- Run preliminary calculations (design phase) to ensure target
- Ensure locate materials that are being installed
- Quantify local materials that are being installed
- When selecting materials consider wide range of environmental, economic and performance attributes
- General contractor should work with trade contractors and suppliers to verify available materials
- General contractors are responsible for documenting amounts and values of materials

### Calculations:

$$\% \text{ local materials} = \frac{\text{Total cost of local materials (\$)}}{\text{total material cost (\$)}}$$

$$\begin{aligned} \text{Total material costs} &= \text{actual costs in CSI Divisions 2-10} \\ &= \text{total material cost} * 45\% \quad (\text{default}) \end{aligned}$$

### Pre Certification Submittal Documentation:

- Narrative describing how the project intends to accomplish credit
- Confirmation of this intent from design professional and owner/developer



**Certification Submittal Documentation:**

- Provide the project’s total cost or total materials cost (CSI Division 2-10)
- Complete the regional materials calculation table – Submittal Template.
  - Product name
  - Material manufacturer
  - Product cost
  - Percentage of product by weight that meets by the manufacturer and extractor criteria
  - Distance between project site and where the location of where the material was harvest, extracted or recovered
  - Distance between project site ad where the location of the manufacturer
- Narrative for any special circumstances

**MR 5 Local/Regional Materials – Sample Tables**

Sample Assembly Percent Regionally Extracted Calculation for Concrete

<b>Components</b>	<b>Weight (lbs)</b>	<b>Distance between Project &amp; Extraction Site (miles)</b>	<b>Weight Contributing to Regional Extraction (lbs)</b>
Cement	282	1,250	0
Fly Ash	282	125	282
Water	275	1	275
Slag	750	370	750
Recycled Concrete & Aggregate	1,000	8	1,000
Sand	1,200	18	1,200
Component Totals	3,789		3,507
<b>Percent Regionally Extracted Materials (3,507/3,789)</b>			<b>92.60%</b>



**MR 5 Local/Regional Materials – Sample Tables (continued...)**

Sample MR Credit 5 Calculation

<b>Product</b>	<b>Manufacturer</b>	<b>Distance Between Project &amp; Manufacturer (mi)</b>	<b>Distance Between Project &amp; Extraction/ Harvest (mi)</b>	<b>Product Cost (\$)</b>	<b>Value Qualifying as Regional</b>	<b>Information Source</b>
Plant material	Green's Landscape	5	5	\$6,770	\$6,770	contractor submittal
Concrete aggregate	Joe's Concrete	15	15	\$21,000	\$21,000	contractor submittal
Insulation	UR Warm	105	1,080	\$9,250	-	product cut sheet
Gypsum board	Gypsum R Us	75	288	\$8,550	\$8,550	letter from manufacturer
Carpet	Fiber Good	355	721	\$15,333	-	
Casework	Top Counter	18	320	\$12,200	\$12,200	contractor submittal
Lumber	My Mill	110	320	\$38,990	\$38,990	contractor submittal
Wood doors	Closeby	71	320	\$7,000	\$7,000	contractor submittal
<b>Total Cost of Regional Materials</b>					<b>\$94,510</b>	
<b>Total Materials Cost (Divisions 2-10)</b>					<b>\$751,000</b>	
<b>Percent Regional Materials</b>					<b>13%</b>	
<b>Points Earned</b>					<b>1</b>	



## **Appendix E.4**

### **LEED Introduction Letter**



### LEED Guidelines for Trade Contractors

There are three documents that compile the LEED Guidelines for Trade Contractors: Submittals, Design Requirement and Waste Management. With each document there are five (5) tabs, which can be found at the bottom left.

The first tab provides a matrix with the specification sections across the top and the respective requirements across the left side. I have already placed an “X” in some boxes where I felt this could be a common place. This guide is meant to be project specific. Therefore, more rows and columns can be added or deleted and the X’s can be changed. With that said, this matrix can become very large and hard to read.

The next two tabs provide a list of the requirements for each specification section and requirement (submittal, design requirement or waste management). The following two tabs, provides a neater version of the previous tabs. Once you review the guide, please answer the following questions.

Was this guide easy to understand?

Yes

No

Please provide explanation.

Was it user friendly?

Yes

No

Please provide explanation.

Did you find it helpful?

Yes

No

Please provide explanation.

Do you have any suggestions as to how this guide can be improved?

Feel free to contact me with any questions. Thank you for your participation in my senior thesis research.

Kristen



**Appendix E.5**  
**Submittal Requirements**  
**Matrix and List**



## Construction Submittals

		S.1	01	7419	Construction Waste Management and Disposal
		S.2	03	2000	Concrete Reinforcing
		S.3	03	3000	CIP Concrete
		S.4	03	4500	Precast Architectural Concrete
		S.5	04	0510	Masonry Mortaring and Grouting
		S.6	04	2000	Unit Masonry
		S.7	04	7313	Calcium Silicate Building Stone
		S.8	05	1200	Structural Steel Framing
		S.9	05	3100	Steel Decking
		S.10	05	4000	Cold-Formed Metal Framing
		S.11	05	5000	Metal Fabrications
		S.12	05	5100	Metal Stairs
		S.13	05	5200	Metal Railings
		S.14	05	7313	Tempered Glass Railings
		S.15	06	1053	Misc. Rough Carpentry
		S.16	06	1643	Gypsum Sheathing
		S.17	06	6400	Architectural Woodwork
		S.18	07	1616	Building Insulation
		S.19	07	1616	Cementitious Waterproofing
		S.20	07	2100	Thermal Insulation
		S.21	07	4220	Metal Panels
		S.22	07	4263	Insulated Metal Wall Panels
		S.23	07	5400	Thermoplastic Membrane Roofing
		S.24	07	8116	Cementitious Fireproofing
		S.25	08	1113	Hollow Metal Doors and Frames
		S.26	08	1416	Flush Wood Doors
		S.27	08	3100	Access Doors and Panels
		S.28	08	4226	All-Glass Entrances
		S.29	08	4313	Aluminum-Framed Openings
		S.30	08	5113	Aluminum Windows
		S.31	08	8100	Glass Glazing
		S.32	08	9100	Metal Wall Louvers
		S.33	09	2116	Gypsum Board Assemblies
		S.34	09	3100	Thin-Set Tiling
		S.35	09	5100	Acoustical Ceiling
		S.36	09	5423	Metal Ceilings
		S.37	09	5426	Wood Ceilings
		S.38	09	6500	Resilient Flooring
		S.39	09	6713	Elastomeric Flooring
		S.40	09	6813	Carpet Tiles
		S.41	09	6816	Carpet
		S.42	09	7200	Wall Coverings
		S.43	09	9100	Painting
		S.44	09	9419	Modified Polymer Coatings
		S.45	09	9420	Metallic Coatings
		S.46	10	2113	Toilet Compartments
		S.47	10	2813	Toilet Accessories
		S.48	10	4400	Fire Protection Specialties
		S.49	10	5113	Metal Lockers
		S.50	12	2100	Window Blinds
		S.51	12	3640	Stone Countertops
		S.52	12	4813	Entrance Floor Mats
CS.1	LEED letter template for Credit MR 2.1 and Credit MR 2.2, signed by contractor, tabulating total waste material, quantities diverted and means by which it is diverted and statement that requirements for the credit have been met.	X			
CS.2	Submit certification/letter from material supplier(s) indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content for Credit MR 4		X	X	X
CS.3	Provide documentation identifying manufacturer and extraction, harvest, and/or recover location of materials provided under this section for Credit MR 5	X	X	X	X



**Arranged by Specifications**

**S.1 01 7419 Construction Waste Management and Disposal**  
 LEED letter template for Credit MR 2.1 and Credit MR 2.2, signed by contractor, tabulating total waste material, quantities diverted and means by which it is diverted and statement that requirements for the credit have been met.

**S.2 03 2000 Concrete Reinforcing**  
 Submit certification/letter from material supplier(s) indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content for Credit MR 4  
 Provide documentation identifying manufacturer and extraction, harvest, and/or recover location of materials provided under this section for Credit MR 5

**S.3 03 3000 CIP Concrete**  
 Submit certification/letter from material supplier(s) indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content for Credit MR 4  
 Provide documentation identifying manufacturer and extraction, harvest, and/or recover location of materials provided under this section for Credit MR 5

**S.4 03 4500 Precast Architectural Concrete**  
 Submit certification/letter from material supplier(s) indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content for Credit MR 4  
 Provide documentation identifying manufacturer and extraction, harvest, and/or recover location of materials provided under this section for Credit MR 5

**S.5 04 0510 Masonry Mortaring and Grouting**  
 Submit certification/letter from material supplier(s) indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content for Credit MR 4  
 Provide documentation identifying manufacturer and extraction, harvest, and/or recover location of materials provided under this section for Credit MR 5

**S.6 04 2000 Unit Masonry**  
 Submit certification/letter from material supplier(s) indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content for Credit MR 4  
 Provide documentation identifying manufacturer and extraction, harvest, and/or recover location of materials provided under this section for Credit MR 5



**Arranged by Submittal Requirements**

**LEED letter template for Credit MR 2.1 and Credit MR 2.2, signed by contractor, tabulating total waste material, quantities diverted and means by which it is diverted and statement that requirements for the credit have been met.**

**CS.1**

S.1	01 7419	Construction Waste Management and Disposal
-----	---------	--

**Submit certification/letter from material supplier(s) indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content for Credit MR 4**

**CS.2**

S.2	03 2000	Concrete Reinforcing
S.3	03 3000	CIP Concrete
S.4	03 4500	Precast Architectural Concrete
S.5	04 0510	Masonry Mortaring and Grouting
S.6	04 2000	Unit Masonry
S.7	04 7313	Calcium Silicate Building Stone
S.8	05 1200	Structural Steel Framing
S.9	05 3100	Steel Decking
S.10	05 4000	Cold-Formed Metal Framing
S.11	05 5000	Metal Fabrications
S.12	05 5100	Metal Stairs
S.13	05 5200	Metal Railings
S.14	05 7313	Tempered Glass Railings
S.15	06 1053	Misc. Rough Carpentry
S.16	06 1643	Gypsum Sheathing
S.17	06 6400	Architectural Woodwork
S.18	07 1616	Building Insulation
S.19	07 1616	Cementitious Waterproofing
S.20	07 2100	Thermal Insulation
S.21	07 4220	Metal Panels
S.22	07 4263	Insulated Metal Wall Panels
S.23	07 5400	Thermoplastic Membrane Roofing
S.24	07 8116	Cementitious Fireproofing

S.25	08 1113	Hollow Metal Doors and Frames
S.26	08 1416	Flush Wood Doors
S.27	08 3100	Access Doors and Panels
S.28	08 4226	All-Glass Entrances
S.29	08 4313	Aluminum-Framed Openings
S.30	08 5113	Aluminum Windows
S.31	08 8100	Glass Glazing
S.32	08 9100	Metal Wall Louvers
S.33	09 2116	Gypsum Board Assemblies
S.34	09 3100	Thin-Set Tiling
S.35	09 5100	Acoustical Ceiling
S.36	09 5423	Metal Ceilings
S.37	09 5426	Wood Ceilings
S.38	09 6500	Resilient Flooring
S.40	09 6813	Carpet Tiles
S.41	09 6816	Carpet
S.42	09 7200	Wall Coverings
S.46	10 2113	Toilet Compartments
S.47	10 2813	Toilet Accessories
S.48	10 4400	Fire Protection Specialties
S.49	10 5113	Metal Lockers
S.50	12 2100	Window Blinds
S.52	12 4813	Entrance Floor Mats

**Provide documentation identifying manufacturer and extraction, harvest, and/or recover location of materials provided under this section for Credit MR 5**

**CS.3**

S.2	03 2000	Concrete Reinforcing
S.3	03 3000	CIP Concrete
S.4	03 4500	Precast Architectural Concrete
S.5	04 0510	Masonry Mortaring and Grouting
S.6	04 2000	Unit Masonry
S.7	04 7313	Calcium Silicate Building Stone
S.8	05 1200	Structural Steel Framing
S.9	05 3100	Steel Decking
S.10	05 4000	Cold-Formed Metal Framing
S.11	05 5000	Metal Fabrications

**\*\*\*Full versions can be found on the CD.\*\*\***



**Appendix E.6**  
**Design Requirements**  
**Matrix and List**





**Arranged by Specification Section**

**S.1 03 3000 CIP Concrete**

Materials shall be manufactured and of raw materials extracted within 500 miles of project site.
Provide materials with recycled content such that sum of post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 10% to 25%.

**S.2 03 4500 Precast Architectural Concrete**

Materials shall be manufactured and of raw materials extracted within 500 miles of project site.
Provide materials with recycled content such that sum of post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25% to 50%.

**S.3 04 0510 Masonry Mortaring and Grouting**

Materials shall be manufactured and of raw materials extracted within 500 miles of project site.
Provide materials with recycled content such that sum of post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 10% to 20%.

**S.4 04 2000 Unit Masonry - Brick**

Materials shall be manufactured and of raw materials extracted within 500 miles of project site.
Provide materials with recycled content such that sum of post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25% to 50%.
Materials used in manufacture of clay brick may incorporate contaminated waste that is neutralized or otherwise rendered inert by a manufacturing process that does not discharge additional pollutants.

**S.5 04 2000 Unit Masonry - CMU**

Materials shall be manufactured and of raw materials extracted within 500 miles of project site.
Provide materials with recycled content such that sum of post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25% to 50%.
Materials used in manufacture of masonry CMU shall incorporate bottom ash, fly ash, and recycled aggregate.

**S.6 04 7313 Calcium Silicate Building Stone**

Materials shall be manufactured and of raw materials extracted within 500 miles of project site.
Provide materials with recycled content such that sum of post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25% to 50%.



**Arranged by Design Requirements**

**Materials shall be manufactured and of raw materials extracted within 500 miles of project site.**

**DR.1**

S.1	03 3000	CIP Concrete
S.2	03 4500	Precast Architectural Concrete
S.3	04 0510	Masonry Mortaring and Grouting
S.4	04 2000	Unit Masonry - Brick
S.5	04 2000	Unit Masonry - CMU
S.6	04 7313	Calcium Silicate Building Stone
S.7	05 1200	Structural Steel Framing
S.8	05 3100	Steel Decking
S.9	05 4000	Cold-Formed Metal Framing
S.10	05 5000	Metal Fabrications
S.11	05 5100	Metal Stairs
S.12	05 5200	Metal Railings
S.13	05 7313	Tempered Glass Railings
S.14	06 1643	Gypsum Sheathing - Synthetic Gypsum
S.15	06 1643	Gypsum Sheathing - Gypsum
S.18	07 1616	Cementitious Waterproofing
S.19	07 2100	Thermal Insulation
S.20	07 4220	Metal Panels
S.21	07 8116	Cementitious Fireproofings
S.22	07 8400	Firestopping
S.23	08 1113	Hollow Metal Doors and Frames
S.24	08 1416	Flush Wood Doors
S.25	08 3100	Access Doors and Panels
S.26	08 4226	All-Glass Entrances
S.27	08 4313	Aluminum-Framed Openings
S.28	08 5113	Aluminum Windows
S.29	08 8100	Aluminum Windows
S.30	08 9100	Metal Wall Louvers
S.31	09 2116	Gypsum Board Assemblies - GWB
S.32	09 2116	Gypsum Board Assemblies - Shaft Wall
S.33	09 2116	Gypsum Board Assemblies - Steel Partition & Soffit Framing

S.34	09 2116	Gypsum Board Assemblies - Steel Suspended Ceiling & Soffit Framing
S.35	09 3100	Thin-Set Tiling
S.36	09 5100	Acoustical Ceiling
S.37	09 5423	Metal Ceilings
S.38	09 5426	Wood Ceilings
S.39	09 6500	Resilient Flooring
S.40	09 6713	Elastomeric Flooring
S.41	09 6813	Carpet Tiles
S.42	09 6816	Carpet
S.43	09 7200	Wall Coverings
S.44	10 2813	Toilet Accessories
S.45	10 4400	Fire Protection Specialties
S.46	10 5113	Metal Lockers
S.47	12 2100	Window Blinds
S.48	12 4813	Entrance Floor Mats

**Provide products from manufacturers with program for reclaiming construction scrap, waste materials, and packaging.**

**DR.2**

S.9	05 4000	Cold-Formed Metal Framing
S.11	05 5100	Metal Stairs
S.13	05 7313	Tempered Glass Railings
S.14	06 1643	Gypsum Sheathing - Synthetic Gypsum
S.15	06 1643	Gypsum Sheathing - Gypsum
S.19	07 2100	Thermal Insulation
S.22	07 8400	Firestopping
S.23	08 1113	Hollow Metal Doors and Frames
S.27	08 4313	Aluminum-Framed Openings
S.31	09 2116	Gypsum Board Assemblies - GWB
S.32	09 2116	Gypsum Board Assemblies - Shaft Wall
S.33	09 2116	Gypsum Board Assemblies - Steel Partition & Soffit Framing
S.35	09 3100	Thin-Set Tiling
S.36	09 5100	Acoustical Ceiling
S.41	09 6813	Carpet Tiles
S.42	09 6816	Carpet
S.43	09 7200	Wall Coverings

**\*\*\*Full versions can be found on the CD.\*\*\***



**Appendix E.7**  
**Construction Waste Management**  
**Matrix and List**









**Arranged by Specification Sections**

**S.1 02 4119 Earthwork**

Separate and handle general construction waste in compliance with Waste Management Plan

**S.2 02 4119 Selective Demolition**

Demolition shall be performed in a manner that maximizes salvage and recycling of materials and includes dismantling and removal of materials. Materials dismantled and removed shall be separated, set aside, prepared for reuse, and stored or delivered to collection point for reuse to maximum extent economically feasible.

Items listed below have unique or regulated disposal requirements and are to be removed and disposed of in manner dictated by law or in most environmentally responsible manner. Typical concerns are listed in parentheses:

- a. Fluorescent light ballast manufactured prior to 1978 (PCB)
- b. Fluorescent lamps (mercury)
- c. Refrigeration, air-conditioning, and other equipment containing refrigerants (CFC recovery)
- d. Batteries (Lead, acid, mercury)
- e. Paints, solvents, and other hazardous fluids
- f. Asbestos based materials
- g. Materials with lead based finishes

Set aside and protect surplus and uncontaminated waste materials. Deliver to or arrange collection by individuals or organizations for verifiable reuse or remanufacturing.

a. Maintain an inventory of removed materials, and submit tracking forms for removed materials indicating type, quantities, condition, destination and end use.

Separate and recycle off-cuts and waste materials in compliance with Waste Management Plan to maximum extent economically feasible

a. Place materials defined as hazardous or toxic waste in designated containers.

g. Return solvent and oil soaked rags for contaminant recovery and laundering or for proper disposal.

**Concrete Forming and Accessories**

**S.3 03 1000**

Separate wood waste in compliance with Waste Management Plan and place in designated areas in following categories for recycling

- a. Solid wood/softwood/hardwood
- b. Composite wood (for example, plywood, OSB, I-joist, parallel strand, MDF, particleboard)
- c. Treated, painted, or contaminated wood

Separate and recycle waste steel formwork accessories in compliance with Waste Management Plan

**S.4 03 2000 Concrete Reinforcing**

Separate and recycle waste reinforcing steel materials in compliance with Waste Management Plan

**S.5 03 3000 CIP Concrete**

Before concrete pours, designate locations or uses for excess concrete. Options include additional paving, post footing anchorage, swale rip-rap reinforcing, mud slab, flowable fill, footing bottom, retaining wall footing ballast, storm structure covers, underground utility pipe kickers, storm pipe flared end section, toe wash protection, and shoulder and toe out-fall restraints for temporary erosion pipes.

Before concrete pours, designate a location for cleaning out concrete trucks. Options include:

- a. Company owned site for that purpose (meeting environmental standards)
- b. Remote on-site area to be paved later in project

Carefully coordinate specified concrete work with weather conditions

Check concrete within 24 hours of placement for flatness, levelness, and other specified tolerances. Adjust formwork and placement techniques on subsequent pours to achieve specified tolerances.

Separate and recycle waste materials in compliance with Waste Management Plan

a. Place materials defined as hazardous or toxic waste in designated containers.

b. Use trigger operated spray nozzles for water hoses



**Arranged by Waste Management Requirements**

Demolition shall be performed in a manner that maximizes salvage and recycling of materials and includes dismantling and removal of materials. Materials dismantled and removed shall be separated, set aside, prepared for reuse, and stored or delivered to collection point for reuse to maximum extent economically feasible.

**WS.1**

S.2	02 4119	Selective Demolition
-----	---------	----------------------

Items listed below have unique or regulated disposal requirements and are to be removed and disposed of in manner dictated by law or in most environmentally responsible manner. Typical concerns are listed in parentheses:

**WS.2**

S.2	02 4119	Selective Demolition
-----	---------	----------------------

**WS.3 a. Fluorescent light ballast manufactured prior to 1978 (PCB)**

S.2	02 4119	Selective Demolition
-----	---------	----------------------

**WS.4 b. Fluorescent lamps (mercury)**

S.2	02 4119	Selective Demolition
-----	---------	----------------------

**WS.5 c. Refrigeration, air-conditioning, and other equipment containing refrigerants (CFC recovery)**

S.2	02 4119	Selective Demolition
-----	---------	----------------------

**WS.6 d. Batteries (Lead, acid, mercury)**

S.2	02 4119	Selective Demolition
-----	---------	----------------------

**WS.7 e. Paints, solvents, and other hazardous fluids**

S.2	02 4119	Selective Demolition
-----	---------	----------------------

**WS.8 f. Asbestos based materials**

S.2	02 4119	Selective Demolition
-----	---------	----------------------

**WS.9 g. Materials with lead based finishes**

S.2	02 4119	Selective Demolition
-----	---------	----------------------

Before concrete pours, designate locations or uses for excess concrete. Options include additional paving, post footing anchorage, swale rip-rap reinforcing, mud slab, flowable fill, footing bottom, retaining wall footing ballast, storm structure covers, underground utility pipe kickers, storm pipe flared end section, toe wash protection, and shoulder and toe out-fall restraints for temporary erosion pipes.

**WS.10**

S.5	03 3000	CIP Concrete
-----	---------	--------------

Before concrete pours, designate a location for cleaning out concrete trucks. Options include:

**WS.11**

S.5	03 3000	CIP Concrete
-----	---------	--------------

a. Company owned site for that purpose (meeting environmental standards)

**WS.12**

S.5	03 3000	CIP Concrete
-----	---------	--------------

b. Remote on-site area to be paved later in project

**WS.13**

S.5	03 3000	CIP Concrete
-----	---------	--------------

Carefully coordinate specified concrete work with weather conditions

**WS.14**

S.5	03 3000	CIP Concrete
-----	---------	--------------

Check concrete within 24 hours of placement for flatness, levelness, and other specified tolerances. Adjust formwork and placement techniques on subsequent pours to achieve specified tolerances.

**WS.15**

S.5	03 3000	CIP Concrete
-----	---------	--------------

Sequence work to minimize use of temporary HVAC to dry out building and control humidity

**WS.16**

S.17	06 1053	Misc. Rough Carpentry
------	---------	-----------------------

**\*\*\*Full versions can be found on the CD.\*\*\***



## Appendix F

### Opinion Survey Response



### SECTION 1

What kind of company do you work for?

- 1\_Owner
- 2\_Architect
- 1\_Construction Manager
- General Contractor
- 8\_Trade Contractor
- Supplier
- 1\_Manufacturer
- 3\_Other: **MEP Engineer, Demolition, Civil Engineer**

Have you participated in the design or construction of a LEED certified building?

- 9\_Yes. Please proceed to SECTION 2
- 6\_No. Please proceed to SECTION 3

### SECTION 2

How many LEED certified building did you take part in?

- 1building/project 3 companies**
- 2 buildings/projects 4 companies**
- 6 buildings/ projects 1 companies**
- 24 building/projects 1 company**

What were the ratings?

- 15\_Certified
- 16\_Silver
- 10\_Gold
- Platinum

If you are a trade partner, supplier or manufacturer, did you have any problems implementing the needed requirements for the anticipated LEED points: MR 2 (Construction Waste Management), MR 4(Recycled Content), MR 5(Local/Regional Materials)?

- 1\_Yes
- 3\_No

If yes, please provide explanation.

- **Most window blind manufacturers comply with LEEDs, Springs Window Fashions (Bali Blinds) utilizes 42% recycles aluminum and 20% recycled steel in their products.**



Construction Management | Dr. Riley | Germantown, Maryland | April 9, 2008

- In some instances, finding components that met recycled content was difficult. However we were able to meet the requirements and also provide the necessary low VOC adhesives

Was there any trouble obtaining verification information needed for submittals?

\_4\_ Yes

\_3\_ No

If yes, please provide explanation.

- The electrical industry is a little behind the curve in regard to LEED requirements.
- Each project seem to have a different reporting process or it was left up to us to come up with a spread sheet that conveyed the information needed for accounting or recycled materials for the project. We are a demolition contractor and the salvage of materials is critical to this process. Also getting the documentation from scrap yards or salvage yards sometimes can be complicated.
- Since Milestone Business Park was a phased site, and part of the stormwater management for the site was being handled off-site in an already-constructed regional (State Highway) stormwater management pond, it was difficult to find the necessary data on that regional pond to address the LEED point for stormwater management quantity control.

When fulfilling requirements for MR 2 Construction Waste Management, what method was used?

\_3\_ third party to separate co-mingled trash

\_3\_ separate recycling bins on site for different materials

Why did you choose this method?

- Packing materials were placed in G.C. provided containers in some instances recycle containers have been provided for cardboard. Blind debris was taken to a recycling facility.
- Each building used each method. From what I have heard, it is easier to let 3<sup>rd</sup> party sort. This would especially be true of mid or hi rise building that are constructed with trash chutes as you could end up having to install separate trash chutes.
- Determined by GC.
- This is customary for our operation (demo).

Where there any complications?

- No, complications have ever occurred.
- We haven't broken ground yet...so unknown.



Did you have any trouble finding products with the noted recycled content in MR4 Recycled Content?

3 Yes

2 No

If yes, please provide explanation.

- As mentioned before
- Electrical industry is behind the curve and lots of our materials etc are manufactured overseas.
- We are currently tracking under our goal of 20%

Were there any trouble finding local materials, suppliers and/or manufacturers for MR 5 Local Materials?

3 Yes

2 No

If yes, please provide explanation.

- Many of our materials are not manufactured within the 500 miles.
- We are currently tracking 10%. We are not certain we can meet the 20%.
- The architect didn't choose products that are consider local.
- Some products were custom made, which made them come from a different place.

### SECTION 3

Would your company be interested in pursuing a LEED project?

13 Yes

1 No

If yes, are you looking to start a LEED project?

- As a window treatment contractor we always try to help with LEED ratings.
- We accept and start LEED projects as they come along. With regards to how we pursue a job, we pursue jobs with equal tenacity regardless if they are LEED or not.
- We are pursuing the LEED points on an interior project, without any submission or certification.
- No. We are a subcontractor, not a LEED trade or LEED Design company.
- Not currently in the DC office, but multiple underway at other offices.
- We have already participated in LEED projects.
- None started at this time.





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- Some of our bid projects have LEED/Green requirements. I would bid them but I do not know enough of the requirements to start one.
- In today's market you have to be interested in pursuing LEED projects because it is the way of the future.
- Yes – all most all of our developments moving forward will be LEED.
- We are currently under contract to begin a LEED project, but we have not started yet.

If no, please provide explanation.

- We operate a small business with minimum office overhead. To take more office work would require us to hire another employee.

Do you feel that you have adequate knowledge of the LEED design and construction?

     Yes

  13   No

Please provide explanation.

- Never done it before.
- We have sufficient knowledge to complete the projects. However more LEED certified classes in this area would be helpful. If there are many already, we do not know about them.
- I am currently studying for the LEED test, but have just started.
- We have the knowledge but our experience is that the documentation portion for the MEP is not standardized enough. We appear to be “inventing the wheel” each time for the documentation.
- We are learning as we go...
- We have LEED certified staff in our office and firm but I am not personally certified.
- The guidelines are not specific to materials (brands, etc) and method used in achieving certain objectives.
- I know of the materials manufacturing requirements within a certain radius of the project and special requirements for the glazing in the building shell.
- I think the process needs to be more standardized and there needs to be more training in the industry. We have a good understanding from a demolition contractor's view but not for the entire project.
- But I am learning more daily.
- There is no central source to find LEED information. Everything seems to be on a job-by-job basis.



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What factors do you feel that have preventing your company from taking part in a LEED project?

- I think the biggest setback to LEED projects is the initial cost impact of products required for LEED certification, most often the long term savings and long term environmental savings are often overlooked due to initial cost(s).
- Nothing has prevented us from taking part in any LEED project
- Lack of opportunity
- The documentation for the MEP portion. The completion of the actual credit templates has not been a problem.
- Cost impacts are new to most of us and may not be properly covered in a competitively bid project. If the low bidders drive the cost down, the rest of the industry has to lower their cost as well until everyone gets hurt financially quite a few times and then captures the additional cost impact in the bids.
- We have - I have not.
- We did not get awarded the bid projects with LEED requirements.
- We really have not shied away from LEED projects. Although they are more of a hassle because of all the paper work involved.
- Red tape.

#### SECTION 4

Was the LEED implementation process successful?

8 Yes

No

Please provide explanation.

- I think there is still a lot of ground work to be done here and the increased costs required to comply with LEEDs needs to be better understood by all.
- Seems to have been successful but we were only a very small part of the process.
- Nobody has complained.
- Yes, in the demolition of a project a lot of points can be rendered because of the sheer volume of materials that get recycled.
- From my perspective, the LEED consultant guided us through the process effectively

For trade contractors, was this your first LEED project?

1 Yes

4 No



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If yes, did you find that when implementing the LEED process for the first time, that you had trouble with any of the requirements?

- Not really but the 1<sup>st</sup> one was only certified and we are working in the design build phase of the 2<sup>nd</sup> one.
- The water based adhesives are formaldehyde free products are inferior.
- It is difficult to meet all of the recycled contents, debris sorting. Meeting the wood requirements is difficult and expensive.

Do you feel that a LEED guide made for trade contractors would be beneficial when implementing LEED into a construction project?

  9  Yes!

   No

- The more information that is out there the better.
- It needs to be specific.

Do you have any suggestions for what can make this process smoother?

- A brief overview of the process, a flow chart of how to proceed, including when to use the documents.
- As I opened each document, I did not grasp all the information, but then reading subsequent documents, I could understand the earlier documents better, but I had to work at it.
- Providing a list of sources for common LEED materials and publications that can educate the contractors.
- You just nailed it. Step one, step 2...would be great
- For the trades, an updatable website showing current means and methods, brand names or products meeting specific criteria, might be more helpful.
- Have a guide for each specific trade versus a general guide. Most subs would want a guideline outlined what they would need to do as opposed to making interpretations of what could be done.
- A software package designed for the accounting aspect of the process. Also some things like GWB are hard to recycle because there are not enough facilities to handle the quantities that are generated. In some cases the cost to recycle far exceeds the benefit to recycle the materials.



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As a trade contractor, do you have your own thoughts about recycling materials that is not mentioned in the LEED guidelines?

- Not really, other than I agree with recycling materials whenever one can.
- Sort by 3<sup>rd</sup> party is the way to go.
- Many of the manufacturers are recycling materials already. Manufacturing locally and wood products is the most difficult.
- For glass and glazing the aluminum portion is not hard to recycle but the glass is. If there was a service for picking up the broken/scrap glass and taking it to a manufacturer/recycler would be good. Right now there is no economical way to achieve this. All glass companies have this waste to deal with.

What benefits have you seen in the LEED projects? Are you happy with your decision in taking part of a LEED project?

- I am always happy to take part in a project, especially one that has less of an impact on the environment; unfortunately, I think far too often costs associated prohibit many of the facets of LEEDs implementation.
- We have not seen any direct benefits, although I do not argue that they exist.
- As an Architect, I am involved in a project that requires waste recycling and other green requirements, but it is not intended to be LEED certified. I am happy to be a part of this process.
- We see benefits to the tenants for the Commercial Interiors portion in that the actual installation of the engineer's design is field verified during the commissioning process and eliminates problems with the installation.
- Yes.
- We participate in LEED because it is the future – and we all need a pay check. Currently, the LEED products are inferior and we can foresee a time when these current (first users of LEED) will be unhappy with the length or longevity of the end product in their spaces.
- As a subcontractor – no benefits. It cost more in management and not able to add cost to the project.
- The obvious benefit is that we are reusing resources. We are happy to participate in LEED projects. In most cases it is cost effective to recycle in our business because it saves money or generates money in the case of salvage cost for metals and other similar materials.
- Awareness of the environmental impacts of construction is a definite benefit. I am quite happy to have taken part.



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- I believe that it is our responsibility to continue to better our environment. The numbers are staggering on how inefficient current buildings operate and how construction is managed. I believe that with these little steps we can make huge differences.

Please feel free to add any additional comments.

- LEED requirements add cost to the project but for most part is a feel good thing. The real brakes come from the government on tax savings. The energy savings on insulating, heating, cooling and any energy consuming devices could be specified and designed without the LEED requirements and be achieved less costly.
- Most people, myself included, are unfamiliar with LEED/Green requirements. These kinds of issues have major impacts, repercussions and consequences that need to be dealt with today for future generations.



**Appendix G**  
**LEED Survey Response**



## LEED Guidelines for Trade Contractors

Once you review the guide, please answer the following questions.

Was this guide easy to understand?

5 Yes

No

Please provide explanation.

- It's nice to see each specific specification section/trade outlined.
- Basically for trade contractors a menu based system for LEED accounting would be better. A system where we could click on Demolition requirements and everything that pertains to LEED for demolition is supplied. Also a system where we can just fill in the blanks on a daily basis would be helpful.

Was it user friendly?

5 Yes

No

Please provide explanation.

Do you find it helpful?

5 Yes

No

Please provide explanation.

- Not so much for our specific trade (electrical) but as I'm sure you are aware, most of the LEED requirements revolve around other construction disciplines and the design teams efforts.
- Architectural Specification say to use "formaldehyde free substrate" or "water based adhesives" So far, we have not had to do any of the calculations or research into other ways to help the specifications. So, we do not yet have a need to research any further.
- Yes I think you are on the right track. The recording of the information is the most time sensitive issue and that is where I think the system needs to make this process easy for the contractor to complete.
- I think that the pamphlet was done well.
- I think that you are on the right track to try and standardize this package. It is very much needed in the industry. If I may borrow a thing in the tax world that many



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have adopted to do their taxes is “Turbo Tax”. We need a “Turbo LEED” program that is easy to use and applicable to the certification process. I hope you get high marks for you efforts in this most important aspect of the construction industry.

Do you have any suggestions in how I can improve this guide?

- For Div 16 Electrical, My suggestion would be to follow the way standard electrical specs are laid out and to put the LEED requirements specific to that section in that spec section. Example: Bus Duct: then go on to list the requirements for that specific product. It would also be very helpful to separate manufacturer requirements from installing contractor requirements when putting this together. That way, we can make sure that the vendor quoting that particular product knows exactly what is expected of them etc.
- Most of the requirements were in general type processes. If each trade had a specific XYZ type of guideline it would be less in the hands of Interpretation of the individual and more concrete. With business being what it is it would be more efficient and productive to have a guideline that basically said what was Right or Wrong. When you get into gray areas that are when good intentions may lead you to the wrong choice, even though the individual thinks what they are doing is the right thing to do.

Example:

Clear glass if recycled could be reused as cullet in making new glass at the float plant stage (ie: where they melt sand down to make raw glass). Some clear glass has coatings on it that are not visible to the naked eye and if this type of glass is mixed with the raw sand the new product will have imperfections in it resulting in more new glass needing to be manufactured. Good intentions, in this case, impact raw materials required, whatever the nature resource was required to process the materials, time, labor and profit because more of all were required.

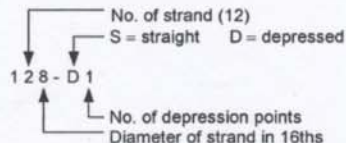
The use of more raw materials, use of more of the natural resource required to process it and additional waste management required to dispose of the imperfections all have affected the environment, but the intentions were good. That is why guidelines with simplified Right or Wrong criteria would be more beneficial.





**Appendix H**  
**PCI Design Charts**

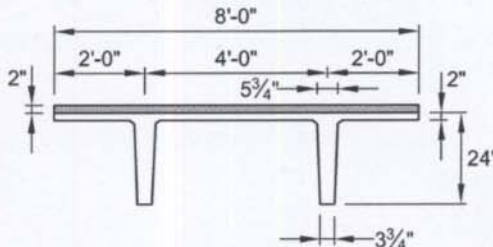
**Strand Pattern Designation**



Safe loads shown include dead load of 10 psf for untopped members and 15 psf for topped members. Remainder is live load. Long-time cambers include superimposed dead load but do not include live load.

**Key**  
 196 - Safe superimposed service load, psf  
 1.2 - Estimated camber at erection, in.  
 1.5 - Estimated long-time camber, in.

**DOUBLE TEE**  
**8'-0" x 24"**  
**Lightweight Concrete**



$f'_c = 5,000$  psi  
 $f_{pu} = 270,000$  psi

**Section Properties**  
 Untopped      Topped

A =	401 in. <sup>2</sup>	—
I =	20,985 in. <sup>4</sup>	29,857 in. <sup>4</sup>
y <sub>b</sub> =	17.15 in.	19.94 in.
y <sub>t</sub> =	6.85 in.	6.06 in.
S <sub>b</sub> =	1,224 in. <sup>3</sup>	1,497 in. <sup>3</sup>
S <sub>t</sub> =	3,064 in. <sup>3</sup>	4,927 in. <sup>3</sup>
wt =	418 plf	520 plf
DL =	40 psf	65 psf
V/S =	1.41 in.	

**8LDT24**

**Table of safe superimposed service load (psf) and cambers (in.)**

**No Topping**

Strand Pattern	y <sub>s</sub> (end) in. y <sub>s</sub> (center) in.	Span, ft																															
		32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80							
68-S	4.00	196	170	149	131	115	102	90	80	72	64	57	51	45	40	36	32	28															
	4.00	1.2	1.3	1.4	1.5	1.6	1.6	1.7	1.8	1.8	1.9	1.9	1.9	1.9	1.8	1.7	1.6	1.4															
88-S	5.00		194	171	152	135	121	108	97	87	79	71	64	58	52	47	43	38	35	31	28												
	5.00		1.8	1.9	2.1	2.2	2.3	2.5	2.6	2.7	2.7	2.8	2.8	2.9	2.9	2.8	2.8	2.6	2.5	2.3	2.0												
108-S	6.00			183	164	147	132	119	107	97	87	78	70	64	58	53	48	44	40	36	33	29	26										
	6.00			2.4	2.5	2.7	2.9	3.0	3.2	3.3	3.4	3.5	3.6	3.6	3.7	3.7	3.6	3.5	3.3	3.1	2.8	2.5	2.0	1.5	0.8	0.0							
128-S	7.00									110	99	89	80	72	65	59	53	49	44	40	37	34	31	28									
	7.00									3.7	3.8	3.9	4.0	4.1	4.2	4.2	4.2	4.1	4.0	3.9	3.7	3.5	3.2										
128-D1	11.67																				83	76	69	62	57	51	46	42	38	34			
	3.25																				4.8	4.9	5.0	5.1	5.1	5.0	4.9	4.6	4.3				
148-D1	12.86																														51	46	42
	3.50																														5.9	5.8	5.7
																															4.6	4.1	3.4

**8LDT24 + 2**

**Table of safe superimposed service load (psf) and cambers (in.)**

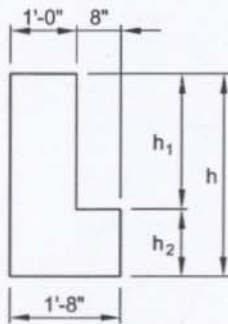
**2 in. Normal Weight Topping**

Strand Pattern	y <sub>s</sub> (end) in. y <sub>s</sub> (center) in.	Span, ft																															
		28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74								
48-S	3.00	178	150	126	107	90	76	64	54	45	38	31	25																				
	3.00	0.6	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.0	1.0	0.9																				
68-S	4.00		198	170	147	127	111	96	84	73	63	55	47	40	34	29																	
	4.00		1.2	1.3	1.4	1.5	1.6	1.7	1.7	1.8	1.9	1.9	1.9	1.9	1.9	1.8																	
88-S	5.00			197	172	151	133	117	103	91	80	71	61	52	45	37	31	25															
	5.00			1.8	1.9	2.1	2.2	2.3	2.5	2.6	2.7	2.7	2.8	2.8	2.9	2.9	2.8																
108-S	6.00					186	164	146	129	115	102	89	76	65	56	48	41	34	29														
	6.00					2.4	2.5	2.7	2.9	3.0	3.2	3.3	3.4	3.5	3.6	3.6	3.7	3.7															
128-S	7.00																																
	7.00																																
128-D1	11.67																																
	3.25																																

Strength is based on strain compatibility; bottom tension is limited to  $12\sqrt{f'_c}$ ; see pages 2-7 through 2-10 for explanation. Shaded values require release strengths higher than 3500 psi.

# L-BEAMS

Normal Weight Concrete



$f'_c = 5,000$  psi  
 $f_{pu} = 270,000$  psi  
 1/2 in. diameter  
 low-relaxation strand

Designation	h in.	h <sub>1</sub> /h <sub>2</sub> in./in.	A in. <sup>2</sup>	I in. <sup>4</sup>	y <sub>b</sub> in.	S <sub>b</sub> in. <sup>3</sup>	S <sub>t</sub> in. <sup>3</sup>	wt plf
20LB20	20	12/8	304	10,160	8.74	1,163	902	317
20LB24	24	12/12	384	17,568	10.50	1,673	1,301	400
20LB28	28	16/12	432	27,883	12.22	2,282	1,767	450
20LB32	32	20/12	480	41,600	14.00	2,971	2,311	500
20LB36	36	24/12	528	59,119	15.82	3,737	2,930	550
20LB40	40	24/16	608	81,282	17.47	4,653	3,608	633
20LB44	44	28/16	656	108,107	19.27	5,610	4,372	683
20LB48	48	32/16	704	140,133	21.09	6,645	5,208	733
20LB52	52	36/16	752	177,752	22.94	7,749	6,117	783
20LB56	56	40/16	800	221,355	24.80	8,926	7,095	833
20LB60	60	44/16	848	271,332	26.68	10,170	8,143	883

1. Check local area for availability of other sizes.
2. Safe loads shown include 50% superimposed dead load and 50% live load. 800 psi top tension has been allowed, therefore, additional top reinforcement is required.
3. Safe loads can be significantly increased by use of structural composite topping.

### Key

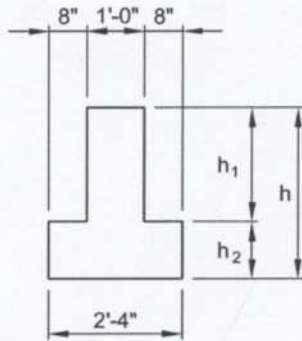
- 6566 – Safe superimposed service load, plf.
- 0.3 – Estimated camber at erection, in.
- 0.1 – Estimated long-time camber, in.

Table of safe superimposed service load (plf) and cambers (in.)

Designation	No. Strand	y <sub>s</sub> (end) in. y <sub>s</sub> (center) in.	Span, ft																			
			16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50		
20LB20	98-S	2.44 2.44	6566	5131	4105	3345	2768	2318	1961	1674	1438	1243	1079									
			0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2									
			0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2									
20LB24	108-S	2.80 2.80	9577	7495	6006	4904	4066	3414	2896	2479	2137	1854	1617	1416	1244	1097	969					
			0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2					
			0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.0				
20LB28	128-S	3.33 3.33	8228	6733	5596	4711	4009	3443	2979	2595	2273	2000	1768	1567	1394	1243	1110	992				
			0.4	0.4	0.5	0.6	0.6	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2	1.2	1.3				
			0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.0	0.0		
20LB32	148-S	3.71 3.71	8942	7446	6281	5356	4611	4001	3495	3071	2712	2406	2143	1914	1715	1540	1386					
			0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3				
			0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.0	0.0	
20LB36	168-S	4.25 4.25	9457	7988	6823	5883	5113	4476	3941	3489	3103	2771	2483	2231	2011	1816						
			0.4	0.5	0.5	0.6	0.7	0.8	0.8	0.9	1.0	1.1	1.1	1.2	1.2	1.3	1.3					
			0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.0	0.0
20LB40	188-S	4.89 4.89	9812	8386	7235	6293	5513	4858	4305	3832	3425	3073	2765	2495	2257							
			0.4	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3				
			0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
20LB44	198-S	5.05 5.05	8959	7803	6845	6042	5363	4783	4284	3851	3474	3143	2850									
			0.5	0.6	0.6	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3				
			0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
20LB48	218-S	5.81 5.81	9226	8100	7158	6360	5678	5092	4584	4140	3751	3408										
			0.5	0.6	0.6	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3				
			0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
20LB52	238-S	6.17 6.17	9634	8521	7578	6774	6082	5482	4958	4499	4094											
			0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.3				
			0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
20LB56	258-S	6.64 6.64	9954	8860	7927	7124	6427	5820	5287	4816												
			0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.3	1.3				
			0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
20LB60	278-S	7.33 7.33	9089	8173	7380	6688	6080	5544														
			0.7	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.3	1.3	1.3				
			0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

# INVERTED TEE BEAMS

Normal Weight Concrete



$f'_c = 5,000$  psi  
 $f_{pu} = 270,000$  psi  
 $\frac{1}{2}$  in. diameter  
 low-relaxation strand

Section Properties								
Designation	h in.	$h_1/h_2$ in./in.	A in. <sup>2</sup>	I in. <sup>4</sup>	$y_b$ in.	$S_b$ in. <sup>3</sup>	$S_t$ in. <sup>3</sup>	wt plf
28IT20	20	12/8	368	11,688	7.91	1,478	967	383
28IT24	24	12/12	480	20,275	9.60	2,112	1,408	500
28IT28	28	16/12	528	32,076	11.09	2,892	1,897	550
28IT32	32	20/12	576	47,872	12.67	3,778	2,477	600
28IT36	36	24/12	624	68,101	14.31	4,759	3,140	650
28IT40	40	24/16	736	93,503	15.83	5,907	3,869	767
28IT44	44	28/16	784	124,437	17.43	7,139	4,683	817
28IT48	48	32/16	832	161,424	19.08	8,460	5,582	867
28IT52	52	36/16	880	204,884	20.76	9,869	6,558	917
28IT56	56	40/16	928	255,229	22.48	11,354	7,614	967
28IT60	60	44/16	976	312,866	24.23	12,912	8,747	1,017

1. Check local area for availability of other sizes.
2. Safe loads shown include 50% superimposed dead load and 50% live load. 800 psi top tension has been allowed, therefore, additional top reinforcement is required.
3. Safe loads can be significantly increased by use of structural composite topping.

**Key**

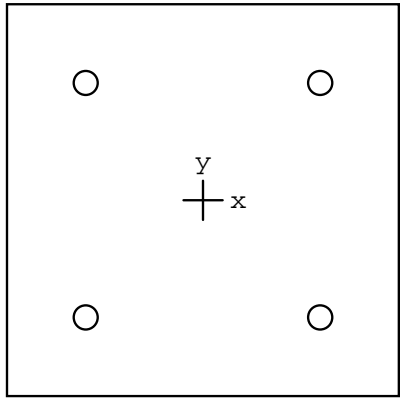
- 6511 – Safe superimposed service load, plf.
- 0.2 – Estimated camber at erection, in.
- 0.1 – Estimated long-time camber, in.

**Table of safe superimposed service load (plf) and cambers (in.)**

Designation	No. Strand	$y_s(\text{end})$ in. $y_s(\text{center})$ in.	Span, ft																		
			16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	
28IT20	98-S	2.44 2.44	6511	5076	4049	3289	2711	2262	1905	1617	1381	1186	1022								
			0.2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8								
			0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-0.1							
28IT24	188-S	2.73 2.73	9612	7504	5997	4882	4034	3374	2850	2427	2081	1795	1555	1351	1178	1029					
			0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.8						
			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-0.1	-0.2				
28IT28	138-S	3.08 3.08	8353	6822	5657	4750	4031	3451	2976	2582	2252	1973	1735	1530	1352	1197	1061				
			0.3	0.3	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.9	0.8	0.8				
			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-0.1	-0.2	-0.2			
28IT32	158-S	3.47 3.47	9049	7521	5333	5389	4628	4006	3490	3057	2691	2379	2110	1876	1673	1495	1337				
			0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	0.9	0.9				
			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	-0.1		
28IT36	168-S	3.50 3.50	9832	8295	7075	6092	5287	4619	4060	3587	3183	2835	2534	2271	2040	1836					
			0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	0.9					
			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	-0.1			
28IT40	198-S	4.21 4.21	8638	7440	6460	5647	4966	4390	3898	3474	3107	2787	2506	2258							
			0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.9	0.9							
			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
28IT44	208-S	4.40 4.40	9186	7989	6997	6165	5462	4861	4344	3896	3505	3162	2859								
			0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.8	0.8							
			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0
28IT48	228-S	4.55 4.55	9719	8525	7523	6676	5953	5330	4791	4320	3907	3542									
			0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.8	0.8							
			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
28IT52	248-S	5.17 5.17	9987	8823	7838	6998	6274	5647	5100	4619	4196										
			0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.8										
			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
28IT56	268-S	5.23 5.23	9307	8319	7469	6731	6088	5524	5026												
			0.5	0.6	0.6	0.7	0.7	0.8	0.8												
			0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
28IT60	288-S	5.57 5.57	9645	8668	7820	7081	6432	5859													
			0.6	0.6	0.7	0.7	0.8	0.8													
			0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

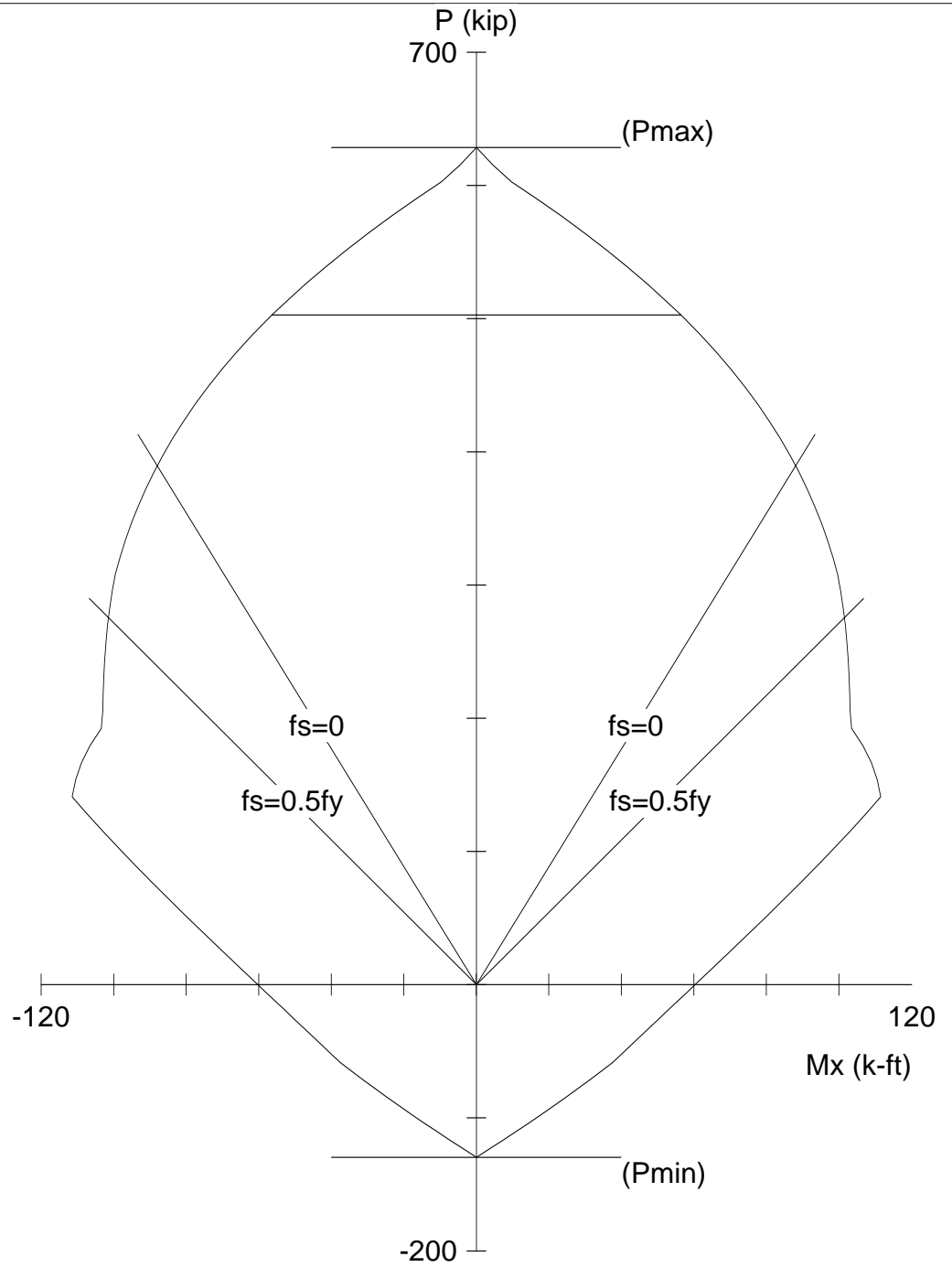


**Appendix I**  
**PCA Column Calculations**



14 x 14 in

Code: ACI 318-02  
 Units: English  
 Run axis: About X-axis  
 Run option: Investigation  
 Slenderness: Not considered  
 Column type: Structural  
 Bars: ASTM A615  
 Date: 04/04/08  
 Time: 21:41:23



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File: untitled.col

Project:

Column:

$f'_c = 5$  ksi

$E_c = 4031$  ksi

$f_c = 4.25$  ksi

$e_u = 0.003$  in/in

Beta1 = 0.8

Confinement: Tied

$f_y = 60$  ksi

$E_s = 29000$  ksi

$f_c = 4.25$  ksi

$\phi(a) = 0.8, \phi(b) = 0.9, \phi(c) = 0.65$

Engineer:

$A_g = 196$  in<sup>2</sup>

$A_s = 2.40$  in<sup>2</sup>

$X_o = 0.00$  in

$Y_o = 0.00$  in

Clear spacing = 7.50 in

4 #7 bars

Rho = 1.22%

$I_x = 3201.33$  in<sup>4</sup>

$I_y = 3201.33$  in<sup>4</sup>

Clear cover = 2.38 in

General Information:

=====

File Name: untitled.col  
 Project:  
 Column: Engineer:  
 Code: ACI 318-02 Units: English  
  
 Run Option: Investigation Slenderness: Not considered  
 Run Axis: X-axis Column Type: Structural

Material Properties:

=====

f'c = 5 ksi fy = 60 ksi  
 Ec = 4030.51 ksi Es = 29000 ksi  
 Ultimate strain = 0.003 in/in  
 Beta1 = 0.8

Section:

=====

Rectangular: Width = 14 in Depth = 14 in  
  
 Gross section area, Ag = 196 in<sup>2</sup>  
 Ix = 3201.33 in<sup>4</sup> Iy = 3201.33 in<sup>4</sup>  
 Xo = 0 in Yo = 0 in

Reinforcement:

=====

Rebar Database: ASTM A615

Size	Diam (in)	Area (in <sup>2</sup> )	Size	Diam (in)	Area (in <sup>2</sup> )	Size	Diam (in)	Area (in <sup>2</sup> )
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

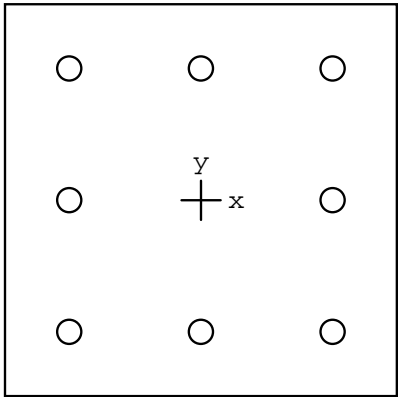
Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.  
 phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular  
 Pattern: All Sides Equal (Cover to transverse reinforcement)  
 Total steel area, As = 2.40 in<sup>2</sup> at 1.22%  
 4 #7 Cover = 2 in

Control Points:

=====

Bending about	Axial Load P kip	X-Moment k-ft	Y-Moment k-ft	N.A. depth in
X @ Pure compression	628.4	-0	-0	36.05
@ Max compression	502.7	56	0	14.45
@ fs = 0.0	389.6	88	0	11.19
@ fs = 0.5*fy	275.6	101	0	8.32
@ Balanced point	193.8	103	0	6.62
@ Tension Control	141.3	112	-0	4.20
@ Pure bending	-0.0	60	0	2.17
@ Pure tension	-129.6	0	0	0.00
-X @ Pure compression	628.4	-0	-0	36.05
@ Max compression	502.7	-56	-0	14.45
@ fs = 0.0	389.6	-88	0	11.19
@ fs = 0.5*fy	275.6	-101	0	8.32
@ Balanced point	193.8	-103	0	6.62
@ Tension Control	141.3	-112	-0	4.20
@ Pure bending	-0.0	-60	-0	2.17
@ Pure tension	-129.6	0	0	0.00



18 x 18 in

Code: ACI 318-02

Units: English

Run axis: About X-axis

Run option: Investigation

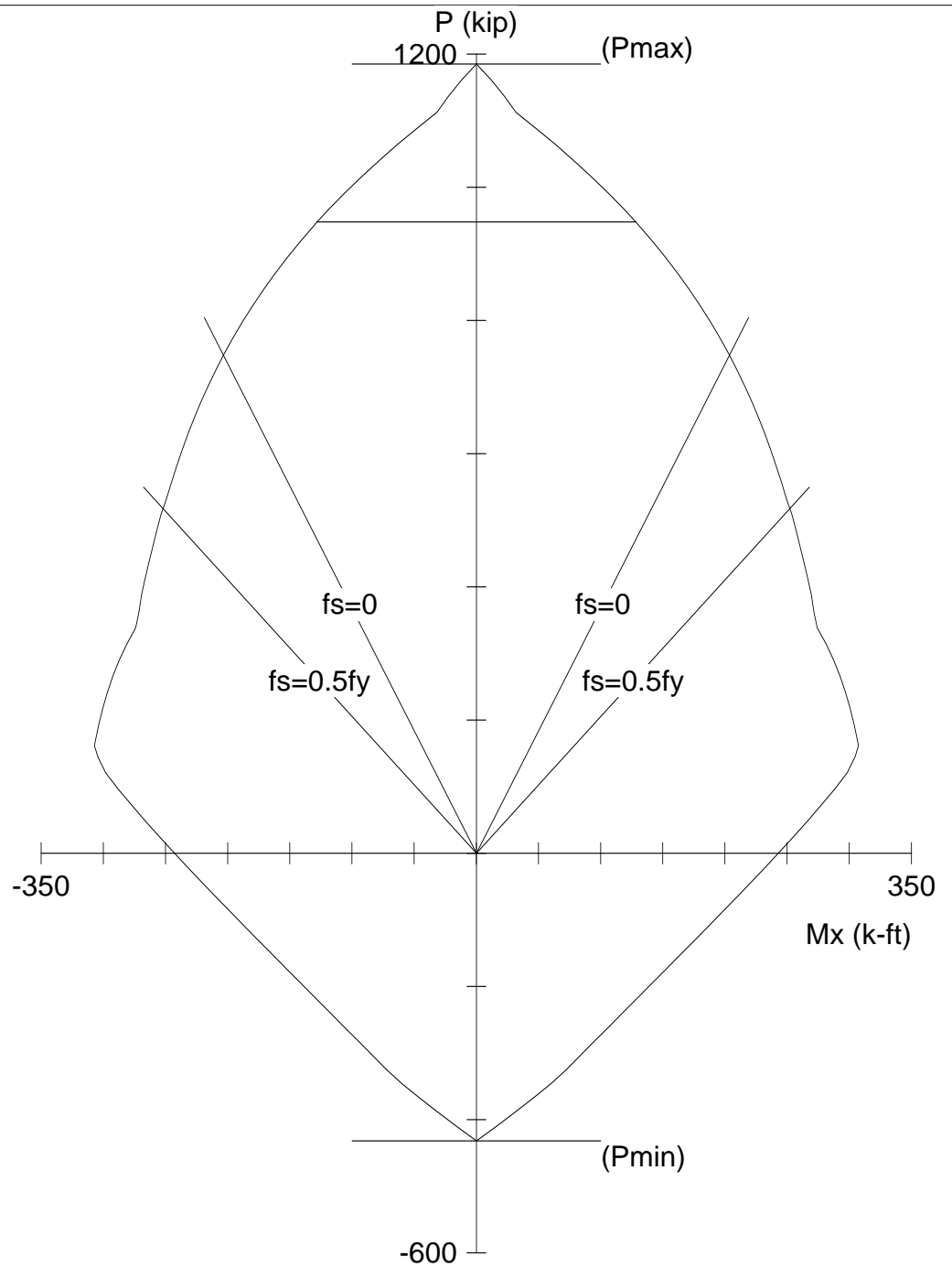
Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 04/04/08

Time: 21:42:16



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File: untitled.col

Project:

Column:

$f'_c = 5$  ksi

$E_c = 4031$  ksi

$f_c = 4.25$  ksi

$e_u = 0.003$  in/in

Beta1 = 0.8

Confinement: Tied

$f_y = 60$  ksi

$E_s = 29000$  ksi

$f_c = 4.25$  ksi

$\phi(a) = 0.8, \phi(b) = 0.9, \phi(c) = 0.65$

Engineer:

$A_g = 324$  in<sup>2</sup>

$A_s = 8.00$  in<sup>2</sup>

$X_o = 0.00$  in

$Y_o = 0.00$  in

Clear spacing = 4.93 in

8 #9 bars

Rho = 2.47%

$I_x = 8748$  in<sup>4</sup>

$I_y = 8748$  in<sup>4</sup>

Clear cover = 2.38 in



General Information:

=====

File Name: untitled.col  
 Project:  
 Column: Engineer:  
 Code: ACI 318-02 Units: English  
 Run Option: Investigation Slenderness: Not considered  
 Run Axis: X-axis Column Type: Structural

Material Properties:

=====

f'c = 5 ksi fy = 60 ksi  
 Ec = 4030.51 ksi Es = 29000 ksi  
 Ultimate strain = 0.003 in/in  
 Beta1 = 0.8

Section:

=====

Rectangular: Width = 18 in Depth = 18 in  
 Gross section area, Ag = 324 in<sup>2</sup>  
 Ix = 8748 in<sup>4</sup> Iy = 8748 in<sup>4</sup>  
 Xo = 0 in Yo = 0 in

Reinforcement:

=====

Rebar Database: ASTM A615

Size	Diam (in)	Area (in <sup>2</sup> )	Size	Diam (in)	Area (in <sup>2</sup> )	Size	Diam (in)	Area (in <sup>2</sup> )
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

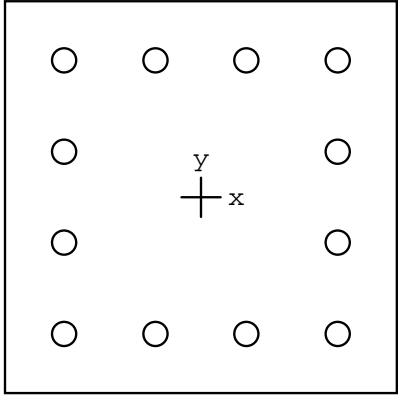
Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.  
 phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular  
 Pattern: All Sides Equal (Cover to transverse reinforcement)  
 Total steel area, As = 8.00 in<sup>2</sup> at 2.47%  
 8 #9 Cover = 2 in

Control Points:

=====

Bending about	Axial Load P kip	X-Moment k-ft	Y-Moment k-ft	N.A. depth in
X @ Pure compression	1184.9	-0	-0	48.53
@ Max compression	948.0	128	0	19.05
@ fs = 0.0	747.8	203	0	15.06
@ fs = 0.5*fy	517.9	252	0	11.20
@ Balanced point	341.9	273	0	8.91
@ Tension Control	157.3	308	0	5.65
@ Pure bending	0.0	243	0	3.99
@ Pure tension	-432.0	0	0	0.00
-X @ Pure compression	1184.9	-0	-0	48.53
@ Max compression	948.0	-128	-0	19.05
@ fs = 0.0	747.8	-203	-0	15.06
@ fs = 0.5*fy	517.9	-252	0	11.20
@ Balanced point	341.9	-273	0	8.91
@ Tension Control	157.3	-308	-0	5.65
@ Pure bending	0.0	-243	-0	3.99
@ Pure tension	-432.0	0	0	0.00



20 x 20 in

Code: ACI 318-02

Units: English

Run axis: About X-axis

Run option: Investigation

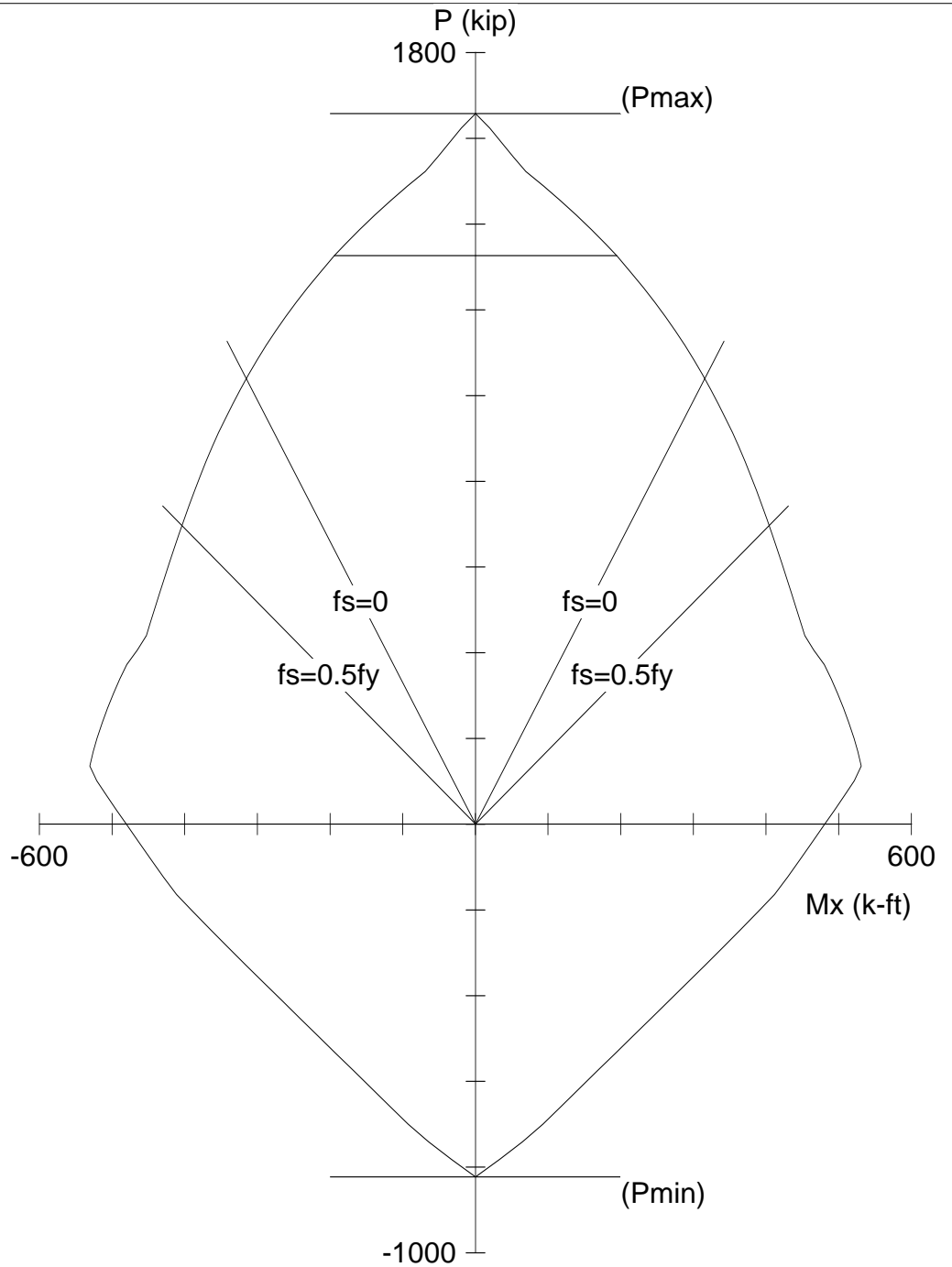
Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 04/04/08

Time: 21:43:33



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File: untitled.col

Project:

Column:

$f'_c = 5$  ksi

$E_c = 4031$  ksi

$f_c = 4.25$  ksi

$e_u = 0.003$  in/in

Beta1 = 0.8

Confinement: Tied

$f_y = 60$  ksi

$E_s = 29000$  ksi

$f_c = 4.25$  ksi

$\phi(a) = 0.8, \phi(b) = 0.9, \phi(c) = 0.65$

Engineer:

$A_g = 400$  in<sup>2</sup>

$A_s = 15.24$  in<sup>2</sup>

$X_o = 0.00$  in

$Y_o = 0.00$  in

Clear spacing = 3.39 in

12 #10 bars

Rho = 3.81%

$I_x = 13333.3$  in<sup>4</sup>

$I_y = 13333.3$  in<sup>4</sup>

Clear cover = 2.38 in

General Information:

=====

File Name: untitled.col  
 Project:  
 Column: Engineer:  
 Code: ACI 318-02 Units: English  
 Run Option: Investigation Slenderness: Not considered  
 Run Axis: X-axis Column Type: Structural

Material Properties:

=====

f'c = 5 ksi fy = 60 ksi  
 Ec = 4030.51 ksi Es = 29000 ksi  
 Ultimate strain = 0.003 in/in  
 Beta1 = 0.8

Section:

=====

Rectangular: Width = 20 in Depth = 20 in  
 Gross section area, Ag = 400 in<sup>2</sup>  
 Ix = 13333.3 in<sup>4</sup> Iy = 13333.3 in<sup>4</sup>  
 Xo = 0 in Yo = 0 in

Reinforcement:

=====

Rebar Database: ASTM A615

Size	Diam (in)	Area (in <sup>2</sup> )	Size	Diam (in)	Area (in <sup>2</sup> )	Size	Diam (in)	Area (in <sup>2</sup> )
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.  
 phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular  
 Pattern: All Sides Equal (Cover to transverse reinforcement)  
 Total steel area, As = 15.24 in<sup>2</sup> at 3.81%  
 12 #10 Cover = 2 in

Control Points:

=====

Bending about	Axial Load P kip	X-Moment k-ft	Y-Moment k-ft	N.A. depth in
X @ Pure compression	1657.3	-0	-0	54.75
@ Max compression	1325.8	194	0	21.59
@ fs = 0.0	1039.2	315	0	16.99
@ fs = 0.5*fy	696.3	404	0	12.63
@ Balanced point	425.0	456	0	10.06
@ Tension Control	128.3	532	0	6.37
@ Pure bending	-0.0	481	0	5.45
@ Pure tension	-823.0	-0	-0	0.00
-X @ Pure compression	1657.3	-0	-0	54.75
@ Max compression	1325.8	-194	-0	21.59
@ fs = 0.0	1039.2	-315	-0	16.99
@ fs = 0.5*fy	696.3	-404	0	12.63
@ Balanced point	425.0	-456	-0	10.06
@ Tension Control	128.3	-532	-0	6.37
@ Pure bending	-0.0	-481	-0	5.45
@ Pure tension	-823.0	-0	-0	0.00