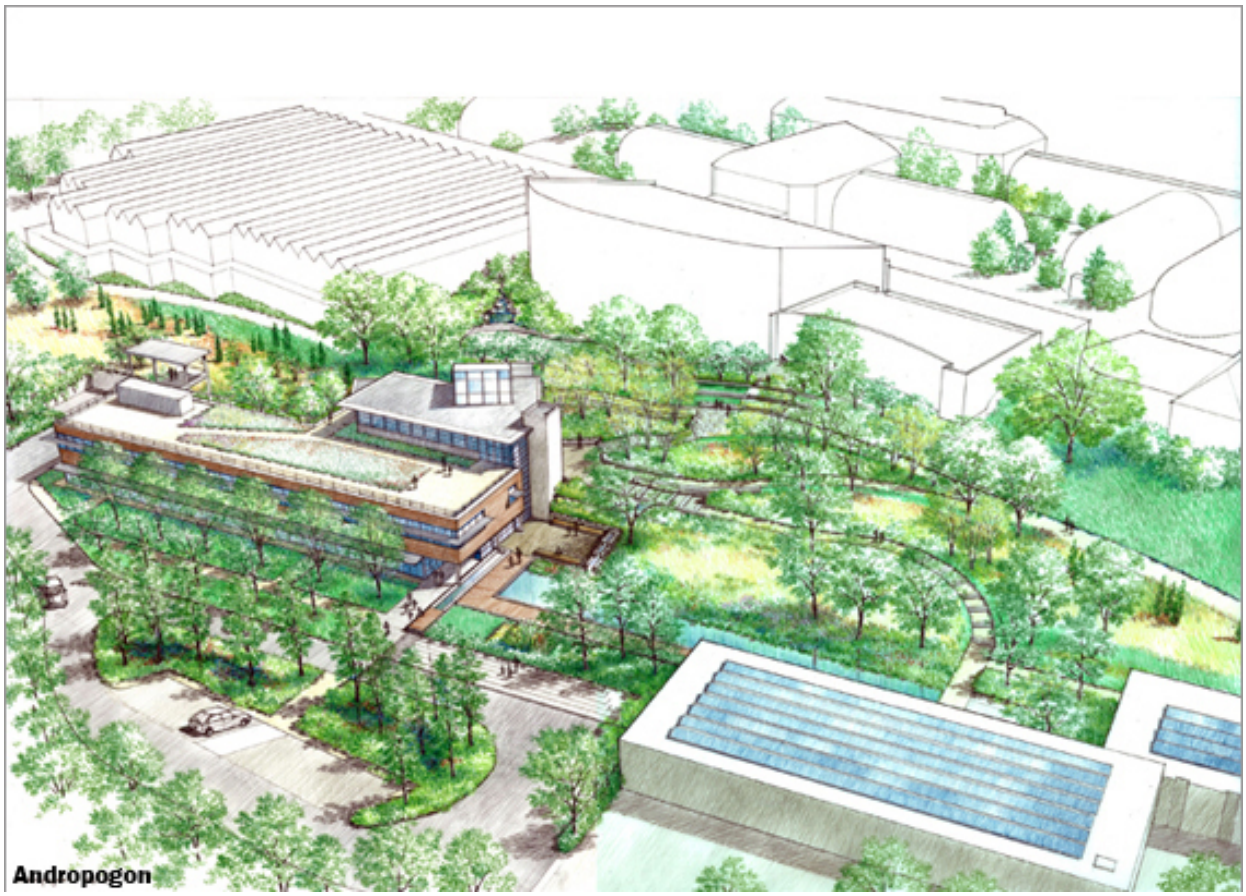
Technical Report 2

The Center for Sustainable Landscapes for The Phipps Conservatory and Botanical Gardens – Pittsburgh, PA



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Construction Option

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Penn State AE Senior Thesis

Executive Summary

Technical Assignment 2 critically analyzes and evaluates the project execution of the Center for Sustainable Landscapes. The Center for Sustainable Landscapes is a 24,350 square foot new construction project being built for the Phipps Conservatory in Pittsburgh, PA. The most distinguishing features of the project are its numerous sustainable technologies and high standard of sustainability. Upon completion, the Center for Sustainable Landscapes will be a net-zero water and net-zero energy use building, on an annual basis. Currently, the project is working toward three separate sustainability certifications: USGBC (U.S. Green Building Council) LEED Platinum, ILFI (International Living Future Institute) Living Building Challenge, and Sustainable SITES.

Explanation of the Detailed Project Schedule is provided within this analysis. This schedule is not complex and does not impose an exhaustive construction duration. The most critical point in the schedule will occur prior to the onset of winter conditions, specifically by reaching the water tight milestone prior to the arrival of inclement weather.

The detailed structural estimate revealed that the project requires: 316 tons of structural steel, 904 cubic yards of concrete, and a total structural system cost of approximately $629,000. This value was found to be only 39% of the actual structural system. The reason for this difference was found to be a variation in scope of work. The most significant difference was found to be the inclusion of the exterior envelope in the actual cost and the exclusion of this cost in the detailed estimate performed.

The included general conditions estimate exhibits the project staffing, utilities, facilities, and indirect costs associated with this project. The general conditions cost for the project is approximately $646,000, which is approximately 6.5% of the total contracted value.

The LEED evaluation revealed that the Center for Sustainable Landscapes is attaining an appropriate LEED platinum certification. The project is being evaluated on LEED v2.2 criteria, the predecessor to LEED 2009. This project is seeking to attain 63 of the 69 LEED Credits

Finally, an evaluation of the level that BIM was implemented on the construction of the Center for Sustainable Landscapes was done. Its use was determined to be not significant. For this project, BIM was limited to 3-D computer aided design and 3-D clash detection. The use of BIM technologies was highly appropriate for this project and the advanced environmentally sustainable systems incorporated in the building. After analyzing the information, this will be entertained as a major area of research in later reports.

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Detailed Project Schedule

❖ ***See Appendix A for the Center for Sustainable Landscape's Detailed Project Schedule***

The Detailed Project Schedule is an explicit representation of the activities and their corresponding durations. This schedule only addresses work completed during the construction phase of the project. Activities that are not represented in the schedule include Schematic Design, Design Development, completion of the Construction Documents, and the Bid/Buyout phases of the project. The project began in the summer of 2008 with the selection of the architect, and the schematic design of the Center for Sustainable Landscapes. The Construction Documents were started in January of 2010 and were completed by July of that year. The bid phase lasted from the beginning of July through the end of August 2010. The Detailed Project Schedule starts with the Notice to Proceed on April 21, 2011. Prior to this date, a small portion of demolition was completed on an adjacent warehouse located onsite.

Construction activities are organized by structural sequences and are phased with one another to optimize the flow of construction as work progresses. Due to the limited size of the schedule, site work activities are categorized by region and assigned a duration during which work will be occurring in that area of the project site. A significant site work activity that is not shown includes the installation of rock anchors (tiebacks) occurring simultaneously with the *Over Excavation & Lean Fill* portion of foundations construction. The most critical portion of the schedule is achieving the watertight deadline prior to the onset of winter conditions. Pushing the schedule later into the session could result in a loss in productivity and an increase in cost.

Substantial Completion is currently scheduled for March 23, 2012. Site work is contracted to be complete April 13, 2012, approximately 3 weeks after substantial completion to accommodate for the growing season. In total, the construction portion of the project takes 51 weeks to complete, 48 of which incurring onsite general condition costs. As a result, this project does not impose over exhaustion of resources to complete construction on schedule. Additionally, this project also does not require complex phasing to accomplish the schedule amount of work in the given amount of time.

Important Construction Dates:

- Notice to Proceed – 4/21/2011
- Substructure Completion – 8/17/2011
- Superstructure Completion – 9/26/2011
- Watertight – 11/2/2011
- Substantial Completion – 3/23/2012
- Completion of Site Work – 4/13/2012

Detailed Structural Systems Estimate

❖ ***See Appendix B for the Center for Sustainable Landscape's Structural System Estimate***

The Detailed Structural Systems Estimate is an accurate approximation of the Center for Sustainable Landscapes substructure and superstructure construction costs. This cost estimate was performed outside of the project with entirely separate pricing indexes and only attempts to reflect the actual project costs. Pricing information was provided by the 2011 *RS Means Building Construction Cost Data*. The scope of work estimated includes: the cast-in-place substructure, and the composite (combined cast-in-place concrete and structural steel) superstructure.

Table 1 display's a summary of the estimated cost of the detailed structural estimate performed. The three major line items include the system's cost for the substructure, the superstructure, and the combined total structure cost. Additional subsystem cost breakout includes: cast-in-place foundations, slab-on-grade, cast-in-place concrete superstructure, and structural steel. Pricing displayed in this category does not include contractor overhead or profit. Pricing is additionally broken down to reveal the total square-foot cost.

Table 1 - Detailed Structural Estimate Summary

System	Base Cost ($)	Bare Cost per Square Foot ($/SF)
Substructure	**$ 85,550.35**	$ 3.26
Foundation	$ 28,287.95	$ 1.08
Slab-on-Grade	$ 57,262.41	$ 2.18
Superstructure	**$ 543,566.54**	$ 20.72
Cast-in-Place Concrete	$ 218,601.32	$ 8.33
Structural Steel	$ 324,965.22	$ 12.38
Total Combined Structural Cost	**$ 629,116.89**	$ 23.98

The detailed estimate required the total quantification of all structural components. This method of cost estimation was a more accurate alternative to the recommended typical bay cost estimation and extrapolation. Additionally, the building is designed in a unique geometric configuration that does not allow for accurate estimation through typical bay cost extrapolation.

Table 2 compares the cost of the actual structural system to the estimated structural system as both a lump sum and square-foot value. The estimated cost of the project is reflected as a percentage of the actual cost at the bottom of the table.

Table 2 - Detailed Structural Estimate Cost Comparison		
	Cost w/ OH&P ($)	**Cost w/ OH&P per Square Foot ($/SF)**
Actual Cost	$ 1,700,000.00	$ 64.79
Estimated Cost	$ 660,572.74	$ 25.17
Estimated Cost as % of Actual Cost	39%	

Variations between the actual project cost and the estimated cost are significant and can be attributed differences in scope of work. The most significant scope of work difference is the inclusion of the cost of the building envelope in the structural system. The cost breakout is not available as it is confidential to the subcontractor delivering both systems. A second variation to the estimate performed is the exclusion of stair systems. Two different stair systems are being used on this project, one of which is a traditional metal pan stair, the other is a highly complex cast-in-place concrete stair. Neither of these stair systems were included in the estimate. A third difference in the scope of work estimated is the exclusion of the thermo radiant heating system built into the slab-on-grade and slab-on-metal deck. Pricing was not available for the increased cost of the slabs. A fourth exclusion to the estimate is the absence of additional funds for the increased cost of architecturally exposed structural steel framing.

The resources used to conduct this estimate include: *RS Means Building Construction Cost Data 2011*, Autodesk's Quantity Takeoff Software, and Microsoft Excel. Structural systems were quantified using Quantity Takeoff and then imported into excel where they were organized by category. Pricing was performed using *RS Means* and a location factor for Pittsburgh of 98.9 was applied directly to all of the prices. A waste factor of 10% was applied to all concrete quantities to accommodate for testing, samples, and spillage on the jobsite.

The effects of LEED have a marginal effect on the estimation of the structural system. LEED credits commonly achieved with the structure include: MR 4 (Recycled Content) and MR 5 (Regional Material). For LEED Credit MR 4, a high quantity of recycled content is already used in structural steel and it requires no additional price allowance for use. For LEED Credit MR 5, local availability of natural resources used in concrete incurs no additional cost for use. **Reference: RS Means Building Construction Cost Data 2011**

General Conditions Estimate

❖ ***See Appendix C for the Center for Sustainable Landscape's General Conditions Estimate***

Table 3 displays the summary of the estimated general conditions cost for the Center for Sustainable Landscapes. These costs were estimated outside of the project and only attempt to reflect actual project costs. Pricing information was provided by the *2011 RS Means Building Construction Cost Data*. General Condition's costs are tabulated assuming a 48-week project duration.

General Condition costs were categorized into 3 separate subcategories: **Personnel**, **Indirect**, and **Temporary Utilities/Facilities**. **Personnel** costs reflect the costs associated with maintaining 3 full-time employees onsite throughout all of construction; this value includes all employee fringe costs. The **Indirect** cost category reflects the costs associated with permitting, testing and inspection, contingency, safety systems, and builders risk insurance. **Temporary Utilities/Facilities** includes the majority of temporary facility and utility costs incurred from operating a construction site and an onsite office trailer with full service utilities. For additional information on what is included in the Temporary Utilities/Facilities category, reference the General Conditions Estimate in Appendix C. Exclusions from the estimate include home office overhead, and snow removal.

Table 3 - General Conditions Cost Estimate Summary

Cost Category	Cost	Unit
Personnel	$ 3,667	Week
Indirect	$ 7,318	Week
Temporary Utilities/Facilities	$ 2,478	Week
Total	$ 13,463	Week

In total, General Conditions are estimated to cost approximately 6.5% of the entire $10 million contracted value of the project. Approximately 55% of this estimated value is associated with "Indirect" construction costs, 85% of which is associated with the project's contingency fund. Not reflected in the estimate is an increased cost of General Conditions to accommodate for the increase of complexity from the high level of sustainability.

Leadership in Energy and Environmental Design (LEED) Evaluation

❖ ***See Appendix D for the Center for Sustainable Landscape's LEED Scorecard***

The Center for Sustainable Landscapes is seeking to obtain a LEED Platinum certification based on LEED-New Construction (LEED-NC), version 2.2. Table 4 summarizes the points being attempted on the Center for Sustainability project. In Table 4, the first column displays the subcategory of evaluation and the remaining columns are a total of the points achieved in that subcategory. Next, the "Yes" column displays the total points expected to be awarded in that subcategory, the "Potential" column displays the total points that are anticipated to be awarded, and the "No" column displays the points that the project will not qualify for. In the last row, the "Project Total" is a summation of the subcategories displayed. For this project to achieve a LEED Platinum certification, a minimum of 52 points must be awarded. Currently, 55 points are expected to be awarded, the project could be awarded up to 63 points if all of the potential points are determined to qualify.

Table 4 – Project Points Summary for LEED - New Construction v 2.2

Category	Yes	Potential	No
Sustainable Sites	8	4	2
Water Efficiency	5	0	0
Energy & Atmosphere	17	0	0
Materials & Resources	6	3	4
Indoor Environment Quality	14	1	0
Innovation & Design Process	5	0	0
Project Total (minimum of 52 points for Platinum Certification)	**55**	**8**	**6**

The project almost fully embraces the LEED Platinum certification by nearly achieving all possible credits in each possible point category. The credits not being completed include:

- Sustainable Sites Credit 7.1 Heat Island Effect, Non-Roof (1 Credit)
- Sustainable Sites Credit 7.2 Heat Island Effect, Roof (1 Credit)
- Materials & Resources Credits 1.1-1.3 Building Reuse (3 Credits)
- Materials & Resources Credit 6 Rapidly Renewable Materials (1 Credit)

Reference: RS Means Building Construction Cost Data 2011

The LEED Evaluation system is comprised of 6 different categories listed in Table 4. Each category addresses different environmental- and occupant-based needs.

The Sustainable Sites category focuses on the sustainable development of the site in both design and construction phases. This category deters the development of greenfield sites and promotes the development of brownfiled sites. This category addresses controlling storm water runoff and erosion control, as well as heat island and light pollution effects. For the Center for Sustainable Landscapes, the project is attempting to meet all of the credits in this category with the exception of the ones design to reduce urban heat island effect. To meet these goals, the project would have to increase the amount of green roof being installed and plan on the installing shading devices to reduce the amount of heat reflected back into the environment.

The Water Efficiency category focuses on the reduction of water consumption over a building's useable life. For the Center for Sustainable Landscapes, all credits are expected to be received. On an annual basis, the building is designed to have a net-zero water use on an annual basis. It is achieving this goal through the use of low flow fixtures and toilets, and will also collect and store rain water in underground cisterns.

The Energy and Atmosphere category promotes the reduction in life cycle energy use of a building. The Center for Sustainable Landscapes current target is to achieve net-zero energy use on an annual basis. The project will employ the use of photovoltaic panels, a geothermal ground source heat pump, an enthalpy wheel, and a wind turbine to mitigate the power needed, and maximize the power generated through renewable technologies.

The Materials and Resources category requires the use of locally extracted and processed materials, materials that are salvaged, highly renewable materials, and materials that posses a high amount of recycled content. The Center for Sustainable Landscapes will be receiving all such credits, save for the credit given for use of a highly renewable resource, and the three credits given for building renovation as an alternative to new construction. Sustainable material use ranges from reclaimed barn lumber as a façade, to pre-consumer recycled steel for the superstructure.

The Indoor Environmental Quality focuses on the design of an indoor environment that increases the amounts of natural daylight and improves indoor air quality. The design of the Center for Sustainable Landscapes features a dynamic building automation system that maximizes and controls the amount of daylight entering a space. In addition, the building features an active and passive HVAC system which allows the building to be ventilated with natural convection. The project is attempting to achieve all credits in this category.

The Innovation and Design Process category allows design teams to be innovative in the development of alternative sustainable design solutions. The Center for Sustainable Landscapes will meet these credits by achieving the annual net-zero water and energy use on an annual basis goal, by managing all storm water onsite in a lagoon, and participate as a pilot project in the development of the Sustainable SITES initiative.

Success in achieving the LEED Platinum certification is expressed by the owner as being one of the most significant features of this project. Additional emphasis is being placed on promotion of sustainable design and construction outside of LEED by also seeking two additional sustainable certifications including: The Living Building Challenge, and the Sustainable SITES initiative. Creating an iconographic sustainable building is of the utmost importance to the owner, and as a result, the sustainable techniques implemented are highly appropriate to the client's and project's needs. Overall, although the project is markedly sustainable, increased sustainability would only further increase the value of the project to the owner.

Reference: U.S. Green Building Council, Rating System and Checklist for v2.2

http://www.usgbc.org/DisplayPage.aspx?CMSPageID=2464

Building Information Modeling (BIM) Use Evaluation

❖ ***See Appendix E & F for the Center for Sustainable Landscape's BIM Use and Process Map***

The implementation of the Building Information Model (BIM) on the Center for Sustainable Landscapes largely did not contribute to the overall delivery of the project. The primary use of BIM-related practices and technologies occurred during Schematic Design, and Design Development. Utilization of BIM technologies was limited to the design of the building systems in Autodesk's Revit, and did not include integration of project-specific information in the information model. Additional software used during design includes Autodesk's Ecotect, which contributed to the development of the passive heating/cooling architectural design. 3-D coordination of mechanical, electrical, plumbing, and fire protection trades did occur during the Design Development period and were consequently removed from the construction phase of the project. The BIM model created for this project was shared only by team members involved in design, and was withheld from the owner and general contractor. There are no current plans to share the BIM model with the owner after the completion of construction.

The level that BIM was implemented on the construction of the Center for Sustainable Landscapes was not significant, and was limited to 3-D computer aided design and 3-D clash detection. The use of BIM technologies was highly appropriate for the advanced environmentally sustainable systems incorporated in the building. Furthermore, the LEED, Living Building, and Sustainable SITES certifications being sought after could have greatly benefited from the increase in information availability as a result of BIM use practices. The BIM implementation process was most significantly limited by the delivery method and contractual arrangement of the project. Contractually Lump-Sum, the Design-Bid-Build delivery method was fragmented and inhibited the utilization of BIM. A contractual agreement that focuses more on increased collaboration between team members, in combination with an increase in industry experience with BIM related technologies, could have added a large amount of value to the project.

Image 1 – View of computer model in Revit

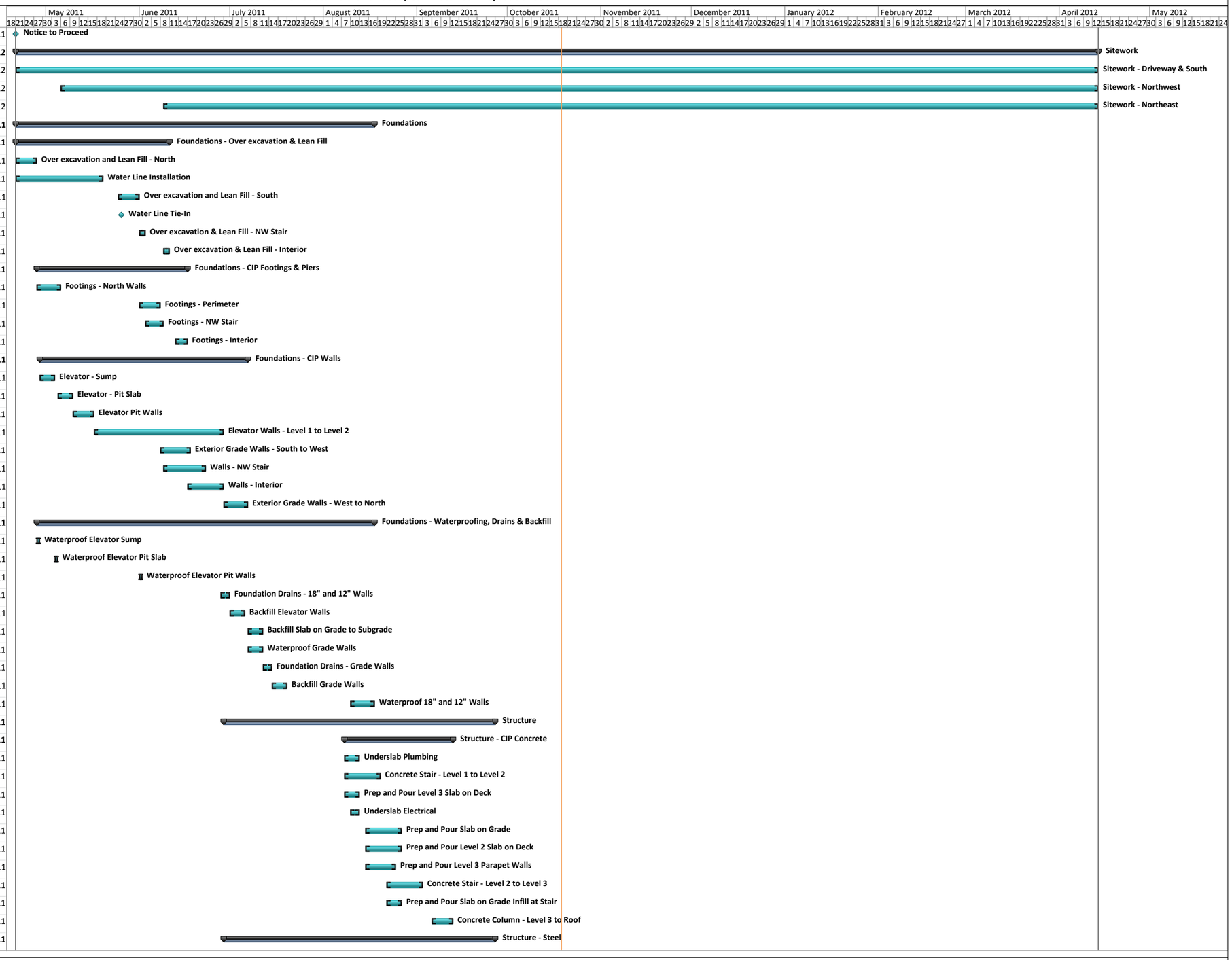
Reference: BIM Project Execution Planning Guide Version 2.0, http://bim.psu.edu/

Appendix A:

Detailed Project Schedule

Center for Sustainable Landscapes - Detailed Project Schedule

ID	Task Name	Duration	Start	Finish
1	**Notice to Proceed**	0 days	Thu 4/21/11	Thu 4/21/11
2	**Sitework**	**257 days**	**Thu 4/21/11**	**Fri 4/13/12**
3	Sitework - Driveway & South	257 days	Thu 4/21/11	Fri 4/13/12
4	Sitework - Northwest	246 days	Fri 5/6/11	Fri 4/13/12
5	Sitework - Northeast	222 days	Thu 6/9/11	Fri 4/13/12
6	**Foundations**	**85 days**	**Thu 4/21/11**	**Wed 8/17/11**
7	**Foundations - Over excavation & Lean Fill**	**37 days**	**Thu 4/21/11**	**Fri 6/10/11**
8	Over excavation and Lean Fill - North	5 days	Thu 4/21/11	Wed 4/27/11
9	Water Line Installation	21 days	Thu 4/21/11	Thu 5/19/11
10	Over excavation and Lean Fill - South	5 days	Wed 5/25/11	Tue 5/31/11
11	Water Line Tie-In	0 days	Thu 5/26/11	Thu 5/26/11
12	Over excavation & Lean Fill - NW Stair	2 days	Wed 6/1/11	Thu 6/2/11
13	Over excavation & Lean Fill - Interior	2 days	Thu 6/9/11	Fri 6/10/11
14	**Foundations - CIP Footings & Piers**	**36 days**	**Thu 4/28/11**	**Thu 6/16/11**
15	Footings - North Walls	6 days	Thu 4/28/11	Thu 5/5/11
16	Footings - Perimeter	5 days	Wed 6/1/11	Tue 6/7/11
17	Footings - NW Stair	4 days	Fri 6/3/11	Wed 6/8/11
18	Footings - Interior	4 days	Mon 6/13/11	Thu 6/16/11
19	**Foundations - CIP Walls**	**49 days**	**Fri 4/29/11**	**Wed 7/6/11**
20	Elevator - Sump	3 days	Fri 4/29/11	Tue 5/3/11
21	Elevator - Pit Slab	3 days	Thu 5/5/11	Mon 5/9/11
22	Elevator Pit Walls	5 days	Tue 5/10/11	Mon 5/16/11
23	Elevator Walls - Level 1 to Level 2	31 days	Tue 5/17/11	Tue 6/28/11
24	Exterior Grade Walls - South to West	8 days	Wed 6/8/11	Fri 6/17/11
25	Walls - NW Stair	10 days	Thu 6/9/11	Wed 6/22/11
26	Walls - Interior	8 days	Fri 6/17/11	Tue 6/28/11
27	Exterior Grade Walls - West to North	6 days	Wed 6/29/11	Wed 7/6/11
28	**Foundations - Waterproofing, Drains & Backfill**	**80 days**	**Thu 4/28/11**	**Wed 8/17/11**
29	Waterproof Elevator Sump	1 day	Thu 4/28/11	Thu 4/28/11
30	Waterproof Elevator Pit Slab	1 day	Wed 5/4/11	Wed 5/4/11
31	Waterproof Elevator Pit Walls	1 day	Wed 6/1/11	Wed 6/1/11
32	Foundation Drains - 18" and 12" Walls	3 days	Tue 6/28/11	Thu 6/30/11
33	Backfill Elevator Walls	3 days	Fri 7/1/11	Tue 7/5/11
34	Backfill Slab on Grade to Subgrade	3 days	Thu 7/7/11	Mon 7/11/11
35	Waterproof Grade Walls	3 days	Thu 7/7/11	Mon 7/11/11
36	Foundation Drains - Grade Walls	3 days	Tue 7/12/11	Thu 7/14/11
37	Backfill Grade Walls	3 days	Fri 7/15/11	Tue 7/19/11
38	Waterproof 18" and 12" Walls	6 days	Wed 8/10/11	Wed 8/17/11
39	**Structure**	**64 days**	**Wed 6/29/11**	**Mon 9/26/11**
40	**Structure - CIP Concrete**	**26 days**	**Mon 8/8/11**	**Mon 9/12/11**
41	Underslab Plumbing	5 days	Mon 8/8/11	Fri 8/12/11
42	Concrete Stair - Level 1 to Level 2	10 days	Mon 8/8/11	Fri 8/19/11
43	Prep and Pour Level 3 Slab on Deck	5 days	Mon 8/8/11	Fri 8/12/11
44	Underslab Electrical	3 days	Wed 8/10/11	Fri 8/12/11
45	Prep and Pour Slab on Grade	10 days	Mon 8/15/11	Fri 8/26/11
46	Prep and Pour Level 2 Slab on Deck	10 days	Mon 8/15/11	Fri 8/26/11
47	Prep and Pour Level 3 Parapet Walls	8 days	Mon 8/15/11	Wed 8/24/11
48	Concrete Stair - Level 2 to Level 3	10 days	Mon 8/22/11	Fri 9/2/11
49	Prep and Pour Slab on Grade Infill at Stair	5 days	Mon 8/22/11	Fri 8/26/11
50	Concrete Column - Level 3 to Roof	5 days	Tue 9/6/11	Mon 9/12/11
51	**Structure - Steel**	**64 days**	**Wed 6/29/11**	**Mon 9/26/11**

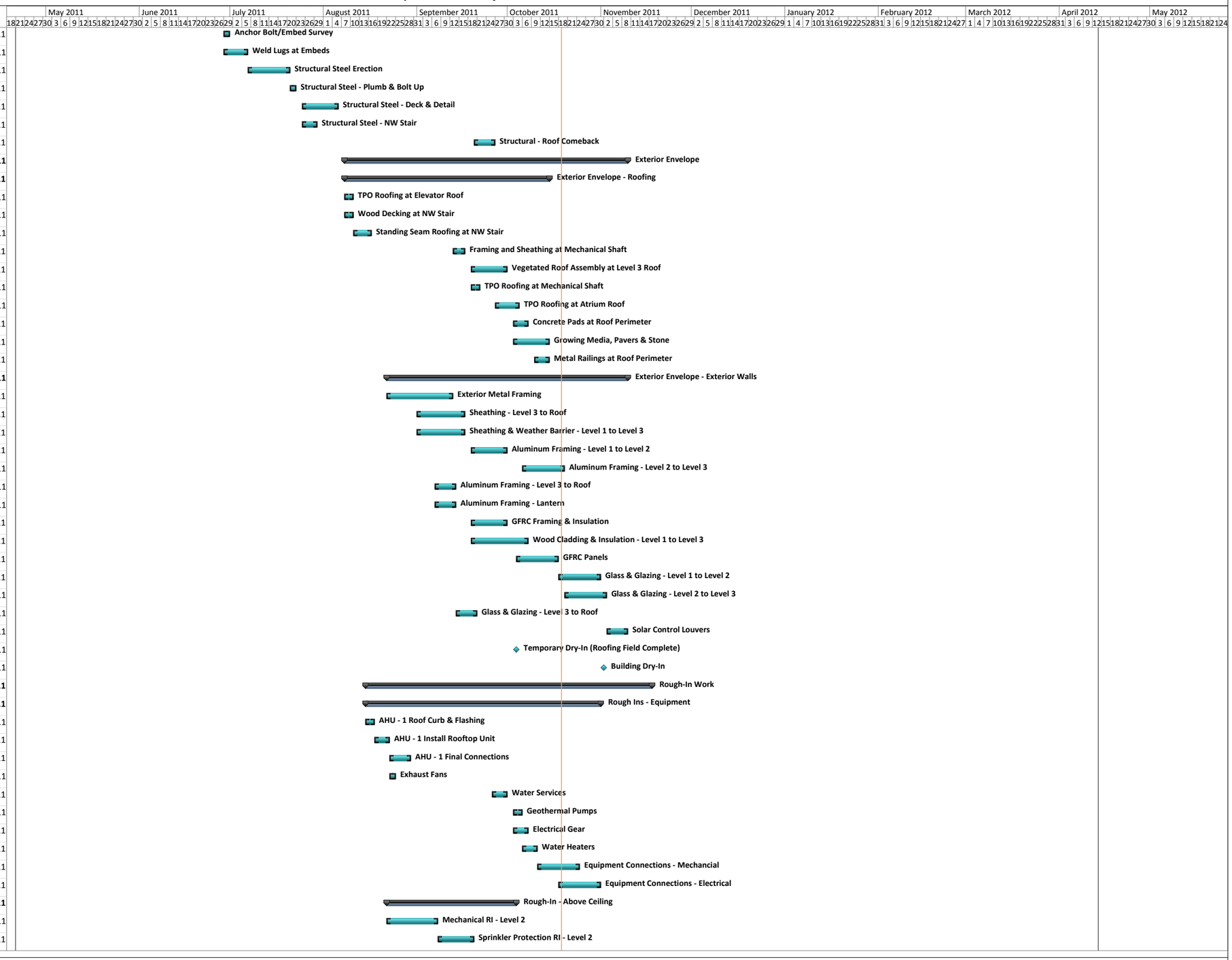


Project: Detailed Project Schedule
Date: Wed 10/19/11

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

Center for Sustainable Landscapes - Detailed Project Schedule

ID	Task Name	Duration	Start	Finish
52	Anchor Bolt/Embed Survey	2 days	Wed 6/29/11	Thu 6/30/11
53	Weld Lugs at Embeds	6 days	Wed 6/29/11	Wed 7/6/11
54	Structural Steel Erection	10 days	Thu 7/7/11	Wed 7/20/11
55	Structural Steel - Plumb & Bolt Up	2 days	Thu 7/21/11	Fri 7/22/11
56	Structural Steel - Deck & Detail	10 days	Mon 7/25/11	Fri 8/5/11
57	Structural Steel - NW Stair	5 days	Mon 7/25/11	Fri 7/29/11
58	Structural - Roof Comeback	5 days	Tue 9/20/11	Mon 9/26/11
59	**Exterior Envelope**	**68 days**	**Mon 8/8/11**	**Wed 11/9/11**
60	**Exterior Envelope - Roofing**	**50 days**	**Mon 8/8/11**	**Fri 10/14/11**
61	TPO Roofing at Elevator Roof	3 days	Mon 8/8/11	Wed 8/10/11
62	Wood Decking at NW Stair	3 days	Mon 8/8/11	Wed 8/10/11
63	Standing Seam Roofing at NW Stair	4 days	Thu 8/11/11	Tue 8/16/11
64	Framing and Sheathing at Mechanical Shaft	4 days	Tue 9/13/11	Fri 9/16/11
65	Vegetated Roof Assembly at Level 3 Roof	10 days	Mon 9/19/11	Fri 9/30/11
66	TPO Roofing at Mechanical Shaft	3 days	Mon 9/19/11	Wed 9/21/11
67	TPO Roofing at Atrium Roof	6 days	Tue 9/27/11	Tue 10/4/11
68	Concrete Pads at Roof Perimeter	5 days	Mon 10/3/11	Fri 10/7/11
69	Growing Media, Pavers & Stone	10 days	Mon 10/3/11	Fri 10/14/11
70	Metal Railings at Roof Perimeter	5 days	Mon 10/10/11	Fri 10/14/11
71	**Exterior Envelope - Exterior Walls**	**58 days**	**Mon 8/22/11**	**Wed 11/9/11**
72	Exterior Metal Framing	16 days	Mon 8/22/11	Mon 9/12/11
73	Sheathing - Level 3 to Roof	12 days	Thu 9/1/11	Fri 9/16/11
74	Sheathing & Weather Barrier - Level 1 to Level 3	12 days	Thu 9/1/11	Fri 9/16/11
75	Aluminum Framing - Level 1 to Level 2	10 days	Mon 9/19/11	Fri 9/30/11
76	Aluminum Framing - Level 2 to Level 3	10 days	Thu 10/6/11	Wed 10/19/11
77	Aluminum Framing - Level 3 to Roof	5 days	Wed 9/7/11	Tue 9/13/11
78	Aluminum Framing - Lantern	5 days	Wed 9/7/11	Tue 9/13/11
79	GFRC Framing & Insulation	10 days	Mon 9/19/11	Fri 9/30/11
80	Wood Cladding & Insulation - Level 1 to Level 3	15 days	Mon 9/19/11	Fri 10/7/11
81	GFRC Panels	10 days	Tue 10/4/11	Mon 10/17/11
82	Glass & Glazing - Level 1 to Level 2	10 days	Tue 10/18/11	Mon 10/31/11
83	Glass & Glazing - Level 2 to Level 3	10 days	Thu 10/20/11	Wed 11/2/11
84	Glass & Glazing - Level 3 to Roof	5 days	Wed 9/14/11	Tue 9/20/11
85	Solar Control Louvers	5 days	Thu 11/3/11	Wed 11/9/11
86	Temporary Dry-In (Roofing Field Complete)	0 days	Tue 10/4/11	Tue 10/4/11
87	Building Dry-In	0 days	Wed 11/2/11	Wed 11/2/11
88	**Rough-In Work**	**69 days**	**Mon 8/15/11**	**Thu 11/17/11**
89	**Rough Ins - Equipment**	**56 days**	**Mon 8/15/11**	**Mon 10/31/11**
90	AHU - 1 Roof Curb & Flashing	3 days	Mon 8/15/11	Wed 8/17/11
91	AHU - 1 Install Rooftop Unit	3 days	Thu 8/18/11	Mon 8/22/11
92	AHU - 1 Final Connections	5 days	Tue 8/23/11	Mon 8/29/11
93	Exhaust Fans	2 days	Tue 8/23/11	Wed 8/24/11
94	Water Services	5 days	Mon 9/26/11	Fri 9/30/11
95	Geothermal Pumps	3 days	Mon 10/3/11	Wed 10/5/11
96	Electrical Gear	5 days	Mon 10/3/11	Fri 10/7/11
97	Water Heaters	3 days	Thu 10/6/11	Mon 10/10/11
98	Equipment Connections - Mechancial	10 days	Tue 10/11/11	Mon 10/24/11
99	Equipment Connections - Electrical	10 days	Tue 10/18/11	Mon 10/31/11
100	**Rough-In - Above Ceiling**	**31 days**	**Mon 8/22/11**	**Mon 10/3/11**
101	Mechanical RI - Level 2	13 days	Mon 8/22/11	Wed 9/7/11
102	Sprinkler Protection RI - Level 2	8 days	Thu 9/8/11	Mon 9/19/11



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Center for Sustainable Landscapes - Detailed Project Schedule

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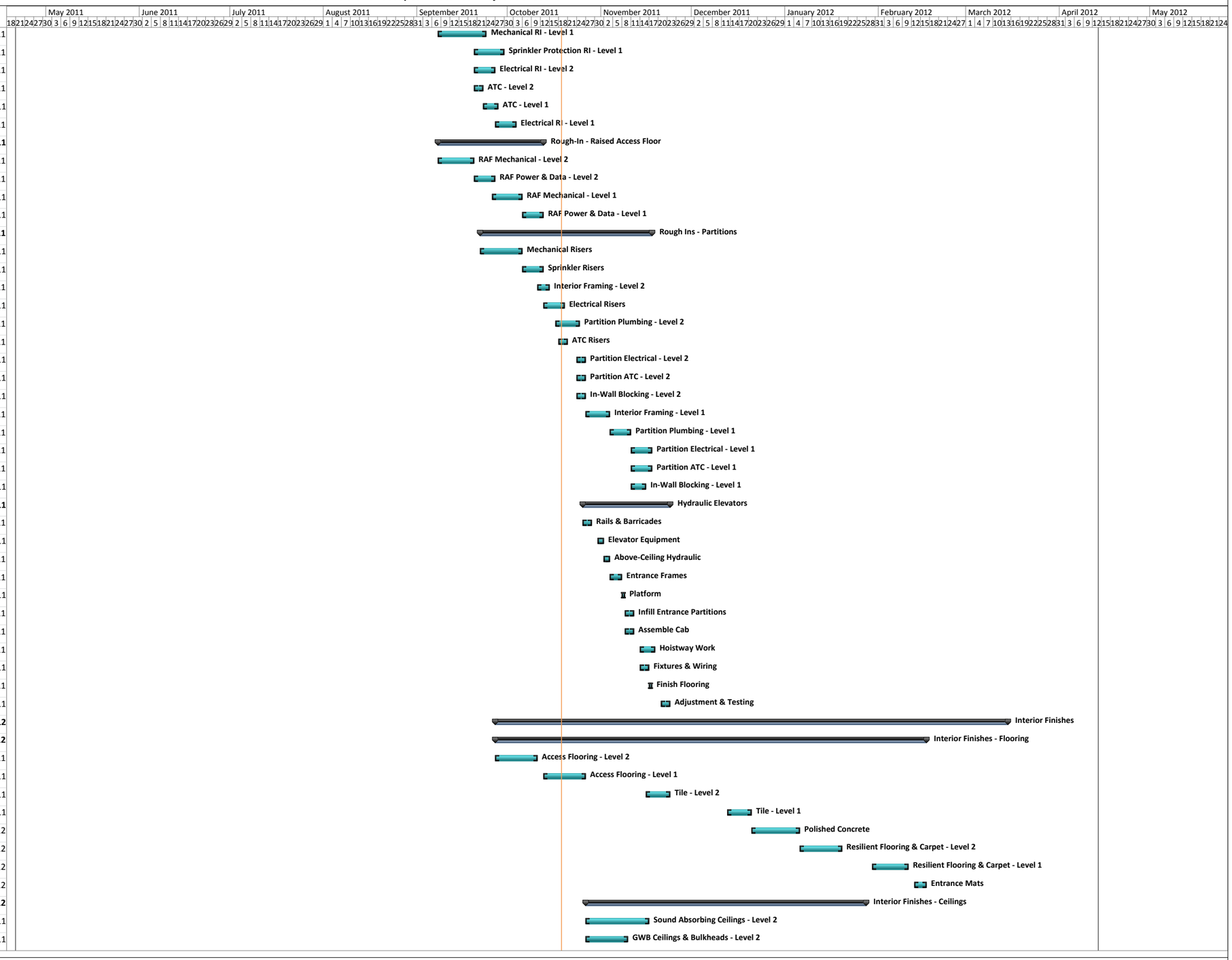
103	Mechanical RI - Level 1	12 days	Thu 9/8/11	Fri 9/23/11
104	Sprinkler Protection RI - Level 1	8 days	Tue 9/20/11	Thu 9/29/11
105	Electrical RI - Level 2	5 days	Tue 9/20/11	Mon 9/26/11
106	ATC - Level 2	3 days	Tue 9/20/11	Thu 9/22/11
107	ATC - Level 1	3 days	Fri 9/23/11	Tue 9/27/11
108	Electrical RI - Level 1	5 days	Tue 9/27/11	Mon 10/3/11
109	**Rough-In - Raised Access Floor**	**25 days**	**Thu 9/8/11**	**Wed 10/12/11**
110	RAF Mechanical - Level 2	8 days	Thu 9/8/11	Mon 9/19/11
111	RAF Power & Data - Level 2	5 days	Tue 9/20/11	Mon 9/26/11
112	RAF Mechanical - Level 1	8 days	Mon 9/26/11	Wed 10/5/11
113	RAF Power & Data - Level 1	5 days	Thu 10/6/11	Wed 10/12/11
114	**Rough Ins - Partitions**	**41 days**	**Thu 9/22/11**	**Thu 11/17/11**
115	Mechanical Risers	10 days	Thu 9/22/11	Wed 10/5/11
116	Sprinkler Risers	5 days	Thu 10/6/11	Wed 10/12/11
117	Interior Framing - Level 2	4 days	Tue 10/11/11	Fri 10/14/11
118	Electrical Risers	5 days	Thu 10/13/11	Wed 10/19/11
119	Partition Plumbing - Level 2	6 days	Mon 10/17/11	Mon 10/24/11
120	ATC Risers	3 days	Tue 10/18/11	Thu 10/20/11
121	Partition Electrical - Level 2	3 days	Mon 10/24/11	Wed 10/26/11
122	Partition ATC - Level 2	3 days	Mon 10/24/11	Wed 10/26/11
123	In-Wall Blocking - Level 2	3 days	Mon 10/24/11	Wed 10/26/11
124	Interior Framing - Level 1	6 days	Thu 10/27/11	Thu 11/3/11
125	Partition Plumbing - Level 1	5 days	Fri 11/4/11	Thu 11/10/11
126	Partition Electrical - Level 1	5 days	Fri 11/11/11	Thu 11/17/11
127	Partition ATC - Level 1	5 days	Fri 11/11/11	Thu 11/17/11
128	In-Wall Blocking - Level 1	3 days	Fri 11/11/11	Tue 11/15/11
129	**Hydraulic Elevators**	**21 days**	**Wed 10/26/11**	**Wed 11/23/11**
130	Rails & Barricades	3 days	Wed 10/26/11	Fri 10/28/11
131	Elevator Equipment	2 days	Mon 10/31/11	Tue 11/1/11
132	Above-Ceiling Hydraulic	2 days	Wed 11/2/11	Thu 11/3/11
133	Entrance Frames	2 days	Fri 11/4/11	Mon 11/7/11
134	Platform	1 day	Tue 11/8/11	Tue 11/8/11
135	Infill Entrance Partitions	3 days	Wed 11/9/11	Fri 11/11/11
136	Assemble Cab	3 days	Wed 11/9/11	Fri 11/11/11
137	Hoistway Work	5 days	Mon 11/14/11	Fri 11/18/11
138	Fixtures & Wiring	3 days	Mon 11/14/11	Wed 11/16/11
139	Finish Flooring	1 day	Thu 11/17/11	Thu 11/17/11
140	Adjustment & Testing	3 days	Mon 11/21/11	Wed 11/23/11
141	**Interior Finishes**	**122 days**	**Tue 9/27/11**	**Wed 3/14/12**
142	**Interior Finishes - Flooring**	**103 days**	**Tue 9/27/11**	**Thu 2/16/12**
143	Access Flooring - Level 2	10 days	Tue 9/27/11	Mon 10/10/11
144	Access Flooring - Level 1	10 days	Thu 10/13/11	Wed 10/26/11
145	Tile - Level 2	6 days	Wed 11/16/11	Wed 11/23/11
146	Tile - Level 1	6 days	Tue 12/13/11	Tue 12/20/11
147	Polished Concrete	12 days	Wed 12/21/11	Thu 1/5/12
148	Resilient Flooring & Carpet - Level 2	10 days	Fri 1/6/12	Thu 1/19/12
149	Resilient Flooring & Carpet - Level 1	10 days	Mon 1/30/12	Fri 2/10/12
150	Entrance Mats	4 days	Mon 2/13/12	Thu 2/16/12
151	**Interior Finishes - Ceilings**	**67 days**	**Thu 10/27/11**	**Fri 1/27/12**
152	Sound Absorbing Ceilings - Level 2	15 days	Thu 10/27/11	Wed 11/16/11
153	GWB Ceilings & Bulkheads - Level 2	10 days	Thu 10/27/11	Wed 11/9/11



Project: Detailed Project Schedule
Date: Wed 10/19/11

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

Center for Sustainable Landscapes - Detailed Project Schedule

ID	Task Name	Duration	Start	Finish
154	Paint GWB Ceilings & Bulkheads - Level 2	4 days	Thu 11/10/11	Tue 11/15/11
155	Sound Absorbing Ceilings - Level 1	13 days	Fri 11/18/11	Tue 12/6/11
156	GWB Ceilings & Bulkheads - Level 1	13 days	Fri 11/18/11	Tue 12/6/11
157	Grid ACT Ceilings - Level 2	10 days	Mon 11/21/11	Fri 12/2/11
158	Paint GWB Ceilings & Bulkheads - Level 1	4 days	Wed 12/7/11	Mon 12/12/11
159	Light Fixtures - Level 2	10 days	Mon 12/12/11	Fri 12/23/11
160	Grid ACT Ceilings - Level 1	8 days	Fri 12/16/11	Tue 12/27/11
161	Sprinkler Heads - Level 2	3 days	Tue 12/27/11	Thu 12/29/11
162	Drop Ceiling Tile - Level 2	5 days	Fri 12/30/11	Thu 1/5/12
163	Light Fixtures - Level 1	10 days	Thu 1/5/12	Wed 1/18/12
164	Sprinkler Heads - Level 1	3 days	Thu 1/19/12	Mon 1/23/12
165	Drop Ceiling Tile - Level 1	4 days	Tue 1/24/12	Fri 1/27/12
166	**Interior Finishes - Partitions**	**36 days**	**Thu 10/27/11**	**Thu 12/15/11**
167	Hang GWB Partitions - Level 2	6 days	Thu 10/27/11	Thu 11/3/11
168	Finish GWB Partitions - Level 2	6 days	Fri 11/4/11	Fri 11/11/11
169	Prime and 1st Coat - Level 2	5 days	Mon 11/14/11	Fri 11/18/11
170	Hang GWB Partitions - Level 1	9 days	Fri 11/18/11	Wed 11/30/11
171	Finish GWB Partitions - Level 1	6 days	Thu 12/1/11	Thu 12/8/11
172	Prime and 1st Coat - Level 1	5 days	Fri 12/9/11	Thu 12/15/11
173	**Interior Finishes - Miscellaneous**	**64 days**	**Fri 12/16/11**	**Wed 3/14/12**
174	Metal Railings at Roof Perimeter	5 days	Fri 12/16/11	Thu 12/22/11
175	Restroom Countertops	2 days	Wed 12/21/11	Thu 12/22/11
176	Plumbing Fixtures	6 days	Fri 12/23/11	Fri 12/30/11
177	Thermal Energy Curtain	6 days	Fri 12/30/11	Fri 1/6/12
178	Toilet Compartments	5 days	Tue 1/3/12	Mon 1/9/12
179	Interior Architectural Woodwork	5 days	Fri 1/6/12	Thu 1/12/12
180	Toilet Accessories	5 days	Tue 1/10/12	Mon 1/16/12
181	Residential Appliances	3 days	Fri 1/13/12	Tue 1/17/12
182	Fire Extinguishers & Cabinets	2 days	Tue 1/17/12	Wed 1/18/12
183	Roller Shades	5 days	Mon 1/30/12	Fri 2/3/12
184	Doors and Hardware	10 days	Mon 2/13/12	Fri 2/24/12
185	Mechanical Trim-Out	10 days	Mon 2/13/12	Fri 2/24/12
186	Electrical Trim-Out	10 days	Mon 2/13/12	Fri 2/24/12
187	Interior Class & Glazing	3 days	Mon 2/27/12	Wed 2/29/12
188	Finish Painting	10 days	Thu 3/1/12	Wed 3/14/12
189	**Testing & Inspection**	**47 days**	**Thu 1/19/12**	**Fri 3/23/12**
190	L & I Elevator Inspection	1 day	Thu 1/19/12	Thu 1/19/12
191	Testing & Balancing	15 days	Mon 2/27/12	Fri 3/16/12
192	Fire Alarm Testing & Inspection	5 days	Mon 2/27/12	Fri 3/2/12
193	ATC Testing	15 days	Mon 2/27/12	Fri 3/16/12
194	HVAC Testing & Inspection	15 days	Mon 2/27/12	Fri 3/16/12
195	Electrical Testing & Inspection	10 days	Mon 2/27/12	Fri 3/9/12
196	Sprinkler Testing & Inspection	5 days	Mon 2/27/12	Fri 3/2/12
197	Plumbing Testing & Inspection	5 days	Mon 2/27/12	Fri 3/2/12
198	Life Safety Inspection	5 days	Mon 3/19/12	Fri 3/23/12
199	**Substantial Completion**	**0 days**	**Fri 3/23/12**	**Fri 3/23/12**

Project: Detailed Project Schedule
Date: Wed 10/19/11

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

Appendix B:

Detailed Structural Systems Estimate

Center for Sustainable Landscapes - Detailed Structural Estimate						
CSI	**Structural System Estimate**	**Quantity**	**Unit**	**Bare Unit Cost**	**Subtotal**	**Total w/ OH&P**
Division 3 - Concrete					**$ 304,151.68**	**$ 319,359.26**
3300	**Concrete Footings and Piers**					
	3000 PSI	133.8	CY	$ 108.00	$ 14,449.60	$ 15,172.08
	Concrete pumped placement	133.8	CY	$ 20.25	$ 2,709.30	$ 2,844.77
3310	**Concrete Walls**					
	5000 PSI	378.0	CY	$ 118.00	$ 44,600.21	$ 46,830.22
	Concrete pumped placement	378.0	CY	$ 29.40	$ 11,112.25	$ 11,667.87
3320	**Concrete Slabs**					
	Light Weight 4000 PSI - Slab on Grade	141.4	CY	$ 160.60	$ 22,710.23	$ 23,845.74
	Light Weight 4000 PSI - Slab on Deck	251	CY	$ 160.60	$ 40,376.62	$ 42,395.46
	Concrete pumped placement	251	CY	$ 27.65	$ 6,951.52	$ 7,299.09
	Steel Trowel	32140	SF	$ 0.72	$ 23,140.66	$ 24,297.69
	Saw Cuts	890.4	LF	$ 0.75	$ 667.80	$ 701.19
3100	**Formwork**					
	Piers	495	SF	$ 1.89	$ 935.55	$ 982.33
	Walls	16129	SF	$ 3.37	$ 54,353.18	$ 57,070.84
	Slab Edge	1800	LF	$ 3.20	$ 5,760.00	$ 6,048.00
3200	**Reinforcement**					
	Bar Stock	22	Ton	$ 1,508.00	$ 33,246.39	$ 34,908.71
	W.W.M. 6 ga	32140	SF	$ 0.75	$ 24,104.85	$ 25,310.09
	Chairs	32140	SF	$ 0.35	$ 11,248.93	$ 11,811.38
3180	**Anchor Bolts and Base Plates**					
	Anchor Bolts 7/8" x 12"	164	EA	$ 7.55	$ 1,238.20	$ 1,300.11
	1/2" Base Plates	41	EA	$ 15.70	$ 643.70	$ 675.89
3250	**Accessories**					
	Vapor Barrier	10518	SF	$ 0.32	$ 3,365.76	$ 3,534.05
	Expansion Joint 8"	600	LF	$ 2.34	$ 1,404.00	$ 1,474.20
	Curing Agent	80	GL	$ 14.10	$ 1,132.93	$ 1,189.57
Division 5 - Steel					**$ 324,965.22**	**$ 341,213.48**
5100	**Structural Steel**					
	Columns	18.89	Ton	$ 2,924.41	$ 55,256.30	$ 58,019.12
	Hollow Structural Shapes	10.20	Ton	$ 2,798.44	$ 28,548.99	$ 29,976.44
	W-Type Members	54.27	Ton	$ 3,041.01	$ 165,044.95	$ 173,297.19
	Misc. Structural Steel	4.50	Ton	$ 1,279.36	$ 5,760.34	$ 6,048.36
	ASTM A325, 3/4"	1962	EA	$ 4.25	$ 8,338.50	$ 8,755.43
	Welding Allowance per Ton	87.87	Ton	$ 71.89	$ 6,317.14	$ 6,633.00
5300	**Metal Decking**					
	2" 20 GA. Composite Deck	18698	SF	$ 2.75	$ 51,419.50	$ 53,990.48
	1 1/2" 20 GA. Roof Deck	1902	SF	$ 2.25	$ 4,279.50	$ 4,493.48
Total Combined Structural Cost Estimate					**$ 629,116.89**	**$ 660,572.74**
* A location factor for Pittsburgh of 98.9 was factored into all pricing directly						
* For additional detail on notes reference individual Steel and Concrete Takeoff Sheets						

Center for Sustainable Landscapes - Structural Steel Quanity Takeoff

Columns	Pieces	Total Length	LB/FT	TONS	Bare Cost ($/L.F.)	$
HSS 4x4x5/16	2	28	15	0.20	$ 25.25	$ 698
HSS 6x6x1/2	1	28	35	0.49	$ 47.42	$ 1,331
HSS 6x6x1/4	3	37	19	0.35	$ 31.85	$ 1,168
HSS 6x6x3/8	3	131	27	1.80	$ 39.42	$ 5,156
HSS 6x6x5/16	15	418	23	4.88	$ 32.35	$ 13,535
HSS 6x6x5/8	17	528	42	11.17	$ 63.20	$ 33,369
Columnes	41	EA	Total Tons	18.89	Total Cost	$ 55,256

Hollow Structural Shapes	Pieces	Total Length	LB/FT	TONS	Bare Cost ($/L.F.)	$
HSS 10x2x5/16	3	53	23	0.62	$ 35.20	$ 1,857
HSS 10x4x3/8	2	61	36	1.08	$ 49.50	$ 3,009
HSS 12x6x1/4	7	105	29	1.54	$ 42.23	$ 4,447
HSS 12x6x3/8	3	44	43	0.93	$ 57.20	$ 2,499
HSS 12x6x5/16	2	37	36	0.67	$ 49.50	$ 1,836
HSS 14x6x1/4	6	81	33	1.33	$ 47.20	$ 3,836
HSS 14x6x3/8	1	21	48	0.49	$ 63.13	$ 1,296
HSS 14x6x5/16	3	62	40	1.25	$ 53.13	$ 3,291
HSS 18x6x3/8	3	47	58	1.35	$ 70.10	$ 3,264
HSS 4x4x1/4	4	29	12	0.18	$ 23.90	$ 697
HSS 8x4x1/4	7	80	19	0.76	$ 31.35	$ 2,517
Hollow Structural Shapes	41	EA	Total Tons	10.20	Total Cost	$ 28,549

W-Type Members	Pieces	Total Length	LB/FT	TONS	Bare Cost ($/L.F.)	$
W10X12	20	297	12	1.78	$ 22.90	$ 6,795
W10X19	5	89	19	0.84	$ 32.85	$ 2,912
W10X22	4	80	22	0.88	$ 34.35	$ 2,757
W12X14	31	437	14	3.06	$ 23.35	$ 10,194
W12X16	1	15	16	0.12	$ 26.25	$ 394
W12X19	94	1,846	19	17.53	$ 32.35	$ 59,704
W12X22	5	62	22	0.68	$ 34.35	$ 2,118
W12X26	10	176	26	2.29	$ 35.83	$ 6,307
W12X30	6	161	30	2.41	$ 47.20	$ 7,590
W12X35	6	161	35	2.81	$ 47.80	$ 7,672
W12X40	1	19	40	0.39	$ 53.25	$ 1,032
W14X22	8	130	22	1.43	$ 37.34	$ 4,869
W16X26	12	266	26	3.45	$ 36.41	$ 9,669
W16X31	13	371	31	5.75	$ 42.31	$ 15,684
W16X34	1	30	34	0.51	$ 42.31	$ 1,280
W16X40	1	27	40	0.53	$ 53.75	$ 1,433
W18X40	7	177	40	3.55	$ 50.57	$ 8,964
W18X50	1	27	50	0.67	$ 63.50	$ 1,695
W24X62	7	177	62	5.50	$ 77.20	$ 13,703
W8X24	1	7	24	0.09	$ 36.80	$ 273
W-Type Members	234	EA	Total Tons	54.27	Total Cost	$ 165,045

MISC STRUCTURE	NO	L	LB/FT	TONS	Bare Cost ($/L.F.)	$
C4x4.5	9	216	4.5	4.37	$ 23.37	$ 5,045
C4x7.2	1	14	7.2	0.05	$ 26.84	$ 370
MC4X13.8	1	12	13.8	0.08	$ 29.31	$ 345
MISC. STRU.			Total Tons	4.50	Total Cost	$ 5,760

DECK		Area		S.F.	Bare Cost ($/L.F.)	$
2" 20 GA. Composite Deck	1	18698		18698	$ 2.75	$ 51,419.50
1 1/2" 20 GA. Roof Deck	1	1902		1902	$ 2.25	$ 4,279.50
DECK			Total SF	20600	Total Cost	$ 55,699.00

Center for Sustainable Landscapes - Cast-in-Place Concrete Quantity Takeoff

					Concrete Calculations					Finish	Forms		Reinforcing					
	Quantity	Length	Width	Height	FTG	Piers	Wall	Lt W. Slabs	Lt W. Slabs	Steel	Pier	Wall	# 4	# 5	# 6	# 7	Mesh	Floor Cuts.
Cont. Wall FTG																		
WF1	1	115	3	1	345									1670				
WF2	1	210	4	2	1680									4627				
WF3	1	28	2	1	56									296				
Spread FTG																		
F1	8	5	5	1.5	300										432			
F2	26	4	4	1.5	624										1092			
F3	1	6	6	1.5	54										132			
Piers																		
P1	15	2	2	3		180					360			720				
P2	3	1	2	7.5		45					135			288				
Walls																		
CW1	1	115	1.5	27			4658					6291		6440		9323		
CW2	1	27.5	1	5.167			142					295		339		120		
CW4	1	280	0.67	3			563					1684	3926					
CW5	1	270	1	14.5			3915					7859		540				
Slabs																		
Slab on Grade	1	1	10518	0.33				3471		10518							10518	848
Slab on Composite Metal Deck	1	1	18700	0.33					6171	18700							18700	
					3059	225	9277	3471	6171	29218	495	16129	3926	14920	1656	9443	29218	848
Waste					1.10	1.10	1.10	1.10	1.10	1.00	Pier	Wall	1.10	1.10	1.10	1.10	1.10	1.00
Conversion					27.0	27.0	27.0	27.0	27.0	1.0	Form	Form	0.67	1.05	1.50	2.04	1.00	1.05
Total					124.6	9.2	378.0	141.4	251.4	29218	495	16129	1.45	8.62	1.4	10.6	32140	890
					Cubic Yards					SF			Ton				SF	LF

* Concrete unit pricing is located on Detailed Structural Estimate Summary

Appendix C:

General Conditions Estimate

Center for Sustainable Landscapes - General Conditions Estimate				
General Conditions	**Quantity**	**Unit**	**Cost**	**Total**
Job Length	48	Week		
Personnel				
Project Engineer	11	Month	$ 16,000.00	$ 176,000.00
Assitant Project Engineer				
Superintendent				
Indirect Costs				
Permits	1	LS	$ 4,000.00	$ 4,000.00
Testing and Inspection Services	1	LS	$ 3,000.00	$ 3,000.00
Contingency	1	LS	$ 300,000.00	$ 300,000.00
Safety Systems	11	Month	$ 750.00	$ 8,250.00
Builders Risk Insurance	1	LS	$ 36,000.00	$ 36,000.00
Temporary Utilities/Facilities				
Temp Office Utilities	11	Month	$ 800.00	$ 8,800.00
Temp Toilets	11	Month	$ 250.00	$ 2,750.00
Temp Communications	11	Month	$ 475.00	$ 5,225.00
Temp Electric	11	Month	$ 6,000.00	$ 66,000.00
Temp Heat	6.5	Month	$ 350.00	$ 2,275.00
Temp. Fencing	11	Month	$ 750.00	$ 8,250.00
Office Trailer	11	Month	$ 900.00	$ 9,900.00
Office Trailer Setup/Removal	1	LS	$ 1,000.00	$ 1,000.00
Storage Trailer	11	Month	$ 250.00	$ 2,750.00
Dumpsters (Recyling and Waste)	48	Week	$ 250.00	$ 12,000.00
Total General Conditions Cost:				**$ 646,200.00**
Total General Conditions Cost per Week:				**$ 13,462.50**
Percentage of Contracted Value				**6.46%**

Appendix D:

LEED Scorecard

LEED for New Construction v 2.2
Registered Project Checklist

Project Name: Phipps Conservatory and Botanical Gardens - Center for Sustainable Landscapes

Project Address: One Schenley Park Drive Pittsburgh, PA 15213

Yes	?	No		
55	8	6	**Project Totals** (Pre-Certification Estimates)	69 Points
PLATINUM			**Certified**: 26-32 points **Silver**: 33-38 points **Gold**: 39-51 points **Platinum**: 52-69 points	

Yes	?	No		
8	4	2	**Sustainable Sites**	14 Points

Yes	?	No			
			Prereq 1	**Construction Activity Pollution Prevention**	Required
1			Credit 1	**Site Selection**	1
1			Credit 2	**Development Density & Community Connectivity**	1
	1		Credit 3	**Brownfield Redevelopment**	1
	1		Credit 4.1	**Alternative Transportation**, Public Transportation	1
1			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
1			Credit 4.3	**Alternative Transportation**, Low-Emitting & Fuel Efficient Vehicles	1
	1		Credit 4.4	**Alternative Transportation**, Parking Capacity	1
	1		Credit 5.1	**Site Development**, Protect or Restore Habitat	1
1			Credit 5.2	**Site Development**, Maximize Open Space	1
1			Credit 6.1	**Stormwater Design**, Quantity Control	1
1			Credit 6.2	**Stormwater Design**, Quality Control	1
		1	Credit 7.1	**Heat Island Effect**, Non-Roof	1
		1	Credit 7.2	**Heat Island Effect**, Roof	1
1			Credit 8	**Light Pollution Reduction**	1

Yes	?	No		
5			**Water Efficiency**	5 Points

1			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
1			Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
1			Credit 2	**Innovative Wastewater Technologies**	1
1			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
1			Credit 3.2	**Water Use Reduction**, 30% Reduction	1

LEED for New Construction v 2.2
Registered Project Checklist

Yes	?	No			
17			Energy & Atmosphere		17 Points
Yes			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Yes			Prereq 1	**Minimum Energy Performance**	Required
Yes			Prereq 1	**Fundamental Refrigerant Management**	Required

***Note for EAc1:** All LEED for New Construction projects registered after June 26, 2007 are required to achieve at least two (2) points.

10			Credit 1	**Optimize Energy Performance**	1 to 10
				Credit 1.1 10.5% New Buildings / 3.5% Existing Building Renovations	1
				Credit 1.2 14% New Buildings / 7% Existing Building Renovations	2
				Credit 1.3 17.5% New Buildings / 10.5% Existing Building Renovations	3
				Credit 1.4 21% New Buildings / 14% Existing Building Renovations	4
				Credit 1.5 24.5% New Buildings / 17.5% Existing Building Renovations	5
				Credit 1.6 28% New Buildings / 21% Existing Building Renovations	6
				Credit 1.7 31.5% New Buildings / 24.5% Existing Building Renovations	7
				Credit 1.8 35% New Buildings / 28% Existing Building Renovations	8
				Credit 1.9 38.5% New Buildings / 31.5% Existing Building Renovations	9
			-->	Credit 1.10 42% New Buildings / 35% Existing Building Renovations	10
3			Credit 2	**On-Site Renewable Energy**	1 to 3
				Credit 2.1 2.5% Renewable Energy	1
				Credit 2.2 7.5% Renewable Energy	2
			-->	Credit 2.3 12.5% Renewable Energy	3
1			Credit 3	**Enhanced Commissioning**	1
1			Credit 4	**Enhanced Refrigerant Management**	1
1			Credit 5	**Measurement & Verification**	1
1			Credit 6	**Green Power**	1

LEED for New Construction v 2.2
Registered Project Checklist

Yes	?	No		
6	3	4	Materials & Resources	13 Points

Yes					
			Prereq 1	**Storage & Collection of Recyclables**	Required
		1	Credit 1.1	**Building Reuse,** Maintain 75% of Existing Walls, Floors & Roof	1
		1	Credit 1.2	**Building Reuse,** Maintain 95% of Existing Walls, Floors & Roof	1
		1	Credit 1.3	**Building Reuse,** Maintain 50% of Interior Non-Structural Elements	1
1			Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1
1			Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1
	1		Credit 3.1	**Materials Reuse**, 5%	1
	1		Credit 3.2	**Materials Reuse**, 10%	1
1			Credit 4.1	**Recycled Content**, 10% (post-consumer + 1/2 pre-consumer)	1
	1		Credit 4.2	**Recycled Content**, 20% (post-consumer + 1/2 pre-consumer)	1
1			Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured	1
1			Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured	1
		1	Credit 6	**Rapidly Renewable Materials**	1
1			Credit 7	**Certified Wood**	1

Yes	?	No		
14	1		Indoor Environmental Quality	15 Points

Yes					
Yes			Prereq 1	**Minimum IAQ Performance**	Required
Yes			Prereq 2	**Environmental Tobacco Smoke (ETS) Control**	Required
1			Credit 1	**Outdoor Air Delivery Monitoring**	1
	1		Credit 2	**Increased Ventilation**	1
1			Credit 3.1	**Construction IAQ Management Plan,** During Construction	1
1			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
1			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
1			Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1
1			Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1
1			Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1
1			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
1			Credit 6.1	**Controllability of Systems**, Lighting	1
1			Credit 6.2	**Controllability of Systems**, Thermal Comfort	1
1			Credit 7.1	**Thermal Comfort,** Design	1
1			Credit 7.2	**Thermal Comfort,** Verification	1
1			Credit 8.1	**Daylight & Views,** Daylight 75% of Spaces	1
1			Credit 8.2	**Daylight & Views,** Views for 90% of Spaces	1

LEED for New Construction v 2.2
Registered Project Checklist

Yes	?	No			
5			**Innovation & Design Process**		**5 Points**
1			Credit 1.1	**Innovation in Design:** EP onsite renewable energy.	1
1			Credit 1.2	**Innovation in Design:** EP reuse or infiltrate 100% of waste water	1
1			Credit 1.3	**Innovation in Design:** EP manage all storm water on site	1
1			Credit 1.4	**Innovation in Design:** Sustainable SITES pilot participation	1
1			Credit 2	**LEED® Accredited Professional**	1

Appendix E:

BIM Use Analysis Worksheet

Center for Sustainable Landscapes - BIM Use Analysis

BIM Use*	Value to Project	Responsible Party	Value to Resp Party	Capability Rating			Additional Resources / Competencies Required to Implement	Notes	Proceed with Use
	High / Med / Low		High / Med / Low	Scale 1-3 (1 = Low)					YES / NO / MAYBE
				Resources	Competency	Experience			
Sustainability (LEED) Evaluation	High	Architect	High	3	3	1	Requires BIM experience	High value to owner due to	**Yes**
		Contractor	Med	3	3	3	Requires Appropriate Contract	the importance of achieving	
		MEP Engineer	High	2	2	1	Requires Training and Software	sustainable goals	
		Site/Civil Engineer	High	1	2	1	Requires Training and Software		
Building Systems Analysis	High	Architect	Med	3	3	1	Requires BIM experience	Ensures building is operating	**Yes**
		MEP - FP Eng.	Med	2	2	1	Requires Training and Software	to specified design sustainable	
		Facility Manager	High	1	1	1	Requires Training and Software	standards	
Record Modeling	High	Contractor	Med	3	3	3		Requires a large amount of	**Yes**
		Architect	Med	2	2	2		documentation	
		Facility Manager	High	1	1	1	Requires Software and Training		
Cost Estimation	High	Architect	Med	2	2	1	Training	Expediates estimating process	**No**
		Contractor	High	3	3	2		but requires an accurate	
		Owner	High	1	1	1			
Phase Planning (4D Modeling)	High	Contractor	High	3	3	3		Efficient planning of all resources	**Yes**
		Subcontractors	High	1	1	1	Requires Software and Training		
3D Coordination (Construction and Design)	High	Contractor	High	3	3	3		Reduce the amount of conflicts	**Yes**
		MEP - FP Eng.	Med	3	3	3		between major building systems	
		MEP - FP Subs.	High	2	2	1	Requires Software and Training	during construction	
		Architect	Low	3	3	2			
Engineering Analysis	High	Architect	High	3	3	2		Improves the design of the facility	**Yes**
		MEP - FP Eng.	High	3	3	3		and its lifecycle energy consumption	
Site Analysis	Med	Architect	High	3	3	2		Optimize location of building on site	**Yes**
Design Reviews	High	Architect	Med	3	3	2		Requires an experienced owner	**No**
		Contractor	High	3	3	3		to understand building materials	
		Owner	Low	1	1	1		and proportions virtually	
Construction System Design	High	Contractor	High	3	3	3		Increases constructability	**Yes**
		Subcontractor	Low	1	1	1	Requires Software and Training		
Building (Preventative) Maintenance Schedule	High	Contractor	Med	3	3	3		High value for the owner to	**Yes**
		Architect	Low	3	3	2		maintain optimum operations	
		Facility Manager	High	1	1	1	Requires Software and Training	efficiency	

* Additional BIM Uses as well as information on each Use can be found at http://www.engr.psu.edu/ae/cic/bimex/

Appendix F:

Level 1 Process Map

Developed with the BIM Project Execution Planning Procedure by the Penn State CIC Research Team.
http://www.engr/psu.edu/ae/cic/bimex

Center for Sustainable Landscapes – Level 1 Process Map

BIM Uses

Start Process

Schematic Design
Author Schematic Design
Architect | Design Authoring

Schematic Design
Record Modeling
Architect | Engineering Analysis

Schematic Design
Perform Design Reviews
Architect | Design Authoring

Schematic Design
Perform Engineering Analysis
Engineer | Engineering Analysis

Design Development
Author Design Development
Architect | Design Authoring

Design Development
Perform 3D Coordination
Engineer | 3D Macro Coordination

Design Development
Record Modeling
Architect | Virtual Prototyping

Design Development
Perform Design Review
Architect | 4D Modeling

Design Development
Perform Engineering Analysis
Engineer | Engineering Analysis

Construction Documents
Author Construction Documents
Architect | Design Authoring

End Process

Information Exchange

Schematic Design
- Architectural Model
- MEP Model
- Structural Model
- Civil Model

- Schematic Design Record Model
- Schematic Design Design Review
- Schematic Design Engineering Analysis Model

Design Development
- Architectural Model
- MEP Model
- Structural Model
- Civil Model

- Design Development 3D Coordination
- Design Development Record Model
- Design Development Design Review
- Design Development Engineering Analysis Model

Construction Documents
- Architectural Model
- MEP Model
- Structural Model
- Civil Model