THE CLARK

The Sterling & Francine Clark Art Institute

Williamstown, MA.

Thesis Technical Assignment II

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Executive Summary

The second technical report provides a more in depth approach to the some of the information and systems developed in the previous technical report. It will discuss the project schedule and the structural system in more detail in addition to LEED evaluation and Building Information Modeling uses.

In the detailed project schedule, there will be 125 tasks that illustrate the project sequences. A brief narrative will describe the sequence followed in the construction.

Afterwards, the detailed structural system estimate will discuss the main system used in the project. The estimate takeoff was taken by hand while RSMeans CostWorks online tool was used to organize and tabulate findings.

The general conditions estimate will briefly show the percentage of the general conditions costs to the building total cost. The general conditions estimate will not include home office overhead fees but will include monthly fees, staffing, and temporary facilities fees.

In the LEED evaluation section of the report, a draft LEED scorecard will be analyzed. This section will discuss where the LEED credits were achieved and missed.

The final section of the report will a develop building information modeling use list and a level 1 process map. It will also evaluate the he appropriateness of the used and what and why those uses should be implemented since the institute didn't apply develop building information modeling uses.

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Detailed project Schedule

The Sterling and Francine Clark Art Institute project schedule is very straightforward as it can be seen in Appendix A. The construction process is basically broken down into phases following a specific sequence of construction with each representing a specific area of the new building being constructed. Initially, the GMP documents were published on 01/04/2011 were it was approved on 04/04/2011. After which the following steps were Approvals, Coordination, Fabrication and delivery until Excavation began on 09/27/2011. The building is intended to be completed by 09/03/2013 which is very close to a period of construction of 2 years.

The construction schedule is broken down into two main sections initially: Preconstruction and Construction. The preconstruction phase includes procurement, shop drawings, MEP coordination, budget development, fabrication and delivery. The Construction process in the detailed project schedule is broken down by trade which is also broken down further by Area; this arrangement helps view the total sequential tasks that will take place within a specific area in the project. After the structural enclosure is completed, Interior fit out process takes place to install the rest of the systems such as HVAC, Mechanical Piping, Electrical and Fire protection.

Further, the order in which the tasks are performed within a specific area are constant throughout the project as it can be seen in Appendix A. The project is actually broken down into smaller section by area where each phase takes places in at least 4 parts and they are such in the following sequence: East Lower Lobby, MEP/ Reservoir, Display and East MER. Furthermore, the East MER area is broken down into a central section, East and West. The structure section includes the 4 main areas while the rest of the trades would have the East MER broken down into central, east and west since it does more time and is based on a set of tasks that would have their own detailed broken down sequence.

- See APPENDIX A for the detailed project schedules.

Detailed Structural System Estimate

The structural system for the new addition of the institute is mainly cast in place concrete. The foundation is a two-way reinforced cast in place flat slab with continuous mat top and bottom reinforcement. In this section of the report, a detailed structural system estimate using the RSMeams CostWorks online tool and the structural drawings provided is developed. The structural drawings were utilized to extract as much detailed information regarding the structural system of the project as possible. The RSMeams CostWorks online tool was used to create a detailed Unit Price Estimate of the system. Unfortunately, there are no actual cost data from the owner as they are classified.

The takeoff of the structural system was done by hand. That included total cubic yards of concrete, calculating total rebar poundage, formwork, etc. Table 1.1 will show a summary of the estimated costs for the concrete structural system of the building.

Table 1.1: summary of estimated costs for structural system

Sub System Type	Mat. O&P	Labor O&P	Equip. O&P	Total O&P
Concrete	$1,808,065	$552,008	$78,787	**$2,438,860**
Rebar	$408,093	$451,392	$0	**$859,485**
Forms & Shoring	$305,150	$857,625	$0	**$1,162,776**
Total	**$2,521,308**	**$1,861,025**	**$78,787**	**$4,461,120**

Due to the irregular shaped building, it was difficult to find a perfect typical bay for the project. As a result, the best match of a typical bay was selected for basement and first floor (Fig. 1) structures and another bay for the roof structure.

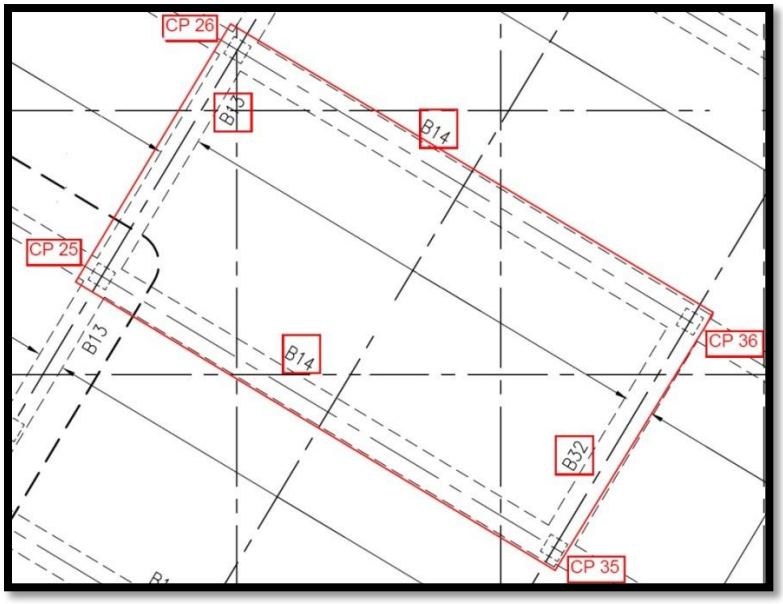


Fig. 1 – Typical bay used in developing the estimate

The following assumptions were made during calculating the detailed estimate:

1. Roof bay reinforcement sizes were accounted similar to the ones on the typical bay since they fall in the same rebar size estimation category. The RSMeans tool will group rebars from #3-#7 to calculate the estimate which will make no difference in final cost.
2. Wall heights were averaged due to the slight differences.
3. For the irregularity of the building shape:
    a. Square root of mat slab area was taken as if it is a regular square shaped building to make the rebar calculation of mat slab feasible (length of rebars and how it would be placed).
    b. The same concept of the previous point was applied in foundation wall rebar calculation.
    c. The average rebar length in beams and columns was taken to calculate total rebar weight for each since RSMeans tool will group rebars as mentioned earlier.

- See APPENDIX B for the detailed RSMeans CostWorks estimates.

General Conditions Estimate:

The General Conditions (GC) estimate was broken into two categories. The first category is the Primary Personnel consists of Project Executive, Project Engineer, Project Manager, Superintendent, MEP Coordinator, and Project Accountant. The other category which is the Field Office Expense & Temporary Facilities which includes office trailers expenses, electric and water consumption expenses, monthly telephone expenses, furniture, office supplies and equipment, porta-johns, temporary storage trailers, tools, etc.

Table 2.1 summarizes the Project's GC based on the mentioned two categories above. Note that the cost of the GC developed doesn't reflect the actual dollar amount in the original contracts.

Table 2.1: General Conditions Summary

Item	Cost
Primary Personnel	$2,242,290
Field Office Expense & Temporary Facilities	$1,399,006
TOTAL GC COST	**$3,641,296**

From the Table 2.1, the Primary Personnel costs are about 61% of the total GC costs whereas the Field Office Expense & Temporary Facilities costs are about 38% of the total GC costs.

The total GC cost is about 13% of the total project cost of $28 million. This number was reached based on the best estimate could be made without information provided by the owner representative.

- See APPENDIX C for the detailed GC estimates tables.

LEED Evaluation

The Sterling and Francine Clark Art Institute is trying to build the new addition environmental friendly. So, they decided to get a LEED certification, and they are aiming for a Silver rating. The building has met all the requirements' prerequisites defined by the U.S. Green Building Council (USGBC) for the LEED certification. This analysis is to show what has been achieved or in the progress of achieving in terms of LEED requirements. The building has achieved the minimum Silver rating requirements according to the draft LEED-NC v2.2 Scorecard provided by the owner representative. However, it is still under the goal it is aiming for by nine points according to the most recent scorecard (LEED-NC 2009). The following bullet point will analyze the Sterling and Francine Clark Art Institute LEED draft scorecard. They will be broken down according to main categories of the scorecard where the sub-bullet points are broken down to the positive credits achieved and negative credits missed respectively.

- Sustainable Sites:
    - The Sterling and Francine Clark Art Institute is reducing pollution and land development impacts from automobile use. For instance, the building provides bicycle racks within 200 yards of the building entrance, shower and changing facilities in the building, and no new parking. The building also reduces pollution from storm water runoff and eliminating contaminants by implementing a storm water runoff management plan.
    - The Sterling and Francine Clark Art Institute did not have many options to choose where to build the new addition. As a result, they could not get the best building location, to avoid the development of inappropriate sites and reduce the environmental impact, according to LEED specifications. They did not reduce pressure on undeveloped lands by rehabilitating damaged sites (Brownfields). In terms of vehicular pollution, they did not meet the requirements for Alternative Transportation—Public Transportation Access to reduce pollution and land development impacts. Also, they did not reduce the input power of all nonemergency interior luminaires with a direct line of sight to any openings in the envelope neither shielded All openings in the envelope (translucent or transparent) with a direct line of sight to any nonemergency luminaires. That resulted in not meeting the requirements of light pollution reduction credits.
- Water Efficiency:
    - The new addition is maximizing water efficiency within the building. It is almost achieving the maximum possible points in this category. In terms of water efficient landscaping, the building eliminates the use of potable water for irrigation. Moreover, it reduces potable water use for building sewage by 50% through the use of the plumbing fixtures that hold water such as efficient water closets and urinals. With all the efforts combined, the building can save 30% of its

total water usage.

- Energy Atmosphere:
  - The building is going in the direction of reducing the impacts associated with excessive energy use. It increases the levels of energy performance further than the energy atmosphere category prerequisites by 21%.
  - The institute is still working on the feasibility on applying most of the requirements of LEED in the Energy Atmosphere category while they applied only two of them. The lack of renewable energy used on site has affected the institute's LEED score negatively.
- Materials and Resources:
  - In terms of materials used in the building, a minimum of 10% of materials were either extracted or manufactured within the building region (within 500 miles radius). Furthermore, a construction and waste management plan is developed and implemented and a minimum of 50% of debris to be recycled.
  - Since the institute decided to demolish an existing building and not to use any of its structure, envelope, and framing as well as not using at least 5%, based on cost, of either salvaged, refurbished, or reused materials, not conserving resources, reducing waste, nor reducing environmental impacts of the new addition were results of that demolition.
- Indoor Environmental Quality:
  - An indoor air quality (IAQ) management plan was developed and implemented for the construction and before occupancy phases of the building. The goal is to reduce IAQ problems and increase construction workers and building occupants comfort. What's more, the use of paints and coatings which are odorous or harmful were minimized on the interior of the building to increase comfort as well as well-being of workers and future occupants. Another aspect is controllability of lighting systems. The flexible controllability of 90% gives the luxury to occupants to adjust lighting according to their needs to improve their productivity, comfort, and most importantly to decrease energy usage.
  - The new addition lacks the following LEED requirements of the indoor environmental quality. The outdoor air monitoring system is to help promoting occupant comfort and well-being. A permanent monitoring system has to be installed in the building to ensure that ventilation systems maintain design minimum requirements according to LEED requirements. Furthermore, LEED requires an improved IQA by ventilating spaces either mechanically (30% more than ASHRAE standards) or naturally (according to CIBSE Applications Manual 10: 2005) to promote occupant comfort and well-being as well. Minimizing and controlling the entry of pollutants into buildings and later cross-contamination of regularly occupied areas was not taken into consideration in the design. If that

was implemented in the building design, the occupant exposure to potentially hazardous particulates and chemical pollutants would have been minimized. The building also lacks thermal comfort according to LEED requirements. For example, to provide a comfortable thermal environment to promote occupant productivity and comfort the building has to provide at least 50% individual comfort controls to meet an individual needs and preferences. According to the nature of the building, lighting has to be highly controlled to serve galleries, for example, at best. So, the building lost the connection between indoor and outdoor spaces through the daylight and outdoor views into the regularly occupied areas of the building.

- Innovation and Design Process & Regional Priority Credits
    - The Sterling and Francine Clark Art Institute new addition gained all maximum possible points in those categories.

➢ See APPENDIX D for the LEED Scorecard.

Building Information Modeling Use Evaluation

The Building Information Model (BIM) consists of "*a digital representation of physical and functional characteristics of a facility*" according to the National Building Information Modeling Standard [(1)]. The key elements to have a successful BIM plan are to have a well-defined plan and to make sure that every team involved in a certain project knows their opportunities and responsibilities applied to them. According to the BIM Execution Planning Guide, "A completed BIM Project Execution Plan should define the appropriate uses for BIM on a project (e.g., design authoring, cost estimating, and design coordination), along with a detailed design and documentation of the process for executing BIM throughout a project's lifecycle."[(2)] For this Assignment, a less detailed BIM documentation will be provided. It will include a Level One Process Map and Goal Use Analysis (Goal Identification and BIM Use Analysis).

The Sterling & Francine Clark Art Institute didn't develop any BIM plans. So, the following BIM use suggestions were developed to show how the institute would have benefited from applying BIM on the new addition.

The first most beneficial BIM use is Asset Management. The asset Management is a process that can aid the maintenance and operation of the Art Museum and its assets and artifacts. The building asset can include the building itself, including its artifacts, and building systems and equipment. This process ensures maintaining, upgrading, and operating assets efficiently at appropriate costs that satisfy both the owner and tenants.

The second use is Engineering Analysis which is a process that manipulates certain tools for structural, lighting, energy, mechanical, and other types of building system analyses to improve the project design. Therefore, it can be applied to analyze the automated systems used in the project (Thermal Comfort and Lighting) to improve the project energy consumption and the quality of the building services.

The third use is Building Systems Analysis, a process that compares the actual building performance to the design specifications and it includes the building mechanical system and its energy use. Mainly, it ensures that building performance matches and maintains design standards. If not, the process will identify areas for improvements. This process can be a supplemental process to the Engineering Analysis and the Sustainability (LEED) Evaluation (next use) processes.

Fourth use of BIM is Sustainability (LEED) Evaluation which is a process that evaluates the project based on U.S. Green Building Council for LEED requirements. Applying this process can speed up design review time and LEED certification process and improve communication within project teams. As mentioned, the Building Systems Analysis can ensure that the building performance matches design specifications to continue maintaining LEED standards after

building occupancy.

Fifth use of BIM is 3D Coordination which is an essential process that can detect any field conflicts may happen in the building during coordination process. By applying this process, it will be easier for the team to get a clearer image of the building and its systems as it is important for applying most of BIM processes as well. This process helps the team visualizing the construction, increase productivity by eliminating conflicts and comparing 3D models of building systems while decreasing construction time, and reducing construction costs.

The last suggest BIM use is Space Management and Tracking. It is a process that allocates, manages, and track assigned workspaces effectively. A 3D model is essential here where the specialized team will utilize it to manage future changes in the use of the space throughout the building's life. The owner is planning to transform one of new addition's spaces to a restaurant. Thus, the Space Management and Tracking process can assist in planning for implementing the future restaurant.

➢ See Appendix E for BIM Worksheets and Plans

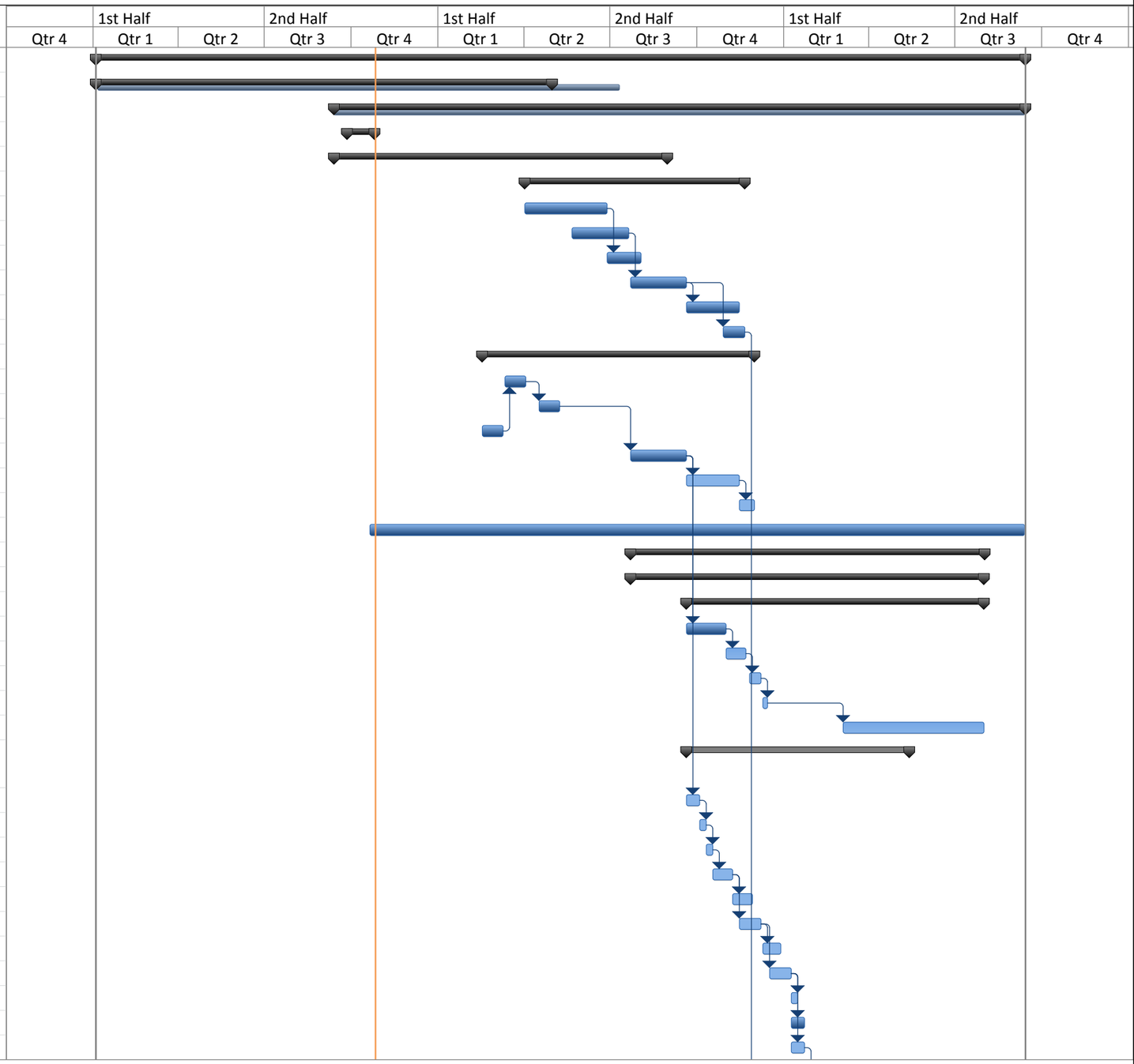
[1], [2] The Computer Integrated Construction Research Program at The Pennsylvania State University. *BIM Project Execution Planning Version 2.0*. Univevrsity Park: Computer Integrated Construction Research Program at The Pennsylvania State University, 2010. Print.

Appendix A
Detailed Project Schedule

The Sterling & Francine Clark Art Institue

Detailed Project Schedule

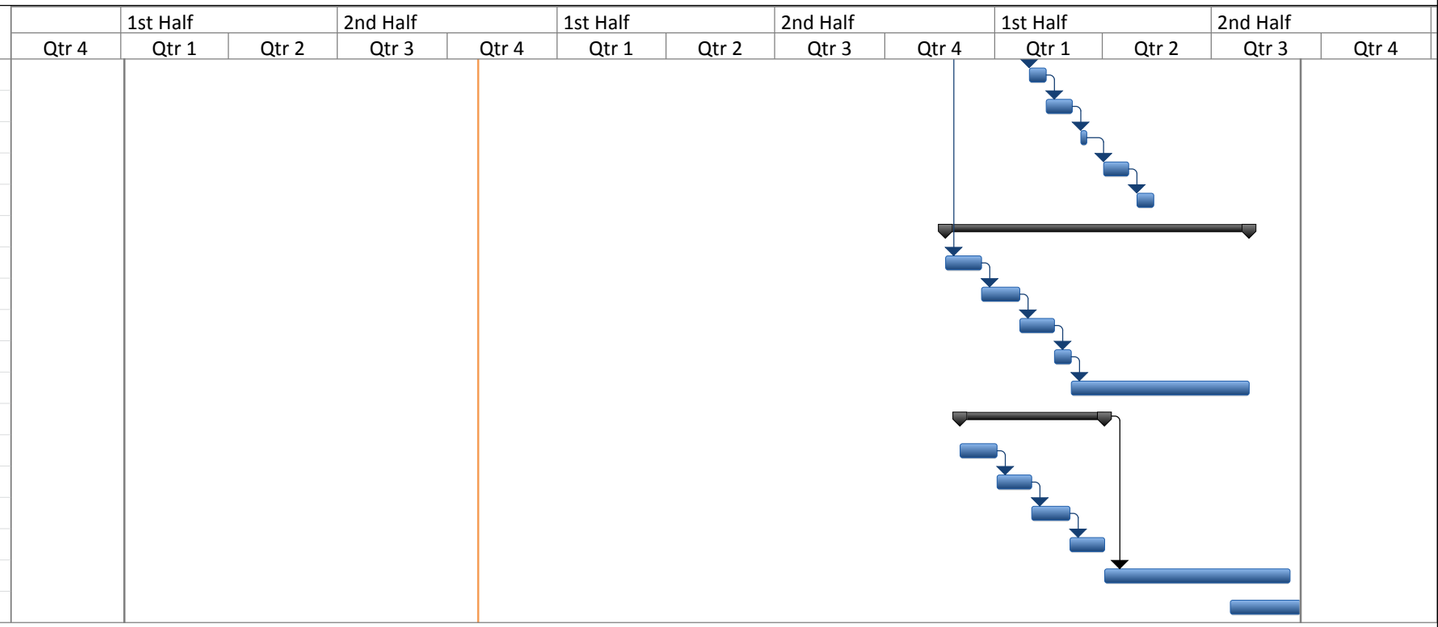
ID	Task Name	Duration	Start	Finish
1	**The Clark**	**706 days**	**Tue 1/4/11**	**Fri 9/13/13**
2	**Preconstruction**	**347 days**	**Tue 1/4/11**	**Mon 4/30/12**
28	**Construction**	**524 days**	**Tue 9/13/11**	**Fri 9/13/13**
29	**Sitework & Excavation**	**21 days**	**Tue 9/27/11**	**Tue 10/25/11**
32	**Structure**	**253 days**	**Tue 9/13/11**	**Thu 8/30/12**
66	**Enclosure**	**167 days**	**Mon 4/2/12**	**Tue 11/20/12**
67	Install Stone Cladding	63 days	Mon 4/2/12	Wed 6/27/12
68	Central: Install Curtainwall	44 days	Tue 5/22/12	Fri 7/20/12
69	West: Install Stone Cladding	26 days	Thu 6/28/12	Thu 8/2/12
70	West: Curtainwall	43 days	Mon 7/23/12	Wed 9/19/12
71	East: Install Curtainwall	40 days	Thu 9/20/12	Wed 11/14/12
72	East: Install Stone Cladding	17 days	Mon 10/29/12	Tue 11/20/12
73	**Roofing & Waterproofing**	**206 days**	**Fri 2/17/12**	**Fri 11/30/12**
74	East Lower Lobby	16 days	Mon 3/12/12	Mon 4/2/12
75	MER/ Resvoir	16 days	Tue 4/17/12	Tue 5/8/12
76	Display	16 days	Fri 2/17/12	Fri 3/9/12
77	Central	43 days	Mon 7/23/12	Wed 9/19/12
78	West	40 days	Thu 9/20/12	Wed 11/14/12
79	East	12 days	Thu 11/15/12	Fri 11/30/12
80	Water Feature	495 days	Fri 10/21/11	Thu 9/12/13
81	**Interior Fitout**	**269 days**	**Mon 7/23/12**	**Thu 8/1/13**
82	**Central**	**268 days**	**Mon 7/23/12**	**Wed 7/31/13**
89	**West**	**225 days**	**Thu 9/20/12**	**Wed 7/31/13**
90	Install Overhead HVAC	30 days	Thu 9/20/12	Wed 10/31/12
91	Install Overhead HVAC Piping	15 days	Thu 11/1/12	Wed 11/21/12
92	Install Overhead Electrical	10 days	Mon 11/26/12	Fri 12/7/12
93	Install Overhead Sprinkler	5 days	Mon 12/10/12	Fri 12/14/12
94	Finishes	107 days	Tue 3/5/13	Wed 7/31/13
95	**Lower Level: Display A, B, C / Court / MER / Resvoir**	**168 days**	**Thu 9/20/12**	**Mon 5/13/13**
96	Survey/ Layout	10 days	Thu 9/20/12	Wed 10/3/12
97	Stud Out Interior Partitions	5 days	Thu 10/4/12	Wed 10/10/12
98	Rough-In Overhead Drainage	5 days	Thu 10/11/12	Wed 10/17/12
99	Rough-In Overhead MEP pipe	15 days	Thu 10/18/12	Wed 11/7/12
100	Rough-In Overhead Ductwork	15 days	Thu 11/8/12	Wed 11/28/12
101	Rough-In Overhead Electric	17 days	Thu 11/15/12	Fri 12/7/12
102	Rough-In Overhead Sprinkler Mains	15 days	Mon 12/10/12	Fri 12/28/12
103	Install Ceiling Framing	17 days	Mon 12/17/12	Tue 1/8/13
104	Install Sprinkler Drops	5 days	Wed 1/9/13	Tue 1/15/13
105	Install Electrical Drops	10 days	Wed 1/9/13	Tue 1/22/13
106	Install Ductwork Drops	10 days	Wed 1/9/13	Tue 1/22/13



Project: Detailed project Schedule
Date: Thu 10/27/11

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

ID	Task Name	Duration	Start	Finish
107	Close Ceiling & Walls	10 days	Wed 1/30/13	Tue 2/12/13
108	Apply Accounstic Plaster - Ceiling	16 days	Wed 2/13/13	Wed 3/6/13
109	Prime & Paint Walls & Ceiling	3 days	Thu 3/14/13	Mon 3/18/13
110	Install Fixtures, Grilles & Devices	15 days	Tue 4/2/13	Mon 4/22/13
111	Lay & Finish Wood Flooring	10 days	Tue 4/30/13	Mon 5/13/13
112	**East - MEP/ Link**	**182 days**	**Wed 11/21/12**	**Thu 8/1/13**
113	Install Overhead Ductwork	22 days	Wed 11/21/12	Thu 12/20/12
114	Install Overhead HVAC Piping	22 days	Fri 12/21/12	Mon 1/21/13
115	Install Overhead Electrical	21 days	Tue 1/22/13	Tue 2/19/13
116	Install Overhead Sprinkler	10 days	Wed 2/20/13	Tue 3/5/13
117	Finishes	107 days	Wed 3/6/13	Thu 8/1/13
118	**MEP**	**87 days**	**Mon 12/3/12**	**Tue 4/2/13**
119	Set Electrical Equipment	23 days	Mon 12/3/12	Wed 1/2/13
120	Set AHUs & Pumps	21 days	Thu 1/3/13	Thu 1/31/13
121	Rterminations at HVAC systems	22 days	Fri 2/1/13	Mon 3/4/13
122	Startup HVAC systems	21 days	Tue 3/5/13	Tue 4/2/13
123	Comissioning	111 days	Wed 4/3/13	Wed 9/4/13
124	Closeout	43 days	Wed 7/17/13	Fri 9/13/13



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Date: Thu 10/27/11

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

Appendix B

RSMeans CostWorks

Detailed Structural System Estimate

The Sterling And Francine Art Institute Detailed Structural Systems Estimate

Wiiliamstown, MA **01267**

Data Release : Year 2011 Quarter 3, **Unit Cost Estimate**

Quantity	LineNumber	Source	SubContracted Ind.	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Ext. Mat.	Ext. Labor	Ext. Equip.	Ext. Total	Mat. O&P	Labor O&P	Equip. O&P	Total O&P	Ext. Mat. O&P	Ext. Labor O&P	Ext. Equip. O&P	Ext. Total O&P	Labor Type	Data Release	Zip Code	Notes
2095.48	033105350400			Building Beams(based on the typical bay selected)				C.Y.	$ 113.11	$ -	$ -	$ 113.11	$ 237,019.74	$ -	$ -	$ 237,019.74	$ 124.32	$ -	$ -	$ 124.32	$ 260,510.07	$ -	$ -	$ 260,510.07	RR	Year 2011 Quarter 3	012	Structural concrete, ready mix, normal weight, 5000 psi, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments
2156	033105350400			Slabs (took average and based on the typical bay selected)				C.Y.	$ 113.11	$ -	$ -	$ 113.11	$ 243,865.16	$ -	$ -	$ 243,865.16	$ 124.32	$ -	$ -	$ 124.32	$ 268,033.92	$ -	$ -	$ 268,033.92	RR	Year 2011 Quarter 3	012	Structural concrete, ready mix, normal weight, 5000 psi, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments
540.11	033105350400			Columns (took average and based on the typical bay selected)				C.Y.	$ 113.11	$ -	$ -	$ 113.11	$ 61,091.84	$ -	$ -	$ 61,091.84	$ 124.32	$ -	$ -	$ 124.32	$ 67,146.48	$ -	$ -	$ 67,146.48	RR	Year 2011 Quarter 3	012	Structural concrete, ready mix, normal weight, 5000 psi, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments
3661.44	033105350400			Mat Slab (calculated the the mat slab area and converted it to CY's)				C.Y.	$ 113.11	$ -	$ -	$ 113.11	$ 414,145.48	$ -	$ -	$ 414,145.48	$ 124.32	$ -	$ -	$ 124.32	$ 455,190.22	$ -	$ -	$ 455,190.22	RR	Year 2011 Quarter 3	012	Structural concrete, ready mix, normal weight, 5000 psi, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments
3240	033105350400			Foundation Walls				C.Y.	$ 113.11	$ -	$ -	$ 113.11	$ 366,476.40	$ -	$ -	$ 366,476.40	$ 124.32	$ -	$ -	$ 124.32	$ 402,796.80	$ -	$ -	$ 402,796.80	RR	Year 2011 Quarter 3	012	Structural concrete, ready mix, normal weight, 5000 psi, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments
306	033105350400			Arch. Foundation Walls				C.Y.	$ 113.11	$ -	$ -	$ 113.11	$ 34,611.66	$ -	$ -	$ 34,611.66	$ 124.32	$ -	$ -	$ 124.32	$ 38,041.92	$ -	$ -	$ 38,041.92	RR	Year 2011 Quarter 3	012	Structural concrete, ready mix, normal weight, 5000 psi, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments
697.9	033105350400			Roof Beams (based on typical roof bay selected)				C.Y.	$ 113.11	$ -	$ -	$ 113.11	$ 78,939.47	$ -	$ -	$ 78,939.47	$ 124.32	$ -	$ -	$ 124.32	$ 86,762.93	$ -	$ -	$ 86,762.93	RR	Year 2011 Quarter 3	012	Structural concrete, ready mix, normal weight, 5000 psi, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments
1655.65	033105350400			Roof Slabs (based on typical roof bay selected)				C.Y.	$ 113.11	$ -	$ -	$ 113.11	$ 187,270.57	$ -	$ -	$ 187,270.57	$ 124.32	$ -	$ -	$ 124.32	$ 205,830.41	$ -	$ -	$ 205,830.41	RR	Year 2011 Quarter 3	012	Structural concrete, ready mix, normal weight, 5000 psi, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments
2793.38	033105700050			Project Beams Placement	C20	60	1.067	C.Y.	$ -	$ 49.45	$ 13.94	$ 63.39	$ -	$ 138,132.64	$ 38,939.72	$ 177,072.36	$ -	$ 80.52	$ 15.37	$ 95.89	$ -	$ 224,922.96	$ 42,934.25	$ 267,857.21	RR	Year 2011 Quarter 3	012	Structural concrete, placing, beam, small, elevated, pumped, includes strike off & consolidation, excludes material
540.11	033105700600			Columns Placement	C20	90	0.711	C.Y.	$ -	$ 32.97	$ 9.31	$ 42.28	$ -	$ 17,807.43	$ 5,028.42	$ 22,835.85	$ -	$ 53.26	$ 10.21	$ 63.47	$ -	$ 28,766.26	$ 5,514.52	$ 34,280.78	RR	Year 2011 Quarter 3	012	Structural concrete, placing, column, square or round, pumped, 18" thick, includes strike off & consolidation, excludes material
3811.65	033105701500			Slabs Placement	C20	160	0.4	C.Y.	$ -	$ 18.64	$ 5.23	$ 23.87	$ -	$ 71,049.16	$ 19,934.93	$ 90,984.09	$ -	$ 29.80	$ 5.75	$ 35.55	$ -	$ 113,587.17	$ 21,916.99	$ 135,504.16	RR	Year 2011 Quarter 3	012	Structural concrete, placing, elevated slab, pumped, 6" to 10" thick, includes strike off & consolidation, excludes material
3661.44	033105702950			Mat Placement	C20	400	0.16	C.Y.	$ -	$ 7.48	$ 2.10	$ 9.58	$ -	$ 27,387.57	$ 7,689.02	$ 35,076.60	$ -	$ 12.05	$ 2.30	$ 14.35	$ -	$ 44,120.35	$ 8,421.31	$ 52,541.66	RR	Year 2011 Quarter 3	012	Structural concrete, placing, foundation mat, pumped, over 20 C.Y., includes strike off & consolidation, excludes material
68153	033529300125			Conc. finishing (floors)	C10	2000	0.012	S.F.	$ -	$ 0.58	$ -	$ 0.58	$ -	$ 39,528.74	$ -	$ 39,528.74	$ -	$ 0.93	$ -	$ 0.93	$ -	$ 63,382.29	$ -	$ 63,382.29	RR	Year 2011 Quarter 3	012	Concrete finishing, floors, basic finishing for unspecified flatwork, bull float & manual float, excludes placing, striking off & consolidating
24406.56	033529600600			Cast In Place Walls (based on average wall height)	1 Cefi	300	0.027	S.F.	$ 0.30	$ 1.38	$ -	$ 1.68	$ 7,321.97	$ 33,681.05	$ -	$ 41,003.02	$ 0.33	$ 2.16	$ -	$ 2.49	$ 8,054.16	$ 52,718.17	$ -	$ 60,772.33	RR	Year 2011 Quarter 3	012	Concrete finishing, walls, float finish, 1/16" thick

5508	033533500100			Line number 033533500100 through 0335335005000 correspond to Arch. walls finishing	1 Cefi	6400	0.001	S.F.	$ 0.39	$ 0.06	$ -	$ 0.45	$ 2,148.12	$ 330.48	$ -	$ 2,478.60	$ 0.43	$ 0.10	$ -	$ 0.53	$ 2,368.44	$ 550.80	$ -	$ 2,919.24	RR	Year 2011 Quarter 3	012	Slab texture stamping, step 1 - first application of dry shake colored hardener, excludes placing, striking off & consolidating
5508	033533500110			Line number 033533500100 through 0335335005000 correspond to Arch. walls finishing	1 Cefi	6400	0.001	S.F.	$ -	$ 0.06	$ -	$ 0.06	$ -	$ 330.48	$ -	$ 330.48	$ -	$ 0.10	$ -	$ 0.10	$ -	$ 550.80	$ -	$ 550.80	RR	Year 2011 Quarter 3	012	Slab texture stamping, step 2 - bull float, excludes placing, striking off & consolidating
5508	033533500130			Line number 033533500100 through 0335335005000 correspond to Arch. walls finishing	1 Cefi	6400	0.001	S.F.	$ 0.19	$ 0.06	$ -	$ 0.25	$ 1,046.52	$ 330.48	$ -	$ 1,377.00	$ 0.21	$ 0.10	$ -	$ 0.31	$ 1,156.68	$ 550.80	$ -	$ 1,707.48	RR	Year 2011 Quarter 3	012	Slab texture stamping, step 3 - second application of dry shake colored hardener, excludes placing, striking off & consolidating
5508	033533500140			Line number 033533500100 through 0335335005000 correspond to Arch. walls finishing	3 Cefi	1280	0.019	S.F.	$ -	$ 0.98	$ -	$ 0.98	$ -	$ 5,397.84	$ -	$ 5,397.84	$ -	$ 1.51	$ -	$ 1.51	$ -	$ 8,317.08	$ -	$ 8,317.08	RR	Year 2011 Quarter 3	012	Slab texture stamping, step 4 - bull float, manual float & steel trowel, excludes placing, striking off & consolidating
5508	033533500150			Line number 033533500100 through 0335335005000 correspond to Arch. walls finishing	1 Cefi	6400	0.001	S.F.	$ 0.08	$ 0.06	$ -	$ 0.14	$ 440.64	$ 330.48	$ -	$ 771.12	$ 0.09	$ 0.10	$ -	$ 0.19	$ 495.72	$ 550.80	$ -	$ 1,046.52	RR	Year 2011 Quarter 3	012	Slab texture stamping, step 5 - application of dry shake colored release agent, excludes placing, striking off & consolidating
5508	033533500160			Line number 033533500100 through 0335335005000 correspond to Arch. walls finishing	3 Cefi	2400	0.01	S.F.	$ 1.44	$ 0.52	$ -	$ 1.96	$ 7,931.52	$ 2,864.16	$ -	$ 10,795.68	$ 1.58	$ 0.81	$ -	$ 2.39	$ 8,702.64	$ 4,461.48	$ -	$ 13,164.12	RR	Year 2011 Quarter 3	012	Slab texture stamping, step 6 - place, tamp & remove mats, excludes placing, striking off & consolidating
5508	033533500170			Line number 033533500100 through 0335335005000 correspond to Arch. walls finishing	1 Cefi	1280	0.006	S.F.	$ -	$ 0.33	$ -	$ 0.33	$ -	$ 1,817.64	$ -	$ 1,817.64	$ -	$ 0.51	$ -	$ 0.51	$ -	$ 2,809.08	$ -	$ 2,809.08	RR	Year 2011 Quarter 3	012	Slab texture stamping, step 7 - touch up edges, mat joints & simulated grout lines, excludes placing, striking off & consolidating
5508	033533500400			Line number 033533500100 through 0335335005000 correspond to Arch. walls finishing	1 Cefi	1600	0.005	S.F.	$ -	$ 0.25	$ -	$ 0.25	$ -	$ 1,377.00	$ -	$ 1,377.00	$ -	$ 0.41	$ -	$ 0.41	$ -	$ 2,258.28	$ -	$ 2,258.28	RR	Year 2011 Quarter 3	012	Slab texture stamping, step 8 - pressure wash @ 3000 psi after 24 hours, excludes placing, striking off & consolidating
5508	033533500500			Line number 033533500100 through 0335335005000 correspond to Arch. walls finishing	1 Cefi	800	0.01	S.F.	$ 0.49	$ 0.52	$ -	$ 1.01	$ 2,698.92	$ 2,864.16	$ -	$ 5,563.08	$ 0.54	$ 0.81	$ -	$ 1.35	$ 2,974.32	$ 4,461.48	$ -	$ 7,435.80	RR	Year 2011 Quarter 3	012	Slab texture stamping, step 9 - roll 2 coats cure/seal compound when dry, excludes placing, striking off & consolidating
91635.8	032110600202			Total rebar lbs in project columns	4 Rodm	3000	0.011	Lb.	$ 0.43	$ 0.57	$ -	$ 1.00	$ 39,403.39	$ 52,232.41	$ -	$ 91,635.80	$ 0.46	$ 0.95	$ -	$ 1.41	$ 42,152.47	$ 87,054.01	$ -	$ 129,206.48	RR	Year 2011 Quarter 3	012	Reinforcing Steel, in place, columns, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories
464858.22	032110600402			All project slabs	4 Rodm	5800	0.006	Lb.	$ 0.45	$ 0.30	$ -	$ 0.75	$ 209,186.20	$ 139,457.47	$ -	$ 348,643.67	$ 0.49	$ 0.50	$ -	$ 0.99	$ 227,780.53	$ 232,429.11	$ -	$ 460,209.64	RR	Year 2011 Quarter 3	012	Reinforcing Steel, in place, elevated slabs, #4 to #7, A615, grade 60, incl labor for accessories, excl material for accessories
168691.68	032110600552			MAT Slab #9 rebars	4 Rodm	7200	0.004	Lb.	$ 0.43	$ 0.23	$ -	$ 0.66	$ 72,537.42	$ 38,799.09	$ -	$ 111,336.51	$ 0.46	$ 0.40	$ -	$ 0.86	$ 77,598.17	$ 67,476.67	$ -	$ 145,074.84	RR	Year 2011 Quarter 3	012	Reinforcing Steel, in place, footings, #8 to #18, A615, grade 60, incl labor for accessories, excl material for accessories
6080.62	032110600102			Total rebar lbs in project beams	4 Rodm	3200	0.01	Lb.	$ 0.43	$ 0.53	$ -	$ 0.96	$ 2,614.67	$ 3,222.73	$ -	$ 5,837.40	$ 0.46	$ 0.89	$ -	$ 1.35	$ 2,797.09	$ 5,411.75	$ -	$ 8,208.84	RR	Year 2011 Quarter 3	012	Reinforcing Steel, in place, beams and girders, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories
125575.53	032110600702			Total rebar lbs in project foundation walls (took most typical found. wall)	4 Rodm	6000	0.005	Lb.	$ 0.43	$ 0.29	$ -	$ 0.72	$ 53,997.48	$ 36,416.90	$ -	$ 90,414.38	$ 0.46	$ 0.47	$ -	$ 0.93	$ 57,764.74	$ 59,020.50	$ -	$ 116,785.24	RR	Year 2011 Quarter 3	012	Reinforcing Steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories
15334.425	031113202500			Forms for project beams	C2	320	0.15	SFCA	$ 2.04	$ 6.87	$ -	$ 8.91	$ 31,282.23	$ 105,347.50	$ -	$ 136,629.73	$ 2.25	$ 11.24	$ -	$ 13.49	$ 34,502.46	$ 172,358.94	$ -	$ 206,861.39	RR	Year 2011 Quarter 3	012	C.I.P. concrete forms, beams and girders, interior, plywood, 24" wide, 1 use, includes shoring, erecting, bracing, stripping and cleaning
9711.8	031113256500			Forms for project columns	C1	190	0.168	SFCA	$ 2.43	$ 7.53	$ -	$ 9.96	$ 23,599.67	$ 73,129.85	$ -	$ 96,729.53	$ 2.67	$ 12.27	$ -	$ 14.94	$ 25,930.51	$ 119,163.79	$ -	$ 145,094.29	RR	Year 2011 Quarter 3	012	C.I.P. concrete forms, column, square, plywood, 24" x 24", 1 use, includes erecting, bracing, stripping and cleaning
3542.4	031113850150			Forms for project foundation walls	C2	280	0.171	L.F.	$ 1.94	$ 7.86	$ -	$ 9.80	$ 6,872.26	$ 27,843.26	$ -	$ 34,715.52	$ 2.13	$ 12.82	$ -	$ 14.95	$ 7,545.31	$ 45,413.57	$ -	$ 52,958.88	RR	Year 2011 Quarter 3	012	C.I.P. concrete forms, wall, box out for opening, to 16" thick, over 10 S.F. (use perimeter), includes erecting, bracing, stripping and cleaning
68153	031113351000			Forms for project slabs	C2	470	0.102	S.F.	$ 3.16	$ 4.67	$ -	$ 7.83	$ 215,363.48	$ 318,274.51	$ -	$ 533,637.99	$ 3.48	$ 7.64	$ -	$ 11.12	$ 237,172.44	$ 520,688.92	$ -	$ 757,861.36	RR	Year 2011 Quarter 3	012	C.I.P. concrete forms, elevated slab, flat plate, plywood, to 15' high, 1 use, includes shoring, erecting, bracing, stripping and cleaning
Total													**$2299864.81**	**$1137953.03**	**$71592.09**	**$3509409.94**					**$2521308.43**	**$1861025.06**	**$78787.07**	**$4461120.54**				

Appendix C
General Conditions Estimate

Table 2.2: Primary Personnel					
Item	**Quantity**	**Unit**	**HRS/WK**	**Unit Labor**	**Total Labor**
Project Executive	156	WKS	8	$1,128	$175,968
Project Engineer	156	WKS	40	$2,000	$312,000
Project Manager	156	WKS	40	$3,558	$555,048
Superintendent	135	WKS	40	$4,038	$545,130
MEP Coordinator	160	WKS	40	$3,558	$569,280
Project Accountant	156	WKS	8	$1,632	$254,592
				TOTAL	**$2,242,290**

Table 2.3: Field Office Expense & Temporary Facilities					
Item	**Quantity**	**Unit**	**Unit Material Cost**	**Total Material Cost**	**Total Cost**
Field Office Expense					
Office Trailers - Set Up	1	LS	$12,500	$12,500	$12,500
Office Trailers - Rental	36	MOS	$2,400	$86,400	$86,400
Electric - Consumption	36	MOS	$600	$21,600	$21,600
Water & Sanitary Consumption	36	MOS	$250	$9,000	$9,000
Telephones - Monthly	36	MOS	$285	$10,260	$10,260
Furniture	1	LS	$30,000	$30,000	$30,000
Stationary & Supplies	36	MOS	$1,150	$41,400	$41,400
Copier - (purchase)	2	LS	$52,500	$105,000	$105,000
Fax Machine - Purchase	1	LS	$2,500	$2,500	$2,500
Computer Equipment	36	MOS	$3,108	$111,888	$111,888
Progress Photos	34	MOS	$625	$21,250	$21,250
Safety Supplies	36	MOS	$235	$8,460	$8,460
				SUB-TOTAL	**$460,258**
Temporary Facilities					
Porta-Johns	20	MOS	$1,450	$29,000	$29,000
Temp. Storage Trailers	20	MOS	$500	$10,000	$10,000
Project Signs	36	MOS	$1,200	$43,200	$43,200
Tool Rentals	36	MOS	$500	$18,000	$18,000
Housing Expenses	36	MOS	$6,647	$239,292	$239,292
Travel Expenses	36	MOS	$5,996	$215,856	$215,856
Automobile Mileage	36	MOS	$10,125	$364,500	$364,500
Meeting Expenses	36	MOS	$525	$18,900	$18,900
				SUB-TOTAL	**$938,748**
				TOTAL	**$1,399,006**

Appendix D
LEED Scorecard

LEED 2009 for New Construction and Major Renovations

Project Checklist

Sterling and Francine Clark Art Institute VECC+PLANT

11.19.2010

Sustainable Sites — Possible Points: 26

Y	?	N			
Y			Prereq 1	Construction Activity Pollution Prevention	
		1	Credit 1	Site Selection	1
	5		Credit 2	Development Density and Community Connectivity	5
		1	Credit 3	Brownfield Redevelopment	1
		6	Credit 4.1	Alternative Transportation—Public Transportation Access	6
1			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
3			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
2			Credit 4.4	Alternative Transportation—Parking Capacity	2
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

Water Efficiency — Possible Points: 10

Y			Prereq 1	Water Use Reduction—20% Reduction	
4			Credit 1	Water Efficient Landscaping	2 to 4
2			Credit 2	Innovative Wastewater Technologies	2
2			Credit 3	Water Use Reduction	2 to 4

Energy and Atmosphere — Possible Points: 35

Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
5	2		Credit 1	Optimize Energy Performance	1 to 19
		1	Credit 2	On-Site Renewable Energy	1 to 7
2			Credit 3	Enhanced Commissioning	2
	2		Credit 4	Enhanced Refrigerant Management	2
	3		Credit 5	Measurement and Verification	3
	2		Credit 6	Green Power	2

Materials and Resources — Possible Points: 14

Y			Prereq 1	Storage and Collection of Recyclables	
		3	Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
		1	Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
1	1		Credit 2	Construction Waste Management	1 to 2
		2	Credit 3	Materials Reuse	1 to 2

Materials and Resources, Continued

Y	?	N			
	2		Credit 4	Recycled Content	1 to 2
1	1		Credit 5	Regional Materials	1 to 2
		1	Credit 6	Rapidly Renewable Materials	1
	1		Credit 7	Certified Wood	1

Indoor Environmental Quality — Possible Points: 15

Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
		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 and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
	1		Credit 4.3	Low-Emitting Materials—Flooring Systems	1
	1		Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
		1	Credit 5	Indoor Chemical and 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 and Views—Daylight	1
		1	Credit 8.2	Daylight and Views—Views	1

Innovation and Design Process — Possible Points: 6

1			Credit 1.1	Innovation in Design: Specific Title	1
1			Credit 1.2	Innovation in Design: Specific Title	1
1			Credit 1.3	Innovation in Design: Specific Title	1
1			Credit 1.4	Innovation in Design: Specific Title	1
1			Credit 1.5	Innovation in Design: Specific Title	1
1			Credit 2	LEED Accredited Professional	1

Regional Priority Credits — Possible Points: 4

1			Credit 1.1	Regional Priority: Specific Credit	1
1			Credit 1.2	Regional Priority: Specific Credit	1
1			Credit 1.3	Regional Priority: Specific Credit	1
1			Credit 1.4	Regional Priority: Specific Credit	1

Total — Possible Points: 110

41	24	25			

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

Appendix E

BIM Worksheets and Plans

BIM Goals Worksheet

Priority (1-3)	Goal Description	Potential BIM Uses
1- Most Important	**Value added objectives**	
1	Aid the the maintenance and operation of the Art Museum and its assets and artifacts.	Asset Management, 3D Coordination
2	Automated systems analysis (Thermal Comfort and Lighting), Efficient Energy Consumption, Improving the quality of the building services.	Engineering Analysis, LEED Evaluation
3	Ensure building is operating to specified design and sustainable standards (Continuing to maintain LEED standards after building occupancy)	Building Systems Analysis, LEED Evaluation
3	Assisting in planning for adding a future restaurant	Space Management and Tracking, 3D Coordination
3	Accelerate design review and LEED certification process and improve communication between project participants in order to achieve LEED credits	LEED Evaluation, 3D Coordination

BIM Use*	Value to	Responsible Party	Value to	Capability Rating			Additional	Notes	Proceed with
	High / Med / Low		High / Med / Low	Scale 1-3 (1 = Low)					YES / NO / MAYBE
				Resources	Competency	Experience			
Building Systems Analysis	MED	MEP Engineer	HIGH						**YES**
		Architect	MED						
3D Coordination (Construction)		Contractor	HIGH						**YES**
		Subcontractors	HIGH						
		Designer	MED						
Engineering Analysis	HIGH	MEP Engineer	HIGH						**YES**
		Architect	MED						
		Owner	LOW						
3D Coordination (Design)	HIGH	Architect	HIGH						**YES**
		MEP Engineer	MED						
		Structural Engineer	HIGH						
Asset Management	HIGH	Owner	HIGH						**YES**
		Architect	HIGH						
Sustainability (LEED) Anlysis	MED	Contractor	MED						**YES**
		MEP Engineer	HIGH						
		Architect	HIGH						
Space Management and Tracking	LOW	Architect	HIGH						**MAYBE**
		Owner	MED						
		Contractor	LOW						
4D Modeling									**NO**
Site Utilization Planning									**NO**
Layout Control & Planning									**NO**
Site Analysis									**NO**
Design Reviews									**NO**
Existing Conditions Modeling									**NO**
Design Authoring									**NO**
Programming									**NO**

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

LEVEL 1: BIM EXECUTION PLANNING PROCESS

The Sterling & Francine Clark Art Institute

Developed with the BIM Project Execution Planning Procedure by the Penn State CIC Research Team

http://www.engr/psu.edu/ae/cic/bimex