# Technical Report 1

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


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September 23, 2011

Construction Option

Advisor: Dr. Robert Leicht

Penn State AE Senior Thesis

## Executive Summary

Technical Report 1 is a synopsis of the scope of work being performed and contractual organization of the construction of the *Center for Sustainable Landscapes* (CSL) for *The Phipps Conservatory and Botanical Gardens* by Turner Construction. The *Center for Sustainable Landscapes* (CSL) project is primarily the development of a currently undeveloped portion of the Phipps Conservatory campus in Schenley Park, Pittsburgh PA. Included in the project is the demolition of a small portion of warehouse and the new construction of a 3 story, 24,350 SF mixed use educational facility and office building.

With the construction of the CSL, the Phipps Conservatory will add to its repertoire of iconographic buildings by becoming a home to one of the most sustainable commercial buildings in the nation. The CSL is attempting to meet the Living Building Challenge issued by the ILBI, and the Sustainable SITES certification issued by the Sustainable Sites Initiative. By meeting the Living Building Challenge objectives, the building will also exceed LEED Platinum certification. As a result, the biggest challenge faced by this project is the successful achievement of all 3 prestigious sustainable goals.

As a result of the sustainable focus, a plethora of unique construction materials and techniques are used on this project. Some of the sustainable features include: a green roof, passive and active HVAC systems, onsite power generation, onsite gray water retention, and a building automation system for the control of the dynamic building elements and power consumption. Due to the heavy emphasis on sustainability, increases in upfront construction costs were seen as an exchange for lower life-cycle costs.

Sustainable challenges aside, the construction of the CSL will not present any additional construction abnormalities. The Phipps Conservatory is a relatively experienced owner that allows the project schedule to be flexible to changes. As a result, the project schedule is not compressed and is of an average duration for the project size. Traditional construction and contractual practices used on the project include: construction of a cast-in-place concrete substructure and structural steel superstructure, the project delivery method used was design-bid-build with a lump-sum contractual agreement. The project budget is approximately ten million dollars. The project is managed by three full time onsite personnel and two office managers. The project site, relative to the building footprint, does not present any unique scheduling or site lay out issues.

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## Synopsis of Project Schedule Summary

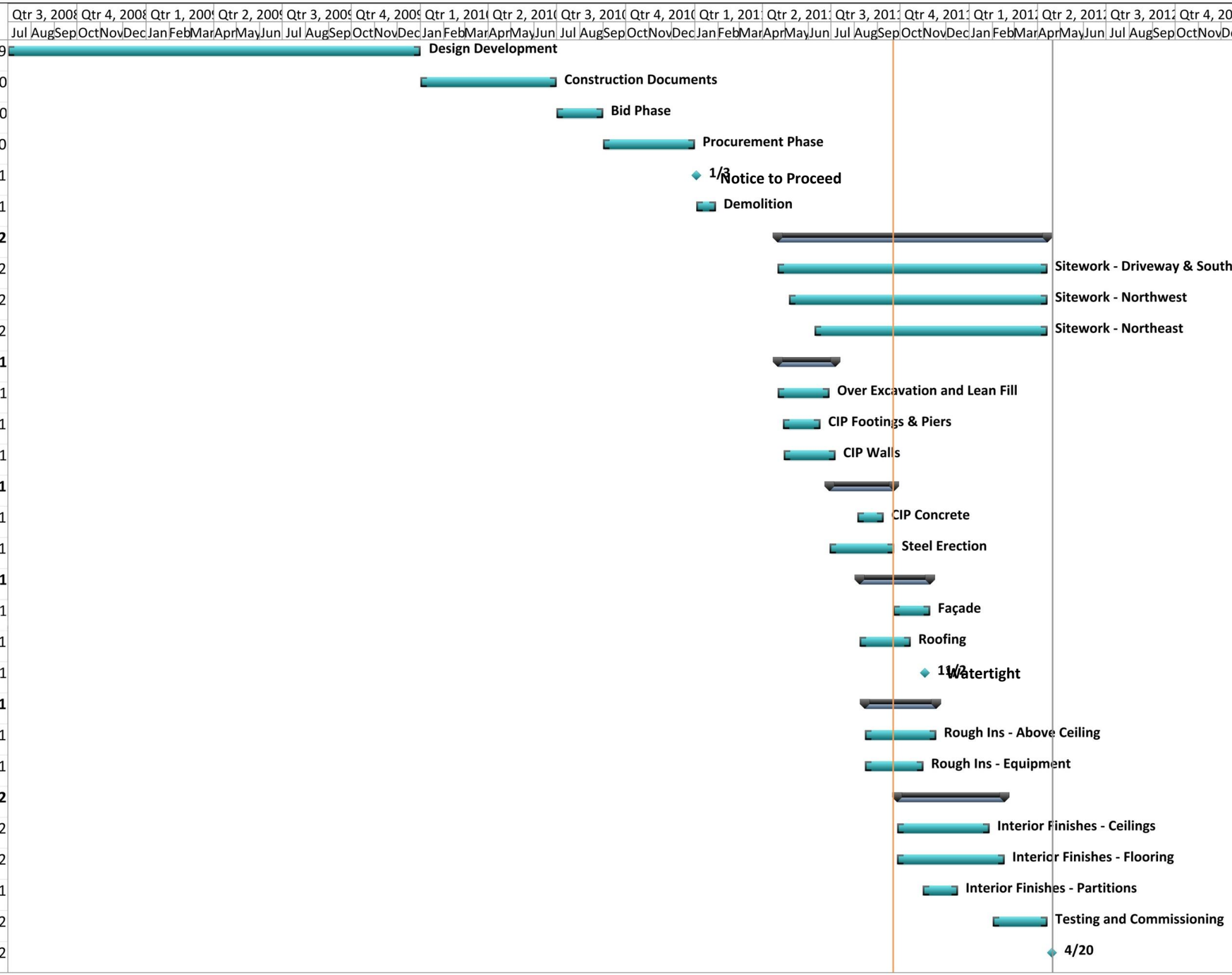
Design development for the project began in the summer of 2008 with the selection of *The Design Alliance Architects* of Pittsburgh, PA. The Construction Documents were started in January of 2010 and were completed June that year. The Bid Phase lasted for a 2 month period from the beginning of July through the end of August. Upon award of the project, Turner Construct finalized the Project Procurement phase with subcontractor buy-outs and purchase orders. The Notice to Proceed occurred in the beginning of January 2011.

The Construction Phase of the project came in with the New Year in January 2011. Demolition of the existing warehouse occurred throughout January and February prior to the start of construction in April. Construction on the CSL began on April 21, 2011 with the excavation of foundations and the construction of the substructure. Substructure construction continued through to the beginning of July with the completion of the CIP concrete structural walls. Erection of the Superstructure began just prior to the ending of substructure construction on June 29, 2011. As the erection of the Superstructure continues, overlapping work begins to take place with the installation of roofing in order to meet the watertight milestone prior to the start of the colder season and winter. Currently, the exterior envelope is on schedule to be completed in the beginning of November. As the structure nears completion, the ramping up of Mechanical, Electrical, Plumbing, and Fire Protection (MEPFP) trades during rough installation will start and continue throughout the winter slowing transitioning into interior finishes installation and ending with testing and commissioning of the newly installed systems. Project completion is currently scheduled for April 20th, 2012.


**Figure 1 -** This photo was taken on September 7th, 2011. Construction crews were working on completion of the 2nd and 3rd floor's Slab on Deck (SOD).

# Project Schedule Summary - Center for Sustainable Landscapes

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | Design Development | 393 days | Tue 7/1/08 | Thu 12/31/09 |
| 2 | Construction Documents | 129 days | Fri 1/1/10 | Wed 6/30/10 |
| 3 | Bid Phase | 44 days | Thu 7/1/10 | Tue 8/31/10 |
| 4 | Procurement Phase | 88 days | Wed 9/1/10 | Fri 12/31/10 |
| 5 | **Notice To Proceed** | 0 days | Mon 1/3/11 | Mon 1/3/11 |
| 6 | **Demolition** | 20 days | Mon 1/3/11 | Fri 1/28/11 |
| 7 | **Site Work** | **257 days** | **Thu 4/21/11** | **Fri 4/13/12** |
| 8 | Sitework - Driveway & South | 257 days | Thu 4/21/11 | Fri 4/13/12 |
| 9 | Sitework - Northwest | 246 days | Fri 5/6/11 | Fri 4/13/12 |
| 10 | Sitework - Northeast | 222 days | Thu 6/9/11 | Fri 4/13/12 |
| 11 | **Substructure** | **55 days** | **Thu 4/21/11** | **Wed 7/6/11** |
| 12 | Over Excavation and Lean Fill | 49 days | Thu 4/21/11 | Tue 6/28/11 |
| 13 | CIP Footings & Piers | 36 days | Thu 4/28/11 | Thu 6/16/11 |
| 14 | CIP Walls | 49 days | Fri 4/29/11 | Wed 7/6/11 |
| 15 | **Superstructure** | **62 days** | **Wed 6/29/11** | **Thu 9/22/11** |
| 16 | CIP Concrete | 25 days | Fri 8/5/11 | Thu 9/8/11 |
| 17 | Steel Erection | 62 days | Wed 6/29/11 | Thu 9/22/11 |
| 18 | **Enclosure** | **68 days** | **Mon 8/8/11** | **Wed 11/9/11** |
| 19 | Façade | 35 days | Thu 9/22/11 | Wed 11/9/11 |
| 20 | Roofing | 50 days | Mon 8/8/11 | Fri 10/14/11 |
| 21 | **Watertight** | 0 days | Wed 11/2/11 | Wed 11/2/11 |
| 22 | **MEP/FP Rough-In** | **69 days** | **Mon 8/15/11** | **Thu 11/17/11** |
| 23 | Rough Ins - Above Ceiling | 69 days | Mon 8/15/11 | Thu 11/17/11 |
| 24 | Rough Ins - Equipment | 56 days | Mon 8/15/11 | Mon 10/31/11 |
| 25 | **Interior Finishes** | **103 days** | **Tue 9/27/11** | **Thu 2/16/12** |
| 26 | Interior Finishes - Ceilings | 89 days | Tue 9/27/11 | Fri 1/27/12 |
| 27 | Interior Finishes - Flooring | 103 days | Tue 9/27/11 | Thu 2/16/12 |
| 28 | Interior Finishes - Partitions | 35 days | Mon 10/31/11 | Fri 12/16/11 |
| 29 | **Testing and Commissioning** | 52.81 days | Wed 2/1/12 | Fri 4/13/12 |
| 30 | **Occupancy** | 0 days | Fri 4/20/12 | Fri 4/20/12 |




Project: Project Schedule without
Date: Thu 9/22/11

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 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 | |

## Building System Summary

| Building Systems Summary | | |
|---|---|---|
| Yes | No | Work Scope |
| x | | Demolition |
| x | | Structural Steel Frame |
| x | | Cast-in-place concrete |
| | x | Precast Concrete |
| x | | Mechanical System |
| x | | Electrical System |
| | x | Masonry |
| x | | Curtain Wall |
| x | | Support of Excavation |
| x | | LEED Certification |
| X | | Living Building Certification |
| X | | Sustainable SITES Certification |

*Demolition* –

Neighboring the CSL building footprint is the existing B & G Warehouse. During the site development stage, eselect demolition of a portion of the single story CMU warehouse occurred. The existing warehouse is approximately 16,000 SF in size, of which 7,500 SF will be demolished. During the demolition process, no hazardous materials were encountered. The remaining portions of the masonry warehouse will be repointed and painted. In Figure 2 below, the area highlighted in red denotes the portion of the building that was demolished.


**Figure 2** – A bird's eye view of the project site from the north, the area in red is the portion of the warehouse that was demolished.

## *Structural Steel Frame* –

The primary structural building material for the CSL is structural steel. Beam sizes consist primarily of type W12 and W16 made of ASTM A992 steel with a yield strength of 50 ksi. Column sizes consist primarily of HSS 4x4 and HSS 6x6 shapes made with ASTM A500 Grade B with a yield strength of 36 ksi. The CSL is unique in that it is being constructed against a steeply sloped hill. The building's structural system benefits from this design in that it requires little lateral bracing. Lateral loads that are imposed on the frame are channeled back into the concrete foundation/retaining wall (highlighted in red on Figure 3) that extends to the bottom of the 3rd story and span across 4 of the 8 structural bays in the building.

The crane used for the erection of steel was a Terex Model T560, a 50 ton hydraulic truck crane. The cranes location changed with the progression of construction; moving from the western portion of the site to the eastern portion.

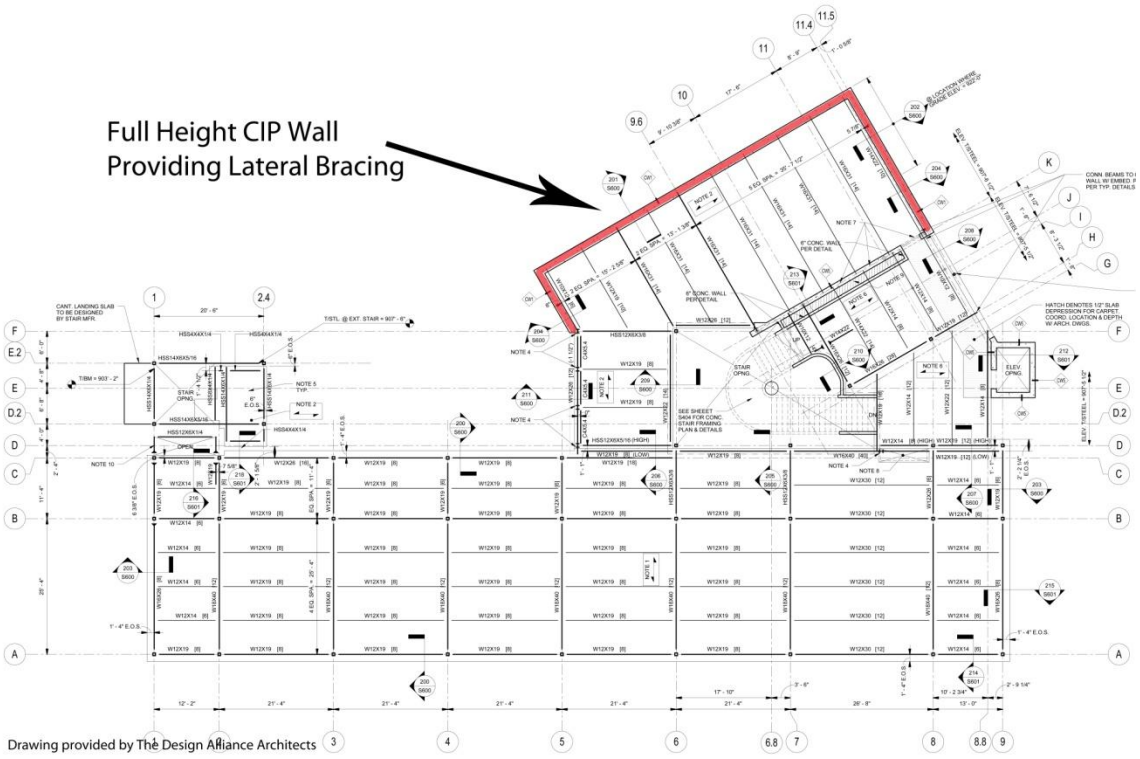


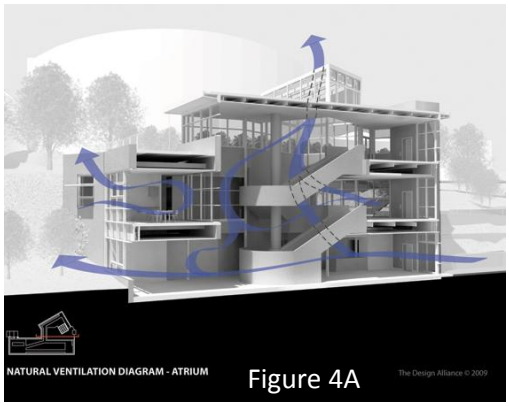

**Figure 3** – First Floor plan provided by The Design Alliance Architects. Area highlighted in red is a CIP concrete wall approximately 28 ft height, extending to the bottom of the 3rd floor.

*Cast-in-Place Concrete* –

Cast-in-place (CIP) concrete was utilized as a secondary structural component on numerous aspects of the project. Specifically, cast-in-place concrete was used as for foundation footings and walls, a column in the atrium, the atrium stair, Slab on Grade 1st floor, Slab on Deck above grade floors, and a few select concrete walls. Metal reusable wall forms were used for all CIP concrete with the exception of the atrium column and stair; both of which are currently being considered to be constructed out of an alternative material for constructability reasons. Above grade SODs are constructed of 2" composite metal decking with a 3-1/2" concrete slab placed on top of welded wire fabric reinforcing. Due to accessibility reasons, placement of the majority of concrete required the use of a concrete pump. In addition, all slabs required the use of Lightweight concrete.

*Mechanical System* –

Perhaps one of the most technically advanced systems in the CSL, the mechanical system is a combination of passive and active design. The majority of the building is heated and cooled by one variable air volume AHU supplying a maximum of 12,400 CFM. A geothermal ground source heat pump and enthalpy wheel was installed in order to further reduce the energy load imposed by the AHU. Housed on the north side of the first floor, the mechanical room supplies the AHU with preconditioned refrigerant from the closed loop geothermal system and air pressure to the dry pipe fire suppression system. In addition, other unique design features include a raised floor system for the distribution of supply air, thermal radiant floor heating to provide supplementary heat, and a green roof for increased thermal mass to stabilize the heating and cooling loads. Unconditioned space, such as the large atrium, remains entirely heated and cooled naturally through passive design. Two diagrams depicting the air flow in the passively design spaces are pictured below.





**Figures 4A & 4B** – Provided by The Design Alliance Architects, images depict the natural ventilation of the passively designed spaces.

*Electrical System* –

Due to the new facilities close proximity to the Phipps Conservatory; a 600 amp 3 phase electrical service connects the new CSL with the existing neighboring facilities. Standard voltages of 120/208 and 277/480 are distributed as needed throughout the building via the raised access floor system. A unique aspect of the electrical system is the large amount of power generated onsite. A current goal for the building is to maintain net-zero energy use on an annual basis. Onsite generation is primarily composed of three 36 kW solar panel arrays, but also utilizes vertical axis wind turbines to supplement demand. Furthermore, the utilization of a Direct Digital Control Building Management System will provide system feedback for optimal energy efficiency. Aside from having onsite variable power generation, no redundant electrical systems are being installed.

The lighting system is a hybrid of energy efficient LED, florescent lighting, and natural lighting design. The CSL is equipped with a building automation system that controls the amount of natural light that enters a space through a system of moveable sunshades. The dynamic shading system for this building enables the shades to move over the course of a day and year to control the amount of natural light entering the space. The dynamic shading system also maximizes or minimizes the thermal gains when appropriate to reduce the cooling and heating loads.

*Exterior Wall Assembly* –

The exterior wall assembly design fully embodies the sustainable design motifs of the project. Depicted in Image 6, is a cross section of a portion of a typical exterior wall. 2 types of exterior glazing are used, all of which are Sealed Clear Insulating Glass Units (IGU) with multiple Low-E suspended films. Significant variations include; thicknesses of 1-1/2", 1-1/4", and R-Value of 10.87, 7.69 respectively.

**Wall Assembly from Outside Surface to Inside Surface**

1. Reclaimed Barn Wood
2. Wood battons
3. Air Space
4. 2" Rigid Board Insulation
5. Weather Barrier
6. 5/8" Glass-Mat Gypsum Sheathing
7. 8" Metal Stud Framing
8. 8" Fiberglass Insulation
9. 5/8" Gypsum Wall Board

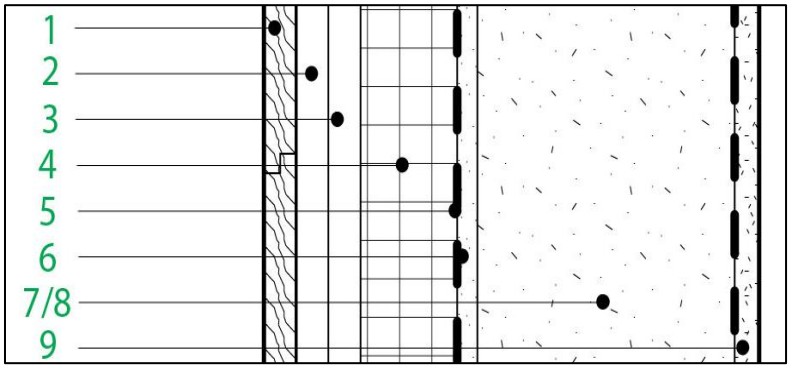



**Figure 6** – Cross Section of Exterior wall

*Excavation Support System* –

In order to properly protect the adjacent Phipps Conservatory greenhouses and to stabilize excavation, the utilization of a rock tieback system was used on the north side of the building. During construction, the internal support from the tiebacks will provide construction workers with a clear space to operate. Once complete, the tieback system will remain in place as a permanent component of the building structure. For this project, no dewatering system was required.

*Sustainable Achievements* –

The CSL is going to set a high standard for sustainability on a national scale. Currently, this project is attempting to meet multiple sets of standards including; LEED Platinum, Living Building Challenge, and SITES Certification for Landscapes. In order to accomplish these goals several design and construction practices have been directly implemented.

Implemented Sustainable Designs and Technologies:

- Passive building design strategies that minimize energy usage through maximizing natural lighting and heating and minimizing cooling
- Direct Digital Control Building Management System will monitor and control dynamic passive systems for optimal efficient operations
- Demand Controlled Ventilation, consisting of $CO_2$ sensors located in rooms to determine the minimum amount of outside air ventilation required per occupancy level.
- High thermal mass façade and low emissivity windows
- Ground source geothermal heat pump used to capture an estimated 70% of heating and cooling energy
- Desiccant energy recovery wheel (Enthalpy Wheel) pre-cools and pre-heats outside air as needed to further reduce cooling and heating loads.
- Solar Photovoltaics and Vertical Axis Wind Turbines for onsite electricity generation.
- Sustainable materials meeting the Regional , Recycled, and salvaged content requirements
- Green Roof to reduce storm water runoff and to reduce heating and cooling loads on the HVAC system
- Rainwater harvesting for reuse as gray water
- Lagoon System to capture overflow from rainwater harvesting cisterns and permit it to enter the environment in a natural manner
- Permeable paving for natural filtration of water into ground
- Constructed Wetland to treat all sanitary water from CSL site

## Project Cost Evaluation

*Actual Construction Cost* –

| | | |
|---|---|---|
| Construction Cost: | $ 10,000,000 | $ 410 /SF |

The entire contracted value for construction was $10 million, which was approximately $410 per SF (value based on the total gross square footage of building). Exclusions from construction cost include; land cost, and permitting.

*Actual Building System Costs* –

| | | |
|---|---|---|
| Mechanical/Plumbing System Cost: | $ 600,000 | $ 25 /SF |
| Electrical System Cost: | $ 1,000,000 | $ 41 /SF |
| Structural System and Facade Cost: | $ 1,700,000 | $ 70 /SF |
| Fire Protection System Cost: | $ 75,000 | $ 3.10 /SF |

The building system costs expose the actual building systems costs. The prices are expressed as lump-sum and square foot values. The scope of work includes the supply and installation of each system. The structural system includes; substructure, superstructure, and façade.

*Square Foot Estimate* –

| | | |
|---|---|---|
| Square Foot Estimated Cost: | $ 3,859,500 | $ 158.50 |

The Square Foot Estimate was performed using cost data from RS Means Costworks, an online data base of pricing and cost estimation software. The square foot estimate revealed that the actual project costs for the CSL were significantly higher than the estimated value. This increased cost is a result of the high amount of money invested in technology and intelligent design.

*Square Foot Estimate Assumptions:*

It was assumed that the building type that most accurately represented the CSL was a College Classroom building, 2-3 Stories in height with a decorative concrete block façade and a structural steel frame. Project specific inputs include: 520 LF of perimeter wall, 24350 SF of floor area, 14 ft story height, and a project location in Pittsburgh PA being built in 2011. Additional equipment added to estimate includes a hydraulic, 3 stop elevator. Contractor's OH&P was estimated to be a generous 6%. Architectural Fees were estimated to 3%. Excluded from this cost is site work. See Square Foot Estimate in Appendix A for more the estimate.

*Assemblies Estimate* –

| | | |
|---|---|---|
| Assembly Estimate Mechanical/Plumbing Cost: | $ 762,400 | $ 31 /SF |
| Assembly Estimate Electrical Cost: | $ 999,643 | $93 /SF |
| Assembly Estimate Fire Protection Cost: | $ 80,700 | $ 3.30 |

The Assemblies Estimate was performed using RS Means Costworks. The values for the assemblies' costs are expressed as lump-sums and square foot costs.

*Results*:

In the Assemblies estimate, the RS Means generic system assumptions do not adequately reflect the actual Mechanical systems specified in the plans and specification. The Mechanical/Plumbing system was estimated to cost an additional 27% more than the actual cost for design and installation. Estimated costs of a raised floor system are not available as an assembly in RS Means, resulting in a significant difference to the scope of work estimated. Furthermore, RS Means also does not provide pricing data for gray water recycling cisterns and other sustainable design features. Effectively, due to the above average level of intricacies built into the sustainable system designed, RS Means was not able to provide an accurate Mechanical/Plumbing system cost.

RS Means did estimate the cost of the Electrical system and Fire Protection systems accurately, with a cost variation of less than 1% and 7% respectively. RS Mean's Assemblies Cost Data for these systems more accurately reflected the actual systems installed than that of the mechanical system.

## Site Plan Description

*Existing Conditions* –

Developed from the original Existing Conditions site plan C100 provided by the Design Alliance Architects, the ensuing Existing Conditions plan is a layout of the undeveloped site prior to the start of construction. This site plan reflects the site layout for temporary facilities, parking, access roads, onsite utilities (above and below ground), and neighboring buildings. Flow of construction vehicular traffic is represented with large yellow arrows. Pedestrian traffic is not depicted as there are no pedestrian walkways on or near the project site. Utilities depicted in gray are future utilities that will be installed during construction.

*Phase 1* –

Phase 1 construction plan is developed from the same Existing Conditions plan, C100, but does not reflect the existing utilities. The original contractor layout prescribed the utilization of the existing warehouse for temporary office space. Technologies demanded by projects teams exceeded those provided by the warehouse, as a result, the placement of a job trailer in an isolated corner of the warehouse was prescribed. Temporary power is shown on the north site of the future building footprint. During this phase demolition of a portion of the existing B & G Warehouse will occur, the area of demolition is depicted in red. Additionally, excavation and construction of the foundation will occur during this phase of construction. Site work completed during this stage includes the installation of rock anchors (tiebacks) into the bank on the north side of the project site. Salvaged material will need to be stockpiled for this portion of construction for reuse in later phases.

*Phase 2* –

Phase 2 is developed from the existing utilities plan C500. During this stage of construction the placement of the concrete and the erection of steel will occur. The operating radius of the crane is depicted as the circle in red. Additional activities that will occur during this phase are the beginning of the construction of the exterior wall, and the beginning of the rough installation of the MEP systems. Problematic areas for Phase 2 will largely be a result of site congestion/traffic passing through the only site access road while work on that portion of the building is occurring.

*Phase 3* –

Phase 3 construction plan is developed from the existing utilities plan C500. The most significant activity represented on this page is the completion of the site. Progression of site work will flow from the north east to south west corners of the site. Important activities occurring during this phase include: MEP Rough-out, partition framing and drywall, installation of building finishes, and commissioning.

NORTH

Closed to public use -
Construction traffic only

Gate

Existing Building:
Phipps Conservatory and Botanical Gardens
Height: Variable/Approx. 40'

Existing Building:
B & G Warehouse
Height: 14' - 0"

Building Height:
46' - 0"

Proposed Building Footprint

Dumpster

Turner Job Trailer

Job Johnny

Parking

Traffic Flow

**LEGEND**

- PROPERTY LINE
- EXISTING ADJACENT PROPERTY LINE
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- EXISTING SANITARY SEWER LINE
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING GAS LINE
- EXISTING UNPAVED DRIVEWAY
- EXISTING UNPAVED ROADWAY
- EXISTING EDGE OF CONCRETE
- EXISTING EDGE OF PAVEMENT
- EXISTING FENCE
- EXISTING GUIDERAIL
- EXISTING TRAIL
- EXISTING TREE/BRUSH LINE
- EXISTING BUSHES
- EXISTING BUILDING
- EXISTING IRON PIN
- EXISTING MANHOLE
- EXISTING STORM SEWER INLET/CATCH BASIN
- EXISTING UTILITY POLE
- EXISTING UTILITY POLE W/ GUY WIRE
- EXISTING GAS VALVE/METER
- EXISTING WATERLINE VALVE
- EXISTING POST
- EXISTING SIGN
- EXISTING MAILBOX
- EXISTING SIGNAL
- EXISTING BOLLARD
- EXISTING SPOT ELEVATION
- PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- PROPOSED WALL
- PROPOSED SPOT ELEVATION
- REINFORCED SOIL SLOPE
- DETAIL NUMBER / SHEET NUMBER

Notes:
- Property lines extend beyond boundaries of plan.
- Non-construction pedestrian / vehicular traffic does not interfere with site.
- Temproary Lighting located on existing utility poles.
- Fire hydrants are not located in the immediate vicinity.
- Worker parking will change frequently. Parking will typically occur at the South Eastern side of the warehouse. And along the south side of the site.

SCALE IN FEET
0 40 80

Center for Sustainable Landscapes (CSL)

for:
Phipps Conservatory and Botanical Gardens

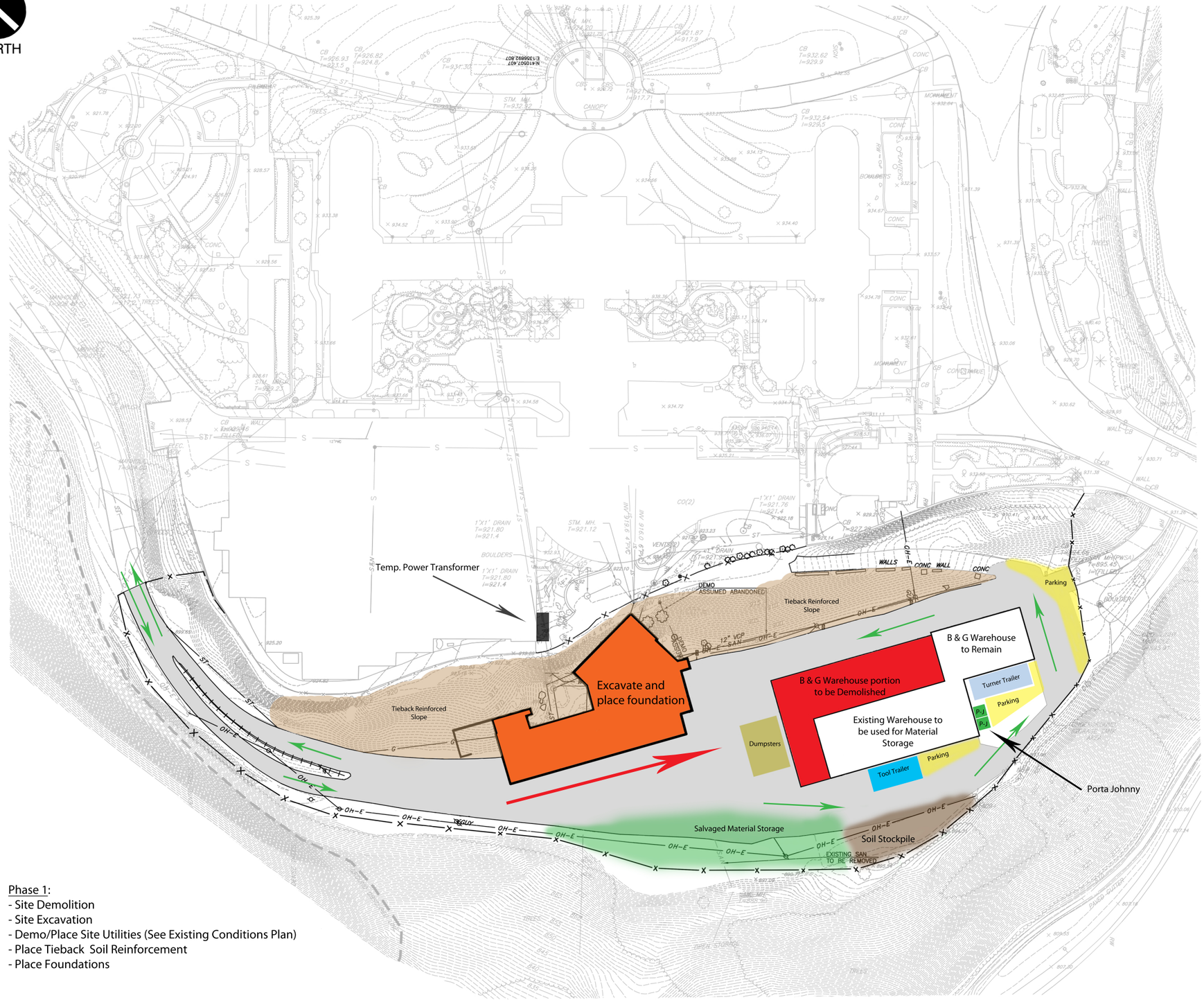
One Schenley Park Drive
Pittsburgh, Pa 15213

DATE: 9/23/2011

EXISTING CONDITIONS

DANIEL ZARTMAN

NORTH




**LEGEND**

- PROPERTY LINE
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- EXISTING SPOT ELEVATION
- PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- PROPOSED WALL
- PROPOSED SPOT ELEVATION
- REINFORCED SOIL SLOPE
- DETAIL NUMBER / SHEET NUMBER
- Direction of Intended Traffic Flow
- Direction of Work Flow

SCALE IN FEET
0 40 80

Phase 1:
- Site Demolition
- Site Excavation
- Demo/Place Site Utilities (See Existing Conditions Plan)
- Place Tieback Soil Reinforcement
- Place Foundations

Center for Sustainable Landscapes (CSL)

for:
Phipps Conservatory and Botanical Gardens

One Schenley Park Drive
Pittsburgh, Pa 15213

DATE: 9/23/2011

Construction Site Plan
Phase 1

DANIEL ZARTMAN

NORTH

**LEGEND**

- PROPERTY LINE
- EXISTING ADJACENT PROPERTY LINE
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
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- EXISTING GAS VALVE/METER
- EXISTING WATERLINE VALVE
- EXISTING POST
- EXISTING SIGN
- EXISTING MAILBOX
- EXISTING SIGNAL
- EXISTING BOLLARD
- EXISTING SPOT ELEVATION
- PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- PROPOSED WALL
- PROPOSED SPOT ELEVATION
- REINFORCED SOIL SLOPE
- DETAIL NUMBER / SHEET NUMBER

Direction of Work Flow

Material Storage

B & G Warehouse to Remain

Material Storage

Turner Trailer

Parking

Existing Warehouse to be used for Material Storage

Parking

Tool Trailer

Parking

Dumpsters

Place Concrete Slab and Erect Steel

Porta John

Salvaged Material Storage

Soil Stockpile

Operationing Radius of Crane

Steel Lay - Down Area

Variable Location of Concrete Pump

Phase 2:
- Erect Steel
- Place Concrete Slabs
- Construct Exterior Wall
- Install Roofing
- Rough Installation of MEP Systems
- Continuation of Site Development
- Operating locations of crane represent the beginning and final location

SCALE IN FEET
0 40 80

Center for Sustainable Landscapes (CSL)

for:

Phipps Conservatory and Botanical Gardens

One Schenley Park Drive
Pittsburgh, Pa 15213

DATE: 9/23/2011

Construction Site Plan
Phase 2

DANIEL ZARTMAN

NORTH

Progression of Site Work

Temp. Power Transformer

Gate

CSL Building Footprint

Existing B & G Warehouse to be used for storage of Materials

Turner Trailer

Tool Trailer

Parking

Dumpsters

Material Storage

Phase 3:
- MEP Rough-out
- Framing and Drywall
- Install Building Finishes
- Complete Site Work and Paving
- Start-Ups, Testing, Inspections, Commissioning

LEGEND

- PROPERTY LINE
- EXISTING ADJACENT PROPERTY LINE
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- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- EXISTING SANITARY SEWER LINE
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING GAS LINE
- EXISTING UNPAVED DRIVEWAY
- EXISTING UNPAVED ROADWAY
- EXISTING EDGE OF CONCRETE
- EXISTING EDGE OF PAVEMENT
- EXISTING FENCE
- EXISTING GUIDERAIL
- EXISTING TRAIL
- EXISTING TREE/BRUSH LINE
- EXISTING BUSHES
- EXISTING BUILDING
- EXISTING IRON PIN
- EXISTING MANHOLE
- EXISTING STORM SEWER INLET/CATCH BASIN
- EXISTING UTILITY POLE
- EXISTING UTILITY POLE W/ GUY WIRE
- EXISTING GAS VALVE/METER
- EXISTING WATERLINE VALVE
- EXISTING POST
- EXISTING SIGN
- EXISTING MAILBOX
- EXISTING SIGNAL
- EXISTING BOLLARD
- EXISTING SPOT ELEVATION
- PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- PROPOSED WALL
- PROPOSED SPOT ELEVATION
- PROPOSED GAS LINE
- PROPOSED UNDERGROUND ELECTRIC
- PROPOSED UTILITY POLE
- PROPOSED TRANSFORMER PAD
- RELOCATED GAS METER

Direction of Work Flow through interior spaces

Material access points to interior spaces

SCALE IN FEET
0 40 80

SEALS

Center for Sustainable Landscapes (CSL)

for:
Phipps Conservatory and Botanical Gardens

One Schenley Park Drive
Pittsburgh, Pa 15213

DATE: 9/23/2011

Construction Site Plan
Phase 3

Daniel Zartman

## Local Conditions

The construction site is located in a large park, in a residential neighborhood. The main vehicular access road to the site is located on a main thoroughfare through the neighborhood leading towards downtown Pittsburgh. The site is of an average size relative to the building's footprint. The only neighboring building to the site is also owned by the owner, Phipps Conservatory. Parking is currently available for all trades onsite, and will remain that way for the entirety of the project. Designated parking locations can be viewed on the preceding phasing plans.

Since this is a sustainable construction site, a large amount of recycling and sorting will occur on site prior to removal. Local tipping fees are $31.00 per ton for trash, and $40 per ton for recyclables.

According to the USDA, Natural Resources Conservation Service soil survey, the soils at the site belong to the Urban Land-Rainsboro and the Gilpin-Uphsur series. Soils consist primarily of residual soil weathered from sandstone, siltsone, and shale. The water level was not obtainable as all 35 of the boring samples were recorded as being dry. The deepest recorded depth sampled was 35 feet, as a result no dewatering is necessary.

Local preferred construction methods that are typical to that of the Pittsburgh region include: steel, masonry, and concrete buildings. For sustainable construction projects, it is more favorable to use steel to contribute to attaining LEED certification as its use increases the percentage of recycled content used on the project.

## Client Information/Project information


Image provided by Phipps Conservatory.

Built in 1893, the original Phipps Conservatory and Botanical Gardens is a cultural icon to the Greater Pittsburgh area. Located in Schenley Park near downtown Pittsburgh, Phipps operates as a non-profit with an intense focus on education on the importance and beauty of plants. Phipps has been noticing sizable growth and an increase in national and international attention, as it was the host for the opening dinner of the 2009 G-20 Summit in Pittsburgh. With this surge of attention, the conservatory has invested in a campus wide development and focused on increasing its national image. The image above is a view of the entrance and the original Phipps greenhouse.

Phipps is expanding to offer more educational services by creating a 24,000 GSF mixed use classroom and research building. The most significant expectations of the project by the owner is that the building is built with sustainability in mind, and achieves all three sustainable design certifications sought. Sustainability is what Phipps preaches, and the purpose of this building, aside from growth and development, is largely increasing awareness for sustainability.

There are almost no externalities affecting work on this project. Site access and size are suitable for the scale of the building footprint and project. The site that the building is going to inhabit is currently not in use, and thus no phased or dual occupancy requirements are needed. Minor inconveniences include the relocation of a few select utilities and the demolition of a portion of an existing warehouse.

## Project Delivery System

The CSL was delivered via traditional design-bid-build approach. This approach was chosen because it is a well known project delivery system amongst local contractors. Furthermore, utilizing a design-bid-build delivery system allowed the owner to lock-in a price, prior to the start of construction (making an exception to change orders). The contractor was selected for this project through a private bid proposal. The contractor, having worked with the owner in the past, utilized knowledge gained from past experiences to their advantage. For the bid, a Bid Bond of 5% of the contracted value was required. The successful bidder was also required to furnish both a Performance Bond and Payment Bond for 100% of the contracted amount upon award. In addition, the successful bidder must also furnish an AIA document A305 Contractor's Qualification Statement.

Turner also operates a contractor controlled insurance program, which requires the prequalification of subcontractors and that they furnish and maintain Builder's Risk Insurance. Turner requires that subcontractors hold Workers' Comp., Employers' Liability Insurance, and Commercial General Liability Insurance. Upon acceptance of a subcontract, Turner also requires each subcontractor to supply a Performance and Payment Bond for the project.

In Figure 7 (Page 20), the project organizational chart is shown. Contracts between all parties are Lump Sum. In the chart, solid lines depict contractual obligations while dotted lines represent lines of communication. Contract types are all typical AIA General Contract and Subcontract documents. Contractually, this project is unique in the owner holds independent subcontractors.

Traditional design-bid-build is not the most ideal for the construction of this project. With such a constrained budget and an existing relationship with the owner, a design-build contract could have been more beneficial. Increased collaboration and planning could have saved the owner significant money while increasing project value. Constructability could have been considered as a more serious design factor. Currently, complications are increasing with the specified construction of a cast-in-place concrete stair, an issue that should have never occurred.

Project Team Organizational Chart
Center for Sustainable Landscapes

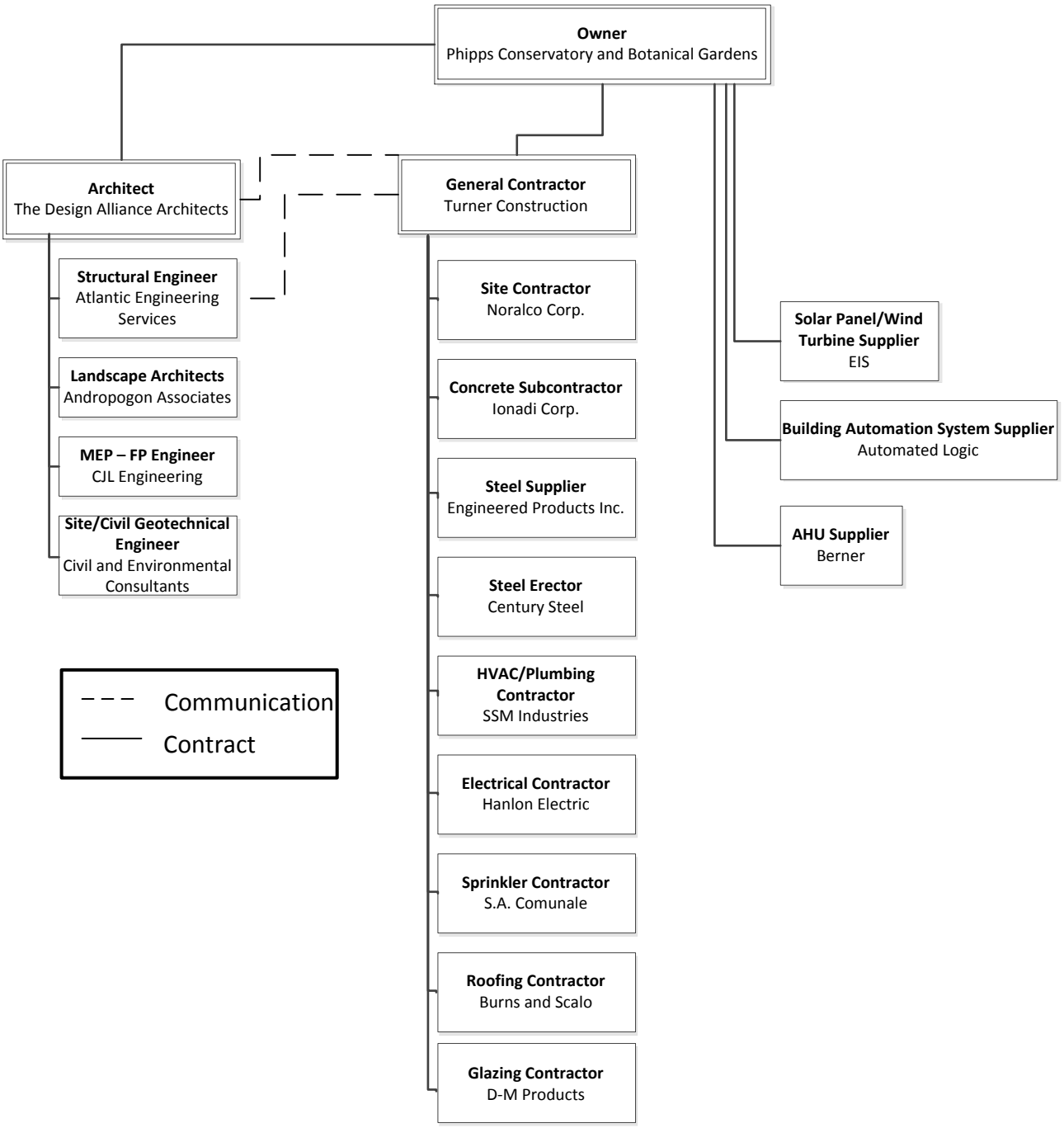


*Figure 7: CSL Project Organizational Chart*

## Staffing Plan

Due to the smaller contract size of the CSL, the optimum size staffing team is notably smaller than the majority of other Turner Projects. Figure 8 shows is the organizational chart of the project team. Due to the projects smaller size, managers are forced to express expertises in a larger range of construction practices. Of the staff listed below: Bill Beck, Dareen Romanchik, and Megan Corrie are located onsite. Relative to other projects of this size, the staffing team is large; this is due to the large amount of paperwork associated with the coordination needed for the addition sustainable systems and goals included in the project.

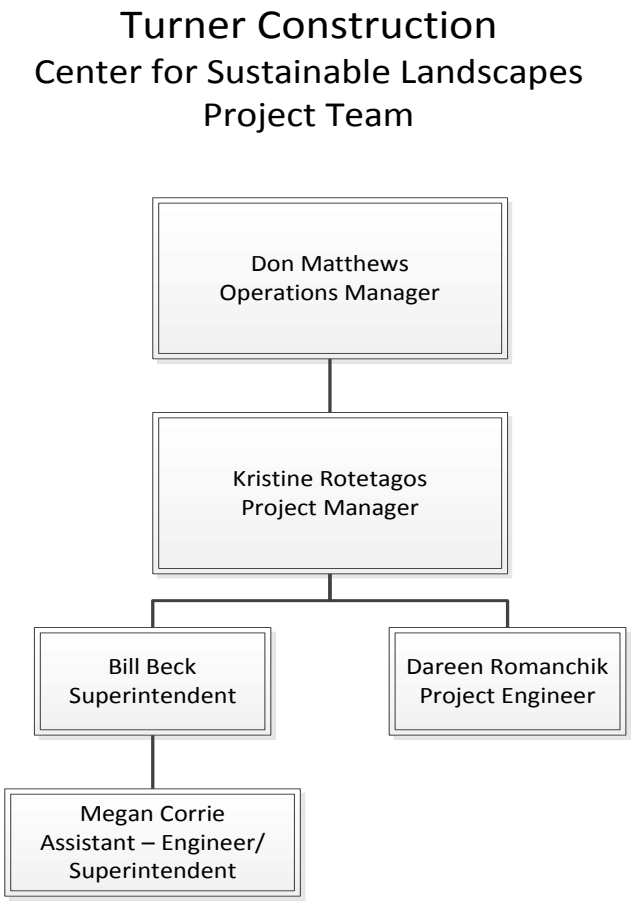


*Figure 8: Turner Project Organizational Staffing Chart*

## Appendix A:

## RS Means Square Foot Estimate

# Square Foot Cost Estimate Report

Estimate Name: **Center for Sustainable Landscapes**

| | |
|---|---|
| Building Type: | **College, Classroom, 2-3 Story with Decorative Concrete Block / Steel Frame** |
| Location: | PITTSBURGH, PA |
| Stories Count (L.F.): | **3.00** |
| Stories Height | **14.00** |
| Floor Area (S.F.): | **24,350.00** |
| LaborType | **Open Shop** |
| Basement Included: | No |
| Data Release: | **Year 2011** |
| Cost Per Square Foot | **$158.50** |
| Total Building Cost | **$3,859,500** |

Costs are derived from a building model with basic components. Scope differences and market conditions can cause costs to vary significantly.
**Parameters are not within the ranges recommended byRSMeans.**

| | | % of Total | Cost Per SF | Cost |
|---|---|---|---|---|
| **A Substructure** | | **2.7%** | **3.96** | **$96,500** |
| **A1010** | **Standard Foundations** | | **0.39** | **$9,500** |
| | Spread footings, 3000 PSI concrete, load 150K, soil bearing capacity 6 KSF, 5' - 6" square x 18" deep | | | |
| | Spread footings, 3000 PSI concrete, load 300K, soil bearing capacity 6 KSF, 7' - 6" square x 25" deep | | | |
| **A1030** | **Slab on Grade** | | **1.52** | **$37,000** |
| | Slab on grade, 4" thick, non industrial, reinforced | | | |
| **A2010** | **Basement Excavation** | | **0.08** | **$2,000** |
| | Excavate and fill, 100,000 SF, 4' deep, sand, gravel, or common earth, on site storage | | | |
| **A2020** | **Basement Walls** | | **1.97** | **$48,000** |
| | Foundation wall, CIP, 4' wall height, direct chute, .099 CY/LF, 4.8 PLF, 8" thick | | | |
| | Foundation wall, CIP, 4' wall height, direct chute, .148 CY/LF, 7.2 PLF, 12" thick | | | |
| **B Shell** | | **27.0%** | **39.20** | **$954,500** |
| **B1010** | **Floor Construction** | | **15.93** | **$388,000** |
| | Steel column, W10, 150 KIPS, 16' unsupported height, 45 PLF | | | |
| | Steel column, W12, 300 KIPS, 16' unsupported height, 72 PLF | | | |
| | Floor, composite metal deck, shear connectors, 5.5" slab, 35'x35' bay, 29.5" total depth, 75 PSF superimposed load, | | | |
| | Fireproofing, gypsum board, fire rated, 3 layer, 1.5" thick, 10" steel column, 3 hour rating, 27 PLF | | | |
| | Fireproofing, gypsum board, fire rated, 3 layer, 1.5" thick, 14" steel column, 3 hour rating, 35 PLF | | | |
| **B1020** | **Roof Construction** | | **2.98** | **$72,500** |
| | Floor, steel joists, beams, 1.5" 22 ga metal deck, on columns, 35'x35' bay, 25" deep, 30 PSF superimposed load, 52 | | | |
| | Floor, steel joists, beams, 1.5" 22 ga metal deck, on columns, 35'x35' bay, 25" deep, 30 PSF superimposed load, 52 | | | |
| **B2010** | **Exterior Walls** | | **7.25** | **$176,500** |
| | Concrete block (CMU) wall, split rib, 8 ribs, hollow, regular weight, 8x8x16, reinforced, vertical #5@32", grouted | | | |
| **B2020** | **Exterior Windows** | | **10.27** | **$250,000** |
| | Aluminum flush tube frame, for 1/4"glass,1-3/4"x4", 5'x6' opening, no intermediate horizontals | | | |
| | Glazing panel, plate glass, 1/4" thick, clear | | | |
| **B2030** | **Exterior Doors** | | **0.60** | **$14,500** |
| | Door, aluminum & glass, with transom, narrow stile, double door, hardware, 6'-0" x 10'-0" opening | | | |

| | | % of Total | Cost Per SF | Cost |
|---|---|---|---|---|
| **B3010** | **Roof Coverings** | | **2.18** | **$53,000** |
| | Roofing, asphalt flood coat, gravel, base sheet, 3 plies 15# asphalt felt, mopped | | | |
| | Insulation, rigid, roof deck, composite with 2" EPS, 1" perlite | | | |
| | Roof edges, aluminum, duranodic, .050" thick, 6" face | | | |
| | Flashing, aluminum, no backing sides, .019" | | | |
| | Gravel stop, aluminum, extruded, 4", mill finish, .050" thick | | | |
| **C Interiors** | | **21.3%** | **30.92** | **$753,000** |
| **C1010** | **Partitions** | | **3.88** | **$94,500** |
| | Concrere block (CMU) partition, light weight, hollow, 6" thick, no finish | | | |
| **C1020** | **Interior Doors** | | **5.01** | **$122,000** |
| | Door, single leaf, kd steel frame, hollow metal, commercial quality, flush, 3'-0" x 7'-0" x 1-3/8" | | | |
| **C1030** | **Fittings** | | **4.62** | **$112,500** |
| | Chalkboards, liquid chalk type, wood frame & chalktrough | | | |
| | Cabinets, school, counter, wood, 32" high | | | |
| **C2010** | **Stair Construction** | | **2.85** | **$69,500** |
| | Stairs, steel, cement filled metal pan & picket rail, 20 risers, with landing | | | |
| **C3010** | **Wall Finishes** | | **4.13** | **$100,500** |
| | 2 coats paint on masonry with block filler | | | |
| | Painting, masonry or concrete, latex, brushwork, primer & 2 coats | | | |
| | Painting, masonry or concrete, latex, brushwork, addition for block filler | | | |
| | Ceramic tile, thin set, 4-1/4" x 4-1/4" | | | |
| **C3020** | **Floor Finishes** | | **4.58** | **$111,500** |
| | Carpet, tufted, nylon, roll goods, 12' wide, 36 oz | | | |
| | Carpet, padding, add to above, maximum | | | |
| | Vinyl, composition tile, minimum | | | |
| | Vinyl, composition tile, maximum | | | |
| | Tile, ceramic natural clay | | | |
| **C3030** | **Ceiling Finishes** | | **5.85** | **$142,500** |
| | Acoustic ceilings, 3/4"mineral fiber, 12" x 12" tile, concealed 2" bar & channel grid, suspended support | | | |
| **D Services** | | **48.7%** | **70.72** | **$1,722,000** |
| **D1010** | **Elevators and Lifts** | | **5.48** | **$133,500** |
| | 1 - Hydraulic, passenger elevator, 2500 lb, 2 floors, 100 FPM | | | |
| | Hydraulic passenger elevator, 2500 lb., 2 floor, 125 FPM | | | |
| **D2010** | **Plumbing Fixtures** | | **14.50** | **$353,000** |
| | Water closet, vitreous china, bowl only with flush valve, wall hung | | | |
| | Urinal, vitreous china, wall hung | | | |
| | Lavatory w/trim, wall hung, vitreous china, 19" x 17" | | | |
| | Lab sink w/trim, polyethylene, single bowl, double drainboard, 54" x 24" OD | | | |
| | Service sink w/trim, vitreous china, wall hung 22" x 20" | | | |
| | Water cooler, electric, wall hung, wheelchair type, 7.5 GPH | | | |
| **D2020** | **Domestic Water Distribution** | | **2.18** | **$53,000** |
| | Gas fired water heater, commercial, 100< F rise, 600 MBH input, 576 GPH | | | |
| **D2040** | **Rain Water Drainage** | | **0.53** | **$13,000** |
| | Roof drain, CI, soil,single hub, 6" diam, 10' high | | | |
| | Roof drain, CI, soil,single hub, 6" diam, for each additional foot add | | | |
| **D3050** | **Terminal & Package Units** | | **17.25** | **$420,000** |
| | Rooftop, multizone, air conditioner, schools and colleges, 25,000 SF, 95.83 ton | | | |
| **D4010** | **Sprinklers** | | **2.63** | **$64,000** |
| | Wet pipe sprinkler systems, steel, light hazard, 1 floor, 10,000 SF | | | |
| | Wet pipe sprinkler systems, steel, light hazard, each additional floor, 10,000 SF | | | |

| | | % of Total | Cost Per SF | Cost |
|---|---|---|---|---|
| **D4020** | **Standpipes** | | **0.27** | **$6,500** |
| | Dry standpipe risers, class III, steel, black, sch 40, 6" diam pipe, 1 floor | | | |
| | Dry standpipe risers, class III, steel, black, sch 40, 6" diam pipe, additional floors | | | |
| **D5010** | **Electrical Service/Distribution** | | **8.93** | **$217,500** |
| | Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 2000 A | | | |
| | Feeder installation 600 V, including RGS conduit and XHHW wire, 2000 A | | | |
| | Switchgear installation, incl switchboard, panels & circuit breaker, 2000 A | | | |
| **D5020** | **Lighting and Branch Wiring** | | **11.95** | **$291,000** |
| | Receptacles incl plate, box, conduit, wire, 10 per 1000 SF, 1.2 W per SF, with transformer | | | |
| | Wall switches, 1.0 per 1000 SF | | | |
| | Miscellaneous power, 1.2 watts | | | |
| | Central air conditioning power, 4 watts | | | |
| | Motor installation, three phase, 460 V, 15 HP motor size | | | |
| | Motor feeder systems, three phase, feed to 200 V 5 HP, 230 V 7.5 HP, 460 V 15 HP, 575 V 20 HP | | | |
| | Fluorescent fixtures recess mounted in ceiling, 2.4 watt per SF, 60 FC, 15 fixtures @ 32 watt per 1000 SF | | | |
| **D5030** | **Communications and Security** | | **6.34** | **$154,500** |
| | Communication and alarm systems, includes outlets, boxes, conduit and wire, sound systems, 30 outlets | | | |
| | Communication and alarm systems, fire detection, addressable, 25 detectors, includes outlets, boxes, conduit and w | | | |
| | Fire alarm command center, addressable with voice, excl. wire & conduit | | | |
| | Communication and alarm systems, includes outlets, boxes, conduit and wire, master clock systems, 20 rooms | | | |
| | Communication and alarm systems, includes outlets, boxes, conduit and wire, master TV antenna systems, 30 outle | | | |
| | Internet wiring, 8 data/voice outlets per 1000 S.F. | | | |
| **D5090** | **Other Electrical Systems** | | **0.66** | **$16,000** |
| | Generator sets, w/battery, charger, muffler and transfer switch, gas/gasoline operated, 3 phase, 4 wire, 277/480 V, 1 | | | |
| **E Equipment & Furnishings** | | **0.3%** | **0.37** | **$9,000** |
| **E1090** | **Other Equipment** | | **0.37** | **$9,000** |
| | 3 - Detection Systems, smoke detector, duct type, excl. wires & conduit | | | |
| | 1 - Hydraulic Passenger Elevators, for number of stops over 2, add | | | |
| **F Special Construction** | | **0.0%** | **0.00** | **$0** |
| **G Building Sitework** | | **0.0%** | **0.00** | **$0** |
| **Sub Total** | | **100%** | **$145.17** | **$3,535,000** |
| **Contractor's Overhead & Profit** | | **6.0%** | **$8.71** | **$212,000** |
| **Architectural Fees** | | **3.0%** | **$4.62** | **$112,500** |
| **User Fees** | | **0.0%** | **$0.00** | **$0** |
| **Total Building Cost** | | | **$158.50** | **$3,859,500** |

**Appendix B:**

**RS Means Assemblies Estimate**

# Assembly Detail Report

Cost Estimate Report CostWorks RSMeans

**Pittsburgh,**

**Year 2011**

**Date: 21-Sep-11**

## Assembly Estimate

**Prepared By:**
**Daniel Zartman**
**a State University AE Department Student**

| Assembly Number | | | Description | Quantity | Unit | Total Incl. O&P | Ext. Total Incl. O&P |
|---|---|---|---|---|---|---|---|
| **D Services** | | | | | | | |
| D20000000000 | | | | 1.00 | | | $0.00 |
| D20101203000 | | | Water closets, battery mount, wall hung, back to back, first pair of closets | 2.00 | Ea. | $3,511.07 | $7,022.14 |
| D20101203100 | | | Water closets, battery mount, wall hung, each additional pair of closets, back to back | 6.00 | Ea. | $3,470.99 | $20,825.94 |
| D20102102000 | | | Urinal, vitreous china, wall hung | 4.00 | Ea. | $1,208.05 | $4,832.20 |
| D20103102080 | | | Lavatory w/trim, wall hung, PE on CI, 19" x 17" | 16.00 | Ea. | $1,483.31 | $23,732.96 |
| D20104201800 | | | Laundry sink w/trim, PE on CI, black iron frame, 24" x 23" single compartment | 1.00 | Ea. | $1,493.28 | $1,493.28 |
| D20104301800 | | | Lab sink w/trim, polyethylene, single bowl, flanged, 18-1/2" x 18-1/2" OD | 6.00 | Ea. | $1,238.32 | $7,429.92 |
| D20108101920 | | | Drinking fountain, 1 bubbler, wall mounted, non recessed, stainless steel, no back | 4.00 | Ea. | $1,642.74 | $6,570.96 |
| D20202402020 | | | Electric water heater, commercial, 100< F rise, 200 gal, 120 KW 490 GPH | 1.00 | Ea. | $28,157.40 | $28,157.40 |
| D20202952600 | | | Solar, closed loop, immersed exchanger, 1/2" tubing, 4 each 4' x 4'-4" vacuum tube collectors, 120 gal | 2.00 | Ea. | $11,699.73 | $23,399.46 |
| D30000000000 | | | | 0.00 | | | $0.00 |
| D30106842560 | | | Solar passive heating, direct gain, 2'-6" x 5', double glazed window, one panel wide | 75.00 | Ea. | $1,012.39 | $75,929.25 |
| D30201041360 | | | Large heating systems, electric boilers, hydronic, 26,100 SF, 420 KW, 1,432 MBH, 4 floors | 24,350.00 | S.F. | $8.43 | $205,270.50 |
| D30501553960 | | | Rooftop, multizone, air conditioner, offices, 25,000 SF, 79.16 ton | 24,350.00 | S.F. | $14.69 | $357,701.50 |
| D40000000000 | | | | 1.00 | | | $0.00 |
| D40103100600 | | | Dry pipe sprinkler systems, steel, light hazard, 1 floor, 5000 SF | 6,230.00 | S.F. | $4.29 | $26,726.70 |
| D40104100620 | | | Wet pipe sprinkler systems, steel, light hazard, 1 floor, 10,000 SF | 18,000.00 | S.F. | $3.00 | $54,000.00 |
| D50000000000 | | | | 1.00 | | | $0.00 |
| D50101200360 | | | Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 600 A | 1.00 | Ea. | $11,918.28 | $11,918.28 |
| D50102300360 | | | Feeder installation 600 V, including RGS conduit and XHHW wire, 600 A | 100.00 | L.F. | $166.38 | $16,638.00 |
| D50102400240 | | | Switchgear installation, incl switchboard, panels & circuit breaker, 600 A | 1.00 | Ea. | $17,895.05 | $17,895.05 |
| D50201150200 | | | Receptacle systems, underfloor duct, 5' on center, low density | 24,350.00 | S.F. | $9.30 | $226,455.00 |
| D50201300280 | | | Wall switches, 2.0 per 1000 SF | 24,350.00 | S.F. | $0.42 | $10,227.00 |
| D50202080600 | | | Fluorescent fixtures, type A, 17 fixtures per 1000 SF | 24,350.00 | S.F. | $7.23 | $176,050.50 |
| D50303100240 | | | Telephone systems, underfloor duct, 5' on center, high density | 22,000.00 | S.F. | $12.92 | $284,240.00 |
| D50309100452 | | | Communication and alarm systems, fire detection, addressable, 25 detectors, includes outlets, boxes, conduit and wire | 12.00 | Ea. | $18,307.30 | $219,687.60 |
| D50309200106 | | | Internet wiring, 6 data/voice outlets per 1000 S.F. | 22.00 | M.S.F. | $1,660.56 | $36,532.32 |
| D50904300100 | | | Photovoltaic power system, grid connected 10kW AC and DC loads | 0.00 | Ea. | $92,281.90 | $0.00 |

| Assembly Number | | | Description | Quantity | Unit | Total Incl. O&P | Ext. Total Incl. O&P |
|---|---|---|---|---|---|---|---|

**D Services Subtotal** **$1,842,735.96**