

PENN STATE AE SENIOR THESIS 2011 - 2012

TECHNICAL ASSIGNMENT 2

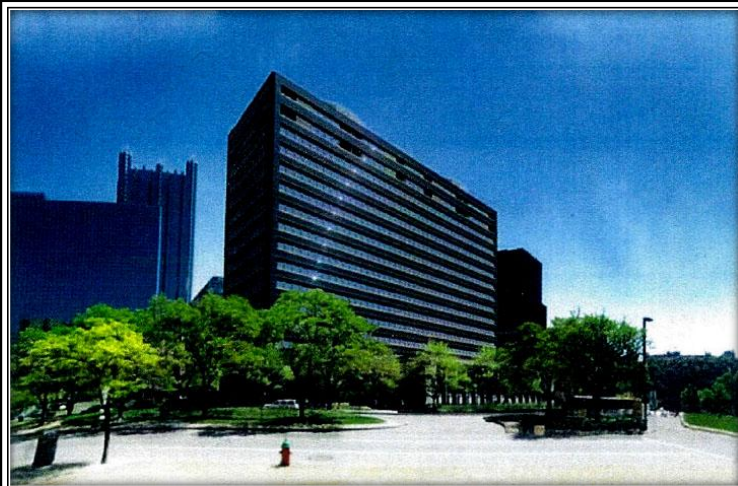
Cost and Schedule Analysis

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RIVER VUE APARTMENTS | NEW LUXURY APARTMENTS RENOVATION | PITTSBURGH, PA



Executive Summary

Technical Assignment 2 is intended to analyze the key features of the River Vue Apartments project that affect project execution and to determine important schedule attributes and the costs of a key building system. River Vue Apartments is the innovative reuse of the former Commonwealth of Pennsylvania State Office Building located in Pittsburgh, PA. Across from Point State Park in the Golden Triangle, these new luxury apartments will offer some of the best views of the city to its residents. The existing building was constructed in the 1950s, and the new construction project is a 295,000 SF renovation of the 16 story building. New additions, to transition from an office building to a residential building, include 218 apartment units, a two-story interior valet-parking garage on the basement and first floors, a small retail space of approximately 1,900 SF, a building party / media room, and a small fitness center.

Information about the schedule of the design, procurement, and construction phases is discussed in the report with a detailed project schedule. It reflects how important the schedule is to the project's overall successful completion. The beginning construction date is June 13, 2011, and the final completion date is October 3, 2012. Using the RS Means 2010 standard estimating manual, a detailed estimate of the structural system elements of the new private exterior inboard balconies on the top two floors was developed and compared to the actual costs provided by Turner Construction Company. The total estimated cost, including formwork, rebar, concrete, steel beams, and metal decks, equals \$9,985.65. It is 1.06% of the actual cost for the concrete and metals for the project. In addition, a general conditions estimate was developed and compared to the actual cost of the general requirements. The total estimated cost, including various temporary facilities and components, equals \$2,487,309.78. It is \$182,965.78 greater than the actual general requirements/in-direct costs. The detailed estimate and the general conditions estimate demonstrated the complexity of the building and the major facilities and other components needed for the construction process.

After developing and analyzing the LEED Project Checklist 2009 for New Construction, the major categories that the River Vue Apartments project achieves its LEED Certified rating are the Sustainable Sites, Energy and Atmosphere, and Indoor Environment Quality. The level of certification for River Vue Apartments is appropriate because it reflects the owner's and project team's goals to achieve a LEED Certified rating. However, the goal could extend even further. To obtain a possible higher rating, there are several additions that could be developed including installing photovoltaic panels on the upper roof, installing a green roof garden area on the lower roof, etc. In addition, after discussing BIM usage with Mr. Todd Havekotte from Intelligent Design Group (IDG), it was determined that Building Information Modeling (BIM) was not used on the project. However, this report evaluates and reflects how BIM could have been utilized for River Vue Apartments. The BIM Uses discussed for the project include Programming, Phase Planning (4D Modeling), Design Authoring, 3D Coordination, Existing Conditions Modeling, Site Utilization Planning, and Building System Analysis. The Level 1 BIM Execution Process Map shows an overview plan for execution of each BIM Use.



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Detailed Project Schedule

**See Appendix A for the Detailed Project Schedule*

Preconstruction

After reviewing the submitted proposals and meeting with the proposing design teams, River Vue Associates, LP (RVA) determined that Design 4 Studio, Inc. and Intelligent Design Group, LLP (IDG) were the most qualified firms to design the new River Vue Apartments. The two architectural firms developed a joint venture. On February 10, 2010, the architects were authorized to begin design activities with RVA's management team. Official work on the schematic design started on February 15, 2010 and design development started on April 4, 2010. After the construction documents were completed on July 9, 2010, RVA approved the design and construction documents. Then, they proceeded to the procurement phase.

Procurement

On July 9, 2010, River Vue Associates announced the River Vue Apartments project to bid for general construction services. They held a mandatory pre-bid meeting and offered an optional pre-bid walk-thru of the project. By 2:00 PM on July 30, 2010, the general construction bid was due to RVA. After reviewing the submitted proposals, RVA awarded the project to Turner Construction Company's Pittsburgh office on September 9, 2010.

Construction

On the River Vue Apartments project, construction began on June 13, 2011. The major phases of construction include Abatement and Demolition, Site Work, Interiors, MEP/FP Rough-In, MEP/FP Finishes, Punch Lists and Inspections, and Completion and Occupancy. Construction of River Vue Apartments will be completed on October 3, 2012. Therefore, the total number of construction days is 342 days or 15.75 months. A detailed construction plan and sequence was utilized for the project to ensure timely project completion. For the construction process schedule, the following tasks and dates are critical.

Critical Construction:

- Mobilization: 6/13/2011
- Garage Ramp: 6/13/2011 – 8/19/2011
- Site Utilities: 8/8/2011 – 9/30/2011
- Site Work: 10/3/2011 – 12/23/2011
- Structural Steel and Concrete In-fills for Levels 15 and 16: 10/24/2011 – 12/2/2011
- Level 2 Roofing: 7/25/2011 – 8/19/2011
- Level 17 Roofing: 10/31/2011 – 12/9/2011
- Glass and Glazing: 7/11/2011 – 11/25/2011



- Abatement and Demolition: 6/13/2011 – 10/21/2011
- Interiors: 7/25/2011 – 6/15/2012
- MEP/FP Rough-In: 7/25/2011 – 2/10/2012
- MEP/FP Finishes: 11/21/2011 – 7/27/2012
- Punch Lists and Inspections: 2/27/2012 – 8/31/2012
- Completion and Occupancy: 4/3/2012 – 10/3/2012
- Final Completion: 10/3/2012

When official work began on Monday, June 13, 2011, the beginning stages of the construction phase included the demolition of all the existing systems and asbestos abatement. Once demolition and asbestos abatement is complete, the element that remains is the superstructure. With the superstructure of the building remaining, the construction of the basement and first floors parking garages begins. During this construction sequence, the site work for the new parking garage ramps is completed. In addition to the site work occurring during the construction of the parking garages, the 218 apartment units are constructed starting on the second floor and moving up to the sixteenth floor. The building is turned over to the owner in two phases. The basement through the fifth floors will be available in April 2012, and the entire building will be turned over by October 2012.

MS Project Detailed Schedule

****See Appendix A for the Detailed Project Schedule***

To develop a detailed construction schedule for River Vue Apartments, the schedule had to be formatted to reflect the major aspects of the construction process without exceeding 200 activities. This section of the report is provided to better understand the layout of the construction process schedule. For the Interiors phase of construction, all of the levels are labeled “Typical.” Looking at the task Levels 2, 3, 4, and 5 (Typical), it shows the tasks associated with that level. The tasks include Interior Studs and Door Frames, Ceilings and Drywall Installation, Prime and Paint Walls, Finish System Trim and Casework, Flooring Installation, and Doors and Hardware. These tasks are associated with the other levels that are labeled “Typical” as well. Similarly, for the MEP/FP Rough-In phase of construction, all of the levels are labeled “Typical.” Looking at the task Levels 6 and 7 Rough-In (Typical), it shows the associated tasks. The tasks include Mechanical, Electrical, Plumbing, and Fire Protection Rough-In. These tasks are associated with the other levels that are labeled “Typical” as well. Finally, for the MEP/FP Finishes phase of construction, all of the levels are labeled “Typical.” Looking at the task Levels 8 and 9 (Typical), it shows the associated tasks with that level. The tasks include Ductwork and VAV, Mechanical Piping and Insulation, Sprinkler Main and Branch Pipe, Fire Alarm Devices, Light Fixtures, and Plumbing Fixtures. These tasks are associated with the other levels labeled “Typical” as well.



Detailed Structural System Estimate

**See Appendix B for Detailed Structural System Estimate and Take – Off Notes*

New Structural System Addition

Since the existing building's superstructure is being reused for the River Vue Apartments building, the detailed structural system estimate analyzes one of the several new additions. The new system being analyzed is the private exterior inboard balconies on the fifteenth and sixteenth floors. Shown in Figure 1, there are 18 balconies on each floor. Therefore, the total number of balconies is 36. For these floors, the existing concrete slab system is 5 - $\frac{5}{8}$ " thick. To accommodate the new balcony slabs, the existing slabs on deck will be removed and replaced with the new 5 - $\frac{5}{8}$ " normal weight concrete slabs with 1 - $\frac{1}{2}$ "x20 GA composite deck. Also, after cutting the required existing steel, full "T" double shear connections will be applied to the new steel components.

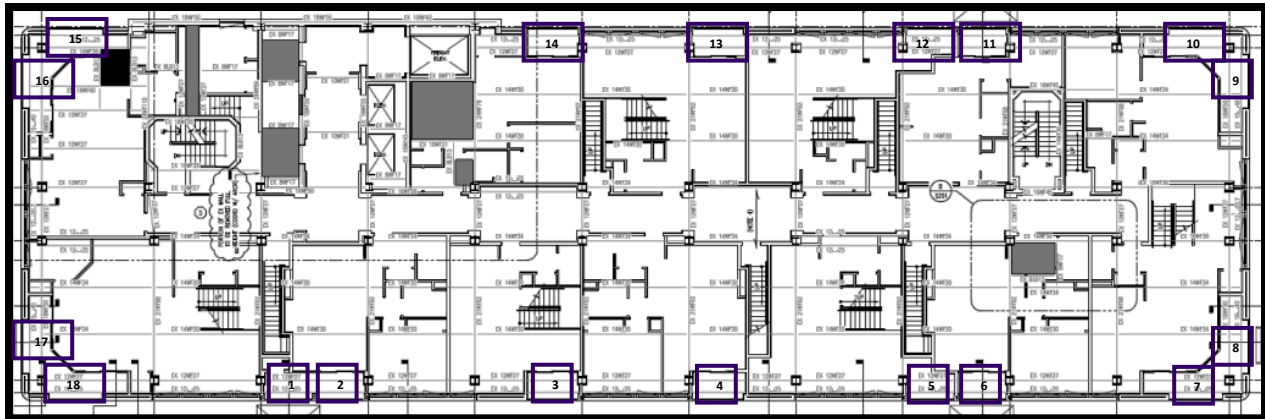


Figure 1: Floor Plan View of the Fifteenth Floors

New Upper Floor Balconies Cost

For this estimate, the standard estimating manual (RS Means Cost Works - RS Means Building Cost Data 2010) was used to obtain the cost values. These values already include the location factor of 0.996 for Pittsburgh, PA. Also, since preconstruction services started in the year 2010, the time factor does not need to be taken into consideration for this estimate. In Table 1, the total cost for each item includes bare labor and bare equipment costs, and it excludes the bare materials costs.



Table 1: Total Detailed Estimate Excluding Material Costs

DETAILED ESTIMATE FOR NEW BALCONIES SUMMARY (EXCLUDING MATERIAL COSTS)				
ITEM	QUANTITY	UNIT	UNIT COST	COST
Formwork	221.368	SF	\$6.13	\$1,356.99
Rebar	1.198	TON	\$1,163.36	\$1,393.71
Concrete	5.697	CY	\$398.61	\$2,270.88
Steel Beams	23	LF	\$10.91	\$250.97
Metal Decking	328	SF	\$1.14	\$373.92
			Total Estimate	\$5,646.47

In the detailed materials costs estimate, sales tax is taken into consideration. Pennsylvania’s state sales tax is 6% of the total materials costs. Table 2 shows the detailed estimate summary for material costs only.

Table 2: Total Detailed Estimate with Materials Costs Only

DETAILED ESTIMATE FOR NEW BALCONIES SUMMARY (MATERIAL COSTS ONLY)				
ITEM	QUANTITY	UNIT	UNIT COST	COST
Formwork	221.368	SF	\$3.20	\$708.38
Rebar	1.198	TON	\$525.83	\$629.94
Concrete	5.697	CY	\$258.64	\$1,473.47
Steel Beams	23	LF	\$30.63	\$704.50
Metal Decking	328	SF	\$1.76	\$577.28
			SUBTOTAL	\$4,093.57
			Pennsylvania Sales Tax	6%
			Total Estimate	\$4,339.18

To get the total estimated cost for the new balconies on the fifteenth and sixteenth floors of the building, the total estimated costs from Table 1 and Table 2 were added together. The total estimated cost now includes bare material, labor, and equipment cost. However, it does not include home office overhead or profit costs. Table 3 shows the summary of the detailed estimate for the total estimated cost for the new balconies.



Table 3: Total Detailed Estimate Including All Costs

DETAILED ESTIMATE FOR NEW BALCONIES SUMMARY (INCLUDING ALL COSTS)				
ITEM	QUANTITY	UNIT	UNIT COST	COST
Formwork	221.368	SF	\$9.52	\$2,107.87
Rebar	1.198	TON	\$1,720.74	\$2,061.45
Concrete	5.697	CY	\$672.77	\$3,832.76
Steel Beams	23	LF	\$43.38	\$997.74
Metal Decking	328	SF	\$3.01	\$985.84
			Total Estimate	\$9,985.65

Comparison between Actual Costs and Estimated Costs

Total Project Construction Costs:

- Concrete = \$800,854
 - Includes Formwork, Rebar, Concrete, and Other Components
- Metals = \$153,268
 - Includes Steel Beams, Metal Decking, and Other Components
- Total Project Cost = \$28,248,910
 - Includes All Project Components

Estimated Costs:

- Concrete = 0.999% of Total Concrete Cost
 - Includes Formwork, Rebar, and Concrete
- Metals = 1.294% of Total Metals Cost
 - Includes Steel Beams and Metal Decking
- Total Estimated Cost = 0.0353% of Total Project Cost
 - Includes Formwork, Rebar, Concrete, Steel Beams, and Metal Decking

The estimate breakdown above provides insight into the fairly inexpensive new addition to the structural system of River Vue Apartments. The new private exterior inboard balconies on the fifteenth and sixteenth floors only contribute to 0.0353% of the total project cost provided by Turner Construction Company.



General Conditions Estimate

**See Appendix C for General Conditions Estimate and Take – Off Notes*

Table 4: General Conditions Estimate Summary

GENERAL CONDITIONS ESTIMATE SUMMARY				
ITEM	UNIT	QUANTITY	TOTAL INCL. O&P	TOTAL
Project & Staff Personnel Costs	Week	63	\$20,154.57	\$1,269,738.15
Construction Facilities & Equipment Costs	Week	63	\$1,489.98	\$93,868.55
Temporary Utilities Costs	Week	63	\$3,011.55	\$189,727.46
Miscellaneous Costs	Week	63	\$14,825.01	\$933,975.62
			TOTAL	\$2,487,309.78

For the new River Vue Apartments project, the general conditions estimate includes four different broken-down factors. Table 4 shows these factors and their corresponding total estimated costs. The Project and Staff Personnel factor includes the Business Unit General Manager, Operations Manager, Project Executive, Project Superintendent, Project Engineer, Site Work Assistant Superintendent, MEP/FP Assistant Superintendent, Second Shift Assistant Superintendent, Engineering Assistant, and Site Laborers. The Construction Facilities and Equipment factor includes storage boxes, office equipment and supplies, temporary construction fencing, dumpsters, temporary portable toilets, etc. The Temporary Utilities factor includes field telephone set-up, the land line telephone bill, temporary power, the temporary construction water bill, etc. The Miscellaneous factor includes insurance, progress photographs, permits, commissioning, and clean-up.

The standard estimating manual (RS Means Facilities Construction Cost Data 2010) was used to obtain the cost values. These values do not include the location factor of 0.996 for Pittsburgh, PA. Therefore, the subtotal of the estimated cost was multiplied by the location factor. Also, since preconstruction services started in the year 2010, the time factor does not need to be taken into consideration for this estimate.

Contingency Costs

With the general conditions, contingency costs are allocated into the project as well. For River Vue Apartments, since Turner Construction Company is providing general contracting services only, the contingency only includes construction. It is 8% of the total project cost of \$28,248,910. Also, the value was multiplied by the location factor of 0.996 to obtain the true contingency cost for Pittsburgh, PA.

- Total Contingency Cost = \$2,250,873.15



Schedule Impact on General Conditions Cost

After doing a general conditions estimate analysis, it is evident that the estimate is greatly affected by the schedule of the construction project. If a construction delay occurs, the general conditions cost will increase. The following values show the estimated weekly fees for each factor of the general conditions portion of the River Vue Apartments project.

- Project and Staff Personnel Costs = \$20,154.57/week
- Construction Facilities and Equipment Costs = \$1,489.98/week
- Temporary Utilities Costs = \$3,011.55/week
- Miscellaneous Costs = \$14,825.01/week

With these weekly cost values, the construction schedule has a great impact on the general conditions cost. Since the weekly cost value is so high, the major factor affected is the Project and Staff Personnel costs. Therefore, it is important to carefully monitor the construction schedule by planning and coordination of sequencing. Also, if there are no other alternatives to solve the construction delays, change the schedule to prevent these weekly cost values from increasing drastically.

Factors' Percentages of General Conditions Cost

To get a better understanding of how much each factor contributes to the general conditions estimate, a pie chart of the percentage summary for each factor is shown in Figure 2. Project and Staff Personnel make up the majority of the estimate. For Turner Construction Company's privacy concerns, the individual costs for each member of the personnel are average values from the estimating manual. Therefore, the actual costs could be higher or lower than the estimated costs. Miscellaneous Items Temporary Utilities, and Construction Facilities and Equipment make up the rest of the chart decreasing in percentage respectively. In addition, this chart shows that most of the general conditions cost is not based on equipment or facilities used on site. It is based on the personnel running the project site and the necessary paperwork needed to complete the project efficiently and effectively.

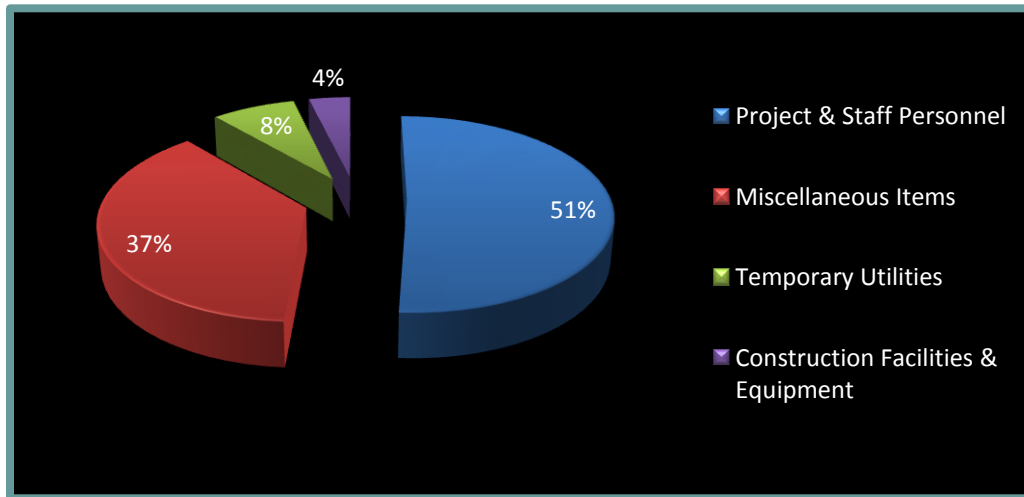


Figure 2: General Conditions Estimate Percentage Summary

Comparison between Actual Costs and Estimated Cost

Total Project Construction Costs:

- Total General Requirements/In-direct Costs = \$2,304,344

Estimated Costs:

- Total General Conditions Estimated Cost = \$2,487,309.78

The total general conditions estimated cost is \$182,965.78 greater than the total general requirements/in-directs cost provided by Turner Construction Company. There are a couple of reasons why the estimated cost is higher than the actual project cost. Since the project and staff personnel costs were based on the standard manual average, these costs could potentially be lower than the average costs used for each member of the personnel. In addition, for the estimated cost, different assumptions could have been made in determining the number of dumpsters, storage boxes, office supplies used on site, etc. The assumptions could greatly increase or decrease the general conditions estimate.



LEED EVALUATION

**See Appendix D for the LEED Evaluation Project Checklist*

River Vue Associates (the owner) and all the members of the project team determined the overall project sustainability goal is to achieve a LEED Certified rating on River Vue Apartments. Table 5 shows the River Vue Apartments project’s qualifications for each category on the LEED Project Checklist for New Construction.

Table 5: LEED Project Checklist Summary

LEED 2009 FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS				
YES	?	NO	CATEGORY	POSSIBLE POINTS
14		12	Sustainable Sites	26
6		4	Water Efficiency	10
9	2	24	Energy and Atmosphere	35
3		11	Materials and Resources	14
9		6	Indoor Environment Quality	15
1	1	4	Innovation and Design Process	6
2		2	Regional Priority Credits	4
44	3	63	TOTAL	110
Certified: 40 to 49 points				

Sustainable Sites: Site selection and alternative transportation are the key aspects for this category. River Vue Apartments is a renovation of the Commonwealth of Pennsylvania state office building located in the Golden Triangle of Pittsburgh, PA. It is already on developed land, and it is within walking distance to many monumental spots in the city including Heinz Field, PNC Park, PPG Plaza, and Point State Park. Also, it is located near the Pittsburgh subway station on Liberty Avenue. Therefore, alternative transportation is obtained by the public transportation system, walking, or biking. Several bike racks are installed in the building’s new parking garage to aid and promote that form of travel.

Water Efficiency: Water reduction is the major aspect. After fulfilling the prerequisite of reducing water use by 20%, water can be reduced by another 30%. Water usage during construction and during building occupancy will be monitored carefully to ensure reduction. New tenants will be provided with more efficient appliances and fixtures that use less water, such as dishwashers, washers, and toilets. Also, water efficient landscaping will reduce the amount of water usage. To achieve water efficiency in landscaping, no potable use or irrigation will occur.

Energy and Atmosphere: Three prerequisites must be achieved before receiving the LEED credit. These prerequisites include fundamental commissioning of the building energy system, minimum energy performance, and fundamental refrigerant management. Then, optimizing energy performance can occur. This aspect will be achieved during the construction process by using more efficient equipment



and small tools, temporary lighting and heating/cooling systems, and by monitoring the overall energy usage of the project's site. Also, by providing the residents of River Vue Apartments with more efficient appliances and lighting systems, the overall energy performance of the building during the occupancy stage will increase ("What LEED Measures").

Materials and Resources: Building reuse and construction waste management are the key aspects for this category. Since River Vue Apartments is a renovation project, materials and resources will be heavily reused. Over 75% of the existing walls, floors, and roof will remain for the completion of this building. In addition, construction waste management's operation will be coordinated by the general contractor to confirm that the recycled material removed is the proper content.

Indoor Environment Quality: The one major aspect of this category is low-emitting materials. For building completion, low-emitting materials will be used such as adhesives, sealants, paints and coatings, flooring systems like carpets or tile, and composite wood and agrifiber products. Also, Indoor Environmental Quality will improve indoor air based on thermal comfort and the controllability of the systems ("What LEED Measures"). Daylighting is another key aspect of this category. The window system on the existing building was dark-tinted and let in very little daylight. However, new thermally insulated glazing for the window system will reduce the amount of heat gain within the building and let in a lot of natural daylighting.

Innovation and Design Process: The major component to this category is to create an innovative design with the help of a LEED accredited professional. For River Vue Apartments, River Vue Associates hired Integrated Holistic Design, Inc. as their LEED consultant. It is a major project goal to achieve LEED certification for the owner and project team.

Regional Priority Credits: The regional priority credits that River Vue Apartments has to achieve are the SS credit 6.1 and the MR credit 1.1 – Building Reuse 55% ("What LEED Measures"). These credits reflect the local environment concerns for Pittsburgh, PA.

Level of Certification Reflection

The level of certification for River Vue Apartments is appropriate because it reflects the owner's and project team's goals to achieve a LEED Certified rating. However, the goal could extend even further. To obtain a possible higher rating, there are several additions that could be developed. These additions include using components that are locally manufactured and shipped to the construction site, installing photovoltaic panels on the upper roof, installing a green roof garden area on the lower roof, and collecting rain water to reuse. These topics are worth doing further research on for possible proposal ideas.



Building Information Modeling Use Evaluation

**See Appendix E for the Building Information Modeling Use Evaluation and Level 1 Process Map*

“Building Information Modeling is the process of designing, analyzing, integrating, and documenting a building’s lifecycle by developing an intelligent virtual prototype of the building” (Dubler, “BIM Execution Planning”). It is important because it reflects innovation, productivity, predictability, and interoperability (Dubler, “BIM Execution Planning”). However, for River Vue Apartments, Building Information Modeling (BIM) was not used on the project. After discussing BIM usage with Mr. Todd Havekotte from Intelligent Design Group (IDG), it was determined why BIM was not used on the project. The only form of modeling they developed was two-dimensional drawings and three-dimensional views on Google Sketch-Up. Therefore, the Building Information Modeling Use Evaluation in this section of the technical report is based on what the appropriateness of BIM could have been if it was used.

To better evaluate the possible BIM usage for the River Vue Apartments project, the BIM Project Execution Planning Guide developed by the Computer Integrated Construction Research Program at the Pennsylvania State University was implemented.

BIM Project Goals and BIM Uses

Table 6: Owner, Designer, and Contractor BIM Goals and Objectives

MAJOR BIM GOALS AND OBJECTIVES		
PRIORITY (High/Med./Low)	GOAL DESCRIPTION	POTENTIAL BIM USES
High	Efficient and Effective Design Performance	Programming
High	Productive Sequence	Phase Planning
High	Design Visualization	Design Authoring
High	Coordination Between Trades	3D Coordination
High	Detailed Layout	Existing Conditions Model
High	Efficient Site Logistics	Site Utilization Planning
High	Reduce Energy Usage	Building System Analysis

The major BIM goals described in Table 6 are the project goals of the owner and project team. Each goal corresponds to a potential BIM Use and priority level. Also, each BIM Use occurs during different levels of the construction process of a project. The different levels are Plan, Design, Construct, and Operate. These different levels of BIM Uses, shown in Table 7, were evaluated for the River Vue Apartments project. The table shows the BIM Uses that could pertain to the building project.



Table 7: BIM Uses for River Vue Apartments

BIM USES FOR RIVER VUE APARTMENTS							
✓	PLAN	✓	DESIGN	✓	CONSTRUCT	✓	OPERATE
✓	Programming	✓	Design Authoring	✓	Site Utilization Planning		Building Maintenance Scheduling
	Site Analysis		Design Reviews		Construction System Design	✓	Building System Analysis
		✓	3D Coordination	✓	3D Coordination		Asset Management
			Structural Analysis		Digital Fabrication		Space Management /Tracking
			Lighting Analysis		3D Control and Planning		Disaster Planning
			Mechanical Analysis		Record Modeling		Record Modeling
			Other Engineering Analysis				
			Sustainability (LEED) Evaluation				
			Code Evaluation				
✓	Phase Planning (4D Modeling)	✓	Phase Planning (4D Modeling)	✓	Phase Planning (4D Modeling)	✓	Phase Planning (4D Modeling)
	Cost Estimation		Cost Estimation		Cost Estimation		Cost Estimation
✓	Existing Conditions Modeling	✓	Existing Conditions Modeling		Existing Conditions Modeling		Existing Conditions Modeling

Programming: The Programming stage of the Plan level is used to “efficiently and accurately assess design performance in regard to spatial requirements. It allows the project team to analyze space and understand the complexity of the standards and regulations” (Messner, “BIM Uses”). This stage is where most of the critical decisions for the design are made. Even though River Vue Apartments is a renovation project, it is important to understand how the space can be utilized in the building that will change the building’s function from state office building to apartment building.

Phase Planning (4D Modeling): “Phase Planning is the process in which a 4D model is utilized to effectively plan the phased occupancy in a renovation and to show the construction sequence and space requirements on a building site” (Messner, “BIM Uses”). 4D modeling combines a three-dimensional computer-based model with time, and it reflects how the schedule of the project relates to the building model. Phase Planning is important in all of the levels of the BIM Uses. For the River Vue Apartments project, this BIM Use could have been developed because the sequence of construction overlaps several activities such as site work, demolition and abatement, interior, and MEP/FP rough-in and finishes. Therefore, since it is a complex sequence, 4D modeling could help the owner visualize the sequence, and it could prevent major sequencing issues from occurring during actual construction.



Design Authoring: “Design Authoring is a process in which three-dimensional software is used to develop a building information model based on the criteria that are important to the translation of the building’s design” (Messner, “BIM Uses”). Also, there are several potential values for Design Authoring including “powerful design visualization and improved quality control and assurance” (Messner, “BIM Uses”). If design visualization is powerful during the Design stage, the owner can better understand what the building is supposed to look like and how it is supposed to properly function.

3D Coordination: “During the coordination process, 3D Coordination is a process in which clash detection software is used to determine conflicts by comparing three-dimensional models of the building systems” (Messner, “BIM Uses”). For River Vue Apartments, the MEP systems are to be newly installed. Therefore, visual coordination between these trades could reduce or eliminate major system conflicts that could occur in the field.

Existing Conditions Modeling: “Existing Conditions is a process where a project team develops a three-dimensional model of the existing conditions for a project site” (Messner, “BIM Uses”). Also, for the River Vue Apartments project, the potential value of this form of modeling is that it provides detailed layout information.

Site Utilization Planning: “Site Utilization Planning is a process in which BIM is used to graphically represent both permanent and temporary facilities on site during the multiple stages of the construction process” (Messner, “BIM Uses”). Since the project is located in an urban environment, this planning model could have been very beneficial to the general contractor (Turner Construction) on River Vue Apartments. The site layout could be developed to avoid safety issues, to effectively communicate the construction sequence and layout of materials.

Buildings System Analysis: “Building System Analysis is the process that measures how a building’s performance compares to the specified design (Messner, “BIM Uses”). On River Vue Apartments, this analysis would have been very useful to the project team. One of their LEED goals is to reduce the energy the building uses. With this analysis, it could be easier to understand the actions that need to be taken to implement a change into the building system to produce less energy.

BIM Process and Design

****See Appendix E for Level 1: BIM Execution Process Map***

The Level 1 BIM Execution Process Map displays an overview plan for execution of each BIM Use.



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Appendix A: Detailed Project Schedule

Detailed Project Schedule

River Vue Apartments | Pittsburgh, PA



ID	Task Name	Duration	Start	Finish	4, '09	Dec 27, '09	Mar 21, '10	Jun 13, '10	Sep 5, '10	Nov 28, '10	Feb 20, '11	May 15, '11	Aug 7, '11	Oct 30, '11	Jan 22, '12	Apr 15, '12	Jul 8, '12	Sep 30, '12	De				
					T	S	W	T	F	T	S	W	T	M	F	T	S	W	T	M	F	T	S
1	PRECONSTRUCTION	108 days	Wed 2/10/10	Fri 7/9/10	2/10																		
2	Contract Awarded via Letter of Intent	0 days	Wed 2/10/10	Wed 2/10/10	2/10	◆	2/10																
3	Schematic Design	33 days	Mon 2/15/10	Wed 3/31/10																			
4	Design Development	22 days	Thu 4/1/10	Fri 4/30/10																			
5	Construction Documents	50 days	Mon 5/3/10	Fri 7/9/10																			
6	Client Approval	0 days	Fri 7/9/10	Fri 7/9/10																			
7	PROCUREMENT	44 days	Fri 7/9/10	Thu 9/9/10																			
8	General Construction Scope Out to Bid	0 days	Fri 7/9/10	Fri 7/9/10																			
9	Mandatory Pre-Bid Meeting	1 day	Wed 7/14/10	Wed 7/14/10																			
10	Optional Pre-Bid walk-Thru	2 days	Thu 7/15/10	Fri 7/16/10																			
11	General Ocncstruction Bid Due Date	0 days	Fri 7/30/10	Fri 7/30/10																			
12	Contract Awarded via Letter of Intent	0 days	Thu 9/9/10	Thu 9/9/10																			
13	CONSTRUCTION	342 days	Mon 6/13/11	Wed 10/3/12																			
14	Mobilization	0 days	Mon 6/13/11	Mon 6/13/11																			
15	Garage Ramp	50 days	Mon 6/13/11	Fri 8/19/11																			
16	Duquesne Light vault	40 days	Mon 6/13/11	Fri 8/5/11																			
17	Site Utilities	40 days	Mon 8/8/11	Fri 9/30/11																			
18	Sitework	60 days	Mon 10/3/11	Fri 12/23/11																			
19	Landscaping	20 days	Mon 12/26/11	Fri 1/20/12																			
20	Structural Steel Basement Level and Level 1	30 days	Mon 7/4/11	Fri 8/12/11																			
21	Concrete Topping Slab Basement Level and Level 1	20 days	Mon 9/26/11	Fri 10/21/11																			
22	Structural Steel and Concrete Infills Elevator Lobbies	50 days	Mon 7/25/11	Fri 9/30/11																			
23	Structural Steel and Concrete Infills Levels 15 and 16	30 days	Mon 10/24/11	Fri 12/2/11																			
24	Level 2 Roofing	20 days	Mon 7/25/11	Fri 8/19/11																			
25	Level 17 Roofing	30 days	Mon 10/31/11	Fri 12/9/11																			
26	Glass and Glazing	100 days	Mon 7/11/11	Fri 11/25/11																			
27	ABATEMENT AND DEMOLITION	95 days	Mon 6/13/11	Fri 10/21/11																			
28	Basment Level and Level 1 (Typical)	15 days	Mon 6/13/11	Fri 7/1/11																			
29	Removal of Existing Walls	15 days	Mon 6/13/11	Fri 7/1/11																			
30	Removal of Existing Flooring Material and Prepare Floor for New Finish Material	15 days	Mon 6/13/11	Fri 7/1/11																			
31	Removal of Existing Doors, Frames, and Hardware	15 days	Mon 6/13/11	Fri 7/1/11																			
32	Removal of Ceiling Tile, Ceiling Tile Tracks, GWB Ceiling, and Other Ceiling Elements	15 days	Mon 6/13/11	Fri 7/1/11																			
33	Removal of Existing Casework	15 days	Mon 6/13/11	Fri 7/1/11																			
34	Removal of Existing Glass System	15 days	Mon 6/13/11	Fri 7/1/11																			
35	Removal of Existing Elevators and Stairs	15 days	Mon 6/13/11	Fri 7/1/11																			

Detailed Project Schedule
River Vue Apartments
Date: 10/19/2011

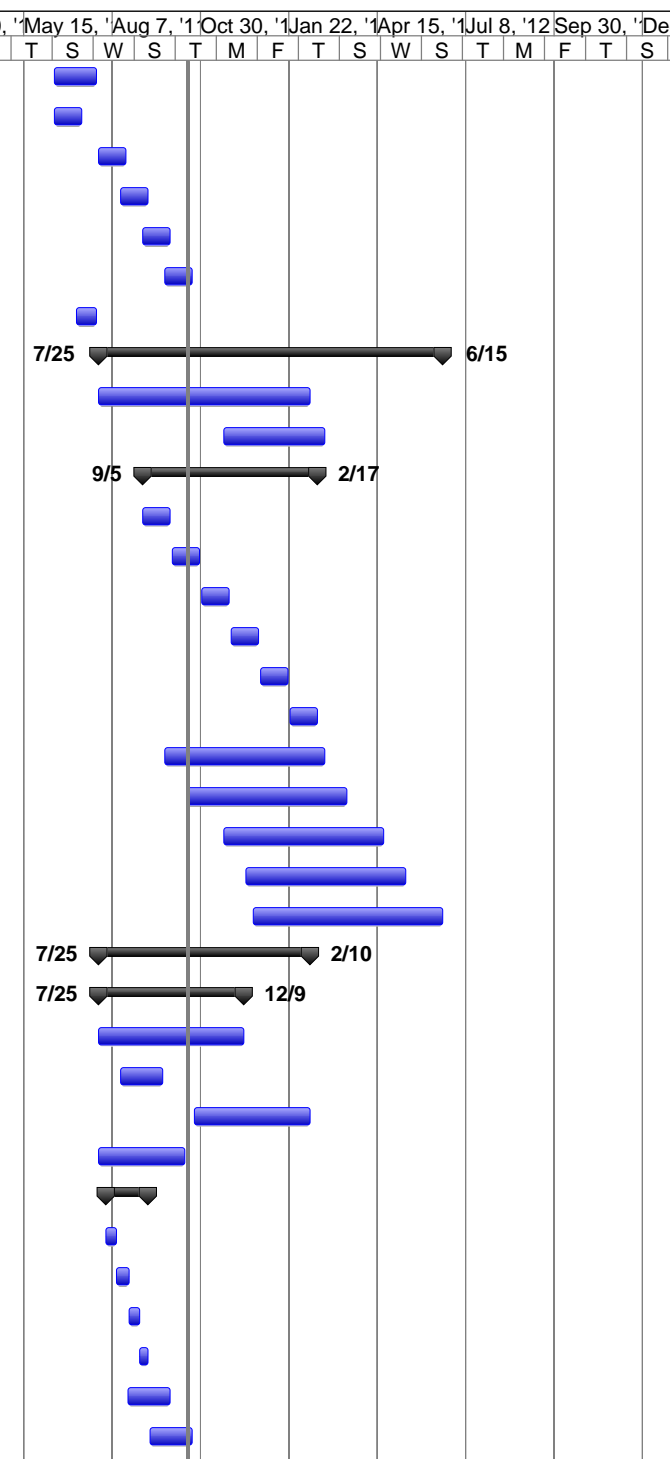
Task		Rolled Up Task		Split		Inactive Task		Duration-only		Finish-only	
Critical Task		Rolled Up Critical Task		External Tasks		Inactive Milestone		Manual Summary Rollup		Progress	
Milestone		Rolled Up Milestone		Project Summary		Inactive Summary		Manual Summary		Deadline	
Summary		Rolled Up Progress		Group By Summary		Manual Task		Start-only			

Detailed Project Schedule

River Vue Apartments | Pittsburgh, PA



ID	Task Name	Duration	Start	Finish	4, '09	Dec 27, '09	Mar 21, '10	Jun 13, '10	Sep 5, '10	Nov 28, '10	Feb 20, '11	May 15, '11	Aug 7, '11	Oct 30, '11	Jan 22, '12	Apr 15, '12	Jul 8, '12	Sep 30, '12	De	
					T	S	W	S	T	M	F	T	S	W	S	T	M	F	T	S
36	Levels 2, 3, 4, and 5 (Typical)	30 days	Mon 6/13/11	Fri 7/22/11																
37	Levels 6 and 7 (Typical)	20 days	Mon 6/13/11	Fri 7/8/11																
38	Levels 8 and 9 (Typical)	20 days	Mon 7/25/11	Fri 8/19/11																
39	Level 10 and 11 (Typical)	20 days	Mon 8/15/11	Fri 9/9/11																
40	Levels 12 and 13 (Typical)	20 days	Mon 9/5/11	Fri 9/30/11																
41	Levels 14, 15, and 16 (Typical)	20 days	Mon 9/26/11	Fri 10/21/11																
42	Penthouse	15 days	Mon 7/4/11	Fri 7/22/11																
43	INTERIORS	235 days	Mon 7/25/11	Fri 6/15/12																
44	Elevator Lobbies and Stair Towers	145 days	Mon 7/25/11	Fri 2/10/12																
45	Basement Level and Level 1 (Typical)	70 days	Mon 11/21/11	Fri 2/24/12																
46	Levels 2, 3, 4, and 5 (Typical)	120 days	Mon 9/5/11	Fri 2/17/12																
47	Interior Studs and Door Frames	20 days	Mon 9/5/11	Fri 9/30/11																
48	Ceilings and Drywall Installation	20 days	Mon 10/3/11	Fri 10/28/11																
49	Prime and Paint Walls	20 days	Mon 10/31/11	Fri 11/25/11																
50	Finish System Trim and Casework	20 days	Mon 11/28/11	Fri 12/23/11																
51	Flooring Installation	20 days	Mon 12/26/11	Fri 1/20/12																
52	Doors and Hardware	20 days	Mon 1/23/12	Fri 2/17/12																
53	Levels 6 and 7 (Typical)	110 days	Mon 9/26/11	Fri 2/24/12																
54	Levels 8 and 9 (Typical)	110 days	Mon 10/17/11	Fri 3/16/12																
55	Levels 10 and 11 (Typical)	110 days	Mon 11/21/11	Fri 4/20/12																
56	Levels 12 and 13 (Typical)	110 days	Mon 12/12/11	Fri 5/11/12																
57	Levels 14, 15, and 16 (Typical)	130 days	Mon 12/19/11	Fri 6/15/12																
58	MEP/FP ROUGH-IN	145 days	Mon 7/25/11	Fri 2/10/12																
59	Elevator Lobbies and Stair Towses Rough-In	100 days	Mon 7/25/11	Fri 12/9/11																
60	Route MEP Chases in Elevator Shafts	100 days	Mon 7/25/11	Fri 12/9/11																
61	Basement Level and Level 1 Underground	30 days	Mon 8/15/11	Fri 9/23/11																
62	Basement Level and Level 1 Rough-In (Typical)	80 days	Mon 10/24/11	Fri 2/10/12																
63	Levels 2, 3, 4, and 5 Rough-In (Typical)	60 days	Mon 7/25/11	Fri 10/14/11																
64	Levels 6 and 7 Rough-In (Typical)	30 days	Mon 8/1/11	Fri 9/9/11																
65	Mechanical Rough-In	8 days	Mon 8/1/11	Wed 8/10/11																
66	Electrical Rough-In	8 days	Thu 8/11/11	Mon 8/22/11																
67	Plumbing Rough-In	8 days	Tue 8/23/11	Thu 9/1/11																
68	Fire Protection Rough-In	6 days	Fri 9/2/11	Fri 9/9/11																
69	Levels 8 and 9 Rough-In (Typical)	30 days	Mon 8/22/11	Fri 9/30/11																
70	Levels 10 and 11 Rough-In (Typical)	30 days	Mon 9/12/11	Fri 10/21/11																



Detailed Project Schedule
River Vue Apartments
Date: 10/19/2011

Task		Rolled Up Task		Split		Inactive Task		Duration-only		Finish-only	
Critical Task		Rolled Up Critical Task		External Tasks		Inactive Milestone		Manual Summary Rollup		Progress	
Milestone		Rolled Up Milestone		Project Summary		Inactive Summary		Manual Summary		Deadline	
Summary		Rolled Up Progress		Group By Summary		Manual Task		Start-only			



Appendix B: Detailed Structural System Estimate



Detailed Concrete Estimate Take – Off Notes

Table 1: Concrete Estimate Take – Off Notes

NEW UPPER FLOOR BALCONY SLABS (4,000 PSI) TAKE – OFF NOTES								
ITEM	DEPTH (FT)	AREA (SF)	VOLUME (CF)	CONCRETE (CY)	REBAR TYPE	REBAR TOTAL (LBS)	REBAR TOTAL (TONS)	FORMWORK (SF)
15th Floor Balconies								
Balcony Slab 1	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 2	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 3	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 4	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 5	0.469	9	4.221	0.156	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	33.056	0.0165	6.097
Balcony Slab 6	0.469	9	4.221	0.156	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	33.056	0.0165	6.097
Balcony Slab 7	0.469	8	3.752	0.139	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	31.052	0.0155	5.628
Balcony Slab 8	0.469	8	3.752	0.139	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	31.052	0.0155	5.628
Balcony Slab 9	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566



Balcony Slab 10	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 11	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 12	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 13	0.469	8	3.752	0.139	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	31.052	0.0155	5.628
Balcony Slab 14	0.469	8	3.752	0.139	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	31.052	0.0155	5.628
Balcony Slab 15	0.469	9	4.221	0.156	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	33.056	0.0165	6.097
Balcony Slab 16	0.469	9	4.221	0.156	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	33.056	0.0165	6.097
Balcony Slab 17	0.469	8	3.752	0.139	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	31.052	0.0155	5.628
Balcony Slab 18	0.469	8	3.752	0.139	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	31.052	0.0155	5.628
			TOTALS	2.849	(18) #4, (90) #6 Top & #4 BOT @ 12" O.C.	599.02	0.2995	110.684



Detailed Concrete Estimate Take – Off Notes Continued

Table 2: Concrete Estimate Take – Off Notes Continued

NEW UPPER FLOOR BALCONY SLABS (4,000 PSI) TAKE – OFF NOTES								
ITEM	DEPTH (FT)	AREA (SF)	VOLUME (CF)	CONCRETE (CY)	REBAR TYPE	REBAR TOTAL (LBS)	REBAR TOTAL (TONS)	FORMWORK (SF)
16th Floor Balconies								
Balcony Slab 1	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 2	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 3	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 4	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 5	0.469	9	4.221	0.156	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	33.056	0.0165	6.097
Balcony Slab 6	0.469	9	4.221	0.156	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	33.056	0.0165	6.097
Balcony Slab 7	0.469	8	3.752	0.139	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	31.052	0.0155	5.628
Balcony Slab 8	0.469	8	3.752	0.139	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	31.052	0.0155	5.628
Balcony Slab 9	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566



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Balcony Slab 10	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 11	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 12	0.469	10	4.690	0.174	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	35.060	0.0175	6.566
Balcony Slab 13	0.469	8	3.752	0.139	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	31.052	0.0155	5.628
Balcony Slab 14	0.469	8	3.752	0.139	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	31.052	0.0155	5.628
Balcony Slab 15	0.469	9	4.221	0.156	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	33.056	0.0165	6.097
Balcony Slab 16	0.469	9	4.221	0.156	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	33.056	0.0165	6.097
Balcony Slab 17	0.469	8	3.752	0.139	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	31.052	0.0155	5.628
Balcony Slab 18	0.469	8	3.752	0.139	(1) #4, (5) #6 Top & #4 BOT @ 12" O.C.	31.052	0.0155	5.628
			TOTALS	2.849	(18) #4, (90) #6 Top & #4 BOT @ 12" O.C.	599.02	0.2995	110.684



Detailed Structural Steel Estimate Take – Off Notes

Table 3: Structural Steel Take – Off Notes for Fifteenth Floor

STRUCTURAL STEEL ADDITIONS FOR NEW BALCONIES TAKE – OFF NOTES					
Metal Deck: 15th Floor Balconies					
ITEM	TYPE	QUANTITY	UNIT	AREA (SF)	TOTAL (SF)
Balcony Metal Deck 1	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 2	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 3	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 4	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 5	1-½"x20GA Comp. Deck	1	SF	9	9
Balcony Metal Deck 6	1-½"x20GA Comp. Deck	1	SF	9	9
Balcony Metal Deck 7	1-½"x20GA Comp. Deck	1	SF	8	8
Balcony Metal Deck 8	1-½"x20GA Comp. Deck	1	SF	8	8
Balcony Metal Deck 9	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 10	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 11	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 12	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 13	1-½"x20GA Comp. Deck	1	SF	8	8
Balcony Metal Deck 14	1-½"x20GA Comp. Deck	1	SF	8	8
Balcony Metal Deck 15	1-½"x20GA Comp. Deck	1	SF	9	9
Balcony Metal Deck 16	1-½"x20GA Comp. Deck	1	SF	9	9
Balcony Metal Deck 17	1-½"x20GA Comp. Deck	1	SF	8	8
Balcony Metal Deck 18	1-½"x20GA Comp. Deck	1	SF	8	8



Detailed Structural Steel Estimate Take – Off Notes Continued

Table 4: Structural Steel Take – Off Notes for Sixteenth Floor

STRUCTURAL STEEL ADDITIONS FOR NEW BALCONIES TAKE – OFF NOTES					
Beam: 16th Floor Balconies					
ITEM	TYPE	QUANTITY	UNIT	LENGTH (LF)	TOTAL (LF)
Beam	W12x19	8	LF	1.5	12
Beam	W12x19	1	LF	2.25	2.25
Beam	W12x19	1	LF	1.25	1.25
Beam	W12x19	2	LF	3	6
Beam	W12x19	2	LF	4	8
Beam	W14x26	6	LF	9.5	57
Beam	W18x35	3	LF	9.5	28.5
Metal Deck: 16th Floor Balconies					
ITEM	TYPE	QUANTITY	UNIT	AREA (SF)	TOTAL (SF)
Balcony Metal Deck 1	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 2	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 3	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 4	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 5	1-½"x20GA Comp. Deck	1	SF	9	9
Balcony Metal Deck 6	1-½"x20GA Comp. Deck	1	SF	9	9
Balcony Metal Deck 7	1-½"x20GA Comp. Deck	1	SF	8	8
Balcony Metal Deck 8	1-½"x20GA Comp. Deck	1	SF	8	8
Balcony Metal Deck 9	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 10	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 11	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 12	1-½"x20GA Comp. Deck	1	SF	10	10
Balcony Metal Deck 13	1-½"x20GA Comp. Deck	1	SF	8	8



Balcony Metal Deck 14	1-½"x20GA Comp. Deck	1	SF	8	8
Balcony Metal Deck 15	1-½"x20GA Comp. Deck	1	SF	9	9
Balcony Metal Deck 16	1-½"x20GA Comp. Deck	1	SF	9	9
Balcony Metal Deck 17	1-½"x20GA Comp. Deck	1	SF	8	8
Balcony Metal Deck 18	1-½"x20GA Comp. Deck	1	SF	8	8

Table 5: Detailed Structural System Estimate (Excluding Material)

DETAILED ESTIMATE FOR NEW BALCONIES (EXCLUDING MATERIAL COSTS)								
DIVISION	ITEM	QTY	UNIT	BARE LABOR	BARE EQUIPMENT	BARE TOTAL	TOTAL O&P	TOTAL COST
FORMWORK								
03 11 13.35	Forms in Place Elevated Slabs	221.368	SF	\$3.70	\$0	\$3.70	\$6.13	\$1,356.99
							TOTAL	\$1,356.99
REBAR								
03 21 10.60	Uncoated, #4-#7	0.599	TON	\$552.08	\$0	\$552.08	\$962.44	\$576.50
03 21 16.10	Epoxy-Coated	0.599	TON	\$0	\$0	\$0	\$1,364.29	\$1,393.71
							TOTAL	\$1,226.93
CONCRETE								
03 30 53.40	Elevated Slab (4,000 PSI)	5.697	CY	\$223.97	\$22.96	\$246.93	\$398.61	\$2,270.88
							TOTAL	\$3,744.35
STEEL BEAMS								
05 12 23.75	W12x19	1	LF	\$3.78	\$2.19	\$5.97	\$11.80	\$11.80
05 12 23.75	W12x19	1	LF	\$3.78	\$2.19	\$5.97	\$11.80	\$11.80
05 12 23.75	W12x19	2	LF	\$3.78	\$2.19	\$5.97	\$11.80	\$23.60
05 12 23.75	W12x19	2	LF	\$3.78	\$2.19	\$5.97	\$11.80	\$23.60
05 12 23.75	W12x19	8	LF	\$3.78	\$2.19	\$5.97	\$11.80	\$94.40
05 12 23.75	W14x26	6	LF	\$3.37	\$1.95	\$5.32	\$6.81	\$40.86
05 12 23.75	W18x35	3	LF	\$5.01	\$2.14	\$7.15	\$14.97	\$44.91
							TOTAL	\$250.97
METAL DECKING								
05 31 13.50	1-½"x20GA Comp. Deck	328	SF	\$0.52	\$0.04	\$0.56	\$1.14	\$373.92
							TOTAL	\$373.92
							SUBTOTAL	\$5,646.47



Table 6: Detailed Structural System Estimate (Material Costs Only)

DETAILED ESTIMATE FOR NEW BALCONIES (MATERIAL COSTS ONLY)					
DIVISION	ITEM	QTY	UNIT	BARE MATERIAL	TOTAL COST
FORMWORK					
03 11 13.35	Forms in Place Elevated Slabs	221.368	SF	\$3.20	\$708.38
				TOTAL	\$708.38
REBAR					
03 21 10.60	Uncoated, #4-#7	0.599	TON	\$726.75	\$435.32
03 21 16.10	Epoxy-Coated	0.599	TON	\$324.90	\$194.62
				TOTAL	\$629.94
CONCRETE					
03 30 53.40	Elevated Slab (4,000 PSI)	5.697	CY	\$258.64	\$1,473.47
				TOTAL	\$1,473.47
STEEL BEAMS					
05 12 23.75	W12x19	1	LF	\$27.17	\$27.17
05 12 23.75	W12x19	1	LF	\$27.17	\$27.17
05 12 23.75	W12x19	2	LF	\$27.17	\$54.34
05 12 23.75	W12x19	2	LF	\$27.17	\$54.34
05 12 23.75	W12x19	8	LF	\$27.17	\$217.36
05 12 23.75	W14x26	6	LF	\$32.16	\$192.96
05 12 23.75	W18x35	3	LF	\$43.72	\$131.16
				TOTAL	\$704.50
METAL DECKING					
05 31 13.50	1-½"x20GA Comp. Deck	328	SF	\$1.76	\$577.28
				TOTAL	\$577.28
				SUBTOTAL	\$4,093.57
				Pennsylvania Sales Tax	6%
					\$4,339.18



Appendix C: General Conditions Estimate



General Conditions Estimate Breakdown

Table 1: General Conditions Estimate Project and Staff Personnel

PROJECT AND STAFF PERSONNEL COSTS					
CATEGORY	ITEM	UNITS	QUANTITY	TOTAL INCL. O & P	TOTAL COST
Field Personnel	Business Unit General Manager	Week	31.5	\$3,5000.00	\$110,250.00
Field Personnel	Operations Manager	Week	31.5	\$3,225.00	\$101,587.50
Field Personnel	Project Executive	Week	31.5	\$2,650.00	\$83,475.00
Field Personnel	Project Superintendent	Week	83	\$3,075.00	\$255,225.00
Field Personnel	Project Engineer	Week	73	\$2,150.00	\$156,950.00
Field Personnel	Site Work Assistant Superintendent	Week	12	\$2,575.00	\$30,900.00
Field Personnel	MEP/FP Assistant Superintendent	Week	36	\$2,575.00	\$92,700.00
Field Personnel	2nd Shift Assistant Superintendent	Week	83	\$2,575.00	\$213,725.00
Field Personnel	Engineering Assistant	Week	73	\$1,425.00	\$104,025.00
Field Personnel	Site Laborers	Week	63	\$2,000.00	\$126,000.00
				SUBTOTAL	\$1,274,837.50
				Location Factor	0.996
				TOTAL	\$1,269,738.15

Table 2: General Conditions Estimate Construction Facilities and Equipment

CONSTRUCTION FACILITIES AND EQUIPMENT COSTS					
CATEGORY	ITEM	UNITS	QUANTITY	TOTAL INCL. O&P	TOTAL COST
Office & Storage Sheds	(2) Storage Boxes, 20'x8'	Month	15.75	\$125.00	\$1,968.75
Field Office Expense	Office Equipment Rental	Month	15.75	\$171.00	\$2,693.25
Field Office Expense	Office Supplies	Month	15.75	\$93.50	\$1,472.63
Field Office Expense	Mobile Phones	Month	15.75	\$500.00	\$7,875.00
Field Office Expense	Lights & HVAC in Office	Month	15.75	\$165.00	\$2,598.75
Temporary Fencing	Chain Link, 11ga, 6' high	Month	15.75	\$600.00	\$9,450.00
Temporary Project Signs	High Intensity Reflectorized	LS	1	\$2,000.00	\$2,000.00
Tools/Equipment	Smalls Tools & All Equipment	Month	15.75	\$1,500.00	\$23,625.00
Clean-Up Equipment	All Clean-up Equipment	Week	58	\$20.00	\$1,160.00
Dumpsters	(7) Site Dumpsters	Month	15.75	\$1,200.00	\$18,900.00
Portable Toilets	(3) Portable Site Toilets	Month	15.75	\$900.00	\$14,175.00
Safety Equipment	Hard Hats, Safety Glasses, etc	Month	15.75	\$100.00	\$1,575.00
Fire Extinguishers	Site Fire Extinguishers	Month	15.75	\$90.00	\$1,417.50
				SUBTOTAL	\$88,910.88
				Location Factor	0.996
				Sales Tax	6%
				TOTAL	\$93,868.55



Table 3: General Conditions Estimate Temporary Utilities

TEMPORARY UTILITIES COSTS					
CATEGORY	ITEM	UNITS	QUANTITY	TOTAL INCL. O&P	TOTAL COST
Temporary Utilities	Field Network Set-up	LS	1	\$3,500.00	\$3,500.00
Temporary Utilities	Field Telephone Set-up	LS	1	\$1,250.00	\$1,250.00
Temporary Utilities	Land Line Telephone Bill	Month	15.75	\$88.00	\$1,386.00
Temporary Utilities	Temp. Power & Lighting Install	LS	1	\$13,500.00	\$13,500.00
Temporary Utilities	Temporary Power	Month	15.75	\$10,000.00	\$157,500.00
Temporary Utilities	Temp. Water/Sanitary Hook-up	LS	1	\$1,500.00	\$1,500.00
Temporary Utilities	Temp. Construction Water Bill	Month	15.75	\$68.00	\$1,071.00
				SUBTOTAL	\$179,707.00
				Location Factor	0.996
				Sales Tax	6%
				TOTAL	\$189,727.46

Table 4: General Conditions Estimate Miscellaneous

MISCELLANEOUS COSTS					
CATEGORY	ITEM	UNITS	QUANTITY	TOTAL INCL. O&P	TOTAL COST
Insurance	Builders Risk, Standard	Job	\$28,248,910.00	0.24%	\$67,797.38
Photographs	Progress Photographs	Month	15.75	\$350.00	\$5,512.50
Permits	Rule of Thumb, Most Cities	Job	\$28,248,910.00	2%	\$564,978.20
Cleaning Up	After Job Completion	Job	\$28,248,910.00	0.30%	\$84,746.73
Commissioning	Performance, Training, etc.	Project	\$28,248,910.00	1%	\$282,489.10
				SUBTOTAL	\$937,726.53
				Location Factor	0.996
				TOTAL	\$933,975.62

Table 5: General Conditions Estimate Contingency

CONTINGENCY COSTS					
CATEGORY	ITEM	UNITS	QUANTITY	TOTAL INCL. O&P	TOTAL COST
Contingency	Construction	Project	\$28,248,910.00	8%	\$2,258,912.80
				SUBTOTAL	\$2,258,912.80
				Location Factor	0.996
				TOTAL	\$2,250,873.15



Appendix D: LEED Evaluation



LEED PROJECT CHECKLIST

		14		12		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	
		6		4		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				2	Credit 3	Water Use Reduction		2 to 4	
		9		2		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			
9		2		8	Credit 1	Optimize Energy Performance		1 to 19	
				7	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	
		3		11		Materials and Resources		Possible Points: 14	
	Y				Prereq 1	Storage and Collection of Recyclables			
2					Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof		1 to 3	
				2	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	



LEED PROJECT CHECKLIST CONTINUED

RIVER VUE APARTMENTS: 300 Liberty Avenue, Pittsburgh, PA 15222			
Materials and Resources, Continued			
Y	?	N	
		2	Credit 4 Recycled Content 1 to 2
		2	Credit 5 Regional Materials 1 to 2
		1	Credit 6 Rapidly Renewable Materials 1
		1	Credit 7 Certified Wood 1
9	6	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
1	1	4	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
2	2	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
44	3	63	Total Possible Points: 110
Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110			



Appendix E: Building Information Modeling Use Evaluation

Level 1: BIM Execution Process Map

River Vue Apartments | Pittsburgh, PA

