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Construction Management Services for the new WPI Residence Hall

James Bellofatto Worcester Polytechnic Institute

Kyle A. Forward Worcester Polytechnic Institute

Matthew Clifford Frasier Worcester Polytechnic Institute

Michael Wood Worcester Polytechnic Institute

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Worcester Polytechnic Institute: Construction Management Services for the new WPI Residence Hall

A Major Qualifying Project Submitted to the faculty of Worcester Polytechnic Institute In partial fulfillment of the requirements for the **Degree of Bachelor of Science**

Submitted By:

James Bellofatto Kyle Forward Matthew Frasier Michael Wood

Sponsoring Agency:

Worcester Polytechnic Institute

Submitted To:

Project Advisors: Guillermo Salazar Paramasivam Jayachandran Date: February 28th, 2008

Abstract

This project presents an alternative design for the foundation wall of the Worcester Polytechnic Institute new residence hall to resist lateral loading during construction. The cost implications of this alternative design were also investigated. A 3-D model of the structure of the building was also constructed using Autdesk Revit software and a quantity takeoff was developed using this model. A cost estimate and takeoff for the structure were also performed and an earned value analysis was developed to access the progress of construction of the exterior walls.

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Capstone Design Statement

The capstone design requirements for this Major Qualifying Project are being satisfied by investigating the implications of redesigning a foundation wall that would perform its load carrying abilities as a foundation wall as well as act as a temporary retaining wall during construction. If the wall had originally been designed in this matter the effort of re-excavating, installation of tiebacks, and backfilling that the construction management firm was forced to undertake to complete this project safely could have been avoided. These tasks also had scheduling and cost impacts to the project. We compared the actual cost of the solution implimented in the field to the cost and impacts of our new cantilevered wall with counterforts.

Redesigning the wall consisted of a structural analysis of the existing wall, investigating the soil conditions on site to determine the type of retaining wall, and designing the wall to support vertical and lateral loads. Vertical loads on the wall were determined by using calculations prepared by Canon Design as well as being calculated by ourselves. Soil characteristics were used to determine horizontal pressures on the wall.

The proposed solution is a design that is a cantilevered retaining wall with counterforts, due to the fact that counterforts add tremendous strength without making the heel slab of the retaining wall to extremely long. This solution would take up minium space as well as materials and would allow the wall to accept the lateral loads presented by construction.

This project will addressed economic, scheduling, and constructability issues created by a differently designed foundation wall. We examined the increased costs of the project due to a foundation wall designed to carry vertical loads while also being able to resist horizontal loads during the construction process. Additionally we determined how the scheduling and constructability of the project would have been impacted if the wall was designed as a retaining wall from the beginning and additional time did not have to be dedicated backfilling the wall and then removing the fill at a later time.

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1.0 Introduction

Worcester Polytechnic Institute (WPI) has seen an annual growth rate for its student body over the past few years as its undergraduate and graduate programs continue to expand and gain global recognition. This is partly due to WPI's increasing success with its global projects program, which send students all around the world to work on either their Initial (IQP) or Major Qualifying Project (MQP), but more so because of a well thought out master plan for WPI that seeks to eventually connect the main WPI campus with its new satellite campus known as Gateway Park. Because of this there has been a need for more undergraduate housing particularly on campus. Traditionally most students move off campus after their first year into the surrounding apartments, sororities and fraternities. In order to foster the expansion of the university as well as provide much needed upper-classman housing, WPI has begun the construction of a new residence hall and parking garage between Boynton St. and Dean St. By bringing upperclassmen back on campus, Janet Richardson, the Vice President of Student Affairs and Campus Life believes that "the university benefits greatly from the leadership, mentorship, experience and talent of its students being part of the residential community on campus"¹.

¹ http://www.wpi.edu/About/NewResHall/facts.html

In order to attract the aforementioned upper-class students and their qualities, the construction of a new residence hall has begun. The school wants the residence hall to be completed by the fall of 2008 in order that students can move in at that time. Therefore the Project is being performed under a fast-track schedule, meaning that construction began before the design phase of the project is completed. The successful implementation of a fast track schedule requires close collaboration between the designer and the builder. This collaboration can best be obtained by using the Construction Manager approach with a guaranteed maximum price (GMP) contract and the selection of competent and experienced firms. For this reason Gilbane was hired as the Construction Manager and Cannon Design was hired as the Architect. Gilbane is in a construction manager at risk contract with a guaranteed maximum price (GMP). In other words, if there are cost overruns it will either cut into Gilbane's profits or if costly enough, even result in a loss for the company. This type of contract works well for the project as it must be completed in a very tight time frame as the university wishes to use the housing the 2008 school year.

The goal of this project is to observe the construction management process and to apply modern project management concepts and techniques used in cost estimating and project control during the building of the new residence hall. The activities conducted in this project include:

- a.) Redesign of the East Foundation Wall of the building to act as a retaining wall during construction.
- b.) Creation of a 3-D model of the structure based on the 2-dimensional plans and drawings using Autodesk Revit, a 3-dimensional Building Information Modeling program.

- c.) Generation of the material quantities for the structural concrete and steel for the building using the information stored in the Revit Model.
- Analysis of the construction progress of the exterior walls of the building using earned value analysis techniques.
- e.) Preparation of cost estimates of the steel and concrete packages by doing a quantity takeoff using the drawings and Microsoft Excel as well as by using the 3-D Revit model.
- f.) An analysis of the relationships of the different parties involved in the project and how they evolved throughout construction. This is known as a "Player Meeting Analysis" and can be used as a measure of how the relationships between important construction team members either hurt or helped the success of the project. The "Meeting Player Analysis" will describe the roles and attributes of the major players in the project, such as; the Project Manager for Gilbane, Neil Benner, Cannon Design's main liaison Ed Mello, WPI's construction consultant, Brent Arthaud, and WPI's head of plant services, Alfred DiMauro.

2.0 Background

Worcester Polytechnic Institute (WPI) has seen an annual growth rate for its student body over the past few years as its undergraduate and graduate programs continue to expand and gain global recognition. This is partly due to WPI's increasing success with its global projects program, which send students all around the world to work on either their Initial (IQP) or Major Qualifying Project (MQP), but more so because of a well thought out master plan for WPI that seeks to eventually connect the main WPI campus with its new satellite campus known as Gateway Park. Because of this there has been a need for more undergraduate housing particularly on campus. Traditionally most students move off campus after their first year into the surrounding apartments, sororities and fraternities. In order to foster the expansion of the university as well as provide much needed upper-classman housing, WPI has begun the construction of a new residence hall and parking garage between Boynton St. and Dean St. By bringing upperclassmen back on campus, Janet Richardson, the Vice President of Student Affairs and Campus Life believes that "the university benefits greatly from the leadership, mentorship, experience and talent of its students being part of the residential community on campus"².

To appeal to upperclassmen, the suites are designed as four person apartment style dorms with a full kitchen, living room, compartmentalized bathroom and either single or double bedrooms. The building also offers wireless internet access, air-conditioning, tech suites on each floor, recreation and fitness space and a separate parking garage able to accommodate

² http://www.wpi.edu/About/NewResHall/facts.html

the parking demand created by the building. It is these services and conveniences that are hoped to give students incentive to remain on campus throughout their time at WPI.

The architect on the project is Cannon Design whose offices are located in Boston, MA. The company was founded over sixty years ago and "is an international architectural, engineering and interior design firm recognized for design excellence and technological innovation."³ Currently Cannon Design has offices in Boston, New York, Baltimore, Washington DC, Jacksonville, Albany, Buffalo, Toronto, Chicago, St. Louis, Vancouver, Victoria, San Francisco and Los Angeles. The dormitory (See Figure 1 below) has 232 beds and 103,610 square feet of floor space. Janet Richardson stated that "The building is designed specifically with the students' needs and expectations in mind, including their desire for privacy, independence, safety, and securityⁿ¹. The design program was based a great deal on student feedback along with information provided by neighbors, faculty, and staff. Also incorporated into the design was to obtain LEED gold certification for the building. LEED, or Leadership in Energy and Environmental Design, certification involves incorporating alternative materials, recycling, reducing power consumption, along with many other criteria into the design and construction. This will make the dormitory environmentally friendly, or also known as a green building.

³ www.canondesign.com



Figure 1: Computer generated image of new WPI dorm

Another one of the main goals for this project is "developing a vibrant lower campus that begins to link WPI's main campus with the downtown area and to Gateway Park, the 11acre mixed-use life sciences-based campus the university is developing in partnership with the Worcester Business Development Corporation⁴". This is accompanying the idea of creating an "attractive route for members of the WPI community and neighbors heading to the Worcester Art Museum, Tuckerman Hall, and the other venues in the downtown arts and culture district". By bringing upperclassmen back onto campus and tying WPI into the surrounding culture, the university can become much more hospitable.

Adjacent to the dormitory is a 189-space parking garage to address the parking issues around campus. This structure will provide parking to the residents, staff, and members. Its location is adjacent to the dormitory as well as the church as can be seen in figure 1.

⁴ (http://www.wpi.edu/News/Releases/20078/developers.html, 2006)

2.1 Fast Track Process

The new dormitory is being constructed under a fast track schedule. The reason for this is That WPI would like to have the building first occupied before the 2008-09 school. This has led to a tight schedule in which the dorm is to be completed. Starting with demolition of the existing buildings in April 2007 the building must be completed by early August 2008. The fast track construction process takes places when construction begins before design is completed. The design comes out in partial packages that are coordinated with the construction. As the design packages are finalized they are turned over to the contractor who then puts them out to bid. This process allows for a significant decrease in the time between the conceptualization and construction phases of the project, which directly translates into economic benefits in the form of lower financial costs & early occupancy rental costs. Even though overall development time is reduced, there is the always present the need for increased coordination and the risk of miscommunication, delays, and other human error. There is also less time to fix any mistakes or changes made in the design, as the construction is being done before the 100% completion of construction documents.

2.2 Construction Management

Project Management is "the art and science of coordinating people, equipment, materials, money and schedules to complete a specified project on time and within approved cost."⁵ The major tasks of the management team include organizing different areas of work and working to identify and solve any problems that may arise including interaction of parties,

⁵ Oberlander, Garold D. <u>Project Management for Engineering and Construction</u>.

conflict resolution, and scheduling issues. Gilbane, a Providence, R.I. based company, is the general contractor of the project and as such is in control of the project management.

2.3 Guaranteed Maximum Price (GMP) Contract

Gilbane is the construction manager at risk for this project and is bound by a Guaranteed Maximum Price contract (GMP). A GMP contract is defined as a form of compensation in a contract where the contractor is paid for actual costs incurred plus a fixed fee and the contractor is responsible for cost overruns above the agreed upon GMP amount. This gives the contractors incentive to keep costs down as they also benefit from the savings⁶. With a fast track design, there needs to be sufficient percentage of the design completed to provide a reasonably accurate cost estimation. The less complete the design is, the higher the contingency allowance is if a GMP is to be given at that point. This means that there is more room for the GMP to move up or down in cost depending on completion of design. As the design develops and more construction packages are bid then the uncertainty about the GMP decreases and the contingency allowance decreases as well.

The GMP for a fast track project is given early on in the project with a higher contingency allowance and is narrowed in on as the different trades for the job are bought out and contracted. This process often takes some time as the design for the building develops and the scope of the different aspects of construction can be determined by the subcontractors. The GMP for the new residence hall was not actually determined until late in the summer 2007,

⁶ (Dagostino & Feigenbaum, 2003)

which was about 3-4 months after construction for the new residence hall began. The GMP for this residence hall is \$33,479,592.

2.4 Cost Estimating

Construction cost estimating is "the determination of probable construction costs of any given project.⁷" Cost estimating is an integral part of the project management process because it provides a means for identifying and organizing materials in terms of quantity and cost value. Cost Estimates are performed on a project multiple times; from its preliminary conception all the way through to its completion. There are four of these types of estimates; the first of which would take place is called a feasibility estimate which is the least accurate. These estimates determine the projected cost of a project which then can be used usually by the architect to develop a cost vs. benefit analysis for the owner. These estimates are usually performed without an actual set of plans or drawings but rather with a general idea and sense of what an owner wants. Sometimes sketches of the facility are also used in the determination. The estimator must then use his expertise, judgement and experience in the construction field to produce the feasibility estimate for that project.

The next type of estimate that would take place is called a pre-construction cost estimate. Pre-construction estimate gives an owner an idea of the general price a project may cost. They are performed when more information about a project is available and they help the owner and architects define the scope of work for the project. They also work well as a basis for

⁷ Oberlander, G. D. (1993).

cost comparison for the various designs or modifications a project may include and help the owner reach the best solution while staying within his budget.

A square foot estimate is an estimate which can be performed when the proposed size of the building is known. A typical square foot cost estimate is broken down into different components, a cost is assessed to these components and then a cost per square foot is determined. These estimates also take into consideration geographic area and cost of construction in these areas. The accuracy of these estimates can vary from -20% to +30% of actual costs.

The most precise type of estimate is a unit price detail estimate. This type of estimate requires a full working set of plans and specifications, known as the working drawings, and is typically the type of estimate performed in the bidding process of construction. "It includes determination of the quantities and costs of everything required to complete the project. This includes the materials, labor, equipment, insurance, bonds, and overhead, as well as an estimate of profit." (Dagostino, 2003) From this information unit prices are established for all the different materials and equipment that will be needed to construct the project. These estimates are usually organized by trade and are typically accurate within -5% to +10% of actual project costs. This is the type of estimate that was performed in this project.

All of these types of estimates were performed at various stages during the development of this project. Initially Cannon Design performed a feasibility estimate for the building to help WPI determine the characteristics that they wanted the new residence hall to have. Gilbane also performed a cost estimate during the schematic stage of the development as well as an independent cost consultant.

2.5 Project Scheduling

A major task in construction management is the scheduling of a project. "Project scheduling is the process of determining the sequential order of the planned activities, assigning realistic duration to each activity, and determining the start and finish dates for each activity." We created an as-built schedule for the construction of the exterior walls based on the observed progress using Primavera software. After this we observed the actual progress and conducted an Earned Value Analysis (EVA) of the construction of the exterior between walls. The EVA is a method that can be used to determine if the real progress in the construction of an activity in terms of its schedule and/or its cost or both. This essentially discerns if the activity being performed is ahead or behind schedule and whether the cost paid for the construction performed is either more or less than it should be based on the real amount of work performed. The exterior walls for this project were initially behind schedule as problems were encountered from the architectural precast manufacturer. The first few pieces of precast arrived late to the site and an acceptable version of the mock-up curtain wall was not initially agreed upon which also lead to delays. Right now they are catching up to their schedule and are almost on track.

2.6 Building Information Modeling

Computer programs that specialize on design have been around for a few decades. Starting with crude two dimensional Computer Aided Design (CAD) systems, programs slowly developed the ability to create crude three dimensional and further improved over the years into more functional programs with more capabilities. Today we no longer have "crude" programs. We have the luxury of Building Information Modeling. "A building information model (BIM) is an object-oriented building development tool that utilizes 5-D modeling concepts, information technology and software interoperability to design, construct and operate a building project, as well as communicate its details"⁸. Programs now have the ability to incorporate nearly every aspect of a project into a three dimensional drawing including cost, time, time of year, location, and link everything together.

Building Information Modeling is becoming an increasingly prominent aspect of design and construction. The ability to visualize a building in three dimensions gives all parties involved a better idea of the overall project. Not only of the outside of the building and its orientation on the site, but all the other aspects of the building including the foundation, structural steel, utilities, floors, walls, ceilings, and essentially every detail of the building. By using the plans to create the model, it is in fact a scaled replica of the actual building. This then allows for changes to be made without having to redraw plans, but by simply clicking a mouse and adjusting the properties or dimensions of an object. BIM Programs even allow the user to create 4D models by linking the entire project to a time schedule, showing the project being completed in a scale of the actual times assigned in the work breakdown structure for the project. Almost everything needed for the entire project can be incorporated into a Building Information Model, potentially making it the only document necessary for linking information from most all aspects of the construction process.

⁸ www.BIMForum.org

Coordination between parties is always a challenge, especially when it pertains to changes or discrepancies within a project. "With BIM, architects and engineers, efficiently generate and exchange information, create digital representations of all stages of the building process, and simulate real-world performance – streamlining workflow, increasing productivity, and improving quality"⁹. Any problems can be seen by all parties in an actual representation of the building. If there is a problem with the model, then there would be a problem with the actual building unless it is changed.

BIM is becoming increasingly popular within construction as programs improve, adding features and becoming more user-friendly. There are many pro-BIM groups developing, spreading the word of BIM and its benefits. One example is Associated General Contractors (AGC) BIM Forum, www.BIMForum.org, chaired by John Tocci of Tocci Building Corporation, located in Woburn, MA. Their goal is to "facilitate and accelerate the adoption of building information modeling (BIM) in the AEC industry"¹⁰. Another example is the National BIM Standard project, which takes information from different phases of their projects and work orders, and calculates an amount that would have been saved, most likely by the owner¹¹. Such groups supply information and praise BIM to everyone involved in design, construction, or any other aspect of a project.

Since BIM is becoming ever more useful, it is only a matter of time before more of the world accepts it as a major source of information on a project. Paper drawings and specs are not going to be phased out, but BIM is a extremely helpful in coordinating this information. A

⁹ Autodesk ¹⁰ BIMForum

¹¹ NBIMS

company bidding on a job is able to display the building developing in real time with exact rendering of the owner's wants and needs, or a construction company that has to make a change can show the owner on a three dimensional model in order to get approval. These characteristics are what make Building Information Modeling popular and potentially the future of the construction industry.

2.7 Foundation and Retaining Wall Design

Foundation Engineering is the science of designing a structure that can adequately support the loads transferred to it from the structure above, as well as prevent any sideways movement from the earth's pressure including an overturning moment. The foundation itself is normally designed by a structural engineering firm, while the soil settlement, soil pressure, and other earth material characteristics of the soil below the foundation is evaluated by a geotechnical engineer. Typical foundations designs are spread footings, slab on grade foundations or deep foundations. Most foundations are made of concrete with reinforcing steel inside. Concrete is an extremely strong material when used in compression, while the steel inside helps protect the concrete from cracking when loaded in tension. The two work well together because they expand and contract at a very similar rate.

Retaining walls are structures that hold back rocks, soils, and other materials acting on one side of the wall. They are either made of timbers, rock, generally concrete, brick, masonry, and steel. Retaining walls are also typically designed by structural engineers. One of the main concerns when designing a retaining wall is the internal friction and cohesiveness of the material that is being retained, because depending on the material the pressures are extremely

different ranging from saturated clays that can act like a fluid and exert extreme pressures, to dry soils that will exert normal earth pressure's, to dry clays that are very cohesive and will exert hardly any pressure on the walls. There are a few different types of retaining walls such as a gravity wall, cantilevered wall, counterfort walls and mechanically stabilized walls.

3.0 The New WPI Residence Hall Project

In order to completely understand the new dormitory construction project, research was conducted on site as well as in the library. Construction meetings and owner meetings were attended weekly from August 25th, 2007 to February 28th 2008 in order to stay updated as to which tasks have been completed as well as any issues that may have risen. At these meetings weekly meeting minutes were handed out which outlined the relevant topics of discussion and coordination between the parties. Also other various project documents were handed out at these meetings which included product specification sheets, weekly project expenses, and subcontractor bid comparison sheets. These documents and the discussions at the meetings gave us great insight into the way a building develops as well as the collaboration of different parties and how critical they are to a projects success and ability to stay on schedule. Our research extends across many aspects of the design and construction process in order to gain a more complete understanding of the project.

The main focus of this chapter is to better explain each of main parties involved with this project. The construction manager for the project, the designer, and the owner of the project. The chapter will also help explain how the three main parties interacted with one another during the duration of our project.

Our objective in completing this MQP is to gain important real-life knowledge of how construction takes place. Applying knowledge learned in the classroom and integrating it with a construction project that is taking place at the same time will give us a very hands-on and challenging experience. We hope to gain a more precise understanding of civil engineering

practices and potentially some direction in terms of where our careers will take us after graduation.

3.1 Owner

The owner of the project is WPI. With 2,861 undergraduates annually enrolled the demand for housing has been an increasing concern. Currently, WPI has 33 major buildings on 80 acres in a residential neighborhood¹² in Worcester, New England's third-largest city. WPI, named the 22nd "*Most Connected Campus*" by *The Princeton Review* for 2006⁸, has a goal to begin the process of connecting the main WPI campus with its new satellite campus known as Gateway Park which was completed in 2007. This effort is an attempt to further tie together the campus as well as begin expanding for the future. In the development of the residence hall building there are many individuals representing WPI in the project including Janet Richardson, Philip Clay, Brent Arthaud and Alfredo DiMauro and Jeff Solomon.

Janet Richardson is responsible for the delivery of services to more than 3,600 undergraduate and graduate students and for oversight of the offices of undergraduate admissions, enrollment management, financial aid, and student life, as well as the Career Development Center and the Department of Physical Education, Recreation, and Athletics. Her main role in the project is to help determine and incorporate the important issues that concern student life with the new residence hall.¹³

Philip Clay is the dean of students at WPI. He represents WPI and the needs of students when it came to the design of the new residence hall. Brent Arthaud was hired as a consultant for WPI to act as an owner's representative for WPI. He was hired because of his knowledge

¹² http://www.wpi.edu/About/facts.html

¹³ http://www.wpi.edu/News/Transformations/2004Winter/richardson.html

and expertise of construction and his main concerns are making sure that the construction of the new residence hall is completed per plans and specifications within the budget allocated for the construction of this project.

Alfredo DiMauro is the assistant vice president of facilities at WPI. His main concerns for the building revolve around the future safe and efficient operation and maintenance of the new residence hall. Alfredo is responsible for making sure all the systems in the building will be working properly and are constantly maintained. The facilities department also deals with all repairs to the facility due to wear and tear and damages. Many of the issues brought up by Mr. DiMauro during the owner's meetings involved materials and their ability to withstand vandalism and general wear and tear. Ultimately he wants a building that is easy to maintain, very user friendly, very safe for the students, and will stay in good condition for a long time to come.

3.2 Architect

Cannon Design is the architect for this project. Established in 1945, Cannon's services include "planning, architecture, engineering, interior design and project delivery"¹⁴. It is a single firm-multi office practice, employing over 700 people and \$102.4 million annual revenue⁹. Working on the project for Cannon are Ed Mello and Lynne Deninger. Lynne Deninger is the main architect for the project who acts as a representative for Cannon at owners meetings. She deals with the selection of many of the furnishings and materials needed in the construction and the design of the building. Ed Mello works with the contracts between

¹⁴ http://cannondesign.com/start_frameset.htm

WPI and Cannon and helps expedite the process of design changes and coordination issues with the design. Coordination issues occur when the plans do not exactly meet up with the way the building is constructed and minor changes must be made in order to complete construction.

3.3 Construction Manager at Risk

The Construction Manager at risk for this project is Gilbane Building Company. They have 1800 employees nationally and in Puerto Rico and revenue of \$3 billion annually. After four generations of owners, Gilbane is "still a privately held, family-run company"¹⁵. Since 1873 their clientele has expanded to the "life sciences, transportation, healthcare, convention/cultural, government, education, mission-critical, corporate, sports/recreation, and criminal justice markets"¹⁰. Managing the project for Gilbane is Neil Benner with Don Venerus acting as the project engineer. Neil Benner is the project manager for the new residence hall and is responsible for all the permits, coordinating sub-contractors, and buying out the job among many other things. Don Venerus deals with the engineering issues involved with construction. Assisting them is WPI graduate Melissa Hinton who works for Gilbane on the job site. She works directly with sub contractors on a day to day basis and is involved with the everyday construction tasks such as coordinating sub contractors, ordering materials, and clarifying issues pertaining to construction. Ralph Stukowski is the project superintendent who oversees the day to day operations and coordinates the on-site subcontractors.

¹⁵ http://www.gilbanebuilding.com/inside/about.aspx

3.4 Owner, Architect, Contractor Relationship

The WPI dorm project is a fast track design with a guaranteed maximum price (GMP). Because of the fact pace and intense coordination for this style of project, there must be exceptional communication amongst all parties involved. The fast track schedule allows for barely any mistakes to be made in the construction project in order to meet the deadline. The construction manager at risk acts as a middle man, taking the owners demands or the demands imposed by the designer and portraying them to subcontractors in plans and directives. With poor communication, it is extremely difficult to get across what is needed and wanted by the owner. This can cause misunderstandings, which can lead to delays, ordering the wrong materials, or poor coordination. Coordination is necessary to have a smooth flowing project. There needs to be coordination of materials, labor and in the case of a fast track project, the design. Any mistakes that are made, starting at the owner, will most often lead to some type of negative consequence. In the case of construction, this is often depicted in an increase of cost.

The owner, architect, contractor relationship and collaboration for the new residence hall at WPI has been exceptional based on observations from the attendance of weekly meetings. Gilbane has worked for WPI before on the new admissions building that was constructed in 2006. In fact Neil Benner was the project manager for that project as well and his relationships with the entire WPI faculty concerned with the project are very good. He is also very knowledgeable of the city 's regulations and ordinances as well as of the local market conditions. Meetings have run very smoothly and there is little tension or disagreement over issues. There have been no major delays to the project as a result of bad relationships between the contractor, architect or owner, despite many disagreements on different concerns.

One main issue arose at the morning meeting on Wednesday, September 12th 2007. The issue was related to the metal studs for the interior wall, in particular about the way top-track connects the wall to the ceiling, mainly concerning its specs. Cannon had designed it to use a certain Hilti top track that was both a connection and a fire stop. Neil Benner (Gilbane) had found a product that met the all the requirements of the Hilti brand but was less expensive. Ed Mello (Canon) was very fervent in his belief that the substitute could not be used in place of the Hilti top track, and if it was used he tried to say it would note meet the intent expressed by Cannon's Design for the top track as a fire stop. Brent Arthaud (WPI) tried explaining to Ed that it would not be a problem, but Ed was not budging on his stance about the design, and eventually convinced them to go with the Hilti top track.

3.5 Project Progress To-date

According to Melissa Hinton, the dormitory is currently 50-55% completed. This figure has been calculated by a program which accounts for the square footage of walls, precast, and other calculable aspects of the project as well as percentage of non calculable portions of the project. These figures then provide an overall percentage completed. However, these figures are not exact, as there are many non quantifiable parts to the project.

4.0 Cost Estimating

A cost estimate for the structure of this building was performed by using the working drawings and specifications for the new residence hall as well as Microsoft Excel. The physical drawings for the residence hall were obtained through Melissa Hinton who is assisting the Project Manager Neil Benner. The drawings used to complete the estimate include the foundation plan, the first-floor through fifth-floor framing plans, vertical steel plan and the roof plan. The specifications for this building were also needed to fill in the gaps that the plans left out such as material types and specifications.

Once the materials were quantified from the plans the cost estimate for this building was performed using R.S Mean's method of Building Construction Cost Data¹⁶. A City Cost Index value was then applied to the prices in order to get a more accurate value for the construction costs in Worcester, MA. Unfortunately Worcester was not listed so the closest city to Worcester listed was Springfield, MA so the value of 1.08 was used.

4.1 Definition of Quantities

The quantity used to measure the concrete needed for construction is the Cubic Yard (CY). Often times Cubic Feet (CF) are also used and then converted to Cubic Yards. A volume measurement of 1 cubic yard is equivalent to 27 cubic feet of material. The measurement used to quantify the steel in the project is the ton. Steel is quantified by its weight and then an associated cost is attached to the weight of the material. One ton is the equivalent to 2000 lbs of material.

¹⁶ RS Means Building Construction Cost Data 2006

4.2 Concrete and Steel Quantity Takeoff

The first step for performing a cost estimate involves quantifying the materials needed for construction. Starting with concrete the different elements that comprise the foundation for the new residence hall include spread footings, piers, continuous footings, grade beams, and slab. The spread footings are taken off individually by their volume which is a combination of their length multiplied by width and height. These foundations are located in the ground underneath the building in the various places which are needed to withstand the vertical loads of the building. These are below grade and each of these spread footings is connected to the building structure by a vertical pier that attaches from the spread footing to either the slab or continuous footing of the building. These piers are also taken off by their volume and vary based on the depth of the spread footing.

The continuous footing runs under the perimeter of the building and are sometimes visualized as the foundation wall. In the case of the new residence hall there is no underground basement so the continuous footing runs under the structural foundation wall. The continuous footings are taken off by volume and the main aspect that changes for the continuous footing will go deeper into the ground in order to support the loads. Grade beams are a special kind of continuous footing that connects different spread footings together for improved strength by running a continuous footing between the piers of two or more spread footings. There are only a few grade beams in the new residence hall and they are also taken off by volume.

The structural concrete slab, which is found on every floor starting from the first floor up to the roof top, supports the various loads on each floor and transfers these loads to the structural steel. The slab provides a solid surface to walk on and is taken off by volume. The square footage of each floor is calculated and then multiplied by a uniform depth. In the case of the new residence hall the square footage was calculated by breaking the whole floor plan into separate sections which is a common practice in estimating the square footage of floor slab. Using this method the square footage and concrete calculations for each floor slab were made.

The spreadsheets for the quantification of all the structural concrete activities can be seen in Appendix C. A short table of the concrete volumes for each activity shows that the Concrete Slab for all of the floors and the roof is 1827.84 cubic yards. Each floor slab averages 290 cubic yards. The grade beams that are found under the first floor slab are equal to 20.42 cubic yards. The spread footings which take much of the structural compressive load of the building are equal to 700.39 cubic yards of concrete. The continuous footing and foundation wall is 213.25 CY. The entire volume of the structural concrete found in the building is 2815.79 cubic yards.

Table 1: Concrete Quantity Total

Concrete Total

Activity	Volume (CY)
Concrete Slab	1827.84
Grade Beams	20.42
Piers	53.89
Continuous Footings + Walls	213.25
Spread Footings	700.39
Subtotal	2815.79

Quantifying the steel in the structure is done by separating the different types of steel beams used in the structure individually. Horizontal beams run across the floors of the building providing a surface for metal decking to lay on which then holds the slab. Columns run vertically from the foundation up to the different floors connecting the frame of the building along with the bracing which reinforces the structure.

The steel beams are broken down by floor and by the columns that connect these floors. Once all of the different types of steel beams were identified they were quantified by taking their linear feet measurements from the working drawings. Once this is done the information for the steel is used to calculate the tonnage of the steel based on the cross-section of the beam and its linear foot measurement. Every specific type of steel beam has a different weight/length measurement. These measurements are given in lbs/feet and then multiplied by linear feet of steel in order to obtain a value for weight.

The spreadsheets for the quantification of structural steel for the building can be found in Appendix E. The second floor framing which is comprised of horizontal steel members weighed 61.21 tons. The third floor through fifth floor had identical steel framing plans and their weight was 60.29 tons each. The roof framing weighed more than the other floors because of the live loads imposed on the roof by the green roof system. The roof framing weighed 72.74 tons. Bracing which connects different floors together to increase the rigidity of the frame weighed 28.4 tons. The columns for the building were 140.81 tons. The total tonnage for the steel frame of the building came out to be 484.03 tons.

Table 2: Steel Quantity Tonnage per Floor

Steel Tonnage per Floor

	Steel Quantity
Activity	(Tons)
2nd Floor Framing	61.21
3rd Floor Framing	60.29
4th Floor Framing	60.29
5th Floor Framing	60.29
Roof Framing	72.74
Bracing	28.4
Columns	140.81
Total Tonnage	484.03

4.2.1 Concrete Pricing

Once the structural concrete and steel were quantified the next step in the process of performing the cost estimate is pricing the different activities associated with the construction. RS Means has a few different ways of pricing activities. One way to do this is by breaking down activities into specific tasks that can be priced individually. An example of this would breaking the floor slab activity into the material cost of concrete, the cost of formwork, the cost of placing concrete, the cost of reinforcing, the cost of curing and the cost of finishing. This method is very specific and in depth thus producing the most accurate estimates for the true price of construction. Another way to price an activity would be to apply a "system" price to the activity. This "system" price explicitly describes what is included in it. An example of this would be a slab system that includes the price of concrete, placement, formwork, and reinforcing all together. The price for this system is the applied to the volume of concrete (CY) of the slab. System pricing is more inaccurate but often times much simpler and leaves less chance of error by the estimator in forgetting to include something in the estimate.

For the concrete pricing combinations of both methods were used. The slab was first broken down by floor and cubic volume. The cubic volume of concrete was the multiplied the cost per CY to obtain the cost of materials. The cost of placing the concrete was then determined by multiplying a cost per CY for each floor. Additions were made for pumping the concrete to higher floors as the placement of concrete is more expensive the higher above the ground it needs to be placed. The cost of formwork was then determined by figuring out the linear feet of formwork needed to place the slab. Given that the floor slabs are almost identical the formwork could be reused for every floor which led to a lower cost per linear feet of formwork. The slabs for the residence hall include fibrous reinforcing which weighs 33 pounds/CY. The unit price for this reinforcing was then determined and multiplied by the volume of cubic yards. The cost of finishing the slabs and curing the slabs were determined based on the square footage of slab multiplied by unit costs for each activity. The average price for each floor was about \$56,000. The price for all of the slab activities for the building was \$279,975.

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The grade beams for the building were priced in the same way that the slab was. The cubic volume of the grade beams were multiplied by different unit price factors to determine the price of concrete, placement and formwork. The cost of reinforcing was done using the cross-section of GB01 from the drawings to determine first the tonnage of reinforcing and then the price. The grade breams for the structure cost \$5,381.

The piers which connect the spread footings to the slab were taken off using the system method. A system cost was found for both the 24" x 24" P24 footings as well as the 30" x 30" P30 footings. The system included forms, concrete, placement as well as reinforcing and the total cost for the concrete piers in the building is \$39,814.52.

The spread footings for the building and foundation walls were also priced using the system method. All of the spread footings for the building are greater than 1CY so they all fit into one unit price category for spread footings which includes formwork, concrete, placement and reinforcing. There are 700.39 CY of spread footings in the building and their cost was determined to be \$202,594.81.

The continuous footings for the building were taken off individually. Their volume of concrete was multiplied by a unit price to determine the cost of concrete. Their placement cost was also figured out using the volume as all of the footings are below grade. The formwork for these footings was determined by figuring out the contact area of the footings and multiplying that by the linear feet of footing. The reinforcing for the continuous footings was determined by multiplying a weight/foot factor to the linear feet and then multiplying that weight by the associated unit cost for steel reinforcing. The total cost for the continuous footings was \$60,306.

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The pricing spreadsheets for the structural concrete can be found in Appendix D. Once the price for all of the concrete was determined this price was then multiplied by the City Cost Index rate for Springfield, MA which is 1.08. A brief table of the prices of concrete shows that the total price determined for all of the structural concrete is \$635,118.

Table 3: Concrete Total Cost

Concrete Total

Activity	Volume (CY)	Cost
Concrete Slab	1827.84	\$279,975.05
Grade Beams	20.42	\$5,381.87
Piers	53.89	\$39,814.52
Continuous Footings	213.25	\$60,305.99
Spread Footings	700.39	\$202,594.81
Subtotal	2815.79	\$588,072.24
Cost Index: Springfield MA		
x1.08		\$635,118.02
Total		\$635,118.02

4.2.2 Steel Pricing

The pricing for steel was done using a unit price per ton of steel and applying that to each activity of steel. The unit price for steel for the building was determined by averaging the minimum and maximum values for a school construction project which were \$2,222/ton and \$3,338/ton which gave a value of \$2780/ton. The spreadsheets for steel pricing can be found in Appendix F. The cost of the structural steel was then multiplied by the city cost index which was 1.08. The total cost of the structural steel for the building was \$1,269,474.77. Each floor had an average steel cost of about \$168,500 and the columns and bracing cost about \$280,000.

Table 4: Steel Tonnage Cost per Floor

Steel Tonnage per Floor

	Steel Quantity	
Activity	(Tons)	Cost
2nd Floor Framing	61.21	\$170,163.80
3rd Floor Framing	60.29	\$167,606.20
4th Floor Framing	60.29	\$167,606.20
5th Floor Framing	60.29	\$167,606.20
Roof Framing	72.74	\$202,217.20
Bracing	28.4	\$78,952.00
Columns	140.81	\$391,451.80
Total Tonnage Cost	484.03	\$1,175,439.60
x City Cost Index		
Springfield MA: 1.08		\$1,269,474.77

5.0 Scheduling and Control

"Project Scheduling is the process of identifying all the activities necessary to successfully complete the project. Project Scheduling is the process of determining the sequential order of the planned activities, assigning realistic durations to each activity, and determining the start and finish dates for each activity."¹⁷ In order to successfully schedule a project, it must first be completely planned out. The omission of any activity would be detrimental to any schedule developed including the omission. It is the goal of construction project management to thoroughly plan and schedule a project. This information is then used to coordinate all activities performed by all parties on the construction project in an effort to improve efficiency, decrease delays, and increase profits.

5.1 Project Scheduling

A schedule was created using Primavera software as well as acquiring information from the schedule reports acquired from Gilbane, such as the one shown in Appendix B: Gilbane Construction Schedule. Primavera is a computer program that allows for inputs of scheduled starts, durations, and finishes as well as the development of a schedule based on the critical path method (CPM). Further, it allows the users to input labor units and cost in order to track cost over the duration of the project. A simplified version of the construction schedule, shown in Appendix T: Simplified Gilbane Construction Schedule, was created in order to gain a better understanding of the scheduling involved in a construction project. Examination of the project schedules developed by Gilbane allowed for the creation of a schedule containing roughly 90

¹⁷ Oberlander, Garold D. Project Management for Engineering and Construction.

activities opposed to the hundreds present in a fully detailed schedule. Using this simplified version it was determined that the critical path of the project was through the following activities: Site work & Foundations \rightarrow Steel Erection \rightarrow Floor Construction. This is not the path for the entire project as the simplified schedule, shown in Appendix T: Simplified Gilbane Construction Schedule , does not include all activities in the project.

5.2 Exterior Walls

Although a simplified scheduled was used for most project activities, a fully detailed schedule of the exterior walls was created using Microsoft Project. Project was chosen because of its simplified input format that more closely matched the less complex values calculated for the Exterior Wall Section. This allowed for the input of estimated costs per activity as opposed to a more complex resource breakdown by labor crew, material, and equipment. However, all of these factors were taken into account as shown in **Error! Reference source not found.**.

The main purpose of this schedule was to allow for an Earned Value analysis of the work package. The schedule was broken down by section of the building. The sections were Architectural Pre-cast, Exterior Sheathing, North Pod, and South Pod. Each section was then further broken down according to location such as East, West, North and/or South Elevations. Activities for the North and South Pod include Veneer Ties, Spray foam and membrane, Staging erection, Brick Veneer, Washdown and Staging Removal, Punch Windows, Curtain Wall, and Curtain Wall trim and seal. The activities are assigned to each façade they will be performed on by location such as East or West.

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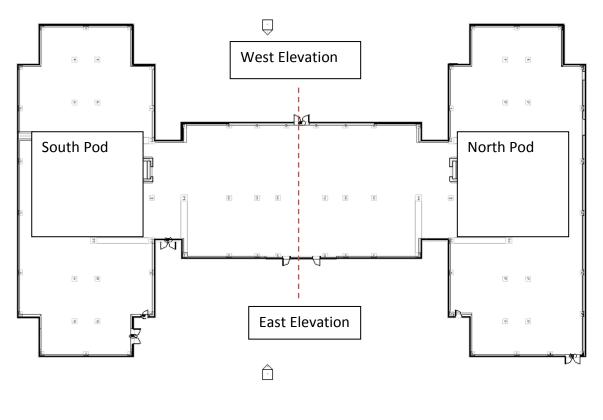


Figure 2: Plan View

5.3 Earned Value Analysis

An earned value analysis was performed on the construction of the exterior walls during the project. Photographs were taken at two separate times, once on December 12th, 2007 and again on January 30th, of 2008, that captured the process of the exterior wall construction.



Figure 3: Photograph Taken on December 12th, 2007

Using these pictures, estimates were made as to the percent completion of the work performed for each particular activity as categorized in **Error! Reference source not found.**.

5.3.1 Methodology

The initial step of the analysis was to determine the total amount of work planned to be completed on the building, known as Budgeted-Work Hours. In order to do so, the Total Labor Hours were calculated. The Total Labor Hours is simply the amount of time it takes a trade to complete one unit multiplied by the total number of units per activity. An example calculation of the Total Labor Hours for the East Elevation/North Pod: Brick Veneer activity is provided for clarity.

Table 5: Sample Total Labor Hour and Cost Calculations

Activity	Unit	Labor	Material	Labor	Cost/Unit	# of	Total	Total Cost

		Hours				Unit	Labor Hours	
East Elevation/North								
Pod: Brick Veneer	М	26.667	470.000	880.000	1350.000	34.425	918.011	\$46,473.75

In this example, the unit M is for every 1000 bricks. There are two types of bonding patterns used for the veneer of the building. A running bond constitutes most of the veneer while a double soldier course is used to separate the floors of the building, as depicted in Figure 4: Running Bond and Solider Course. Conveniently, both bond patterns use 6.75 bricks per square foot of wall place. The total area for the East Elevation/North Pod Brick was 5100 S.F.



Figure 4: Running Bond and Solider Course

The following equation was used to calculate the total number of bricks placed during the East Elevation/North Pod: Brick Veneer activity: $(6.75 \frac{Bricks}{S.F.} * 5100 S.F.)/1000 = 34.425 M.$

Next, the Total Labor Hours was calculated as the product of Labor Hours and the total quantity of the unit. Continuing with the previous example, the calculation would be performed as follows: $26.667 \frac{Labor Hrs}{M} * 34.24 M = 918.011 Labor Hrs$. The total numbers of Labor Hours for all activities were calculated in a similar manner and may be viewed, in

addition to all other calculations performed in this section, in **Error! Reference source not found.** The same quantity unit was used to determine to determine the total cost of the activity as shown in this calculation taken from the same example: $34.24 M * \frac{\$1350.00}{M} =$ \$46,473.75. Again, the total costs for all activities were calculated in a similar manner.

The calculations of the Actual Labor hours and Scheduled Labor hours were simply a matter of multiplying the estimated actual percentage of work complete and the scheduled percent completion by the Total Labor hours, respectively. A sample of the spreadsheet used for these calculations is shown in Table 6: Sample Spreadsheet for Actual and Scheduled Labor Hours Complete. The Actual Cost of Work Performed (ACWP) and Budgeted Cost of Work Performed (BCWP) were calculated in a similar manner as depicted in Table 7: Sample Spreadsheet for ACWP and BCWP. Similar calculations were made for all exterior wall activities.

		Percent pleted	Sch	eduled (Complete		Actual Labor	Hours		led Labor ours
Activity East Elevation/North	Dec. 12	Jan. 30th	Dec	. 12	Jan. 30th	Total Labor Hours		inuary 30th	Dec. 12	Jan. 30th
Pod: Brick Veneer	50.00%	100.00%	i 100	.00%	100.00%	918.011	459.01	688.51	918.01	918.01
		Table	7: Sampl	le Sprea	dsheet for A	CWP and B	CWP			
		Percent pleted	Scheo Com				ACWP		BCW	Р
	Dec.	Jan.	Dec.	Jan.						
Activity East Elevation/North Pod:	12	30th	12	30th	Total Cost	Dec. 12	Jan. 30th	De	c. 12	Jan. 30th
Brick Veneer	50%	100.%	100%	100%	\$46,473.75	\$23,236.	88 \$46,473.7	5 \$46,	473.75	\$46,473.75

Table 6: Sample Spreadsheet for Actual and Scheduled Labor Hours Complete

5.3.2 Results

The earned-value system was used to monitor the progress of work and compare accomplished work with planned work.¹⁸ This was accomplished using a Microsoft Project

¹⁸ Oberlander, Garold D. Project Management for Engineering and Construction.

feature that allows for the exportation of time-scaled data into Microsoft Excel for graphical analysis. This project lacked access to the Actual Costs of Work Performed (ACWP) therefore ACWP was set equal to BCWP in an attempt to illustrate the methods used in an earned value analysis. However, all scheduling information is believed to be accurate.

The first graph created was Figure 5: Integrated Cost/Schedule/Work Graph which is more commonly referred to as a "Lazy-S Curve" because of its consistent resemblance as can be seen.

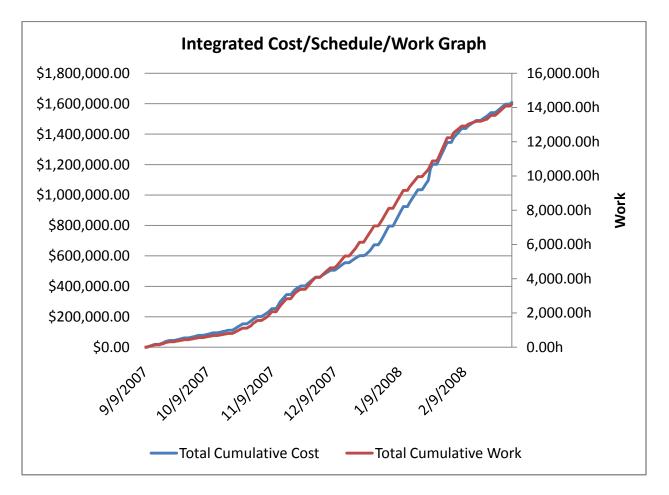


Figure 5: Integrated Cost/Schedule/Work Graph

This graph is created simply using the cumulative cost and work scheduled over the course of a project vs. time. As is shown, the projected amount of work for the exterior walls is 14019.207

Total Labor hours accumulating a Total Cost of \$1,608,858.61. The input of the ACWP and the Actual Work Completed on any date along the X-axis results in the determination of the current status of the project with respect to the baseline schedule. This is known as the Percent Complete Matrix Method. Using this method, it was determined that as of December 12th, 2008 the exterior wall activities were 1387.94 labor-hours behind schedule and \$143,712.69 under budget. As of January 30th, 2008 the activities were 1804.79 labor-hours behind schedule and \$46,487.29 under budget. The ACWP is considered equal to the BCWP in this analysis and because the actual work was behind the crews were not being overpaid. However, further analysis must be performed to interpret the true trends of the project.

The Cost Variance (CV) and Schedule Variance (SV) were calculated using the following equations: CV = BCWP - ACWP SV = BCWP - BCWS. The Cost Variances for both dates were equal to zero due to the equality of BCWP and ACWP. The Schedule Variances for the two dates were, -143,712.69 and -46487.29, respectively. This reduction in variance indicates that the activities have gained time on the schedule between December 12th, 2007 and January 30th, 2008.

In addition to the variances, the Cost Performance Index (CPI) and the Schedule Performance Index (SPI) were then used to track the trends of the current project using the BCWP, ACWP, and Budgeted Cost of Work Schedule (BCWS). The equations for these indices are show here: $CPI = \frac{BCWP}{ACWP}$ $SPI = \frac{BCWP}{BCWS}$. Both Indices give a value greater than one for favorable performance, i.e. under budget and ahead of schedule.

The CPI was equal to one because BCWP is equal to ACWP for the project without actual costs. The SPI, however, was equal to .75 on this date showing the project was behind

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schedule. This is displayed in **Error! Reference source not found.** Similar calculations produced a CPI equal to one and an SPI of .85 for January 30th, 2008 and are illustrated in Figure 7: Cost and Schedule Variance Graph for Jan. 30th. The increase of the SPI by .10 confirms the fact that the progress of the activities has gained time on the schedule. This is further illustrated in Figure 8: Cost Performance Index (CPI) vs. Schedule Performance Index (SPI) as the movement toward 1.0 is shown graphically.

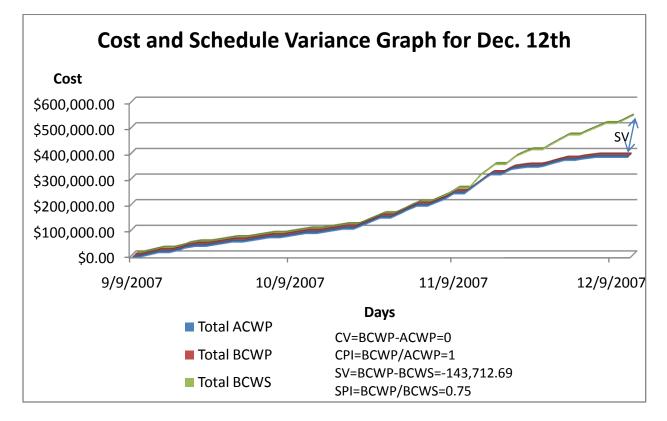


Figure 6: Cost and Schedule Variance Graph for Dec. 12th

The Percent Complete of the exterior wall activities were calculated for both dates and determined to be 33% and 89%, respectively. Percent complete is equal to the Budgeted Units minus the Units to Complete divided by Budgeted Units. The values were calculated using Microsoft Project as shown in Appendix M: Microsoft Project Screenshot December 12th, 2008 and Appendix N: Microsoft Project Screenshot January 30th, 2008

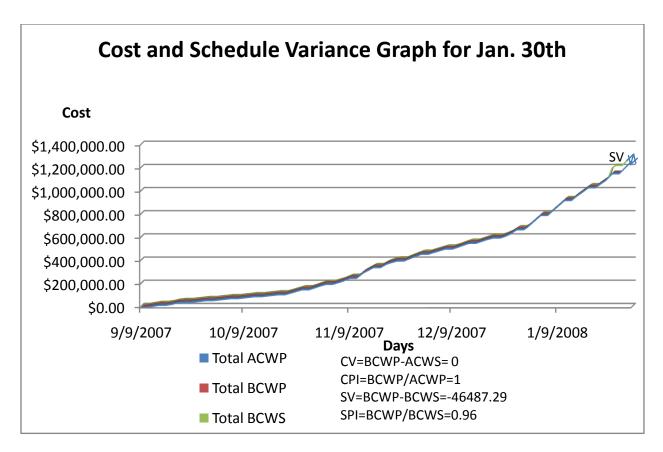


Figure 7: Cost and Schedule Variance Graph for Jan. 30th

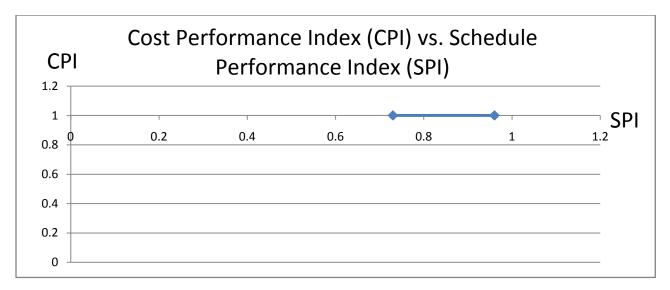


Figure 8: Cost Performance Index (CPI) vs. Schedule Performance Index (SPI)

6.0 Building Information Model – Revit

The program which we are using to create our Building Information Model is Revit Building 9.1 by Autodesk. Published in 2006, the program has since been replaced by Revit Architecture 2008, but it is still applicable to most any current construction project. It has many useful features of design, a vast library of materials, styles, furniture, and various other components. Revit also has the capability to import other design program files, such as AutoCAD. This can be useful to convert a 2 dimensional layout and turn it into a multi story structure. It can also export data from the drawing, eliminating the need to quantify by hand as well as DWG format into AutoCAD. Autodesk is a prominent name in CAD and BIM, with Revit being its major architectural BIM-based design program.

6.1 Model Design

Going by the drawings and specifications, our model was developed over the past three terms. With little background in Building Information Modeling, our group was somewhat nervous approaching the Revit design of the dormitory. At first, it was a bit frustrating, learning the program and its properties, not knowing commands or how to approach the design. However, with time, we became fairly proficient with Revit. Much like an education, we started at the foundation, doing what we thought was right, and learning from our mistakes along the way. However, as the building went up, so did our understanding of the program. By the time we had the structure done, we were able to make the building much more accurate and realistic.

6.1.1 Getting Started

Opening Revit, it seems as if you have far too many options (See Figure 9: Revit Menu**Error! Reference source not found.**). The left side of the screen has 10 main tabs, each with numerous options within them. Right next to the tab there are expandable views from different viewpoints as well as legends, sheets, families, and other options. At the top of the screen are countless options, ranging from an eyeball (dynamically modify view), to a hammer (demolish). These are very confusing at first, but each option has some benefit which gets discovered later and what once seemed like too many options becomes much more comfortable to navigate.

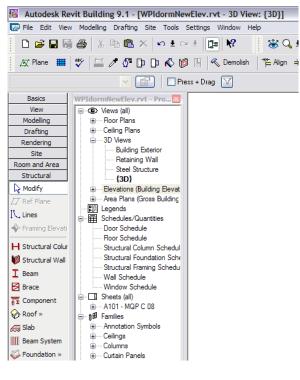


Figure 9: Revit Menu

Once we got our bearings straight, our model began by creating the levels of the building. These levels start with the foundation and go all the way up to the top of the screen

wall. Levels are represented by dashed lines in the Building Elevation views (See Figure 10: Revit Elevations). The views that these levels are visible in are the North, South, East, and West and appear as if looking directly at the associated side of the building. Our model was oriented the same way as in the plans. The levels which we created were based on the first floor elevation being 0'. The actual elevation of the first floor in the project starts at 502.60' works up or down from this. We thought it would simplify the calculations by using a base of 0', when in reality it may have made it more difficult.

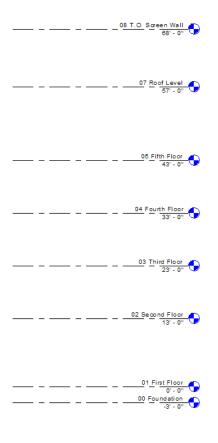


Figure 10: Revit Elevations

Next, we created a grid, exactly like the plans for the building. This grid is spaced at positions where the framing steel follows, making it easier to follow. The grid is again represented by dotted lines, but used in the Floor Plan views (See Figure 11: Floor Plan Grid).

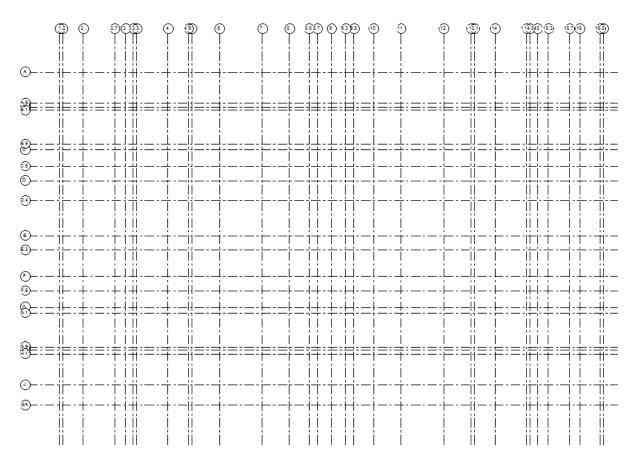


Figure 11: Floor Plan Grid

This grid can be appear to be a bit overwhelming at first, but in fact is extremely useful. Most of the dimensions are taken from these gridlines, so it would be even more confusing not having them. When they get in the way, Revit has a useful feature that lets you hide selected objects, or an entire category of objects. Once the grid was created, we could start creating the footprint of the building.

6.1.2 Foundation

At first, the foundation was somewhat complicated because this was the true starting point of the actual building, and again, we have had little experience with Revit at this point and limited exposure to foundation design. However Revit does make most general operations relatively simple to its user. You are able to select footings from the structural tab by selecting the components option and selecting a footing. A drop down menu becomes active, and you are able to select footings of certain dimensions. When a footing, for example, a type F8 8'0" x 8'0" x 1'10" spread footing, is not available, you can load it from the library, or create it by duplicating, renaming, and adjusting properties of other spread footings. Early on during the design of the model, we relied mostly on creating our own because we were not sure how to utilize the library. Once you have the footing loaded, you can select a level and offset from that level to place it. This is how we placed our spread footings at their appropriate levels (See Figure 12: Foundation).

With the footings in place, the foundation walls and piers can be drawn and set at the appropriate base depth. While the top of the foundation is constant, the depth varies from 3' up to over 10' on the South East corner (Figure 12: Foundation), which is the focus of our structural analysis. We are focusing on this wall because of the fact that it had to be redesigned due to overturning moment.

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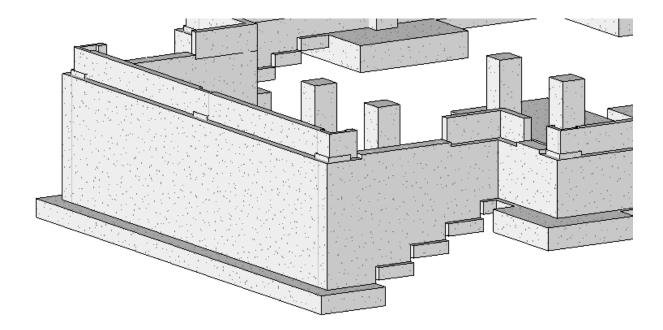


Figure 12: Foundation

6.1.3 Steel Frame

Once the foundation was completed, we were able to start building our model up. Starting with the vertical steel, the columns were set in place by simply selecting structural column and a beam size, then centering them on the piers. The columns were given a base and top constraint, reaching up to various heights, but mainly to the roof level. With the vertical steel columns in place, we were able to utilize the levels that we had created. Because the steel is not on the same level as the floor, a separate layer for the steel was created by offsetting the second floor level downwards. On the new level we followed the structural plans for the second floor steel. To draw a beam, you click the structural the tab on the left, and then select beam. Again, you can select different beams from the drop down menu, or load new ones. Once you have the beam you are putting in place, it is as simple as drawing a line. One issue we encountered in drawing the structural framing is that no connections are displayed between beams (See Figure 13: Steel Connections). We searched meticulously for what the problem was, learning later that it was merely a characteristic of the program. The program is Revit Building 9.1, but it is architectural. In order to create and view connections, you must use Revit Structural. With our software, the connections are made even though they cannot be visualized.

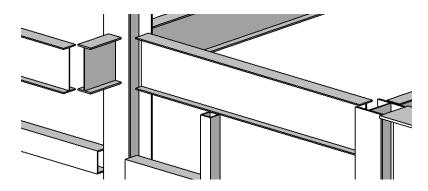


Figure 13: Steel Connections

After creating the structural frame, the model progressed quickly. For the most part, each level was very similar, with the steel framing for the roof being the only one with different size beams. This allowed us to copy and paste the framing from one level aligned to multiple levels at once. The result is a complete steel skeleton of the building (See Figure 14: Steel Frame), which allows us to begin wrapping the building.

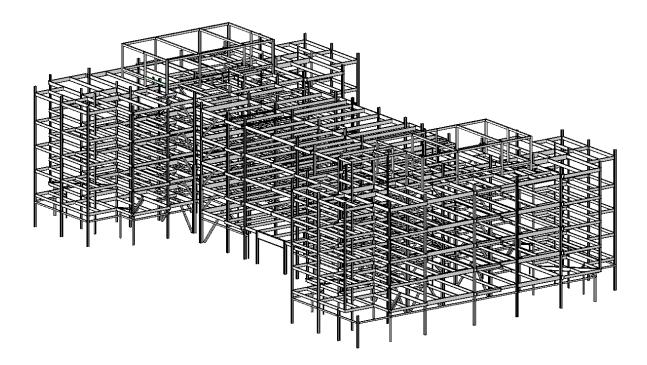
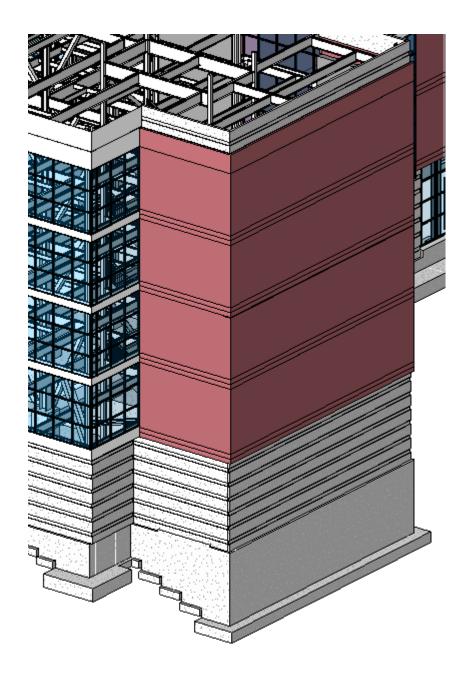


Figure 14: Steel Frame

6.1.4 Outer Walls

With the steel frame complete, walls could then be constructed. This is done by selecting wall from the basic tab. There are several options for wall types, including brick, concrete, glass, and aluminum. There are also different backings such as insulation, air barriers, and studs, which can be altered in the properties menu. Again, Revit makes it simple, with the ability to place a wall by offsetting it from a beam or other object by a specified distance or by simply drawing it.

The first floor is wrapped mainly in precast, which was fairly easy to put in place. One alteration made to the precast are the decorative reveals, giving it a more textured look, which were created by changing the properties of the wall. Also on the first floor is a glass curtain wall at the West and East entrances, as well as four other locations. This went in place just like the other walls, and had to connect with the brick. For the second floor and up, the walls were more of a challenge. The majority of the wall space is brick, backed by insulation and metal studs. The wall also includes a soldier course at the base, which again was added by changing the walls properties. Also on all floors after the first floor is glass curtain wall. Aluminum trim was added between each level of the glass curtain wall and extending from the fifth floor to the roof level. Again, once one floors walls were in place, we were able to copy and paste aligned to the other floors, saving us from having to repeat the process three more times. At the top of the fifth floor brick wall is more precast concrete reaching up to the roof level.

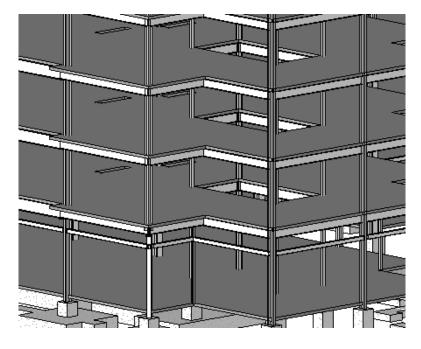




6.1.5 Slabs

The next step once the walls were in place was to place the slabs. This operation is located again in the structural tab under slab. For the most part, the slab is poured to the edge of the wall, but many places, mainly around openings, the slab will extend a certain distance

past the steel or edge. This is done by simply offsetting the desired line a certain distance. Also with the slab command you can draw the lines you want and leaving out openings in the floor. Once the slab is drawn, the desired thickness can be assigned, and it is set. Again, the second through fifth floor slabs are the same, so again we copied and pasted aligned to the desired level. This then gives us set floors within the building, and essentially, completing the concrete for the building.





6.1.6 Finishes

Once the slabs were placed, windows and doors were put in place. By selecting door or window in the modeling tab, then specifying types and sizes, doors and windows go in extremely easy. It is just a matter of selecting the wall it is to be placed on, its location, and for doors, the direction of their swing. When put in place, it automatically cuts out the wall and it is set. They can be easily moved and changed if necessary. To finish the building off, we wrapped the chiller housing on the roof with "ribbed steel", which for our project was just a thin aluminum wall and the canopy over the West entrance was covered. Also, we put the panel roof caps over the glass curtain walls as well as stairs on the interior. This was more for aesthetics purposes, as it served no purpose for the structure of the building. With some minor adjustments and fixing mistakes that became noticeable further along in the design, the dormitory was finished and we could then utilize our hard work to simplify our quantities and takeoffs.

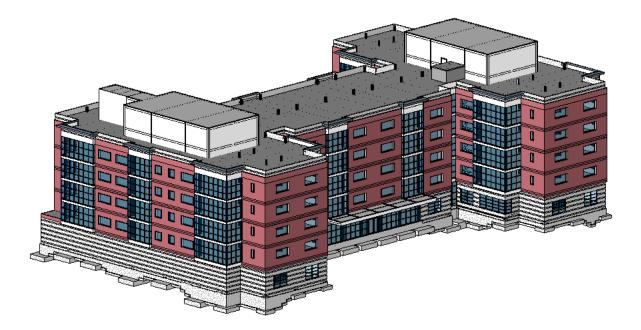


Figure 17: Exterior of Building

6.2 Summary of Design

Although it was a learning experience using Revit, we believe that it helped us get a better understanding of the building. It was a challenge to create the model; much like a big three dimensional puzzle on the computer. We learned about the design of the foundation, vertical steel and steel frame within the building as well as the overall orientation of the building and all of its internal structural components. Although we did not develop the architectural floors, including interior walls, bathrooms, utilities or finishes, these elements can be added to the model at any point in the future.

Most people will only see the final product, a furnished dormitory with a roof, walls, windows and doors. However, we learned how much actually goes into supporting the building, the types and quantities of the materials used and the overall design of such a structure. Even though it was frustrating at times, the Revit model proved to be a very valuable aspect of our project.



Figure 18: Final Building Design

6.3 Estimating Using Revit

An extremely useful aspect of Revit is the ability to extract quantities from the model. By adding the correct materials and dimensions, the building becomes a scaled replica of the actual building. With this, all the information can be obtained with a few clicks of the mouse. At any point during the design, a schedule can be created. Options are given as to which category to create the schedule for, such as doors, windows, rooms, electrical, and even such categories as gutters. For our project, we focused on the structural columns, structural foundation, and structural framing categories. Within the categories are the options to which fields are to be included in the schedule. The schedules which we created included fields such as Family and Type, Length, Volume, and Level. At any point, these fields can be added or removed to display other pertinent information. As the project develops, the schedule is automatically updated. Cost can also be incorporated as long as each object and material is given a price per unit.

02 Second floor Steel		
02 Second floor Steel		
	2' - 4"	0.05 CF
03 Third floor Steel	2' - 4"	0.05 CF
05 Fifth floor Steel	2' - 4"	0.05 CF
04 Fourth Floor Steel	2" - 4"	0.05 CF
06 Roof Steel	2' - 4"	0.05 CF
	11' - 8"	0.27 CF
07 Top of Elevator	2' - 7 5/8"	0.06 CF
07 Top of Elevator	2" - 7 5/8"	0.06 CF
07 Top of Elevator	2" - 7 5/8"	0.06 CF
07 Top of Elevator	2" - 7 5/8"	0.06 CF
	10' - 6 1/2"	0.25 CF
02 Second floor Steel	3" - 1"	0.08 CF
		0.08 CF
		0.08 CF
	-	0.08 CF
		0.08 CF
		0.08 CF
		0.08 CF
	-	0.08 CF
		0.08 CF
		0.08 CF
04 Fourth Floor Steel		0.08 CF
		1.25 CF
		0.09 CF
		0.09 CF
		0.09 CF
02 Second floor Steel	3" - 6 1/2"	0.09 CF
03 Third floor Steel	3' - 6 1/2"	0.09 CF
03 Third floor Steel		0.09 CF
03 Third floor Steel	3' - 6 1/2"	0.09 CF
03 Third floor Steel	3' - 6 1/2"	0.09 CF
05 Fifth floor Steel	3" - 6 1/2"	0.09 CF
05 Fifth floor Steel	3" - 6 1/2"	0.09 CF
05 Fifth floor Steel	3' - 6 1/2"	0.09 CF
05 Fifth floor Steel	3" - 6 1/2"	0.09 CF
04 Fourth Floor Steel	3' - 6 1/2"	0.09 CF
04 Fourth Floor Steel	3' - 6 1/2"	0.09 CF
		0.09 CF
		0.09 CF
	56' - 8"	1.40 CF
02 Second floor Steel		0.12 CF
	06 Roof Steel 07 Top of Elevator 02 Second floor Steel 03 Third floor Steel 03 Third floor Steel 03 Third floor Steel 05 Fifth floor Steel 05 Fifth floor Steel 05 Fifth floor Steel 05 Fifth floor Steel 04 Fourth Floor Steel 02 Second floor Steel 03 Third floor Steel 04 Fourth Floor Steel 04 Fourth Floor Steel 02 Second floor Steel 03 Third floor Steel 03 Third floor Steel 03 Third floor Steel 03 Third floor Steel 03 Fifth floor Steel 03 Fifth floor Steel 03 Fifth floor Steel 03 Fifth floor Steel 04 Fourth Floor Steel 04 Fourth Floor Steel 04 Fourth Floor Steel <td>06 Roof Steel 2' - 4'' 11' - 8'' 11' - 8'' 07 Top of Elevator 2' - 7 5/8'' 10' - 6 1/2'' 2' - 5/8'' 10' Top of Stevator 2' - 7 5/8'' 10' 2 Second floor Steel 3' - 1'' 02 Second floor Steel 3' - 1'' 03 Third floor Steel 3' - 1'' 03 Third floor Steel 3' - 1'' 05 Fifth floor Steel 3' - 1'' 04 Fourth Floor Steel 3' - 1'' 04 Fourth Floor Steel 3' - 1'' 04 Fourth Floor Steel 3' - 1'' 04 Second floor Steel 3' - 6 1/2'' 02 Second floor Steel 3' - 6 1/2'' 03 Third floor Steel 3' - 6 1/2'' 03 Third floor S</td>	06 Roof Steel 2' - 4'' 11' - 8'' 11' - 8'' 07 Top of Elevator 2' - 7 5/8'' 10' - 6 1/2'' 2' - 5/8'' 10' Top of Stevator 2' - 7 5/8'' 10' 2 Second floor Steel 3' - 1'' 02 Second floor Steel 3' - 1'' 03 Third floor Steel 3' - 1'' 03 Third floor Steel 3' - 1'' 05 Fifth floor Steel 3' - 1'' 04 Fourth Floor Steel 3' - 1'' 04 Fourth Floor Steel 3' - 1'' 04 Fourth Floor Steel 3' - 1'' 04 Second floor Steel 3' - 6 1/2'' 02 Second floor Steel 3' - 6 1/2'' 03 Third floor Steel 3' - 6 1/2'' 03 Third floor S

Figure 19: Schedule

When the model is completed, the schedules can be extracted, easily going into a spreadsheet. Totals can be given by changing some options, but additional calculations were necessary for our project. For example, the tonnage of steel was not given, but the linear footage was. By multiplying the linear footage by the beams weight per foot, we get a weight in feet, and then dividing by 2000 gives us the tonnage. The spreadsheets are rather large, including hundreds and hundreds of beams, footings, and walls of different sizes, weights, and volumes (Figure 19: Schedule). Even though it is time consuming and tedious to calculate the totals from the spreadsheets, it is much easier than reviewing each floors structural drawing and measuring and adding beams by hand.

After extracting the structural columns, structural foundation, and structural framing schedules, we were able to calculate total cubic yards of concrete and tonnage of steel. This allowed us to compare the results obtained by Revit to the ones calculated by hand. These figures can be viewed in Section 8.2 Hand Estimate vs. Revit Estimate on page 76.

7.0 Structural Design and Analysis of Retaining Wall

As a requirement for our MQP we were required to complete a capstone design that related to the project. For the WPI residence hall we decided to redesign the southeast foundation wall. We chose this because it was not designed originally to act as both a load bearing foundation wall and a soil retaining wall. The original design was for strictly a vertical load bearing foundation wall in the southeast corner of the building. Early on in the planning of the project but after the design it was determined that Gilbane would begin construction of the parking garage during construction of the dormitory. In order to do this the front face of the southeast foundation wall would not be covered with soil in order to have enough room to construct forms for the parking garage retaining wall and facilitate equipment movement around the new dormitory.

This task would prove to be very interesting because time was lost early on in the project when excavation had to be performed so that field changes could be made to the foundation wall so it could act as both retaining and foundation wall. To fulfill our capstone requirement we designed the wall to both prevent the overturning moment of the earth as well as to support the weight of the building. Next we compared the difference in price for the original design, including costs to go back and install the tieback system, and the new design of the wall. Finally we compared how much of a difference it could have made in terms of scheduling to use this design in the first place, compared to having gone back and lost time to excavate, install the solution, and backfill again. A redesign of the wall was definitely needed in order to construct the parking garage while the front face of the foundation wall was not covered with soil to help counteract the overturning moment.

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7.1 Analysis of Original Design

The first step in completing the wall redesign was to analyze the original design of the wall to determine the deficiencies in the wall. To do so we had to first obtain the geo-mechanical properties of the soil on site that would be acting against the wall in the horizontal direction. Once the properties were gathered we began our investigation into whether or not the southeast foundation wall of the new WPI Residence hall could resist the overturning moment created from the soil. Using formula's from Arthur Nilson's book we could determined the pressure caused by the earth as follows:

> P=.5C_{ah}wh(h+2h') =.5*.333*130*11.65*(11.65+2(17)) =11,511.3 lbs.

 C_{ah} is the coefficent of active earth pressure

w is the unit weight of the soil

h is the height of the wall

h' is the surcharge converted to feet created by the building

The overturning moment that the pressure created was then calculated by multiplying the pressure from the earth with the distance at which it acts, the moment arm.

Moment Arm Distance

y=(h²+3hh')/3(h+2h') =[11.65²+3(11.65)(17)]/3[11.65+(2*17)]

=5.33 ft.

Overturning moment

M_o=P*y =11,511.3*5.33 =61,354 ft-lbs.

Once this was done we then determined how much counteracting force was generated by the weight of the concrete in the wall and the soil resting on the heel of the spread footing. It was found that the overturning moment created by the earth's pressure was 61,354 ft-lbs while the resisting force from the weight of the wall and soil resting on the heel was a mere 27,714 ftlbs. Calculations for the resisting force can be found in Appendix Q.

7.2 Design of Combined Retaining and Foundation Wall.

The first step in the process was to decide what type of design would be best suited for the application and size constraints since the wall was less than 10' away from where the parking garage would be constructed. Due to this fact, a buttress wall could not be constructed since as much free space as possible was need on the front face of the wall to facilitate construction of

the wall forms for the parking garage. Possible choices were now narrowed to a gravity wall, a cantilevered retaining wall, or a cantilevered wall with counterforts.

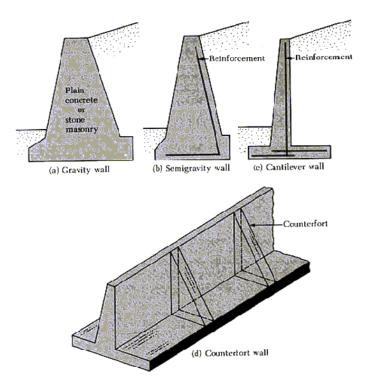


Figure 20: Possible solutions for the wall design

Counterforts are basically concrete ¹⁹stiffeners that connect the slab to the arm by

triangulation and increase the walls ability to hold back material and resist overturning

moment.

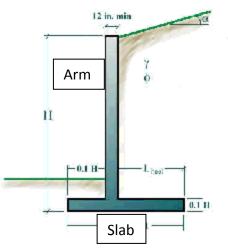


Figure 21: Simple cantilevered wall

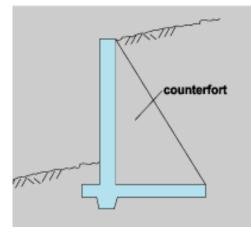


Figure 22: Retaining wall showing counterfort connecting the heel to the arm

The choice was made to design the cantilevered retaining wall with counterforts, due to the fact that counterforts add tremendous strength without making the heel slab of the retaining wall to extremely long. The heel is the slab located on the horizontal plane extending backwards from the arm of the wall.

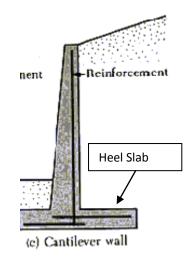


Figure 23: View of heel slab

Soil resting on top of the heel helps to resist the overturning moment, so the longer the heel, the more weight acting downwards on the slab and preventing the wall from rotating about the bottom corner of the toe. The one problem with this is that an extremely long heel can become costly in terms of the concrete and time to construct the vast forms. This was another reason why a counterfort design was chosen, to hopefully limit costs of the wall.

Not only would the wall have to resist the overturning moments and the inkling to slide if enough friction was not created between the slab and the soil, it must also be able to carry the large dead and live loads transmitted through the columns of the building down into the earth. The two combined would lead to an interesting challenge for the design.

The next step taken in the process was determining the vertical loads that would be acting on the wall in accordance with ACI code, because they would act as a surcharge, or an additional amount of soil, pressing against the wall. Dead loads for the steel and concrete that would be in place at the time of the construction of the parking garage retaining wall. Additional loads were factored in for tradesman and tools that might be transmitted to the foundation during the period that the front face would be exposed. The loads were

determined by calculating how much steel would be erected at the time construction of the garage would have started as well as the amount of concrete that would be adding to the total weight of the building in terms of the poured floor slabs. The surcharge was calculated by determing the weight on one column of the building multyplying it by three, the number of columns on the southeast wall, and dividing by the total length of the wall. The new pressure could be calculated using the same formula as earlier stated. Next the moment arm, distance at which the resultant pressure was acting, was calculated as follows:

y=(h²+3hh')/3(h+2h') =[(12.15²)+(3*2.15*17)]/[3*(12.15+(2*17))] =5.54 ft.

h' being the additional height of soil created by the surcharge.

With the two calculated values we then determined the overturning moment acting on the wall from the soil and the surcharge, plus a design factor that would increase the moment, to make sure the final design could handle an enhanced overturning moment in case the pressure was ever increased due to the soil becoming saturated with water and changing the characteristics. Preliminary design could now begin with the acquisition of the values.

The first order of business in the preliminary design was to use the moment and other known values to determine a possible dimension for the width of the arm and key, d, at the base of the slab, even though this would not be the actually distance of d. The arm is the vertical component that the soil pushes against, while the key is on the bottom side of the slab and helps or create friction to prevent sliding.

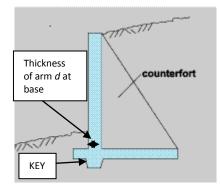


Figure 24: Diagram of Arm thickness and Key

The reason this could not be the actual thickness is because 2 inches had to be added to the distance to account for a concrete cover over the reinforcing steel as well as .5in for ½ the diameter of a typical piece of reinforcing steel. In the case of our design a thickness, d, was found to be 14.7 in. plus the 2in. cover, plus .5in. for the rebar thickness equaling a value of 17.2in. Refer to Appendix Q for the calculation of distance *d*. It was then rounded up to 2ft. because our group had wanted our design to be very conservative in case of the event that construction of the garage was delayed and additional loads were added to the wall from the surcharge. Shear at the base of the wall was also checked to make sure there would be no failures along a shear plane.

The next step was to make an assumption about the thickness of the slab, being that the slab is usual the same thickness or slightly thicker than the arm and key, followed by determining the width of the arm at the top of the wall. Normally the width decreases at the top of the arm to half the width at the base, but since this would be a foundation wall as well as a retaining wall, it was decided to leave the width of the arm stay constant at 2ft. from top to bottom to prevent any cracking or crushing damage that could be created from over loading to small an area at the top of the wall from the load bearing columns.

Our dimensions were starting to come together now with a 2ft. wide arm and key, as well as a 2ft. thick slab and the arm being 14.15 ft. tall from the bottom of the slab to the top of the ledge.

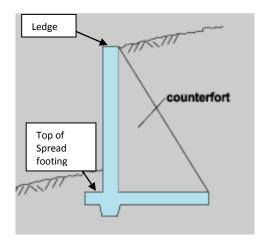


Figure 25: View of Ledge

The original distance from the top of the spread footing to the ledge was 10.15ft., but it was not designed to be exposed to the elements since it was thought that the distance from grade to the top of the footing would be well below 4ft. and would prevent any movement due to frost. Therefore the new design had to go 4 ft. below 10.15 ft. to prevent frost action since the full 10.15 ft. would be exposed and that would leave only 18" which is far too little and the foundation could have been affected by frost.

An educated guess was then made to have a starting point for the length of the toe and heel slab for the retaining wall. Next computations were done to some the weights and moments about the front edge of the toe. A few trials were made with different length heels and toes to determine what dimensions would work best to satisfy external stability of the wall. The final dimensions of a 2ft. toe, 8ft. long heel and 2ft. by 2ft., were chosen because they provided enough weight and resisting moment to prevent overturning with a factor of safety of 1.48, as well as resist sliding. 1.5 is the accepted factor of safety, but being that the safety factor was within 1% of the accepted, it would work. It was also kept because weight of the counterforts were not in the calculations and they would provide quite a bit more weight and resisting moment and increase the factor of safety. The factor of safety for resisting overturning moment is calculated by taking the resisting moment created by the weight multiplied by the distance from center of mass to the front edge of the toe, and dividing it by the overturning moment created by the earth's pressure at the resultant distance.

F.S=(Resisting Moment)/(Earth's Overturning Moment)

=139,543 ft-lbs./94067 ft-lbs.

=1.48

So as one could imagine the counterforts would certainly provide the added moment to resist overturning with a factor of safety greater than 1.5 and closer to 1.55.

Next the walls ability to resist sliding was checked using Reynold's formulas, to combine the resistance created by the toe with the soil, the resistance created by the key jutting below the slab, resistance from friction between the slab and soil, and finally the small amount of passive earth pressure created in front of the wall. The friction created between the toe and heel is much different, not due to the length, but because of the pressure gradient created from the non uniform loading of the arm. What this means is that the most pressure is located almost directly under the front edge of the toe and goes to practically zero at the back edge of the heel. The combined forces resisting sliding were 22,889 lbs, as opposed to the 14,744 lbs if sliding force created by earth pressures. The factor of safety was found by dividing the resisting sliding force by the sliding force created by earth, (22889)/(14744) equaling 1.55, therefore external stability of the retaining wall was found.

F.S.=(Sliding Resisting Force)/(Earth's Sliding Force)

=22889/14744

=1.55

Next the reinforcing steel in the footing, wall and counterforts had to be determined. First we determined the horizontal steel for the counterfort by calculating the moment using the formula,

$$M_u = pl^2/10,$$

= [14,744*(9.375*12)²]/10
= 18,660,375 in²-lbs.

p is the earth's pressure

I is the distance from the center of one counterfort to the center of the next counterfort to determine the moment acting on the two lower most 1 ft. tall horizontal strips on the wall between two counterforts. Once the moment was determined in in.²-lbs. we could plug the moment into the formula used to determine the area of steel that would be necessary in a given 1ft. section,

> $A_s = M_u / \phi f_y (jd).$ =18,660,375/[.9(60,000)(.875)(8.5)(12)]

=3.51 in²

A_s, being the area of the steel required,

M_u being the moment,

 ϕf_y being the tensile strength of steel times a limiting factor of .9 for concrete, and jd being the distance from where the arm meets the slab and the center of the bottom

section of the wall.

Once A_s is calculated the correct reinforcing bar can be selected and spacing can be determined. Spacing is determined by making sure that the amount of steel in a 1ft. section. That could be by either having bigger bar spaced further apart or smaller bar closer together. So if required steel area was .59 you could use no. 7 bar spaced 1ft. O.C. (on center),or no. 8 bar spaced 16" O.C., since in 4ft, you would have .79*3 or 2.37 in² in 4ft. of length and you would have 2.4 in² in 4ft. with the no. 7 bars 12" O.C.. Our calculations provide us with no. 18 reinforcing steel spaced 8" apart for the first 32" of the counterfort then decreasing to no.16 bar spaced at 8" for the next 40", and no.16 bar spaced 16" O.C. for the rest of the height, due to decreased bending moment.

Next, the vertical steel size and spacing must be determined. This is done by dividing a factored shear value by the tensile strength of steel multiplied by phi for steel and the distance from the back of the arm to the edge of the slab.

 $A_v = V_1 / \phi f_v d$ =85,450/.85(60,000)(8) =.209 in.²

V₁ is the factored shear load

f_v is the steel strength in tension

d is the distance from the base of the arm to the end of the slab

 ϕ is the limiting factor for steel

Our vertical reinforcing steel ended up coming out to be no. 5 bars spaced 8" O.C for the entire counterfort. After horizontal and vertical steel was designed for the counterfort we moved on to determining the steel needed to reinforce the arm, key, toe, and heel.

After using some of the same formulas and a few different formulas from Reynold's, *Reinforce Concrete Design Handbook,* we designed all the reinforcing steel for the rest of the retaining wall. Refer to, Appendix Q:Design Computations, Notes, and Diagrams, for all steel design computations.

At this point in time our wall had been designed including, necessary dimensions, and all reinforcing steel design. We were able to simply compare the dimensions of our new design and reinforcing steel to realize that our design would be more than capable to car the vertical loads transmitted to the foundation from the columns since our footing and wall was thicker and more reinforced than the original design. It was now time to complete the next part of the design, which was to complete a concrete takeoff for our newly designed retaining and foundation wall, so we could determine and compare costs to the original design plus the tieback solution.

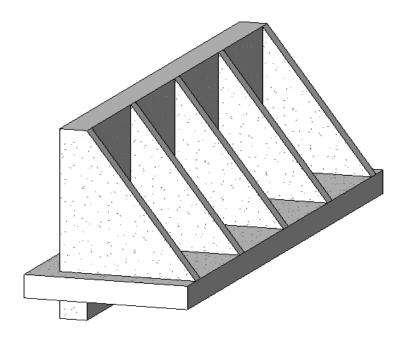


Figure 26: Redesigned Retaining and Foundation Wall

7.3 Concrete Takeoff and Estimate

To perform our takeoff and cost estimate we used the dimensions of our new wall and convert it into cubic yards of concrete. Calculations are in **Error! Reference source not found.**. We found that our design contained approximately 60 more cubic yards of concrete than the original design without the tieback and was about 47 cubic yards larger than the original design plus the tieback solution. The new design contained about twice as much concrete than the original specifications plus the tieback deadman. The final value for the concrete formed and poured in place was about 48,752 dollars as opposed to 28,100 dollars for the cost of the original foundation plus the cost to install the tiebacks. At first glance the price difference

seems quite substantial but that does not take into account the amount of time that was lost to move ahead in construction due to having to stop work to go back and fix the problem.

8.0 Conclusions

The results garnered through our project work have led us to several conclusions. These conclusions have been outlined in four sections. The Earned Value Analysis Benefits, Hand Estimate vs. REVIT Estimate, Hand Estimate vs. REVIT Estimate

One portion of our project was to compare the quantities acquire by Revit to the ones done by hand. Originally we had predicted that there would be a substantial discrepancy in the quantities, but the results were much better than we had guessed. The differences that exist in the quantities are due to human error. Even though the Revit output exact quantities, any flaws in the model will have a direct effect on the schedule, for example any deviation of wall dimensions creates error.

Concrete Volume		
(CY)		Hand
	Revit	Calculations
Footings	714.73	700.39
Piers	53.26	53.89
Grade Beams	31.91	20.42
Cont. Footings	352.75	280.23
Slabs	1766.28	1827.84
Total	2918.93	2882.77
	Difference	36.16
Table 9, 0	oncroto Volumo	

Our concrete volumes were as follows:

 Table 8: Concrete Volume

With a difference of only 36.16 Cubic Yards, our two methods were relatively close. The largest discrepancy was with the slabs. This main reason for this is most likely the Revit model. In Revit, when pouring a slab, the outer edges are usually walls, unless offset elsewhere. In some places in the model, there were some variations between the drawings and what actually was done. A small offset in a wall of even just a few inches could create a surplus of concrete.

For example, the West wall is about 230 feet long. If the wall was off by just 2 inches, with a 5 inch slab, this would result in an extra 8.5 cubic yards of concrete for one slab, and there are 6 slabs. That means that a 2 inch discrepancy would be the cause for an extra 51 cubic yards of concrete. Such errors do exist in the model, so it is inevitable that the Revit schedule does not exactly reflect the exact quantities. Another means of error is simple calculation mistakes. The drawings can be confusing in certain areas, and can create problems in accurately measuring and quantifying. However, we believe our difference of 36.16 cubic yards of concrete is acceptable, and both the Revit quantities and those obtained by hand were done with a fairly high degree of accuracy.

Steel (Tons)		Hand
	Revit	Calculations
Vertical	137.31	140.81
Framing	345.53	314.82
Bracing	28.95	28.4
	511.80	484.03
	Difference	27.77

Our steel volumes were as follows:

Table 9: Steel Tonnage

Again, our two methods were respectably close. However, unlike the concrete volumes, the difference was most likely due to error in hand calculations. Quantifying steel by hand can be extremely difficult because of the number of beams, difference in sizes and location. There are many beams on different levels, and in small spaces. Human error here plays a big part, because by missing only a few beams, the total can be off. For example, by missing just one 11'10" W27x84 beam would result in a half ton difference. Or one vertical HSS7X7X.500 column that stretched from the foundation to the top of the screen wall would result in over

one and a half ton difference. It is errors like these, along with incorrect measuring that could lead in such variation. Also, with Revit, if a structural beam is not connected correctly and extends to the wrong column, it will result in a small over calculation in the framing steel. Certain structural BIM software is more accurate, for example that used by steel fabricators, will automatically adjust the beam to fix this issue, but we used an Architectural program and this is not a feature. However, with Revit, such issues are often easily recognizable, and you have the luxury of going back and fixing the error. Usually these errors are spotted with oddities in the model, or error messages when something is placed incorrectly. Although there is a difference of 27.77 tons of steel, the difference was less that our group had expected. With such a complex matrix of structural beams and columns, we predicted a much higher margin of error, so once again, were satisfied with our steel quantities

Feasibility of Retaining Wall Design, and Gilbane Owner/Architect Meetings. The Earned Value Analysis Benefits section describes the uses and benefits of earned value methods for construction management. The Hand Estimate vs. REVIT Estimate compares and contrasts the quantities obtained using the different methods and possible reasons for discrepancies. The Feasibility of Retaining Wall Design will discuss the impact the redesigned wall would have on the schedule and overall cost of the project. Finally, the Gilbane Owner/Architect Meetings will contain observations and impressions made by attendance at weekly construction and owner meetings.

8.1 Earned Value Analysis Benefits

This project served as an example of how earned-value analysis can be used to track the trends of a project. As was discussed in Gilbane site construction meetings, the exterior walls are indeed behind schedule mainly due to issues with discolored and poorly fabricated Pre-cast concrete segments in the beginning of the project. Project manager Neil Benner stated this as fact, but there was little concern as the activities remained out of the Critical Path of the project and as such was not in a position to affect the completion date. It has been shown that the exterior wall activities are indeed behind schedule, however, they are making up ground on the schedule.

The final information to be gained from analysis is the forecasting of project completion. The information gather from this analysis include the Estimate to Complete (ETC) and the Estimate at Completion (EAC). The following equations were used in the analysis: $ETC = \frac{BAC - BCWP}{CPI} EAC = (ACWP + ETC)$ where BAC= Budget at Completion = Original Estimate. As of January 30th, 2008, the most recent date of analysis, the ETC is equal to \$367,026.06 and the EAC is equal to \$1,609,395.93. The Estimate at Completion is equal to the Original project estimate as a result of the lack of actual cost values in our data. However, this is where the forecasting of cost at completion would show budget overruns or savings. If there were budget overruns they would be absorbed by the CM at-risk unless they were able to then pass the costs on to responsible subcontractors. Almost all construction projects stray from the schedule. The benefits of Earned Value methods allow construction managers to keep track of the trends of their project.

8.2 Hand Estimate vs. REVIT Estimate

One portion of our project was to compare the quantities acquire by Revit to the ones done by hand. Originally we had predicted that there would be a substantial discrepancy in the quantities, but the results were much better than we had guessed. The differences that exist in the quantities are due to human error. Even though the Revit output exact quantities, any flaws in the model will have a direct effect on the schedule, for example any deviation of wall dimensions creates error.

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slabs. That means that a 2 inch discrepancy would be the cause for an extra 51 cubic yards of concrete. Such errors do exist in the model, so it is inevitable that the Revit schedule does not exactly reflect the exact quantities. Another means of error is simple calculation mistakes. The drawings can be confusing in certain areas, and can create problems in accurately measuring and quantifying. However, we believe our difference of 36.16 cubic yards of concrete is acceptable, and both the Revit quantities and those obtained by hand were done with a fairly high degree of accuracy.

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8.3 Feasibility of Retaining Wall Design

The capstone project allowed our group to experience designing something that is not just used to get practice from, but instead we had to determine an alternative way to come up with an effective design that could perform as designed as well as think economically so that we could minimize cost. Our design seems very feasible for a multitude of reasons, including the fact that no time would be lost re-excavating and installing the tieback, no additional costs for engineering a new design and purchasing the materials for it, and no change in the critical path of the project.

First being that before installing the tieback system our design would have cost approximately 34,000 dollars more. When looking at that number quickly it seems very high, but as you take a deeper look at the situation, you realize there were quite a few more costs that would have to be added to the original price that would close that gap. The first thing that

closes the price gap is that concrete alone for the tieback system costs roughly 6,000 dollars, which closes the gap to a 28,000 dollar difference. The next thing that must be looked at is the price to install the tieback system, 7,600 dollars, which includes excavation, machines costs, installation and backfilling once installed. This closes the gap now to just over 20,000 dollars, which does not include any of the fees from the engineering firm that had to design the restraint system on short notice. Now we are probably looking at just over a 15,000 dollar difference. What it does not factor into the difference is the amount of time lost to go back and install this, the cost to have a professional engineer design a support system that could handle the loads, time spent by project engineers and project managers to reschedule work plan, or the increase to the General Condition costs of the project.

The lost time to go back over work that has already done to re-work a problem is very great in even the smallest of projects. Three days lost to excavate, install, and backfill could translate in a week or more of delay in other jobs that could be getting done. The week delay that was created by an oversight in planning as to whether or not to construct the garage and dorm simultaneously could lead to a penalty of 20,000\$ dollars or more if stipulations are in the contract to finish on a certain date, and no later than that. In this case, the penalty could be much more than 20,000 dollars because if the dormitory is not finished by the completion date it could possibly lead to 300 or more students not being able to move into their rooms which could lead to a lawsuit from the owner against the CM for lost revenue if some of the students who could not move in decide to not go to WPI because they were mistreated the first day they arrived there or because WPI would have to spend additional money to temporarily accommodate the students in hotels or other housing until the dormitory was completed.

So our group feels this is a very feasible design because what started out costing the owner almost 30,000 dollars could lead to a lot more than that lost by the CM in the long run. Any time there is a problem like this in the construction of a project there is always more than what one sees the first time that look at a problem. In today's fast paced construction industry, time is money, therefore lost time can very often be more detrimental than a few thousand dollars difference in the design of part of the project involved in the critical path of the project.

8.4 Gilbane Owner/Architect Meetings

Over the duration of our project we attended weekly construction meetings between the Construction Manager At-Risk, Gilbane, the Architect, Canon Design, and the Owner, WPI. Through these meetings we gained perspective on the type of discussions made both in a construction meeting and in owner meetings. In both cases, a representative is usually on hand for all three parties. However, in a construction meeting the main focus is on scheduling, the progress of the sub-contractors, RFI's, and change orders, and the determination of GMP line items. Owner meetings mainly focused on sub-contract bids and awards, as well as architectural decisions. Attending these meetings also displayed the types of conflicts that often arise on a construction project.



Figure 27: CM/Owner/Architect Meeting

A major topic at the meeting was the type of chiller that would be purchased for the new dormitory. If a Smardt chiller was chosen, WPI would be eligible to receive a discount of \$46,000, but not if they purchased a York chiller. They were trying to determine which chiller would be quieter, and if either of them had a substantially lower operating and maintenance cost than the other. The Smardt chiller was more expensive up front, but offered a much larger rebate than the York chiller. The plan was to present what they thought would be the best chiller at the 1pm owners meeting later that day. They also discussed possible MEP coordination problems that they might be facing above the 5th floor and below the roof due to

low clearance. By the second meeting they had informally decided on the Smardt chiller

because of its overall cost and efficiency.



Figure 28: CM/Owner/Architect Meeting II

These are merely two examples of the myriad number of issues that must be dealt with over the course of a project. The necessity of these meetings on a timely basis, in this case weekly, is utterly apparent as they quickly quell any issues that arise. This prevents conflicts that could strain working relationships, prolong the project, and ultimately increase the overall cost. The three parties worked particularly well throughout the meetings we attended although issues arose over the course of this project and there was tension at times.

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Appendix A: Proposal

1.0 Introduction

Worcester Polytechnic Institute (WPI) has seen an annual growth rate for its student body over the past few years as its undergraduate and graduate programs continue to expand and gain global recognition. Because of this there has been a need for more undergraduate housing particularly on campus. Traditionally most students move off campus after their first year into the surrounding apartments, sororities and fraternities. In order to foster the expansion of the university as well as provide much needed upper-classman housing, WPI has begun the construction of a new residence hall and parking garage between Boynton St. and Dean St. By bringing upperclassmen back on campus, Janet Richardson, the Vice President of Student Affairs and Campus Life believes that "the university benefits greatly from the leadership, mentorship, experience and talent of its students being part of the residential community on campus"²⁰.

The goal of this project will be to examine and perform project management techniques that are common in construction and will be used during the building process of the new residence hall. The project will also include the redesign of the East Foundation wall of the parking garage to a retaining wall as the Capstone Design. A 3-D model of the residence hall will be created using REVIT and will be used for its feature of obtaining material quantities.

We will do this by performing an earned value analysis for the interior and exterior walls while tracking the scheduling of their construction with respect to percent scheduled versus percent complete using practices learned at WPI. We will also perform a cost estimate of the steel and concrete packages by doing a quantity take-off using excel as well as by using our 3-D REVIT model. An analysis of the relationships between the different parties and how they changed throughout construction will also be done to help understand how essential

²⁰ http://www.wpi.edu/About/NewResHall/facts.html

communication is in the construction industry. The foundation wall will be redesigned using hand calculations.

The deliverables of this project will include the following. The first deliverable will be an estimate of the concrete and steel used in the project. The exterior and interior wall construction will be tracked and scheduled using Primavera. Also, there will be a REVIT building model of the concrete, steel, and walls. The capstone design project will include the analysis and design of the foundation wall. A cost-benefit analysis of the wall will be completed with a determination of the potential benefits of building the wall so there would no longer be a need to backfill the parking garage area. At the conclusion of the project a "Meeting Player Analysis" will describe the roles and attributes of the major players in the project.

2.0 Literature Review

2.1 General Construction and Design

The new residence hall was designed to appeal to upperclassmen and in order to accomplish these suite-style rooms were chosen. The suites have been designed as four person apartment style dorms with a full kitchen, living room, compartmentalized bathroom and either single or double bedrooms. The building also offers wireless internet access, air-conditioning,

tech suites on each floor, and recreation and fitness space. Adjacent to the dormitory will also be a parking garage, allowing upper classmen to have their vehicles on campus. It is these services and conveniences that will give students incentive to remain on campus throughout their time at WPI.

Designed by Cannon Design, the



dormitory (Figure 29: A computer-generated view of WPI's future residence hall) has 232 beds and 103,610 square feet of space.

Janet Richardson stated that "The building is designed specifically with the students' needs and expectations in mind, including their desire for privacy, independence, safety, and security"¹. The design was based a great deal on student feedback along with information provided by neighbors, faculty, and staff. Also incorporated into the design was to obtain LEED gold certification for the building. LEED, or Leadership in Energy and Environmental Design, certification involves incorporating alternative materials, recycling, reducing power consumption, along with many other criteria into the design and construction. This will make the dormitory environmentally friendly, or also known as a green building.

Another one of the main goals for this project is "developing a vibrant lower campus that begins to link WPI's main campus with the downtown area and to Gateway Park, the 11acre mixed-use life sciences-based campus the university is developing in partnership with the Worcester Business Development Corporation". This is accompanying the idea of creating an "attractive route for members of the WPI community and neighbors heading to the Worcester Art Museum, Tuckerman Hall, and the other venues in the downtown arts and culture district"²¹. By bringing upperclassmen back onto campus and tying WPI into the surrounding culture, the university can become much more hospitable.

Accompanying the dormitory is a 189-space parking garage to address the parking issues around campus. This structure will provide parking to the residents, staff, and even the adjacent church members.

2.2 Project Management

Project Management is "the art and science of coordinating people, equipment, materials, money and schedules to complete a specified project on time and within approved cost."²² The major tasks of the management team include organizing different areas of work and working to identify and solve any problems that may arise including interaction of parties, conflict resolution, and scheduling issues. Gilbane is the general contractor of the project and as such is in control of the project management.

²¹ http://www.wpi.edu/About/NewResHall/facts.html

²² Oberlander, Garold D. <u>Project Management for Engineering and Construction</u>.

2.3 Fast Track Process

The new dormitory is being constructed under a fast track schedule. The fast track construction process takes places when construction begins before design is completed. Often in such cases design work is done concurrently with construction. The design comes out in packages that work with the schedule of the contractor. As the design packages are finalized they are turned over to the contractor who then puts them out to bid. This process allows for a significant decrease in the time between the conceptualization and construction phases of the project, which directly translates into cost savings. Even though time is conserved, there is the always present risk of miscommunication, delays, and other human error. There is also less time to fix any mistakes or changes made in the design, as the construction is being done as the plans are made.

2.4 Guaranteed Maximum Price (GMP) Contract

Gilbane is the general contractor for WPI and is bound by a guaranteed maximum price contract. A guaranteed Maximum Price contract is defined as a contract where the contractor is compensated for actual costs incurred plus a fixed fee and the contractor is responsible for cost overruns. This gives the contractors incentive to keep costs down as they also benefit from the savings²³. With a fast track design, there needs to be sufficient design completed in order to provide accurate cost estimation.

2.5 Cost Estimating

Construction cost estimating is "the determination of probable construction costs of any given project." Cost estimating is an integral part of the project management process because it provides a means for identifying and organizing materials in terms of quantity and cost value. Cost Estimates are performed on a project multiple times from its preliminary conception all the way through to its completion. There are four of these types of estimates; the first of which would take place is called a feasibility estimate which is the least accurate. These estimates demonstrate the projected cost of a project which then can be used to develop a cost vs. benefit analysis. These estimates are usually performed without an actual set of plans or drawings but rather with a general idea and sense of what an owner wants. The estimator must

²³ (Dagostino & Feigenbaum, 2003)

then use his expertise and experience in the construction field to produce the feasibility estimate for that project.

The next type of estimate that would take place is called a pre-construction cost estimate. Pre-construction estimate gives an owner an idea of the general price a project may cost. They are performed once more information about a project is available and they help the owner and architects define the scope of work for the project. They also work well as a basis for cost comparison for the various designs or modifications a project may include and help the owner reach the best solution while staying within his budget.

A square foot estimate is an estimate which can be performed when the proposed size of the building is known. A typical square foot cost estimate is broken down into different components, a cost is assessed to these components and then a cost per square foot is determined. These estimates also take into consideration geographic area and cost of construction in these areas. The accuracy of these estimates can vary from -20% to +30% of actual costs.

The most precise type of estimate is a unit price detail estimate. This type of estimate requires a full working set of plans and specifications and is typically the type of estimate performed in the bidding process of construction. "It includes determination of the quantities and costs of everything required to complete the project. This includes the materials, labor, equipment, insurance, bonds, and overhead, as well as an estimate of profit." (Dagostino, 2003) From this information unit prices are established for all the different materials and equipment that will be needed to construct the project. These estimates are usually organized by trade and are typically accurate within -5% to +10% of actual project costs. This is the type of estimate to be performed during this project.

2.6 Project Scheduling

A major task in construction management is the scheduling of a project. "Project scheduling is the process of determining the sequential order of the planned activities, assigning realistic duration to each activity, and determining the start and finish dates for each activity." We will look at and analyze the schedule of activities for the construction of the interior and exterior walls.

2.7 Building Information Modeling

Building information modeling is the application of a software program to create a 3-Dimensional representation of a building allowing for model reviews, virtual huddles, and electronic CAVES (computer-aided virtual environments) that allow for change to the environment, duration, nature, and results of the construction process. Further, this software can be used to track the entire design-construction process from beginning to end. This technology is in its infancy and a new tool for architects, engineers, and contractors alike. Currently the Institute of Building Sciences (NBIS) and the International Alliance of Interoperability (IAI) have begun to work together as buildingSMART to create the first National Standard for Building Information Modeling (NSBIMS).

One hope for BIM is that it will move away from the common mistakes seen when using CAD. Such problems include missing or generating inconsistent information, difficulties in collaboration, and mistakes detected at the construction site. These mistakes can end up being very substantial in terms of time, labor, and equipment. Whenever any of these resources are wasted it shows up in terms of money whether at the cost of the contractor, architect, or owner.

The model will also help with the coordination of the project between the owner, architect, and contractor and subsequently any subcontractors. Each discipline within the development of a facility including planning, design, construction, and management look only at their 12-18 month view and lack much concern about anything outside their window. "The loser is the owner—to the tune of \$15.8B annually according to the National Institute of Standards and Technology (NIST)." The cooperation and understanding gained through the use of a building information model could substantially decrease that number.

3.0 Methodology

This project will take three terms to complete and will include a Capstone Design aspect as well as a comparative cost analysis between using this design and the cost of construction in the field.

3.1 Earned Value Analysis of interior and Exterior Walls

The construction of the interior and exterior walls will be tracked throughout their construction as well as scheduled using Primavera software. This information will be compared to the amount paid to the subcontractors performing said work. The payment information will be obtained through the representatives of Gilbane, Co. The amount paid and the amount of work completed will be compared to create an earned value analysis.

3.2 3-D REVIT Model

A REVIT model of the concrete and steel frame of the building will be created using acquired drawings and specifications. This model will be examined and used in an estimate as well as being studied to determine the possible benefits of using this technology.

3.3 Steel and Concrete Estimate

The steel and concrete estimates will be calculated in two manners. One will be done conventionally as a takeoff of quantities multiplied by the pricing of those units found in the means. A second approach will use a program that will perform a quantity takeoff from the REVIT model. We will then compare the two approaches and perform an analysis of them.

3.4 Player Meeting Analysis

Weekly construction and owner meeting will be attended. Notes will be taken from these meetings as well as their minutes and any other pertinent information that is provided. Throughout the course of the project, people who play key roles will be studied ultimately compiling information for an analysis. This analysis will look at the relationships between those who attended the meetings as well as their roles in the project.

4.0 Project Specifications

In order to complete our project we have four goals. The first is to track the construction of the interior and exterior walls. Using this information we will perform an earned value analysis. We will then be able to evaluate the performance of Gilbane in terms of budget, scheduling,

and completion of the scope of work. Our second goal is to provide a cost estimate of the concrete and steel frame of the building using both hand calculations and computer software. Through the determination of quantities and pricing using means we will create a detailed cost estimate of these work packages. The third goal of our project is to create a 3D model of the structural frame of the building, composed of steel and concrete, using REVIT. The final goal of our project will be to redesign and analyze the east foundation wall of the parking garage to act as a retaining wall as well as a foundation wall.

4.1 Capstone Design

The capstone design requirements for this Major Qualifying Project will be satisfied by investigating the implications of redesigning a foundation wall that would perform its load carrying abilities as a foundation wall as well as act as a temporary retaining wall during construction. If the wall had originally been designed in this matter the effort of re-excavating and backfilling that Gilbane was forced to undertake to complete this project safely could have been avoided. These tasks also had scheduling and cost impacts to the project. We will look at these and evaluate them compared to the cost and impacts of our new design.

Re-design of the wall will consist of a structural analysis of the existing wall, investigating the soil conditions on site to be used in determining the type of retaining wall, and designing the wall to satisfy both of the walls needs. Vertical loads on the wall will be determined by using calculations prepared by Canon Design as well as being calculated by ourselves. Soil characteristics will be used to determine horizontal pressures on the wall using the according foundation engineering formulas.

This project will address economic, scheduling, and constructability issues created by a differently designed foundation wall. We will examine the increased costs of the project due to a foundation wall designed to carry vertical loads while also being able to resist horizontal loads during the construction process. Additionally we intend to determine how scheduling and constructability of the project would have been impacted if the wall was designed as a retaining wall from the beginning and time did not have to be wasted backfilling the wall and then removing the fill at a later time.

Appendix B: Gilbane Construction Schedule

Activity			Rem		Early	Total	2007	<u>2008</u> O N D J F M A M J J A S O I
ID	Description	Dur	Dur	Start	Finish	Float		
CONSTR	RUCTION							
Project N	Ailestones							
Certificat	te of Occupancy							
9025	Pre-test Elevator/Run test	2	2 2	2 17JUL08	18JUL08	14		17JUL08 I Pre-test Elevator/Run t
MS1	Fire Alarm Pretest (Initial Clean All Floors)	5		5 17JUL08	23JUL08	8		Fire Alarm Pretest (Initial Clean All Floors) 17JUL08
9035	Elevator State Inspections	2		2 21JUL08	22JUL08	14		Elevator State Inspections21JUL08
MS2	Fire Alarm Testing	5		5 24JUL08	30JUL08	8		24JUL08 E Fire Alarm Testing
MS3	Certificate of Occupancy 8/11/08*	0	0 0	ו	30JUL08	8		Certificate of Occupancy 8/11/08*
Substant	tial Completion							
11000				1	0.0.11.10.00			Level 3: Clean/Punched Completed for Turn-over
MS23	Level 3: Clean/Punched Completed for Turn-over				30JUN08	33		Level 2; Clean/Punched Completed for Turn-over
MS20 MS24	Level 2: Clean/Punched Completed for Turn-over				03JUL08 11JUL08	25		Level 4: Clean/Punched Completed for Turn-over
MS24 MS25	Level 4: Clean/Punched Completed for Turn-over Level 5: Clean/Punched Completed for Turn-over				28JUL08	25		Level 4. Clean/Punched Completed for Turn-over
MS25 MS21	Level 5. Clean/Punched Completed for Turn-over		-	-	28JUL08	14		Level 1: Clean/Punched Completed for Turn-over
MS30	Substantial Completion 8/18/08*			-	30JUL08	12		Substantial Completion 8/18/08*
Owner M		1 0	η t	4	13030E08	1 12		
Ownerin	ove-m							
6240	Owner Move-in (8/18 to 8/22)	5		5 18AUG08*	22411000	0		Owner Move-in (8/18 to 8/22)18AUG08*
	Owner Occupy (8/22/08)			22AUG08	2240000	1		Owner Occupy (8/22/08)22AUG08
Residence				2240000				
Site Finis	shes							
7400	Otest Otto West (vistor constraint)				1	53		
	Start Site Work (winter constraint)	0	_	03MAR08*		53		03MAR08*∳Start Site Work (winter constraint) 03MAR08 Site Work
7410	Site Work Site Finishes & Improvements	25		03MAR08	04APR08 02JUN08	53		07APR08 Site Finishes & Improvements
	Site Completed				02JUN08	53		Site Philstes & inprovements Site Completed
		1 1	η t	4	02301408	55		
	ing Elevations							
-	tural Pre-Cast East Elevation: Install Base Pre-cast	15		5 19SEP07A	2500707	16		East Elevation: Install Base Pre-cast
	South Elevation: Install Base Pre-cast	7		190CT07		16		South Elevation: Install Base Pre-cast
	West Elevation: Install Base Pre-cast	15		5 30OCT07		16		07 West Elevation: Install Base Pre-cast
	Sheathing		1 15	1300010/	120110101	1 10		
	North Elevation: Exterior Sheathing	4	d a	2 13OCT07/	2200707	21	130CT074	North Elevation: Exterior Sheathing
	East Elevation: Exterior Sheathing	8		5 15OCT07/		21		East Elevation: Exterior Sheathing
	South Elevation: Exterior Sheathing	4		190CT07		41		South/Elevation: Exterior Sheathing
	South Pod: Exterior Sheathing	9		9 19OCT07	310CT07	21		7 South Pod: Exterior Sheathing
MS5	North Building "Tight" for Elec Roughin & Insul	0		26OCT07		40		DI North Building "Tight" for Elec Roughin & Insul
MS5.S	South Building "Tight" for Elec Roughin & Insul	0	0 0	01NOV07		206		/07♦South Building "Tight" for Ele¢ Roughin & Insul
North Po	d			1	1			
North Fac								
	North Elevation: Veneer Ties	4	1 2	2 18OCT07/	22OCT07	30	180CT07A	North Elevation: Veneer Ties
		1						
Start Date Finish Date	224UG08	ent Schedule	WP31	CII	BANE BUIL		Sheet 1 of 14	Duschine Schedule New Progress opdate (MPS1)
Data Date	19OCT07	ress Bar		GIL	Constucti			Constuction Schedule Updated 19OCT07
Run Date	19OCT07 13:38 Critic	al Activity			WPI RESI			opulied recertif
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Activity	Activity	Orig	Rem	Early	Early	Total	2007	
ID	Description	Dur	Dur	Start	Finish	Float		
	North Elevation: Spray Foam/Window Membrane	2		23OCT07	24OCT07	30		North Elevation: Spray Foam/Window Membrane
	North Elevation: Erect Staging	3		25OCT07	29OCT07	42		North Elevation: Erect Staging
	North Elevation: Brick Veneer	10		30OCT07	13NOV07	42		7 🔜 North Elevation: Brick Veneer
	North Elevation: Washdown & Staging Removal	5		14NOV07	20NOV07	42		V07 🗖 North Elevation: Washdown & Staging Removal
	North Elevation: Punch Windows	10		03DEC07	14DEC07	45	03	DEC07 🗖 North Elevatioh: Punch Windows
	North Elevation: Curtain Wall	20		18DEC07	16JAN08	24		1βDECp7
7311	North Elevation: Curtain Wall Trim & Seal	10	10	17JAN08	30JAN08	100		17JANØ8 🔜 North Elevation: Çurtain Wall Trim & Seal
East Faca	de							
7329	East Elev/North Pod: Veneer Ties	6	6	26OCT07	02NOV07	23		East Elev/North Pod: Veneer Ties
	East Elev/North Pod: Spray Foam/Membrane 50%	2		05NOV07	06NOV07	23	1 1	07 East Elev/North Pod: Spray Foam/Membrane \$0%
	East Elev/North Pod: Erect Staging 50%	3	-	07NOV07	09NOV07	25		07 East Elev/North Pod: Erect Staging 50%
	East Elev/North Pod: Brick Veneer	18		13NOV07	07DEC07	25	13NO	V07 East Elev/North Pod: Brick Veneer
7318	East Elev/North Pod: Washdown & Staging Removal	5	5	10DEC07	14DEC07	25		10DEC07 East Elev/North Pod: Washdown & Staging Removal
7333	East Elev/North Pod: Punch Windows	10		17DEC07	31DEC07	35		17DEC07 East Elev/North Pod: Punch Windows
7322	East Elev/North Pod: Curtain Wall	20	20	17DEC07	15JAN08	25	i	17DEC07 East Elev/North Pod: Curtain Wall
7347	East Elev/North Pod: Curtain Wall Trim & Seal	8	8	16JAN08	25JAN08	95		16JAN08 🗖 East Elev/North Pod: Curtain Wall Trim & Seal
West Faca	ade					ſ		
7331	West Elev/North Pod: Veneer Ties	6	6	01NOV07	08NOV07	21	01NΦV0	7 🖬 West Elev/North Pod: Veneer Ties
7339	West Elev/North Pod: Spray Foam/Membrane 50%	2	2	09NOV07	13NOV07	21	09NO	07 🖬 West Elev/North Pod: Spray Foam/Membrane 50%
7338	West Elev/North Pod: Erect Stagging 50%	3	3	21NOV07	26NOV07	16	21N	DV07 Dvest Elev/North Pod: Erect Stagging 50%
7340	West Elev/North Pod: Brick Veneer	18	18	27NOV07	20DEC07	16	27	VOV07 West Elev/North Pod: Brick Veneer
7342	West Elev/North Pod: Washdown & Staging Removal	5	5	21DEC07	28DEC07	16		21DEC07 🖬 West Elev/North Pod: Washdown & Staging Removal
7343	West Elev/North Pod: Punch Windows	10	10	31DEC07	14JAN08	26	1	31DEC07 💶 West Elev/North Pod: Punch Windows
7345	West Elev/North Pod: Curtain Wall	20	20	31DEC07	28JAN08	16		31DEC07 West Elev/North Pod: Curtain Wall
MS6	North Pod Building "Tight" for Boarding	0	0	29JAN08		16		29JAN08 North Pod Building "Tight" for Boarding
7346	West Elev/North Pod: Curtain Wall Trim & Seal	8	8	29JAN08	07FEB08	94		29JAN08 📮 West Elev/North Pod: Curtain Wall Trim & Seal
South Po	d							
East Faca	de							
7329.1	East Elev/South Pod: Veneer Ties	6	6	05NOV07	13NOV07	49	05NOV	07 🖬 East Elev/South Pod: Veneer Ties
7315.1	East Elev/South Pod: Spray Foam/Membrane 50%	2	2	14NOV07	15NOV07	49	14NC	V07 I East Elev/South Pod: Spray Foam/Membrane 50%
7314.1	East Elev/South Pod: Erect Staging 50%	3		16NOV07	20NOV07	49		V07 East Elev/South Pod: Erect Staging 50%
7316.S	East Elev/South Pod: Brick Veneer	18	18	10DEC07	04JAN08	37		0DEC07 East Elev/South Pod: Brick Veneer
7318.S	East Elev/South Pod: Washdown & Staging Removal	5	5	07JAN08	11JAN08	37		07JAN08 🛽 East Elev/South Podi Washdown & Staging Removal
7333.S	East Elev/South Pod: Punch Windows	10	10	14JAN08	25JAN08	47	1	14JAN08 🔲 East Elev/South Pod: Punch Windows
7322.S	East Elev/South Pod: Curtain Wall	20	20	16JAN08	12FEB08	35		16JAN08 East Elev/South Pod: Curtain Wall
7347.S	East Elev/South Pod: Curtain Wall Trim & Seal	8	8	13FEB08	22FEB08	83		13FEB08 🔲 East Elev/South Pod: Curtain Wall Trim & Seal
West Faca	ade					' ł		
	West Elev/South Pod: Veneer Ties	6	6	09NOV07	19NOV07	45	09NO	07 🖬 West Elev/South Pod: Veneer Ties
	West Elev/South Pod: Spray Foam/Membrane 50%	2		20NOV07	21NOV07	45		0√07 ∎ West Elev/South Pod: Spray Foam/Membrane 50%
	West Elev/South Pod: Erect Stagging 50%	3		23NOV07	27NOV07	45		OV07 ■ West Elev/South Pod: Erect Stagging 50%
	West Elev/South Pod: Brick Veneer	18	-	21DEC07	17JAN08	28		21DE¢07 West Elev/South Pod: Brick Veneer
7342.S	West Elev/South Pod: Washdown & Staging Removal	5		18JAN08	24JAN08	28		18JAN08 West Elev/Sputh Pod: Washdown & Staging Removal
7343.S	West Elev/South Pod: Punch Windows	10		25JAN08	07FEB08	38		25JAN08 West Elev/South Pod, Punch Windows
7345.S	West Elev/South Pod: Curtain Wall	20		29JAN08	25FEB08	26		29JAN08 West Elev/South Pod: Curtain/Wall
	Exterior Facade Completed	0			22FEB08	83		Exterior Facade Completed
	0000700						 	
Start Date Finish Date	300CT06 22AUG08		WP31	GII	BANE BUILI		Sheet 2 of 14	Baseline Schedule Rev#0 Progress Update (WP31) Constuction Schedule
Data Date	19OCT07			GIL	Constuctio			Updated 19OCT07
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Activity	Activity	Orig	Rem		Early	Total	2007 JJJAS		2008 J F M A M J J A S O N
ID MS6.S	Description	Dur 0	Dur	Start 26FEB08	Finish	Float 26	•••	• • <mark>•</mark> • •,• • • • • • •	2005 D00 County Doubleting "Tinger" for Doubleting
	South Pod Building "Tight" for Boarding West Elev/South Pod: Curtain Wall Trim & Seal	8		26FEB08	06MAR08	20			26FEB08 South Pod Building "Tight" for Boarding 26FEB08 West Elev/South Pod: Curtain Walt Trim & Seal
		8	8	20FEBU8	UGWIARU8	119			26FEB08 West Elev/South Pod. Curtain wait min & Sea
South Fac									
	South Elevation: Veneer Ties	4		14NOV07	19NOV07	52			h Elevation: Veneer Ties
7327	South Elevation: Spray Foam/Window Membrane	3		20NOV07	23NOV07	52			th Elevation: Spray Foam/Window Membrane
7326	South Elevation: Erect Staging	3	-	26NOV07	28NOV07	52			uth Elevation: Erect \$taging
7328	South Elevation: Brick Veneer	10		29NOV07	12DEC07	52			South Elevatioh: Brick Veneer
7332	South Elevation: Washdown & Staging Removal	5		13DEC07	19DEC07	52			South Elevation: Washdown & Staging Removal
7348	South Elevation: Punch Windows	10		20DEC07	04JAN08	62			South Elevation: Punch Windows
7349	South Elevation: Curtain Wall	20		20DEC07	18JAN08	52			South Elevation: Curtain Wall
7351	South Elevation: Curtain Wall Trim & Seal	10	10	21JAN08	01FEB08	98		21J/	AN08 🗖 South Elevation: Curtain Wall Trim & Seal
Level 1									
General F	Floor Area								
612-0	Level-1: Interior & Exterior Top Track	10	5	05OCT07A	25OCT07	20	05OCT07A	Level-1: Ir	nterior & Exterior Top Track
745-0	Able to Start Electrical MC/Wire (Bdg. Tight)	0	0	26OCT07		56	26OCT	07 Able to St	art Electrical MC/Wire (Bdg. Tight)
675-0	Level-1: Receive Vinyl Tubs	3	3	26OCT07	30OCT07	34	26001	07 🛛 Level-1: I	Receive Vinyl Tubs
635-0	Level-1: Exterior/Support Wall Framing	10	10	26OCT07	08NOV07	27	26001	07 💻 Level-1	: Exterior/Support Wall Framing
980-0	Able to Start Boarding (Bdg. Tight)	0	0	29JAN08		40		29	JAN08♦Able to Start Boarding (Bdg. Tight)
North Poo						' ト			
730-0	N-Level-1: Receive/Set Door Frames	4	4	26OCT07	31OCT07	33	26001	07 N-Level-	1: Receive/Set Door Frames
645-0	N-Level-1: HVAC/Mech Shaft Risers	15		260CT07	16NOV07	54			vel-1: HVAC/Mech Shaft Risers
646-0	N-Level-1: Initial OH Duct/Mech Pipe	15		14NOV07	05DEC07	10			-Level-11 Initial OH Duct/Mech Pipe
654-0	N-Level 1: Frame & Board Shaft Walls	7		19NOV07	28NOV07	54			Level-1: Frame & Board Shaft Walls
652-0	N-Level-1: Frame Balance of Interior Walls	7		06DEC07	14DEC07	10			N-Level-1: Frame Balance of Interior Walls
650-0	N-Level-1: Top-off Corridor Walls	7		17DEC07	26DEC07	10			N-Level-1: Top-off Corridor Walls
690-0	N-Level-1: OH/In-Wall Mechanical Pipe Roughin	20		17DEC07	15JAN08	12			N-Level-1: OH/In-Wall Mechanical Pipe Roughin
700-0	N-Level-1: Electrical Layout/Conduit/Boxes	20		27DEC07	03JAN08	12			N-Level-1: Electrical Layout/Conduit/Boxes
750-0	N-Level-1: OH/In-Wall Plumbing	7		27DEC07 27DEC07	07JAN08	28			N-Level-1: OH/In-Wall Plumbing
	-			27DEC07 27DEC07		28			
670-0	N-Level-1: Fire Protection Mains/Branches	10			10JAN08				N-Level-1: Fire Protection Mains/Branches
680-0	N-Level-1: Balance of OH HVAC Ductwork	15		27DEC07	17JAN08	10			N-Level-1: Balance of OH HVAC Ductwork
708-0	N-Level-1: OH Electrical	20		04JAN08	31JAN08	10			08 N-Level-1: OH Electrical
710-0	N-Level-1: OH Pipe/Duct Insulate	20		18JAN08	14FEB08	10			N08 N-Level 1: OH Pipe/Duct Insulate
720-0	N-Level-1: OH MEP Completed for Ceiling Framing	0		01FEB08		10			IFEB08 N-Level-1: OH MEP Completed for Ceiling Framing
705-0	N-Level-1: OH-Inspections	2		01FEB08	04FEB08	75	1 1		IFEB08 I N-Level-1 OH-Inspections
740-0	N-Level-1: Frame Ceilings	5		01FEB08	07FEB08	10			IFEB08 📕 N-Level-1: Frame Ceilings
800-0	N-Level-1: HVAC Duct Drops	10		08FEB08	21FEB08	15			08FEB08 🔲 N-Level-1: HVAC Duct Drops
760-0	N-Level-1: Ceiling & Lighting Cans	15		08FEB08	28FEB08	10			08FEB08 N-Level-1: Ceiling & Lighting Cans
765-0	N-Level-1: In-Wall Electrical	15		08FEB08	28FEB08	10			08FEB08 M-Level-1: (n-Wal) Electrical
770-0	N-Level-1: OH/In-Wall Fire Alarm	15		08FEB08	28FEB08	10			08FEB08 N-Level-1: OH/In-Wall Fire Alarm
780-0	N-Level-1: Mount/Wire Control Devices	15		08FEB08	28FEB08	10			08FEB08 Revel-1: Mount/Wire Control Devices
790-0	N-Level-1: Mount/Wire Security Devices	15		08FEB08	28FEB08	10			08FEB08 N-Level-1: Mount/Wire Security Devices
810-0	N-Level-1: In-Wall Building Inspections	2		29FEB08	03MAR08	10			29FEB08 II N-Level-1: In-Wall Building Inspections
820-0	N-Level-1: Complete Pipe/Duct Insulation	5		04MAR08	10MAR08	10			04MAR08 - N-Level-1: Complete Pipe/Duct Insulation
830-0	N-Level-1: Sheetrock Walls & Ceilings	8	8	11MAR08	20MAR08	10			11MAR08 N-Level-1: Sheetrock Walls & Ceilings
840-0	N-Level-1: Tape/ Finish Walls & Ceilings	8	8	21MAR08	01APR08	10			21MAR08 N-Level-1: Tape/ Finish Walls & Cellings
tart Date	30OCT08		WP31	-	-	- I	Sheet 3 of 1	14 Dec. 10	a had when December 21 and a feature of the second se
inish Date	224UG08	ent Schedule	wF31	GII	BANE BUILI			Duschine St	chedule Rev#0 Progress Update (WP31) n Schedule
ata Date	190CT07	ress Bar		UIL.	Constuctio			Updated 19	
Run Date	19OCT07 13:38 Critic	al Activity			WPI RESID				
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Activity	Activity	Orig	Rem	Early	Early	Total	
ID	Description	Dur	Dur	Start	Finish	Float	at
850-0	N-Level-1: Sand/ Prime Paint & 1st Coat	5	5	02APR08	08APR08	16	
942-0	N-Level-1: Install FCU's & Tie-in	5	5	09APR08	15APR08	19	
880-0	N-Level-1: Waterproof & Ceramic Tile	8	8	09APR08	18APR08	16	16 09APR08 🗖 N-Level-1: Waterproof & Ceramic Tile
870-0	N-Level-1: ACT ceiling grid corridors/Rooms	10	10	09APR08	22APR08	29	29 N-Level-1; ACT ceiling grid corridors/Rooms09APR08 🗖
910-0	N-Level-1: Millwork/ kitchen Counter/Cab	10	10	21APR08	02MAY08	16	16 21APR08 🗖 N-Level-1: Millwork/ kitchen Counter/C
890-0	N-Level-1: Fire Protection Drops	10	10	23APR08	06MAY08	35	35 23APR08 💻 N-Level-1 Fire Protection Drops
900-0	N-Level-1: Doors & Hardware	10	10	23APR08	06MAY08	76	76 23APR08 🛄 N-Level-1: Doors & Hardware
920-0	N-Level-1: Plumbing Fixtures	5	5	05MAY08	09MAY08	16	16 05MAY08 🗖 N-Level-1: Plumbing Fixtures
930-0	N-Level-1: Electrical Fixtures & Finishes	8	8	12MAY08	21MAY08	16	16 N-Level-1: Electrical Fixtures & Finishes12MAY08
940-0	N-Level-1: HVAC/ Mech Trim & Finishes	8	8	22MAY08	03JUN08	16	16 N-Level 1: HVAC/ Mech Trim & Finishes 22MAY08 💶
	N-Level-1: Acoustical Tile corridor	2	2	04JUN08	05JUN08	16	
	N-Level-1: Flooring	10		06JUN08	19JUN08	16	
	N-Level-1: Finish Paint	5		20JUN08	26JUN08	16	
South Poo	L		-	2000.000	20000000		
	S-Level-1: HVAC/Mech Shaft Risers	15	15	26OCT07	16NOV07	62	260CT07
	S-Level-1: Receive/Set Door Frames	4		01NOV07	06NOV07	37	
	S-Level-1: Initial OH HVAC/Mech Pipe	25	-	14NOV07	19DEC07	8	
	S-Level-1: Frame & Board Shaft Walls	23		29NOV07	07DEC07	55	
	S-Level-1: Frame Balance of Interior Walls	7		29NOV07	31DEC07		8 20DEC07 S-Level-1: Frame Balance of Interior Walls
		5		02JAN08	08JAN08	15	
	S-Level-1: Electrical Layout/Conduit/Boxes	5	-	02JAN08	10JAN08		8 02JAN08 S-Level-1: Electrical Layout/Conduit/Boxes
	S-Level-1: Top-off Corridor Walls					-	
	S-Level-1: OH/In-Wall Plumbing	7		02JAN08	10JAN08	21	
	S-Level-1: Fire Protection Mains/Branches	10		02JAN08	15JAN08	30	
	S-Level-1: Balance of OH HVAC Ductwork	15		02JAN08	22JAN08	13	
	S-Level-1: OH/In-Wall Mechanical Pipe Roughin	20		02JAN08	29JAN08		8 02JAN08 S-Level-1: OH/In-Wall Mechanical Pipe Roughin
	S-Level-1: OH Electrical	20		09JAN08	05FEB08	15	
	S-Level-1: OH-Inspections	2		30JAN08	31JAN08		8 30JAN08 S-Level-1: OH-Inspections
	S-Level-1: OH Pipe/Duct Insulate	20		01FEB08	28FEB08	-	8 01FEB08 S-Level-1: OH Pipe/Duct Insulate
	S-Level-1: OH MEP Completed for Ceiling Framing	0		15FEB08			8 15FEBØ8 SLevel-1: OH MEP Completed for Ceiling Framing
	S-Level-1: Frame Ceilings	5		15FEB08	21FEB08		8 15FEB08 🖬 Ş-Level-1: Frame Çeilings
	S-Level-1: HVAC Duct Drops	10		22FEB08	06MAR08	13	
	S-Level-1: Ceiling & Lighting Cans	15		22FEB08	13MAR08		8 22FEB08 S-Level-1: Ceiling & Lighting Cans
	S-Level-1: In-Wall Electrical	15		22FEB08	13MAR08	-	8 22FEB08 S-Level-1: In-Wall Electrical
	S-Level-1: OH/In-Wall Fire Alarm	15		22FEB08	13MAR08		8 22FEB08 S-Level-1: OH/In-Wall Fire Alarm
S-780-0	S-Level-1: Mount/Wire Control Devices	15	15	22FEB08	13MAR08	8	8 22FEB08 S-Level-1: Mount/Wire Control Devices
S-790-0	S-Level-1: Mount/Wire Security Devices	15	15	22FEB08	13MAR08	8	8 22FEB08 S-Level-1: Mount/Wire Security Devices
S-810-0	S-Level-1: In-Wall Building Inspections	2	2	14MAR08	17MAR08		8 14MAR08 S-Level-1: In-Wall Building Inspections
S-820-0	S-Level-1: Complete Pipe/Duct Insulation	5	5	18MAR08	24MAR08	8	8 18MAR08 S-Level-1: Complete Pipe/Duct Insulation
S-830-0	S-Level-1: Sheetrock Walls & Ceilings	8	8	25MAR08	03APR08	8	8 25MAR08 S-Level-1: Sheetrock Walls & Ceilings
S-840-0	S-Level-1: Tape/ Finish Walls & Ceilings	8	8	04APR08	15APR08	8	8 04APR08 🗖 S+Level+1: Tape/ Finish Walls & Ceilings
S-850-0	S-Level-1: Sand/ Prime Paint & 1st Coat	5	5	16APR08	22APR08	8	8 16APR08 🖬 S-Level-1: Sand/ Prime Paint & 1st Coa
S-942-0	S-Level-1: Install FCU's & Tie-in	5	5	23APR08	29APR08	11	
S-880-0	S-Level-1: Waterproof & Ceramic Tile	8	8	23APR08	02MAY08		8 23APR08 🖬 S-Level-1: Waterproof & Ceramic T(le
S-870-0	S-Level-1: ACT ceiling grid corridors/Rooms	10	10	23APR08	06MAY08	21	21 S-Level-1: ACT deiling grid corridors/Rooms23APR08
S-910-0	S-Level-1: Millwork/ kitchen Counter/Cab	10	10	05MAY08	16MAY08	8	8 S-Level-1: Millwork/ kitchen Counter/Cab05MAY08
tart Date inish Date ata Date un Date	22AUG08 19OCT07	t Schedule ss Bar Activity	WP31	GIL	BANE BUIL Constucti WPI RESIE	on Acti	
© Prima	avera Systems, Inc.						

Activity	Activity	Orig	Rem	Early	Early	Total	J	JA	2007 S)	N	D	J		=	м	A	N		008 J	J	A		S	0	N
ID	Description	Dur	Dur	Start	Finish	Float		<mark>,,</mark>						<mark>,</mark>	ų, i	- Ļ					щ.		<u></u>	ų,		<u> </u>	
S-890-0	S-Level-1: Fire Protection Drops	10		07MAY08	20MAY08	27					i.	i			÷.	- i				\$-Le							pş
S-900-0	S-Level-1: Doors & Hardware S-Level-1: Plumbing Fixtures	10		07MAY08 19MAY08	20MAY08 23MAY08	27					į.	i			į.	- į				I\$-L∈ IS-L							i i
S-920-0	5	5				8					j.	-		-	i.						.evei	-1: P	jumo	oing	FIXU	ires	i i
S-930-0	S-Level-1: Electrical Fixtures & Finishes	8		27MAY08	05JUN08 17JUN08	8								Fixtu							-			_i			<u> </u>
S-940-0 S-950-0	S-Level-1: HVAC/ Mech Trim & Finishes S-Level-1: Acoustical Tile corridor			06JUN08 18JUN08	17JUN08 19JUN08	8				5-Le										08¦		i		÷			i.
S-950-0 S-960-0	S-Level-1: Acoustical file comdor S-Level-1: Flooring	2		18JUN08	01JUL08	8		1 1			į.	S-Le	vel-1	ACO	uşuc	arin	e cor			N08		0.1	i hon i d	i.		-	- i
S-960-0 S-970-0	S-Level-1: Finish Paint	10		02JUL08	09JUL08	8	1				÷.	į			÷.	- i-				JNØ8 2JUL(-	
•	1	5	၁	UZJULU8	109JOE08	8	' 				-i-			-	<u> </u>	_				2301	08 1	3-1	ever	1-1,1	Finisi	n Pa	unic
Electrical 8490		0		20 14 10 0	1	77						į	20.1	1.00	ا			Tinha									1
8490	Elec room: "Tight" ready for Elec Equipment/Wire Elec Room: Frame & Board (one side)	6		29JAN08 29JAN08	05FEB08	77					÷.	i								ady fo & Boa					/wire	;	1
8470	Elec Room: Install Electrical Panels	30	_	29JAN08 06FEB08	18MAR08	50 66														& ⊭oa ∷Insta							
8480	Elec Room: Install Electrical Panels Elec Room: Install Switchboard Panels	30		06FEB08	18MAR08	81	-					1	00	TEBU		1		ec R	oom	. Insta		ecune	are	ane	is		1
													00	TEBU	18	1		ec R	oom	: Insta : Insta	all 2/	witch	Doan	a Pa	aneis		1
8502	Elec Room: Install Switch Gear	30		06FEB08	18MAR08	71										-											D
8460	Elec Room: Roughin OH Electrical to Elec Room	40		06FEB08	01APR08	56							06	FEBO													ed Roo
8510	Elec room: Hook-up Switchboard Panels	30		20FEB08	01APR08	71					, I	¦		20FE		1			1	m: Ho	ok+u	ip Sv	vitchi	boar	rd Pa	neis	5 1
	Elec room:Pull Veritical Wire(Elec Rm to Floors)	15		02APR08	22APR08	56		ec room:Pull	veritica	al V	ire(i	Elec	Rm t		ors)U					! .	_	1	¦				1
	Establish Permanent Power	0	0	23APR08	1	56	' <u> </u>				- 1			-		23	АРК	08	•⊭sta	ablish	Perr	nane	nt Pe	owe	r		
	cy Generator										÷							_					1				
	Set & Tie-in Emergency Generator (Exterior)	20		03MAR08	28MAR08	67			1					031						in Er					itor (E	Exter	rior)
	Start Emegency Generator	5	-	31MAR08	04APR08	67					÷									neģer							1
	Test ATS for Building	1		07APR08	07APR08	67										07AF				TS for		-		_			-
	Emergency Panel/Power Completed	0	0		07APR08	67					1			-	-			€Em	nerg	enċy F	Pane	I/Pov	wer (Com	plete	ed	1
Mechanic												l l			i al				i -					Ì			1
8580	3	0		29JAN08		21						1								for Eq			& Pa	nels	\$		1
8570	Mech Room: Set PRV Station	5	-	29JAN08	04FEB08	82					1	Ì								₹V ¦Sta			1	Ì			1
8590	Mech Room: Set Equipment	5	-	29JAN08	04FEB08	92					į.	i								uipm			i i	i			i.
8582	Mech Room: Frame & Board (one side)	6	-	29JAN08	05FEB08	21					i.	i								e & Bo		•					i i
8620	Mech Room: Install Heat Exchanges	5		05FEB08	11FEB08	82		i			i	i								ll Hea			~	i			<u> </u>
8670	Mech Room: Install Hot Water Flue	10		05FEB08	18FEB08	92					÷.	i								all Ho			lue	i			i i
8600	Mech Room: Set Fire Pump	5		06FEB08	12FEB08	56					į.	į								Fire P	- r			÷			1
8560	Mech room: Roughin Mech Piping	40		06FEB08	01APR08	21						i i		FEBO						om: R					-		1
8630	Mech Room: Equip Controls (wire/trim)	25		12FEB08	17MAR08	82													Roon	n: Ęqu	Jip (C	ontro	șis (v	wir e/	/trim)		
8610	Mech Room: Mech Pipe/Tie-in Equipment	25		02APR08	06MAY08	21		Mech Roc											-				1				
8640	Mech Room: Elec Rough-in/Trim Equipment	25		07MAY08	11JUN08	21		Mech	Roor															÷			
8650	Mech Room: Insulate Duct/Pipe	40		07MAY08	02JUL08	36								ulate									1				
8680	Mech Room: Ready for Start-up & Commissioning	0	0		11JUN08	21				Me	ch'H	loom	: Rea	dy to	r Sta	rt-up	& C0	mmis	ssioi	ninge							
Transform															1				-				1	ł			1
	Pull Cable & Terminations @ Transformer	20		26MAR08	22APR08	56																	natio	on\$ (@ Tr	ansf	ormer
9030		10		09APR08	22APR08	56										09/AF	'R08			Trạns							
. '	Vertical Wire Completed to Elec Room	0	0		22APR08	56									_			•	Yert	ical V	/ire (Comp	lete	d to	Ele¢	Roo	om
Floor Clos																			1			_		1			
8250	Level-1: Clean Floor	5	-	10JUL08	16JUL08	8									1					10JU			evel-	-1:¦C	Clean	Flo	or
8255	Level-1: Ready for Fire Alarm Test	0		17JUL08		8							Lev							st17J			1				1
8260	Level-1: A/E Punchlist Floor	5	5	17JUL08	23JUL08	12						1		Le	vel-1	: AYE	Pun	chlist	t Flo	or17J	ULÞ	8 🗖	1				
Start Date	30OCT06	it Schedule	WP31					Sh	ieet 5 of	14	Bas	eline	s Sr	hedu	e R	v#0	Pro	Iree	s I In	ndate	(WE	31)					
Finish Date	22AUG08			GIL	BANE BUIL	DING (CON	MPANY -			Cor	stud	tion	Sche	edul	e		,	- 04	auto		511					
Data Date		ss Bar Activity			Constuction	on Acti	ivities	s						OCT0													
Run Date	19OCT07 13:38 Critical	-source			WPI RESID	ENCE	HA	ALL .																			
@ Drim	avera Svetema Inc.																										
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Activity ID	Activity Description	Orig Dur	Rem Dur	Early Start	Early Finish	Total Float	J J J A S O N D J F M A M J J J A S O	
-	Level-1: Subs Complete Punchlist	5		24JUL08	30JUL08	12	· · · · · · · · · · · · · · · · · · ·	!
	Level-1: Ready to Turn Over Floor	0			30JUL08	12		
Level 2		_		·				
General F	loor Area							
	Able to Start Electrical MC/Wire (Bdg. Tight)	0	0	26OCT07		40	40 260CT07 ♦ Able to Start Electrical MC/Wire (Bdg. Tight)	
	Able to Start Boarding (Bdg. Tight)	0		29JAN08		16		
North Pod		1 -	-		I			
	N-Level-2: Frame Balance of Interior Walls	7	5	05OCT07A	25OCT07	31	31 05OCT07A/CL N-Level-2: Frame Balance of Interior Walls	
	N-Level-2: Top-off Corridor Walls	7		15OCT07A		31		
700	N-Level-2: Electrical Layout/Conduit/Boxes	5	5	19OCT07	25OCT07	40		i I
750	N-Level-2: Tie-in Plumbing	7		19OCT07	29OCT07	48		i
708	N-Level-2: OH Electrical	10	10	26OCT07	08NOV07	40	40 260CT07 🗰 N-Level-2: OH Electrical	i I
710	N-Level-2: OH Pipe/Duct Insulate	10	10	26OCT07	08NOV07	42	42 260CT07 🛄 N-Level-2: OH Pipe/Duct Insulate	1
720	N-Level-2: OH MEP Completed for Ceiling Framing	0	0		08NOV07	42	42 ♦N-Level-2: OH MEP Completed for Ceiling Framing	
705	N-Level-2: OH-Inspections	2	2	09NOV07	13NOV07	40	40 09NOV07 D N-Level-2: OH-Inspections	i
670	N-Level-2: Fire Protection Mains/Branches	10	10	06DEC07	19DEC07	15	15 05DEC07 🗖 N-Level-2: Fire Protection Mains/Branches	i
740	N-Level-2: Frame Ceilings	5	5	20DEC07	27DEC07	15	15 20DEC07 🖬 N-Level-2: Frame Ceilings	
800	N-Level-2: HVAC Duct Drops	10	10	28DEC07	11JAN08	20	20 28DEC07 DN-Level-2: HVAC Duct Drops	
760	N-Level-2: Ceiling & Lighting Cans	15	15	28DEC07	18JAN08	15		
765	N-Level-2: In-Wall Electrical	15	15	28DEC07	18JAN08	15	15 28DEC07 N-Level-2: In Wall Electrical	i
770	N-Level-2: OH/In-Wall Fire Alarm	15	15	28DEC07	18JAN08	15		
780	N-Level-2: Mount/Wire Control Devices	15	15	28DEC07	18JAN08	15		
790	N-Level-2: Mount/Wire Security Devices	15	15	28DEC07	18JAN08	15		
810	N-Level-2: In-Wall Building Inspections	2	2	21JAN08	22JAN08	15		
820	N-Level-2: Complete Pipe/Duct Insulation	5		23JAN08	29JAN08	15		i i
830	N-Level-2: Sheetrock Walls & Ceilings	8	-	30JAN08	08FEB08	15		i i
840	N-Level-2: Tape/ Finish Walls & Ceilings	8		11FEB08	20FEB08	37		i
850	N-Level-2: Sand/ Prime Paint & 1st Coat	5	-	21FEB08	27FEB08	45		
870	N-Level-2: ACT ceiling grid corridors	5		28FEB08	05MAR08	63		i
880	N-Level-2: Waterproof & Ceramic Tile	8		28FEB08	10MAR08	45		i i
942	N-Level-2: Install FCU's & Tie-in	5		04MAR08	10MAR08	45		i
890	N-Level-2: Fire Protection Drops	10		06MAR08	19MAR08	69		1
900	N-Level-2: Doors & Hardware	10		06MAR08	19MAR08	86		i i
910	N-Level-2: Millwork/ kitchen Counter/Cab	10		11MAR08	24MAR08	45		
920 930	N-Level-2: Plumbing Fixtures	5		25MAR08 01APR08	31MAR08 10APR08	45 45		i i
930	N-Level-2: Electrical Fixtures & Finishes N-Level-2: HVAC/ Mech Trim & Finishes	8	-	11APR08	22APR08	45		
940	N-Level-2: Acoustical Tile corridor	8		23APR08	22APR08 24APR08	40		les
	N-Level-2: Acoustical file contdor N-Level-2: Flooring	10		25APR08	24APR08 08MAY08	40		i I
	N-Level-2: Flooring N-Level-2: Finish Paint	10		25APR08	15MAY08	40 45		1
1 - 1		5	1 3	103MIAT08	LIDMAT08	40		
South Poo S-652	a S-Level-2: Frame Balance of Interior Walls	7	5	09OCT07A	25OCT07	43	43 090¢T07A	
S-650	S-Level-2: Frame Balance of Interior Walls	7		150CT07A		43		
S-050 S-700	S-Level-2: Flectrical Lavout/Conduit/Boxes	5		190CT07A	250CT07	43		1
S-750	S-Level-2: Electrical Eayour Conduit/Boxes	7	-	190CT07	290CT07	57		
Start Date	300CT08	nt Schedule	/ WP31				Sheet 6 of 14 Baseline Schedule Rev#0 Progress Update (WP31)	i
Finish Date Data Date	22AUG08 19OCT07			GIL	BANE BUIL. Constucti		G COMPANY Constuction Schedule	
Run Date	190CT07 13:38	al Activity			WPI RESIE			
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Activity	Activity	Orig		Early	Early	Total	J			S		N D				M ,	J					
ID	Description	Dur	Dur	Start	Finish	Float		1.1.1	, i i i i	hand the		S-L'evel-2		<mark></mark>	n ny		<mark>n y n</mark>	<mark>n y</mark>		i i qu	n y	<u>.</u>
S-708	S-Level-2: OH Electrical S-Level-2: OH-Inspections	10		26OCT07 09NOV07	08NOV07 13NOV07	50			1						i		_					
S-705		2				50			i i		_)7 В S-Level-						- i	i		- i	i
S-710	S-Level-2: OH Pipe/Duct Insulate	10		14NOV07	28NOV07	50				14N	IOV	/07 🛄 S-Le	1 1	" I			. _	į	i i		- i	
S-720	S-Level-2: OH MEP Completed for Ceiling Framing	0			28NOV07	60				i			vel-2: OH N								- i	
S-670	S-Level-2: Fire Protection Mains/Branches	10		06DEC07	19DEC07	45					061	DEC07					ranche	es			- i	
S-740	S-Level-2: Frame Ceilings	5		28DEC07	04JAN08	40					4	28DEC07										
S-800	S-Level-2: HVAC Duct Drops	10		07JAN08	18JAN08	45			1	¦			8 🗖 S-Lev					÷			÷	
S-760	S-Level-2: Ceiling & Lighting Cans	15		07JAN08	25JAN08	40			1	¦		1 1	8 💻 S-Le		-			IS ¦			l l	ł
S-765	S-Level-2: In-Wall Electrical	15		07JAN08	25JAN08	40			1			1 1	8 💻 S-Le									
S-770	S-Level-2: OH/In-Wall Fire Alarm	15		07JAN08	25JAN08	40			1				B 💻 S-Le									1
S-780	S-Level-2: Mount/Wire Control Devices	15		07JAN08	25JAN08	40							B 🔲 S-Le									
S-790	S-Level-2: Mount/Wire Security Devices	15		07JAN08	25JAN08	40			1			1 1	B 💻 S-Le	1	1		1	1			- i	
S-810	S-Level-2: In-Wall Building Inspections	2		28JAN08	29JAN08	40			i	i l		1	N08 S-L		1			1			i	i
S-820	S-Level-2: Complete Pipe/Duct Insulation	5	-	30JAN08	05FEB08	40			i i			30J/	4N08 🗖 S-								- i	į
S-830	S-Level-2: Sheetrock Walls & Ceilings	8	8 8	26FEB08	06MAR08	26				i			26FEB08								- i	
S-840	S-Level-2: Tape/ Finish Walls & Ceilings	8	8 8	07MAR08	18MAR08	26							07MAR0	8 🗖 S-	-Level-	2: Tape/	Finis	h Wal	ls & C	eilings		
S-850	S-Level-2: Sand/ Prime Paint & 1st Coat	5	5 5	19MAR08	25MAR08	26					Т		19MA	R08 🗖 🕏	S-Leve	l-2: San	d/ 🛉 rir	me Þa	int & 1	st Coa	at i	
S-870	S-Level-2: ACT ceiling grid corridors	5	5 5	26MAR08	01APR08	44			1	-			26M	4R08 🗖	S-Lew	/el-2: AC	T deil	ing gri	id corri	idor\$		
S-942	S-Level-2: Install FCU's & Tie-in	5	5 5	26MAR08	01APR08	29			1				26M	akos 🗖	S-Le	/el-2: Ins	tall F0	CU'\$ 8	Tierir	n		
S-880	S-Level-2: Waterproof & Ceramic Tile	8	8 8	26MAR08	04APR08	26				¦		-	26M	akos 🗖	S-Le	vel-2: ¹ W	aterpr	roof &	Ceran	nic Tile	•	
S-890	S-Level-2: Fire Protection Drops	10	10	02APR08	15APR08	50			i I				02/	APR08	s sł	Level-2:	Fire P	rotect	ion Dr	ops	- i	1
S-900	S-Level-2: Doors & Hardware	10	10	02APR08	15APR08	52			1	<u>;</u>	t		02/	APR08	S-	Level-2:	Doors	s & Ha	rdwar	e	İ	
S-910	S-Level-2: Millwork/ kitchen Counter/Cab	10		07APR08	18APR08	26										Level-2:					er/Ca	b
S-920	S-Level-2: Plumbing Fixtures	5		21APR08	25APR08	26										S-Level-2						
S-930	S-Level-2: Electrical Fixtures & Finishes	8		28APR08	07MAY08	26			1			-				S-Leve					Finis	hes
S-940	S-Level-2: HVAC/ Mech Trim & Finishes	8		08MAY08	19MAY08	26				s-Level-	2 н	WAC/ Mech 1	Irim & Finis						1			100
S-950	S-Level-2: Acoustical Tile corridor	2		20MAY08	21MAY08	26				1	-		1			08 \$-L	ovol-7	> Acor	ustic ¹	Tile cr	orrido	_
S-960	S-Level-2: Flooring	10		20MAT08	05JUN08	26			1							08 🛄 S					Jinqu	· 1
S-970	S-Level-2: Finish Paint	5		06JUN08	12JUN08	26			1	¦				1							÷	
		1 3	1 3	00001100	1200100	20			1	-	╉			1	000			ver-2.	1 111311	rain		
Floor Clo				42.0.000		20			1						13	JUN08		- 1· () Noob I		- i	
990	Level-2: Clean Floor	5		13JUN08	19JUN08	26			i	i l			i					ei-2. (Jean	FIOOI	i	i
992	Level-2: Ready for Fire Alarm Test	0		20JUN08	0.0.11 10.000	26			i i			Level-2: R	eady for Fi	e Alarm								
	Level-2: A/E Punchlist Floor	5	_	20JUN08	26JUN08	30				i						OJUN(08		ever-2:	AVEF	unchi	st⊢io	or
996	Level-2: Subs Complete Punchlist	5	_	27JUN08	03JUL08	30			1			Level-2:	Subs Com									
998	Level-2: Ready to Turn Over Floor	0	0 0		03JUL08	30					_		Level-2:	Ready to	orum	OverFic	por					
Level 3									1						1	1			1			
General F	Floor Area								1	¦				1				l l				
745-3	Able to Start Electrical MC/Wire (Bdg. Tight)	0		26OCT07		50			1	260CT	07	Able to Star	1 1		· -	-					l.	
980-3	Able to Start Boarding (Bdg. Tight North Pod)	0	0 0	29JAN08		24			1	¦		29JA	N08 Able	e to Star	t Boark	ding (Bdg	g. Tigl	ht Nor	th P¢d)		
North Po	d								1						1	1					1	
700-3	N-Level-3: Electrical Layout/Conduit/Boxes	5	5 5	19OCT07	25OCT07	50			1	poctor	7 🗖	N-Level-3: E	lectrical La	yout/Co	nduit/E	Boxes						
650-3	N-Level-3: Top-off Corridor Walls	7	7	19OCT07	29OCT07	33			i i	ростр	7 🗖	N-Level-3:	top-off Cor	ridor Wa	alls	i		- i	i		i	
652-3	N-Level-3: Frame Balance of Interior Walls	7	7	19OCT07	29OCT07	29					_	N-Level-3:	1			Walls						į
680-3	N-Level-3: Balance of OH HVAC Ductwork	7	7	19OCT07	29OCT07	48						N-Level-3:									į.	
690-3	N-Level-3: OH/In-Wall Mechanical Pipe Roughin	20		23OCT07	20NOV07	31						N-Leve					Rough	in				
			luna								-						-		1			
Start Date Finish Date	22AUG08		WP31	C 11				DAN	-	heet 7 of 1	. 10	Baseline Sch		#0 Prog	gress	Update	(WP3	31)				
Data Date	19OCT07 Progress			GIL	BANE BUIL. Constuctio				T			Constuction										
Run Date	19OCT07 13:38 Critical Ac	ctivity			WPI RESIE						0	puated 190	0107									
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Activity	Activity	Orig	Rem	Early	Early	Total	
ID	Description	Dur	Dur	Start	Finish	Floot	J J A S O N D J F M A M J J A S O N
708-3	N-Level-3: OH Electrical	10	10	26OCT07	08NOV07	50	26OCT07 📮 N-Level-3: OH ¢lectri¢al
	N-Level-3: Tie-in Plumbing	7	7	30OCT07	07NOV07	49	300¢T0 <mark>7 📮</mark> N-Level-3: Tie-in Plumbing
705-3	N-Level-3: OH-Inspections	2	2	21NOV07	23NOV07	41	21NDV07 N-Level-3: OH-Inspections
710-3	N-Level-3: OH Pipe/Duct Insulate	10	10	21NOV07	05DEC07	33	21NDV07 💷 N-Level-3 OH Pipe/Duct Insulate
720-3	N-Level-3: OH MEP Completed for Ceiling Framing	0	0		05DEC07	33	◆N-Level-3, OH MEP Completed for Ceiling Framing
670-3	N-Level-3: Fire Protection Mains/Branches	10	10	06DEC07	19DEC07	17	060EC07 IN Level-3: Fire Protection Mains/Branches
740-3	N-Level-3: Frame Ceilings	5	5	28DEC07	04JAN08	18	28DEC07 🖬 N-Level-3, Frame Ceilings
800-3	N-Level-3: HVAC Duct Drops	10	10	07JAN08	18JAN08	23	07,JAN08 🗖 N-Level-3: HVAC Duct Drops
760-3	N-Level-3: Ceiling & Lighting Cans	15	15	07JAN08	25JAN08	18	07JAN08 N-Level-3: Ceiling & Lighting Cans
	N-Level-3: In-Wall Electrical	15		07JAN08	25JAN08	18	07JAN08 - N-Level-3: In-Wall/Electrical
	N-Level-3: OH/In-Wall Fire Alarm	15		07JAN08	25JAN08	18	07JAN08 V-Level-3: OH/In-Wall Fire Alarm
	N-Level-3: Mount/Wire Control Devices	15		07JAN08	25JAN08	18	07JAN08 - N-Level-3: Mount/Wire Control Devices
	N-Level-3: Mount/Wire Security Devices	15		07JAN08	25JAN08	18	07JAN08 N-Level-3: Mount/Wire Security Devices
	N-Level-3: In-Wall Building Inspections	2		28JAN08	29JAN08	18	28JAN08 II N-Level-3: In-Wall Building Inspections
	N-Level-3: Complete Pipe/Duct Insulation	5		30JAN08	05FEB08	18	30JAN08 A -Level-3: Complete Pipe/Duct Insulation
	N-Level-3: Sheetrock Walls & Ceilings	8		11FEB08	20FEB08	15	11FEB08 N-Level-3: Sheetrock Walls & Ceilings
	-	8		21FEB08	03MAR08	29	21FEB08 A N-Level-3: Tape/ Finish Walls & Ceilings
	N-Level-3: Tape/ Finish Walls & Ceilings N-Level-3: Sand/ Prime Paint & 1st Coat	5		21FEB08 04MAR08	10MAR08	37	04MAR08 N-Level-3: Sand/ Prime Paint & 1st Coat
		5	-		10MAR08		11MAR08 IN N-Level-3: Sand/ Prime Paint & 1st Coat
	N-Level-3: ACT ceiling grid corridors	-	-	11MAR08		55	
	N-Level-3: Install FCU's & Tie-in	5	-	11MAR08	17MAR08	40	11№AR08 III N-Level-3: Install F¢U's & Tie-in
	N-Level-3: Waterproof & Ceramic Tile	8		11MAR08	20MAR08	37	11MAR08 N-Leve)-3: Waterproof & Ceramic Tile
	N-Level-3: Fire Protection Drops	10		18MAR08	31MAR08	61	18MARD8 💻 N-Lelvel-3: Fire Protection Drops
	N-Level-3: Doors & Hardware	10		18MAR08	31MAR08	63	1\$MARD8 N-Level-3: Doors & Hardware
	N-Level-3: Millwork/ kitchen Counter/Cab	10		21MAR08	03APR08	37	2¦1MAR08 📫 N-Level-3: Millwork/ kit/chen Counter/Cab
	N-Level-3: Plumbing Fixtures	5		04APR08	10APR08	37	04APR08 🖬 N-Level-3: Plumbing Fixtures
	N-Level-3: Electrical Fixtures & Finishes	8		11APR08	22APR08	37	11/APR08 🗖 N-Levél-3: Electrical Fixtures & Finishes
	N-Level-3: HVAC/ Mech Trim & Finishes	8		23APR08	02MAY08	37	23APR08 🗖 N-Level-3: HVAC/ Mech Trim & Finishes
950-3	N-Level-3: Acoustical Tile corridor	2		05MAY08	06MAY08	37	05MAY08 N-Level-3: Acoustical Tile corridor
960-3	N-Level-3: Flooring	10	10	07MAY08	20MAY08	37	07NIAY08 🛄 N-Level-3: Fiboring
970-3	N-Level-3: Finish Paint	5	5	21MAY08	28MAY08	37	21MAY08 III N-Level-3: Finish Paint
South Poo	1				•		
S-652-3	S-Level-3: Frame Balance of Interior Walls	7	7	30OCT07	07NOV07	31	300¢T07 🗖 S-Level-3; Frame Balance of Interior Walls
S-700-3	S-Level-3: Electrical Lavout/Conduit/Boxes	5	5	08NOV07	15NOV07	58	08NOV07 🖬 S-Level-3: Electrical Lavout/Conduit/Boxes
S-650-3	S-Level-3: Top-off Corridor Walls	7	7	08NOV07	19NOV07	31	08NOV 07 💶 S-Level-3: Top-off Corridor Walls
	S-Level-3: Balance of OH HVAC Ductwork	7		08NOV07	19NOV07	42	08NOV07 🖬 S-Level-3: Balance of OH HVAC Ductwork
	S-Level-3: Tie-in Plumbing	7		08NOV07	19NOV07	50	08NOV07 🖬 S-Level-3: Tie-in Plumbing
	S-Level-3: OH/In-Wall Mechanical Pipe Roughin	20		08NOV07	07DEC07	31	08NOV07
S-708-3	S-Level-3: OH Electrical	10		16NOV07	30NOV07	58	16NOV07 S-Level-3: OH Electrical
	S-Level-3: Fire Protection Mains/Branches	10		06DEC07	19DEC07	25	06DEC07 S-Level-3: Fire Protection Mains/Branches
	S-Level-3: OH-Inspections	2		10DEC07	11DEC07	51	10DEC07 S-Level-3: OH-Inspections
	S-Level-3: OH Pipe/Duct Insulate	10		10DEC07	21DEC07	43	10DEC07 S-Level-3: OH Pipe/Duct Insulate
	S-Level-3: OH MEP Completed for Ceiling Framing	0	0		21DEC07	43	◆S-Level-3: OH Pipe/Duct insulate
		-	-				
	S-Level-3: Frame Ceilings	5		07JAN08	11JAN08	35	07JAN08 S-Level-8: Frame Ceilings
	S-Level-3: HVAC Duct Drops	10		14JAN08	25JAN08	40	14JAN08 S-Level-3: HVAC Duct Drops
S-760-3	S-Level-3: Ceiling & Lighting Cans	15	15	14JAN08	01FEB08	35	14JAN08 🔜 S-Level-3: Ceiling & Lighting Cans
Start Date Finish Date Data Date	22AUG08 19OCT07	ent Schedule ress Bar al Activity	WP31	GIL	BANE BUILI	on Activiti	ities Updated 19OCT07
Run Date	19OCT07 13:38 Critic	an Activity			WPI RESID	DENCE H/	HALL
© Prima	avera Systems, Inc.						

Activity	Activity	Orig	Rem	Early	Early	Total				200	07	2008
ID	Description	Orig Dur	Dur	Start	Finish	Total Float	J			S	0	ONDJFMAMJJJASOI
S-765-3	S-Level-3: In-Wall Electrical	15	5 15	14JAN08	01FEB08	35		[' '				14JAN0/8 🗔 S-Level-3: In-Walii Electrical
S-770-3	S-Level-3: OH/In-Wall Fire Alarm	15		14JAN08	01FEB08	35			-	1		14JAN08 S-Level-3: OH/In-Wall Fire Alarm
S-780-3	S-Level-3: Mount/Wire Control Devices	15	5 15	14JAN08	01FEB08	35				1		14JAN08 S-Level-3: Mount/Wire Control Devices
S-790-3	S-Level-3: Mount/Wire Security Devices	15	5 15	14JAN08	01FEB08	35				1		14JAN08 - S-Level-3: Mount/Wire Security Devices
S-810-3	S-Level-3: In-Wall Building Inspections	2	2 2	04FEB08	05FEB08	35				1		04FEB08 I S-Level-3. In-Wall Building Inspections
S-820-3	S-Level-3: Complete Pipe/Duct Insulation	5	5 5	06FEB08	12FEB08	35				i -		06FEB08 S-Level-3: Complete Pipe/Duct Insulation
S-830-3	S-Level-3: Sheetrock Walls & Ceilings	8	8 8	21FEB08	03MAR08	29			-	1		21FEB08 🛄 S-Level-3: Sheetrock Walls & Ceilings
S-840-3	S-Level-3: Tape/ Finish Walls & Ceilings	8	8 8	04MAR08	13MAR08	29				i i		04MAR08 🗖 S-Level-3: Tape/ Finish Walls & Ceilings
S-850-3	S-Level-3: Sand/ Prime Paint & 1st Coat	5	5 5	14MAR08	20MAR08	29				1		14MAR08 🖪 S-Level-3: Sand/ Prime Paint & 1st Coat
S-870-3	S-Level-3: ACT ceiling grid corridors	5	5 5	21MAR08	27MAR08	47				1		21MAR08 🗖 S-Level-3: ACT ceiling grid corridors
S-942-3	S-Level-3: Install FCU's & Tie-in	5	5 5	21MAR08	27MAR08	32				1		21MAR08 🗖 S-Level-3: Install FCU's & Tie-in
S-880-3	S-Level-3: Waterproof & Ceramic Tile	8	8 8	21MAR08	01APR08	29			-	i		21MAR08 S-Level-3: Waterproof & Ceramic Tile
S-890-3	S-Level-3: Fire Protection Drops	10	10	28MAR08	10APR08	53			ł			28MAR08 🗖 S-Level-3: Fire Protection Drops
S-900-3	S-Level-3: Doors & Hardware	10	10	28MAR08	10APR08	55			-	ł		28MAR08 🗖 S-Level-3: Doors & Hardware
S-910-3	S-Level-3: Millwork/ kitchen Counter/Cab	10	10	02APR08	15APR08	29			1	ł		02APR08 S+Level+3: Millwork/ kitchen Counter/Cab
S-920-3	S-Level-3: Plumbing Fixtures	5	5 5	16APR08	22APR08	29			-	ł		16APR08 S-Level-3: Plumbing Fixtures
S-930-3	S-Level-3: Electrical Fixtures & Finishes	8	8 8	23APR08	02MAY08	29			-	1	+	23APR08 🗖 S-Level-3: Electrical Fixtures & Finishe
S-940-3	S-Level-3: HVAC/ Mech Trim & Finishes	8	_	05MAY08	14MAY08	29			1 5	S-Leve	el-3:	HVAC/ Mech Trim & Finishes05MAY08
S-950-3	S-Level-3: Acoustical Tile corridor	2	2 2	15MAY08	16MAY08	29			-	1		15MAY08 I S-Level-3: Acoustical Tile corridor
S-960-3	S-Level-3: Flooring	10		19MAY08	02JUN08	29	-		i.	i -		19MAY08 💶 S-Level-3; Flooring
S-970-3	S-Level-3: Finish Paint	5	-	03JUN08	09JUN08	29				į.		03JUN08 🗖 S-Level-3: Finish Paint
Floor Clo		-	-					-	-	i –	-	
8250-3	Level-3: Clean Floor	5	5	10JUN08	16JUN08	29				1		10JUN08 🖬 Level-3; Clean Floor
8255-3	Level-3: Ready for Fire Alarm Test	0		17JUN08	10001100	29	_			1		Level-3: Ready for Fire Alarm Test17JUN08
8260-3	Level-3: A/E Punchlist Floor	5	-	17JUN08	23JUN08	33	-			1		17JUN08 Level-3: A/E Punchlist Floor
8270-3	Level-3: Subs Complete Punchlist	5		24JUN08	30JUN08	33				1		Level-3: Subs Complete Punchlist24JUN08
8280-3	Level-3: Ready to Turn Over Floor	0		24001100	30JUN08	33	_		1	ł		Level-3: Ready to Turn/Over Floor
Level 4	Eavers, ready to runnever hoor		<u> </u>		30001400	1 33		-	-	1	+	
	51 A						•		ł			
	Floor Area	40		05007074	2500707	24	-		-	- 		
635-4	Level-4: Exterior/Support Wall Framing	10		05OCT07A		31						Level 4: Exterior/Support Wall Framing
675-4 745-4	Level-4: Receive Vinyl Tubs	0	-	19OCT07	23OCT07	33 58						Level-4: Receive Vinyl Tubs
	Able to Start Electrical MC/Wire (Bdg. Tight)		-	26OCT07		32	_			1260	910/	Able to Start Electrical MC/Wire (Bdg. Tight)
980-4	Able to Start Boarding (Bdg. Tight)	U	0	29JAN08		32	-	<u> </u>		-		29JAN08♦Able to Start Boarding (Bdg. Tight)
North Po				1000707	0.01/07	1.10	-		-	, 		
646-4	N-Level-4: Initial OH HVAC/Mech Pipe	15		19OCT07	08NOV07	10						N-Level-4: Initial OH HVAC/Mech Pipe
730-4	N-Level-4: Receive/Set Door Frames	4		23OCT07	26OCT07	30						I N-Level-4: Receive/Set Door Frames
700-4	N-Level-4: Electrical Layout/Conduit/Boxes	5		09NOV07	16NOV07	43						07 🖬 N-Level-4: Electrical Layout/Conduit/Boxes
650-4	N-Level-4: Top-off Corridor Walls	7		09NOV07	20NOV07	21	4					07 🖬 N-Level-4: Tdp-off Corridor Walls
652-4	N-Level-4: Frame Balance of Interior Walls	7		09NOV07	20NOV07	21						07 🛄 N-Level-4: Frame Balance of Interior Walls
680-4	N-Level-4: Balance of OH HVAC Ductwork	7		09NOV07	20NOV07	40	1					07, III N-Level-4: Balance of OH HVA¢ Ductwork
750-4	N-Level-4: OH/In-Wall Plumbing	7		09NOV07	20NOV07	48						07, 🖬 N-Level-4: OH/In-Wall Plumbing
708-4	N-Level-4: OH Electrical	10		19NOV07	03DEC07	43						0Vp7 III N-Level-4: OH Electrical
690-4	N-Level-4: OH/In-Wall Mechanical Pipe Roughin	20		21NOV07	19DEC07	21	_			1	21N	DV07 N-Level-4: OH/In-Wall Mechanical Pipe Roughin
705-4	N-Level-4: OH-Inspections	2		20DEC07	21DEC07	29				1		20DEC07 N-Level-4: OH-Inspections
670-4	N-Level-4: Fire Protection Mains/Branches	10	10	20DEC07	04JAN08	17						20DEC07
Start Date	30OCT06 Current S	obodula	WP31						S	heet 9	of 14	Baseline Schedule Rev#0 Progress Update (WP31)
Finish Date	22AUG08			GIL	BANE BUIL				NY			Constuction Schedule
Data Date Run Date	190CT07 13:38 Critical Ac				Constuction							Updated 19OCT07
run Date		,			WPI RESID	JENCE	: HA	LL				
@ Driv	navera Systems, Inc.											
⊌rillî	lavera oystellis, lite.		1									

Activity	Activity	Orig	Rem	Early	Early	Total		2007	2008
ID	Description	Dur	Dur	Start	Finish	Float	JJ	ASC	ONDJEMAMJJJASON
710-4	N-Level-4: OH Pipe/Duct Insulate	10		20DEC07	04JAN08	21			20DEC07 🖽 N-Level-4; OH Pipe/Duct Insulate
720-4	N-Level-4: OH MEP Completed for Ceiling Framing	0	0		04JAN08	21			◆N-Level-4: OH MEP Completed for Ceiling Framing
740-4	N-Level-4: Frame Ceilings	5	5	07JAN08	11JAN08	21			07JAN08 N-Level-4: Frame Ceilings
800-4	N-Level-4: HVAC Duct Drops	10			25JAN08	26			14JAN08 🗖 N-Level-4: HVAC Duct Drops
760-4	N-Level-4: Ceiling & Lighting Cans	15		14JAN08	01FEB08	21		1	14JAN08 N-Level-4: Ceiling & Lighting Cans
765-4	N-Level-4: In-Wall Electrical	15		14JAN08	01FEB08	21		1	14JAN08 V-Level-4: In-Wall Electrical
770-4	N-Level-4: OH/In-Wall Fire Alarm	15	15		01FEB08	21		1	14JAN08 N-Level-4: OH/In-Wall Fire Alarm
780-4	N-Level-4: Mount/Wire Control Devices	15		14JAN08	01FEB08	21		1	14JAN08 N-Level-4: Mount/Wire Control Devices
790-4	N-Level-4: Mount/Wire Security Devices	15		14JAN08	01FEB08	21		¦	14JAN08 N-Level-4: Mount/Wire Security Devices
810-4	N-Level-4: In-Wall Building Inspections	2		04FEB08	05FEB08	21		1	04FEB08 IN-Level-4 In-Wall Building Inspections
820-4	N-Level-4: Complete Pipe/Duct Insulation	5	-	06FEB08	12FEB08	21		ł I	06FEB08 N·Level-4: Complete Pipe/Duct Insulation
830-4	N-Level-4: Sheetrock Walls & Ceilings	8		21FEB08	03MAR08	15	i	i	21FEB08 N-Level 4: Sheetrock Walls & Ceilings
840-4	N-Level-4: Tape/ Finish Walls & Ceilings	8		04MAR08	13MAR08	21			04MAR08
850-4	N-Level-4: Sand/ Prime Paint & 1st Coat	5	-	14MAR08	20MAR08	29		. I	14MAR08 N-Level-4: Sand/ Prime Paint & 1st Coat
870-4	N-Level-4: ACT ceiling grid corridors	5		21MAR08	27MAR08	47			21MAR08 N-Level-4: ACT ceiling grid corridors
942-4	N-Level-4: Install FCU's & Tie-in	5		21MAR08	27MAR08	32			21MAR08 N-Level-4: Install FCU's & Tie-in
942-4 880-4	N-Level-4: Install FCU's & Tie-In N-Level-4: Waterproof & Ceramic Tile	5 8	_	21MAR08 21MAR08	01APR08	29			2/IMAR08 N-Level-4: Install FC0 si& Tie-In 2/IMAR08 N-Level-4: Waterproof & Ceramic Tile
880-4 890-4	N-Level-4: Waterproor & Ceramic Tile N-Level-4: Fire Protection Drops	10		21MAR08 28MAR08	10APR08	29			21MAR08 N-Level-4: Watelproor & Ceramic The
900-4	N-Level-4: Doors & Hardware	10		28MAR08	10APR08	55		1	28MAR08 N-Level-4: Doors & Hardware
900-4					15APR08	29	1	1	02APR08 N-Level-4: Millwork/kitchen Counter/Cab
	N-Level-4: Millwork/ kitchen Counter/Cab	10		02APR08 16APR08	15APR08 22APR08	29			
920-4	N-Level-4: Plumbing Fixtures	5	-					¦	16APR08 ■ N-Level-4: Plumbing Fixtures
930-4	N-Level-4: Electrical Fixtures & Finishes	8		23APR08	02MAY08	29			23APR08 🖬 N-Level-4: Electrical Fixtures & Finishe
940-4	N-Level-4: HVAC/ Mech Trim & Finishes	8	-	05MAY08	14MAY08	29		NrLevel-4:	HVAC/ Mech Trim & Finishes05MAY08 🗖
950-4	N-Level-4: Acoustical Tile corridor	2	-	15MAY08	16MAY08	29	i	i	15MAY08 II N-Level-4: Acoustical Tile corridor
960-4	N-Level-4: Flooring	10		19MAY08	02JUN08	29		i l	19MAY08 III N-Level-4. Flooring
	N-Level-4: Finish Paint	5	5	03JUN08	09JUN08	29			03JUN08 🗖 N-Level-4: Finish Paint
South Po	d S-Level-4: Initial OH HVAC/Mech Pipe	45	45	40.00707	001/01/07	40	i	i hooma	
S-646-4		15		19OCT07	08NOV07	18		19OCT07	
S-730-4	S-Level-4: Receive/Set Door Frames			29OCT07	01NOV07	38	i i	' '	III S-Level-4: Recei≬e/Set Door Frames
S-700-4	S-Level-4: Electrical Layout/Conduit/Boxes	5		21NOV07	28NOV07	50			DV07
S-650-4	S-Level-4: Top-off Corridor Walls			21NOV07	30NOV07	26			DV07
S-652-4	S-Level-4: Frame Balance of Interior Walls	7		21NOV07	30NOV07	26			DV07
S-680-4	S-Level-4: Balance of OH HVAC Ductwork	7		21NOV07	30NOV07	41			DV07 🗖 S-Level-4: Balance of OH HVAC Ductwork
S-750-4	S-Level-4: OH/In-Wall Plumbing	7		21NOV07	30NOV07	49			DV07 🗖 S-Level-4: OH/In-Wall Plumbing
S-708-4	S-Level-4: OH Electrical	10		29NOV07	12DEC07	50			NOV07 S-Level-4: OH Electrical
S-690-4	S-Level-4: OH/In-Wall Mechanical Pipe Roughin	20		03DEC07	31DEC07	26		0	3DEC07 S-Level-4: OH/In-Wall Mechanical Pipe Roughin
S-670-4	S-Level-4: Fire Protection Mains/Branches	10		20DEC07	04JAN08	25			20DEC07 S-Level-41 Fire Protection Mains/Branches
S-705-4	S-Level-4: OH-Inspections	2		02JAN08	03JAN08	36			02JAN08 S-Level-4: OH-Inspections
S-710-4	S-Level-4: OH Pipe/Duct Insulate	10		02JAN08	15JAN08	28			02JAN08 SLevel-4: OH Pipe/Duct Insulate
S-720-4	S-Level-4: OH MEP Completed for Ceiling Framing	0	-		15JAN08	28			S Level 4: OH MEP Completed for Ceiling Framing
S-740-4	S-Level-4: Frame Ceilings	5		16JAN08	22JAN08	28			16JAN08 🗖 S-Level-4: Frame Ceilings
S-800-4	S-Level-4: HVAC Duct Drops	10		23JAN08	05FEB08	33			23JAN08 🖬 S-Level-4 HVAC Duct Drops
S-760-4	S-Level-4: Ceiling & Lighting Cans	15		23JAN08	12FEB08	28			23JAN08 📥 S-Level-4: Ceiling & Lighting Cans
S-765-4	S-Level-4: In-Wall Electrical	15		23JAN08	12FEB08	28			23JAN08 S-Level-4: In-Wall Electrical
S-770-4	S-Level-4: OH/In-Wall Fire Alarm	15	15	23JAN08	12FEB08	28			23JAN08 S-Level-4: OH/In-Wall Fire Alarm
Start Date	30OCT08		WP31					Sheet 10 of 14	Baseline Schedule Rev#0 Progress Update (WP31)
Finish Date	22AUG08	t Schedule		GIL	BANE BUIL	DING (COMPANY		Constuction Schedule
Data Date	1900107			216	Constuctio	on Acti	vities		Updated 19OCT07
Run Date	190CT07 13:38 Critical	Activity			WPI RESID	ENCE	HALL		
@ D-:	avera Systems, Inc.								
©Prim	avera systems, mc.								

Activity	Activity	Orig	Rem	Early	Early	Total	JJJ	200 A S	7 C	
ID	Description	Dur	Dur	Start	Finish	Float				
S-780-4	S-Level-4: Mount/Wire Control Devices	15		23JAN08	12FEB08	28		i i		23JAN08 S-Level 4: Mount/Wife Control Devices
S-790-4	S-Level-4: Mount/Wire Security Devices	15		23JAN08	12FEB08	28				23JAN08 S-Level-4: Mount/Wire Security Devices
S-810-4	S-Level-4: In-Wall Building Inspections	2	-	13FEB08	14FEB08	28		1		13FEB08 S-Level-4: In-Wall Building Inspections
S-820-4	S-Level-4: Complete Pipe/Duct Insulation	5		15FEB08	21FEB08	28		i.		15FEB08 🗖 S-Level-4: Complete Pipe/Duct Insulation
S-830-4	S-Level-4: Sheetrock Walls & Ceilings	8	-	04MAR08	13MAR08	21				04MAR08 E S-Level-4: Sheetrock Walls & Ceilings
S-840-4	S-Level-4: Tape/ Finish Walls & Ceilings	8	-	14MAR08	25MAR08	21		1		14MAR08 🗖 S-Level-4: Tape/ Finish Walls & Ceilings
S-850-4	S-Level-4: Sand/ Prime Paint & 1st Coat	5	-	26MAR08	01APR08	21				26MAR08 S-Level-4: Sand/ Prime Paint & 1st Coat
S-870-4	S-Level-4: ACT ceiling grid corridors	5		02APR08	08APR08	39		ł		02APR08 🗖 S-Level-4: ACT ceiling grid corridors
S-942-4	S-Level-4: Install FCU's Tie-in	5	-	02APR08	08APR08	24				02APR08 🗖 S-Level-4: Install FCU's Tie-in
S-880-4	S-Level-4: Waterproof & Ceramic Tile	8		02APR08	11APR08	21		1		02APR08 E S-Level-4: Waterproof & Ceramic Tile
S-890-4	S-Level-4: Fire Protection Drops	10		09APR08	22APR08	45				09APR08 🔤 \$-Level-4: Fire Protection Drops
S-900-4	S-Level-4: Doors & Hardware	10		09APR08	22APR08	47				09APR08 🔜 \$-Level-4: Doors & Hardware
S-910-4	S-Level-4: Millwork/ kitchen Counter/Cab	10		14APR08	25APR08	21		i		14APR08 🗖 S-Level-4: Millwork/ kitchen Counter/Cab
S-920-4	S-Level-4: Plumbing Fixtures	5		28APR08	02MAY08	21		i.		28APR08 🛽 S-Level-4: Plumbing Fixtures
S-930-4	S-Level-4: Electrical Fixtures & Finishes	8	8	05MAY08	14MAY08	21				Electrical Fixtures & Finishes05MAY08 🗖
S-940-4	S-Level-4: HVAC/ Mech Trim & Finishes	8	8	15MAY08	27MAY08	21		S-Lev	vel-4	: HVAC/ Mech Trim & Finishes15MAY08 🗖
S-950-4	S-Level-4: Acoustical Tile corridor	2	2	28MAY08	29MAY08	21		1		28MAY08 S-Level-4: Acoustical Tile corridor
S-960-4	S-Level-4: Flooring	10	10	30MAY08	12JUN08	21		i		30MAY08 🗖 S-Level-4: Flooring
S-970-4	S-Level-4: Finish Paint	5	5	13JUN08	19JUN08	21		1		13JUN08 🗖 \$-Leve)-4: Finish Paint
Floor Clo	seout				•			i		
8250-4	Level-4: Clean Floor	5	5	20JUN08	26JUN08	21				20JUN08 Level-4: Clean Floor
8255-4	Level-4: Ready for Fire Alarm Test	0		27JUN08		21				Level-4: Ready for Fire Alarm Test27JUN08€
8260-4	Level-4: A/E Punchlist Floor	5	5	27JUN08	03JUL08	25		i		27JUN08 📮 Level-4: A/E Punchlist Floor
8270-4	Level-4: Subs Complete Punchlist	5		07JUL08	11JUL08	25		i		Level-4: Subs Complete Punchlist07JUL08
8280-4	Level-4: Ready to Turn Over Floor	0	0		11JUL08	25		i.		Level-4: Ready to Turn Over Floor◆
Level 5			-					-		
	Floor Area							i.		
635-5	Level-5: Exterior/Support Wall Framing	10	5	10OCT07A	2500707	45	1			Level-5: Exterior/Support Wall Framing
675-5	Level-5: Extendi/Support wai Framing	3			230CT07	43				Level-5: Receive Vinyl Tubs
745-5	-	3		190CT07 260CT07	2300107	4/				Able to Start Electrical MC/Wire (Bdg. Tight)
	Able to Start Electrical MC/Wire (Bdg. Tight)	0	-			38		2600	10	
980-5	Able to Start Boarding (Bdg. Tight)	1 0	l 0	29JAN08	1	38	1			29JAN08 Able to Start Boarding (Bdg. Tight)
North Po			-							
654-5	N-Level-5: Frame & Board Shaft Walls	7		16OCT07A		74				N-Level-5: Frame & Board Shaft Walls
730-5	N-Level-5: Receive/Set Door Frames	4		23OCT07	26OCT07	44				N-Level-5: Receive/Set Door Frames
646-5	N-Level-5: Initial OH HVAC/Mech Pipe	25		09NOV07	17DEC07	10		09	NOV	07 Level-5: Initial OH HVAC/Mech Pipe
652-5	N-Level-5: Frame Balance of Interior Walls	7		18DEC07	27DEC07	10		i.		18DEC07 🖬 N-Level-5: Frame Balance of Interior Walls
700-5	N-Level-5: Electrical Layout/Conduit/Boxes	5		28DEC07	04JAN08	10				28DEC07 🖬 N-Level-5, Electrical Layout/Conduit/Boxes
650-5	N-Level-5: Top-off Corridor Walls	7	-	28DEC07	08JAN08	10				28DEC07 🗖 N-Level-5: Top-off Corridor Walls
750-5	N-Level-5: OH/In-Wall Plumbing	7		28DEC07	08JAN08	23		1		28DEC07 🗖 N-Level-5: OH/In-Wall Plumbing
680-5	N-Level-5: Balance of OH HVAC Ductwork	15		28DEC07	18JAN08	15				28DEC07 N-Leve)-5: Balance of OH HVAC Ductwork
690-5	N-Level-5: OH/In-Wall Mechanical Pipe Roughin	20		28DEC07	25JAN08	10		i		28DEC07 N-Level-5: OH/In-Wall Mechanical Pipe Roughin
670-5	N-Level-5: Fire Protection Mains/Branches	10		07JAN08	18JAN08	17				07JAN08 🗖 N-Leve)-5: Fire Protection Mains/Branches
708-5	N-Level-5: OH Electrical	15		07JAN08	25JAN08	10		1		07JAN08 N-Level-5: OH Electrical
705-5	N-Level-5: OH-Inspections	2	-	28JAN08	29JAN08	10		1		28JAN08 N-Level-5: OH-Inspections
710-5	N-Level-5: OH Pipe/Duct Insulate	20	20	28JAN08	22FEB08	19				28JAN08 N-Level-5: OH Pipe/Duct Insulate
Start Date	300CT06		WP31					Sheet 11 o	of 14	Baseline Schedule Rev#0 Progress Update (WP31)
Finish Date	22AUG08			GII	BANE BUILI			Sheet 110		Constuction Schedule
Data Date	190CT07 100CT07 19:32				Constuctio	on Activ	vities			Updated 19OCT07
Run Date	19OCT07 13:38 Critical A	cuvity			WPI RESID	ENCE	HALL			-
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				- ·	-	2007	2008
Activity ID	Activity Description	Orig Dur	Rem Early Dur Start	Early Finish	Float		O N D J F M A M J J A S O N
720-5	N-Level-5: OH MEP Completed for Ceiling Framing	0		29JAN08	10		♦N-Level-5: OH MEP Completed for Ceiling Framing
740-5	N-Level-5: Frame Ceilings	5	-	05FEB08	10		30JAN08 🔲 N-Level-5: Frame Ceilings
800-5	N-Level-5: HVAC Duct Drops	10		19FEB08	15		06FEB08
760-5	N-Level-5: Ceiling & Lighting Cans	15		26FEB08	10		06FEB08 - N-Level-5: ¢eiling & Lighting ¢ans
765-5	N-Level-5: In-Wall Electrical	15		26FEB08	10		06FEB08
770-5	N-Level-5: OH/In-Wall Fire Alarm	15		26FEB08	10		06FEB08
780-5	N-Level-5: Mount/Wire Control Devices	15		26FEB08	10		06FEB08
790-5	N-Level-5: Mount/Wire Security Devices	15		26FEB08	10	1	06FEB08
810-5	N-Level-5: In-Wall Building Inspections	2		28FEB08	10		27FEB08 DN-Level-5: In-Wall Building Inspections
820-5	N-Level-5: Complete Pipe/Duct Insulation	5		06MAR08	10		29FEB08 IN-Level-5: Complete Pipe/Duct Insulation
830-5	N-Level-5: Sheetrock Walls & Ceilings	8		18MAR08	10		07MAR08 N-Level-5: Sheetrock Walls & Ceilings
840-5	N-Level-5: Tape/ Finish Walls & Ceilings	8		28MAR08	10		19MAR08 N-Level-5: Tape/ Finish Walls & Ceilings
850-5	N-Level-5: Sand/ Prime Paint & 1st Coat	5		04APR08	18		31MAR08 N-Level-5; Sand/ Prime Paint & 1st Coat
	N-Level-5: ACT ceiling grid corridors	5		11APR08	36		07APR08 N-Level-5: ACT ceiling grid corridors
942-5	N-Level-5: Install FCU's & Tie-in	5		11APR08	21		07APR08 IN Level-5: Install FCU's & Tie-in
880-5	N-Level-5: Waterproof & Ceramic Tile	8		16APR08	18		07APR08 N-Level-5: Waterproof & Ceramic Tile
890-5	N-Level-5: Fire Protection Drops	10		25APR08	42		14APR08 N-Level-5: Fire Protection Drops
900-5	N-Level-5: Doors & Hardware	10	10 14APR08	25APR08	83		14APR08 N-Level-5: Doors & Hardware
	N-Level-5: Millwork/ kitchen Counter/Cab	10		30APR08	18		17APR08 N-Level-5: Millwork/ kitchen Gounter/Cab
920-5	N-Level-5: Nilliwold Riccleri Councer/Cab	5		07MAY08	18		01MAY08 N-Level-5: Plumbing Fixtures
920-5	N-Level-5: Electrical Fixtures & Finishes	8		19MAY08	18	N LOVALE	Electrical Fixtures & Finishes08MAY08
940-5	N-Level-5: HVAC/ Mech Trim & Finishes	8		30MAY08	18		5: HVAC/ Mech Trim & Finishes20MAY08
940-5	N-Level-5: Acoustical Tile corridor	2		03JUN08	18	N-Leve	02JUN08 I N-Level-5; Acoustical Tile corridor
960-5	N-Level-5: Flooring	10		17JUN08	18		02J0N08 IN-Level-5, Acoustical file condor 04JUN08 IN-Level-5; Flobring
	N-Level-5: Flooring N-Level-5: Finish Paint	5		24JUN08	18		18JUN08 IN-Level-5: Finish Paint
		1 5	5 10501400	24301408	10	1	
South Poo		7	7 2000707	05101/07	75	accorta	
S-654-5 S-730-5	S-Level-5: Frame & Board Shaft Walls S-Level-5: Receive/Set Door Frames	7	7 26OCT07 4 29OCT07	05NOV07 01NOV07	75 48		T 🛱 S-Level-5; Frame & Board Shaft Walls T 🛙 S-Level-5; Receive/Set Door Frames
	S-Level-5: Initial OH HVAC/Mech Pipe	25		17DEC07	18		07, Clevel-5. Receive/Set Door Frames
S-640-5 S-652-5	S-Level-5: Frame Balance of Interior Walls	25	7 28DEC07	17DEC07 08JAN08	18	Dalia	28DEC07 S-Level-5: Frame Balance of Interior Walls
	S-Level-5: Electrical Layout/Conduit/Boxes	5		15JAN08	11		09JAN08 S-Level-5: Electrical Layout/Conduit/Boxes
S-650-5	S-Level-5: Top-off Corridor Walls	7	7 09JAN08 7 09JAN08	17JAN08 17JAN08	11		09JAN08 Steve(-5: Top-off Corridor Walls
	S-Level-5: OH/In-Wall Plumbing				24		09JAN08 SLevel-5: OH/In-Wall Plumbing 09JAN08 SLevel-5: Fire Protection Mains/Branches
S-670-5	S-Level-5: Fire Protection Mains/Branches	10		22JAN08	23		
S-680-5	S-Level-5: Balance of OH HVAC Ductwork	15		29JAN08 05FEB08	16		09JAN08 S-Level-5: Balance of OH HVAC Ductwork
	S-Level-5: OH/In-Wall Mechanical Pipe Roughin		20 09JAN08		11		09JAN08 S-Level-5 OH/In-Wall Mechanical Pipe Roughin
S-708-5	S-Level-5: OH Electrical	15		05FEB08	11		16JAN08 S-Level-5 OH Electrical
	S-Level-5: OH-Inspections	20		07FEB08	11 20		06FEB08 S-Level-5: OH-Inspections
S-710-5	S-Level-5: OH Pipe/Duct Insulate			04MAR08			06FEB08 S-Level-5: OH Pipe/Duct Insulate S-Level-5: OH MEP Completed for Ceiling Framing
	S-Level-5: OH MEP Completed for Ceiling Framing S-Level-5: Frame Ceilings	0		07FEB08 14FEB08	11		08FEB08 S+Level-5: Frame Ceilings
	1						15FEB08 Stevens: HVAC Duct Drops
	S-Level-5: HVAC Duct Drops	10		28FEB08	16		
S-760-5	S-Level-5: Ceiling & Lighting Cans	15		06MAR08	11		15FEB08 S-Level-5: Ceiling & Lighting Cans
S-765-5	S-Level-5: In-Wall Electrical	15		06MAR08	11		15FEB08 S-Level-5i In-Wall Electrical
S-770-5	S-Level-5: OH/In-Wall Fire Alarm	15	15 15FEB08	06MAR08	11	1	15FEB08 S-Level-5: OH/In-Wall Fire Alarm
Start Date	30OCT08	rent Schedule	WP31			Sheet 12 of 14	Baseline Schedule Rev#0 Progress Update (WP31)
Finish Date	22AUG08	gress Bar	GIL		DING COMPANY	,	Constuction Schedule
Data Date Run Date		cal Activity			on Activities		Updated 19OCT07
Null Date		,		WPI RESID	DENCE HALL		
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Activity ID	Activity Description	Orig Dur	Rem Dur	Early Start	Early Finish	Total Float	2007 JJJAS	2008 D N D J F M A M J J A S O N B
S-780-5	S-Level-5: Mount/Wire Control Devices	15		15FEB08	06MAR08	11		15FEB08 S-Level-5: Mount/Wire Control Devices
S-790-5	S-Level-5: Mount/Wire Security Devices	15		15FEB08	06MAR08	11		15FEB08 S-Level-5: Mount/Wire Security Devices
S-810-5	S-Level-5: In-Wall Building Inspections	2		07MAR08	10MAR08	11		07MAR08 S-Level-5: In-Wall Building Inspections
S-820-5	S-Level-5: Complete Pipe/Duct Insulation	5		11MAR08	17MAR08	11		11MAR08 S-Level-5: Complete Pipe/Duct Insulation
S-830-5	S-Level-5: Sheetrock Walls & Ceilings	8	_	19MAR08	28MAR08	10		19MAR08 S-Level-5: Sheetrock Walls & Ceilings
S-840-5	S-Level-5: Tape/ Finish Walls & Ceilings	8		31MAR08	09APR08	10		31MAR08 S-Level-5: Tape/ Finish Walls & Ceilings
S-850-5	S-Level-5: Sand/ Prime Paint & 1st Coat	5		10APR08	16APR08	10		10/APR08 StLevel-5: Sand/ Prime Paint & 1st Coat
S-870-5	S-Level-5: ACT ceiling grid corridors	5		17APR08	23APR08	28		17APR08 S-Level-5: ACT ceiling grid corridors
S-942-5	S-Level-5: Install FCU's & Tie-in	5		17APR08	23APR08	13		17APR08 🔳 S-Level-5: Install FCU's & Tie-in
S-880-5	S-Level-5: Waterproof & Ceramic Tile	8	-	17APR08	28APR08	10		17APR08 🔤 S-Level-5: Waterproof & Ceramic Tile
S-890-5	S-Level-5: Fire Protection Drops	10		24APR08	07MAY08	34		24APR08 S-Level-5: Fire Protection Drops
S-900-5	S-Level-5: Doors & Hardware	10		24APR08	07MAY08	36		24APR08 S-Level-5: Doors & Hardware
S-910-5	S-Level-5: Milwork/ kitchen Counter/Cab	10		29APR08	12MAY08	10	S-lievel-5 M	Ilwork/ kitchen Counter/Cab29APR08
S-920-5	S-Level-5: Plumbing Fixtures	5		13MAY08	19MAY08	10		13MAY08 S-Level-5: Plumbing Fixtures
S-930-5	S-Level-5: Electrical Fixtures & Finishes	8		20MAY08	30MAY08	10	S-Level	5: Electrical Fixtures & Finishes20MAY08
S-940-5	S-Level-5: HVAC/ Mech Trim & Finishes	8		02JUN08	11JUN08	10		vel-5: HVAC/ Mech Trim & Finishes02JUN08
S-950-5	S-Level-5: Acoustical Tile corridor	2		12JUN08	13JUN08	10	3-16	S-Level-5: Acoustical Tile conidor12JUN08
S-960-5	S-Level-5: Flooring	10	-	16JUN08	27JUN08	10		16JUN08 S-Level-5: Flooring
S-970-5	S-Level-5: Finish Paint	5			07JUL08	10		30JUN08 S-Level-5; Finish Paint
Floor Clo		1 3	5	30001100	0700200	10		
8250-5	Level-5: Clean Floor	5	5	08JUL08	14JUL08	10		08JUL08 Level-5: Clean Floor
8255-5	Level-5: Ready for Fire Alarm Test	0	_	15JUL08	14JUL08	10		Level-5: Ready for Fire Alarm Test15JUL08
8260-5	Level-5: A/E Punchlist Floor	5	-	15JUL08	21JUL08	14		Level-5: A/E Punchlist Floor15JUL08
8270-5	Level-5: Subs Complete Punchlist	5		22JUL08	21JUL08	14		Level-5: Subs Complete Puhchlist22JUL08
8280-5	Level-5: Ready to Turn Over Floor	0		22JUL00	28JUL08	14		Level-5: Ready to Turn Over Floor
		1 0			2000000	14		
Roof Lev	el							
Stucture 8734	North Eleve Trees Electrics Descent	5	-	45007074	2500707	91	45007074	North Elev: Temp Flashing Parapet
	North Elev: Temp Flashing Parapet	-		15OCT07A				East Elev: Temp Flashing Parapet
8735	East Elev: Temp Flashing Parapet	10		150CT07A		91 91		
8736 8737	West Elev: Temp Flashing Parapet	10		15OCT07A				West Elev: Temp Flashing Parapet South Elev: Temp Flashing Parapet
8737	South Elev: Temp Flashing Parapet	30		02NOV07 03MAR08*		91 78		03MAR08* Roof Level: Install Roofing System
	Roof Level: Install Roofing System Roof Level: Install Flashing & Roof Finishes					78	Deef Levels Install	Flashing & Roof Finishes 14 APR08
	-	15			02MAY08			
	Roof Level: Install Green Roof System	1 15		05MAY08*	23MAY08	63	ROOLLEVE	: Ihstall Green Roof \$ysterh05MAY08*
Mechanic		1 45	-	00050074	0500707		door ob to A	
	Install Roof Risers & Tie-in	15		26SEP07A		40		Install Roof Risers & Tie-in
8710	Roof Level: Install Equipment Rooms Panels	20		20NOV07	18DEC07	84	20N	0V07 Constant Roof Level: Install Equipment Rooms Panels
8770	Roof Level: Install Chiller	10		26DEC07	09JAN08	100		26DEC07 C Roof Level: Install Chiller
8760	Roof Level: Install Exhaust Fan	10		24JAN08	06FEB08	80		24JAN08 🛄 Roof Level: Install Exhaust Fan
8750	Roof Level: Install: RTU	10		31JAN08	13FEB08	75		31JAN08 🗖 Roof Level: Install: RTU
8780	Roof Level: Install AHU	10		31JAN08	13FEB08	65		31JAN08 🗖 Roof Level: Install AHU
8790	Roof Level: Install Condenser/Fans/Water Pump	30		07FEB08	19MAR08	50		07FEB08 Roof Level: Install Condenser/Fans/Water Pump
8850	Roof Level: Install: Mech louvers	10		21FEB08	05MAR08	60		21FEB08 Roof Level: Install: Mech louvers
8800	Roof Level: Rough-in & Connect	60		06MAR08	29MAY08	60		06MAR08 Roof Level Rough-in & Connect
8810	Roof Level: mech piping & Connect Equipment	30	30	20MAR08	30APR08	50		20MAR08 Roof Level: mech piping & Connect Equip
Start Date	30OCT06 Current 5	Schedule	WP31				Sheet 13 of 14	Baseline Schedule Rev#0 Progress Update (WP31)
Finish Date Data Date	22AUG08 19OCT07			GIL	BANE BUIL			Constuction Schedule
Data Date Run Date	190C107 13:38 Critical A				Constuction WPI RESID			Updated 19OCT07
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Activity	Activity	Orig	Rem Early	Early	Total	2007	2008
ID	Description	Dur	Dur Start	Finish	Float	JJJAS	O N D J F M A M J J A S O N
8820	Roof Level: Equipment Electrical & Tie-in	30	30 20MAR08	30APR08	50		20MAR08 Roof Level: Equipment Electrical & Tie-i
8830	Roof Level: Roof Equipment Controls	30	30 20MAR08	30APR08	50		20MAR08 Roof Level: Roof Equipment Controls
8840	Roof Systems ready for Start-up	0	0	30APR08	50		Roof Systems ready for Start-up
Systems	Start-up & Commissioning						
8910	Ready to Start-up Equipment	0	0 12JUN08		21		12JUN08♦Ready to Start-up Equipment
8860	Start-up/ Check Roof RTU	10		25JUN08	41		12JUN08 🛄 Start-up/ Check Roof RTU
8870	Start-up Roof Condenser	10	10 12JUN08	25JUN08	31		12JUN08 🗖 Start-up Roof Condenser
8880	Start-up Pumps	10	10 12JUN08	25JUN08	31		12JUN08 🛄 Start-up Pumps
8890	Flush System	10	10 12JUN08	25JUN08	31		12JUN0β 🗖 Flush¦System
8900	Start-up Chiller	10		25JUN08	31		12JUN0β 🔤 Start-μp Chiller
8940	Test & Balance Air System	15	15 12JUN08	02JUL08	21		12,JUN0β 🔤 Test & Balance Air System
8950	Test & Balance Wet System	15	15 12JUN08	02JUL08	21		12JUN0β 🔤 Test & Balance Wet System
8980	Ready to Install Millwork ? (to determine)	0	0 26JUN08		41		Ready to Install Millwork ? (to determine)26JUN08
8920	Building Start-up & Check-List	10		10JUL08	31		Building Start-up & Check-List26JUN08
8930	Temperature Control Check-out	10	10 26JUN08	10JUL08	31		Temperature Control Check-out26JUN08
8960	Building Commissioning	15	15 03JUL08	24JUL08	21		03JUL08 E Building Commissionin
8970	Building Commissioning Completed	0	0	24JUL08	21		Building Commissioning Completed
Elevator							
9000	Building Tight - ready for install elevator	0	0	28JAN08	94		Building Tight - ready for install elevator
9015	Install Elevators	40	40 14FEB08	09APR08	82		14FEB08 Install Elevators
General E		-10	10 11 2000	00/11/100	02		
General	Salialing						
9048	Install Stair #1	12	10 18OCT07A	04NOV07	193	1000007	Install Stair #1
9048	Install Stair #1	12		20NOV07	193		/07 Linstall Stair #3
	Flush North FCU Riser	2		17APR08	64		16APR08 I Flush North FCU Riser
942-1 942-6		15		08MAY08	64		
942-0	Insulate North FCU Piping	15	2 30APR08	01MAY08			18APR08 III Insulate North FCU Piping 30APR08 I Flush South FCU Riser
942-7	Flush South FCU Riser Insulate South FCU Piping	15		22MAY08	54		02MAY08 I Flush South FCU Riser
	Insulate South FCO Piping	15	15 UZMAYU8	22MA 108	54		02MAY08 Data Insulate South FCO Piping
Garage							
6500	Garage: Exc/FRP Foundations	30	15 18JUN07A	08NOV07	130		Garage: Exc/FRP Foundations18JUN07A
6535	Precast Contractor Mobilize/Close Dean Street	5		17DEC07	105		11DEC07 🗖 Precast Contractor Mobilize/Close Dean Street
6505	Start Garage Precast Structure Delivery	0			105		18DEC07♦Start Garage Precast Structure Delivery
6515	Garage: Erect Precast Structure	20	20 18DEC07	16JAN08	105		18DEC07 Garage: Erect Precast Structure
6520	Garage: Install Railings	10	10 17JAN08	30JAN08	135		17JANØ8 📼 Garage: Install Railings
6530	Garage: Install Elevator	40	40 17JAN08	12MAR08	105		17JANØ8 Garage: Install Elevator
6540	Garage: Electrical/ Power/ Fire Alarm	40	40 17JAN08	12MAR08	105		17JANØ8 Garage: Electrical/ Power/ Fire Alarm
6550	Garage: Mechanical	40	40 17JAN08	12MAR08	105		17JAN08 Garage: Mechanical
6552	Garage: Site Finishes & Sidewalks	40	40 17JAN08	12MAR08	105		17JAN08 Garage: Site Finishes & Sidewalks
6560	Garage: Cleanup & Punchlist	10	10 13MAR08	26MAR08	105		13MAR08 🔤 Garage: Cleanup & Punchlist
					. 1		
Start Date	30OCT08 Current S	chedule	WP31			Sheet 14 of 1	Duscinic Schedule Review Progress opdate (m 51)
Finish Date Data Date	22AUG08 19OCT07		GIL	BANE BUIL			Constuction Schedule
Run Date	190CT07 13:38 Critical Ac	tivity		Constucti WPI RESI			Updated 19OCT07
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Appendix C: Concrete Takeoff Sheets

		_	ES	TIMATI	E WORK	SHEET					
Project: Location Architect Items	NEW RESHALL WPI Canon Footings			Concre	ete Spread F	ootings		Estimate No. Sheet No. Date By	0	Checked	
				Dime	ensions						
Cost		Lei	ngth	1	idth	He	ight	Volume			
Code	Description	Ft.	In.	Ft.	In.	Ft.	In.	CF	Count	Quantity	Unit
	F6	6	0	6	0	0	18	54.00	4	8.00	CY
	F6-42	6	0	41	8	0	18	375.00	1	13.89	CY
	F7	7	0	7	0	0	20	81.67	3	9.07	CY
	F8	8	0	8	0	0	22	117.33	16	69.53	CY
	F9	9	0	9	0		24	162.00	9	54.00	CY
	F9-18	9	0	18	2.5	0	24	327.75	8	97.11	CY
	F10	10	0	10	0	0	26	216.67	20	160.49	CY
	F11	11	0	11	0	0	29	292.42	1	10.83	CY
	F13U	13	0	13	0	0	36	507.00	13	244.11	CY
	Subtotal									667.04	CY
	Add 5% Waste									33.35	CY
	Total									700.39	CY

			ES	TIMATI	E WORK	SHEET					
Project: Location Architect Items	NEW RESHALL WPI Canon Piers			C	Concrete Pie	rs		Estimate No. Sheet No. Date By)	Checked	
Cost Code	Description	Lei Ft.	ngth In.		nsions idth In.	Hei Ft.	ght In.	Volume	Count #	Quantity	Unit
Coue	Description	F 1.	- 111.	Γι.	111.	гι.		CF	#	Quantity	
	P24	0	24	0	24	2	0	8	35	10.37	СҮ
		0	24	0	24	4	6	18	1	0.67	CY
		0	24	0	24	5	0	20	22	16.30	CY
		0	24	0	24	6	0	24	1	0.89	CY
		0	24	0	24	6	6	26	4	3.85	CY
		0	24	0	24	7	0	28	1	1.04	CY
		0	24	0	24	10	5	41.66667	4	6.17	CY
	Subtotal P24	+								39.28	СҮ
	P30	0	30	0	30	2	0	12.5	6	2.78	CY
		0	30	0	30	5	0	31.25	8	9.26	CY
	Subtotal P30									12.04	СҮ
	Subtotal									51.32	СҮ
	Add 5% Waste									2.57	CY
	Total									53.89	CY

		_	ES	STIMATI	E WORK	SHEET	I				
Project:	NEW RESHALL			(Grade Beam	ıs		Estima	te No.		
Location	WPI							Sheet	No.		
Architect	Canon							Date			
Items	Grade Beams							By _		Checked	
				Dime	nsions						
Cost		Lei	ngth	Wi	idth	He	ight	Volu	ne		
Code	Description	Ft.	In.	Ft.	In.	Ft.	In.	CI	Count	Quantity	Unit
	GB01	5	0	2	6	3	6	43.7	5 12	19.44	CY
	Subtotal									19.44	CY
	Add 5% Waste									0.97	CY
	Total									20.42	CY

		Ε	STIMAT	'E WORI	K SHEE'	Т				
Project:	NEW RESHALL							Estimate N	lo.	
Location	WPI							Sheet No.		
Architect	Canon							Date		
Items	Concrete Continuous Footings							By	Checked	
			1							
				Dime	nsions					
Cost		Lei	ngth	-	ight	Width		Volume		
Code	Description	Ft.	In.	Ft.	In.	Ft.	In.	CF	Quantity	Unit
	Walls With Upper Lip	819	0	6	3	1	3	6398.44	236.98	CY
	Walls Withough Upper Lip	136	0	4	9	1	3	807.50	29.91	CY
	Subtotal							7205.94	266.89	CY
	Add 5% for Waste								13.34	CY
	Total								280.23	CY

				E	STIMAT	E WORI	K SHEE	Г						
Project:	NEW RESHALL	1					oncrete S			Estimata N				
Location	WPI					0.	Shiel ete b	14.0		Estimate NoSheet No				
Architect	Canon									Date				
Items	Concrete Slab									By Checked				
		_ _			1	<u> </u>	<u> </u>		<u> </u>					
				Dime	nsions									
Cost		Len	gth		idth	He	ight			Volume				
Code	Description	Ft.	In.	Ft.	In.	Ft.	In.			CF	Count	Quantity	Unit	
	1st Floor													
	Section 1	15	11.5	35	8	0	5			237.1586	3	26.35	CY	
	Section 2	40.04	0	13	0	0	5			216.8833	2	16.07	CY	
	Section 3	99.458	0	53	0	0	5			2196.364	2	162.69	CY	
	Section 4	15	11.5	44	4	0	5			294.7859	1	10.92	CY	
	Section 5	52	4.5	94	4	0	5			2058.628	1	76.25	CY	
	0.1											202.25	CIV.	
	Subtotal											292.27	CY	
	Elevator Shafts	10.541	0	8	4	0	5			36.60069	2	2.71	СҮ	
	First Floor Total											289.56	СҮ	
	2nd Floor											289.56	СҮ	
	Glass Extension 1	19	7.5	3	0	0	5			24.53125	8	7.27	CY	
	Glass Extension 2	11	6	3	0	0	5			14.375	6	3.19	CY	
	Subtotal											300.02	CY	
	Stairwells	9.208	0	17.2	0	0	5			65.99067	4	9.78	CY	
	2nd Floor Total											290.25	CY	
	3rd Floor											290.25	СҮ	
	51 0 1 1001											270.23	U	
	4th Floor											290.25	CY	
	5th Floor											290.25	CY	
├─── ╞━	Roof							<u> </u>				290.25	СҮ	
╞───╞━	Subtotal											1740.80	СҮ	
	Add 5% Waste							1				87.04	CY	
╞───╞━	Slab Total							t				1827.84	CY	

Appendix D: Concrete Estimate

Concrete Slab

Activity	Quantity (CY)	Concrete Cost	Placement Cost	Formwork	Reinforcing (Fibrous)	Finishing	Curing	Total Cost/Floor
1st Floor Slab 4000PSI	289.56	\$26,349.96	\$5,458.21	\$4,687.00 (5 Uses @ 15" High)	\$6,659.88	\$9,375.00	\$2,711.25	\$55,241.30
2nd Floor Slab 4000PSI	290.25	\$26,412.75	\$5,892.08	\$4,578.00	\$6,675.75	\$9,375.00	\$2,711.25	\$55,644.83
3rd Floor Slab 4000PSI	290.25	\$26,412.75	\$6,327.45	\$4,578.00	\$6,675.75	\$9,375.00	\$2,711.25	\$56,080.20
5th Floor Slab 4000PSI	290.25	\$26,412.75	\$6,762.83	\$4,578.00	\$6,675.75	\$9,375.00	\$2,711.25	\$56,515.58
Roof Slab 4000PSI	290.25	\$26,412.75	\$7,198.20	\$4,120.20	\$6,675.75	\$9,375.00	\$2,711.25	\$56,493.15
							Total Cost of Slab	\$279,975.05

Grade Beams

Activity	Quantity (CY)	Concrete Cost	Placement Cost	Formwork	Reinforcing Tons	Reinforcing Cost	Total Cost
GB01	20.42	\$1,858.22	\$194.60	\$1,100.40	1.682	\$2,228.65	\$5,381.87
4000PSI				(4 Uses @ 36" High)			

Piers

Activity	Quantity (CY)		Description		Total Cost/Type	
P24 4000PSI	39.28		x 24" Average Reinfo Concrete, Placemen	•	\$31,856.08	
P30 4000PSI	12.04		x30" Average Reinfo Concrete, Placemen	•	\$7,958.44	
			Total Cost of Footing	S	\$39,814.52	
Continuous Footing	S					
Activity	Quantity (CY)	Concrete Cost	Placement Cost	Formwork	Reinforcing (Fiberious)	Total Cost/Type
Walls With Upper Lip 4000PSI	o 237	\$21,567.00	\$2,855.85	\$24,262.88	\$4,664.00	\$53,349.73
Walls Without Lip 4000 PSI	30	\$2,730.00	\$357.30	\$3,062.04	\$806.93	\$6,956.27
4000131					Total Cost	\$60,305.99
Spread Footings						
Activity	Quantity (C	Y)	Descri	otion	Total Cost	
Spread Footings (Over 5 CY Each)		(Includes	Spread Footin Forms, Concrete, P	-	\$202,594.81 forcing)	

Concrete Total

Activity	Volume (CY)	Cost
Concrete Slab	1827.84	\$279,975.05
Grade Beams	20.42	\$5,381.87
Piers	53.89	\$39,814.52
Continuous Footings	213.25	\$60,305.99
Spread Footings	700.39	\$202,594.81
Subtotal Cost Index: Springfield MA	2815.79	\$588,072.24
x1.08		\$635,118.02
Total		\$635,118.02

Appendix E: Steel Takeoff Sheets

		EST	ГІМАТЕ	WOI	RK SH	IEET					
Project:	WPI NEW RES HALL		STRUC	CTURAI	L STEEI			Estimate N	lo.		
Location	Worcester, MA							Sheet No.			
Architect	Canon Design										
Items	Second Floor Framing							Ву		Checked	
Cost		Designation	Pounds /	Len	gth	Length	Cost				
Code	Description		Foot	Ft.	In.	Ft.				Quantity	Unit
	W14x22	W14x22	22	1481		1481				32,582	Pounds
	W14x26	W14x26	26	110		110				2,860	Pounds
	W14x30	W14x30	30	384		384				11,520	Pounds
	W14x34	W14x34	34	275		275				9,350	Pounds
	W14x48	W14x48	48	50		50				2,400	Pounds
	W16x26	W16x26	26	550		<u>550</u>				14,300	Pounds
	W18x40	W16x40	40	78		78				3,120	Pounds
	W16x45	W16x45	45	8		8				360	Pounds
	W18x35	W18x35	35	200		200				7,000	Pounds
	W21x44	W21x44	44	90		90				3,960	Pounds
	W24x55	W24x55	55	172		172				9,460	Pounds
	W24x76	W24x76	76	58		58				4,408	Pounds
	W8x15	W8x15	15	130		130				1,950	Pounds
	W10x26	W10x12	26	55		55				1,430	Pounds
	C8x11.5	C8x11.5	11.5	350		350				4,025	Pounds
	W36x135	W36x135	135	19		19					Pounds
	W18x119	W18x119	119	200		200				23,800	Pounds
	W27x84	W27x84	84	12		12					Pounds
	W36x150	W36x150	150	19		19				2,850	Pounds
	MC7x22.5	MC7x22.5	22.5	50		50					Pounds
	W10x68	W10x68	68	45		45					Pounds
						0				0	
									Total	111,290	Pounds
								10% For C	Connections	122,419	Pounds
										61.21	Tons

ESTIMATE WORK SHEET											
Project:	WPI NEW RES HALL		S	TRUCT	URAL S	TEEL	E	stimate No	•		
Location	Worcester, MA						S	heet No.			
Architect	Canon Design						Đ	hate			
Items	Third Floor Framing	_					В	y		Checked	
Cost		Designation	Pounds /	Len	gth	Length					
Code	Description		Foot	Ft.	In.	Ft.				Quantity	Unit
	W14x22	W14x22	22	1428		1428				31,416	Pounds
	W14x26	W14x26	26	434		<mark>434</mark>				11,284	Pounds
	W14x30	W14x30	30	384		<mark>384</mark>				11,520	Pounds
	W14x34	W14x34	34	275		275				9,350	Pounds
	W14x48	W14x48	48	92		92				4,416	Pounds
	W16x26	W16x26	26	562		<u>562</u>				14,612	Pounds
	W16x40	W16x40	40	14		14				560	Pounds
	W16x45	W16x45	45	8		8				360	Pounds
	W18x35	W18x35	35	72		72				2,520	Pounds
	W21x44	W21x44	44	90		90				3,960	Pounds
	W24x55	W24x55	55	172		172				9,460	Pounds
	W24x76	W24x76	76	58		58				4,408	Pounds
	W8x15	W8x15	15	78		78				1,170	Pounds
	W10x12	W10x12	12	16		16				192	Pounds
	C8x11.5	C8x11.5	11.5	350		350				4,025	Pounds
	Wt7x15	Wt7x15	15	24		24				360	Pounds
								T	Total	109,613	Pounds
			+				1	0% For Co	onnections	120,574	Pounds
										60.29	Tons

			ESTIMATE WORK SHEET										
Project:	WPI NEW RES HALL			TRUCT				No.					
Location	Worcester, MA						Sheet No.						
Architect	Canon Design												
Items	Fourth Floor Framing	_					By		Checked				
Cost		Designation	Pounds /	Len	gth	Length				<u> </u>			
Code	Description		Foot	Ft.	In.	Ft.			Quantity	Unit			
	W14x22	W14x22	22	1428		1428			31,416	Pounds			
	W14x26	W14x26	26	434		<mark>434</mark>			11,284	Pounds			
	W14x30	W14x30	30	384		<mark>384</mark>			11,520	Pounds			
	W14x34	W14x34	34	275		275			9,350	Pounds			
	W14x48	W14x48	48	92		92			4,416	Pounds			
	W16x26	W16x26	26	562		<u>562</u>			14,612	Pounds			
	W16x40	W16x40	40	14		14			560	Pounds			
	W16x45	W16x45	45	8		8			360	Pounds			
	W18x35	W18x35	35	72		72			2,520	Pounds			
	W21x44	W21x44	44	90		90			3,960	Pounds			
	W24x55	W24x55	55	172		172			9,460	Pounds			
	W24x76	W24x76	76	58		58			4,408	Pounds			
	W8x15	W8x15	15	78		78			1,170	Pounds			
	W10x12	W10x12	12	16		16			192	Pounds			
	C8x11.5	C8x11.5	11.5	350		350			4,025	Pounds			
	Wt7x15	Wt7x15	15	24		24			360	Pounds			
								Total	109,613	Pounds			
							10% For 0	L Connections	120,574	Pounds			
									60.29	Tons			

ESTIMATE WORK SHEET										
Project:	WPI NEW RES HALL		S	TRUCT	URAL S	TEEL	Estimate I	No.		
Location	Worcester, MA	_					Sheet No.			
Architect	Canon Design									
Items	Fifth Floor Framing	_					By		Checked	
Cost		Designation	Pounds /	Len	gth	Length				
Code	Description		Foot	Ft.	In.	Ft.			Quantity	Unit
	W14x22	W14x22	22	1428		1428			31,416	Pounds
	W14x26	W14x26	26	434		<mark>434</mark>			11,284	Pounds
	W14x30	W14x30	30	384		<mark>384</mark>			11,520	Pounds
	W14x34	W14x34	34	275		275			9,350	Pounds
	W14x48	W14x48	48	92		92			4,416	Pounds
	W16x26	W16x26	26	562		<u>562</u>			14,612	Pounds
	W16x40	W16x40	40	14		14			560	Pounds
	W16x45	W16x45	45	8		8			360	Pounds
	W18x35	W18x35	35	72		72			2,520	Pounds
	W21x44	W21x44	44	90		90			3,960	Pounds
	W24x55	W24x55	55	172		172			9,460	Pounds
	W24x76	W24x76	76	58		58			4,408	Pounds
	W8x15	W8x15	15	78		78			1,170	Pounds
	W10x12	W10x12	12	16		16			192	Pounds
	C8x11.5	C8x11.5	11.5	350		350			4,025	Pounds
	Wt7x15	Wt7x15	15	24		24			360	Pounds
								Total	109,613	Pounds
		_					10% For (Connections	120,574	Pounds
	<u>†</u>								120,014	
									60.29	Tons

			ATE V	VORE	K SHEET	1						
Project:	WPI NEW RES HALL		S	TRUCT	URAL S	TEEL			Es timate N	No.		l
Location	Worcester, MA								Sheet No.			
Architect	Canon Design								Da te			
Items	Roof Framing								By		Checked	
Cost		Designation	Pounds /	Len	lgth	Length						
Code	Description		Foot	Ft.	In.	Ft.					Quantity	Unit
	W12x26	W12x26	26	290		290					7,540	Pounds
	W14x22	W14x22	22	320		320					7,040	Pounds
	W18x46	W18x46	46	12		12					552	Pounds
	W18x55	W18x55	55	100		100						Pounds
	W18x40	W18x40	40	124		124					4,960	Pounds
	W16x26	W16x26	26	1175		<u>1175</u>					30,550	Pounds
	W16x31	W16x31	31	138		<mark>138</mark>					4,278	Pounds
	W18x50	W18x50	50	90		90					4,500	Pounds
	W18x35	W18x35	35	1088		1088					38,080	Pounds
	W21x44	W21x44	44	188		188					8,272	Pounds
	W24x55	W24x55	55	292		292					16,060	Pounds
	W24x76	W24x76	76	56		<mark>56</mark>					4,256	Pounds
	W8x15	W8x15	15	10		10					150	Pounds
	W10x15	W10x15	15	25		25					375	Pounds
	Wt7x15	Wt7x15	15	10		10					150	Pounds
										Total	132,263	Pounds
			<u> </u>						10% For (145,489	Pounds
	 							├			72.74	Topo
											12.14	TONS

		ES	STIMAT	E WO	RK S	HEET				
Project: Location	WPI NEW RES HALL Worcester, MA		STRU	CTURAI	L STEE	Ĺ	Sheet No.	No		
Architect Items	Canon Design Bracing	_					Date By	. <u> </u>	Checked	
Cost		Designation	Pounds /	Ler	gth					
Code	Description		Foot	Ft.	In.				Quantity	Unit
	HSS7x7x1/2"	HSS7x7x1/2"	41.9	328					13,743	Pounds
	200k		ן ר							
	HSS7x7x1/2"	HSS7x7x1/2"	41.9	620					25,978	Pounds
	300k		ן ר					1		
	HSS7x7x1/2"	HSS7x7x1/2"	41.9	104					4,358	Pounds
	400k		ן ר							
	HSS8x8x5/8"	HSS8x8x5/8"	59.1	128					7,565	Pounds
								Total	51,644	Pounds
							10% For (Connections	56,808	Pounds
						1			28.40	Tons

		EST	IMATE	WOF	RK SH	IEET				
Project: Location	WPI NEW RES HALL Worcester, MA		STRU	CTURAL	. STEEL		Estimate I Sheet No.			
Architect Items	Canon Design Vertical Steel								Checked	
Cost		Designation	Pounds /	Len	gth	Length				
Code	Description		Foot	Ft.	In.	Ft.			Quantity	Unit
	W10x33	W10x33	33	1344		1344			44,352	Pounds
	W10x49	W10x49	49	1484		1484			72,716	Pounds
	W12x87	W12x87	87	392		392			34,104	Pounds
	W12x152	W12x152	152	280		280			42,560	Pounds
	W10x77	W10x77	77	56		56			4,312	Pounds
	W12x190	W12x190	190	112		112			21,280	Pounds
	W10x54	W10x54	54	28		28			1,512	Pounds
	HSS7x7x1/2"	HSS7x7x1/2"	41.9	239		239			10,014	Pounds
	HSS6x6x1/2"	HSS6x6x1/2"	35.1	717		717			25,167	Pounds
								Total	256,017	Pounds
							10% For (Connections	281,618	Pounds
		_							140.81	Tons

Appendix F: Steel Estimate

Steel Tonage per Floor

Activity	Steel Quantity (Tons)	Cost
2nd Floor Framing	61.21	\$170,163.80
3rd Floor Framing	60.29	\$167,606.20
4th Floor Framing	60.29	\$167,606.20
5th Floor Framing	60.29	\$167,606.20
Roof Framing	72.74	\$202,217.20
Bracing	28.4	\$78,952.00
Vertical Steel	140.81	\$391,451.80
Total Tonage Cost	484.03	\$1,175,439.60
x City Cost Index Springfield MA: 1.08		\$1,269,474.77

Appendix G: Earned Value Analysis Spreadsheet

		Actual P	ercent																	
		Compl	leted	Scheduled	Complete						Total		Actual Lab	or Hours	Scheduled L	abor Hours	Actua	l Cost	Schedu	ed Cost
Activity	Unit	December 12th	January 15th	December 12th	January 30th	Labor Hours	Material	Labor	Cost/Unit	# of Unit	Labor Hours	Total Cost	December 12th	January 30th	December 12th	January 30th	December	January	December	January
East Elevation/North Pod: Brick Veneer	м	50.00%	100.00%	100.00%	100.00%	26.667	470.000	880.000	1350.000	34.425	918.011	\$46.473.75	459.01	688.51	918.01	918.01	\$23,236,88	\$46.473.75	\$46.473.75	\$46,473.75
East Elevation/North Pod: Curtain Wall East Elevation/North Pod: Curtain Wall Trim &	S.F.	0.00%	100.00%	0.00%	100.00%	0.164	30.000	6.100	36.100	2604.000	427.056	\$94,004.40	0.00	427.06	0.00	427.06	\$0.00	\$94,004.40	\$0.00	\$94,004.40
Seal	S.F.	0.00%	75.00%	0.00%	100.00%	0.168	11.550	5.750	17.300	2604.000	437.472	\$45,049.20	0.00	437.47	0.00	437.47	\$0.00	\$33,786.90	\$0.00	\$45,049.20
East Elevation/North Pod: Erect Staging	C.S.F.	100.00%	100.00%	100.00%	100.00%	0.189	25.500	35.500	61.000	51.000	9.639	\$3,111.00	9.64	9.64	9.64	9.64	\$3,111.00	\$3,111.00	\$3,111.00	\$3,111.00
East Elevation/North Pod: Punch Windows East Elevation/North Pod: Spray	Ea	0.00%	100.00%	0.00%	100.00%	1.600	194.000	64.000	258.000	16.000	25.600	\$4,128.00	0.00	20.48	0.00	25.60	\$0.00	\$4,128.00	\$0.00	\$4,128.00
Foam/Window Membrane 50% Fast Elevation/North Pod: Veneer Ties	S.F.	100.00%	100.00%	100.00%	100.00%	0.012	0.230	0.340	0.570	5100.000 136.170	61.200 103.762	\$2,907.00 \$16.340.40	61.20 103.76	61.20 103.76	61.20 103.76	61.20 103.76	\$2,907.00 \$16,340.40	\$2,907.00 \$16,340.40	\$2,907.00 \$16.340.40	\$2,907.00 \$16.340.40
East Elevation/North Pod: Veneer Ties East Elevation/North Pod: Washdown & Staging Removal	S.F.	0.00%	100.00%	60.00%	100.00%	0.023	0.060	0.640	0.700	5100.000	103.762	\$16,340.40	0.00	103.76	70.38	103.76	\$16,340.40	\$16,340.40	\$16,340.40	\$16,340.40
East Elevation/South Pod: Brick Veneer	м	50.00%	100.00%	16.67%	100.00%	26.667	470.000	880.000	1350.000	34.425	918.011	\$46,473.75	459.01	918.01	153.00	918.01	\$23,236.88	\$46,473.75	\$7,745.63	\$46,473.75
East Elevation/South Pod: Curtain Wall	S.F.	0.00%	95.00%	0.00%	55.00%	0.164	30.000	6.100	36.100	2604.000	427.056	\$94,004.40	0.00	405.70	0.00	234.88	\$0.00	\$89,304.18	\$0.00	\$51,702.42
East Elevation/South Pod: Curtain Wall Trim & Seal	S.F.	0.00%	50.00%	0.00%	0.00%	0.168	11.550	5.750	17.300	2604.000	437.472	\$45,049.20	0.00	218.74	0.00	0.00	\$0.00	\$22,524.60	\$0.00	\$0.00
East Elevation/South Pod: Erect Staging	C.S.F.	100.00%	100.00%	100.00%	100.00%	0.189	25.500	35.500	61.000	51.000	9.639	\$3,111.00	9.64	9.64	9.64	9.64	\$3,111.00	\$3,111.00	\$3,111.00	\$3,111.00
East Elevation/South Pod: Punch Windows	Ea	0.00%	100.00%	0.00%	100.00%	1.600	194.000	64.000	258.000	16.000	25.600	\$4,128.00	0.00	25.60	0.00	25.60	\$0.00	\$4,128.00	\$0.00	\$4,128.00
East Elevation/South Pod: Spray Foam/Window Membrane 50%	S.F.	100.00%	100.00%	100.00%	100.00%	0.012	0.230	0.340	0.570	5100.000	61.200	\$2,907.00	61.20	61.20	61.20	61.20	\$2,907.00	\$2,907.00	\$2,907.00	\$2,907.00
East Elevation/South Pod: Veneer Ties	с	90.00%	100.00%	100.00%	100.00%	0.762	92.000	28.000	120.000	13.617	10.376	\$1,634.04	9.34	10.38	10.38	10.38	\$1,470.64	\$1,634.04	\$1,634.04	\$1,634.04
East Elevation/South Pod: Washdown & Staging Removal	S.F.	0.00%	100.00%	0.00%	100.00%	0.023	0.060	0.640	0.700	5100.000	117.300	\$3,570.00	0.00	117.30	0.00	117.30	\$0.00	\$3,570.00	\$0.00	\$3,570.00
East Elevation: Exterior Sheathing	S.F.	100.00%	100.00%	100.00%	100.00%	0.013	0.960	0.470	1.430	10200.000	132.600	\$14,586.00	132.60	132.60	132.60	132.60	\$14,586.00	\$14,586.00	\$14,586.00	\$14,586.00
East Elevation: Install Base Pre-cast	S.F.	100.00%	100.00%	100.00%	100.00%	0.125	12.400	4.890	17.290	5437.000	679.625	\$94,005.73	679.63	679.63	679.63	679.63	\$94,005.73	\$94,005.73	\$94,005.73	\$94,005.73
North Elevation/North Pod: Brick Veneer	м	66.00%	75.00%	100.00%	100.00%	26.667	470.000	880.000	1350.000	15.390	410.405	\$20,776.50	270.87	307.80	410.41	410.41	\$13,712.49	\$15,582.38	\$20,776.50	\$20,776.50
North Elevation/North Pod: Curtain Wall North Elevation/North Pod: Curtain Wall Trim	S.F. S.F.	40.00%	100.00%	0.00%	100.00%	0.164	30.000 11.550	6.100 5.750	36.100 17.300	3570.000	585.480 599.760	\$128,877.00 \$61,761.00	234.19	585.48	0.00	585.48	\$51,550.80 \$0.00	\$128,877.00 \$61,761.00	\$0.00	\$128,877.00 \$61,761.00
& Seal	5.F. C.S.F.	66.00%	100.00%	100.00%	100.00%	0.188	25.500	35,500	61.000	22.800	4,309	\$1,390.80	2.84	4.31	4.31	4.31	\$917.93	\$1,390.80	\$1,390.80	
North Elevation/North Pod: Erect Staging North Elevation/North Pod: Punch Windows	Ea	0.00%	80.00%	80.00%	100.00%	1.600	194.000	64.000	258.000	22.800	4.509	\$1,390.80	2.84	25.60	25.60	4.51	\$917.93	\$4,128.00	\$4,128.00	\$1,390.80 \$5,160.00
North Elevation/North Pod: Putch Windows North Elevation/North Pod: Spray foam/Window Membrane	S.F.	100.00%	100.00%	100.00%	100.00%	0.012	0.230	0.340	0.570	2280.000	27.360	\$1,299.60	27.36	25.60	23.80	27.36	\$1,299.60	\$1,299.60	\$1,299.60	\$1,299.60
North Elevation/North Pod: Veneer Ties North Elevation/North Pod: Washdown &	с	100.00%	100.00%	100.00%	100.00%	0.762	92.000	28.000	120.000	60.876	46.388	\$7,305.12	46.39	46.39	46.39	46.39	\$7,305.12	\$7,305.12	\$7,305.12	\$7,305.12
Staging Removal	S.F.	66.00%	100.00%	100.00%	100.00%	0.023	0.060	0.640	0.700	2280.000	52.440	\$1,596.00	34.61	52.44	52.44	52.44	\$1,053.36	\$1,596.00	\$1,596.00	\$1,596.00
North Elevation: Exterior Sheathing	S.F.	100.00%	100.00%	100.00%	100.00%	0.013	0.960	0.470	1.430	2280.000	29.640	\$3,260.40	29.64	29.64	29.64	29.64	\$3,260.40	\$3,260.40	\$3,260.40	\$3,260.40
North Elevation: Install Base Pre-cast	S.F.	100.00%	100.00%	100.00%	100.00%	0.125	12.400	4.890	17.290	1960.000	245.000	\$33,888.40	245.00	245.00	245.00	245.00	\$33,888.40	\$33,888.40	\$33,888.40	\$33,888.40
South Elevation/South Pod: Brick Veneer	м	0.00%	100.00%	100.00%	100.00%	26.667	470.000	880.000	1350.000	15.390	410.405	\$20,776.50	0.00	410.41	410.41	410.41	\$0.00	\$20,776.50	\$20,776.50	\$20,776.50
South Elevation/South Pod: Curtain Wall South Elevation/South Pod: Curtain Wall Trim	S.F.	0.00%	50.00%	0.00%	100.00%	0.164	30.000	6.100	36.100	3570.000	585.480	\$128,877.00	0.00	292.74	0.00	585.48	\$0.00	\$64,438.50	\$0.00	\$128,877.00
& Seal	S.F.	0.00%	0.00%	0.00%	80.00%	0.168	11.550	5.750	17.300	6570.000	1103.760	\$113,661.00	0.00	0.00	0.00	883.01	\$0.00	\$0.00	\$0.00	\$90,928.80
South Elevation/South Pod: Erect Staging South Elevation/South Pod: Punch Windows	C.S.F. Ea	0.00%	100.00% 0.00%	100.00% 0.00%	100.00% 100.00%	0.189	25.500 194.000	35.500 64.000	61.000 258.000	22.800 20.000	4.309 32.000	\$1,390.80 \$5,160.00	0.00	4.31 0.00	4.31 0.00	4.31 32.00	\$0.00 \$0.00	\$1,390.80 \$0.00	\$1,390.80 \$0.00	\$1,390.80 \$5,160.00
South Elevation/South Pod: Punch Windows South Elevation/South Pod: Spray foam/Window Membrane	Ea S.F.	50.00%	100.00%	100.00%	100.00%	0.012	0.230	0.340	0.570	2280.000	27,360	\$1,299.60	13.68	27.36	27.36	27.36	\$0.00	\$0.00	\$0.00	\$1,299.60
South Elevation/South Pod: Veneer Ties	с	100.00%	100.00%	100.00%	100.00%	0.762	92.000	28.000	120.000	60.876	46.388	\$7,305.12	46.39	46.39	46.39	46.39	\$7,305.12	\$7,305.12	\$7,305.12	\$7,305.12
South Elevation/South Pod: Washdown & Staging Removal	S.F.	0.00%	100.00%	0.00%	100.00%	0.023	0.060	0.640	0.700	2280.000	52.440	\$1,596.00	0.00	52.44	0.00	52.44	\$0.00	\$1,596.00	\$0.00	\$1,596.00
West Elevation: Exterior Sheathing	S.F.	100.00%	100.00%	100.00%	100.00%	0.013	0.960	0.470	1.430	10200.000	132.600	\$14,586.00	132.60	132.60	132.60	132.60	\$14,586.00	\$14,586.00	\$14,586.00	\$14,586.00
South Elevation: Install Base Pre-cast	S.F.	100.00%	100.00%	100.00%	100.00%	0.125	12.400	4.890	17.290	1960.000	245.000	\$33,888.40	245.00	245.00	245.00	245.00	\$33,888.40	\$33,888.40	\$33,888.40	\$33,888.40
South Elevation: Exterior Sheathing	S.F.	100.00%	100.00%	100.00%	100.00%	0.013	0.960	0.470	1.430	2280.000	29.640	\$3,260.40	29.64	29.64	29.64	29.64	\$3,260.40	\$3,260.40	\$3,260.40	\$3,260.40
West Elevation/North Pod: Brick Veneer	м	0.00%	33.00%	66.67%	100.00%	26.667	470.000	880.000	1350.000	34.425	918.011	\$46,473.75	0.00	302.94	612.01	918.01	\$0.00	\$15,336.34	\$30,982.50	\$46,473.75
West Elevation/North Pod: Curtain Wall West Elevation/North Pod: Curtain Wall Trim	S.F.	0.00%	75.00%	0.00%	100.00%	0.164	30.000	6.100	36.100	2604.000	427.056	\$94,004.40	0.00	320.29	0.00	427.06	\$0.00	\$70,503.30	\$0.00	\$94,004.40
& Seal West Elevation/North Pod: Erect Staging 50%	S.F. C.S.F.	0.00%	0.00%	0.00%	25.00% 100.00%	0.168	11.550 25.500	5.750 35.500	17.300 61.000	2604.000 77.040	437.472	\$45,049.20 \$4.699.44	0.00	0.00	0.00	109.37 14.56	\$0.00 \$1.879.78	\$0.00 \$4,229,50	\$0.00 \$4,699,44	\$11,262.30 \$4,699.44
West Elevation/North Pod: Punch Windows	Ea	100.00%	100.00%	0.00%	100.00%	1.600	194.000	64.000	258.000	16.000	25,600	\$4,128.00	25.60	25.60	0.00	25.60	\$4,128.00	\$4,229.50	\$4,699.44	\$4,099.44
West Elevation/North Pod: Spray Foam/Window Membrane 50%	S.F.	0.00%	100.00%	100.00%	100.00%	0.012	0.230	0.340	0.570	51.000	0.612	\$4,128.00	0.00	0.61	0.61	0.61	\$4,128.00	\$4,128.00	\$29.07	\$29.07
West Elevation/North Pod: Veneer Ties West Elevation/North Pod: Washdown &	с	5.00%	100.00%	100.00%	100.00%	0.762	92.000	28.000	120.000	136.170	103.762	\$16,340.40	5.19	103.76	103.76	103.76	\$817.02	\$16,340.40	\$16,340.40	\$16,340.40
Staging Removal	S.F.	0.00%	0.00%	0.00%	100.00%	0.020	0.060	0.640	0.700	5100.000	102.000	\$3,570.00	0.00	0.00	0.00	102.00	\$0.00	\$0.00	\$0.00	\$3,570.00
West Elevation/South Pod: Brick Veneer	м	0.00%	85.00%	0.00%	100.00%	26.667	470.000	880.000	1350.000	34.425	918.011	\$46,473.75	0.00	780.31	0.00	918.01	\$0.00	\$39,502.69	\$0.00	\$46,473.75
West Elevation/South Pod: Curtain Wall West Elevation/South Pod: Curtain Wall Trim	S.F.	0.00%	40.00%	0.00%	10.00%	0.164	30.000	6.100	36.100	2604.000	427.056	\$94,004.40	0.00	170.82	0.00	42.71	\$0.00	\$37,601.76	\$0.00	\$9,400.44
& Seal	S.F.	0.00%	0.00%	0.00%	0.00%	0.168	11.550	5.750	17.300	2604.000	437.472	\$45,049.20	0.00	0.00 9.64	0.00	0.00	\$0.00	\$0.00	\$0.00	\$0.00
West Elevation/South Pod: Erect Staging 50% West Elevation/South Pod: Punch Windows	C.S.F. Ea	0.00%	100.00%	100.00% 0.00%	40.00%	0.189	25.500 194.000	35.500 64.000	61.000 258.000	51.000 16.000	9.639 25.600	\$3,111.00 \$4.128.00	0.00	9.64 25.60	9.64 0.00	9.64 10.24	\$0.00 \$0.00	\$3,111.00 \$4,128.00	\$3,111.00 \$0.00	\$3,111.00 \$1.651.20
West Elevation/South Pod: Punch Windows West Elevation/South Pod: Spray Foam/Window Membrane 50%	Ea S.F.	0.00%	100.00%	100.00%	40.00%	0.012	0.230	0.340	0.570	5100.000	61.200	\$4,128.00	0.00	61.20	61.20	61.20	\$0.00	\$2,907.00	\$0.00	\$1,651.20
West Elevation/South Pod: Veneer Ties	с	90.00%	100.00%	100.00%	100.00%	0.762	92.000	28.000	120.000	136.170	103.762	\$16,340.40	93.39	103.76	103.76	103.76	\$14,706.36	\$16,340.40	\$16,340.40	\$16,340.40

West Elevation/South Pod: Washdown & Staging Removal	S.F.	0.00%	0.00%	0.00%	100.00%	0.023	0.060	0.640	0.700	5100.000	117.300	\$3,570.00	0.00	0.00	0.00	117.30	\$0.00	\$0.00	\$0.00	\$3,570.00
West Elevation: Install Base Pre-cast	S.F.	100.00%	100.00%	100.00%	100.00%	0.125	12.400	4.890	17.290	5437.000	679.625	\$94,005.73	679.63	679.63	679.63	679.63	\$94,005.73	\$94,005.73	\$94,005.73	\$94,005.73
Total		42.05%	84.51%	58.61%	92.91%						14429.822	\$1,646,052.25	4152.85	10206.14	5531.45	12414.14	\$473,127.22	\$1,202,358.95	\$519,530.73	\$1,370,052.01

Appendix H: Activity Information from RS Means Cost Data 2006

			Labor	Materi		Equipme							
Activity	Unit	Crew	Hours	al	Labor	nt	Total			Α	dd-Ons		
		5.0	26.667	470.00	880.00	0.000	1350.0						
East Elevation/North Pod: Brick Veneer	М	D-8	26.667	0	0	0.000	00						
East Elevation/North Pod: Curtain Wall	S.F.	H-1 2	0.164	30.000	6.100	0.000	36.100						
East Elevation/North Pod: Curtain Wall Trim & Seal	S.F. C.S.	Glaz 3	0.168	11.550	5.750	0.000	17.300						
East Elevation/North Pod: Erect Staging 50%	F.	Carp	0.189	25.500	35.500	0.000	61.000						
East Elevation/North Pod: Punch Windows	Ea	2 Sswk	1.600	194.00 0	64.000	0.000	258.00 0						
East Elevation/North Pod: Spray Foam/Windows	Ed	SSWK	1.600		64.000	0.000	0						
Membrane 50%	S.F.	G-2	0.012	0.230	0.340	0.060	0.630 120.00						
East Elevation/North Pod: Veneer Ties East Elevation/North Pod: Washdown & Staging	С	1 Bric	0.762	92.000	28.000	0.000	0						
Removal	S.F.	D-1	0.020	0.060 470.00	0.640 880.00	0.000	0.700 1350.0						
East Elevation/South Pod: Brick Veneer	М	D-8	26.667	470.00 0	00.008 0	0.000	1350.0						
East Elevation/South Pod: Curtain Wall	S.F.	Ы-8 Н-1	0.164	30.000	6.100	0.000	36.100						
		2	0.104	50.000	0.100	0.000	50.100						
East Elevation/South Pod: Curtain Wall Trim & Seal	S.F. C.S.	Glaz 3	0.168	11.550	5.750	0.000	17.300						
East Elevation/South Pod: Erect Staging 50%	F.	Carp 2	0.189	25.500 194.00	35.500	0.000	61.000 258.00						
East Elevation/South Pod: Punch Windows East Elevation/South Pod: Spray Foam/Window	Ea	Sswk	1.600	0	64.000	0.000	0						
Membrane 50%	S.F.	G-2	0.012	0.230	0.340	0.060	0.630 120.00						
East Elevation/South Pod: Veneer Ties East Elevation/South Pod: Washdown & Staging	С	1 Bric	0.762	92.000	28.000	0.000	0		4	400.00	S.F./	0.002	Labor
Removal	S.F.	D-1 2	0.023	0.060	0.640	0.000	0.700	REMOV AL	4 Carp	400.00 0	S.F./ Hr	0.002	Hours/S.F.
East Elevation: Exterior Sheathing	S.F.	Carp	0.013	0.960	0.470	0.000	1.430						
East Elevation: Install Base Pre-cast	S.F.	C-11	0.125	12.400	4.890	2.670	19.960						
				470.00	880.00		1350.0						
North Elevation/North Pod: Brick Veneer	М	D-8	26.667	0	0	0.000	00						
North Elevation/North Pod: Curtain Wall	S.F.	H-1 2	0.164	30.000	6.100	0.000	36.100						
North Elevation/North Pod: Curtain Wall Trim & Seal	S.F. C.S.	Glaz 3	0.168	11.550	5.750	0.000	17.300						
North Elevation/North Pod: Erect Staging	F.	Carp	0.189	25.500	35.500	0.000	61.000						
North Elevation/North Pod: Punch Windows	Ea	2	1.600	194.00	64.000	0.000	258.00						

		Sswk		0			0						
North Elevation/North Pod: Spray foam/Window Membrane	S.F.	G-2	0.012	0.230	0.340	0.060	0.630 120.00						
North Elevation/North Pod: Veneer Ties North Elevation/North Pod: Washdown & Staging	С	1 Bric	0.762	92.000	28.000	0.000	0	REMOV	4	400.00	S.F./	0.002	Labor
Removal	S.F.	D-1 2	0.020	0.060	0.640	0.000	0.700	AL	Carp	0	Hr	5	Hours/S.F.
North Elevation: Exterior Sheathing	S.F.	Carp	0.013	0.960	0.470	0.000	1.430						
North Elevation: Install Base Pre-cast	S.F.	C-11	0.125	12.400 470.00	4.890 880.00	2.670	19.960 1350.0						
South Elevation/South Pod: Brick Veneer	М	D-8	26.667	0	0	0.000	00						
South Elevation/South Pod: Curtain Wall	S.F.	H-1 2	0.164	30.000	6.100	0.000	36.100						
South Elevation/South Pod: Curtain Wall Trim & Seal	S.F. C.S.	Glaz 3	0.168	11.550	5.750	0.000	17.300						
South Elevation/South Pod: Erect Staging	F.	Carp 2	0.189	25.500 194.00	35.500	0.000	61.000 258.00						
South Elevation/South Pod: Punch Windows South Elevation/South Pod: Spray foam/Window	Ea	Sswk	1.600	0	64.000	0.000	0						
Membrane	S.F.	G-2	0.012	0.230	0.340	0.060	0.630 120.00						
South Elevation/South Pod: Veneer Ties South Elevation/South Pod: Washdown & Staging	С	1 Bric	0.762	92.000	28.000	0.000	0	REMOV	4	400.00	S.F./	0.002	Labor
Removal	S.F.	D-1 2	0.020	0.060	0.640	0.000	0.700	AL	Carp	0	Hr	5	Hours/S.F.
South Elevation: Exterior Sheathing	S.F.	Carp	0.013	0.960	0.470	0.000	1.430						
South Elevation: Install Base Pre-cast	S.F.	C-11 2	0.125	12.400	4.890	2.670	19.960						
South Pod: Exterior Sheathing	S.F.	Carp	0.013	0.960 470.00	0.470 880.00	0.000	1.430 1350.0						
West Elevation/North Pod: Brick Veneer	М	D-8	26.667	0	0	0.000	00						
West Elevation/North Pod: Curtain Wall	S.F.	H-1 2	0.164	30.000	6.100	0.000	36.100						
West Elevation/North Pod: Curtain Wall Trim & Seal	S.F. C.S.	Glaz 3	0.168	11.550	5.750	0.000	17.300						
West Elevation/North Pod: Erect Staging 50%	F.	Carp 2	0.189	25.500 194.00	35.500	0.000	61.000 258.00						
West Elevation/North Pod: Punch Windows West Elevation/North Pod: Spray Foam/Window	Ea	Sswk	1.600	0	64.000	0.000	0						
Membrane 50%	S.F.	G-2	0.012	0.230	0.340	0.060	0.630 120.00						
West Elevation/North Pod: Veneer Ties West Elevation/North Pod: Washdown & Staging	С	1 Bric	0.762	92.000	28.000	0.000	0	REMOV	4	400.00	S.F./	0.002	Labor
Removal	S.F.	D-1	0.020	0.060 470.00	0.640 880.00	0.000	0.700 1350.0	AL	Carp	0	Hr	5	Hours/S.F.
West Elevation/South Pod: Brick Veneer	Μ	D-8	26.667	0	0	0.000	00						

West Elevation/South Pod: Curtain Wall	S.F.	H-1 2	0.164	30.000	6.100	0.000	36.100						
West Elevation/South Pod: Curtain Wall Trim & Seal	S.F. C.S.	Glaz 3	0.168	11.550	5.750	0.000	17.300						
West Elevation/South Pod: Erect Staging 50%	F.	Carp 2	0.189	25.500 194.00	35.500	0.000	61.000 258.00						
West Elevation/South Pod: Punch Windows West Elevation/South Pod: Spray Foam/Window	Ea	Sswk	1.600	0	64.000	0.000	0						
Membrane 50%	S.F.	G-2	0.012	0.230	0.340	0.060	0.630 120.00						
West Elevation/South Pod: Veneer Ties West Elevation/South Pod: Washdown & Staging	С	1 Bric	0.762	92.000	28.000	0.000	0	REMOV	4	400.00	S.F./	0.002	Labor
Removal	S.F.	D-1	0.020	0.060	0.640	0.000	0.700	AL	Carp	0	Hr	5	Hours/S.F.
West Elevation: Install Base Pre-cast	S.F.	C-11	0.125	12.400	4.890	2.670	19.960						
West Elevation: Install Base Pre-cast	S.F.	C-11	0.125	12.400	4.890	2.670	19.960						

Ap	pendix	I: Tota	l bv Floo	or in Squa	re Feet
P	penam	II IOCA		n moquu	

Floor	Walls Height	Linear Ft.	Sq. Ft. of Wall	Linear Ft. Precast	Sq. Ft. Precast	% Precast	Linear Ft. Brick	Sq. Ft. Brick	% Brick of Total	Linear Ft. Curtain Wall	Sq. Ft. CW	% CW of Total	Total %
1	13	1042	13546	1042	13546	100.00 %	0	0	0.00%	0	0	0.00%	100.00 %
2	10	1042	10420	0	0	0.00%	624	6240	59.88%	418	4180	40.12%	100.00 %
3	10	1042	10420	0	0	0.00%	624	6240	59.88%	418	4180	40.12%	100.00 %
4	10	1042	10420	0	0	0.00%	624	6240	59.88%	418	4180	40.12%	100.00 %
5	10	1042	10420	0	0	0.00%	624	6240	59.88%	418	4180	40.12%	100.00 %
Roof	2	1042	2084	624	1248	59.88%	0	0	0.00%	418	836	40.12%	100.00 %
Total			57310		14794	25.81%		24960	43.55%		17556	30.63%	100.00 %

Appendix J: Total Area by Activity in Square Feet

Area	Wall Type	Total Height	Linea r Ft.	Area (Ft^2)	Precast Elevation	Wall Height	Linear Ft.	Area (ft^2)	True Area(Incl. Top pieces)
North Elevation/North Pod	Brick	40	57	2280	North	13	142	1846	1960
South Elevation/South Pod	Brick	40	57	2280	East	13	379	4927	5437
East Elevation/North Pod	Brick	40	127.5	5100	South	13	142	1846	1960
East Elevation/South Pod	Brick	40	127.5	5100	West	13	379	4927	5437
West Elevation/North Pod	Brick	40	127.5	5100	North	2	57	114	
West Elevation/South Pod	Brick	40	127.5	5100	East	2	255	510	
North Elevation/North Pod	Curtain Wall	42	85	3570	South	2	57	114	
South Elevation/South Pod	Curtain Wall	42	85	3570	West	2	255	510	
East Elevation/North Pod	Curtain Wall	42	62	2604					
East Elevation/South Pod	Curtain Wall	42	62	2604					
West Elevation/North Pod	Curtain Wall	42	62	2604					
West Elevation/South Pod	Curtain Wall	42	62	2604					
Totals			1042	42516			1666	14794	

***Only Floors 2-5

Appendix K: Table for CPI vs. SPI

 SPI
 CPI

 0.73
 1

 0.96
 1

Appendix L: Earned Value Indices Spreadsheet

BAC	BCWP	CPI	ETC	EAC
\$1,608,858.61	\$1,241,832.55	1	367026.1	\$1,608,858.61

Appendix M: Microsoft Project Screenshot December 12th, 2007

Mic	rosoft Project - MQPWALLSDec12th.mpp												
🕹 Eile	e Edit <u>V</u> iew Insert F <u>o</u> rmat <u>T</u> ools <u>P</u> roject <u>C</u> ollaborate <u>W</u> indow <u>H</u> elp												
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🔄 Ta	asks • Resources • Track • Report • 😴 👯 🖓 Show all items	 Show data 	a columns only	. 3	I								
	Exterior Walls												
	Task Name	Work	Actual	Baseline Cost	PlannedWork	ACWP	BCWS	BCWP	SV	CPI	SPI 9	% Complete	EAC
1	- Exterior Walls	14,201.52 hrs	4,152.88 hrs	\$1,608,858.61	14090.22 hrs	\$391,383.06	\$535,183.52	\$391,470.83	(\$143,712.69)	1	0.73	33%	\$1,608,497.87
2	 All Building Elevations 	2,173.77 hrs	2,173.77 hrs	\$291,481.06	2173.77 hrs	\$291,481.06	\$291,481.06	\$291,481.06	\$0.00	1	1	90%	\$291,481.06
3	 Architectural Pre-cast 	1,849.27 hrs	1,849.27 hrs	\$255,788.26	1849.27 hrs	\$255,788.26	\$255,788.26	\$255,788.26	\$0.00	1	1	85%	\$255,788.20
7	East Elevation: Install Base Pre-cast	679.63 hrs	679.63 hrs	\$94,005.73	679.63 hrs	\$94,005.73	\$94,005.73	\$94,005.73	\$0.00	1	1	100%	\$94,005.73
4	Level-1: Install Tube for Pre-cast Support	0 hrs	0 hrs	\$0.00	0 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$0.0
5	Level-1:Spray Fire Proof (@precast)	0 hrs	0 hrs	\$0.00	0 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$0.00
6	North Elevation: Install Base Pre-cast	245 hrs	245 hrs	\$33,888.40	245 hrs	\$33,888.40	\$33,888.40	\$33,888.40	\$0.00	1	1	100%	\$33,888.40
8	South Elevation: Install Base Pre-cast	245 hrs	245 hrs	\$33,888.40	245 hrs	\$33,888.40	\$33,888.40	\$33,888.40	\$0.00	1	1	100%	\$33,888.4
9	West Elevation: Install Base Pre-cast	679.63 hrs	679.63 hrs	\$94,005.73	679.63 hrs	\$94,005.73	\$94,005.73	\$94,005.73	\$0.00	1	1	100%	\$94,005.73
10	- Exterior Sheathing	324.5 hrs	324.5 hrs	\$35,692.80	324.5 hrs	\$35,692.80	\$35,692.80	\$35,692.80	\$0.00	1	1	99%	\$35,692.80
12	East Elevation: Exterior Sheathing	132.6 hrs	132.6 hrs	\$14,586.00	132.6 hrs	\$14,586.00	\$14,586.00	\$14,586.00	\$0.00	1	1	100%	\$14,586.0
16	North "Tight" for Elec. Roughin & Insulation	0 hrs	0 hrs	\$0.00	0 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$0.00
11	North Elevation: Exterior Sheathing	29.65 hrs	29.65 hrs	\$3,260.40	29.65 hrs	\$3,260.40	\$3,260.40	\$3,260.40	\$0.00	1	1	100%	\$3,260.40
17	South "Tight" for Elec. Roughin & Insulation	0 hrs	0 hrs	\$0.00	0 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$0.0
14	South Elevation: Exterior Sheathing	29.65 hrs	29.65 hrs	\$3,260.40	29.65 hrs	\$3,260.40	\$3,260.40	\$3,260.40	\$0.00	1	1	100%	\$3,260.40
15	Start Exterior Sheathing (4th 100% & 5th 50% fr)	0 hrs	0 hrs	\$0.00	0 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$0.00
13	West Elevation: Exterior Sheathing	132.6 hrs	132.6 hrs	\$14,586.00	132.6 hrs	\$14,586.00	\$14,586.00	\$14,586.00	\$0.00	1	1	100%	\$14,586.00
18	- North Pod	6,069.53 hrs	1,286.47 hrs	\$658,044.03	5958.25 hrs	\$69,752.08	\$184,834.84	\$69,838.72	(\$114,996.12)	1	0.38	27%	\$657,227.67
28	- East Facade	2,100.03 hrs	633.6 hrs	\$215,583.75	2100.03 hrs	\$45,595.28	\$55,922.78	\$45,595.28	(\$10,327.50)	1	0.82	28%	\$215,583.75
32	East Elevation/North Pod: Brick Veneer	918.02 hrs	459 hrs	\$46,473.75	918.02 hrs	\$23,236.88	\$33,564.38	\$23,236.88	(\$10,327.50)	1	0.69	50%	\$46,473.75
35	East Elevation/North Pod: Curtain Wall	427.07 hrs	0 hrs	\$94,004.40	427.07 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$94,004.4
36	East Elevation/North Pod: Curtain Wall Trim & Seal	437.47 hrs	0 hrs	\$45,049.20	437.47 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$45,049.20
31	East Elevation/North Pod: Erect Staging 50%	9.63 hrs	9.63 hrs	\$3,111.00	9.63 hrs	\$3,111.00	\$3,111.00	\$3,111.00	\$0.00	1	1	100%	\$3,111.0
34	East Elevation/North Pod: Punch Windows	25.6 hrs	0 hrs	\$4,128.00	25.6 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$4,128.00
30	East Elevation/North Pod: Spray Foam/Window Membrane 50%	61.2 hrs	61.2 hrs	\$2,907.00	61.2 hrs	\$2,907.00	\$2,907.00	\$2,907.00	\$0.00	1	1	100%	\$2,907.00
29	East Elevation/North Pod: Veneer Ties	103.77 hrs	103.77 hrs	\$16,340.40	103.77 hrs	\$16,340.40	\$16,340.40	\$16,340.40	\$0.00	1	1	100%	\$16,340.40
33	East Elevation/North Pod: Washdown & Staging Removal	117.3 hrs	0 hrs	\$3,570.00	117.3 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$3,570.00
19	- North Facade	1,869.45 hrs	616.25 hrs	\$228,166.02	1758.13 hrs	\$21,501.51	\$36,981.60	\$21,572.54	(\$15,409.05)	1	0.58	38%	\$227,414.68
23	North Elevation/North Pod: Brick Veneer	459.02 hrs	270.87 hrs	\$20,776.50	410.4 hrs	\$11,011.55	\$20,776.50	\$11,086.70	(\$9,689.80)	1.01	0.53	53%	\$20,635.66
25	North Elevation/North Pod: Curtain Wall	585.48 hrs	234.2 hrs	\$128,877.00	585.48 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	40%	\$128,877.00
27	North Elevation/North Pod: Curtain Wall Trim & Seal	599.77 hrs	0 hrs	\$61,761.00	599.77 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$61,761.00
22	North Elevation/North Pod: Erect Staging	9.63 hrs	2.83 hrs	\$1,390.80	4.32 hrs	\$917.93	\$1,390.80	\$914.35	(\$476.45)	1	0.66	66%	\$1,396.24
26	North Elevation/North Pod: Punch Windows	32 hrs	0 hrs	\$5,160.00	32 hrs	\$0.00	\$4,613.58	\$0.00	(\$4,613.58)		0	0%	\$5,160.00
21	North Elevation/North Pod: Spray foam/Window Membrane	27.37 hrs	27.37 hrs	\$1,299.60	27.37 hrs	\$1,286.60	\$1,299.60	\$1,286.06	(\$13.54)		0.99	99%	\$1,300.15
20	North Elevation/North Pod: Veneer Ties	103.77 hrs	46.38 hrs	\$7,305.12	46.38 hrs	\$7,232.07	\$7,305.12	\$7,232.07	(\$73.05)		0.99	99%	\$7,305.12
24	North Elevation/North Pod: Washdown & Staging Removal	52.43 hrs	34.62 hrs	\$1,596.00	52.43 hrs	\$1,053.36	\$1,596.00	\$1,053.36	(\$542.64)	1	0.66	66%	\$1,596.0
37	- West Facade	2,100.03 hrs	36.62 hrs	\$214,294.26	2100.03 hrs	\$2,655.30	\$91,930.47	\$2,670.90	(\$89,259.56)		0.03	17%	\$213,042.31
46	North Pod Building "Tight" for Boarding	0 hrs	0 hrs	\$46,473.75	0 hrs	\$0.00	\$0.00	\$0.00	\$0.00		0	0%	\$46,473.7
41	West Elevation/North Pod: Brick Veneer	918.02 hrs	0 hrs	\$94,004.40	918.02 hrs	\$0.00	\$67,892.07	\$0.00			0	0%	\$94,004.4
	West Elevation/North Pod: Curtain Wall	427.07 hrs	0 hrs	\$45,049.20	427.07 hrs	\$0.00	\$0.00	\$0.00	\$0.00		0	0%	\$45,049.20
44	West Elevation/North Fou. Cultain waii												

	EXTERIOR YVDIG												
Т	Fask Name	Work	Actual	Baseline Cost	PlannedWork	ACWP	BCWS	BCWP	SV	CPI	SPI	% Complete	EAC
45	West Elevation/North Pod: Curtain Wall Trim & Seal	437.47 hrs	0 hrs	\$4,699.44	437.47 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$4,699.44
40	West Elevation/North Pod: Erect Staging 50%	9.63 hrs	5.82 hrs	\$4,128.00	9.63 hrs	\$2,476.80	\$4,128.00	\$2,492.28	(\$1,635.72)	1.01	0.6	60%	\$4,102.36
43	West Elevation/North Pod: Punch Windows	25.6 hrs	25.6 hrs	\$29.07	25.6 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	100%	\$29.07
39	West Elevation/North Pod: Spray Foam/Window Membrane 50%	61.2 hrs	0 hrs	\$16,340.40	61.2 hrs	\$0.00	\$16,340.40	\$0.00	(\$16,340.40)	0	0	0%	\$16,340.40
38	West Elevation/North Pod: Veneer Ties	103.77 hrs	5.18 hrs	\$3,570.00	103.77 hrs	\$178.50	\$3,570.00	\$178.62	(\$3,391.38)	1	0.05	5%	\$3,567.52
42	West Elevation/North Pod: Washdown & Staging Removal	117.3 hrs	0 hrs	\$0.00	117.3 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$0.00
47	- South Pod	5,958.23 hrs	692.65 hrs	\$659,333.52	5958.28 hrs	\$30,149.92	\$58,867.62	\$30,151.05	(\$28,716.57)	1	0.51	12%	\$659,308.71
48	- East Facade	2,100.03 hrs	539.18 hrs	\$215,583.75	2100.03 hrs	\$7,488.64	\$22,358.40	\$7,488.64	(\$14,869.76)	1	0.33	20%	\$215,583.75
52	East Elevation/South Pod: Brick Veneer	918.02 hrs	459 hrs	\$46,473.75	918.02 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	50%	\$46,473.75
55	East Elevation/South Pod: Curtain Wall	427.07 hrs	0 hrs	\$94,004.40	427.07 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$94,004.40
56	East Elevation/South Pod: Curtain Wall Trim & Seal	437.47 hrs	0 hrs	\$45,049.20	437.47 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$45,049.20
51	East Elevation/South Pod: Erect Staging 50%	9.63 hrs	9.63 hrs	\$3,111.00	9.63 hrs	\$3,111.00	\$3,111.00	\$3,111.00	\$0.00	1	1	100%	\$3,111.00
54	East Elevation/South Pod: Punch Windows	25.6 hrs	0 hrs	\$4,128.00	25.6 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$4,128.00
50	East Elevation/South Pod: Spray Foam/Window Membrane 50%	61.2 hrs	61.2 hrs	\$2,907.00	61.2 hrs	\$2,907.00	\$2,907.00	\$2,907.00	\$0.00	1	1	100%	\$2,907.00
49	East Elevation/South Pod: Veneer Ties	103.77 hrs	9.33 hrs	\$16,340.40	103.77 hrs	\$1,470.64	\$16,340.40	\$1,470.64	(\$14,869.76)	1	0.09	9%	\$16,340.40
g 53	East Elevation/South Pod: Washdown & Staging Removal	117.3 hrs	0 hrs	\$3,570.00	117.3 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$3,570.00
5 66	 South Facade 	1,758.15 hrs	60.07 hrs	\$228,166.02	1758.15 hrs	\$7,954.92	\$14,150.82	\$7,954.92	(\$6,195.90)	1	0.56	8%	\$228,166.02
2 70	South Elevation/South Pod: Brick Veneer	410.42 hrs	0 hrs	\$20,776.50	410.42 hrs	\$0.00	\$4,155.30	\$0.00	(\$4,155.30)	0	0	0%	\$20,776.50
5 73	South Elevation/South Pod: Curtain Wall	585.48 hrs	0 hrs	\$128,877.00	585.48 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$128,877.00
3 74	South Elevation/South Pod: Curtain Wall Trim & Seal	599.77 hrs	0 hrs	\$61,761.00	599.77 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$61,761.00
ë 69	South Elevation/South Pod: Erect Staging	4.32 hrs	0 hrs	\$1,390.80	4.32 hrs	\$0.00	\$1,390.80	\$0.00	(\$1,390.80)	0	0	0%	\$1,390.80
3 72	South Elevation/South Pod: Punch Windows	32 hrs	0 hrs	\$5,160.00	32 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$5,160.00
88 📴	South Elevation/South Pod: Spray foam/Window Membrane	27.37 hrs	13.68 hrs	\$1,299.60	27.37 hrs	\$649.80	\$1,299.60	\$649.80	(\$649.80)	1	0.5	50%	\$1,299.60
67	South Elevation/South Pod: Veneer Ties	46.38 hrs	46.38 hrs	\$7,305.12	46.38 hrs	\$7,305.12	\$7,305.12	\$7,305.12	\$0.00	1	1	100%	\$7,305.12
71	South Elevation/South Pod: Washdown & Staging Removal	52.43 hrs	0 hrs	\$1,596.00	52.43 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$1,596.00
57	- West Facade	2,100.03 hrs	93.38 hrs	\$215,583.75	2100.03 hrs	\$14,706.36	\$22,358.40	\$14,707.49	(\$7,650.91)	1	0.66	8%	\$215,567.12
61	West Elevation/South Pod: Brick Veneer	918.02 hrs	0 hrs	\$46,473.75	918.02 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$46,473.75
64	West Elevation/South Pod: Curtain Wall	427.07 hrs	0 hrs	\$94,004.40	427.07 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$94,004.40
65	West Elevation/South Pod: Curtain Wall Trim & Seal	437.47 hrs	0 hrs	\$45,049.20	437.47 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$45,049.20
60	West Elevation/South Pod: Erect Staging 50%	9.63 hrs	0 hrs	\$3,111.00	9.63 hrs	\$0.00	\$3,111.00	\$0.00	(\$3,111.00)	0	0	0%	\$3,111.00
63	West Elevation/South Pod: Punch Windows	25.6 hrs	0 hrs	\$4,128.00	25.6 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$4,128.00
59	West Elevation/South Pod: Spray Foam/Window Membrane 50%	61.2 hrs	0 hrs	\$2,907.00	61.2 hrs	\$0.00	\$2,907.00	\$0.00	(\$2,907.00)	0	0	0%	\$2,907.00
58	West Elevation/South Pod: Veneer Ties	103.77 hrs	93.38 hrs	\$16,340.40	103.77 hrs	\$14,706.36	\$16,340.40	\$14,707.49	(\$1,632.91)	1	0.9	90%	\$16,339.14
62	West Elevation/South Pod: Washdown & Staging Removal	117.3 hrs	0 hrs	\$3,570.00	117.3 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$3,570.00
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Appendix N: Microsoft Project Screenshot January 30th, 2008

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	80%				_							
	Task Name	Work	Actual	PlannedWork	ACWP	BCWS	BCWP	SV	CPI	SPI	%	EAC
	Task Name (Name)	┓↓									Complete	
1	- Exterior Walls Help on Name	14,281.52 hrs	12,139.28 hrs			\$1,288,319.84		(\$46,487.29)	1	0.96	89%	\$1,609,395.
2	- All Building Elevations	2,253.77 hrs	2,253.77 hrs	2173.77 hrs	\$291,481.06	\$291,481.06	\$291,481.06	\$0.00	1	1	99%	\$291,481.0
3	 Architectural Pre-cast 	1,929.27 hrs	1,929.27 hrs	1849.27 hrs	\$255,788.26	\$255,788.26	\$255,788.26	\$0.00	1	1	100%	\$255,788.2
7	East Elevation: Install Base Pre-cast	679.63 hrs	679.63 hrs	679.63 hrs	\$94,005.73	\$94,005.73	\$94,005.73	\$0.00	1	1	100%	\$94,005.
4	Level-1: Install Tube for Pre-cast Support	40 hrs	40 hrs	0 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	100%	\$0.0
5	Level-1:Spray Fire Proof (@precast)	40 hrs	40 hrs	0 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	100%	\$0.0
6	North Elevation: Install Base Pre-cast	245 hrs	245 hrs	245 hrs	\$33,888.40	\$33,888.40	\$33,888.40	\$0.00	1	1	100%	\$33,888.4
8	South Elevation: Install Base Pre-cast	245 hrs	245 hrs	245 hrs	\$33,888.40	\$33,888.40	\$33,888.40	\$0.00	1	1	100%	\$33,888.4
9	West Elevation: Install Base Pre-cast	679.63 hrs	679.63 hrs	679.63 hrs	\$94,005.73	\$94,005.73	\$94,005.73	\$0.00	1	1	100%	\$94,005.
10	 Exterior Sheathing 	324.5 hrs	324.5 hrs	324.5 hrs	\$35,692.80	\$35,692.80	\$35,692.80	\$0.00	1	1	99%	\$35,692.
12	East Elevation: Exterior Sheathing	132.6 hrs	132.6 hrs	132.6 hrs	\$14,586.00	\$14,586.00	\$14,586.00	\$0.00	1	1	100%	\$14,586.
16	North "Tight" for Elec. Roughin & Insulation	0 hrs	0 hrs	0 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$0.
11	North Elevation: Exterior Sheathing	29.65 hrs	29.65 hrs	29.65 hrs	\$3,260.40	\$3,260.40	\$3,260.40	\$0.00	1	1	100%	\$3,260.
17	South "Tight" for Elec. Roughin & Insulation	0 hrs	0 hrs	0 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$0.
14	South Elevation: Exterior Sheathing	29.65 hrs	29.65 hrs	29.65 hrs	\$3,260.40	\$3,260.40	\$3,260.40	\$0.00	1	1	100%	\$3,260.
15	Start Exterior Sheathing (4th 100% & 5th 50% fr)	0 hrs	0 hrs	0 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$0.
13	West Elevation: Exterior Sheathing	132.6 hrs	132.6 hrs	132.6 hrs	\$14,586.00	\$14,586.00	\$14,586.00	\$0.00	1	1	100%	\$14,586.0
18	- North Pod	6,069.53 hrs	5,790.17 hrs	5958.25 hrs	\$574,086.03	\$620,495.86	\$574,008.57	(\$46,487.29)	1	0.93	98%	\$658,132.8
28	 East Facade 	2,100.03 hrs	2,010.97 hrs	2100.03 hrs	\$198,817.35	\$198,690.30	\$198,690.30	\$0.00	1	1	98%	\$215,721.0
32	East Elevation/North Pod: Brick Veneer	918.02 hrs	918.02 hrs	918.02 hrs	\$46,473.75	\$46,473.75	\$46,473.75	\$0.00	1	1	100%	\$46,473.
35	East Elevation/North Pod: Curtain Wall	427.07 hrs	427.07 hrs	427.07 hrs	\$94,004.40	\$94,004.40	\$94,004.40	\$0.00	1	1	100%	\$94,004.4
36	East Elevation/North Pod: Curtain Wall Trim & Seal	437.47 hrs	348.4 hrs	437.47 hrs	\$28,282.80	\$28,155.75	\$28,155.75	\$0.00	1	1	80%	\$45,252.4
31	East Elevation/North Pod: Erect Staging 50%	9.63 hrs	9.63 hrs	9.63 hrs	\$3,111.00	\$3,111.00	\$3,111.00	\$0.00	1	1	100%	\$3,111.0
34	East Elevation/North Pod: Punch Windows	25.6 hrs	25.6 hrs	25.6 hrs	\$4,128.00	\$4,128.00	\$4,128.00	\$0.00	1	1	100%	\$4,128.0
30	East Elevation/North Pod: Spray Foam/Window Membrane 50	61.2 hrs	61.2 hrs	61.2 hrs	\$2,907.00	\$2,907.00	\$2,907.00	\$0.00	1	1	100%	\$2,907.
29	East Elevation/North Pod: Veneer Ties	103.77 hrs	103.77 hrs	103.77 hrs	\$16,340.40	\$16,340.40	\$16,340.40	\$0.00	1	1	100%	\$16,340.4
33	East Elevation/North Pod: Washdown & Staging Removal	117.3 hrs	117.3 hrs	117.3 hrs	\$3,570.00	\$3,570.00	\$3,570.00	\$0.00	1	1	100%	\$3,570.0
19	 North Facade 	1,869.45 hrs	1,768.23 hrs	1758.13 hrs	\$209,197.20	\$209,273.59	\$209,260.05	(\$13.54)	1	1	97%	\$228,097.4
23	North Elevation/North Pod: Brick Veneer	459.02 hrs	459.02 hrs	410.4 hrs	\$20,776.50	\$20,776.50	\$20,776.50	\$0.00	1	1	100%	\$20,776.5
25	North Elevation/North Pod: Curtain Wall	585.48 hrs	585.48 hrs	585.48 hrs	\$128,877.00	\$128,877.00	\$128,877.00	\$0.00	1	1	100%	\$128,877.0
27	North Elevation/North Pod: Curtain Wall Trim & Seal	599.77 hrs	498.53 hrs	599.77 hrs	\$42,805.18	\$42,868.57	\$42,868.57	\$0.00	1	1	83%	\$61,669.
22	North Elevation/North Pod: Erect Staging	9.63 hrs	9.63 hrs	4.32 hrs	\$1,390.80	\$1,390.80	\$1,390.80	\$0.00	1	1	100%	\$1,390.
26	North Elevation/North Pod: Punch Windows	32 hrs	32 hrs	32 hrs	\$5,160.00	\$5,160.00	\$5,160.00	\$0.00	1	1	100%	\$5,160.
21	North Elevation/North Pod: Spray foam/Window Membrane	27.37 hrs	27.37 hrs	27.37 hrs	\$1,286.60	\$1,299.60	\$1,286.06	(\$13.54)	1	0.99	99%	\$1,300.
20	North Elevation/North Pod: Veneer Ties	103.77 hrs	103.77 hrs	46.38 hrs	\$7,305.12	\$7,305.12	\$7,305.12	\$0.00	1	1	100%	\$7,305.
24	North Elevation/North Pod: Washdown & Staging Removal	52.43 hrs	52.43 hrs	52.43 hrs	\$1,596.00	\$1,596.00	\$1,596.00	\$0.00	1	1	100%	\$1,596.
37	- West Facade	2,100.03 hrs	2,010.97 hrs	2100.03 hrs	\$166,071.47	\$212,531.97	\$166,058.22	(\$46,473.75)	1	0.78	98%	\$214,311.3
46	North Pod Building "Tight" for Boarding	0 hrs	0 hrs	0 hrs	\$0.00	\$46,473.75	\$0.00	(\$46,473.75)	0	0	0%	\$46,473.
41	West Elevation/North Pod: Brick Veneer	918.02 hrs	918.02 hrs	918.02 hrs	\$94,004.40	\$94,004.40	\$94,004.40	\$0.00	1	1	100%	\$94,004.4
41												

	Task Name	Work	Actual	PlannedWork	ACWP	BCWS	BCWP	SV	CPI	SPI	% Complete	EAC
45	West Elevation/North Pod: Curtain Wall Trim & Seal	437.47 hrs	348.4 hrs	437.47 hrs	\$2,950.40	\$2,937.15	\$2,937.15	\$0.00	1	1	80% ÷	\$4,720.65
40	West Elevation/North Pod: Erect Staging 50%	9.63 hrs	9.63 hrs	9.63 hrs	\$4,128.00	\$4,128.00	\$4,128.00	\$0.00	1	1	100%	\$4,128.00
43	West Elevation/North Pod: Punch Windows	25.6 hrs	25.6 hrs	25.6 hrs	\$29.07	\$29.07	\$29.07	\$0.00	1	1	100%	\$29.07
39	West Elevation/North Pod: Spray Foam/Window Membrane 50	61.2 hrs	61.2 hrs	61.2 hrs	\$16,340.40	\$16,340.40	\$16,340.40	\$0.00	1	1	100%	\$16,340.40
38	West Elevation/North Pod: Veneer Ties	103.77 hrs	103.77 hrs	103.77 hrs	\$3,570.00	\$3,570.00	\$3,570.00	\$0.00	1	1	100%	\$3,570.0
42	2 West Elevation/North Pod: Washdown & Staging Removal	117.3 hrs	117.3 hrs	117.3 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	100%	\$0.00
47	' - South Pod	5,958.23 hrs	4,095.35 hrs	5958.28 hrs	\$376,680.20	\$376,342.92	\$376,342.92	\$0.00	1	1	75%	\$659,924.42
48	East Facade	2,100.03 hrs	1,367.38 hrs	2100.03 hrs	\$98,908.82	\$98,792.85	\$98,792.85	\$0.00	1	1	68%	\$215,836.82
52	2 East Elevation/South Pod: Brick Veneer	918.02 hrs	918.02 hrs	918.02 hrs	\$46,473.75	\$46,473.75	\$46,473.75	\$0.00	1	1	100%	\$46,473.7
55	East Elevation/South Pod: Curtain Wall	427.07 hrs	136.05 hrs	427.07 hrs	\$23,607.15	\$23,501.10	\$23,501.10	\$0.00	1	1	32%	\$94,428.5
56	East Elevation/South Pod: Curtain Wall Trim & Seal	437.47 hrs	0 hrs	437.47 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$45,049.20
51	East Elevation/South Pod: Erect Staging 50%	9.63 hrs	9.63 hrs	9.63 hrs	\$3,111.00	\$3,111.00	\$3,111.00	\$0.00	1	1	100%	\$3,111.0
54	East Elevation/South Pod: Punch Windows	25.6 hrs	21.43 hrs	25.6 hrs	\$2,899.52	\$2,889.60	\$2,889.60	\$0.00	1	1	84%	\$4,142.1
50	East Elevation/South Pod: Spray Foam/Window Membrane 50	61.2 hrs	61.2 hrs	61.2 hrs	\$2,907.00	\$2,907.00	\$2,907.00	\$0.00	1	1	100%	\$2,907.0
49	East Elevation/South Pod: Veneer Ties	103.77 hrs	103.77 hrs	103.77 hrs	\$16,340.40	\$16,340.40	\$16,340.40	\$0.00	1	1	100%	\$16,340.4
53	East Elevation/South Pod: Washdown & Staging Removal	117.3 hrs	117.3 hrs	117.3 hrs	\$3,570.00	\$3,570.00	\$3,570.00	\$0.00	1	1	100%	\$3,570.0
66	5 - South Facade	1,758.15 hrs	1,360.58 hrs	1758.15 hrs	\$178,862.56	\$178,757.22	\$178,757.22	\$0.00	1	1	90%	\$228,300.48
70	South Elevation/South Pod: Brick Veneer	410.42 hrs	410.42 hrs	410.42 hrs	\$20,776.50	\$20,776.50	\$20,776.50	\$0.00	1	1	100%	\$20,776.5
73	South Elevation/South Pod: Curtain Wall	585.48 hrs	585.48 hrs	585.48 hrs	\$128,877.00	\$128,877.00	\$128,877.00	\$0.00	1	1	100%	\$128,877.0
74	South Elevation/South Pod: Curtain Wall Trim & Seal	599.77 hrs	202.2 hrs	599.77 hrs	\$12,457.54	\$12,352.20	\$12,352.20	\$0.00	0.99	1	34%	\$62,287.7
69	South Elevation/South Pod: Erect Staging	4.32 hrs	4.32 hrs	4.32 hrs	\$1,390.80	\$1,390.80	\$1,390.80	\$0.00	1	1	100%	\$1,390.8
72	2 South Elevation/South Pod: Punch Windows	32 hrs	32 hrs	32 hrs	\$5,160.00	\$5,160.00	\$5,160.00	\$0.00	1	1	100%	\$5,160.0
68	South Elevation/South Pod: Spray foam/Window Membrane	27.37 hrs	27.37 hrs	27.37 hrs	\$1,299.60	\$1,299.60	\$1,299.60	\$0.00	1	1	100%	\$1,299.6
67	' South Elevation/South Pod: Veneer Ties	46.38 hrs	46.38 hrs	46.38 hrs	\$7,305.12	\$7,305.12	\$7,305.12	\$0.00	1	1	100%	\$7,305.1
71	South Elevation/South Pod: Washdown & Staging Removal	52.43 hrs	52.43 hrs	52.43 hrs	\$1,596.00	\$1,596.00	\$1,596.00	\$0.00	1	1	100%	\$1,596.00
57	' - West Facade	2,100.03 hrs	1,367.38 hrs	2100.03 hrs	\$98,908.82	\$98,792.85	\$98,792.85	\$0.00	1	1	68%	\$215,836.82
61	West Elevation/South Pod: Brick Veneer	918.02 hrs	918.02 hrs	918.02 hrs	\$46,473.75	\$46,473.75	\$46,473.75	\$0.00	1	1	100%	\$46,473.7
64	West Elevation/South Pod: Curtain Wall	427.07 hrs	136.05 hrs	427.07 hrs	\$23,607.15	\$23,501.10	\$23,501.10	\$0.00	1	1	32%	\$94,428.5
65	West Elevation/South Pod: Curtain Wall Trim & Seal	437.47 hrs	0 hrs	437.47 hrs	\$0.00	\$0.00	\$0.00	\$0.00	0	0	0%	\$45,049.2
60	West Elevation/South Pod: Erect Staging 50%	9.63 hrs	9.63 hrs	9.63 hrs	\$3,111.00	\$3,111.00	\$3,111.00	\$0.00	1	1	100%	\$3,111.0
63	West Elevation/South Pod: Punch Windows	25.6 hrs	21.43 hrs	25.6 hrs	\$2,899.52	\$2,889.60	\$2,889.60	\$0.00	1	1	84%	\$4,142.1
59	West Elevation/South Pod: Spray Foam/Window Membrane 5	61.2 hrs	61.2 hrs	61.2 hrs	\$2,907.00	\$2,907.00	\$2,907.00	\$0.00	1	1	100%	\$2,907.0
58	West Elevation/South Pod: Veneer Ties	103.77 hrs	103.77 hrs	103.77 hrs	\$16,340.40	\$16,340.40	\$16,340.40	\$0.00	1	1	100%	\$16,340.40
62	West Elevation/South Pod: Washdown & Staging Removal	117.3 hrs	117.3 hrs	117.3 hrs	\$3,570.00	\$3,570.00	\$3,570.00	\$0.00	1	1	100%	\$3,570.0

Appendix O: Cost Analysis Spreadsheet

Cost Comparison

Design	Section	Concrete Cost \$	Placement Cost \$	Formwork\$	Reinforcing (steel) \$	Total Cost per section \$	Total Cost\$
Original	Spread Footing	1264	165.43	765.1	2240	4434.53	
	Piers	424.06	133.28	997.54	1275	2829.88	
	Foundation Wall	1440.53	188.54	3522.73	2115	7266.8	
							14531.21
Cannon Tieback Solution	Dead Man	1253.07	164	606.26	3920		
							5943.33
Cannon + Orginal Design		4381.66	651.25	5891.63	9550		
							20474.54
Redesign	Spread Footing and Key	3867.5	506.29	1177	3360	8910.79	
	Walls and Counterforts	4791.15	627.06	11922.73	22500	39840.94	48751.73

	0	
Takeoff Comparison		
Design	Section	Quantity (yds. ³)
Original	Spread Footing	13.89
Original	Piers	4.66
	Foundation Wall	15.83
	Total	34.38
Cannon Tieback Solution	Dead Man	13.77
	Total	13.77
Cannon + Original Design	Total	48.15
Redesign	Spread Footing and Key	42.51
	Walls and Counterforts	52.65
	Total	95.16

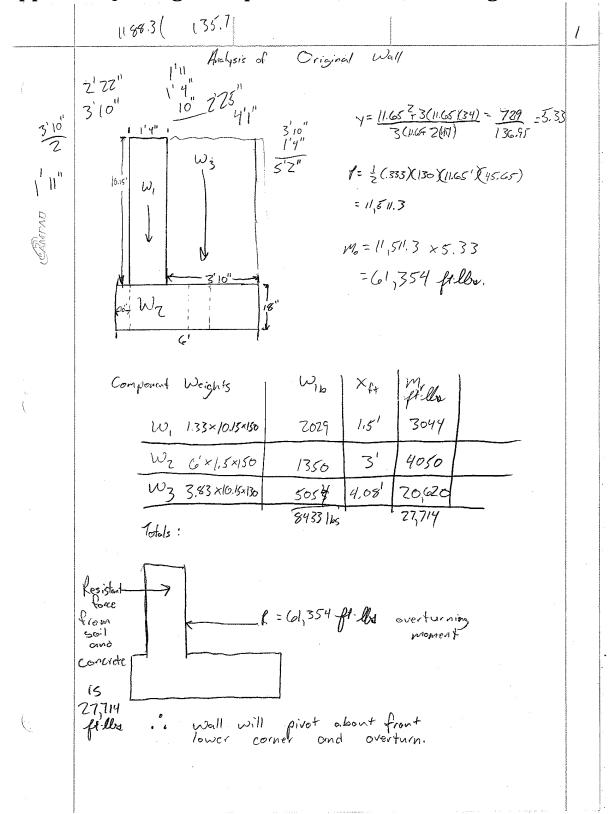
Appendix P: Concrete Takeoff for Different Designs

Cannon Tieback Solution		
Dead Man	Length (ft.)	18
	Width (ft.)	10.33
	Height (ft.)	2
	Total (ft ³)	371.88
	Total (yds ³)	13.77
Total Weight (lbs)		55782
Total Weight (tons)		27.89

Designed Footing, Wall and Counterforts		
Footing	Length (ft.)	41
	Width (ft.)	12
	Height (ft.)	2
	Total (ft ³)	984
	Total (yds ³)	36.44
Counterforts, 5	Base (ft.)	8
	Height (ft.)	12.15
	Width (ft.)	1
	Counterforts	5
	Total (ft ³)	486
	Total (yds ³)	18
Foundation Wall	Length (ft.)	38.5
	Width (ft.)	2
	Height (ft.)	12.15
	Total (ft ³)	935.5
	Total (yds ³)	34.65
Кеу	Length (ft.)	41
	Width (ft.)	2
	Height (ft.)	2
	Total (ft ³)	164
	Total (yds ³)	6.07
Total Cubic Feet		2569.5
Total Cubic Yards		95.17
Total Weight (lbs)		385425
Total Weight (tons)		192.71

Original Footing and Foundation wall		
Spread Footing	Length (ft.)	41.67
	Width (ft.)	6
	Height (ft.)	1.5
	Total (ft ³)	375.03
	Total (yds ³)	13.89
Piers, 3	Length (ft.)	2
	Width (ft.)	2
	Height (ft.)	10.48
	Piers	3
	Total (ft ³)	125.76
	Total (yds ³)	4.66
Foundation Wall	Length (ft.)	31.66
	Width (ft.)	1.333
	Height (ft.)	10.15
	Total (ft ³)	427.39
	Total (yds ³)	15.83
Total Cubic Feet		928.18
Total Cubic Yards		34.38
Total Weight (lbs)		139227
Total Weight (tons)		69.61

Tieback Additional Cost						Total	
	Excavation				Cost\$	Cost\$	
		Bank Cubic Yards					
		249.26			388.85		
	Equipment						
		Type Excavator 150+	Mobilization	Demob.			
		hp	250.5	250.5	501		
	Installation						
		Section					
		Deadman			2268.61		
		Tiebacks			2885.8		
	Additional Parts						
		Structural Tube			1300		
		Bolts			66.8		
	Deals Filling	Cubic Vende					
	Back Filling	Cubic Yards 235.3			174.12		
		233.3			174.12	7585.18	
						, 565.10	
							Final Cost\$
Tieback, Original, and Install \$							28059.72 + engineering costs
Redesign Cost Installed							48751.73

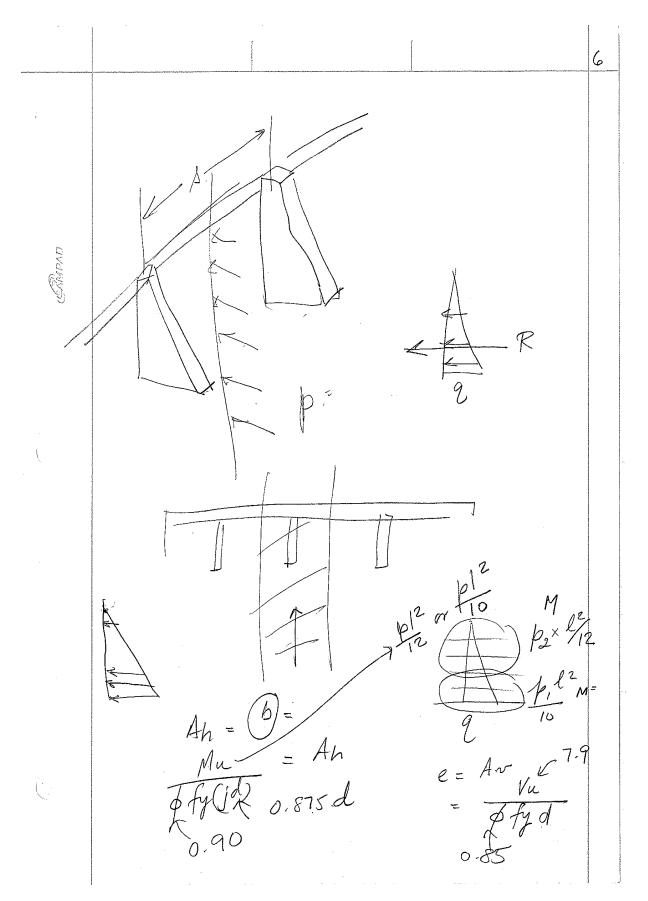


Appendix Q: Design Computations, Notes, and Diagrams

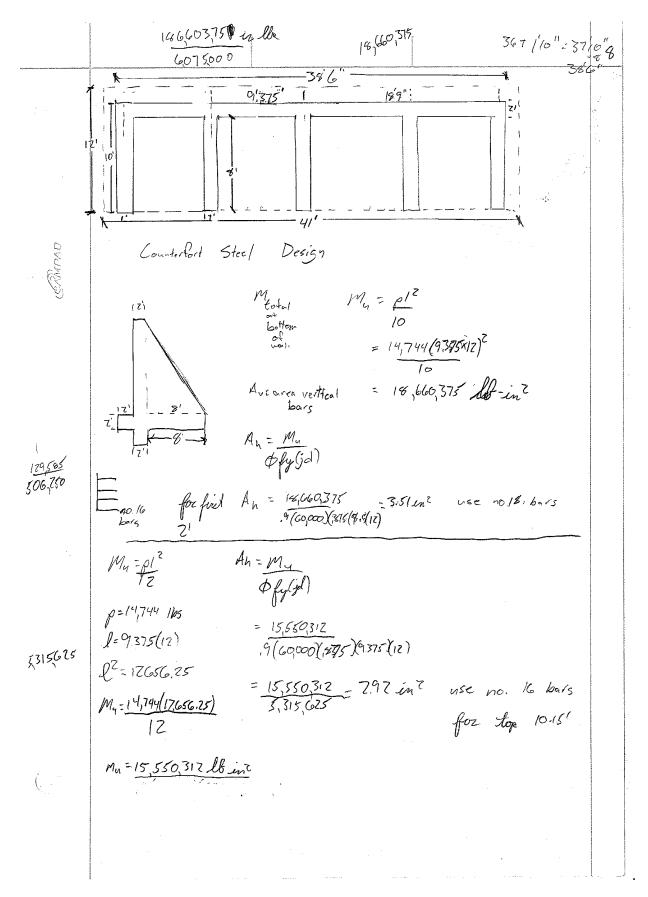
$$\begin{array}{c} \begin{array}{c} \label{eq:2} \label{eq:2} \end{tabular} \\ \end{tabular} \end{tabular} \end{tabular} \\ \end{tabular} \end{tabular} \\ \end{tabular} \end{tabular} \\ \end{tabular} \end{tabular} \\ \$$

$$\int_{0}^{2} = .01 \quad \text{obtain from 5 top 1 in approximate of MUltimit back} \\
\frac{M_{12}}{6M_{12}} = .570 \\
\frac{dM_{12}^{2}}{6M_{12}^{2}} \\
(M_{11} + longh, d & well (L = 12 in), p. 9.90 \\
d = \sqrt{\frac{11}{12} \frac{12}{2M_{12}} \frac{1}{3M_{12}}} \\
= 1/4.67 = 1/4.7 \rightarrow 1/\text{inch disorder steel} \quad i = 1/4.7 in \\
The woll = 21/m \\
\frac{1}{2m_{12}} = \frac{1}{2} \frac{1}{2M_{12}} \frac{1}{3M_{12}} \frac{$$

5 33' Design Woll Concrete Concrete Take-off - Original Sprend footing 41'.67 × 6 5 10 - 375.03 ft³ + 1.53 × 33'×10.15 = 1455/4³ 2'+2'×10.15*3=121.8 6 9423 fl³ of Cone in original + concrete in Tiebecke CANNER C lowe $M = \frac{pl}{pl}$ M = $p|^2$ $M = \underline{pl}$ $M = \frac{pl^2}{pl^2}$ M As = íd) 10 V 0,875 d 0.85 10 ban e $\frac{1}{p} = \frac{1}{r} \frac{1}{psf}$



7 Counterforts SARAD $M = \frac{p/2}{h_{-}} \sim \frac{p/2}{h_{-}}$ $\frac{\text{vertical bars } d}{\text{Moment}} = A_v = d = A_h = shear$ Mu \$ Fg(jd) 0.875d $h = \frac{V_1}{\sqrt{p_1^2}} \qquad V_1 = V \pm \frac{M}{d} \frac{t_{an} \phi_1}{t_{an} \phi_1} = (7.9) \frac{\rho_1 m}{\rho_1}$ shinkaya steel = 0.0035 bxd Ah b = width 1-0''d =18" S= equel; 8" c/c (



9 $V_1 = V + \frac{M}{d} (\tan \Theta + \tan \beta) 25^{\circ}$ AV = V, = 18,070 + 165,870 165 (tan () T tan () = 18,070 - 222,1477 (.466) Av = 45,450 ,45(copoo)(8) V = 14,070 -103,520 - 115 = 85,450 165 =. 709 use Chillera no 5 bas @ 8" spacing f= ,0035 6-1 =.0035×1×14.15 = 105 No.3 bars would work, but use No.4 Steel for arm and kay Zuin arm - Zin. cover - 5/for ro. 8 bar Mu = 114, 306.26 ft. blo $\frac{M_{b}}{\Phi b d^{2}} = \frac{114,306+12}{9(47(21.5)^{2}} = \frac{114,306}{416} = 275$ fy=60,000 k=4000 steel ratio p=.0049 A5=.0049×12×21.5 No. 9 bars on 8"Cotr = 1.26 in2/ft to Center At about 6 you can switch to No & bars C/6" on center due to the decreased moment at this height No 8 bors use no 6 vertical bars spaced at 24" on the front face of the wall and no 8 bars vertically spaced @ 16" on center on the back face of (spaced the wall

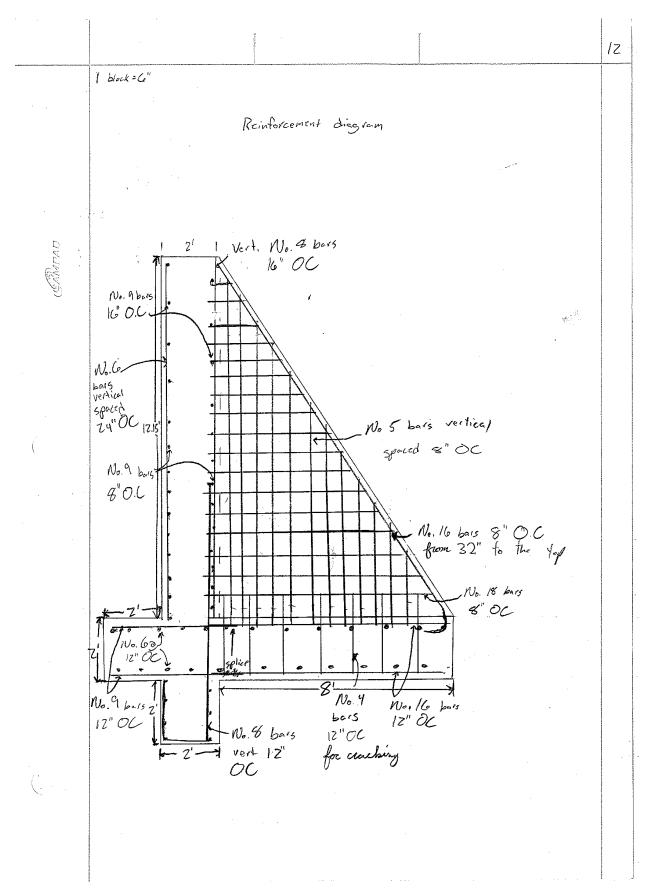
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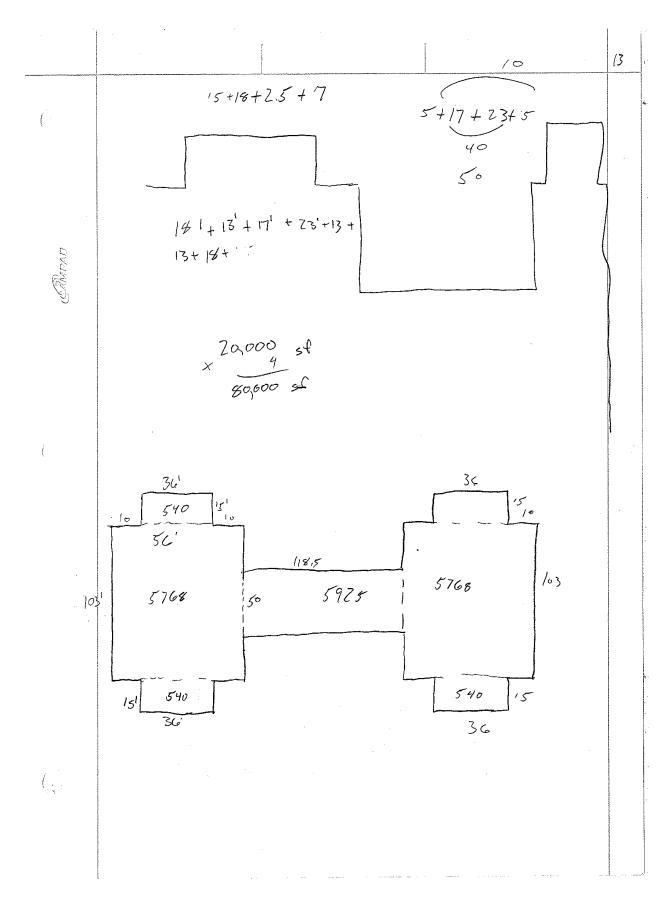
The SILE
The SILE

$$M_{a} = 17 \left(\frac{6435}{2} \times 2^{2} \times \frac{3}{2} + \frac{2}{2} \times 2^{2} \times \frac{1}{3} \right) = 9 \left(3000 \times 2^{24}, 5 \right)$$

 $\left[\frac{10}{2} \times 1^{2} \times 1^{2} \times \frac{1}{2} + \frac{2}{2} \times 2^{2} \times \frac{1}{3} \right] = 540$
 $\left((9055) + (3010.8) - 540$
 $M_{a} = 20,100 \times 7}{(9055) + (3010.8)} - 540$
 $M_{a} = 20,100 \times 7}{(9055) + 205}$ with uno.9 on 12° centrs
 $\frac{10}{2} \times \frac{10}{2}

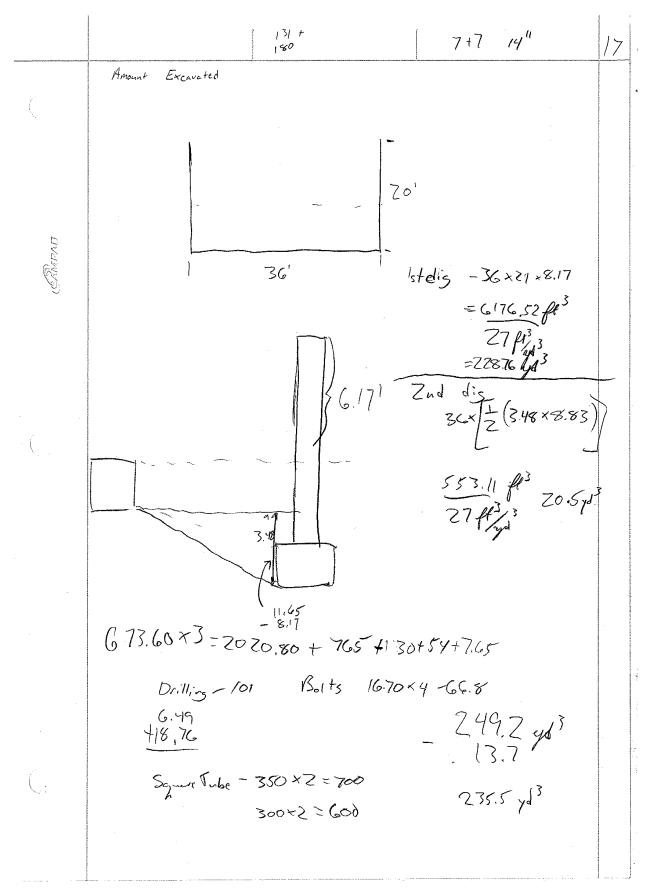
μ Check Shear Vu= 1,7(0+8) +1.4 (Z140+5) = 23,968 S passes sheen test d V_C = 26,450 passes shear test No. Ce bars 12 in Q.C for crack control ENMERD





15 P4 Ps Pz Pi EAMADU EAMADU 7 Counter forts 1/4 (points) Cantileves ret. wall Ć 1. Charles E. Reynolds RC Design Handbark (Brstish)

14 $\frac{f_{mn}sations}{use} R_{b} = \frac{0.85f_{c}^{\prime}E}{f_{d}} \begin{pmatrix} 300\\ R_{1} \end{pmatrix} \begin{pmatrix} 87200\\ 87007f_{q} \end{pmatrix}}{f_{d}} \frac{f_{d}}{f_{d}} E_{q} \frac{3.44}{3.44} \end{pmatrix} \frac{1}{f_{d}} \frac{f_{d}}{f_{d}} \frac{1}{f_{d}} \frac{1}{f$ CAMERAD $P_{all} = \left(\frac{P_b}{2}\right) 0.75$ 0.375 Ph . 2'+ 11.5 =13.5 fy = 60,02 Althor H. Wielson fic = 4000 psi Winter + Wielson 11.5 -15 3.5 -1.5 3.5 -1.5 Winter + Wielson Ferguson - Reinforced Columns - 12000 10-33 14' 10,15 4 4 41



Appendix R: December 12th, 2007 Progress Photos

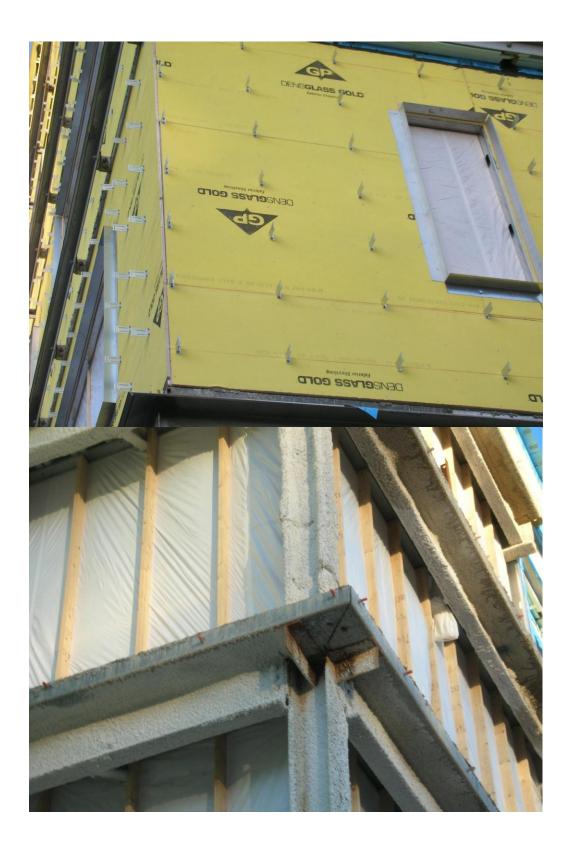




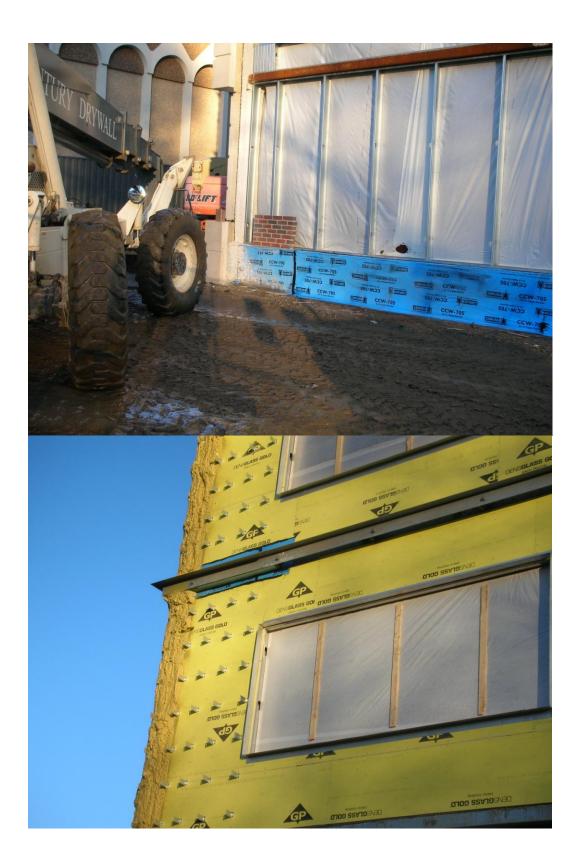


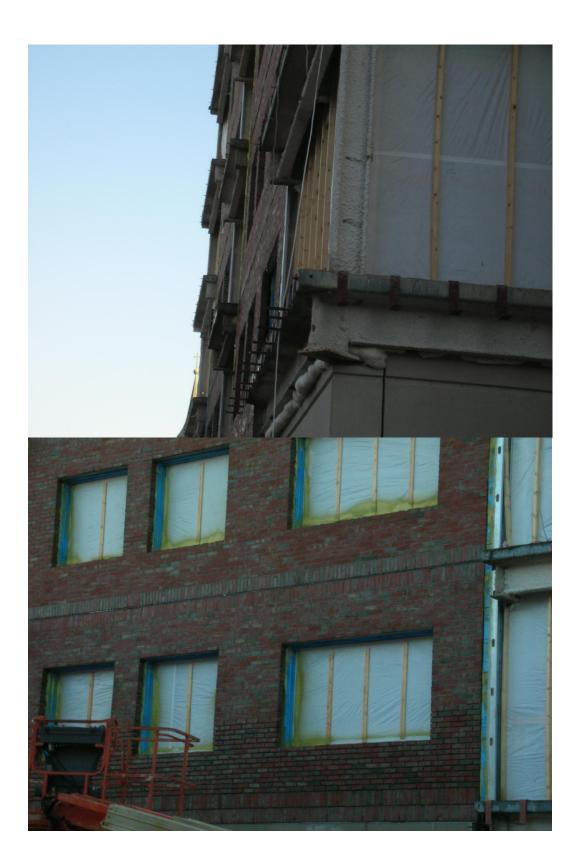












Appendix S: January 30th, 2008 Progress Photos

















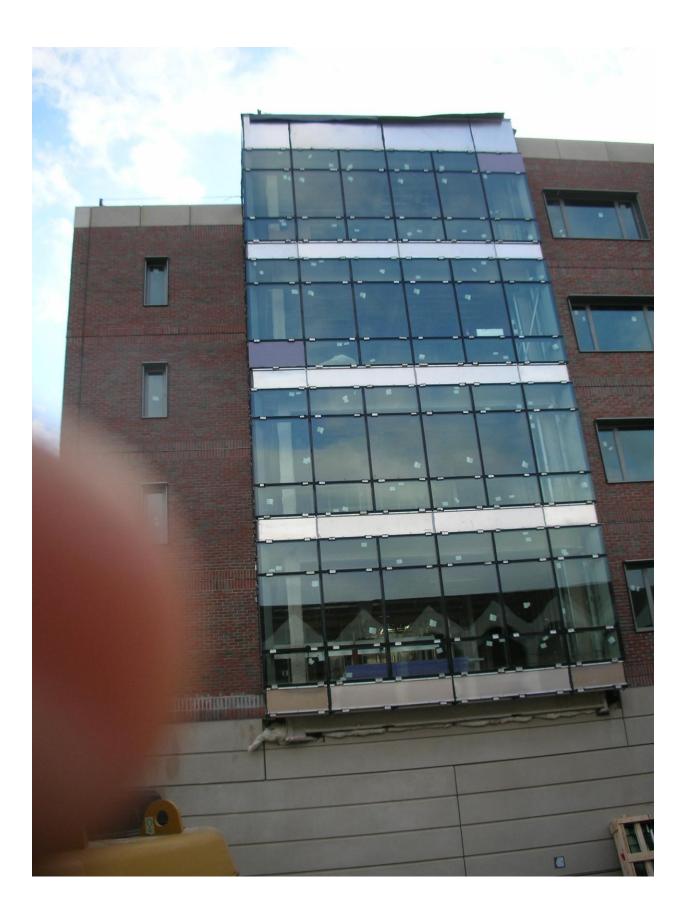


















	0	Task Name	Duration	Start	Finish
1		- New ResHall Construction	463 days	Mon 10/30/06	Mon 8/18/08
2	√ ଔ	Start Milestone	0 days	Mon 10/30/06	Mon 10/30/06
3	4	Substantial Completion	0 days	Mon 8/18/08	Mon 8/18/08
4	4	Owner Move-In and Occupy	5 days	Thu 8/7/08	Wed 8/13/08
5		- Other Construction	144 days	Mon 10/30/06	Wed 5/23/07
6	4	Site & Foundations	60 days	Mon 10/30/06	Thu 1/25/07
7	4	Steel/Detail/Deck/Slab Placement/ Spray	49 days	Fri 1/26/07	Wed 4/4/07
8	4	Exterior Wall Framing	35 days	Thu 4/5/07	Wed 5/23/07
9		- Steel Erection	135 days	Mon 10/30/06	Thu 5/10/07
10	4	Steel frame 4th 100% & 5th 50%	135 days	Mon 10/30/06	Thu 5/10/07
11		- Floor Construction	255 days	Mon 8/13/07	Thu 8/7/08
12	4	Roof	155 days	Thu 9/6/07	Mon 4/14/08
13	4	Level 1	242 days	Mon 8/13/07	Mon 7/21/08
14	4	Level 2	231 days	Thu 8/23/07	Wed 7/16/08
15	4	Level 3	237 days	Fri 8/24/07	Fri 7/25/08
16		Level 4	241 days	Fri 8/31/07	Thu 8/7/08
17	64	Level 5	240 days	Fri 8/31/07	Wed 8/6/08
18	1	Floor Construction Start	0 days	Mon 8/13/07	Mon 8/13/07
19		- Exterior Walls	127 days	Thu 4/5/07	Fri 9/28/07
20		- All Building Elevations	53 days	Thu 4/5/07	Mon 6/18/07
21		Architectural Pre-cast	53 days	Thu 4/5/07	Mon 6/18/07
22	6	Level-1: Install Tube for Pre-cast Support	5 days	Thu 4/5/07	Wed 4/11/07
23	4	Level-1:Spray Fire Proof (@precast)	5 days	Thu 4/5/07	Wed 4/11/07
24	4	North Elevation: Install Base Pre-cast	7 days	Mon 4/9/07	Tue 4/17/07
25	4	East Elevation: Install Base Pre-cast	28 days	Tue 4/17/07	Thu 5/24/07
26	4	South Elevation: Install Base Pre-cast	7 days	Fri 5/18/07	Mon 5/28/07
27	4	West Elevation: Install Base Pre-cast	15 days	Tue 5/29/07	Mon 6/18/07
28		- Exterior Sheathing	24 days	Fri 4/27/07	Wed 5/30/07
29	P	North Elevation: Exterior Sheathing	7 days	Fri 5/11/07	Mon 5/21/07
30	2	East Elevation: Exterior Sheathing	9 days	Mon 5/14/07	Thu 5/24/07
31	4	South Pod: Exterior Sheathing	9 days	Fri 5/18/07	Wed 5/30/07
32	4	South Elevation: Exterior Sheathing	4 days	Fri 4/27/07	Wed 5/2/07
33	4	Start Exterior Sheathing (4th 100% & 5th 50% fr)	0 days	Thu 5/10/07	Thu 5/10/07
34	4	North "Tight" for Elec. Roughin & Insulation	0 days	Thu 5/24/07	Thu 5/24/07
35	4	South "Tight" for Elec. Roughin & Insulation	0 days	Wed 5/30/07	Wed 5/30/07
36		- North Pod	77 days	Thu 5/17/07	Fri 8/31/07
37		- North Facade	70 days	Thu 5/17/07	Wed 8/22/07
38	¢,	North Elevation/North Pod: Veneer Ties	3 days	Thu 5/17/07	Mon 5/21/07
39	2	North Elevation/North Pod: Spray foam/Window Membrane	2 days	Tue 5/22/07	Wed 5/23/07
40	¢.	North Elevation/North Pod: Erect Staging	3 days	Thu 5/24/07	Mon 5/28/07
41	(P)	North Elevation/North Pod: Brick Veneer	10 days	Tue 5/29/07	Mon 6/11/07

Appendix T: Simplified Gilbane Construction Schedule

42	<u> </u>	North Elevation/North Pod: Washdown & Staging Removal	5 days	Tue 6/12/07	Mon 6/18/07
43	2	North Elevation/North Pod: Curtain Wall	20 days	Thu 7/12/07	Wed 8/8/07
44	2	North Elevation/North Pod: Punch Windows	10 days	Tue 6/19/07	Mon 7/2/07
45	2	North Elevation/North Pod: Curtain Wall Trim & Seal	10 days	Thu 8/9/07	Wed 8/22/07
46		- Fast Facade	62 days	Fri 5/25/07	Mon 8/20/07
40 47	2	East Elevation/North Pod: Veneer Ties	6 days	Fri 5/25/07	Fri 6/1/07
48		East Elevation/North Pod: Spray Foam/Window Membrane 50%	2 days	Mon 6/4/07	Tue 6/5/07
+0 49	<u> </u>	East Elevation/North Pod: Erect Staging 50%	3 days	Wed 6/6/07	Fri 6/8/07
+9 50	<u> </u>	East Elevation/North Pod: Brick Veneer	18 days	Mon 6/11/07	Wed 7/4/07
50 51	<u> </u>				
	<u> </u>	East Elevation/North Pod: Washdown & Staging Removal	5 days	Thu 7/5/07	Wed 7/11/07
52	_	East Elevation/North Pod: Punch Windows	10 days	Thu 7/12/07	Wed 7/25/07
53	9	East Elevation/North Pod: Curtain Wall	20 days	Thu 7/12/07	Wed 8/8/07
54	÷.	East Elevation/North Pod: Curtain Wall Trim & Seal	8 days	Thu 8/9/07	Mon 8/20/07
55	Ċ	- West Facade	67 days	Thu 5/31/07	Fri 8/31/07
56	A	West Elevation/North Pod: Veneer Ties	6 days	Thu 5/31/07	Thu 6/7/07
57	<u>6</u>	West Elevation/North Pod: Spray Foam/Window Membrane 50%	2 days	Fri 6/8/07	Mon 6/11/07
58	4	West Elevation/North Pod: Erect Staging 50%	3 days	Tue 6/19/07	Thu 6/21/07
59	<u>6</u>	West Elevation/North Pod: Brick Veneer	18 days	Fri 6/22/07	Tue 7/17/07
50	<u>2</u>	West Elevation/North Pod: Washdown & Staging Removal	5 days	Wed 7/18/07	Tue 7/24/07
61	<u>6</u>	West Elevation/North Pod: Punch Windows	10 days	Wed 7/25/07	Tue 8/7/07
62	4	West Elevation/North Pod: Curtain Wall	20 days	Wed 7/25/07	Tue 8/21/07
53	<u>6</u>	West Elevation/North Pod: Curtain Wall Trim & Seal	8 days	Wed 8/22/07	Fri 8/31/07
64	<u>6</u>	North Pod Building "Tight" for Boarding	0 days	Wed 8/22/07	Wed 8/22/07
65		- South Pod	85 days	Mon 6/4/07	Fri 9/28/07
56	-	- East Facade	76 days	Mon 6/4/07	Mon 9/17/07
67	2	East Elevation/South Pod: Veneer Ties	6 days	Mon 6/4/07	Mon 6/11/07
58	4	East Elevation/South Pod: Spray Foam/Window Membrane 50%	2 days	Tue 6/12/07	Wed 6/13/07
9	4	East Elevation/South Pod: Erect Staging 50%	3 days	Thu 6/14/07	Mon 6/18/07
70	4	East Elevation/South Pod: Brick Veneer	18 days	Thu 7/5/07	Mon 7/30/07
71	A	East Elevation/South Pod: Washdown & Staging Removal	5 days	Tue 7/31/07	Mon 8/6/07
72	4	East Elevation/South Pod: Punch Windows	10 days	Tue 8/7/07	Mon 8/20/07
73	4	East Elevation/South Pod: Curtain Wall	20 days	Thu 8/9/07	Wed 9/5/07
74	4	East Elevation/South Pod: Curtain Wall Trim & Seal	8 days	Thu 9/6/07	Mon 9/17/07
75		- West Facade	81 days	Fri 6/8/07	Fri 9/28/07
76	P	West Elevation/South Pod: Veneer Ties	6 days	Fri 6/8/07	Fri 6/15/07
77	4	West Elevation/South Pod: Spray Foam/Window Membrane 50%	2 days	Mon 6/18/07	Tue 6/19/07
78	4	West Elevation/South Pod: Erect Staging 50%	3 days	Wed 6/20/07	Fri 6/22/07
79	P	West Elevation/South Pod: Brick Veneer	18 days	Wed 7/18/07	Fri 8/10/07
30	P	West Elevation/South Pod: Washdown & Staging Removal	5 days	Mon 8/13/07	Fri 8/17/07
31		West Elevation/South Pod: Punch Windows	10 days	Mon 8/20/07	Fri 8/31/07
32	P	West Elevation/South Pod: Curtain Wall	20 days	Wed 8/22/07	Tue 9/18/07
33	2	West Elevation/South Pod: Curtain Wall Trim & Seal	aveb 9	Wed 9/19/07	Fri 9/28/0
53 84		- South Facade	8 days 55 days	Tue 6/12/07	Mon 8/27/0
35	2	South Elevation/South Pod: Veneer Ties			
	ē.		4 days	Tue 6/12/07	Fri 6/15/0
36		South Elevation/South Pod: Spray foam/Window Membrane	3 days	Mon 6/18/07	Wed 6/20/0
37	A	South Elevation/South Pod: Erect Staging	3 days	Thu 6/21/07	Mon 6/25/0
38	4	South Elevation/South Pod: Brick Veneer	10 days	Tue 6/26/07	Mon 7/9/0
39	<u>6</u>	South Elevation/South Pod: Washdown & Staging Removal	5 days	Tue 7/10/07	Mon 7/16/0
90	<u>6</u>	South Elevation/South Pod: Punch Windows	10 days	Tue 7/17/07	Fri 7/27/0
	1.21	O and the Elementic of O and the D and a O and a line Wall	0.0 dame	Tue 7/17/07	Mon 9/12/01
91 92	\$ \$	South Elevation/South Pod: Curtain Wall	20 days	Tue 7/17/07	Mon 8/13/01