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Oct 5, 2005

EXECUTIVE SUMMARY

The construction of the Arts & Humanities Instructional Building (AHIB) will be an interesting project to study. The new building is located on the relatively small campus of Howard Community College, which is the owner. The project is being delivered by a construction manager, Riparius Construction, Inc., as a design-bid-build with a GMP. This seems appropriate since the owner, Howard Community College, is inexperienced with the construction process. A major concern with construction is having the building occupied by the start of the 2006 academic school year. The time frame for construction of the building is September 2004 to August 2006. A milestone of construction will be the enclosure the building which occurs by the end of September 2005.

The twenty-million-dollar job consists of new offices, classrooms, and most interesting, a 100-seat auditorium and a 3000-square-foot black box theater. The building is two stories above grade with partial basement housing mechanical equipment. A new curtain wall entrance lobby will connect the AHIB with an existing building, the Smith Theater. A curtain wall as well as a masonry façade makes up the building's skin. The building's structural steel frame is supported by cast-in-place spread footings. Steel open-web joists support the 4-ply built-up roof and standing-seam metal roof. Four air handling units sit on the roof serving four zones of the building. Two gas-fired boilers are housed in the partial basement serving the entire building.

A D4 cost estimate returned an approximate estimate of $16.8 M. This estimate is based on similar jobs. A square foot estimate returned an estimate of only $9.5 M. A possible cause for the discrepancy is the level of technology in the building. The complex stage lighting and telecomm system could account for a small portion of the difference as well as the electric kilns and the system required to support them. These are a few issues that need to be investigated more in depth in the future.

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PROJECT SCHEDULE SUMMARY

The total timeframe for construction of the Arts and Humanities Instructional Building is about 77 weeks. The design phase took approximately 2 years; site work on the project lasted approximately 3 weeks. The spread footing foundations have been scheduled to be completed in a month. The structural steel frame will be erected with final connections taking place in just over 2 months. The building will be completely enclosed within 12 months of beginning the site work, and will take 5 months from start to completion. Finishes will last about 4 months, with final occupancy taking place the end of June.

The foundation system for the majority of the building is a spread footing. Although this type of construction is fairly typical, it requires some specific attention. The rebar must be procured and placed in time to keep the project on schedule. Construction managers are also concerned with the formwork, as forming and stripping the forms requires a lot of manpower, which is a potential issue.

The structural steel frame clearly is on the critical path of the job. The steel needs to be procured and delivered on site for the construction managers to shake out the steel for the job to run smoothly. Some coordination needs to be done between the construction manager and the steel fabricator to have the correct pieces on site and on time. This is especially important if a lot of beam sizes differ, because the steel fabricator will want to stay productive and produce all the same beam sizes at once, regardless of when they are needed.

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The finish schedule is especially problematic for the construction manager and requires more attention. During this time, there will be many different trades on site simultaneously. It is important to know when items are being delivered, and to be prepared with lay down areas for the contractors. Construction managers must also prevent trade stacking and prepare schedules that allow subcontractors enough room to work. It is important to provide a good work plan and work sequence so that the work flows in a logical and efficient pattern. Knowing in which area of the building work will be started, and where work will go from there, is one of the most important functions of the construction manager.

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BUILDING SYSTEMS SUMMARY

DEMOLITION

Minimal demolition is required to construct the AHIB. The AHIB will share an entrance with an existing building on campus, the Smith Theater. The existing entrance on the Smith Theater requires demolition in order to construct the new curtain wall entrance lobby. Some of the materials requiring demolition are a sloped metal panel roof overhang, a precast beam, 20 ft of storefront, and concrete pavers. Other demolition requirements include removing lighting fixtures and a payphone in the same area. This demolition is very minor compared to the entire project, and no hazardous materials are expected to be encountered during excavation.

STRUCTURAL STEEL FRAME

The portion of the AHIB building with no basement is supported primarily by structural steel with a 3" poured concrete on a metal deck composite system. The structural steel system is comprised of approximately 28' x 28' bays. The roof is framed with open web steel joists. Bolted moment connections are used for the construction of the wide flange beams. The crane being used is a 100 ton rubber tire truck crane.

CAST-IN-PLACE CONCRETE

The cast in place concrete walls for the AHIB only exist in the small basement level. The walls are not very complicated with curves, but are straight and perpendicular to each other. Also, the walls are only 15 feet high. The form selection for this wall type is a traditional reusable form. The cast in place concrete floor is poured on the metal deck, which acts also as the form. The concrete that will not be place out of the truck chute will be place with a pump.

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PRECAST CONCRETE

Precast concrete is not used for the AHIB.

MECHANICAL SYSTEM

The basement of the AHIB is fully dedicated for mechanical space. There are four air handling units all located on the roof. The 12,200 cfm AHU is dedicated to serving the theater. A 40,000 cfm AHU serves the studio spaces as well as the classrooms and offices. A 9,000 cfm AHU serves only the black box theater. Another 33,500 cfm AHU serves the lobby and art gallery. A 380-ton cooling tower is located on the roof to provide chilled water. Two gas-fired boilers are located in the basement, providing heated water to the building. A fully sprinkled and automatic wet pipe system is used for fire protection.

ELECTRICAL SYSTEM

The main power enters the building at the basement mechanical room and is stepped down to 480Y/277V by the primary transformer. The power is then fed to the main switchboard. The main switchboard distributes the power to the mechanical equipment and to transformers to further step the power down. The majority of the sources in the building require 208Y/120V, which is provided by the secondary transformers feeding the individual panel boards.

MASONRY

The exterior wall of the AHIB is a split face CMU façade with an 8” CMU wall carrying the load. The load bearing CMU wall is tied to the spread footing foundations with steel rebar ties. The façade is attached to the CMU wall with masonry ties spaced at 16” on center. Ladder or truss-

type horizontal reinforcement spaced at 16" on center is used for the construction of the masonry walls. The mason will use a hydraulic scaffold to lay the concrete block for the entire building.

CURTAIN WALL

A pressure-glazing system with a pre-finished extruded aluminum pipe and tube frame was selected for the curtain wall. The curtain wall uses spandrel glass throughout the entire system. The glazing is two panes separated by a 1" gap filled with an insulating gas. The entire system is self-supporting.

SUPPORT OF EXCAVATION

Sloped banks complying with OSHA standards are used to excavate the site. Dewatering of the site is not necessary.

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PROJECT COST EVALUATION

Comparison

Actual project costs:	$ 20,180,431
D4 Cost Estimate:	$ 16,814,401
RS Means 2004:	$ 9,581,651

Actual Building Costs

- Actual Building Costs: $ 15,209,129
- Cost per square foot (@ 77,000 s.f.): $ 197.52
- Total Project Costs: $ 20,180,431
- Total Cost per square foot: $ 262.08

Major Building Systems Costs

	$ Cost	$ Cost / SF	%
Structural Steel	$1,284,750	$16.69	8.45 %
Mechanical Cost	$ 3,855,000	$50.06	25.35 %
Electrical Cost	$ 1,850,200	$24.03	12.17 %
Masonry	$ 1,630,601	$21.18	10.72 %
Plumbing Cost	$ 26,000	$ 0.34	0.17 %

D4 COST ESTIMATE

- D4 cost estimate: $ 16,814,401

D4 Cost version 7.5 estimating software is used to perform a parametric estimate. The program averages selected projects by criteria selected from the user. The three major criteria for similar programs from which to compare are building size, building type, and building use. Four similar projects have been selected as the baseline to produce the estimate for the AHIB.

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SQUARE FOOT ESTIMATE (RS Means 2004)

Cost based on Total Building Square Feet

- Total above grade area: 70,000 square feet
- Basement area: 7,000
- Face Brick with Concrete Backup
- Steel Frame
- From interpolation cost per square foot is $132.05
- Add $25.95/sf of basement area
- Add $53,700 for each elevator (2 elevators total)
- Add $234 for each auditorium seat. Assumed upholstered seat. (100 total)
- Cost: $9,555,950
- Location Factor for Baltimore, Maryland: 0.93
- Total Cost: $8,887,034

Cost based on Building Perimeter

- Total perimeter: 528 feet
- Basement area: 7,000
- Face Brick with Concrete Backup
- Steel Frame
- From interpolation cost per square foot is $142.72
- Add $25.95/sf of basement area
- Add $53,700 for each elevator (2 elevators total)
- Add $234 for each auditorium seat. Assumed upholstered seat. (100 total)
- Cost: $10,302,850
- Location Factor for Baltimore, Maryland: 0.93
- Total Cost: $9,581,651

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CONCLUSIONS

The estimate produced by D4Cost comes fairly close to the actual building costs. This method of estimate proves to be accurate because multiple projects that have actually been constructed are used as a baseline to produce a new estimate. The program allows for the manual entry of key aspects to the estimate, such as location and building size. These factors further the accuracy of the estimate. The estimate produced RS Means is a square foot estimate and is not very accurate. A square foot estimate sometimes disregards the complexity of different building systems, and can lead to a less accurate estimate.

LOCAL CONDITIONS

The new AHIB is located in the relatively flat and wooded area of Columbia, Maryland, which was the first planned community in the United States. I plan on investigating further the implications this has on the design of the AHIB, if any. Existing buildings on the HCC campus are steel structure with brick façade and curtain wall. The first buildings on campus were constructed in the late sixties and early seventies.
Upon investigation of the soil conditions, a soft weathered rock was encountered at depths of 18 to 30 feet below the ground surface. Sands and clays were found at the surface of the soil and at depths up to 28 feet. Measurable subsurface water was encountered in depths ranging from 15 to 27 feet.

CLIENT INFORMATION

The owner of the new Arts and Humanities Instructional Building is the Howard Community College, is a small local college in Columbia, MD. The largest department in the school is the art and science department with a growing business department. Currently, Howard Community College has just over thirteen thousand students enrolled. The college has grown in recent years and has seen many new construction projects on campus. The construction manager for the AHIB, Riparius Construction, Inc. has already completed another project for the college.

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HCC is known for its strong performing arts program, and building this facility is seen as furthering their commitment to the arts. The facility must be technologically advanced, and thus be a symbol of the schools' strength in the arts. The building will be used for the study and presentation of various arts as well as theatrical performances, and will serve as a showcase for the college's arts department. Howard Community College has also requested the building be operational by the start of the 2006 academic school year, probably the greatest requirement set forth by the owners.

PROJECT DELIEVERY SYSTEM

Riparius Construction, Inc. has scheduled the project to be constructed in one phase. The owner has expressed a few concerns over the construction of the new AHIB: First, the college requests the building be operational and occupied by the start of the new 2006 academic school year. Second, a high quality product is required of the project. The last major concern for this project, as for many projects, is safety. The new building is located very close to the entrance of the college campus. Keeping students away from the dangers on the construction site is a main concern being addressed by Riparius Construction, Inc.

Riparius Construction, Inc., is acting as the construction manager for this project. The project was bid as a GMP with a construction manager at risk. All the subcontracts are held by the construction manager. This project delivery method is appropriate for the owner and the type of project. Although the owner, HCC, has recently completed a few other projects, it is a relatively inexperienced owner. The construction manager delivery system allows Riparius to hold all the contracts and deliver the project in an efficient manner.

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STAFFING PLAN

To complete the construction of the AHIB, Riparius Construction, Inc. has assembled a diverse project team. Riparius Construction is employing a project administrator to spend the majority of his time on the AHIB. Currently working onsite in the construction trailer are the two main project managers who are devoted solely to the AHIB project and who have two full-time field superintendents working for them. Also on the team is a full-time carpenter. Although this project is more than just a typical office or classroom building, Riparius and the project team are familiar with the constructability issues of the building, since they have already completed similar jobs.