Technical Assignment 1

Construction Project Management

Casey Mowery

AE 481W – Senior Thesis

Advisor: Dr. Horman

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Washington Christian Academy

Table of Contents

Executive Summary

The Washington Christian Academy (WCA) Flagship and Gymnasium Buildings are part of a phased construction project located in Olney, MD; Montgomery County. These two initial buildings will serve as the base for a growing religious education campus. This technical report addresses the conditions and construction aspects of the Flagship Building and Gymnasium. The following items will be discussed in much greater detail in each respective section of the paper.

A. Project Schedules Summary: The milestone and key activities are scheduled and addressed. A 30-item, one page summary schedule is in Appendix A for the Flagship Building and another for the Gymnasium. This section also addresses how the foundation, structural system, and finish work affects the schedule.

B. Building Systems Summary: Included in this section are comprehensive descriptions of each major building system including the foundation, structural system, building envelope, façade, emergency systems, and more. Familiarity with systems is essential when analyzing scheduling and costs for the project.

C. Project Cost Evaluation: The project cost is analyzed from an actual building cost breakdown and a total project cost breakdown. Additionally, there is a *R.S. Means 2007* building cost analysis and a *D4 2002* parametric estimate. These estimates are evaluated and compared.

D. Site Plan of Existing Conditions: The visual location of the site and descriptive aerial photographs are found in this section. In addition, the site layout of temporary facilities are shown and discussed. This section is very graphically descriptive, and will answer the question of why the Washington Christian Academy decided to move to rural Maryland.

E. Local Conditions: Site advantages and disadvantages, soil conditions, ground water status, and recycling are each briefly addressed. Requirements for soil compaction and reuse of materials are also discussed. One unique site constraint that the WCA team faces is talked about.

F. Client Information: The owner (WCA) is described in section F. This section encompasses general information about the owner, their mission, and their construction priorities.

G. Project Delivery System: This section talks about the Design-Build project delivery method and subsequent contract types. A comprehensive organizational chart for the WCA project is included. It represents the major players in the project. Insurance and bonds are also addressed in this section. A personal analysis is included which discusses the appropriateness of the delivery system and contract types.

H. Staffing Plan: The main purpose of this section is to display an organizational chart for the Forrester Construction Company. It graphically describes how the GC staff is assigned to the job. There is a brief written section highlighting some of the chart details.

A. Project Schedules Summary

A.1 General Schedule Overview

While this project is classified as design-build, the project schedule does not reflect the fast track process that usually coincides with a design-build project. After referencing the two project schedules in Appendix A (one for the Flagship Building and one for the Gymnasium), it is apparent that the design phase was completed before building construction began. The reason for the design-build classification will be addressed in section G. *Project Delivery System*. It should be noted that design changes are still being made to the project today, however the main design was to be finalized before construction began so it could be approved by the Washington Christian Academy Organization. Upon further review of the schedules, a large gap in time exists between October 30, 2006 and January 25, 2007. The reason for the almost 3 month delay was obtaining the necessary permits for construction. During this lapse, the project essentially shut down and valuable time was wasted. To compensate for this delay, many item durations have been shortened and tasks condensed. So in a sense, the project will be moving at a fast track pace even though that was not the initial intention.

The driving force of this project is the schedule. The Flagship School and Gymnasium must be open for the commencement of the 2008-2009 school year. As it is scheduled now, WCA moves in at the end of July 2008, and punchlist items continue through August. While this meets the crucial school year deadline, this leaves no room for delays or complications from now until project completion. The initial delay of permits took away any float or "buffer time" from the contractor. There are key elements in the building process that must happen sequentially. Ensuring that these tasks are completed on time is essential in finishing successfully, as one delay will cause a domino effect. It is the designed structure of the building that dictates this sequential order.

A.2 Foundation and Structural Schedule Impacts

The structural foundations are mainly made up of shallow concrete continuous wall footings. The rest of the base structure is a simple slab on grade, bearing on compacted soil. The foundations must be excavated, formed, and placed before the superstructure can begin being constructed. The superstructure of both buildings is CMU load bearing walls with steel joists. These must also be built sequentially, due to the obvious necessity that the CMU walls must bear on the foundation, and the steel must be supported by the CMU. Some overlapping occurs in the schedule for the structural construction of the multiple floors. Once the steel trusses are up, and the decking and concrete is placed, the next floor's load bearing walls may begin. Simultaneously, the lower floors rough-in may begin. Once the roof is complete, the exterior façade and interior finish work may begin.

Proper foresight by the construction manager resulted in building the Gymnasium at the same time as the Flagship Building. This is to keep production and efficiency rates high. Since some items of the Flagship Building will take longer to construct (because it is larger and more complex), the Gymnasium can use trades that are not busy on the Flagship Building. For instance, both foundations will go in at the same time because it is logical to excavate, form, and place concrete at the same time. Naturally, the Gymnasium foundation will be completed first. While the foundation is still being worked on for the Flagship Building, CMU block can be placed at the Gym. Once finished at the Gym, the mason can move directly over to the Flagship. This creates a parade of trades from the Gymnasium to the Flagship.

A.3 Finishing Constraints

The finish work in the Gymnasium is slightly different than an average building. In order to lay the gym flooring, there must be a conditioning period for not less than 7 days prior to the placement of the floor, during the placement of the floor, and 3 days after placement. From this point forward, the ambient temperature must be maintained between 65 and 75 degrees F and have no more than 50 percent relative humidity. All overhead work including mechanical and lighting systems and athletic equipment must be installed. Although the gym flooring is a-typical of building finishes and has strict guidelines, it should not cause problems for the overall schedule because the Flagship Building determines when the project is finished.

B. Building Systems Summary

The following table and written information summarize the main building systems in the WCA Flagship and Gymnasium Buildings. The information describes the key design and construction aspects of the project.

Work Scope	Flagship Building		Gymnasium	
	Yes	No	Yes	No
Is demolition required?		✓		✓
What provides excavation support?	--	--	--	--
Is there a structural steel frame?	✓		✓	
Is concrete cast-in-place?	✓		✓	
Is precast concrete used?		✓		✓
Describe the mechanical system.	--	--	--	--
Describe the electrical system.	--	--	--	--
Is there masonry?	✓		✓	
Is there a curtain wall?		✓		✓

Table B.1 Building Systems Summary Table

As seen in the table, the same design and construction elements are used in the Flagship and Gymnasium Buildings. This is to alleviate an added learning curve, make construction more efficient, and create buildings that look similar.

B.1 Demolition

The Washington Christian Academy Flagship Building and Gymnasium reside on 60 acres that was once covered in forests. This land will eventually become a resting place for an entire educational and recreational campus. Of the 60 acre site, approximately 26 acres are reserved for forest retention. Retaining a high amount of trees and green space is important to the owner and the community. Therefore, the only demolition that must take place is the necessary clearing of trees and vegetation to make way for the buildings. Extra caution and money were spent to carefully remove only what was necessary, and to retain as much natural vegetation as possible especially along the roadways.

B.2 Excavation

The excavation for the foundation was simple in nature due to the shallowness of the foundation system. The foundation is comprised of continuous concrete wall footings and a slab on grade. Most of the excavation work had to do with removing the upper 1-2 feet of the top layer of soil and recompacting for bearing strength under the slab on grade. A few man made storm water management ponds were excavated around the site for water management, however these are not deep and have sloped sides. As far as the actual footings, they are under the 5 foot requirement that necessitates the use of excavation support, such as sloped or stepped walls. The soils from the onsite cuts are acceptable to use as compacted backfill, as long as they are aerated and dried a bit. The excavated soils have moisture contents above what is needed for optimum compaction levels. In order to handle the excess water, the man made ponds around the site collect most of the site drainage. They are bordered by silt fences to ensure that they do not get overfilled or clogged with silt and other fine particles. Additionally, there is a pump for dewatering during construction. A stream that runs near the entrance of the site has been temporarily diverted for the construction of an entrance bridge, and will be returned to its original location upon bridge completion. Any remaining ground water is pumped through hoses into one of the storm water management ponds so that the water does not cause erosion and further problems during construction.

B.3 Structural Systems

Cast-in-place concrete, CMU load bearing block walls, and steel joists comprise the foundation and superstructure of the building. There are also steel tube columns that are supported by cast-in-place concrete piers and footings in the areas of the building where the span from each load bearing wall is too great. No precast concrete (unless the concrete masonry units are an exception) is used in either the Flagship Building or Gymnasium.

B.4 Cast-in-Place Concrete

The cast-in-place concrete foundation is the same for both buildings. The continuous wall footings range in size from 2'-6" to 4'-0" and in thickness from 1'-0" to 1'-4". They are typically reinforced with #5 or #7 rebar running in both directions along the bottom of the footing. Turned down slabs are also employed in the foundation of the Flagship Building. The depth of this part of the foundation is intended to surpass the freeze-thaw line. Also unique to the Flagship Building are concrete footings and piers in the center of the building to support steel tube columns. The cast-in-place pier footings range from 5' square to 8'-6" square, and support 20"x20" concrete piers with 4-#8 reinforcing bars. The slab on grade (SOG) requires the bearing soil to have a minimum compaction strength of 2500 psf. On top of the compacted soil is 4" of washed gravel and a 6 mil. vapor barrier. The SOG is 5" thick. The cast-in-place concrete slabs for the second and third floors are 3" thick. All slabs in the building are reinforced with 6"x6" W1.4xW1.4 Welded Wire Fabric for reinforcing. The required strength of the concrete is 3000 psi normal weight at 28 days, with the extra stipulation of 4500 psi normal weight if the concrete will be exposed to weather while curing. The preferred method of placing concrete on the site is by a concrete pump. The pump can easily reach the third floor slab, and can reach the entire floor with a minimal amount of truck movement. Keyed construction joints allow for multiple concrete placements.

B.5 CMU Block & Steel

The Flagship Building uses 8" CMU and the Gymnasium uses 12" CMU block for the load bearing walls. The reinforcing in these walls is spaced every 24" on center. For non-load bearing walls, the only difference is that the reinforcement spaces out to 48" on center. The CMU minimum compression strength is 1900 psi. The steel used in both buildings acts as a load bearing system that spans the distance between load bearing walls. The steel is in the standard forms of beams, joists, and trusses. The ends of the steel beams bear on an average size steel plate of 8"x12"x5/8". Joists that bear on masonry walls are supported by a steel plate and a bond beam. There are 13 steel tube columns in the Flagship Building, which allow for large, open architectural spaces. The large spaces would not be possible with CMU load bearing walls alone because the span distance would be too great. The typical column is a HSS 8”x8”x ½”. Anchor bolts with a ¾” diameter connect the columns to a steel base plate that sits on top of the cast-in-place concrete pier mentioned previously. The steel is set in place by a mobile crane that will move through three locations for the Flagship Building and one location for the Gymnasium.

B.6 Mechanical System

Once the building’s structure is complete, the mechanical and electrical systems are ready to be put in place. The Flagship Building has an adjoining mechanical and electrical room in the northwest section of the building. There is also a small electrical closet located in the main corridor of every floor. 16 mechanical rooftop units serve the entire building and are typically 480V, 3phase. These units are hidden from a pedestrian line of sight by a shed-like gabled roof that runs along the perimeter of the built up roof. This aesthetic barrier adds a sense of completeness to the building, as well as hides the roof mechanical units. Roof top metal ventilators, bases, and soil stacks are kept watertight by metal flashing and roof sheathing. The kitchen on the main floor of the building requires additional mechanical equipment that would not typically be seen in every building. Compressors and condensing units for the kitchen are located on the roof in addition to 2 exhaust fans. The exhaust fans are rated at 600 and 3250 cfm and are equipped to exhaust very high temperature air reaching up to 300 degrees F with no damage to the fans.

The supply air is distributed throughout the Flagship Building by VAV fan powered terminal units with electric heat. The size of the units range from 720 to 1350 max cfm. Most of these VAV units serve 4 or 5 air supply diffusers. Typically, one unit is located above each room for occupant temperature control and comfort. The VAV units are connected to each diffuser with a removable flex duct. Larger open spaces, such as the corridors, are equipped with VAV single duct terminal units with electric heat that range in capacity from 300 to 1025 cfm. Typical registers and grilles collect the return air. All of the ductwork is to be insulated sheet metal and sealed with a mastic sealer. Any duct interiors that are visible through a grille or register are to be spray painted mat black to avoid an unfinished metal aesthetic look.

The Gymnasium’s mechanical system is similar, only with less ductwork and stronger powered air handling units. There are two roof top units. The first unit has a capacity of 1600 cfm, which serves the lobby, locker rooms, restrooms, and offices. The second unit has a much larger capacity of 6000 cfm and serves the entire gymnasium. Both units are 480V, 3 phase. There is a small mechanical room located in the gym.

B.7 Electrical System

The electricity is supplied to the Flagship Building through a switchgear located on the other side of Batchellors Forest Road from the school. The 15kV switchgear connects by way of a one-way duct bank to an electrical manhole. This manhole is then connected by a one-way duct bank to a pad mounted 480V Delta Primary – 208Y/120V Secondary 3 phase transformer which is located directly outside the south end of the Flagship Building. Once inside the building, the main power distribution panel is

480Y/277V 3 phase, 4 wire, 1600A, and 100% rated. All conductors are copper with type THW 75C insulation. The current AV equipment is connected to a junction box embedded in the slab by a 3" diameter conduit. To account for future demand, an extra 3" diameter conduit is attached to a junction box in the ceiling above the AV room for future equipment hookup. Electrical receptacles are mounted on the roof for servicing mechanical equipment.

The lighting in the Flagship Building hallways and classrooms are rectangular fluorescent luminaires. The foyer, also referred to as the Great Hall, has incandescent ceiling and wall mounted fixtures. Some indirect wall pendants are used in this space to create a certain aesthetically pleasing atmosphere.

The Gymnasium gains its electricity from the main Flagship Building electrical room. Two 4" diameter PVC conduits run underground from the electrical room to the Gymnasium. Fluorescent lighting is used in the lobby, offices, and locker rooms. In the gym, HID light fixtures are ceiling mounted for efficiency. There are 2 main electrical panels for the building, which serve the same areas as the mechanical units.

B.8 Emergency System

The fire and emergency systems for the two buildings are the same. The fire alarm control panel is located in the first floor main electrical room of the Flagship Building. Annunciator panels are located next to the front doors of each building. The Great Hall has addressable smoke detectors, and the rest of the building and gym has dual audio/visual smoke detectors. In any HVAC over 2000 cfm each, or any HVAC serving a common plenum space exceeding 2000 cfm in that plenum, a smoke detector is required. The emergency lighting is unique because it is self-testing. Self-testing bodine ballasts and circuitry will automatically test emergency lights for 30 seconds every 30 days and 90 minutes per year. The sprinkler systems in both buildings are a standard wet sprinkler with cast iron pipe and steel fittings. The sprinkler heads are semi-recessed pendant type with chrome painted finish.

B.9 Masonry Facade

Masonry exists in two forms on this project. First, it appears as CMU blocks to provide the main superstructure and interior walls. Secondly, brick serves as the exterior veneer of both buildings. All of the buildings on the WCA campus will be brick in order to create a unified campus aesthetic. The brick exterior exudes a familiar, time-honored architectural feel that exemplifies the WCA traditional theme. A standard modular size brick in two colors is used, as well as bands of 8" split face CMU. 8" accent brick patterns project 1/2" from the face brick on all of the Flagships 3-story peaked tower elevations as well as on the Gymnasium exterior walls. The brick is supported by masonry wall ties anchored into the CMU backup walls. It is the responsibility of the mason to ensure that the brick and mortar are the correct size and color. The schedule allows for a continual work flow from the Gymnasium to the Flagship Building.

B.10 Building Envelope

While no curtain wall exists on either building, a standard cavity wall system serves as the building envelope. The cavity wall system is located to the exterior of the CMU load bearing walls and is comprised of 2” rigid insulation and 2” air gap. Cavity drainage material and through wall flashing are located within the cavity wall near ground level, which allows the moisture to escape. Six large arched storefront windows are located on the Flagship building and three on the Gymnasium. There is one window on each side of the 3 towers of the Flagship, and 3 on the NE face of the Gymnasium. These windows are aluminum and glass, with cast stone lintels.

C. Project Cost Evaluation

C.1 Actual Cost

- Total Size: 78,271 SF
  - Flagship: 67,616 SF
  - Gymnasium: 10,655 SF
- Actual Building Construction Costs (CC) and Construction Costs per SF (CC/SF)

Building	Cost per SF (CC/SF)	Size (SF)	Total Cost (CC)
Flagship	$164.03	67,616	**$11,091,050**
Gymnasium	$148.23	10,655	**$1,579,390**
			$12,670,440

This results in a cost of approximately $161.88/SF for the entire project (both buildings).

C.2 Project Cost

- Total Project Costs (TC) and Project Costs per SF (TC/SF)

Included	Cost per SF (TC/SF)	Size (SF)	Total Cost (TC)
A	$220.72	78,271	**$17,275,640**
B	$264.99	78,271	**$20,741,480**

A: Includes Actual Building Construction Costs, Permits, and Sitework

B: Includes all of *A*, plus Design Costs, Unsuitable Soils Contingency Allowance, Owner's Change Contingency, Testing, and Owner's Rep. Salary

C.3 Major Building Systems Costs

System	Building	Cost/SF	Size (SF)	Total Cost
Electrical[1]	F	$31.24	67,616	$2,112,322
	G	$9.00	10,655	$95,900
	B	$28.21	78,271	$2,208,222
Fire Protection	F	$2.58	67,616	$174,360
	G	$2.31	10,655	$24,640
	B	$2.54	78,271	$199,000
Mechanical[2]	F	$24.73	67,616	$1,672,188
	G	$18.19	10,655	$193,790
	B	$23.84	78,271	$1,865,978
Structural[3]	F	$37.88	67,616	$2,561,300
	G	$62.39	10,655	$664,765
	B	$41.22	78,271	$3,226,065
TOTAL	B	$95.81	78,271	$7,499,265

F: Flagship Building G: Gymnasium B: Both Buildings (total for project)

[1] Includes Electrical System and Communication System
[2] Includes Plumbing, HVAC Systems, and Mechanical Equipment
[3] Includes Concrete, Masonry, and Structural Steel Only

C.4 Square Foot Estimate using *R.S. Means 2007*

The *2007 R.S. Means Square Foot* estimate guide contained item M.520: Religious Education. Upon review, the largest SF area for this building type was 13,000 SF, 1 story. Even multiplied by 3 to account for the extra stories in the Flagship Building results in 39,000 SF, which is significantly less than the buildings' actual 78,271 SF.

It was decided to use M.580: School, Jr. High, 2-3 story. The reasons for this decision were the following:

- The Flagship Building is a school teaching K-12, Jr. High is in the middle of that range.
- The costs for Elementary schools and High schools were less than the Jr. High, so using the Jr. High for the cost estimate would yield the highest school cost and therefore be the most conservative solution.
- The gymnasium is included in the Jr. High estimate.
  Please see Appendix B for a copy of the *R.S. Means* M.580 data.

Below is the cost breakdown using *R.S Means*:

Cost per square foot of floor area: $121.19
Perimeter Adjustment: $2.51
Story Height Adjustment: <u>$1.22</u>
$124.92/SF

$124.92/SF at 78,271 SF yields a building construction cost of:
$9,777,613

Common Additives account for an approximate additional cost of:
$1,500,000

Location Factor:
Olney, Maryland was not on the list and the WCA is not actually in Washington, D.C.
Therefore, the most fair and accurate method available was to use an average.

Average for all listings in Maryland	.865
Washington, D.C.	.98
Location Factor Average:	.92

Time Factor:
Not used because data from 2007

<u>Final Result</u>
R.S. Means M.580: School, Jr. High, 2-3 Story Building Construction Cost:
$132.56/SF x 78,271SF: **$10,375,404**

C.5 Parametric Estimate

The following parametric estimate was performed in the *D4 Cost 2002* estimating software. The table represents four similar projects that were chosen to produce SF and Building Construction Cost estimates. The location, time, size, and construction methods were changed from the projects listed below to better match those of the WCA project. After the adjustments, the following cost estimates were reported.

Building Name	Description	Cost per SF	Total Building Construction Cost
St. Anne's Episcopal School	Rural, traditional architecture, gym included	$178.48	$13,969,976
Christ the Teacher Catholic School	Rural, gym included, K-8	$108.72	$8,509,695
Pope John XXIII HS	High School Building	$83.41	$5,639,553
	High School Gymnasium	$82.84	$882,608
			$6,522,161
Northwood School District	Rural, K-12, gym included	$53.61	$4,196,163
AVERAGE		$106.03	$8,299,499

C.6 Comparison

Summary of Estimates

Estimating Tool	Cost/SF	Cost
Actual Building Construction Cost	$161.88	$12,670,440
Total Project Cost	$264.99	$20,741,480
R.S. Means 2007	$132.56	$10,375,404
D4 2002	$106.03	$8,299,499

For comparisons sake, the total project cost should not be considered because no other estimating tool accounted for sitework, contingencies, design fees, etc. Therefore, the true comparison lies between the Actual Building Construction Cost vs. *R.S Means 2007* and *D4 2002*. The *R.S. Means 2007* comparison is relatively close to the actual cost. This is predictable because practically every part of the WCA buildings were included (correct size, height, school & gymnasium, kitchen, bleachers, etc.). The fact that the guide is from 2007 also helps because SF values are current and more accurate to today's estimates. The *D4 2002* cost estimate is significantly lower. Section C.5 illustrates that only one of the four similar institutions was in the proximity of the actual building cost. This could be attributed to outdated information, not finding suitable school matches (most were only K-8), and the high quality construction that the WCA owner is seeking.

D. Site Information & Plan of Existing Conditions

The Washington Christian Academy campus site is located in Olney, Maryland, which is in Montgomery County. The WCA website describes the site in the following way:

> Through many miraculous providences, the Lord has provided sixty acres of undeveloped land enhanced by streams, wetlands, and forest stands. This property provides a contemplative setting for the new campus located at Georgia Avenue and Batchellor's Forest Road. Montgomery County has designated Batchellor's Forest Road as a rural road, so the school's pastoral location will be maintained into the future. Portions of the acreage have been deemed environmental areas that cannot be developed, which provide educational opportunities in themselves.
>
> *http://www.washingtonchristian.org/page05b3.html*

The full address of the site is 16227 Batchellors Forest Road, Olney, Maryland 20832. Below are pictures and a site diagram showing the WCA site, location, and surrounding roads/neighborhoods. Each picture gets progressively closer to the site. Batchellors Forest Road and the site are highlighted in red in every picture for consistency.

Image D.1 Zoomed out aerial photo

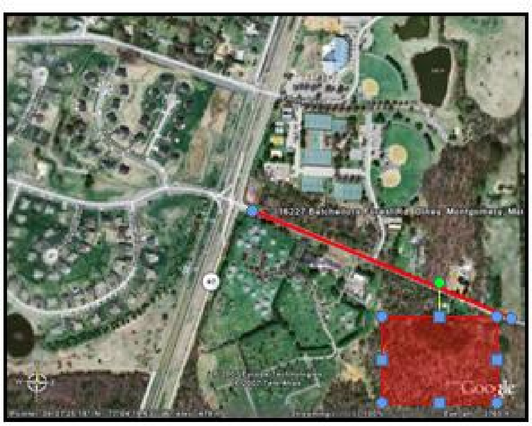


Image D.2 Major intersection near site

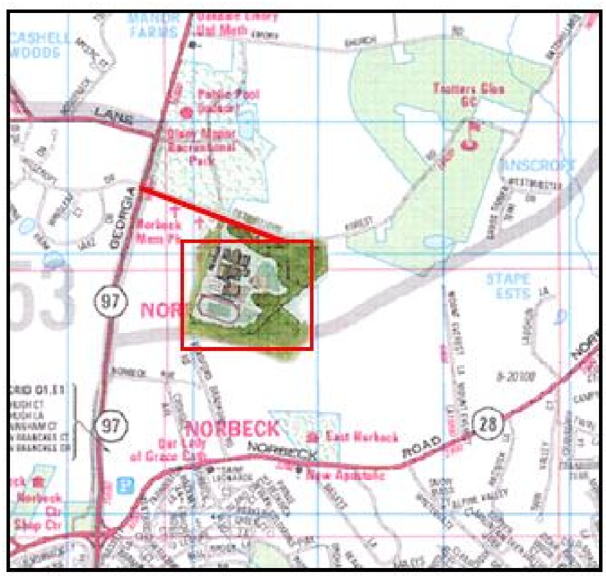


Image D.3 Major roads and WCA rendered site

Below is an aerial Google Earth photograph of the entire site and existing conditions with the future construction and neighbors shown by colored layers.

Image D.4 Aerial photo with approximate site layout and usage.

- Eventual outline of WCA campus (buildings only)
- WCA Gymnasium
- WCA Flagship Building
- Water Retention Ponds
- Neighbors
- Cleared for Phase I

The puporse of this layout is to visualize the site orientation and grasp the full layout of the 60 acres. Everything labeled is an approximation. The only neighbors to the site are a cemetery to the West and one house across Batchellors Forest Road. The rural setting of this site alleviates the typical site conflicts of congestion, lack of parking and storage, and noise restrictions. Most of the remaining forests shown in the photograph will be retained with the exception of adding a few athletic fields.

Site Plan of the Existing Conditions at the WCA Site

16227 Batchellors Forest Road, Olney, MD 20832

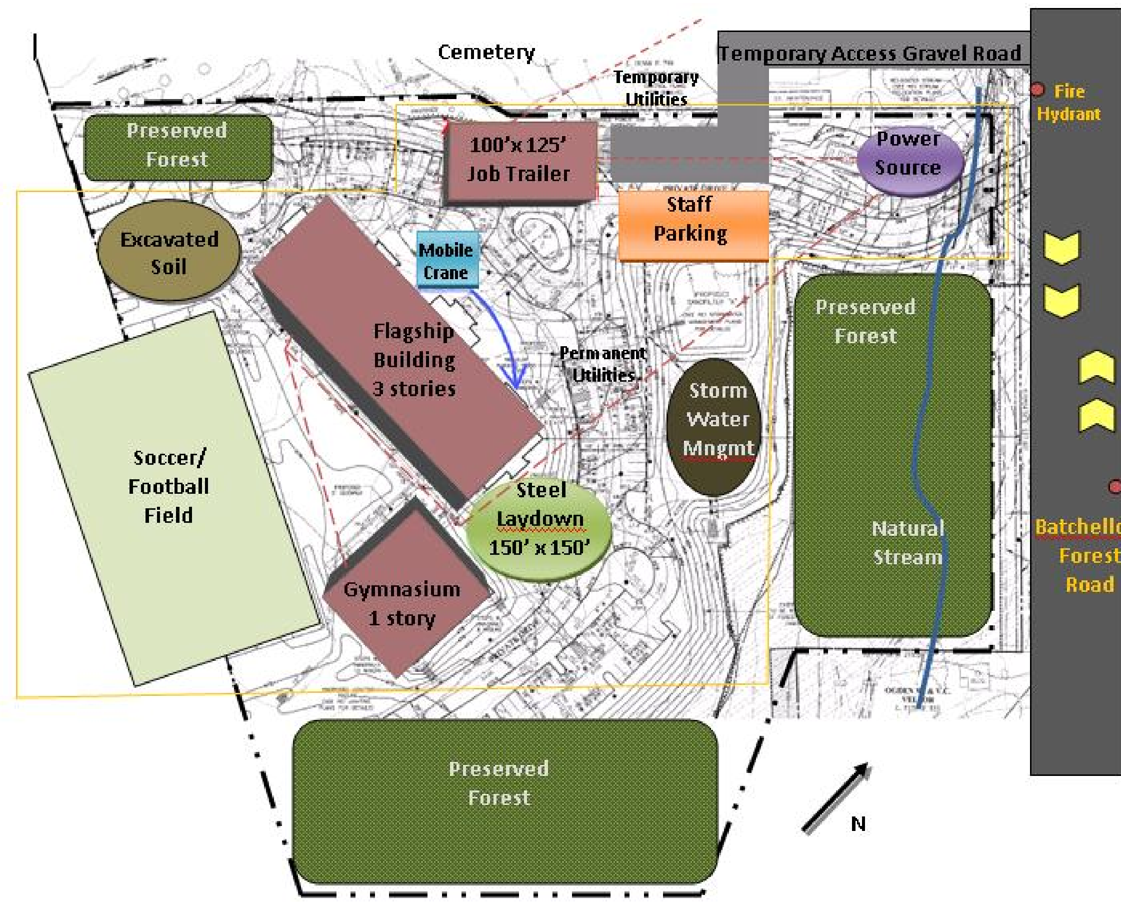


Image D.5 WCA Site Plan

The above site plan represents Phase I of construction. A large site lends itself nicely to much storage area. The site fence (orange line) runs to the interior of the preserved forests. The natural stream was temporarily diverted to build an entrance bride onto the site from Batchellors Forest Road. There is no traffic light to turn into the site; however Batchellors Forest Road is not busy enough to complicate machinery and truck deliveries. The largest obstructions in the temporary site plan are the turns in the temporary access road, which may cause problems with large delivery trucks. The road had to be run around the utility access point, which also powers a maintenance building for the neighboring cemetery. The site is concealed from the street by thick trees, which also helps to dampen sound coming from construction.

E. Local Conditions

The new Washington Christian Academy site is located in a rural area of Montgomery Count, Maryland. It is approximately 30 miles in the slight northwest direction from the center of Washington, DC. The rural area and large site eliminate many of the typical constraints that come along with congested, urban sites. There is designated room to store the excavated soil on site so it can be reused at a later date. Excavating, hauling, and bringing in more soil is a costly process that is eliminated at the WCA site. Another advantage of having a large site is the ability to have a large job site trailer. The main WCA team can work together on site everyday, and avoid a lot of the misunderstandings and communication delays that occur when teams work in separate buildings.

The soil conditions on site are defined as the following:

- Minimum required bearing pressure is 2500 psf.
- Soils from site may be compacted and reused.
- In place moisture contents are above optimum level for compaction, so excavated soils must be spread out and aerated (for drying purposes) before being reused.
- No rock excavation will be needed.
- Two dry storm water management ponds [seen in section D] collect site water and runoff.
- Soils are typically soft to medium density sandy silt and lean clay.

One unique local condition the WCA team faces is a substantial overgrowth of bamboo on the site. Bamboo is natural to this region and is a threat to building structures. Bamboo grows at an alarmingly fast rate and spreads easily. Its strength can break concrete foundations, which is why it must be removed from the site. Removing the bamboo will take a fairly good amount of time due to the fact that it must be chopped down and then each new shoot must be mowed down before it has time to spread again. Eventually, after an unpredictable amount of attempts, the bamboo will lose its energy supply and die.

The two buildings on the WCA site are not attempting LEED certification. However, some attempt to recycle construction materials is still being made. There is a “masonry only” dumpster on site that is used for CMU waste. Tipping fees are less expensive to have “masonry only” dumpsters pulled from the site. While typical dumpster removal charges by weight, the masonry dumpsters are charged a flat fee per dumpster. This creates a win-win situation for the environment and the construction teams.

F. Client Information

F.1 General Owner Information & Mission

The owner of the project is a Christian Educational Organization known as the Washington Christian Academy. Their intention is to build a Washington Christian Academy campus that will educate students academically and spiritually. The original school was founded in 1960 by families from Presbyterian and Christian churches. It was founded on the principle of Reformed Tradition, which is based on welcoming a diverse student population (racially, socially, and any Christian denomination). In 1996, the school merged with Silver Spring Christian Academy and henceforth was named Washington Christian Academy. The new Flagship school will provide education for approximately 300 K-12 students and serve as a home to the WCA administration offices. The reasons for the move from WCA's current location in Silver Spring, MD to Olney, MD are outlined below in an excerpt taken from the Washington Christian Academy website.

> Building the Promise is rooted in wisdom and good sense. It has been seasoned in prayer and in wide consultation, and it makes sensible provisions for the future of Washington Christian Academy. The proposed location provides many practical advantages: a good location on a major regional road; a setting of natural beauty; room to expand. A permanent home gives our families greater security and stability than rented facilities. We are designing our campus to suit our educational goals. Academics, athletics, music, drama, and extracurricular activities will finally get the space they need.
>
> *http://www.washingtonchristian.org/page05b2.html*

The master plan will take over 10 years to build. Phase I is currently being constructed, which includes the Flagship Building, Gymnasium, a soccer/football field, baseball field, and softball field. The overall campus will accommodate 1,100 students when it is finished and will include separate elementary, middle and high schools, an athletic complex, more athletic fields, a chapel, and performing arts spaces.

F.2 Construction Details & Priorities

During construction, the owner is represented by an owner's representative. The school's Headmaster, Vice President, and Chief Financial Officer make most of the decisions concerning the construction of the building, but are represented by one man who attends meetings and deals directly with the general contractor. He serves as the liaison between the WCA decision makers and the field.

The owner is concerned with cost constraints on the project, but ensuring that the job is done well and that the building is of high quality is more important. Vic Bonardi, the Forrester Design-Build Manager, was quoted saying, "In the process of controlling the budget, we never wanted to cheapen any part of the facility that would have to stand the test of time". The owner put some contingency money in the project budget to allow for changes and additions, but would most like to use the money for last minute upgrades that would really make the educational facility first class. At this point, schedule constraints are of the most importance to the Washington Christian Academy. The buildings must be open and operational for the 2008-2009 school year. As it is scheduled now, Phase I will be completed in early August which does not allow for many more changes or delays. An example of how important the schedule is to the owner is demonstrated by the fact that the owner is spending money to accelerate the project. They are willing to pay overtime in order to recover from the initial project delays.

A close second in priority to the owner is keeping the parties involved happy. Running a smooth project without complaints or high numbers of change orders is important. There is a prosperous working relationship in the fact that everyone is actively doing the best they can to solve problems quickly and efficiently, and avoid change orders whenever possible. Keeping the neighbors happy is just as important to the Washington Christian Academy. For instance, the WCA spent a bit of extra money to excavate differently near the main road to save some trees that the neighbors wanted to be retained. A few neighbors across Georgia Avenue had concerns that they were not being properly notified of construction dates and durations. These concerns have been addressed and remedied. The WCA intends to keep a positive rapport with its future neighbors in order to gain local support and acceptance in the Olney Community.

G. Project Delivery System

G.1 Project Delivery Method

The conventional delivery type in Washington, DC and surrounding areas is the standard Design-Bid-Build method. This project, on the contrary, uses the less typical Design-Build approach. The usual trademark characteristics of a Design-Build project are integrated design and construction phases, early retainage of subcontractors, subcontractor input in design, fast moving projects, incomplete design documents, and most notably a single contract between the owner and construction manager. The Washington Christian Academy Flagship Building and Gymnasium only make use of the single contract characteristic of a typical Design-Build delivery. The original contract schedule does not show construction beginning until the final design was complete. This counteracts the concept of a fast-track project and overlapping design/construction phases.

So why did the WCA choose a Design-Build project delivery system, and why choose Forrester Construction Company as the company to hold the contract with? The answer is that the WCA is not an experienced owner. Typically, school boards and presidents are inexperienced in the construction process and hire a third party construction manager to oversee the construction details and logistics. The Washington Christian Academy decided to hire Forrester to assume the role of the construction manager and general contractor. It was then Forrester's job to contract with the architect, engineers, and subcontractors. While the subcontractors were not involved in the design process, Forrester Construction Company was. As a result, the construction consideration during design was still achieved, which is a large benefit of using the Design-Build method. This has the potential to result in fewer change orders and missed scope. Additionally, there is typically less risk for the owner in a Design-Build project delivery. The single prime contract protects the owner from missing scope between multiple contracts. It is Forrester's job to ensure that the building is completed to the owner's standards and contract agreement terms.

The reason Forrester was chosen as the Design-Builder is because they are a qualified, local, reputable construction company in the metro DC area. Their Design-Build division is growing and completing many successful projects. The project was gained by a negotiated bid. Forrester Construction Company obtained the subcontractors through a competitive bid process. It is required of all subs to have General Liability, Automobile Liability, Workers Comp., and Excess Umbrella Insurance. Any subcontractor that has a contract amount under $100,000 does not requiring bonding. A contract amount over $100,000 requires a bond for the full contract amount for performance and payment. All forms of insurance must be job specific.

G.2 Organizational Structure & Contract Types

The following page is an organizational chart that demonstrates the project hierarchy as well as the contract types held between each major party.

<u>Single Prime Contract:</u> The single contract that the owner holds is with the Forrester Construction Company. The primary purpose of a contract is to allocate risk; and this type of system allocates a great

deal of risk to Forrester. It is a safe method of contracting for the owner and can be a profitable method of contracting for the Design-Builder. Typically in a GMP contract, the owner recovers the contingency money (and in this case wants to re-invest the extra money for high end finishes). This cost reimbursable contract type is frequently used for Design-Build projects because it typically occurs before 100% of the construction documents are complete.

Contracts with Design Companies: Forrester hired and collaborated with Grimm+Parker Architects. The contract type in this situation is a lump sum contract. It becomes the responsibility of Grimm+Parker to obtain and contract engineering consultants. This partially adds to the Design-Build characteristics of the project. The architectural design incorporates the engineers and the construction perspectives because the typical "middle man" is out of the picture.

Contracts with Construction Subcontractors: Forrester holds lump sum contracts with each subcontractor on the site (only the major subs are shown in the organizational chart). Every CSI division is the responsibility of one or two subcontractors, depending on how the work scope is divided. The subcontractors are chosen based on a variety of selection criteria. This criterion includes but is not limited to previous experience on the type of project, familiarity and relationship with Forrester, current workload and capacity of the subcontractor, and verification of insurance.

These contract types seem appropriate for this type of project delivery system. A typical contract defines scope, compensation, time, schedule constraints, and legal issues. It is logical that an inexperienced owner would only hold one of these contracts with a reputable, trustworthy Design-Builder. The owner is still making changes and additions to the final design (even though final contract documents have been issued). This contract allows for the owner's contingency money to be used as they deem necessary, which in this case is for accelerating the project, change orders, and upgrades.

Organizational Structure for Washington Christian Academy

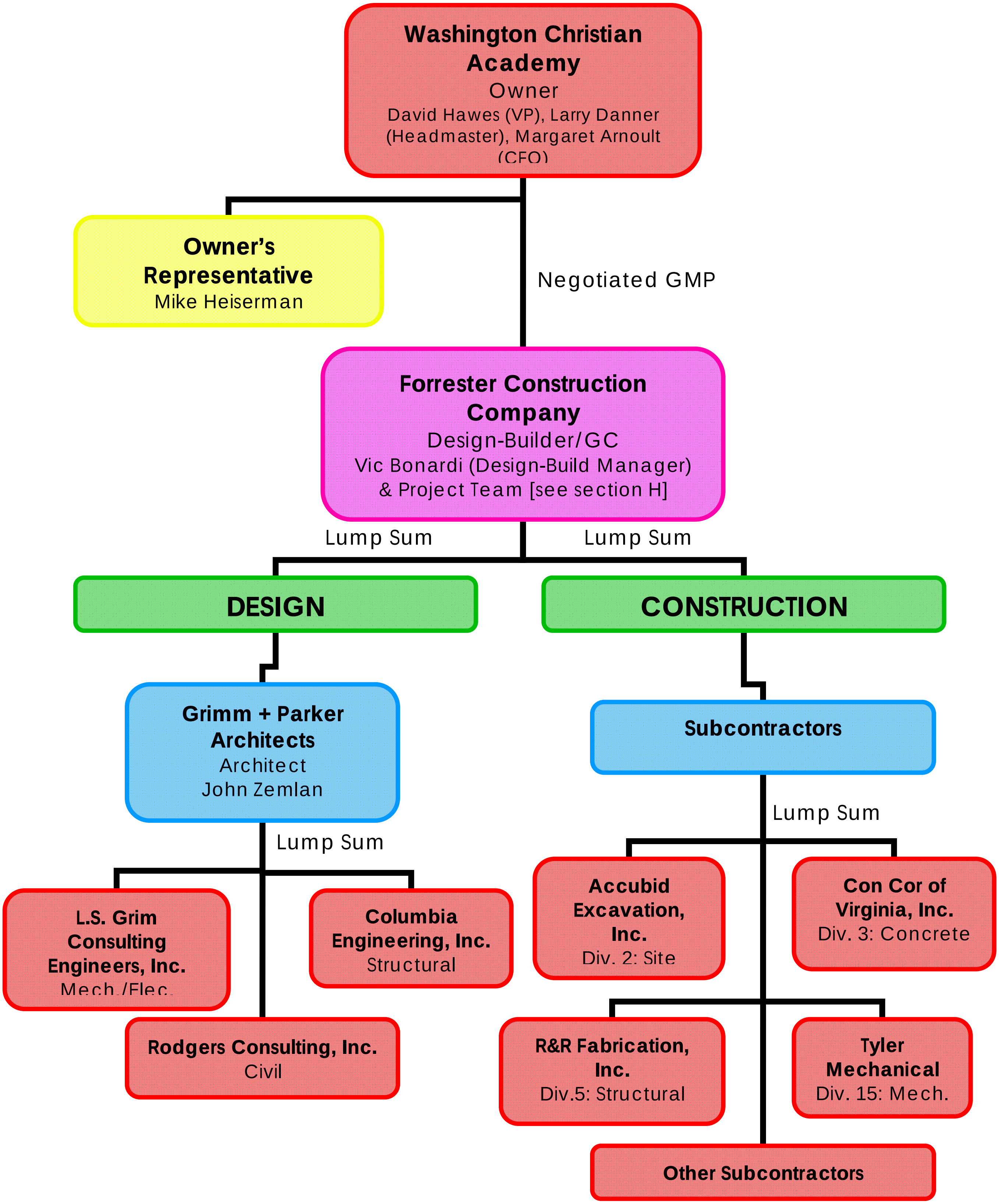
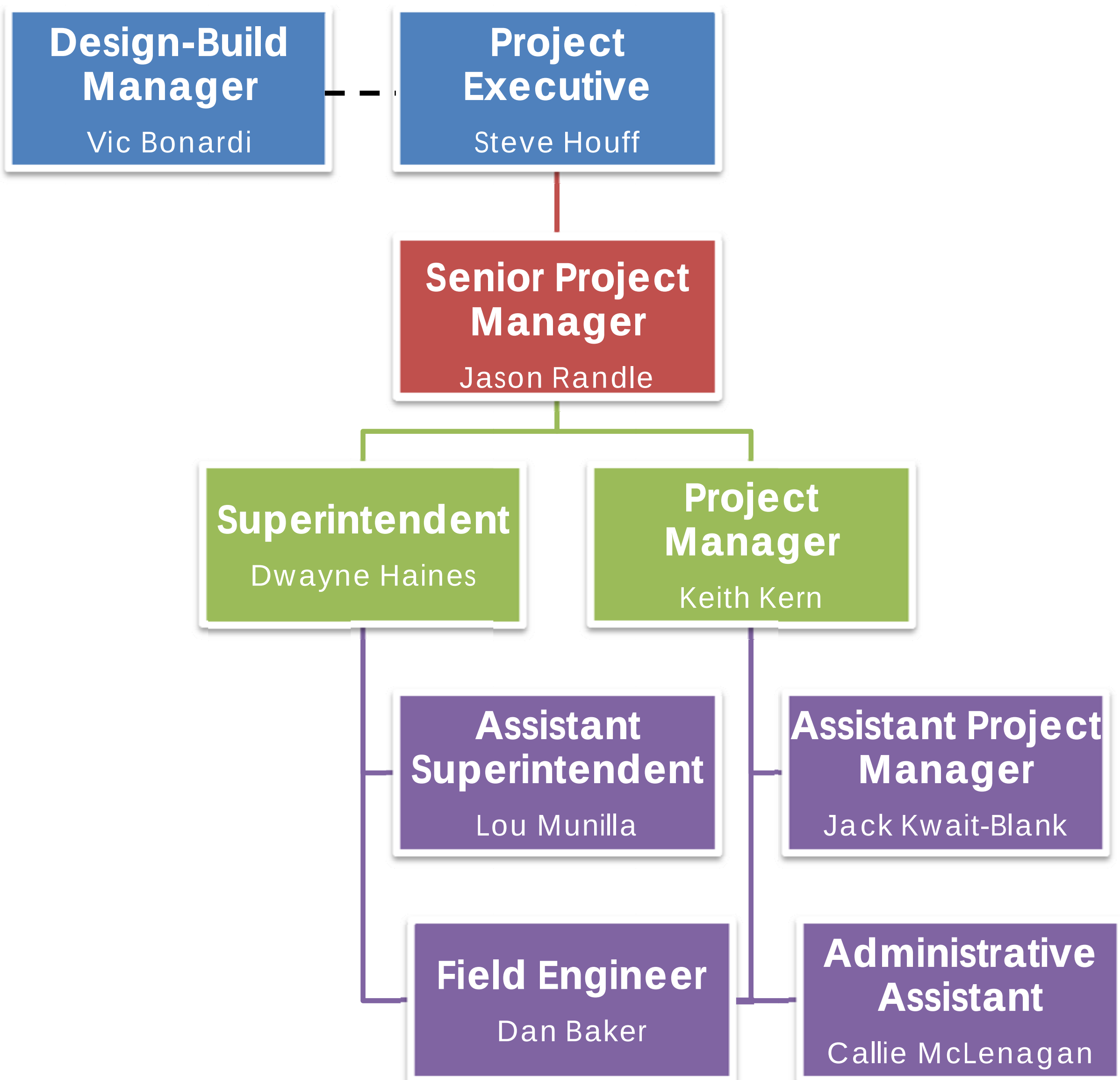


Figure G.1 Organizational Chart for Washington Christian Academy and Contract Types

H. Staffing Plan

Internal Organizational Structure for Washington Christian Academy

Forrester Construction Company



Employees based from the main office in Rockville, MD.
Employees based from the main office in Rockville, MD.
Employees based from the WCA site trailer.
Employees typically based from the WCA site trailer, may travel & assist with other projects from time to time.

The organizational chart shows the current structure of the Washington Christian Academy team. The Design-Build Manager oversees all of the Design-Build projects in the company, which is why there is a dotted line connecting him to the project. The Project Executive and Senior Project Manager also supervise multiple projects simultaneously. The Superintendent and Project Manager are the most involved upper management on a day-to-day basis. Typically, they are only assigned to one project at a time. These two men work together collectively to solve problems, manage subcontractors, and complete the project successfully. Supporting the Superintendent and Project Manager are the Assistant Superintendent, Assistant Project Manager, Field Engineer, and Administrative Assistant. These employees help to complete tasks, supervise work, and keep everything running smoothly. At Forrester Construction Company, there is a strong emphasis on team work. In fact, the above employees shown in the organizational structure would be referred to as the “WCA Team”. While a certain level of hierarchy exists, the atmosphere is one of equality and respect. Each team member is acknowledged as a vital part of the project’s success.

References

About WCA. Washington Christian Academy Web Site. Retrieved September 26, 2007, from http://www.washingtonchristian.org/

Arundinaria gigantean (Walt.) Muhl. giant cane. *PLANTS Database*. USDA. Retrieved September 30, 2007, from http://plants.usda.gov/java/profile?symbol=ARGI

Balboni, Barbara, senior editor. *R.S. Means Square Foot Costs, 28th Annual Edtion*. Reed Construction Data, Inc., 2006. p 190-191, 202-203, 453-454.

Magent, Chris. AE 472 Class Notes, Spring Semester 2007. The Pennsylvania State University.