Emory University Psychology Building

Atlanta, Georgia

Technical Assignment #1

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Construction Management
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Submitted September 29, 2009

Executive Summary

The Emory Psychology Building is a 119,000 square foot academic building for Emory University in Atlanta, Georgia. It has a total of five stories as well as a mechanical penthouse. The project started in late October, 2007 and will be complete in late February or early March of 2009. Emory chose HOK as the architect for the project and Holder Construction as their construction manager. Emory and Holder have agreed on a $35,029,000 guaranteed maximum price for Holder to deliver the project. Emory is pursuing LEED Silver certification for this building and is currently the leader among universities for buildings with LEED certification.

The entire project for Emory consisted of demolishing two dormitories, relocation of utilities, construction of a new road, and construction of the new Psychology Building. The scope and complexity of the project caused Holder to use Building Information Modeling (BIM). They have used BIM primarily for planning, sequencing, and clash detection. By using the model, Holder was able to make a congested site much more manageable and reduce costly field clashes.

The building will house the psychology department and add to the science commons of Emory. It will contain classrooms, laboratories, and offices. Like many buildings on Emory's campus, the Psychology Building has stone and stucco cladding backed by CMU and a red clay tile roof. HOK added a modern look to the building with a glazed curtain wall along the east façade. The building is supported by a cast in place concrete frame and slabs, with the tile roof supported by a steel structural frame.

This report takes an in depth look at the existing conditions of the project as well as the cost, project team, and project delivery method. Its contents include a construction project summary, building systems summary, cost evaluation, construction site plan, summary of local conditions, owner information, the delivery system of the project, and how the construction manager has staffed the project.

Table of Contents

1.1 Project Schedule Summary

The design of this building began in March, 2007 by HOK Inc. To obtain a construction manager, Emory sent out a Request for Proposal (RFP) to a select list of companies. After responding and subsequently being awarded the RFP by Emory, Holder joined the project team for an earlier phase of the project and started procuring trades for the building in August, 2007.

The total project for Emory is actually two phases, with the first phase being mostly construction of a new road. The focus of this schedule is only on the second phase, the new Psychology Building. Excavation and site utility work started shortly after receiving the building permit on October 19, 2007. Approximately one month later, foundation work had begun. Although the foundation took nearly three months to complete, Holder was able to start the slab on grade and first floor columns about one month after the foundation started. The elevated slabs and associated columns started on January 16, 2008. Typically each level took about 40 days to form, reinforce, pour, strip, and remove re-shoring. Each slab started approximately two weeks apart. Structural steel for the penthouse roof support started in mid April and took close to two months to complete all aspects of the steel, including the decking.

After the concrete work was complete, masons started to work on the building skin on March 17, 2008. The work has continued and is expected to be complete on October 8, 2008, and will provide the building with a barrier to outdoor conditions.

Just before the masons mobilized, rough in work started on the first floor for MEP systems. Rough in continued up through the building and was followed by wall framing and door frame installation. In June of 2008, finishes started and followed a path similar to rough in. The final finishing touches will be put on in February, 2009, just before the owner starts to move in on February 10. Close out will continue until substantial completion on March 3, 2009.

For a complete schedule please see Appendix A.

1.2 Building Systems Summary

The following table provides a brief overview of the scope of work contained on this project.

YES	NO	Work Scope
X		Demolition Required?
X		Structural Steel Frame
X		Cast-in-Place Concrete
	X	Pre-cast Concrete
X		Mechanical System
X		Electrical System
X		Masonry
X		Curtain Wall
X		Support of Excavation

Table 1 Building system scope.

1.2.1 Demolition

Although there were no existing buildings on the building site, some demolition had to be completed along with the excavation. Most of the demolition included removal and relocation of underground utilities. These included gas, storm, water, and sanitary sewer lines as well as man holes and duct banks. The only structures that needed to be removed were a site wall, slab, stair, and pavement connected to the adjacent Chemistry Building. Tree removal and relocation was coordinated with Emory.

1.2.2 Structural Steel Frame

The structural steel on this building is used only as support for the penthouse roof. A braced frame is used as well as wide flange beams ranging in size from W12x16 to W18x35. Channels along the outside perimeter of the roof make up the last part of the structural steel. The steel was set partially by the tower crane already in place for the concrete, and partially by a mobile crane. The steel erector used both to expedite the installation process.

1.2.3 Cast-in-Place Concrete

This building's primary structural system is cast-in-place concrete. The foundation consists of drilled piers for deep foundations, and grade beams for shallow foundations. The drilled piers average about 40 ft. deep and range in diameter from 3 ft. to 4 ft. The grade beams are 4 ft. thick and support the east façade of the building. The columns, beams, and slabs of the superstructure are all cast-in-place concrete with steel reinforcing. Slabs are typically 5 in. thick. Post-tensioning was used for the girders that support the beams for added support. A crane was used to place the concrete.

1.2.4 Mechanical System

There are 4 penthouse air handling units (AHUs) for this building. Each unit is a different size ranging from 4,900 cubic feet per minute (CFM) to 55,280 CFM for a total of 104,380 CFM. There is also an outdoor air energy recovery unit (ERU) that helps to cool/heat the outside air using stale indoor air, depending on the season, to save energy in the AHUs. Outdoor air is supplied through perforated panels from the plenum under the large roof overhang. The AHUs are fed from 6" chilled water pipes from the campus, which decrease in size as they enter the building. The campus pipes enter on the west side of the building and run up a chase on the west side to the mechanical penthouse. The steam is also fed from the campus. The steam enters on the south end of the building and runs up a chase in the south stairwell to the mechanical penthouse. The penthouse also contains two unit heaters for heating water.

Each room in the building contains a variable air volume (VAV) unit to allow for individual room temperature control. There is a thermostat in every room that works with the VAV to control the temperature of that room. The VAV controls how much air it will supply from the return air and supply air since they each enter the VAV at different temperatures. They are mixed based on a percentage determined by the VAV to provide the room with the desired temperature. A large air conditioner, separate from the rest of the building, will serve the functional magnetic resonance imaging (fMRI) room.

1.2.5 Electrical System

The Psychology building is fed by a 19.8 kV utility from Emory's Campus. There is a service yard located just outside of the NE corner of the building that takes in the 19.8 kV from campus and steps it down to 480/277V before entering the building. From there the power is distributed to 2 electrical rooms on each floor. Once the power gets to the electrical rooms, it is either sent to various panel boards on that floor, or stepped down again to 208/120 V and sent out to panel boards on that floor. The service yard also houses a 300 kW 480/277 V generator to account for any utility power outages. In the future, the Psychology building and Chemistry building will share the service yard for incoming electric service.

1.2.6 Masonry

The north, south, and west exterior walls of the building are all backed by 8" CMU. The first floor and half of the second floor of these walls are each clad in dimensional limestone. The rest of the façade of each of those walls is clad in stucco. There is also a small amount of limestone with CMU backing on the east façade.

1.2.7 Curtain Wall

Almost the entire east façade of the Psychology Building is a glazed curtain wall. The curtain wall is comprised of aluminum infill panels and solarban 60 glass. Solarban 60 glass reduces heat gain while allowing visible light to pass through, which is perfect for the hot climate of Atlanta. There are also similar curtain wall constructions on the north and west facades, but are on a much smaller scale.

1.2.8 Support of Excavation

There was very little support necessary for this project; however, there is a retaining wall on the east side of the building that required shoring. Soldier beams and lagging were used for this part of construction to hold back the soil.

1.3 Project Cost Evaluation

The following table displays the total building cost, project cost and major systems costs for Emory's Psychology Building.

Item	Cost	Cost/SF
Sitework/Site Utilities	$ 3,026,243.00	$ 25.42
Foundations/Structure	$ 5,202,505.00	$ 43.70
Building Skin	$ 5,958,134.00	$ 50.05
Interior Construction	$ 4,606,691.00	$ 38.70
HVAC/Plumbing	$ 5,329,653.00	$ 44.77
Electrical	$ 4,263,367.00	$ 35.82
General Conditions/Fee	$ 2,409,406.00	$ 20.24
Building	$ 32,002,757.00	$ 280.05
Total Project	$ 35,029,000.00	$ 294.27

Table 2 Costs and Costs/SF by system.

The building cost is the total project cost minus landscaping, excavation, and site utilities, etc. costs. Basically, it starts with the foundations and includes everything from there on. As you can see, the building estimate came in at just over $35 million.

An initial cost evaluation was based on RS Means 2008 Construction Cost Data. RS Means provides a simple, easy way to estimate construction costs based on square footage and lineal feet of the building footprint and similar building types. The building type chosen for this evaluation was an 8 story, concrete-framed office building, with a limestone façade, backed up by CMU. The following table shows the calculations to come up with a rough construction estimate for the Psychology Building. Also, please refer to RS Means data sheets located in Appendix C.

		Psych. Area
	SF	119,000
	Cost/SF	147.33
Adjustments		
Perimeter Adjustment=	(220/100)*4.59	10.1
Height Adjustment=	(12-12)*1.76	0
	Cost/SF	157.43
	Cost	$ 18,734,170.00
Basement Adjustment=	22,066*33.5	$ 740,000.00
Location Adjustment=	(0.9)Cost	$ 19,474,170.00
	Final Cost:	**$ 17,526,753.00**

Table 3 RS Means Cost Evaluation.

Obviously, this evaluation is not very accurate. The final cost from this evaluation is about half of the GMP. Fortunately, RS Means includes a breakdown of the scope of work of the average building with the square foot estimation data. The scope of work was for a basic office building. The Psychology Building has space for offices, classrooms, and laboratory space. The finishes are of high quality and building support systems are more complicated. To customize the evaluation of this building, some increases and allowances had to be included. The following table on the next page shows a customized evaluation for the psychology building.

System	% of Building Cost	Adjustment?	Adjusted %	New % Cost
Substructure	2.3	None	2.3	1.2
Superstructure	17.8	None	17.8	9.1
Exterior Enclosure	17.3	x2.5	43.3	22.2
Roofing	0.6	Allowance	0.6	0.3
Interiors	19.2	x2	38.4	19.7
Conveying	9.5	None	9.5	4.9
Plumbing	2	x3	6.0	3.1
HVAC	14.8	x3	44.4	22.8
Fire Protection	0.2	None	0.2	0.1
Electrical	16.2	x2	32.4	16.6
	100		**195**	100

Table 4 Adjusted RS Means systems percentages.

The reasons for each of the increases are as follows:

- The exterior enclosure from RS Means is a pre-cast concrete system. The actual system is CMU back up with limestone and stucco cladding. The time to complete this construction and quality of product warrants a 150% increase.
- The interiors of this building, especially common areas, are of very high quality and include a lot of wood. A 100% increase was given over gypsum board and standard finishes.
- The plumbing for the labs and the fact that air handling units are located on the roof warrants a 200% increase over the standard plumbing system.
- The HVAC systems required for labs and VAV units throughout the building require a 200% cost increase.
- The electrical system contains a large generator and powers lab equipment, requiring a 100% cost increase.

When you apply the increases, the price is much more reasonable. Also, there are some items that apply to the Psychology Building that were not included in the RS Means estimate that need to be factored in. The cost for the factored in allowances was estimated based on scope of work and schedule implications. The following table, on the next page, shows the final evaluated cost, including scope of work percentage increases and allowances.

Initial RS Means Cost:	$	17,526,753.00
Cost increase		x1.95
Adjusted Cost:	**$**	**34,177,168.35**
Allowances		
Deep Foundations	$	300,000.00
Clay Tile Roof	$	70,000.00
Re-route Utilities	$	10,000.00
Curtain Wall	$	1,000,000.00
	$	**2,210,000.00**
Total Cost=	**$**	**35,557,168.35**

Table 5 Final RS Means Evaluation.

Finally, the price is very close to where it should be. The RS Means data proved to be useful in some aspects, but vague in others. Although it eliminates the need to do detailed take-offs, an inexperienced user may not look deeply into the systems of their building and change the percentages to fit their building's need. If the building being evaluated is very similar to the one used as the RS Means data, RS Means is a great tool. If the user takes a deeper look into the building and RS Means data, he or she can also find some very useful results.

The next means of cost evaluation for the Psychology Building was D4 Cost Estimating Software. D4 uses actual cost information from previously built buildings to estimate costs of future buildings. The method used for this building was called a "smart average." For a smart average, the software combines information from a number of buildings in order to match as many traits of the estimated building as possible. The user simply picks three buildings that closely relate to their building, then the program averages them together to find an estimated cost.

The Psychology Building was based on information from three previously built projects, a science education building for Texas A&M, an engineering building for Virginia Polytechnic Institute and State University, and a government office building. These projects were chosen based on the occupancy, type of building, stories, and individual traits such as lab space, a curtain wall, and environmentally friendly goals. Individual traits are added to the scope during the smart average, while the common traits are averaged to come up with an estimate. That number is then adjusted for inflation, location, and square footage.

CSI #	Division	Cost	% of Cost
0	Procurement and Contract Requirements	$ 965,407.00	2.93
1	General Requirements	$ 782,075.00	2.37
2	Existing Conditions	$ 1,297,305.00	3.94
3	Concrete	$ 4,613,467.00	14.00
4	Masonry	$ 1,010,189.00	3.07
5	Metals	$ 916,945.00	2.78
6	Woods, Plastics, Composites	$ 826,243.00	2.51
7	Thermal/Moisture Protection	$ 894,504.00	2.71
8	Openings	$ 1,464,445.00	4.44
9	Finishes	$ 2,119,445.00	6.43
10	Specialties	$ 239,932.00	0.73
11	Equipment	$ 65,298.00	0.20
12	Furnishings	$ 300,054.00	0.91
13	Special Construction	$ 401,659.00	1.22
14	Conveying Systems	$ 286,260.00	0.87
15	Mechanical	$ 5,601,175.00	16.99
16	Electrical	$ 2,104,491.00	6.39
21	Fire Suppression	$ 371,896.00	1.13
22	Plumbing	$ 1,102,852.00	3.35
23	HVAC	$ 3,013,963.00	9.14
26	Electrical	$ 2,169,656.00	6.58
27	Communications	$ 269,903.00	0.82
31	Earthwork	$ 1,118,039.00	3.39
32	Exterior Improvements	$ 513,027.00	1.56
33	Utilities	$ 510,475.00	1.55
	Total =	**$ 32,958,705.00**	

Table 6 D4 cost breakdown by division.

At just under $33 million, this seems to be a pretty accurate estimate of the building without even looking at the drawings. Just by knowing basic information like number of floors, occupancy, and where and when it will be built, the software estimated the cost to about 6% of the actual cost. Although D4 is certainly not practical for a final estimate; the software can give a company a good starting point of how much a building will cost.

1.4 Site Plan of Existing Conditions

Please see Appendix B for a site plan of existing conditions.

1.5 Local Conditions

Like many universities, Emory's buildings look very much alike and all have basically the same style of limestone or granite dimensional stone, stucco, and a clay tile roof. They usually have a structure of concrete with steel to support the roof, similar to the new Psychology Building. The curtain wall on this building will set it apart from the traditional style and showcase Emory's dedication to innovation and the future.

The new building's foundation will vary because of inconsistent depths of bedrock underneath the footprint. The drilled piers of the foundation extend to the depths of the rock and are located mostly under the central and western areas of the building. They are as deep as 63'-0" in some places, but luckily there were no issues with the water table, even at that depth. Under the east façade of the building, the shallow rock depth allowed for grade beams as a foundation.

Emory's campus is urban and due to area restrictions on the site, workers have to park off site in a remote lot about one mile away. The on-site subcontractors are each allowed one parking spot on the site and hire a shuttle to get the rest of the workers to the job. The parking fees were about $65/month/spot, so most subs accounted for parking in their pricing.

Atlanta is located in the southeastern United States and is subject to very warm temperatures and humidity. Temperatures are uncomfortable in the summer, but the climate is mild and easy to work in during the spring and fall. The winters are not as warm but snow is rarely an issue. The south is also associated with lower costs, and construction is no exception. Based on RS Means Data, Atlanta's costs are about 90% of what the average cost for the rest of the country would be. Based on data collected from local businesses, a typical 30 yard, six ton dumpster will cost between $350-$375 per removal, which is consistent with the RS Means Data location adjustment. For the psychology building Holder has implemented onsite recycling and does not pay any additional fees associated with recycled material.

1.6 Client Information

The owner of this project is Emory University. Emory is a private liberal arts school located in Dekalb County, Georgia, a part of Atlanta. They have an excellent academic reputation and strive to provide the best learning environment possible for their students. Emory understands the need for environmental awareness and currently they have more LEED-certified buildings than any other university in the United States.

The new building is being built to house the psychology department. Currently the department is spread all over campus and this new building will bring them all under one roof. The building is strategically located in the newly planned science commons along with the chemistry building. The chemistry and psychology departments are both strengths of Emory and the close proximity allows for free flow of ideas from department to department.

The construction manager on this project, Holder Construction, has worked with Emory many times in the past. During those projects Holder gained the trust of Emory and that trust has helped make the Psychology Building a very successful project. Since they have a good relationship, cost and schedule are strictly monitored , but quality is the main

focus of this project. Emory expects the same quality and efficiency that they received on previous projects for their new building. In addition to Holder's internal quality assurance actions, they must follow the Emory College Standards and Emory Campus Services Standards in their efforts to provide an exceptional product.

Emory does not plan to move into the building until after substantial completion. Most of the psychology department will not even move in until a couple of months after that in May. The building will not be fully occupied and used until the Fall Semester of 2009.

1.7 Project Delivery System

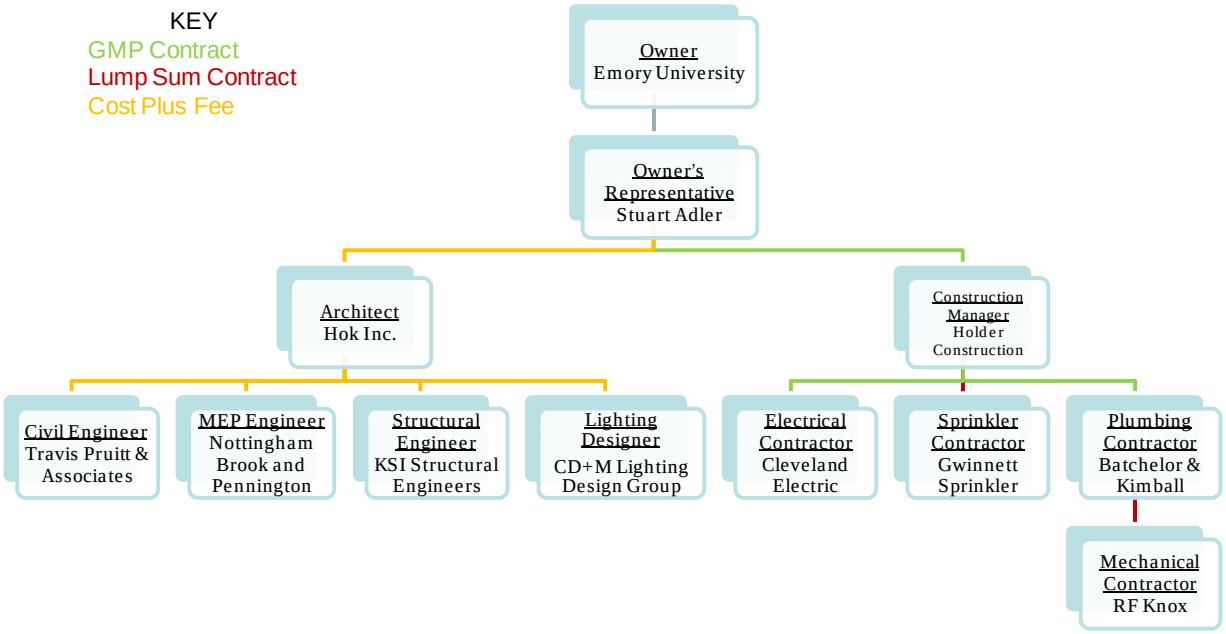


Figure 1 Project team hierarchy.

Holder Construction is the at risk construction manager for this project. They assume some risk because they are performing the concrete work for the project. Emory holds a Guaranteed Maximum Price (GMP) Contract with Holder, and they hold similar contracts with the mechanical and electrical contractors. The rest of the contracts are lump sum. The architect has a separate contract with Emory. Holder communicates with the architect only for RFIs and things of that nature; they do not have a contract.

Holder was selected by Emory over other contractors after responding to Emory's Request for Proposal. Subcontractors were selected based on price, reputation and past performance when working with Holder. The owner mandates that the subs participate in an Owner Controlled Insurance Program (OCIP) that is held by Marsh Inc. Each sub submits their forms and information to be reviewed for safety performance. After they are approved, they receive a certificate of insurance issued by Marsh Inc. The contracts, insurance, and selection methods were all fairly standard for a University building of this size and scope.

1.8 Staffing Plan

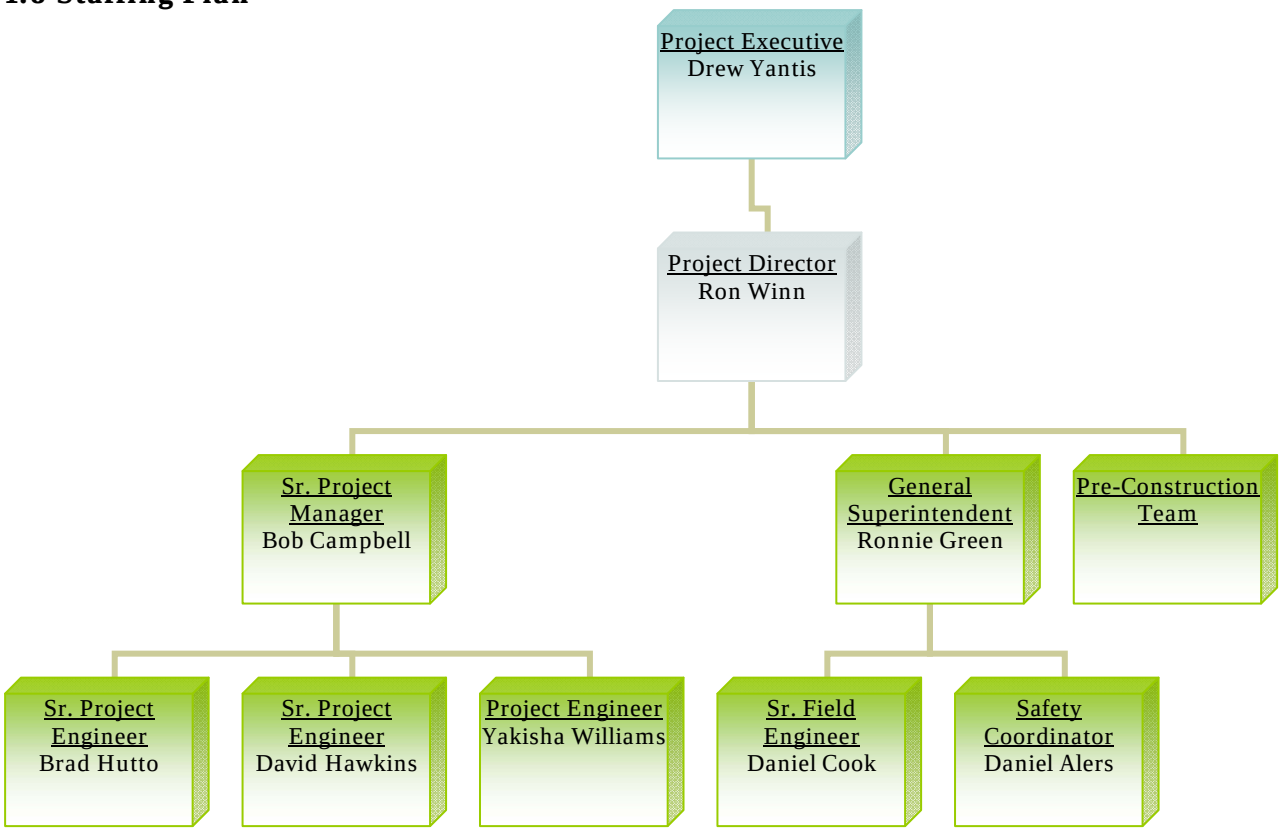


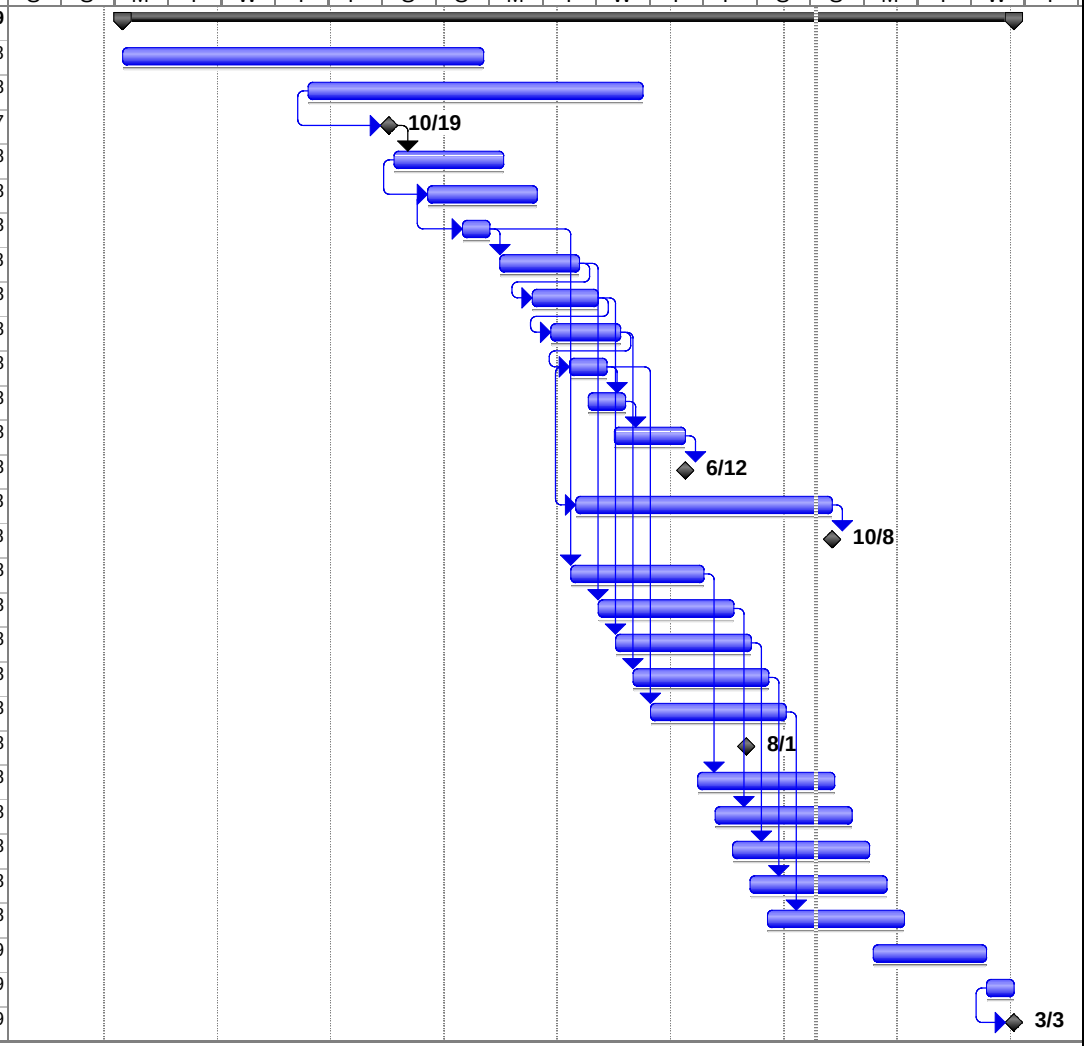
Figure 2 Holder Construction project staff hierarchy.

Holder Construction assigns separate responsibilities to the field supervision, pre-construction services, and management staff with a project executive and a project director to oversee the whole project. All of the pre-construction services are performed by a team at the Holder home office. The construction services have their own operations team. For this project as well as most Holder projects there is a project manager and superintendent on the site at all times. The project management staff primarily deals with cost, procurement, and material delivery status. They settle most issues that arise from the offices of the subcontractors. The project engineers typically are given trades as their own to manage and report their work to the project manager. They are also responsible for most of the paperwork including RFIs, submittals, change orders, etc. The smallest scope trades are assigned to the project engineer, larger scope trades to the senior project engineers, and the largest scope trades may be run by the project manager. The project manager, in this case Sr. project manager, brings all of their information together to assure that the project will run smoothly. The superintendent is responsible for maintaining the schedule, quality assurance, and safety. His job is to oversee work and help subcontractors with large scope planning between other subcontractors. He also collects daily reports from subcontractor's foremen and deals with day to day issues that may arise in the field. The Sr. Field Engineer assists the Superintendent and also is responsible for layout work on the site. The Safety Coordinator is walks the job and makes sure that all of the workers will be safe; he also runs weekly safety meetings.

Appendix A:

Project Summary Schedule

ID	Task Name	Duration	Start	Finish
1	**Emory Psychology Building**	**504 days**	**Mon 3/19/07**	**Tue 3/3/09**
2	Design Phase	202 days	Mon 3/19/07	Wed 1/2/08
3	Trade Procurement	186 days	Wed 8/15/07	Fri 5/9/08
4	Building Permit Received/NTP	0 days	Fri 10/19/07	Fri 10/19/07
5	Earthwork/Site Utilities	59 days	Tue 10/23/07	Fri 1/18/08
6	Foundations	58 days	Mon 11/19/07	Thu 2/14/08
7	SOG+Columns 1st Floor	13 days	Mon 12/17/07	Mon 1/7/08
8	2nd Floor Elev. Slab+Columns	44 days	Wed 1/16/08	Wed 3/19/08
9	3rd Floor Elev. Slab+Columns	38 days	Mon 2/11/08	Thu 4/3/08
10	4th Floor Elev. Slab+Columns	40 days	Tue 2/26/08	Mon 4/21/08
11	5th Floor Elev. Slab+Columns	22 days	Wed 3/12/08	Thu 4/10/08
12	Penthouse Slab	22 days	Thu 3/27/08	Fri 4/25/08
13	Penthouse Steel	41 days	Thu 4/17/08	Thu 6/12/08
14	Topping Out	0 days	Thu 6/12/08	Thu 6/12/08
15	Exterior Skin	148 days	Mon 3/17/08	Wed 10/8/08
16	Building Enclosure	0 days	Wed 10/8/08	Wed 10/8/08
17	1st Floor Rough in/Pull wire	77 days	Thu 3/13/08	Fri 6/27/08
18	Second Floor Rough in/Pull wire	77 days	Fri 4/4/08	Mon 7/21/08
19	Third Floor Rough in/Pull Wire	77 days	Fri 4/18/08	Mon 8/4/08
20	Fourth Floor Rough in/Pull Wire	77 days	Fri 5/2/08	Mon 8/18/08
21	Fifth Floor Rough in/Pull Wire	77 days	Fri 5/16/08	Mon 9/1/08
22	Permanent Power	0 days	Fri 8/1/08	Fri 8/1/08
23	First Floor Framing/Finishes	80 days	Mon 6/23/08	Fri 10/10/08
24	Second Floor Framing/Finishes	80 days	Mon 7/7/08	Fri 10/24/08
25	Third Floor Framing/Finishes	80 days	Mon 7/21/08	Fri 11/7/08
26	Fourth Floor Framing/Finishes	80 days	Mon 8/4/08	Fri 11/21/08
27	Fifth Floor Framing/Finishes	80 days	Mon 8/18/08	Fri 12/5/08
28	Landscape/Hardscape	65 days	Tue 11/11/08	Mon 2/9/09
29	FFE/Owner Occupancy Begins	16 days	Tue 2/10/09	Tue 3/3/09
30	Substantial Completion	0 days	Tue 3/3/09	Tue 3/3/09

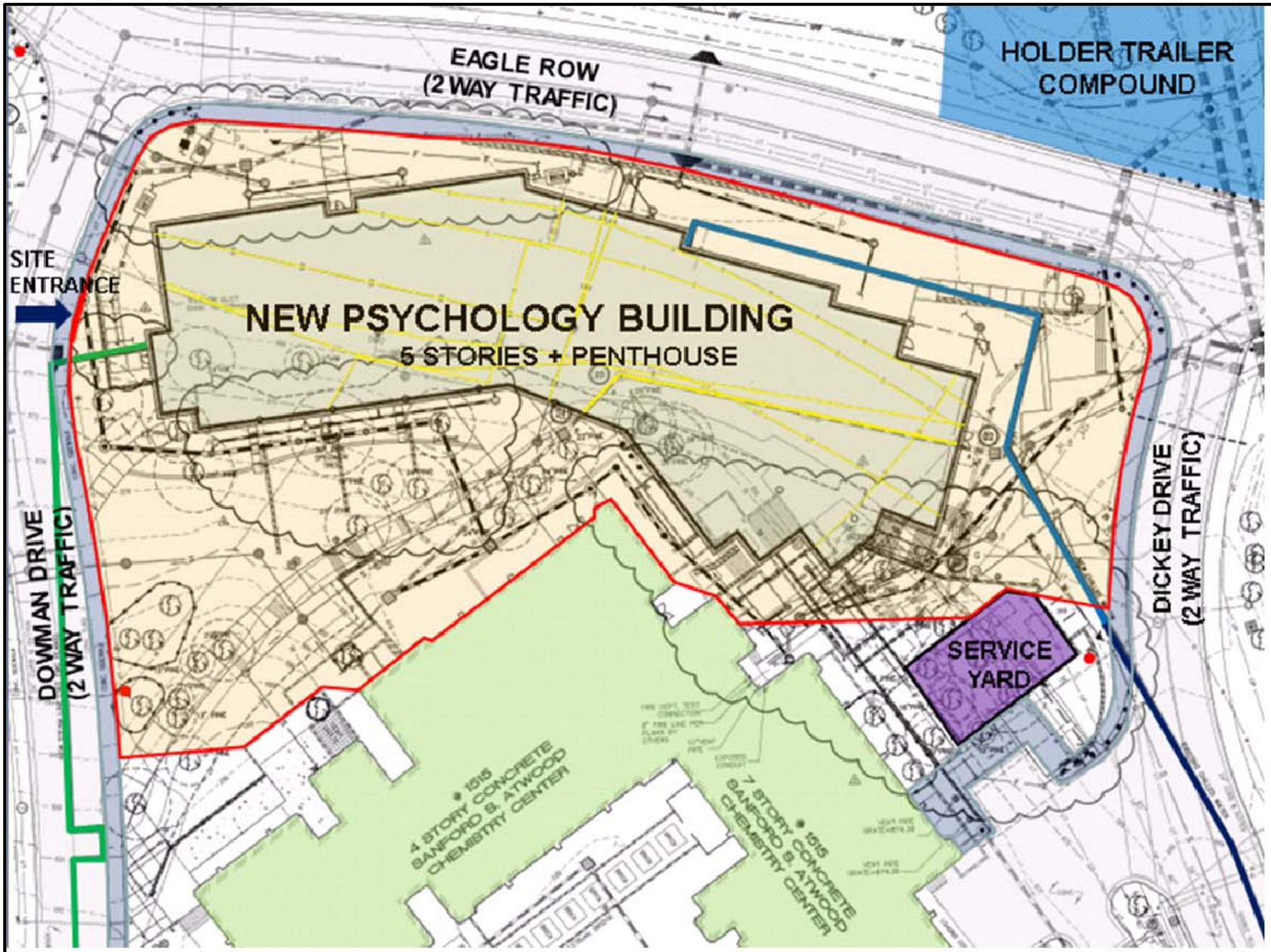


Project: Emory Psychology Building
Date: Thu 9/25/08

Task	Milestone	External Tasks	
Split	Summary	External Milestone	
Progress	Project Summary	Deadline	

Appendix B:

Site Plan of Existing Conditions



EMORY PSYCHOLOGY BUILDING ATLANTA, GA	**CONSTRUCTION SITE PLAN**	**CHRIS RENSHAW**	**SEPTEMBER 29, 2008**

Appendix C:

RS Means Data Sheets

Costs per square foot of floor area

Exterior Wall	S.F. Area	20000	40000	60000	80000	100000	150000	200000	250000	300000
	L.F. Perimeter	260	360	400	420	460	520	600	640	700
Precast Concrete Panel	Steel Frame	193.70	166.10	151.60	143.05	138.95	132.15	129.30	126.65	125.30
	R/Conc. Frame	193.10	165.25	150.70	142.10	137.90	131.10	128.20	125.60	124.20
Face Brick with Concrete Block Back-up	Steel Frame	184.25	159.40	146.65	139.10	135.50	129.55	127.00	124.70	123.50
	R/Conc. Frame	183.10	158.30	145.55	138.05	134.40	128.45	125.85	123.65	122.40
Limestone Panel Concrete Block Back-up	Steel Frame	231.60	192.30	171.00	158.30	152.25	142.20	137.95	134.10	132.05
	R/Conc. Frame	230.55	191.15	169.85	157.20	151.15	141.10	136.80	132.95	130.90
Perimeter Adj., Add or Deduct	Per 100 L.F.	26.35	13.20	8.80	6.55	5.25	3.50	2.60	2.15	1.75
Story Hgt. Adj., Add or Deduct	Per 1 Ft.	5.45	3.80	2.80	2.25	1.95	1.45	1.20	1.10	1.00

***For Basement**, add $33.50 per square foot of basement area*

The above costs were calculated using the basic specifications shown on the facing page. These costs should be adjusted where necessary for design alternatives and owner's requirements. Reported completed project costs, for this type of structure, range from $68.65 to $201.80 per S.F.

Common additives

Description	Unit	$ Cost
Clock System		
20 room	Each	15,400
50 room	Each	37,400
Closed Circuit Surveillance, One station		
Camera and monitor	Each	1750
For additional camera stations, add	Each	940
Directory Boards, Plastic, glass covered		
30" x 20"	Each	580
36" x 48"	Each	1450
Aluminum, 24" x 18"	Each	570
36" x 24"	Each	635
48" x 32"	Each	925
48" x 60"	Each	1950
Elevators, Electric passenger, 5 stops		
2000# capacity	Each	127,300
3500# capacity	Each	134,300
5000# capacity	Each	139,800
Additional stop, add	Each	7875
Emergency Lighting, 25 watt, battery operated		
Lead battery	Each	278
Nickel cadmium	Each	800

Description	Unit	$ Cost
Intercom System, 25 station capacity		
Master station	Each	2500
Intercom outlets	Each	160
Handset	Each	440
Smoke Detectors		
Ceiling type	Each	174
Duct type	Each	445
Sound System		
Amplifier, 250 watts	Each	2225
Speaker, ceiling or wall	Each	181
Trumpet	Each	345
TV Antenna, Master system, 12 oulet	Outlet	299
30 outlet	Outlet	192
100 outlet	Outlet	179

Important: See the Reference Section for Location Factors

Model costs calculated for a 8 story building with 12′ story height and 80,000 square feet of floor area

Office, 5-10 Story

				Unit	Unit Cost	Cost Per S.F.	% Of Sub-Total
A. SUBSTRUCTURE							
1010	Standard Foundations	Poured concrete; strip and spread footings		S.F. Ground	10.96	1.37	
1020	Special Foundations	N/A		—	—	—	
1030	Slab on Grade	4" reinforced concrete with vapor barrier and granular base		S.F. Slab	4.63	.58	2.3%
2010	Basement Excavation	Site preparation for slab and trench for foundation wall and footing		S.F. Ground	.25	.03	
2020	Basement Walls	4′ foundation wall		L.F. Wall	70	.46	
B. SHELL							
	B10 Superstructure						
1010	Floor Construction	Concrete slab with metal deck and beams		S.F. Floor	21.13	18.49	17.8%
1020	Roof Construction	Metal deck, open web steel joists, interior columns		S.F. Roof	6.16	.77	
	B20 Exterior Enclosure						
2010	Exterior Walls	Precast concrete panels	*80% of wall*	S.F. Wall	37.10	14.96	
2020	Exterior Windows	Vertical pivoted steel	*20% of wall*	Each	523	3.52	17.3%
2030	Exterior Doors	Double aluminum and glass doors and entrance with transoms		Each	3352	.21	
	B30 Roofing						
3010	Roof Coverings	Built-up tar and gravel with flashing; perlite/EPS composite insulation		S.F. Roof	5.12	.64	0.6%
3020	Roof Openings	N/A		—	—	—	
C. INTERIORS							
1010	Partitions	Gypsum board on metal studs	*30 S.F. Floor/L.F. Partition*	S.F. Partition	8.28	2.76	
1020	Interior Doors	Single leaf hollow metal	*400 S.F. Floor/Door*	Each	842	2.11	
1030	Fittings	Toilet Partitions		S.F. Floor	.71	.71	
2010	Stair Construction	Concrete filled metal pan		Flight	12,150	2.58	19.2%
3010	Wall Finishes	60% vinyl wall covering, 40% paint		S.F. Surface	1.28	.85	
3020	Floor Finishes	60% carpet, 30% vinyl composition tile, 10% ceramic tile		S.F. Floor	7.03	7.03	
3030	Ceiling Finishes	Mineral fiber tile on concealed zee bars		S.F. Ceiling	4.74	4.74	
D. SERVICES							
	D10 Conveying						
1010	Elevators & Lifts	Four geared passenger elevators		Each	204,200	10.21	9.5%
1020	Escalators & Moving Walks	N/A		—	—	—	
	D20 Plumbing						
2010	Plumbing Fixtures	Toilet and service fixtures, supply and drainage	*1 Fixture/1370 S.F. Floor*	Each	2384	1.74	
2020	Domestic Water Distribution	Gas fired water heater		S.F. Floor	.31	.31	2.0%
2040	Rain Water Drainage	Roof drains		S.F. Roof	1.12	.14	
	D30 HVAC						
3010	Energy Supply	N/A		—	—	—	
3020	Heat Generating Systems	Included in D3050		—	—	—	
3030	Cooling Generating Systems	N/A		—	—	—	14.8 %
3050	Terminal & Package Units	Multizone unit gas heating, electric cooling		S.F. Floor	15.95	15.95	
3090	Other HVAC Sys. & Equipment	N/A		—	—	—	
	D40 Fire Protection						
4010	Sprinklers	N/A		—	—	—	0.2 %
4020	Standpipes	Standpipes and hose systems		S.F. Floor	.26	.26	
	D50 Electrical						
5010	Electrical Service/Distribution	1600 ampere service, panel board and feeders		S.F. Floor	1.62	1.62	
5020	Lighting & Branch Wiring	Fluorescent fixtures, receptacles, switches, A.C. and misc. power		S.F. Floor	10.36	10.36	16.2%
5030	Communications & Security	Alarm systems, internet and phone wiring, emergency lighting		S.F. Floor	4.57	4.57	
5090	Other Electrical Systems	Emergency generator, 100 kW, uninterruptible power supply		S.F. Floor	.99	.99	
E. EQUIPMENT & FURNISHINGS							
1010	Commercial Equipment	N/A		—	—	—	
1020	Institutional Equipment	N/A		—	—	—	0.0 %
1030	Vehicular Equipment	N/A		—	—	—	
1090	Other Equipment	N/A		—	—	—	
F. SPECIAL CONSTRUCTION							
1020	Integrated Construction	N/A		—	—	—	0.0 %
1040	Special Facilities	N/A		—	—	—	
G. BUILDING SITEWORK		**N/A**					
					Sub-Total	107.96	**100%**
	CONTRACTOR FEES (General Requirements: 10%, Overhead: 5%, Profit: 10%)				*25%*	26.99	
	ARCHITECT FEES				*6%*	8.10	
					Total Building Cost	**143.05**	