Loyola/Notre Dame Library

Baltimore, MD

Technical Report 1:
Construction Project Management

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Construction Management
Dr. Michael J. Horman
Friday, October 5, 2007

Loyola/Notre Dame Library, Baltimore, MD

Technical Report 1: Construction Project Management

Sandra DiRupo | Construction Management | Dr. Horman | Oct. 5, 2007

Executive Summary

After analyzing the Construction Project Management techniques for the Loyola/Notre Dame Library located in Baltimore, MD on both The Loyola College of Maryland and College of Notre Dame campuses, a variety of background information has been assessed.

In this technical report, a project schedule summary, building systems summary, project cost evaluation, site plan of existing conditions, local conditions, client information, project delivery system, staffing plan, and corresponding data sheets have been summarized.

The Whiting-Turner Contracting Company was hired by the Loyola/Notre Dame Library as the Construction Manager at Risk with a GMP budget for this $19.6 million renovation and expansion project.

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A. Project Schedule Summary

The project schedule summary is broken down by phase. Since the renovation tasks are not concurrent with the new addition tasks, the phasing begins with site work, followed by the new addition shell and first floor renovations. After first floor renovations, lower level, second floor, then third floor renovations will follow in accordance with each expansion floor. MEP rough in continues on each floor during phase I, and completed at the end of September 2007. Some of the major construction activities are as follows:

The **design phase** began in spring of 2004 by Hillier Architecture and was turned over to aba architects after the design was complete.

Site work lasted about a month and a half before excavation began for the new 25,000 SF expansion. (Excavation for new lower level auditorium above)

By mid December 2006, **foundation** work began for the new **building shell**. This work, along with **underground drainage structures and waterproofing** continued until the beginning of March, when the **superstructure was cast in place**.

Five slabs and circular columns were poured by **concrete truck and pump**, including one slab on grade and one roof slab. Slab construction went on from the beginning of March and lasted until late May

Curtain wall assembly began immediately after the final slab was poured and lasted until the end of June.

As the curtain wall was being completed, MEP and sprinkler rough in commenced on the entire first floor, followed by **drywall, painting, door and hardware installation, acoustical ceiling tile, glazing, slate flooring, carpeting, and millwork installation**.



These activities are typical for each floor.

(See Appendix A for a Project Schedule Summary)

B. Building Systems Summary

Demolition: Demolition of the existing building began in the first week of construction. The south façade of the building was removed as well as a floor slab at the mechanical and elevator shafts. Selective demolition also took place in the addition fit out as well as the existing four floors. Although tests were performed, no evidence of asbestos, lead paint, or any other contaminants have been found, therefore; no additional demolition work was necessary.

Cast in Place Concrete: The existing building and expansion are both cast in place concrete systems. The expansion was erected using a concrete truck and pump. Deep foundations made up of mini piles and a retaining wall will carry the 25,000 SF structure. Typical vertical formwork was used for foundation walls, and doka framed formwork was used for horizontal slab placement. By using this new type of formwork, the project was kept on schedule by reducing labor hours and cost.

Mechanical System: The mechanical system consists of four air handling units ranging from 2640 to 38,000 CFM. Existing AHU are VAV systems, while the two new AHU are VAV and constant volume air with companion return fans. A 150 ton crane was used for the rigging of AHU #3, #4, and several types of equipment onto the roof. A constant volume AHU is to serve the special collections room on the third floor (~1000 CFM). A gas-fired cast-iron sectional boiler (~50 BHP) serves heating and plumbing for the building. Existing chiller and cooling tower are to remain since they are adequate capacity to support the addition. Renovation of the existing duct system, new exhaust systems for restrooms and storage rooms, and finned tube radiation are some of the other new mechanical and plumbing features for the new library.

Electrical System: Electrical distribution throughout the building consists of two electrical closets on each floor, each with a 480/277 V, 225 amp panel, (2) 45 kVA dry type transformers and (2) 150 amp, main circuit breaker, 208/120 V, 3 phase, 4 wire, and 42 pole panelboards. In the mechanical penthouse, new 480 and 208 V panels were installed as well as a motor control center. Emergency power is produced by a new 480/277 V 150 kW generator.

Masonry: The existing building enclosure is primarily a red brick façade over cast in place concrete. Minimal masonry repairs were done inside and outside of the building. The existing building façade is not in need of any repairs. Mechanical and elevator shafts accounted for most of the repair costs after demolition in these areas.

Curtain Wall: An aluminum curtain wall makes up the entire façade of the expansion. The types of glass vary for the storefront. Each floor consists primarily of a clear glass wall with a green spandrel glass above and a decorative, fritted glass below, and separated by aluminum mullions. Aluminum sunshades are an additional feature for the curtain wall. The curtain wall design will be sure to attract plenty of daylight for the building occupants.

Support of Excavation: Sheeting with H piles was used at the East side of the building. The auditorium has sloped seating and is about 30 ft. lower than the adjacent road. Wood shoring was removed and piles were cut and left in place when backfilled.

C. Project Cost Evaluation

(See Appendix C1 for detailed cost breakdowns)

Construction Cost	Total Project Cost
$12,867,371	$19,604,229
$125/SF	$165.74/SF

Major Building Systems		
Structural	Mechanical	Electrical
$1,515,000	$3,013,000	$2,447,247

Parametric Estimate Using D4 Cost:

(See Appendix C2 for detailed SF costs per the D4 Cost Analysis)

Code	Division Name	%	Sq. Cost	Projected
	Bidding Requirements	3.43	$7.91	$791,255.37
1	General Requirements	5.43	$12.53	$1,253,212.29
2	Site Work	5.87	$13.55	$1,354,922.51
3	Concrete	10.61	$24.46	$2,446,391.25
4	Masonry	5.47	$12.61	$1,261,015.04
5	Metals	7.79	$17.97	$1,797,404.41
6	Wood & Plastics	1.83	$4.22	$421,552.61
7	Thermal & Moisture Protection	3.63	$8.38	$838,228.22
8	Doors & Windows	6.51	$15.03	$1,502,552.77
9	Finishes	10.24	$23.61	$2,360,806.81
10	Specialties	1.10	$2.53	$253,369.04
11	Equipment	3.15	$7.28	$727,535.46
12	Furnishings	1.76	$4.05	$405,083.62
13	Special Construction	0.99	$2.29	$228,903.70
14	Conveying Systems	1.71	$3.94	$394,332.89
15	Mechanical	20.68	$47.69	$4,768,939.56
16	Electrical	9.79	$22.59	$2,259,101.61
	Total Building Costs	**100.00**	**$230.65**	**$23,064,607.00**

Square Foot Estimate Using 2007 RS Means:

- Used M.460 Office, 2-4 story for building addition
  - $157.35/SF
  - Location Modifier: Baltimore, MD 0.90
- Used M.390 Library, 526 L.F. Perimeter
  - $131.75/S.F.
  - Location Modifier: Baltimore, MD 0.90
- Building Addition: $157.35 x 0.25=$39.34
- Building Renovation: $131.75 x 0.75=$98.81
- Square Foot Estimate: $138.15
- RS Means SF Estimate with location modifier: $124.34

After analyzing the different estimates I realized that the actual estimate is less than the schematic estimate performed in D4 cost. This may have occurred because the project types ranged from schools to educational buildings that were not necessarily libraries or renovations/expansions. This caused an increase in building costs since D4 cost recognized the building as a new one.

Square foot estimates were under the contract amount. Because the existing library and the new expansion are somewhat different facilities, both aesthetically and functionally, I performed a SF estimate based on a typical office building and typical library. The renovated space has some high tech features that typical library construction may not take into consideration. Also, the addition was more complex than the average. Some of the fancy features include: deep foundations, an auditorium space, an arched curtain wall, and a cyber café. For these reasons, RS means may have underestimated the actual square foot cost.

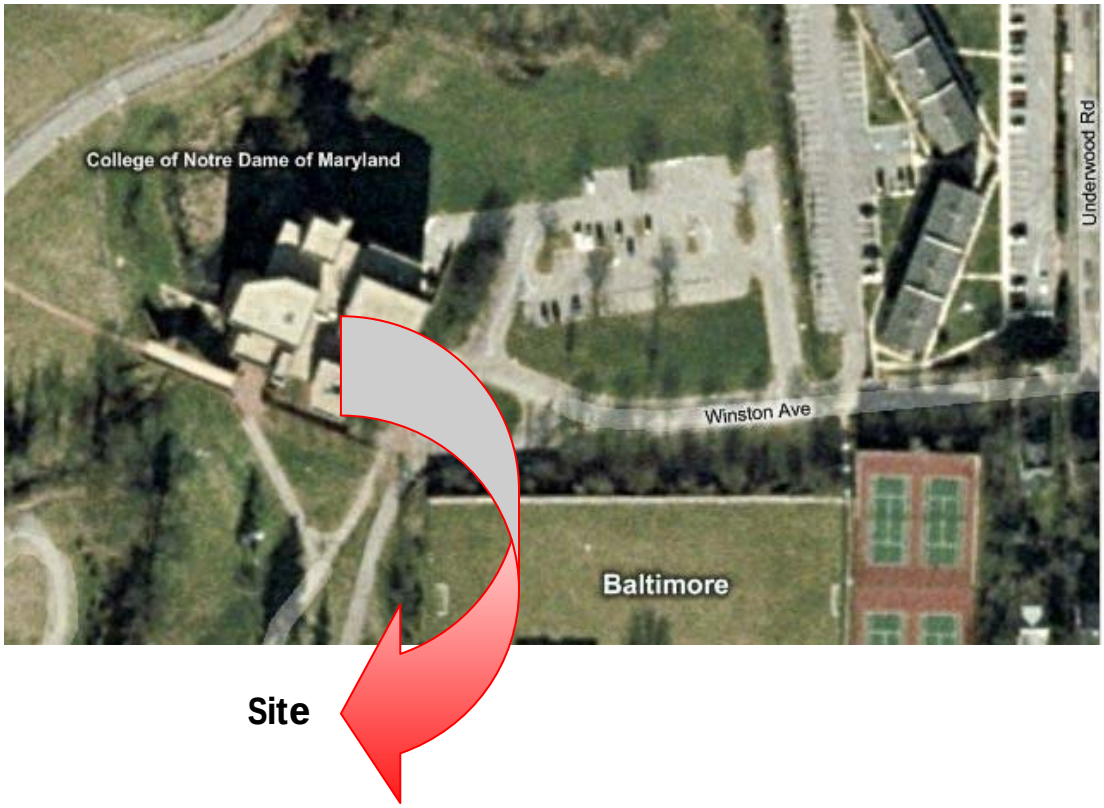
(See Appendix C3 for SF estimate information for each building system.)

D. Site Plan of Existing Conditions

(See Appendix D for a site layout drawing for the following items):

- General Conditions Items
- Locations of Parking, Access Rods, Utility Locations
  *(*See E. Local Conditions for more parking/access road information also)*
- Neighboring Buildings
- Storm Water Management Facilities
- Traffic and Pedestrian Patterns
- Existing Building
- New Building Expansion

Vicinity Map



E. Local Conditions

The Loyola/Notre Dame Library is located at 200 Winston Avenue in Baltimore, MD. There are not any specific preferred methods of construction. Parking is scarce, and contractors are not permitted to park in the college or library parking lots. Winston Avenue is also closed to contractors. Notre Dame Lane is to be used as an alternate route as seen below:

Two parking passes are issued to each subcontractor to park along Notre Dame Lane, but all other parking is directed to the Cathedral on Charles Street. Towing will be enforced for the duration of the project.

The soil type has been classified as type C, very dense soil and soft rock, according to the geotechnical report performed by D.W. Kozera, Inc. Test borings indicated that groundwater levels are approximately one to five feet below the existing crawl space floor grade. A subdrainage system collecting groundwater around the perimeter of the addition and from under the floor has been installed to maintain groundwater below the floor level.

F. Client Information

Owner Description: The existing Loyola/Notre Dame Library is owned by the Loyola/Notre Dame Library, not either of the two colleges directly, but a separate entity. John McGinty, director of the library, is the owner's representative for the Loyola/Notre Dame Library.

Reason for Building this Facility: The main reason that The College of Notre Dame and Loyola College in Maryland have decided to undertake a joint $19.6 million library expansion and renovation project is due to growing curricular enrollment demands and improvements in information technology.

Expectations for the Project: The goal of the new student-centered facility is to enhance teaching and learning by creating a library for the 21st century. The current 75,000-square-foot building will be enlarged to 100,000-square-feet, offering enhanced spaces for teaching, personal and group study, scholarly and cultural programming and informal gatherings. The new Library will be a welcoming place with a new glass façade enclosing the four story addition.

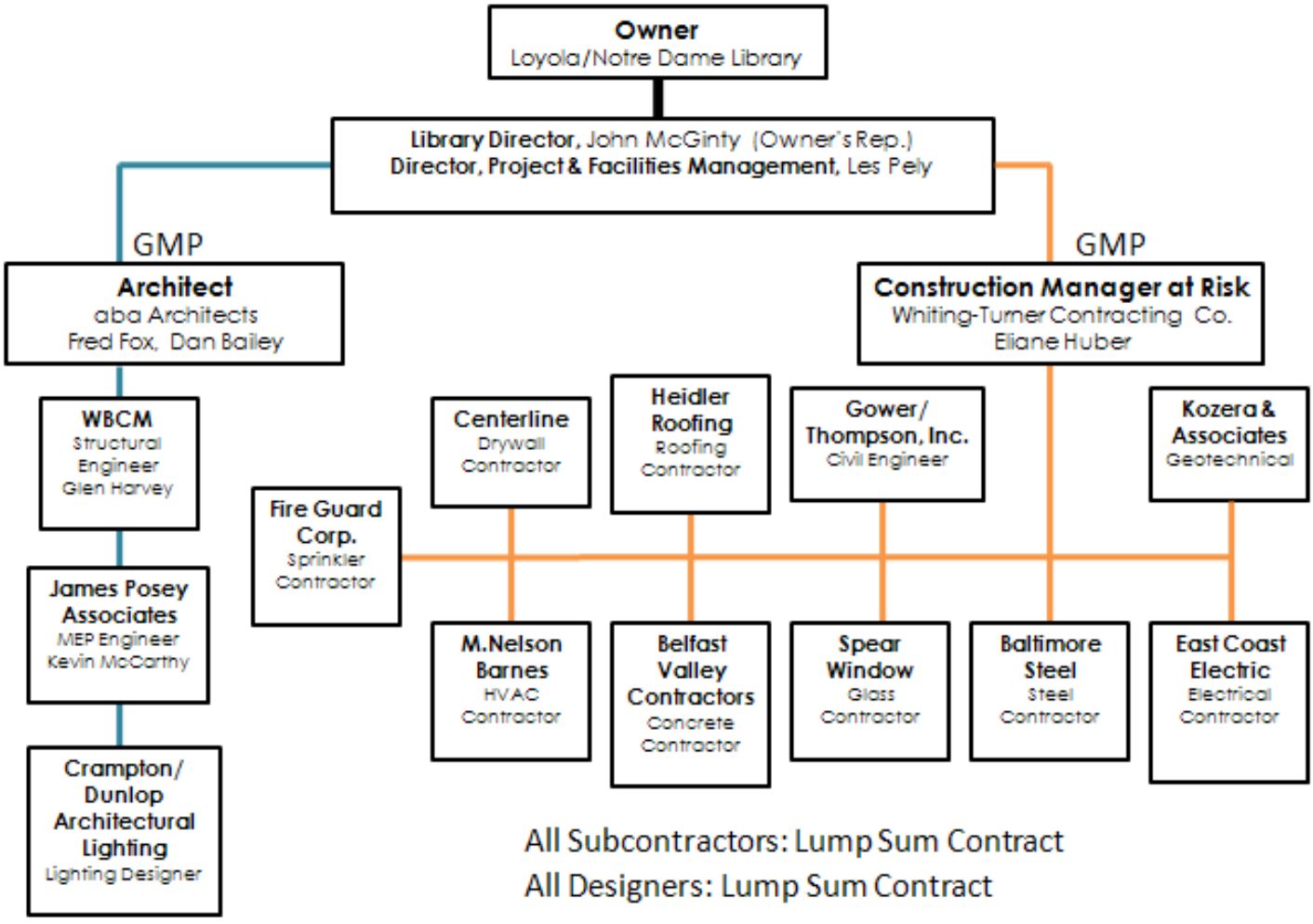
Cost expectations: Like most building owners, the library hopes to complete the project according to the original budget with minimal change orders or exceptions. However; efficiency is also a top priority. New building systems are expected to operate at peak efficiency and lowest cost.

Sequencing Issues: The library will remain open during construction, so turning over each floor is an important milestone at the end of each phase; so that office and library space is not sacrificed during the school year. Bathrooms must remain open on each floor during construction. (With an exception of the floor being renovated) These are two of the more important sequencing issues to be strictly enforced among the affected subcontractors.

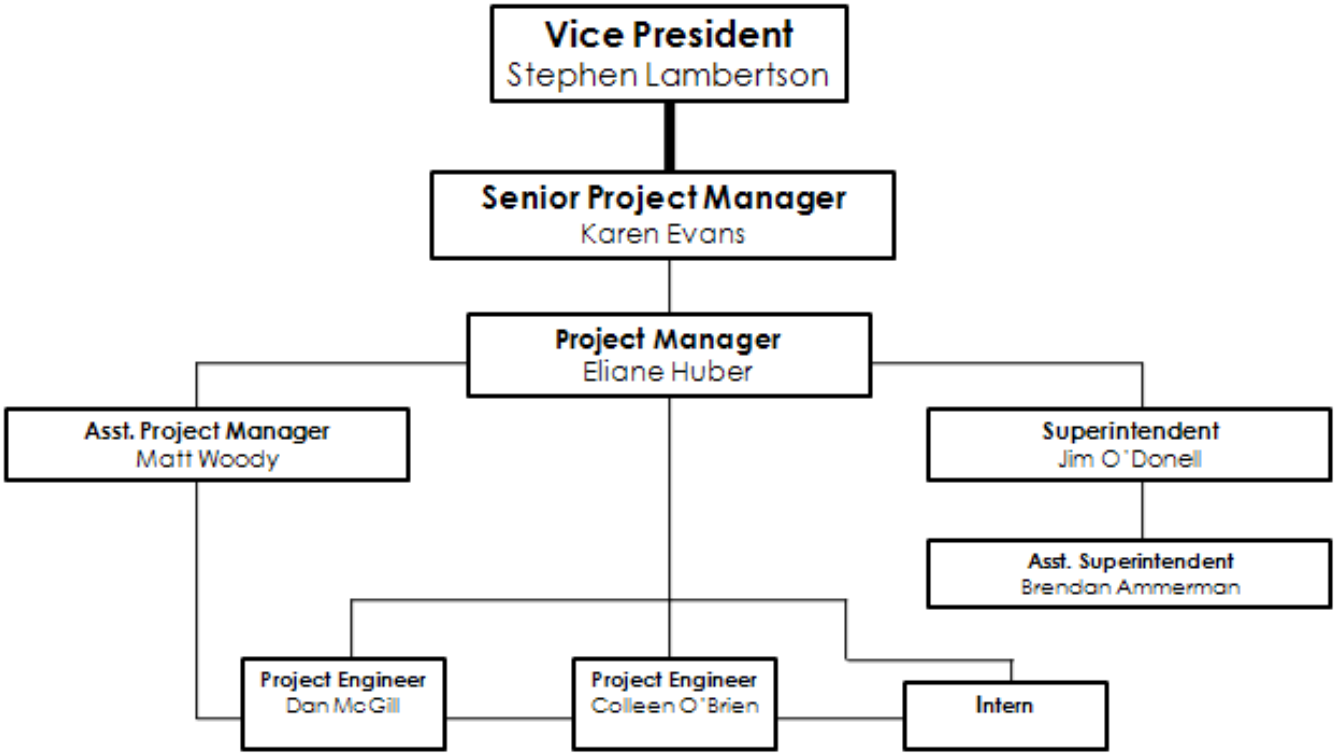
Phased Occupancy Requirements: Since the library is to remain open during all construction and renovations, phasing is an integral part of the construction process. While school was still in session at the start of construction in October 2006, demolition and the four story addition began phase 1 of the project. Once school let out in May, the existing first floor renovations began. The entire first floor and principal site work was a main concern for the owner and building occupants since school was back in session at the end of August.

Keys to Completing the Project to Owner's Satisfaction: In order to complete the project to the owner's satisfaction, the library will monitor the construction processes with great care. The library's top priority is to manage the building project effectively and efficiently through completion and first year occupancy.

G. Project Delivery System



H. Staffing Plan



Appendices A-D

Appendix A: Project Schedule Summary

- Microsoft Project Schedule Summary

Appendix C1: Project Cost Evaluation

- Construction & Total Cost Data Sheet

Appendix C2: Project Cost Evaluation

- Schematic Summary print out from D4 Cost

Appendix C3: Project Cost Evaluation

- Square Foot Estimate Data Sheets

Appendix C4: Project Cost Evaluation

- RS Means print out

Appendix D: Site Plan of Existing Conditions

- Site Plan of Existing Conditions

Loyola/Notre Dame Library Schedule Summary

Appendix A

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Construction Management
October 5, 2008

Senior Thesis
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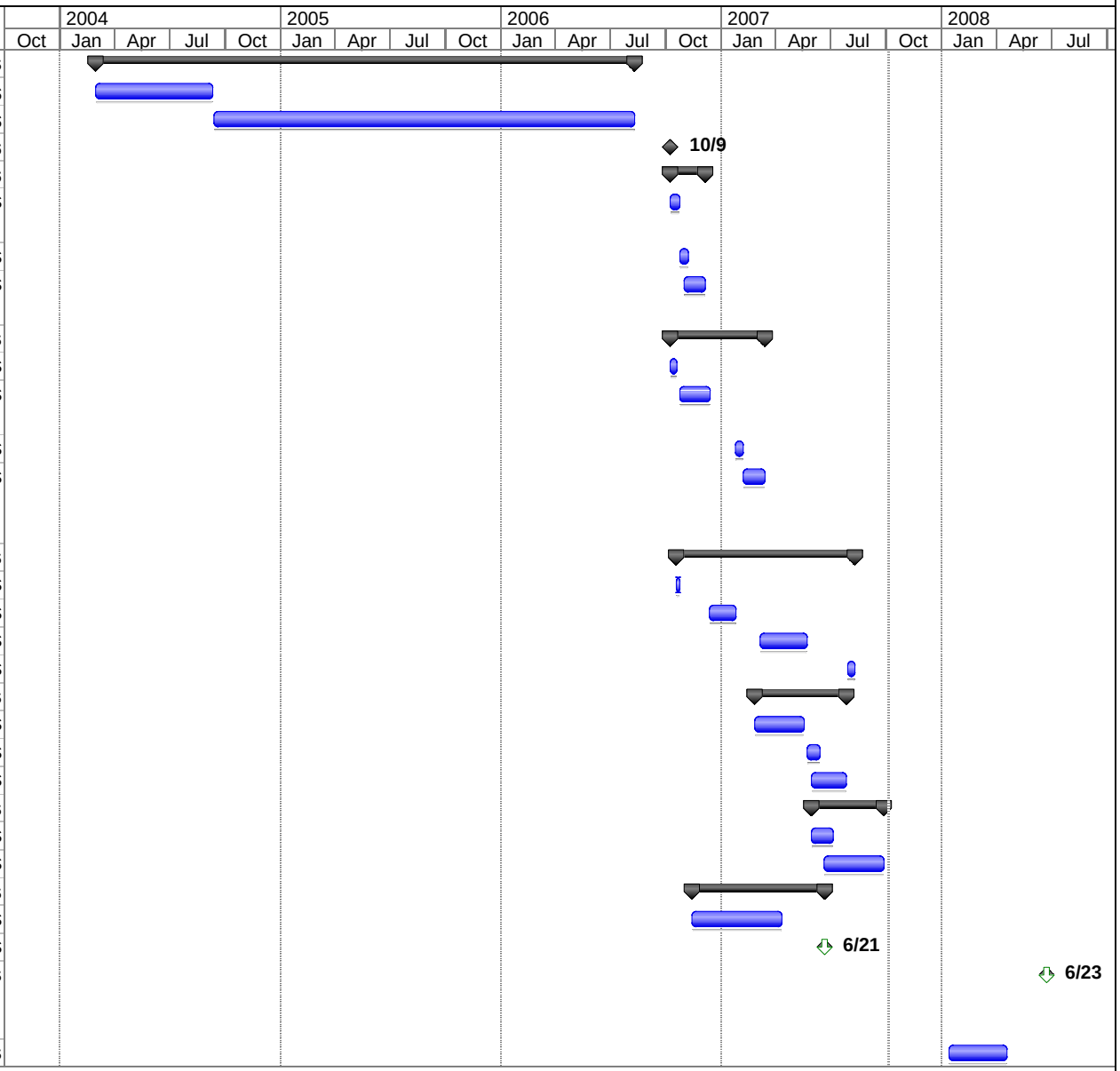
ID	Task Name	Duration
1	**Preconstruction**	**639 days**
2	Permitting	140 days
3	Design/Preconstruction	499 days
4	**Procurement of Construction Services**	**0 days**
5	**Sitework**	**42 days**
6	Stakeout & Temporary Access Roads and Building Entrances	12 days
7	Site Demolition	10 days
8	Reloacate Sanitary Line and Site Utilities	25 days
9	**Addition Fit-Out**	**113 days**
10	Temporary Partitions	9 days
11	Selective Demolition & Interior MEP	36 days
12	Mini Piles	9 days
13	New Elevator Shaft Work (Demo,Waterproofing, & Concrete)	26 days
14	**Building Shell**	**212 days**
15	Removal of Existing Storefront	4 days
16	Load Test & Piles	32 days
17	Pour Concrete Slabs	56 days
18	Landscaping & Site Furnishings	10 days
19	**New Addition-First Floor**	**110 days**
20	Elevator Procurement	60 days
21	MEP Rough In	15 days
22	Interior Finishes	42 days
23	**New Addition-All Remaining Floors**	**86 days**
24	MEP Rough In	26 days
25	Interior Finishes	71 days
26	**Existing First Floor Fit-Out**	**158 days**
27	MEP Rough In	107 days
28	Interior Finishes	158 days
29	**Existing Lower Level, Second, and Third Floor Fit-Out (Same as First Floor Fit-Out)**	**269 days**
30	**Refurbrishing of Existing Elevators**	**70 days**



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Construction Cost (CC)				
Div	**Description**	**CC/SF**	**% of CC**	**Total CC**
3	Concrete	$15.15	11.77%	$1,515,000
4	Masonry	$1.25	0.97%	$125,000
5	Metals	$4.34	3.37%	$434,093
6	Wood & Plastics	$3.41	2.65%	$341,030
7	Moisture Protection	$6.12	4.76%	$612,030
8	Doors & Windows	$14.47	11.25%	$1,447,060
9	Finishes	$17.70	13.75%	$1,769,535
10	Specialties	$0.82	0.63%	$81,600
11	Equipment	$0.41	0.31%	$40,500
12	Furnishings	$0.25	0.19%	$24,620
13	Special Construction	$2.91	2.26%	$291,400
14	Conveying Systems	$3.69	2.87%	$369,240
15	Mechanical	$30.13	23.42%	$3,013,000
16	Electrical	$24.47	19.02%	$2,447,247
	IT Infrastructure		2.77%	$356,016
			Total CC	**$12,867,371**
			Total CC/SF	**$125.11**

Total Cost			
Description	**TC/SF**	**% of TC**	**Total CC**
General Conditions	$15.88	8.10%	$1,588,063
Sitework	$15.14	7.72%	$1,513,631
Insurances	$1.33	1.24%	$243,294
Construction Contingency	$7.43	3.79%	$743,444
AE Fees		7.51%	$1,473,088
Furnishings		4.98%	$975,338
Library Shelving		1.02%	$200,000
AV/IT Equipment			
Escalation (6.5%)			
Construction Cost	$125.11	65.64%	$12,867,371
		Total TC	**$19,604,229**
		Total TC/SF	**$165.74**

Schematic Estimate

Loyola/Notre Dame Library - Aug 2008 - MD - Baltimore

Prepared By:	Sandra DiRupo-Appendix C2 AE 481W 236 S. Fraser St, apt. 105 State College, PA 16148 (724) 977-0444 Fax:	Prepared For:	Dr. Michael J. Horman Thesis Advisor 104 Engr. Unit A University Park, PA 16802 Fax:
Building Sq. Size:	100000	Site Sq. Size:	49443
Bid Date:	4/15/2006	Building use:	Educational
No. of floors:	4	Foundation:	CON/PIL
No. of buildings:	1	Exterior Walls:	CUR/MAS
Project Height:	50	Interior Walls:	MAS/GYP
1st Floor Height:	12.67	Roof Type:	MEM
1st Floor Size:	25000	Floor Type:	VCT/CAR/TIL
		Project Type:	ADD/REN

Division		Percent	Sq. Cost	Amount
00	**Bidding Requirements**	**3.43**	**7.91**	**791,255**
	Bidding Requirements	3.43	7.91	791,255
	Untitled	0.00	0.00	0
01	**General Requirements**	**5.43**	**12.53**	**1,253,212**
	General Requirements	5.43	12.53	1,253,212
02	**Site Work**	**5.87**	**13.55**	**1,354,923**
	Site Work	5.87	13.55	1,354,923
03	**Concrete**	**10.61**	**24.46**	**2,446,391**
	Concrete	10.61	24.46	2,446,391
04	**Masonry**	**5.47**	**12.61**	**1,261,015**
	Masonry	5.47	12.61	1,261,015
05	**Metals**	**7.79**	**17.97**	**1,797,404**
	Metals	7.79	17.97	1,797,404
06	**Wood & Plastics**	**1.83**	**4.22**	**421,553**
	Wood & Plastics	1.83	4.22	421,553
07	**Thermal & Moisture Protection**	**3.63**	**8.38**	**838,228**
	Thermal & Moisture Protection	3.63	8.38	838,228
08	**Doors & Windows**	**6.51**	**15.03**	**1,502,553**
	Doors & Windows	6.51	15.03	1,502,553
09	**Finishes**	**10.24**	**23.61**	**2,360,807**
	Finishes	10.24	23.61	2,360,807
10	**Specialties**	**1.10**	**2.53**	**253,369**
	Specialties	1.10	2.53	253,369
11	**Equipment**	**3.15**	**7.28**	**727,535**
	Equipment	3.15	7.28	727,535
12	**Furnishings**	**1.76**	**4.05**	**405,084**
	Furnishings	1.76	4.05	405,084
13	**Special Construction**	**0.99**	**2.29**	**228,904**
	Special Construction	0.99	2.29	228,904
14	**Conveying Systems**	**1.71**	**3.94**	**394,333**
	Conveying Systems	1.71	3.94	394,333
15	**Mechanical**	**20.68**	**47.69**	**4,768,940**
	Mechanical	20.68	47.69	4,768,940
16	**Electrical**	**9.79**	**22.59**	**2,259,102**
	Electrical	9.79	22.59	2,259,102

Total Building Costs	100.00	230.65	23,064,607
Total Non-Building Costs	100.00	0.00	0
Total Project Costs	--	--	23,064,607

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Appendix C3
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SF Estimates for Expansion using R.S. Means

A. Substructure

			Quantity	Unit	Unit Cost	Cost Per S.F.	Subtotal
1010	Standard Foundations	Poured concrete; strip and spread footings	6250	S.F. Ground	$6.69	$2.23	$13,937.50
1030	Slab on Grade	4" Reinforced Concrete with vapor barrier and granular base	6250	S.F. Slab	$4.45	$1.48	$9,250.00
2010	Basement Excavation	Site preparation for lab and trench for foundation wall and footing	6337	S.F. Ground	$0.14	$0.05	$316.83
2020	Basement Walls	4" foundation wall	260	L.F. Wall	$64.00	$1.45	$16,640.00
						Total	**$40,144.33**
						Cost of Substructure	**$40,144.33**

B. Shell

B10 Superstructure			Quantity	Unit	Unit Cost	Cost Per S.F.	Subtotal
1010	Floor Construction	Open web steel joists, slab form, concrete, columns	18750	S.F. Floor	$15.89	$10.59	$198,562.50
1020	Roof Construction	Metal deck, open web steel joists, columns	6250	S.F. Roof	$5.91	$1.97	$12,312.50
						Total	**$210,875.00**
B20 Exterior Enclosure							
2020	Exterior Windows	Aluminum outward projecting (~100% of Walls)	13000	S.F. Wall	$630.00	$3.55	$92,300.00
2030	Exterior Doors	Aluminum and glass, hollow metal	6	Each	$2,717.00	$0.83	$16,302.00
						Total	**$108,602.00**
B30 Roofing							
2020	Roof Coverings	Built-up tar and gravel with flashing; perlite/EPS comp.	6250	S.F. Roof	$5.61	$1.87	$11,687.50
						Total	**$11,687.50**
						Cost of Shell	**$331,164.50**

C. Interiors

			Quantity	Unit	Unit Cost	Cost Per S.F.	Subtotal
1010	Partitions	Gypsum board on metal studs	122100	S.F. Partition	$8.68	$3.47	$423,687.00

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1020	Interior Doors	Single leaf hollow metal	18	Each	$521.00	$4.08	$9,378.00
2010	Stair Construction	Concrete Filled Metal Pan	3	Flight	$11,550.00	00004	$34,650.00
3010	Wall Finishes	60% vinyl wall covering, 40% Paint	290000	S.F. Surface	$1.26	$1.01	$292,900.00
3020	Floor Finishes	60% Carpet, 30% Vinyl Composition Tile, 10% Ceramic	25,000	S.F. Floor	$6.81	$6.81	$170,250.00
3030	Ceiling Finishes	Mineral fiber tile on consealed zee bars	25,000	S.F. Ceiling	$4.71	$4.71	$117,750.00
						Total	**$1,048,615.00**
						Cost of Interiors	**$1,048,615.00**

SF Estimates for Renovation using R.S. Means

D. Services							
D10 Conveying			Quantity	Unit	Unit Cost	Cost Per S.F.	Subtotal
1010	Elevators and Lifts	Two hydraulic passenger elevators	2	Each	$92,400.00	$9.24	$184,800.00
						Total	**$184,800.00**
D20 Plumbing							
2010	Plumbing Fixtures	Toilet and service fixtures, supply and drainage		Each	$2,283.00	$1.73	$0.00
2020	Domestic Water Distribution	Gas fired water heater	25000	S.F. Floor	$0.23	$0.23	$5,750.00
2040	Rain Water Drainage	Roof Drains	6250	S.F. Roof	$0.87	$0.29	$1,812.50
						Total	**$7,562.50**
D30 HVAC							
3050	Terminal & Packaging Units	Multizone unit gas heating, electric cooling	25000	S.F. Floor	$15.65	$15.65	$391,250.00
						Total	**$391,250.00**
D40 Fire Protection							
4010	Sprinklers	Wet pipe sprinkler system	25000	S.F. Floor	$2.16	$2.16	$54,000.00
						Total	**$54,000.00**
D50 Electrical							

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5020	Lighting and Branch Wiring	Fluorescent fixtures, receptacles, switches, A.C. and misc. power	25000	S.F. Floor	$10.32	$10.32	$258,000.00
5030	Communications and Security	Alarm systems, internet and phone wiring, and emergency lighting	25000	S.F. Floor	$4.61	$4.61	$115,250.00
5090	Other Electrical Systems	Emergency generator, 7.5 kW, uninterruptible power supply	25000	S.F. Floor	$0.21	$0.21	$5,250.00
						Total	**$378,500.00**
						Cost of Services	**$1,016,112.50**

Cost of Expansion $2,436,036.33

C. Interiors

			Quantity	Unit	Unit Cost	Cost Per S.F.	Subtotal
1010	Partitions	Gypsum board on metal studs	248,000	S.F. Partition	$10.15	$4.06	$1,006,880.00
1020	Interior Doors	Single leaf wood	105	Each	$521.00	$1.74	$54,705.00
1030	Fittings	Toilet partitions	2184	S.F. Floor	$1.04	$1.04	$4,542.72
3010	Wall Finishes	Paint	587700	S.F. Surface	$0.71	$0.57	$669,978.00
3020	Floor Finishes	50% carpet, 50% vinyl tile	75,000	S.F. Floor	$3.80	$3.80	$285,000.00
3030	Ceiling Finishes	Mineral fiber tile on consealed zee bars	75,000	S.F. Ceiling	$4.71	$4.71	$353,250.00
						Total	**$2,374,355.72**
						Cost of Interiors	**$2,374,355.72**

D. Services

D10 Conveying

			Quantity	Unit	Unit Cost	Cost Per S.F.	Subtotal
1010	Elevators and Lifts	Two hydraulic passenger elevators	2	Each	$69,740.00	$3.17	$139,480.00
						Total	**$139,480.00**

D20 Plumbing

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Friday, Oct. 5, 2007

2020	Domestic Water Distribution	Gas fired water heater	75000	S.F. Floor	$0.76	$0.76	$114,000.00
2040	Rain Water Drainage	Roof Drains	18750	S.F. Roof	$0.64	$0.32	$12,000.00
						Total	**$126,000.00**
D30 HVAC							
3050	Terminal & Packaging Units	Multizone unit gas heating, electric cooling	75000	S.F. Floor	$19.35	$19.35	$5,805,000.00
						Total	**$5,805,000.00**
D40 Fire Protection							
4010	Sprinklers	Wet pipe sprinkler system	75000	S.F. Floor	$2.16	$2.16	$324,000.00
						Total	**$324,000.00**
D50 Electrical							
5010	Electrical Service/Distribution	1000 ampere service, panel board and feeders	75000	S.F. Floor	$0.99	$0.99	$74,250.00
5020	Lighting and Branch Wiring	Fluorescent fixtures, receptacles, switches, A.C. and misc. power	25000	S.F. Floor	$9.78	$9.78	$244,500.00
5030	Communications and Security	Alarm systems, internet and phone wiring, and emergency lighting	75000	S.F. Floor	$1.24	$1.24	$93,000.00
5090	Other Electrical Systems	Emergency generator, 7.5 kW, uninterruptible power supply	25000	S.F. Floor	$0.22	$0.22	$5,500.00
						Total	**$834,500.00**
						Cost of Services	**$7,228,980.00**

Cost of Building Systems $9,665,016.33

COMMERCIAL/INDUSTRIAL/ INSTITUTIONAL | **M.460** | **Office, 2-4 Story**

Costs per square foot of floor area

28000 SF

Exterior Wall	S.F. Area	5000	8000	12000	16000	20000	35000	50000	65000	80000
	L.F. Perimeter	220	260	310	330	360	440	490	548	580
Face Brick with Concrete Block Backup	Wood Joists	207.70	177.60	160.45	148.75	142.60	130.55	124.75	121.85	119.45
	Steel Joists	212.65	182.55	165.35	153.70	147.50	135.45	129.65	126.80	124.40
Glass and Metal Curtain Wall	Steel Frame	248.40	210.10	188.25	172.85	164.80	148.95	141.15	137.35	134.10
	R/Conc. Frame	246.15	207.90	186.00	170.70	162.65	146.75	139.00	135.10	131.95
Wood Siding	Wood Frame	171.00	147.70	134.50	125.95	121.30	112.50	108.30	106.25	104.60
Brick Veneer	Wood Frame	187.55	160.00	144.25	133.75	128.10	117.25	112.05	109.40	107.30
Perimeter Adj., Add or Deduct	Per 100 L.F.	32.50	20.25	13.50	10.15	8.10	4.65	3.25	2.45	2.00
Story Hgt. Adj., Add or Deduct	Per 1 Ft.	5.30	3.90	3.10	2.50	2.15	1.55	1.20	.95	.90

For Basement, add $29.50 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 $58.15 to $225.20 per S.F.

$I = I_2 - I_1 \times \frac{\theta - \theta_1}{\theta_2 - \theta_1} + I_1$

Common additives

Description	Unit	$ Cost
Clock System		
20 room	Each	15,000
50 room	Each	36,400
Closed Circuit Surveillance, One station		
Camera and monitor	Each	1675
For additional camera stations, add	Each	910
Directory Boards, Plastic, glass covered		
30" x 20"	Each	570
36" x 48"	Each	1375
Aluminum, 24" x 18"	Each	555
36" x 24"	Each	635
48" x 32"	Each	885
48" x 60"	Each	1850
Elevators, Hydraulic passenger, 2 stops		
1500# capacity	Each	53,600
2500# capacity	Each	56,200
3500# capacity	Each	60,400
Additional stop, add	Each	8750
Emergency Lighting, 25 watt, battery operated		
Lead battery	Each	265
Nickel cadmium	Each	770

Description	Unit	$ Cost
Smoke Detectors		
Ceiling type	Each	171
Duct type	Each	440
Sound System		
Amplifier, 250 watts	Each	2125
Speaker, ceiling or wall	Each	174
Trumpet	Each	335
TV Antenna, Master system, 12 outlet	Outlet	288
30 outlet	Outlet	185
100 outlet	Outlet	173

20000 SF $162.65
25,000 SF $157.35/SF
35,000 SF $146.75

$25000-20000 \times \left(\frac{x-162.65}{146.75-162.65}\right) + 20000 = 25000$

$15000(x-162.65) + -15.9(20000) = 25000(-15.9$

$15000x - 2439750 - 318000 = -397500$

Important: See the Reference Section for Location Factor

Model costs calculated for a 3 story building with 12' story height and 20,000 square feet of floor area

Office, 2-4 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	6.69	2.23	4.7%
1030	Slab on Grade	4" reinforced concrete with vapor barrier and granular base		S.F. Slab	8.45	1.48	
2010	Basement Excavation	Site preparation for slab and trench for foundation wall and footing		S.F. Ground	.14	.05	
2020	Basement Walls	4' foundation wall		L.F. Wall	64	1.45	
B. SHELL							
	B10 Superstructure						
1010	Floor Construction	Open web steel joists, slab form, concrete, columns		S.F. Floor	15.89	10.59	11.4%
1020	Roof Construction	Metal deck, open web steel joists, columns		S.F. Roof	3.91	1.97	
	B20 Exterior Enclosure						
2010	Exterior Walls	Face brick with concrete block backup	80% of wall	S.F. Wall	26	13.87	16.5%
2020	Exterior Windows	Aluminum outward projecting	20% of wall	Each	630	3.55	
2030	Exterior Doors	Aluminum and glass, hollow metal		Each	2717	.83	
	B30 Roofing						
3010	Roof Coverings	Built-up tar and gravel with flashing; perlite/EPS composite		S.F. Roof	5.61	1.87	1.7%
3020	Roof Openings	N/A		–	–	–	
C. INTERIORS							
1010	Partitions	Gypsum board on metal studs	20 S.F. Floor/L.F. Partition	S.F. Partition	8.68	3.47	22.8%
1020	Interior Doors	Single leaf hollow metal	200 S.F. Floor/Door	Each	815	4.08	
1030	Fittings	Toilet partitions		S.F. Floor	1.04	1.04	
2010	Stair Construction	Concrete filled metal pan		Flight	11,550	4.05	
3010	Wall Finishes	60% vinyl wall covering, 40% paint		S.F. Surface	1.26	1.01	
3020	Floor Finishes	60% carpet, 30% vinyl composition tile, 10% ceramic tile		S.F. Floor	6.81	6.81	
3030	Ceiling Finishes	Mineral fiber tile on concealed zee bars		S.F. Ceiling	4.71	4.71	
D. SERVICES							
	D10 Conveying						
1010	Elevators & Lifts	Two hydraulic passenger elevators		Each	92,400	9.24	8.4%
1020	Escalators & Moving Walks	N/A		–	–	–	
	D20 Plumbing						
2010	Plumbing Fixtures	Toilet and service fixtures, supply and drainage	1 Fixture/1320 S.F. Floor	Each	2283	1.73	2.0%
2020	Domestic Water Distribution	Gas fired water heater		S.F. Floor	.23	.23	
2040	Rain Water Drainage	Roof drains		S.F. Roof	.87	.29	
	D30 HVAC						
3010	Energy Supply	N/A		–	–	–	14.2%
3020	Heat Generating Systems	Included in D3050		–	–	–	
3030	Cooling Generating Systems	N/A		–	–	–	
3050	Terminal & Package Units	Multizone unit gas heating, electric cooling		S.F. Floor	15.65	15.65	
3090	Other HVAC Sys. & Equipment	N/A		–	–	–	
	D40 Fire Protection						
4010	Sprinklers	N/A		–	–	–	0.7%
4020	Standpipes	Standpipes and hose systems		S.F. Floor	.82	.82	
	D50 Electrical						
5010	Electrical Service/Distribution	1000 ampere service, panel board and feeders		S.F. Floor	4.13	4.13	17.5%
5020	Lighting & Branch Wiring	Fluorescent fixtures, receptacles, switches, A.C. and misc. power		S.F. Floor	10.32	10.32	
5030	Communications & Security	Alarm systems, internet and phone wiring, and emergency lighting		S.F. Floor	4.61	4.61	
5090	Other Electrical Systems	Emergency generator, 7.5 kW, uninterruptible power supply		S.F. Floor	.21	.21	
E. EQUIPMENT & FURNISHINGS							
1010	Commercial Equipment	N/A		–	–	–	0.0%
1020	Institutional Equipment	N/A		–	–	–	
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	110.29	100%
	CONTRACTOR FEES (General Requirements: 10%, Overhead: 5%, Profit: 10%)				25%	27.56	
	ARCHITECT FEES				7%	9.65	
					Total Building Cost	147.50	

COMMERCIAL/INDUSTRIAL/INSTITUTIONAL | **M.390** | **Library**

Costs per square foot of floor area

526

Exterior Wall	S.F. Area	7000	10000	13000	16000	19000	22000	25000	28000	31000
	L.F. Perimeter	240	300	336	386	411	435	472	510	524
Face Brick with Concrete Block Back-up	R/Conc. Frame	163.20	154.45	147.10	143.85	139.70	136.65	135.05	133.85	131.75
	Steel Frame	158.60	149.85	142.55	139.25	135.10	132.00	130.50	129.30	127.20
Limestone with Concrete Block	R/Conc. Frame	204.75	190.75	178.45	173.05	165.95	160.60	157.90	155.95	152.25
	Steel Frame	200.15	186.15	173.85	168.45	161.30	156.00	153.35	151.30	147.65
Precast Concrete Panels	R/Conc. Frame	165.10	156.05	148.55	145.15	140.85	137.75	136.10	134.80	132.70
	Steel Frame	160.50	151.50	143.95	140.60	136.30	133.10	131.45	130.25	128.15
Perimeter Adj., Add or Deduct	Per 100 L.F.	19.85	13.85	10.70	8.65	7.35	6.25	5.55	4.95	4.55
Story Hgt. Adj., Add or Deduct	Per 1 Ft.	3.00	2.60	2.30	2.10	1.90	1.75	1.65	1.60	1.50
For Basement, add $38.60 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 $82.40 to $211.50 per S.F.

Common additives

Description	Unit	$ Cost
Carrels Hardwood	Each	875 - 1325
Closed Circuit Surveillance, One station		
Camera and monitor	Each	1675
For additional camera stations, add	Each	910
Elevator, Hydraulic passenger, 2 stops		
1500# capacity	Each	53,600
2500# capacity	Each	56,200
3500# capacity	Each	60,400
Emergency Lighting, 25 watt, battery operated		
Lead battery	Each	265
Nickel cadmium	Each	770
Flagpoles, Complete		
Aluminum, 20' high	Each	1375
40' high	Each	3125
70' high	Each	9725
Fiberglass, 23' high	Each	1675
39'-5" high	Each	3225
59' high	Each	8025

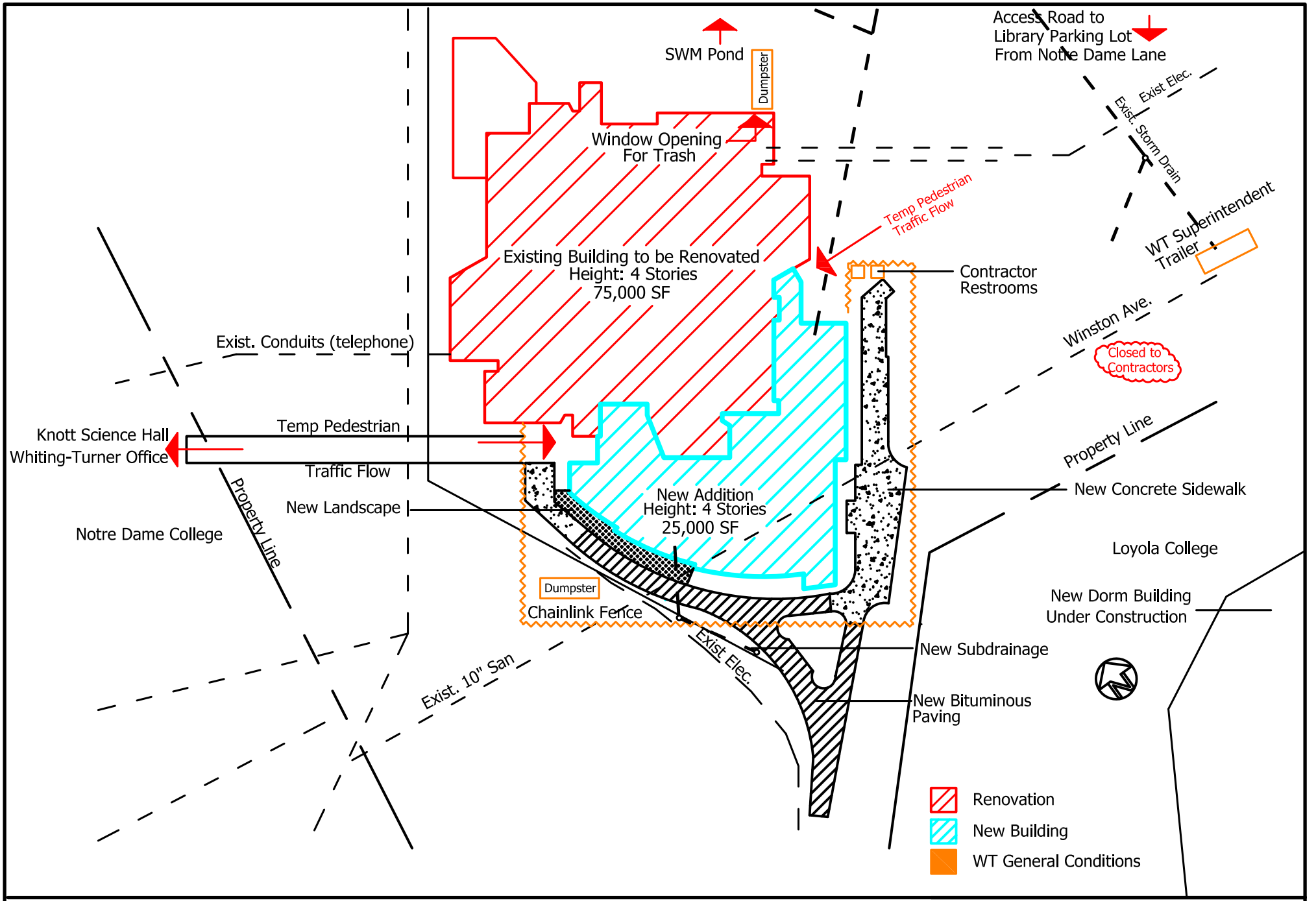
Description	Unit	$ Cost
Library Furnishings		
Bookshelf, 90" high, 10" shelf double face	L.F.	208
single face	L.F.	198
Charging desk, built-in with counter		
Plastic laminated top	L.F.	545
Reading table, laminated		
top 60" x 36"	Each	550

Approx. $131.75/SF

Model costs calculated for a 2 story building with 14' story height and 22,000 square feet of floor area

Library

				Unit	Unit Cost	Cost Per S.F.	% Of Sub-Total
A. SUBSTRUCTURE							
1010	Standard Foundations	Poured concrete; strip and spread footings		S.F. Ground	3.42	1.71	5.4%
1030	Slab on Grade	4" reinforced concrete with vapor barrier and granular base		S.F. Slab	4.45	2.23	
2010	Basement Excavation	Site preparation for slab and trench for foundation wall and footing		S.F. Ground	.24	.12	
2020	Basement Walls	4' foundation wall		L.F. Wall	69	1.36	
B. SHELL							
	B10 Superstructure						
1010	Floor Construction	Concrete waffle slab		S.F. Floor	.25	12.66	22.1%
1020	Roof Construction	Concrete waffle slab		S.F. Roof	19.40	9.70	
	B20 Exterior Enclosure						
2010	Exterior Walls	Face brick with concrete block backup	90% of wall	S.F. Wall	.27	11.55	16.2%
2020	Exterior Windows	Window wall	10% of wall	Each	44	2.46	
2030	Exterior Doors	Double aluminum and glass, single leaf hollow metal		Each	4525	.41	
	B30 Roofing						
3010	Roof Coverings	Single ply membrane, EPDM, fully adhered; perlite/EPS composite insulation		S.F. Roof	6.58	7.19	7.2%
3020	Roof Openings	Roof hatches		S.F. Roof	.08	.04	
C. INTERIORS							
1010	Partitions	Gypsum board on metal studs	30 S.F. Floor/L.F. Partition	S.F. Partition	10.15	4.06	15.4%
1020	Interior Doors	Single leaf wood	300 S.F. Floor/Door	Each	521	1.74	
1030	Fittings	N/A		–	–	–	
2010	Stair Construction	Concrete filled metal pan		Flight	7775	.71	
3010	Wall Finishes	Paint		S.F. Surface	.71	.57	
3020	Floor Finishes	50% carpet; 50% vinyl tile		S.F. Floor	3.80	3.80	
3030	Ceiling Finishes	Mineral fiber on concealed zee bars		S.F. Ceiling	4.71	4.71	
D. SERVICES							
	D10 Conveying						
1010	Elevators & Lifts	One hydraulic passenger elevator		Each	69,740	3.17	3.1%
1020	Escalators & Moving Walks	N/A		–	–	–	
	D20 Plumbing						
2010	Plumbing Fixtures	Toilet and service fixtures, supply and drainage	1 Fixture/1835 S.F. Floor	Each	2202	1.20	2.3%
2020	Domestic Water Distribution	Gas fired water heater		S.F. Floor	.76	.76	
2040	Rain Water Drainage	Roof drains		S.F. Roof	.64	.32	
	D30 HVAC						
3010	Energy Supply	N/A		–	–	–	19.1%
3020	Heat Generating Systems	Included in D3050		–	–	–	
3030	Cooling Generating Systems	N/A		–	–	–	
3050	Terminal & Package Units	Multizone unit, gas heating, electric cooling		S.F. Floor	19.35	19.35	
3090	Other HVAC Sys. & Equipment	N/A		–	–	–	
	D40 Fire Protection						
4010	Sprinklers	Wet pipe sprinkler system		S.F. Floor	2.16	2.16	2.1%
4020	Standpipes	N/A		–	–	–	
	D50 Electrical						
5010	Electrical Service/Distribution	400 ampere service, panel board and feeders		S.F. Floor	.99	.99	12.1%
5020	Lighting & Branch Wiring	Fluorescent fixtures, receptacles, switches, A.C. and misc. power		S.F. Floor	9.78	9.78	
5030	Communications & Security	Alarm systems, internet wiring, and emergency lighting		S.F. Floor	1.24	1.24	
5090	Other Electrical Systems	Emergency generator, 7.5 kW, Uninterruptible power supply		S.F. Floor	.21	.22	
E. EQUIPMENT & FURNISHINGS							
1010	Commercial Equipment	N/A		–	–	–	0.0%
1020	Institutional Equipment	N/A		–	–	–	
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	101.21	**100%**
	CONTRACTOR FEES (General Requirements: 10%, Overhead: 5%, Profit: 10%)				25%	25.32	
	ARCHITECT FEES				8%	10.12	
					Total Building Cost	**136.65**	



Loyola/Notre Dame Library

Sandra DiRupo
Construction Management
Friday, October 5, 2006

Appendix D
Technical Report 1
Dr. Horman