The Pennsylvania State University
5th Year Senior Thesis

Technical Assignment One

Construction Project Management

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Somewhere, USA
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Executive Summary:

Technical Assignment one is an in depth review on the Unknown Data Center. Some key construction management aspects were explored during this report. They include: the project schedule, the building systems, the project cost, the existing conditions/utilities, the local conditions, the client, the project delivery method, as well as the staffing plan used on this project.

This is a highly sensitive project; therefore, some information from the topics mentioned above will not be given in this report. The Data Center is the second of three expansions to the existing building. It is a one story structural steel frame building expanding south from the first phase of the expansion.

The project main focal challenge was the complex mechanical and electrical systems integrated in this project. The project's schedule is based off the MEP systems. The need to procure all the long lead items early in the design stage was necessary in order to have a short, efficient schedule. During construction, regular coordination meetings were a must in order to decrease the amount of clashes in the MEP systems. The preconstruction of this project started August 21, 2009, followed a month later with the construction. The building was then complete August 30, 2010.

The total construction cost of this project was determined to be $21 Million. This worked out to be $1,200 per square foot. This price is much higher than typical project of the same nature obtained using D4Cost and RS Means Costworks. This is due to different façade, structural systems and a higher complexity in the MEP systems.

After analyzing all the information in this report, key components to this project are the mechanical and electrical systems in this building. Since the MEP systems in this project are critical for success on this project, it will make for an interesting research topic.

Table of Contents:

A. Project Schedule:

The design for the Data Center was completed in December of 2008. However the preconstruction did not start until August of 2009 with the completion of the conceptual documents and the soils report. This project is the second of three expansions. The first and second expansions are done. The third expansion will be underway in the future.

Preconstruction started August 21, 2009. The preconstruction phase includes bids, submittals, an intense review for all the complex mechanical and electrical systems, and the contract awards for the subcontractors. To accelerate the project Turner construction fabricated all the long lead items such as chillers, dry coolers, pump packages, etc… The schedule can be seen on Appendix A for more detail.

The procurement phase started roughly a month after the preconstruction phase was underway, September of 2009. The procurement phase includes the review and the submittals of all trades as well as the shop drawing submittals. The procurement phase also includes all the notice to proceeds for all the major subcontractors that were awarded contracts for the Data Center. The milestone represented in the schedule from Appendix A is the first trade that mobilizes onsite.

The construction started on the 21st of September, 2009. The construction phase is broken up into nine categories: Site, existing, upper/lower slab on grade, roof, underground/upper floor/lower floor, and under raised floor coordination. The site all of the trades that will be working in the Data Center, this includes: the excavation, foundation work, steel erection, enclosure, etc… The existing portion refers to all the work the trades performed to the existing building. The upper/lower slab on grade portion includes work done by all trades in the building. The roof portion includes structural, finishes, and MEP fit-out. The coordination started before all the construction done inside the building. This was done by Sigma 7 for the purpose to reduce clashes in the mechanical, electrical, and plumbing components of the building.

The construction is wrapped up with the installation of the sprinkler systems and is followed by a milestone, substantial completion. The Data Center is then enters its final inspection followed by the closeout, August 30, 2010.

B. Building Systems Summary:

Yes	No	Work Scope
	X	Demolition Required?
X		Structural Steel Frame
X		Cast in Place Concrete
X		Precast Concrete
X		Mechanical System
X		Electrical System
	X	Masonry
	X	Curtain Wall
	X	Support of Excavation

Structural Steel Frame:
This project consists of a one story addition with a braced steel frame structure. A typical bay size is roughly 25' X 40'. The design of the beams is very unique due to the heavy mechanical load on the roof. Therefore, the beam's size and weight sporadically changes throughout the building. A typical size girder and beam where there is no mechanical equipment above is a W24X76 and a W24X68, respectively. Where mechanical systems lie on roof top, the girders and beams are typically a W30X90 and a W30X108, respectively. There are beams on this project that get up to W40'sX250's. The steel was erected with a 250 ton All Terrain Crane. The crane was located on the south side of the building. More detail on the location of the crane will be presented in later reports

In addition to this unique steel frame design, the structural engineer had to design a dunnage type system to support the mechanical systems on the roof. This dunnage is made of 6"X6" hollow tube structural steel (See building statistics 2 for more detail).

The flooring of the Data Center consists of a composite slab structure. The total slab depth is 5" lightweight concrete. The metal deck used is 1 ½" 16 gauge composite metal deck and spans east-to-west along the building. The concrete slab is reinforced with 4X4 - W4.0XW4.0 welded wire fabric.

Cast in Place Concrete:
This project consisted of very little cast in place concrete. Cast in place concrete consisted of slab on grade, slab on deck, equipment pads, and the foundation footings and spread footings. The concrete used for the footers and slabs was 4000 psi normal weight concrete and 3000 psi lightweight concrete, respectively. The design of the formwork was the contractor's decision. The material of the formwork that was used on this project consisted of chamfer strips. These chamfer strips was one of the following material sporadically used onsite: wood, metal, PVC or rubber. The placement method used to place the concrete was by truck.

Precast Concrete:
The Data Center's expansion envelope was all done by precast concrete. Since the new expansion only included new mechanical, computer, and electrical rooms, no windows were needed. Due to the sensitivity of the project, the pre-casting location will remain unknown. The precast panels had at least a 20 work day lead time for contractor erection and review of calculations. The precast panels are designed to withstand wind forces up to 200 mph. The panels are connected by use of bearing pads. There are four different type of bearing pads used to connect the panels. The bearing pads include: Elastomeric, laminated fabric-rubber, frictionless and tempered hardboard pads. The panels will be temporarily braced by the contractor until ready to be placed permanently. Jacks, shims or bolts were used to align and level the precast depending on the type of bearing pad. The type of connection used is to fill with grout, bolt or weld depending on what is specified in the shop drawings. The minimum bearing on steel, concrete, and masonry (existing), shall be 2 ½", 3", and 3" respectively. To ensure quality, if any precast panel falls under any tolerances, the panels must be replaced to the cost of the contractor. As stated in the structural steel section. The crane used to erect the precast panels was a 250 ton All Terrain Crane.

Mechanical System(s):
The primary mechanical room is located on the first floor on the west side of the building. This project also includes a generator room, pump room, substation room, and a mechanical yard also located on the first floor. On the roof includes chillers, dry coolers, and radiators. The Data Center consists of many different types of mechanical systems. They include: Chilled water systems, glygol water systems. The chilled water system is 350 ton and the GPM ranges from 1,100 – 1,300. The dry cooling is a 190 ton system. The glygol water system is located on the roof and pumps out 110,040 CFM.

The fire-suppression systems include a combination of sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers, smoke exhaust systems, and fire alarm panels.

Electrical System(s):
The design of the Data Center's electrical system includes a 2N electrical infrastructure with concurrent maintenance. The building includes an existing 600A, 480Y/277V mass distribution systems. The expansion includes three new mass distribution systems that consists of 1200A, 480Y/277V. First mass distribution panel distributes to a 600A, 480Y/277V system. This services the new lighting and receptacles, as well as some mechanical systems. The second mass distribution panel distributes to a 600A, 480Y/277V system that services mechanical equipment and is reserved for the future use (third expansion). The final mass distribution panel distributes to a 600A, 480Y/277V system that services more lighting and receptacles, as well as more mechanical systems. An important issue to note, the contractors had to bring in a 300 Ton Crane to set the generators on the roof.

C. Project Cost Evaluation:

Due to Turner's contract agreement with the owner, the building system cost breakdown will not be included in this report. Below in Table C.1 shows the different cost associated with the Data Center:

	Cost	Cost/SF
Construction:	$21 Million	$1,200.00
Total Project:	$33 Million	$1,890.00
Building System:	$12 Million	$688.00

Table C.1Project Cost Summary

D4Cost was used for the Data Center. D4Cost does this by referencing historical data on past projects with similar size, type, and number of stories. D4Cost was used to generate an estimated construction cost of roughly $2.2 million with a square foot cost of $110.00. Also a total project cost of roughly $5.6 million and a square foot cost of roughly $321.00. To see a more detailed breakdown, refer to Appendix C.2. There are several reasons why these numbers differ from the actual project numbers. First, D4Cost did not have any data on a past project that consisted with a Data Center that used an Architectural precast envelope which will increase the cost sporadically. Additionally, the Unknown Data Center has multiple mechanical systems as well as an advanced electrical system that include three 2MW generators. Lastly, D4Cost did not include any cost for structural steel frame. The historical data only included a Data Center that structure is cast in place concrete. The Unknown Data Center has a structural steel frame and composite slab on deck, as well as, cast in place concrete for the foundation spread footers and concrete footers.

RS Means Costworks was also used to produce a square foot estimate for this project. Like the D4Cost, RS Means Costworks uses historical data with similar size, building height, type, and number of stories. RS Means Costworks generated and estimated construction cost of $5.6 Million and a square foot costs of $320.00. The value that the RS Means Costworks generates closer to Turners values, given above. However, the values still falls short from Turners given cost information explained in the beginning of this section. The same reasoning for the differences in price from the D4Cost analysis applies to this scenario as well.

D. Site Plan of Existing Conditions:

Due to location restrictions on this project, the location will not be given in this report. Refer to Appendix D.1 for a satellite view of the site. Based on the observation with the vicinity map, the site is fairly remote, thus, vehicular and pedestrian traffic was not a top concern. The attached site plan shows a basic north plan layout of Phase 2 of the Data Center's expansion as well as the Phase 1 and the existing building with the height related to the building. The attached site plan also shows traffic patterns, storm drainage and existing water layouts. The temporary facilities such as electric, sanitary and gas is not shown in the site plan. The reasoning is all temporary facilities used for this project came from the existing building, including phase 1. Refer to Appendix D.2 for more details.

E. Local Conditions:

Due to the sensitivity of the project, the location of the project will not be released in this section. The zoning type integrated in this project is type 2 zoning. The allowable height is restricted to 55 feet. Due to the use of sprinklers, the allowable height became 75 feet which was plenty for the 43 foot one story expansion.

The type of soil surrounding the area was a mix between sand, silt, clay, shale, siltstone, and sandstone. Because the Data Center is a one story expansion, excavation was not a complex issue on this project.

F. Client Information:

Due to the nature of this project, this report will not release any client information. For a general idea, the Data Center Expansion is the second of three expansions. The owner is building to expand their business.

G. Project Delivery System:

The project delivery system selected by the owner to use for the Data Center is a Design-Bid-Build. In the figure below, figure G.1, is a detailed breakdown of the project team organization chart.

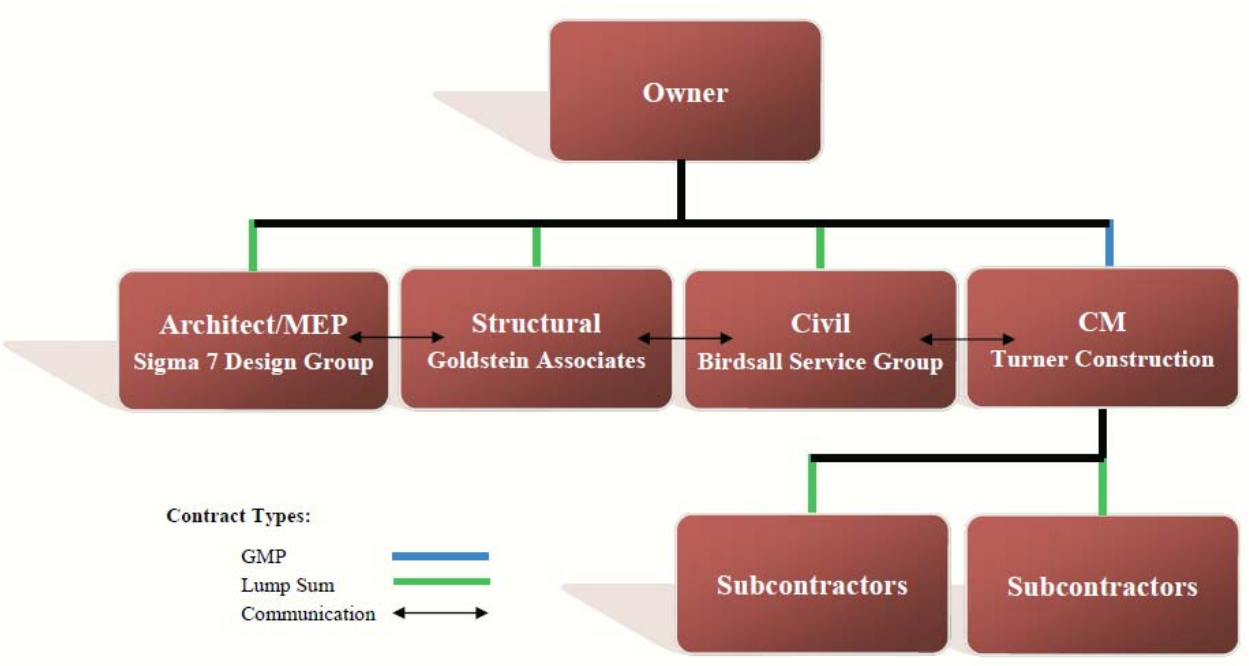


Figure G.1- Project Organizational Chart

The owner holds a contract with Sigma 7 design group. Sigma 7 is a very odd company in which they service architecture as well as engineering design. The contract type is lump sum. Moving along the chart, the owner has lump sum contracts with Goldstein Associates, who serviced the structural components of the Data Center, and Birdsall Service Group, who serviced the civil part of the Data Center. Lastly, the owner holds a guaranteed maximum price (GMP) contract with Turner Construction Co. Turner holds lump sum contracts with several subcontractors.

The major subcontractors are as follows:

Nordic Contracting – Concrete/Foundation
Universal Concrete – Precast
Lynchburg Steel - Steel Erection

For this particular project, it was critical for communication between all trades involved in this project, especially Turner and Sigma 7. Coordination meetings for all MEP systems were vital to keeping the project on schedule. For more information, refer to section A and Appendix A of this report.

H. Staffing Plan:

Turner Construction staffed this project a little different due to the Data Center being a specialized construction project. Below in figure H.1 show a detailed chart of the staffing plan used for the Data Center.

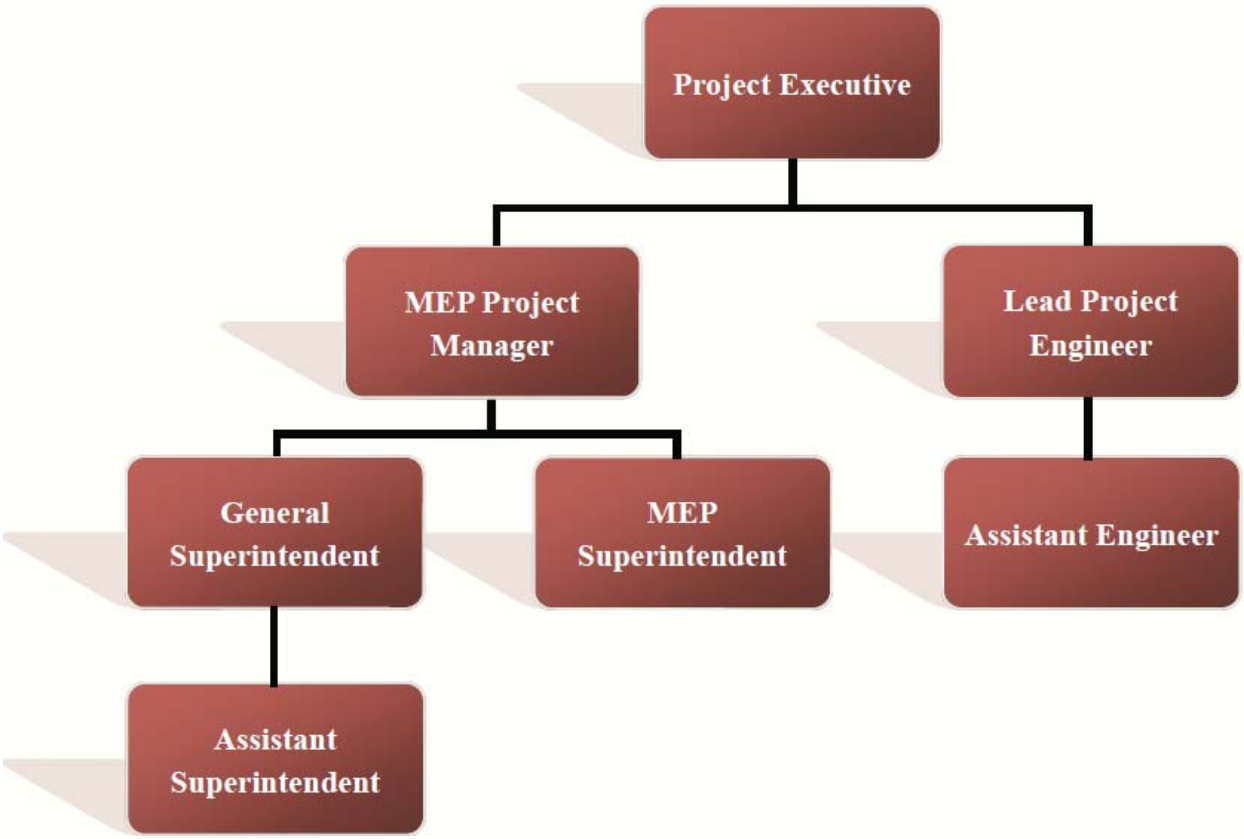
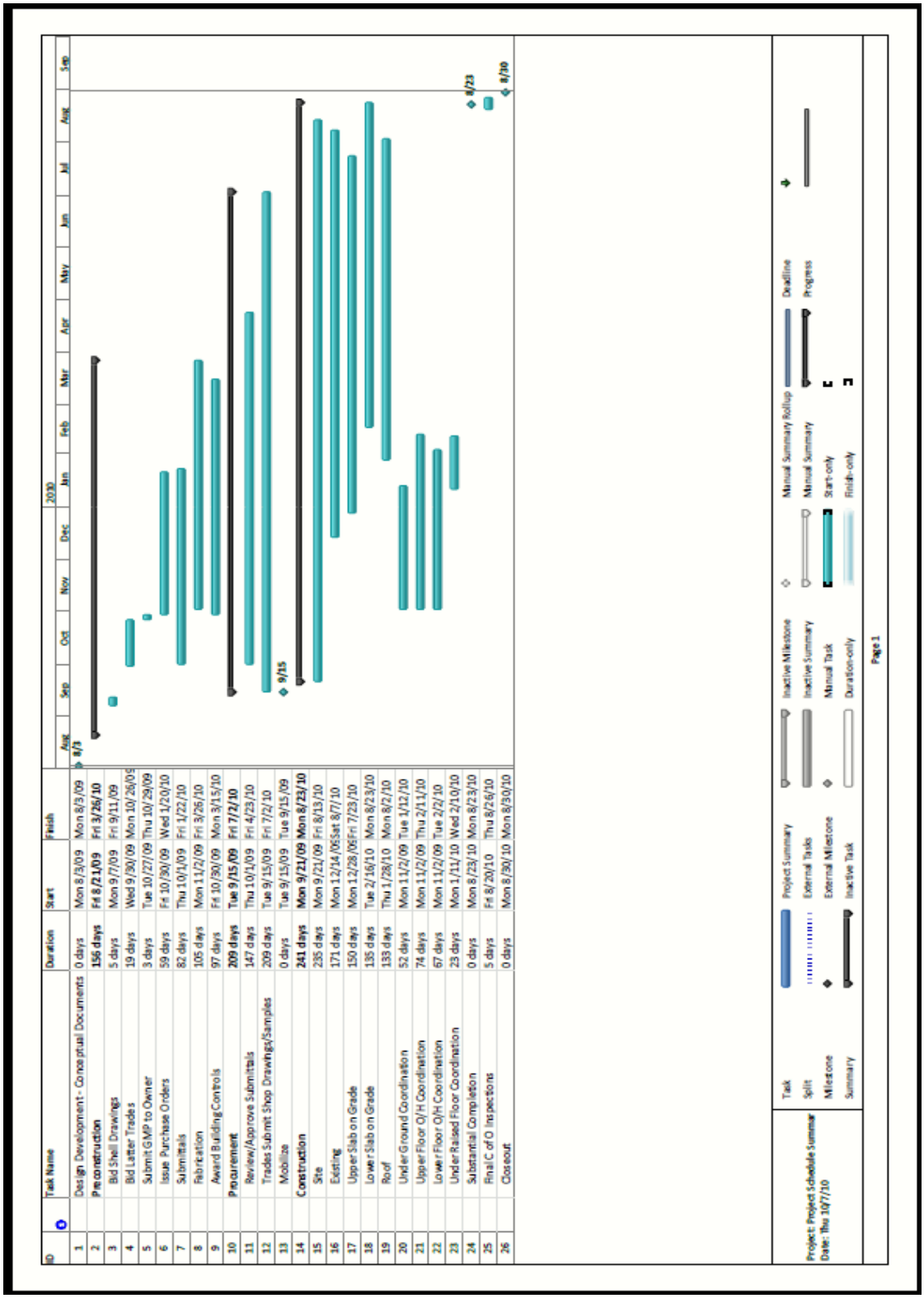


Figure H.1 Project Management and Supervision Staff Organizational Chart

Because the mechanical, electrical, and plumbing systems of this project were critical, it was necessary for Turner to have a MEP project manager look over the general superintendent and MEP superintendent.

Appendix A:


ID
Task Name
Duration
Start
Finish
2010
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
1 Design Development - Conceptual Documents 0 days Mon 8/3/09 Mon 8/3/09
2 Pre construction 156 days Fri 8/21/09 Fri 3/26/10
3 Bid Shell Drawings 5 days Mon 9/7/09 Fri 9/11/09
4 Bid Latter Trades 19 days Wed 9/30/09 Mon 10/26/09
5 Submit GMP to Owner 3 days Tue 10/27/09 Thu 10/29/09
6 Issue Purchase Orders 59 days Fri 10/30/09 Wed 1/20/10
7 Submittals 82 days Thu 10/1/09 Fri 1/22/10
8 Fabrication 105 days Mon 11/2/09 Fri 3/26/10
9 Award Building Controls 97 days Fri 10/30/09 Mon 3/15/10
10 Procurement 209 days Tue 9/15/09 Fri 7/2/10
11 Review/Approve Submittals 147 days Thu 10/1/09 Fri 4/23/10
12 Trades Submit Shop Drawings/Samples 209 days Tue 9/15/09 Fri 7/2/10
13 Mobilize 0 days Tue 9/15/09 Tue 9/15/09
14 Construction 241 days Mon 9/21/09 Mon 8/23/10
15 Site 235 days Mon 9/21/09 Fri 8/13/10
16 Existing 171 days Mon 12/14/09 Sat 8/7/10
17 Upper Slab on Grade 150 days Mon 12/28/09 Fri 7/23/10
18 Lower Slab on Grade 135 days Tue 2/16/10 Mon 8/23/10
19 Roof 133 days Thu 1/28/10 Mon 8/2/10
20 Under Ground Coordination 52 days Mon 11/2/09 Tue 1/12/10
21 Upper Floor O/H Coordination 74 days Mon 11/2/09 Thu 2/11/10
22 Lower Floor O/H Coordination 67 days Mon 11/2/09 Tue 2/2/10
23 Under Raised Floor Coordination 23 days Mon 1/11/10 Wed 2/10/10
24 Substantial Completion 0 days Mon 8/23/10 Mon 8/23/10
25 Final C of O Inspections 5 days Fri 8/20/10 Thu 8/26/10
26 Closeout 0 days Mon 8/30/10 Mon 8/30/10
8/3
9/15
8/23
8/30
Project: Project Schedule Summar
Date: Thu 10/7/10
Task
Split
Milestone
Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
Deadline
Progress
Page 1

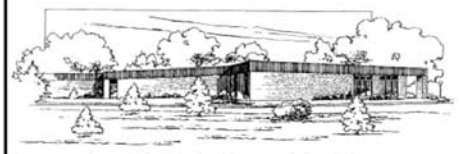
Appendix C.1 – D4 Cost Summary:

Div.#	Division/Subdivision	Base Cost	%	Sq. Cost	Projected
00	Procurement and Contracting Require	63,379	4.99	5.47	109,358
01	General Requirements	165,036	12.98	14.24	284,765
03	Concrete	310,448	24.43	26.78	535,667
04	Masonry	13,611	1.07	1.17	23,485
05	Metals	65,400	5.15	5.64	112,845
06	Wood, Plastics, and Composites	5,950	0.47	0.51	10,266
07	Thermal and Moisture Protection	30,402	2.39	2.62	52,457
08	Openings	62,684	4.93	5.41	108,158
09	Finishes	50,476	3.97	4.35	87,095
10	Specialties	1,611	0.13	0.14	2,780
11	Equipment	52	0.00	0.00	89
12	Furnishings	36,676	2.89	3.16	63,284
14	Conveying Systems	24,028	1.89	2.07	41,459
21	Fire Suppression	9,640	0.76	0.83	16,633
22	Plumbing	34,535	2.72	2.98	59,590
23	HVAC	166,263	13.08	14.34	286,882
26	Electrical	230,834	18.16	19.91	398,295
	Total Building Cost	1,271,024	100.00	109.66	2,193,108
	Total Project Cost	3,231,352			5,575,588

Appendix C.2 – RS Means Square Foot Cost Summary:

CostWorks® RSMeans **Square Foot Cost Estimate Report** Back Print Export

Estimate Name: **Untitled**	
Building Type:	**Computer Data Center with Tilt Up Concrete / Steel Frame**
Location:	**National Average**
Stories:	**1**
Story Height (L.F.):	**43.5**
Floor Area (S.F.):	**17445**
Labor Type:	**Union**
Basement Included:	**No**
Data Release:	**Year 2010 Quarter 3**
Cost Per Square Foot:	**$320.43**
Building Cost:	**$5,590,000**



Costs are derived from a building model with basic components. Scope differences and market conditions can cause costs to vary significantly. **Parameters are not within the ranges recommended by RSMeans.**

	% of Total	Cost Per S.F.	Cost
A Substructure	**3.8%**	**$9.00**	**$157,000**
A1010 Standard Foundations		**$1.66**	**$29,000**
Strip footing, concrete, reinforced, load 11.1 KLF, soil bearing capacity 6 KSF, 12" deep x 24" wide			
Spread footings, 3000 PSI concrete, load 100K, soil bearing capacity 6 KSF, 4' - 6" square x 15" deep			
Spread footings, 3000 PSI concrete, load 200K, soil bearing capacity 6 KSF, 6' - 0" square x 20" deep			
A1030 Slab on Grade		**$4.76**	**$83,000**
Slab on grade, 4" thick, non industrial, reinforced			
A2010 Basement Excavation		**$0.20**	**$3,500**
Excavate and fill, 30,000 SF, 4' deep, sand, gravel, or common earth, on site storage			
A2020 Basement Walls		**$2.38**	**$41,500**
Foundation wall, CIP, 4' wall height, direct chute, .148 CY/LF, 7.2 PLF, 12" thick			
B Shell	**20.4%**	**$48.84**	**$852,000**
B1020 Roof Construction		**$7.97**	**$139,000**
Roof, steel joists, joist girder, 1.5" 22 ga metal deck, on columns, 50'x50' bay, 40 PSF superimposed load, 59" deep, 64 PSF total load			
Roof, steel joists, joist girder, 1.5" 22 ga metal deck, on columns, 50'x50' bay, 40 PSF superimposed load, 59" deep, 64 PSF total load, add for columns			
B2010 Exterior Walls		**$30.30**	**$528,500**
Brick veneer wall, standard face, 20 ga x 3-5/8" NLB @ 16" metal stud back-up, running bond			
B2020 Exterior Windows		**$2.55**	**$44,500**
Windows, aluminum, sliding, insulated glass, 5' x 3'			
B2030 Exterior Doors		**$0.92**	**$16,000**
Door, aluminum & glass, without transom, narrow stile, with panic hardware, 3'-0"x 7'-0"opening			
Door, aluminum & glass, with transom, narrow stile, double door, hardware, 6'-0" x 10'-0" opening			
B3010 Roof Coverings		**$6.99**	**$122,000**
Roofing, single ply membrane, EPDM, 60 mils, loosely laid, stone ballast			
Insulation, rigid, roof deck, polyisocyanurate, 2#/CF, 3" thick			
Insulation, rigid, roof deck, polyisocyanurate, tapered for drainage			
Roof edges, aluminum, duranodic, .050" thick, 8" face			

	Gravel stop, aluminum, extruded, 8", duranodic, .050" thick			
B3020	**Roof Openings**		**$0.11**	**$2,000**
	Roof hatch, with curb, 1" fiberglass insulation, 2'x6" x 8'-0", aluminum curb and cover, 260 lbs			
C	**Interiors**	**7.6%**	**$18.26**	**$318,500**
C1010	**Partitions**		**$5.19**	**$90,500**
	Metal partition, 5/8"fire rated gypsum board face, no base,3 -5/8" @ 24" OC framing, same opposite face, no insulation			
	Gypsum board, 1 face only, exterior sheathing, fire resistant, 5/8"			
	Add for the following: taping and finishing			
C1020	**Interior Doors**		**$1.72**	**$30,000**
	Wood door/metal frame, solid core/flush, oak face, 2'-8" x 6'-8", butt welded frame, 8-3/4"			
C1030	**Fittings**		**$0.46**	**$8,000**
	Toilet partitions, cubicles, floor and ceiling anchored, plastic laminate			
C3010	**Wall Finishes**		**$4.39**	**$76,500**
	Painting, interior on plaster and drywall, brushwork, primer & 2 coats			
	Painting, interior on plaster and drywall, brushwork, primer & 2 coats			
	Ceramic tile, thin set, 4-1/4" x 4-1/4"			
C3020	**Floor Finishes**		**$5.85**	**$102,000**
	Carpet tile, nylon, fusion bonded, 18" x 18" or 24" x 24", 35 oz			
	Tile, porcelain type, minimum			
	Tile, quarry tile, mud set, maximum			
C3030	**Ceiling Finishes**		**$0.66**	**$11,500**
	Acoustic ceilings, 3/4"mineral fiber, 12" x 12" tile, concealed 2" bar & channel grid, suspended support			
D	**Services**	**67.4%**	**$161.54**	**$2,818,000**
D2010	**Plumbing Fixtures**		**$3.58**	**$62,500**
	Water closet, vitreous china, bowl only with flush valve, wall hung			
	Urinal, vitreous china, wall hung			
	Lavatory w/trim, wall hung, vitreous china, 24" x 20"			
	Kitchen sink w/trim, countertop, stainless steel, 19" x 18" single bowl			
	Kitchen sink w/trim, countertop, stainless steel, 33" x 22" double bowl			
	Service sink w/trim, PE on CI, corner floor, 28" x 28", w/rim guard			
	Drinking fountain, 1 bubbler, wall mounted, non recessed, fiberglass, 12" back			
D2020	**Domestic Water Distribution**		**$0.60**	**$10,500**
	Gas fired water heater, commercial, 100< F rise, 100 MBH input, 91 GPH			
D2040	**Rain Water Drainage**		**$0.97**	**$17,000**
	Roof drain, CI, soil,single hub, 5" diam, 10' high			
	Roof drain, CI, soil,single hub, 5" diam, for each additional foot add			
D3010	**Energy Supply**		**$5.56**	**$97,000**
	Hot water reheat system for 22,500 SF computer center			
D3020	**Heat Generating Systems**		**$7.65**	**$133,500**
	Boiler, oil, cast iron, hot water, 236 MBH			
	Pump, base mounted with motor, end-suction, 3" size, 5 HP, to 225 GPM			
	Pump, base mounted with motor, end-suction, 4" size, 7-1/2 HP, to 350 GPM			
D3030	**Cooling Generating Systems**		**$8.60**	**$150,000**
	Chiller, reciprocating, water cooled, standard controls, 150 ton			
	Cooling tower, stainless steel, packaged unit, draw thru, 300 ton			
D3090	**Other HVAC Systems/Equip**		**$63.06**	**$1,100,000**
	Ductwork for 22,500 SF computer center			
	Plate heat exchanger, 400 GPM			

	AHU, central station, cool/heat coils, VAV, filters, 10,000 CFM			
	AHU, central station, cool/heat coils, VAV, filters, 20,000 CFM			
	AHU, central station, cool/heat coils, VAV, filters, 30,000 CFM			
	VAV terminal, cooling, hot water reheat, with actuator / controls, 1250 CFM			
	VAV terminal, cool, hot water reheat, fan powered, with actuator/controls, 1250 CFM			
	Roof vent. system, power, centrifugal, aluminum, galvanized curb, back draft damper, 800 CFM			
D4010	**Sprinklers**		**$3.73**	**$65,000**
	Preaction sprinkler systems, steel, black, sch 40, light hazard, 1 floor, 2000 SF			
	Wet pipe sprinkler systems, steel, light hazard, 1 floor, 10,000 SF			
D4020	**Standpipes**		**$0.54**	**$9,500**
	Wet standpipe risers, class III, steel, black, sch 40, 4" diam pipe, 1 floor			
D5010	**Electrical Service/Distribution**		**$4.39**	**$76,500**
	Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 1200 A			
	Feeder installation 600 V, including RGS conduit and XHHW wire, 1200 A			
	Switchgear installation, incl switchboard, panels & circuit breaker, 1200 A			
D5020	**Lighting and Branch Wiring**		**$15.53**	**$271,000**
	Receptacles incl plate, box, conduit, wire, 16.5 per 1000 SF, 2.0 W per SF, with transformer			
	Receptacle systems, underfloor duct, 5' on center, high density			
	Wall switches, 2.0 per 1000 SF			
	Miscellaneous power, 1.2 watts			
	Central air conditioning power, 8 watts			
	Motor installation, three phase, 460 V, 10 HP motor size			
	Motor installation, three phase, 460 V, 15 HP motor size			
	Motor installation, three phase, 460 V, 25 HP motor size			
	Variable frequency drive's for 22500 SF computer center			
	Fluorescent fixtures recess mounted in ceiling, 1.6 watt per SF, 40 FC, 10 fixtures @32watt per 1000 SF			
D5030	**Communications and Security**		**$32.22**	**$562,000**
	Telephone systems, conduit system with floor boxes, high density			
	Communication and alarm systems, includes outlets, boxes, conduit and wire, sound systems, 30 outlets			
	Communication and alarm systems, fire detection, addressable, 50 detectors, includes outlets, boxes, conduit and wire			
	Fire alarm command center, addressable with voice, excl. wire & conduit			
	Internet wiring, 8 data/voice outlets per 1000 S.F.			
D5090	**Other Electrical Systems**		**$15.10**	**$263,500**
	Generator sets, w/battery, charger, muffler and transfer switch, diesel engine with fuel tank, 350 kW			
	Uninterruptible power supply with 15 minutes pack, 375 kVA, 120 V			
	Automatic transfer switch, enclosed 120/240 volt, UPS 375 KVA			
E	**Equipment & Furnishings**	**0.0%**	**$0.00**	**$0**
E1090	**Other Equipment**		**$0.00**	**$0**
F	**Special Construction**	**0.8%**	**$1.95**	**$34,000**
F1020	**Integrated Construction**		**$1.95**	**$34,000**
	Special construction, pedestal access floors, steel panels, no stringers, vinyl covering, >6000 SF			
G	**Building Sitework**	**0.0%**	**$0.00**	**$0**

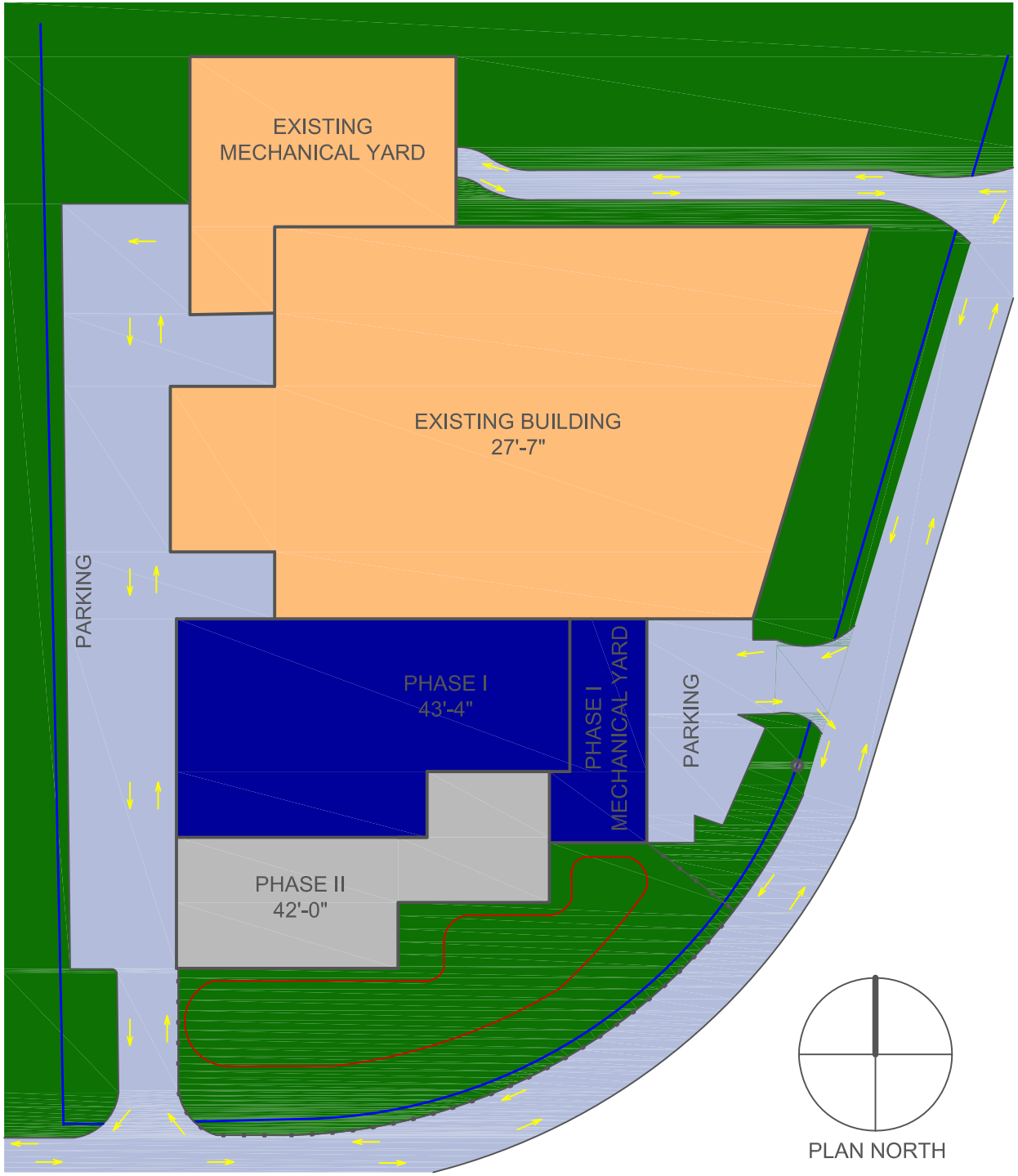
SubTotal	**100%**	**$239.58**	**$4,179,500**
Contractor Fees (GC,Overhead,Profit)	**25.0%**	**$59.90**	**$1,045,000**
Architectural Fees	**7.0%**	**$20.95**	**$365,500**
User Fees	**0.0%**	**$0.00**	**$0**

Total Building Cost	$320.43	$5,590,000

Appendix D.1 – Vicinity Maps:

Appendix D.2 – Site Plan of Existing Conditions:

See Attached



LEGEND:

EXISTING UTILITIES:

WATER — EXISTING
GAS — EXISTING
STORM — EXISTING
SANITARY — EXISTING
ELECTRIC — EXISTING

SYMBOLS:

FIRE HYDRANT
VEHICULAR TRAFFIC
CONSTRUCTION FENCE

UNKNOWN DATA CENTER

EXISTING CONDITIONS SITE PLAN

OCTOBER 5, 2010

DANIEL SUTER - CM