Technical Assignment Two

Penn State AE Senior Thesis

Image courtesy of U.S. Army Corps of Engineers

Advanced Individual Training

A.I.T. Barracks

Fort Eustis, VA

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Construction Management

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October 19, 2011

Executive Summary

The Advanced Individual Training (A.I.T.) Barracks is a three story building with a progressive collapse avoidance structural system. The owner of the building is the U.S. Army Corps of Engineers. The building envelope has precast accents and a brick veneer (non load bearing) façade. A.I.T plans to house a total of 300 soldiers in 150 sleeping modules. This 91,800 S.F. building will cost approximately 18,166,185 dollars when the project is finished in February of 2012. The building has many unique features not present in a normal Barracks i.e. the building lacks an elevator. Although the building has many unique features no unusual techniques were implemented. LEED Silver is the current goal of the project, the project is projected to successfully achieve it.

Technical assignment two will analyze the key features of the project that affect project execution. This report includes an executive summary, detailed project schedule, detailed structural systems estimate, general conditions estimate, LEED evaluation, and building information modeling use evaluation.

The detailed project schedule evaluates the sequence of the design and construction process. It gives a through and concise description of all important trades, and shows the constructability and flow of work.

The detailed structural system estimate assesses a typical bay within the A.I.T. barracks progressive collapse structural system. This typical bay estimate is then used to calculate the cost of the superstructure of the building

The general conditions estimate gives the budget used on the project for general conditions including staffing cost and temporary utilities.

This project is projected to be LEED silver. The LEED evaluation is broken down into each category and discussed on a more detailed level.

The BIM use evaluation section shows the effective use of BIM and how it was successful on the project. This success has led to all goals being met or currently ongoing and exceeding expectations.

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A.I.T Barracks

Fort Eustis, VA

October 19, 2011

Project Schedule

See Appendix A for 11" x 17" Detailed Project Schedule

	Task Name	Duration	Start	Finish
1				
2	NTP	0 days	Thu 10/14/10	Thu 10/14/10
3	Design Phase			
4	Geotechnical Survey and Analysis	100 days	Sun 11/14/10	Thu 3/31/11
5	Civil Design	89 days	Thu 10/14/10	Tue 2/15/11
6	Structural Design	137 days	Tue 10/19/10	Wed 4/27/11
7	Architectural Design	140 days	Thu 10/14/10	Wed 4/27/11
8	Design Packages - Building MEP/F	155 days	Thu 10/14/10	Wed 5/18/11
9	Final Design Documents Available	0 days	Wed 5/18/11	Wed 5/18/11
10	Bid and Award Phase			
11	Bid and Award Sitework	154 days	Mon 11/29/10	Thu 6/30/11
12	Bid and Award Foundations	31 days	Fri 12/17/10	Fri 1/28/11
13	Bid and Award Structure	74 days	Wed 1/12/11	Mon 4/25/11
14	Bid and Award Building Envelope	95 days	Mon 2/7/11	Fri 6/17/11
15	Bid and Award MEPF	78 days	Mon 11/15/10	Wed 3/2/11
16	Bid and Award Int. Framing & Finishes	176 days	Mon 11/15/10	Mon 7/18/11
17	Bid and Award Accessories	61 days	Fri 3/25/11	Fri 6/17/11
18	Bid and Award Commissioning	125 days	Mon 11/29/10	Fri 5/20/11
19	Pre-Construction Submittals			
20	Submit Cert. of Insurance, Bonds	0 days	Wed 10/6/10	Wed 10/6/10
21	SWPPP (Storm Water Plan)	71 days	Thu 10/14/10	Thu 1/20/11
22	Environmental Plan	46 days	Thu 10/14/10	Thu 12/16/10
23	Quality Control Plan	178 days	Thu 10/14/10	Mon 6/20/11
24	Network Anaysis System	195 days	Thu 10/14/10	Wed 7/13/11
25	Submital Register	107 days	Thu 10/14/10	Fri 3/11/11
26	List of Subs & Products	84 days	Mon 5/2/11	Thu 8/25/11
27	Accident Prevention Plan	62 days	Thu 10/14/10	Fri 1/7/11
28	Waste Management Plan	48 days	Mon 11/15/10	Wed 1/19/11
29	Health & Safety Plan	107 days	Thu 10/14/10	Fri 3/11/11
30	Fire Protection Specialist	28 days	Thu 10/14/10	Mon 11/22/10
31	Construction Submittals			
32	Utilities Submittals & Fabrication	28 days	Mon 2/14/11	Wed 3/23/11
33	Concrete Submittals & Fabrication	32 days	Mon 2/7/11	Tue 3/22/11
34	Structure Submittals & Fabrication	139 days	Mon 1/31/11	Thu 8/11/11
35	Building Envelope Submittals & Fabricatio	99 days	Mon 3/14/11	Thu 7/28/11
36	Glazing Submittals & Fabrication	99 days	Mon 3/14/11	Thu 7/28/11
37	Walls, Clgs, GWB, Doors, I.Wind	166 days	Mon 3/14/11	Mon 10/31/11
38	MEP Equipment Submittals & Fabrication	219 days	Thu 1/27/11	Tue 11/29/11
39	Landscaping Submittals	31 days	Fri 7/22/11	Fri 9/2/11

Fig 1. Detailed Project Schedule

The detailed project schedule seen in Figure 1 summarizes the A.I.T. barracks sequence of design and construction. Because the project was a design-build project the schedule was seen as detrimental to the project's success. The sequence is broken into 4 areas of construction, Area A, Area B, Area C, and Area D.

Project Schedule

The first floor layout is as follows - please reference Figure 2:

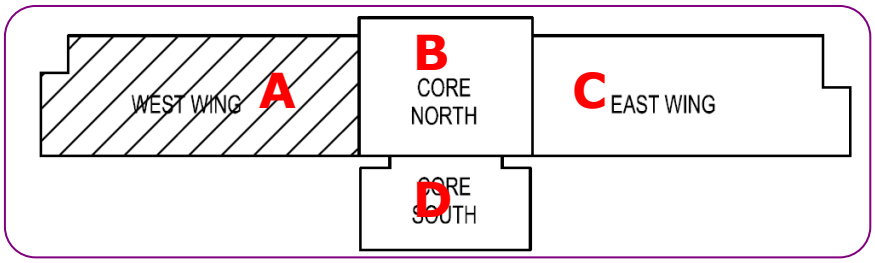


Fig 2. Area A—D designations

A: West Wing (barracks room)

B: Core North (day room, computer room, profile recovery, laundry)

C: East Wing (barracks room)

D: Core South (offices, arms room, supply room) only on the first floor

The second and third floors mirror each area except there is no area D.

Design Phase:

During the design phase the design of the A.I.T. barracks was started and completed. This project is a design-build project therefore the design process went into the construction phase. The design phase consisted of geotechnical survey and analysis, civil design, structural design, architectural design, and MEP/F design.

Bid and Award Phase:

The Bid and Award Phase is when the site work, foundations, structure, building envelope, MEP/F, Int. framing and finishes, accessories, and commissioning contracts were sent to the subcontractors for bid. The general contractor then evaluated all bids and awarded the contracts to the most qualified bidder.

Pre-construction and Construction Submittals:

The pre-construction and construction submittals were completed during this time.

Project Schedule

Site work:

During this phase of construction all of the Underground utilities were placed enclosures were formed and paving was completed.

Foundations:

The foundation for this project is rammed aggregate piers (Geopiers) with strip footings on top and a slab on grade set on the footings. The process for setting the footings for each area is very similar. A typical area footing process consists of taking a soil sample, running a shrink swell test of the soil; conducting underslab plumbing main prep, installing the underslab plumbing main, then backfilling the underslab plumbing main. The concrete layout area is then labeled. The footings are formed and rebar is placed. Footing are then poured with a concrete test & inspection following. Underslab electrical and plumbing bath are then installed and inspection.

The slab on grade is then prepped, a layer of spray termiticide is then placed below the vapor barrier and mesh. The concrete is tested and inspected. Miscellaneous metal embeds for the slab on grade are then installed. A pre concrete placement is inspected then the slab on grade is poured.

Structure:

The completion of the structure was done very quickly. The different areas labeled in Figure 2 are constructed very similarly therefor the structure can be explained very simply. The first floor area's A, B, and C process is laying out the steel and constructing the steel frame for the 1st floor walls. In area D not only are the 1st floor walls constructed the beams and columns are also constructed. The building is then constructed by floor in area A-C installing joists/deck, concrete, walls, beams & columns, and stairs. The roof is constructed by installing the frame, deck roof, and installing window wash anchors.

Project Schedule

Building Envelope:

The building envelope consist of placing and installing all exterior elements to the building such as:

Roof Hatches

Metal Roof trim

Metal Soffit

Exterior Gypsum Sheathing

Spray Foam

Brick Veneer

Paint

Exterior Electrical Devices

Windows

Louvers

Exterior Door Frames

MEP Conventional Frame In wall Rough In:

The MEP Conventional Frame In wall Rough In consist of metal stud framing, electrical inst. Boxes, security raceway rough in, telecom conduit rough in, interior door frames, mechanical duct rough in, plumbing rough in, metal strap framing, sprinkler rough in, and mechanical pipe rough in.

MEP Overhead/Wall Rough in:

The MEP Overhead/Wall Rough phase contains all the overhead mechanical, electrical, and plumbing work.

Project Schedule

Interior Finishes:

The interior finishes consist of placing and installing all interior elements to the building such as:

Drywall

Doors

Paint

VCT flooring

ACT Tile

Wire Closet Shelving

Window blinds

Signage

Display cases

MEP Finishes:

The MEP finishes consist of placing and installing all MEP elements to the building such as:

Security/Telecom Access Hatches

Security Wire

Plumbing Fixtures

Sprinkler trim

Pluming trim

Control devices

Telecom outlets

Structural System Estimate

The A.I.T. Barracks has a progressive collapse structural system set on a 5" concrete slab and a strip footing foundation. A progressive collapse system is defined by the American Society of Civil Engineers as "the spread of an initial local failure from element to element, eventually resulting in the collapse of an entire structure or a disproportionately large part of it." The progressive collapse system can be designed in varying levels. This system was designed using the alternate path method (linear static procedure). The alternate path method requires that the building must bridge across a removed element. This requirement has been met in the design of the A.I.T. structure as seen in Figure 3. The structural system consists of HHS 6x6x4 columns (square tube) and C12 x 25 beams (channels), with a 4'-0" spacing. Figure 4 shows the process of choosing the typical bay used to comprise the structural system estimate. The typical bay was selected by looking at the key plan. The key plan shows the basic outline of a plan view of the A.I.T. barracks floor plan. This floor plan contains the west wing, core north, core south, and east wing. The west wing was then chosen. The west wing is comprised of three bays, the central bay from the west wing is being picked as the typical bay. The typical bay chosen is on the second floor. This typical bay sits on a 3VLI22 composite deck with a 6" total thickness 3000 PSI light weight concrete reinforced with 6x6-W2.9xW2.9 W.W.F. The typical bay dimensions are 74.5 feet long by 28.5 feet, giving it a square footage of 2123.25. There are approximately 430 number of steel members and approximately 1617 cubic yards of concrete.

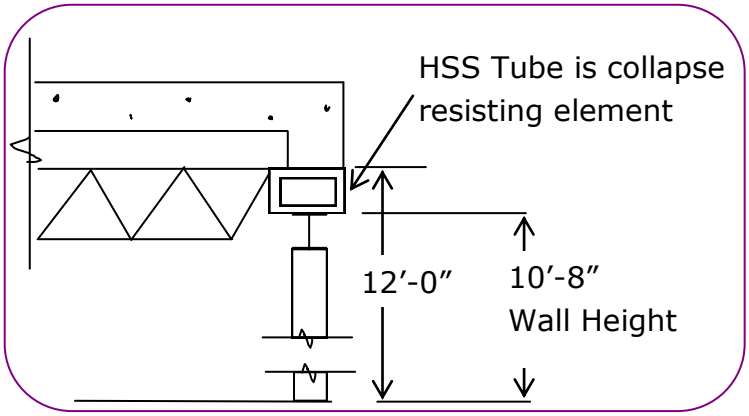


Fig 3. Detail of Progressive Collapse

Structural System Estimate

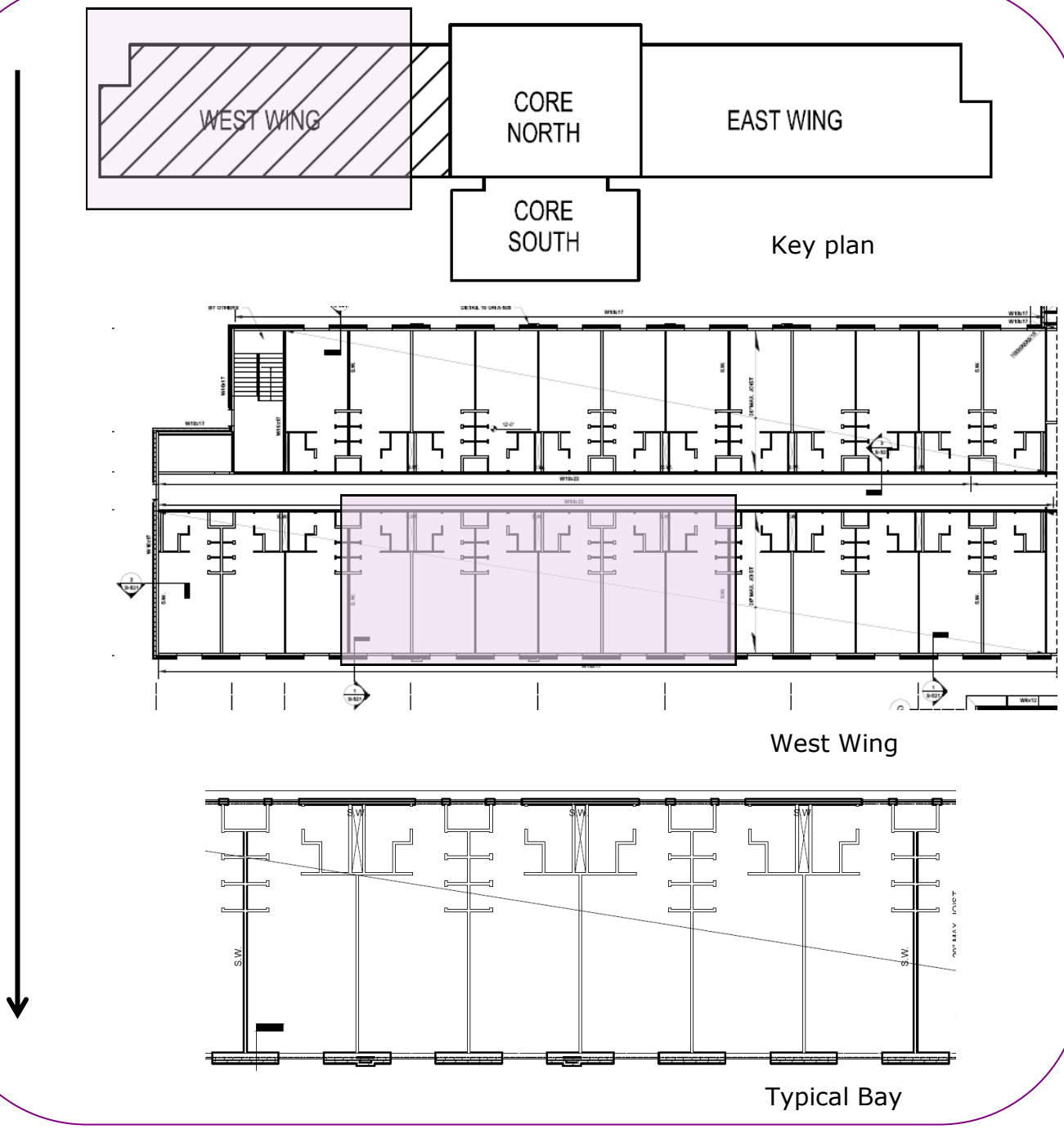


Fig 4. Typical Bay breakdown used to complete detailed structural estimate

Structural System Estimate

When completing the structural system estimate many calculations and assumptions had to be made before finding a final price. The first calculation to be made was finding the typical exterior bearing wall for the progressive collapse using alternate path method. It was found that the member size should be HSS 10x6x 3/16 for the external bearing wall. After calculating the typical interior bearing wall for the progressive collapse using alternate path method it was found that the member size should remain 10x6x3/16. The progressive collapse sits on a W10x17 beam on the typical exterior bearing wall, the typical interior bearing wall sits on a W10x22 beam. The progressive collapse systems columns were then calculated yielding a result of HSS 6x6x4. The shear walls located on the interior walls have X-bracing to help support the walls against shear stress. This bracing can be seen in figure 5. Table 1. shows the typical Bay calculation area's used for each member. These area's were calculated using the structural drawings and Contract Documents.

Table 1. Typical Bay Take-off

Description	Area
HSS 10x6x3/16	2 E.A.
HSS 6x6x4	4 E.A.
C12x25	342 L.F.
W10x22	74.5 L.F.
W10x17	74.5 L.F.
3" deep 22 gauge	2123.25 S.F.
Concrete (3000psi)	39.32 C.Y.
6x6-W2.9xW2.9 W.W.F	21.23 C.S.F.
Shear wall X-Bracing	3 E.A.

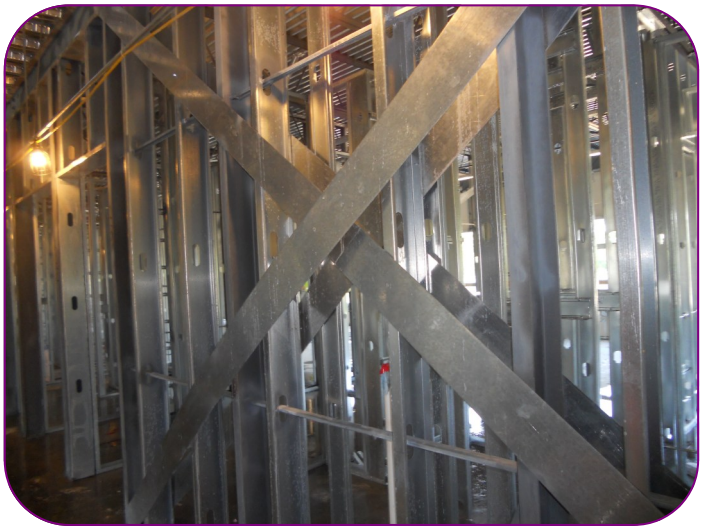


Fig 5. Detail of Shear wall X– Bracing

Structural System Estimate

Table 2. comprising the cost information for the structural system estimate. This data was collected from RS means Building Construction Cost Data 2011, and adjusted for Newport News location factor. To find the cost the RS means data was multiplied by the unit area found in Table 1.

Table 2. Typical Bay Estimate

Description	RS means data	Cost	Location adjustment (85.5) Newport News
HSS 10x6x3/16	$745.20	$1490.40	$1274.29
HSS 6x6x4	$360.00/E.A.	$1440.00	$1231.20
C12x25	$43.78/L.F.	$14972.76	$12801.71
W10x22	$34.12/L.F.	$2514.94	$2150.27
W10x17	$32.41/L.F.	$2414.55	$2064.44
3” deep 22 gauge composite deck	1.79/S.F.	$3800.62	$3249.53
Concrete (3000psi)	$99/C.Y.	$3892.63	$3328.19
Form Decking	2.25/S.F.	$4777.31	$4227.92
6x6-W2.9xW2.9 W.W.F	48/C.S.F.	$1019.04	$871.28
Shear wall X-bracing	55.15/EA.	$165.45	$141.46
		Total	$31340.29

Structural System Estimate

Table 3. Shows the Foundations Estimate for a Typical Bay **this information is incomplete, when full information is given this section will be revised.**

Table 3. Foundations Estimate

Description	Area	RS means data	Cost	Location Adjustment
Footing strip (3000psi) 20" x 10" reinforced	3.83 C.Y.	$250.59/C.Y.	$960.34	$821.09
5" (3000psi) SOG	32.77 C.Y.	$99/C.Y.	$3244.23	$2773.82
#4 @ 24"	.79 Tons	$1530/Ton	$1085.02	$927.70
Geopiers	12 E.A.	$2000/E.A.	$24000.00	$20520.00
			Total	$25042.61

The foundation was constructed on predominantly fat and lean clays. These clays were not suitable to build on due to the fact that clays shrink and swell when exposed to water. To mitigate this, Geopiers were installed approximately every 8' O.C. throughout the perimeter of the building and within the building at the load bearing walls in the foundation. The Geopiers are constructed by using a drill bit about 3' in diameter and drilled about 40' into the ground. This enabled the footings to be designed much smaller, resulting in a reduced cost for concrete and labor time. The 5" concrete slab on grade sits on the strip footings.

Geopier data was not found with RS means data; it was estimated using an average cost from different manufacturers.

Structural System Estimate

Table 4. Total Typical Bay Estimate is the complete Typical Bay Estimate, it is comprised of table 2, and table 3. The cost per S.F. is also denoted in table 4.

Table 4. Total Typical Bay Estimate

Description	Cost
Typical Bay Estimate	$31340.29
Foundations Estimate	$25042.61
Total	$56382.90
Cost per S.F.	$26.55
Entire Building Total	$2,437,290

Structural System Estimate

When calculating the cost of the entire building the cost per S.F. found in table 4 was multiplied by 91,800 S.F. (the gross building area). The entire building superstructure cost was $2,437,290. This estimate is about 20% of the actual budget proposed for the A.I.T. barracks. This could be due to the cost per S.F. found for the typical bay. Although this bay is typical per barracks rooms (West wing & East wing) it is not typical per the day room, computer room, profile recovery.. Etc (North core, and South core). Figure 6 shows the location of wings and core. Therefore when calculating the Cost per S.F. it is assumed the building is all typical bays.

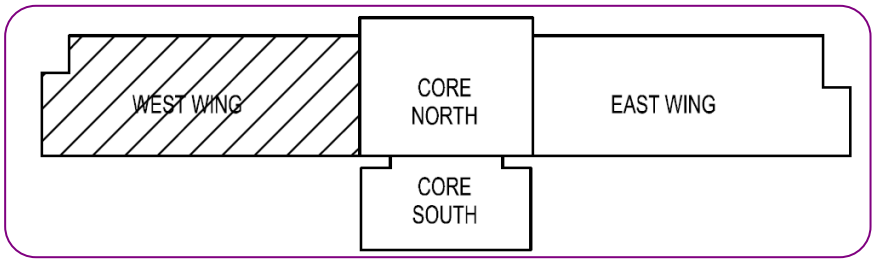


Fig 6. location of wings and core

One way the two areas differ is the deck type. Non-Corridor Deck (located in the core's) is a non-composite deck where the Corridor Deck (located in the wings) is composite. The price difference between the two decks is in favor of the composite deck. Concluding that if the non-composite deck was estimated the estimate would be ultimately be less with overall deck cost.

Although the difference between deck types if calculated would reduce the price for the superstructure, one large part of the superstructure was not calculated. The roof truss system was not included in the superstructure estimate. This was not included because adequate construction documents were not received in time to construct an estimate.

Structural System Estimate

Table 5. Shows the results organized by CSI Masterformat

Table 5. CSI Masterformat	
Description	CSI Masterformat
Concrete (3000psi)	03 Concrete
#4 @ 24”	03 21 00 Reinforcement Bars
6x6-W2.9xW2.9 W.W.F	03 22 00 Fabric and Grid Reinforcing
W10x22	05 12 00 Structural Steel Framing
W10x17	05 12 00 Structural Steel Framing
HSS 6x6x4	05 12 00 Structural Steel Framing
HSS 10x6x3/16	05 12 00 Structural Steel Framing
C12x25	05 12 00 Structural Steel Framing
3” deep 22 gauge	05 31 00 Steel Decking

General Conditions Estimate

The general conditions estimate was arrived at by adding up all the details in Table 6. The details comprise all staffing cost and temporary facilities needed for the construction process to go as smooth as possible. One surprising cost for this project was the cost of the Professional Engineers. This cost was $1,507,500 almost 40% of the entire general conditions estimate. The cost endured could be because of the structural progressive collapse system. This system needs to be engineered so that the building must bridge across a removed element. A successful design was seen in the previous structural system estimate section (figure 2). The cost of $1,507,500 could become a concern if the system was not designed correctly. However, this was not the case as the system was designed correctly.

Table 6. General Conditions Estimate

Description	Budget	% of Total G.C.
Vehicle lease	$19,350	0.5%
Vehicle Fuel	$7,442	0.2%
Preventive Maintenance	$1,488	0.04%
Office/Trailer Expense –GCs	$21,250	0.6%
Trailer set-up/takedown	$17,500	0.5%
Trailer steps & deck	$3,200	0.08%
Security System	$2,250	0.06%
Office Maintenance	$1,500	0.04%
Office Toilets	$400	0.01%
Telephone Monthly Charges	$21,750	0.6%
Telephone Co Installation	$2,000	0.05%
Phone System Equip. & Inst.	$8,750	0.2%

General Conditions Estimate

Table 6. General Conditions Estimate

Description	Budget	% of Total G.C.
Postage/Shipping—GC's	$13,500	0.4%
Printing/Reproduction—GC's	$7,800	0.2%
Record Retention	$2,500	0.07%
Travel	$3,400	0.09%
Ceremony/Mtgs/Entertain—GC's	$1,500	0.04%
Jobsite Progress Photos	$1,850	0.05%
Rodman	$35,310	0.9%
Surveying Equipment	$7,000	0.2%
Survey Materials	$2,500	0.07%
Professional Engineering	$1,507,500	39%
Geotech Engineering	$39,750	1%
Project Carpenter	$40,800	1%
Project Labor	$30,800	0.8%
Warehouse Facilities	$2,000	0.05%
Equipment rental	$10,500	0.3%
Equipment repair	$2,100	0.05%
Equipment fuel	$1,050	0.03%
Rough Hardware	$1,500	0.04%
Small Tools	$7,400	0.2%

General Conditions Estimate

Table 6. General Conditions Estimate

Description	Budget	% of Total G.C.
Small Tool repairs	$1,480	0.04%
Protection Materials	$5,000	0.1%
Trash Haul-off	$39,600	1%
Daily Clean-Up	$1,200	0.03%
Trash Chute	$3,100	0.08%
Final Clean	$15,075	0.4%
Ice, Water, and Cups	$1,800	0.05%
Street Barricades	$2,000	0.05%
Street Cleaning	$2,000	0.05%
Temporary Toilets	$8,660	0.2%
Safety Equip/Supplies—GC's	$2,500	0.07%
Safety Training—GC's	$400	0.01%
Safety Incentive Programs—GC's	$2,000	0.05%
Drug Testing	$256	0.007%
Perimeter Protection	$14,940	0.4%
Perimeter Fall Protection	$5,084	0.1%
Temporary Power Hook-Up	$35,000	0.9%
Temporary Power Consumption	$15,750	0.4%
Power Consumption w/ HVAC	$30,000	0.8%

General Conditions Estimate

Table 6. General Conditions Estimate

Description	Budget	% of Total G.C.
Temporary Water Meter	$15,000	0.4%
Temporary Water and Sewer	$500	0.01%
Temporary Fire Protection	$1,750	0.05%
Redi-Check Review	$10,000	0.3%
Scheduling Services	$7,500	0.2%
Misc. General Conditions—GC's	$3,750	0.1%
Field T&I	$28,647	0.7%
Field W/C	$14,049	0.4%
Salary Payroll	$748,859	20%
Misc. Payroll	$2,340	0.06%
Salaried T&I	$293,320	8%
Salary W/C	$15,668	0.4%
Auto Allowance	$27,242	0.7%
Gross Receipts Tax	$27,831	0.7%
Builders Risk Insurance	$51,951	1%
PMT & Performance Bonds	$249,031	7%
Sub & Supply Bonds	$134,422	4%
GEN/Excess Liability	$55,662	1%
Data Processing	$68,650	2%

General Conditions Estimate

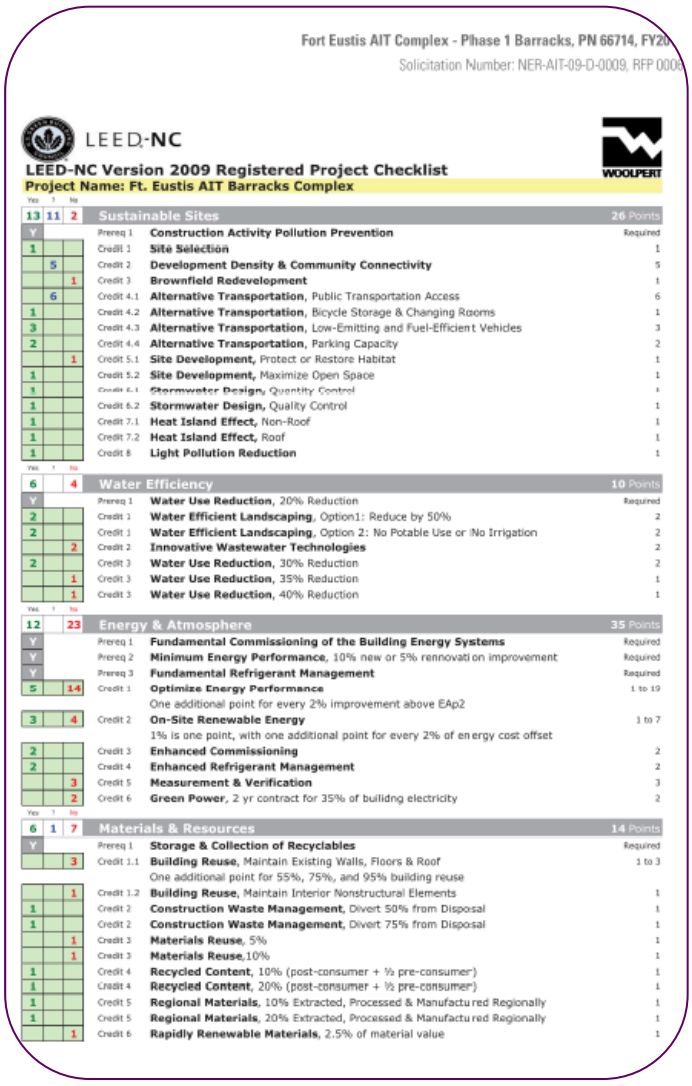
Table 6. General Conditions Estimate		
Description	Budget	% of Total G.C.
Mobile Phone	$1,513	0.04%
Computer Equip./Supplies –GC's	$26,800	0.7%
Software	$2,400	0.06%
Drinking Water	$1,875	0.05%
Office/Trailer Supplies—GC's	$7,500	0.2%
Office Equipment	$8,300	0.2%
Office Equipment Maintenance	$4,500	0.1%

Table 7. Total General Conditions Estimate	
Description	Budget
Total General Conditions Estimate	$3,822,545

Other concerns related to the general conditions estimate could be the salary payroll. This cost is approximately 20% of the total general conditions cost. If this cost is not carefully monitored the total can get out of control very quickly. To monitor this cost an income statement could be created. An income statement is a financial statement that is a way to look at a period of time. With this sheet in hand the general conditions budget should be monitored and remain under control.

LEED Evaluation

See Appendix B for full size LEED Scorecard



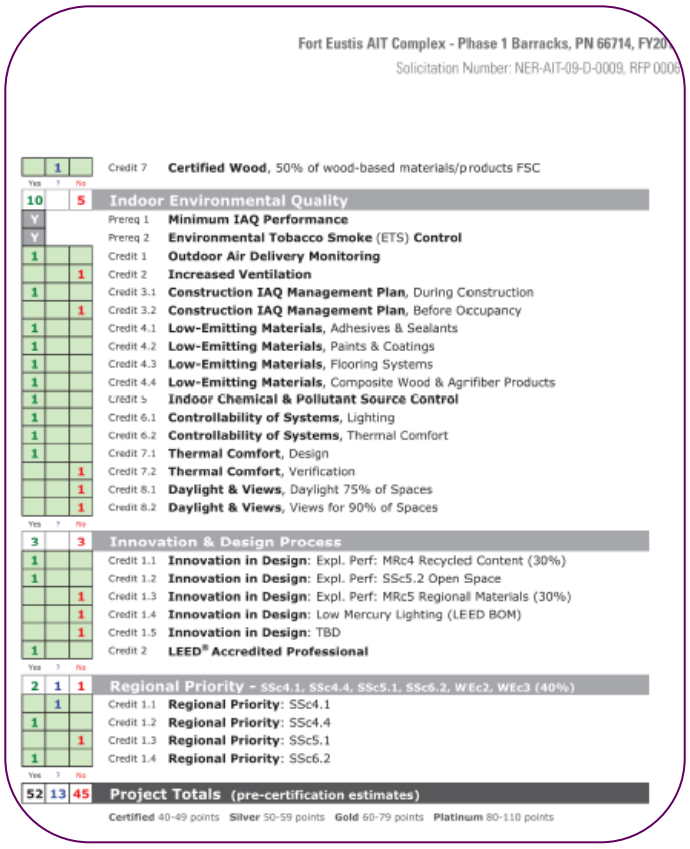
Fort Eustis AIT Complex - Phase 1 Barracks, PN 66714, FY20
Solicitation Number: NER-AIT-09-D-0009, RFP 000

LEED-NC

LEED-NC Version 2009 Registered Project Checklist

Project Name: Ft. Eustis AIT Barracks Complex

Yes	?	No			
13	11	2	**Sustainable Sites**		26 Points
Y			Prereq 1	**Construction Activity Pollution Prevention**	Required
1			Credit 1	**Site Selection**	1
	5		Credit 2	**Development Density & Community Connectivity**	5
		1	Credit 3	**Brownfield Redevelopment**	1
	6		Credit 4.1	**Alternative Transportation**, Public Transportation Access	6
1			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
3			Credit 4.3	**Alternative Transportation**, Low-Emitting and Fuel-Efficient Vehicles	3
2			Credit 4.4	**Alternative Transportation**, Parking Capacity	2
		1	Credit 5.1	**Site Development,** Protect or Restore Habitat	1
1			Credit 5.2	**Site Development,** Maximize Open Space	1
1			Credit 6.1	**Stormwater Design,** Quantity Control	1
1			Credit 6.2	**Stormwater Design,** Quality Control	1
1			Credit 7.1	**Heat Island Effect,** Non-Roof	1
1			Credit 7.2	**Heat Island Effect,** Roof	1
1			Credit 8	**Light Pollution Reduction**	1
6		4	**Water Efficiency**		10 Points
Y			Prereq 1	**Water Use Reduction,** 20% Reduction	Required
2			Credit 1	**Water Efficient Landscaping,** Option1: Reduce by 50%	2
2			Credit 1	**Water Efficient Landscaping,** Option 2: No Potable Use or No Irrigation	2
		2	Credit 2	**Innovative Wastewater Technologies**	2
2			Credit 3	**Water Use Reduction,** 30% Reduction	2
		1	Credit 3	**Water Use Reduction,** 35% Reduction	1
		1	Credit 3	**Water Use Reduction,** 40% Reduction	1
12		23	**Energy & Atmosphere**		35 Points
Y			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Y			Prereq 2	**Minimum Energy Performance,** 10% new or 5% rennovation improvement	Required
Y			Prereq 3	**Fundamental Refrigerant Management**	Required
5		14	Credit 1	**Optimize Energy Performance**	1 to 19
				One additional point for every 2% improvement above EAp2	
3		4	Credit 2	**On-Site Renewable Energy**	1 to 7
				1% is one point, with one additional point for every 2% of energy cost offset	
2			Credit 3	**Enhanced Commissioning**	2
2			Credit 4	**Enhanced Refrigerant Management**	2
		3	Credit 5	**Measurement & Verification**	3
		2	Credit 6	**Green Power,** 2 yr contract for 35% of buildng electricity	2
6	1	7	**Materials & Resources**		14 Points
Y			Prereq 1	**Storage & Collection of Recyclables**	Required
		3	Credit 1.1	**Building Reuse,** Maintain Existing Walls, Floors & Roof	1 to 3
				One additional point for 55%, 75%, and 95% building reuse	
		1	Credit 1.2	**Building Reuse,** Maintain Interior Nonstructural Elements	1
1			Credit 2	**Construction Waste Management,** Divert 50% from Disposal	1
1			Credit 2	**Construction Waste Management,** Divert 75% from Disposal	1
		1	Credit 3	**Materials Reuse,** 5%	1
		1	Credit 3	**Materials Reuse,** 10%	1
1			Credit 4	**Recycled Content,** 10% (post-consumer + ½ pre-consumer)	1
1			Credit 4	**Recycled Content,** 20% (post-consumer + ½ pre-consumer)	1
1			Credit 5	**Regional Materials,** 10% Extracted, Processed & Manufactured Regionally	1
1			Credit 5	**Regional Materials,** 20% Extracted, Processed & Manufactured Regionally	1
		1	Credit 6	**Rapidly Renewable Materials,** 2.5% of material value	1



Fort Eustis AIT Complex - Phase 1 Barracks, PN 66714, FY20
Solicitation Number: NER-AIT-09-D-0009, RFP 000

Yes	?	No		
	1		Credit 7	**Certified Wood,** 50% of wood-based materials/products FSC
10		5	**Indoor Environmental Quality**	
Y			Prereq 1	**Minimum IAQ Performance**
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**
1			Credit 1	**Outdoor Air Delivery Monitoring**
		1	Credit 2	**Increased Ventilation**
1			Credit 3.1	**Construction IAQ Management Plan,** During Construction
		1	Credit 3.2	**Construction IAQ Management Plan,** Before Occupancy
1			Credit 4.1	**Low-Emitting Materials,** Adhesives & Sealants
1			Credit 4.2	**Low-Emitting Materials,** Paints & Coatings
1			Credit 4.3	**Low-Emitting Materials,** Flooring Systems
1			Credit 4.4	**Low-Emitting Materials,** Composite Wood & Agrifiber Products
1			Credit 5	**Indoor Chemical & Pollutant Source Control**
1			Credit 6.1	**Controllability of Systems,** Lighting
1			Credit 6.2	**Controllability of Systems,** Thermal Comfort
1			Credit 7.1	**Thermal Comfort,** Design
		1	Credit 7.2	**Thermal Comfort,** Verification
		1	Credit 8.1	**Daylight & Views,** Daylight 75% of Spaces
		1	Credit 8.2	**Daylight & Views,** Views for 90% of Spaces
3		3	**Innovation & Design Process**	
1			Credit 1.1	**Innovation in Design:** Expl. Perf: MRc4 Recycled Content (30%)
1			Credit 1.2	**Innovation in Design:** Expl. Perf: SSc5.2 Open Space
		1	Credit 1.3	**Innovation in Design:** Expl. Perf: MRc5 Regional Materials (30%)
		1	Credit 1.4	**Innovation in Design:** Low Mercury Lighting (LEED BOM)
		1	Credit 1.5	**Innovation in Design:** TBD
1			Credit 2	**LEED® Accredited Professional**
2	1	1	**Regional Priority - SSc4.1, SSc4.4, SSc5.1, SSc6.2, WEc2, WEc3 (40%)**	
	1		Credit 1.1	**Regional Priority:** SSc4.1
1			Credit 1.2	**Regional Priority:** SSc4.4
		1	Credit 1.3	**Regional Priority:** SSc5.1
1			Credit 1.4	**Regional Priority:** SSc6.2
52	13	45	**Project Totals** (pre-certification estimates)	

Certified 40-49 points **Silver** 50-59 points **Gold** 60-79 points **Platinum** 80-110 points

Images courtesy of BBC

LEED Evaluation

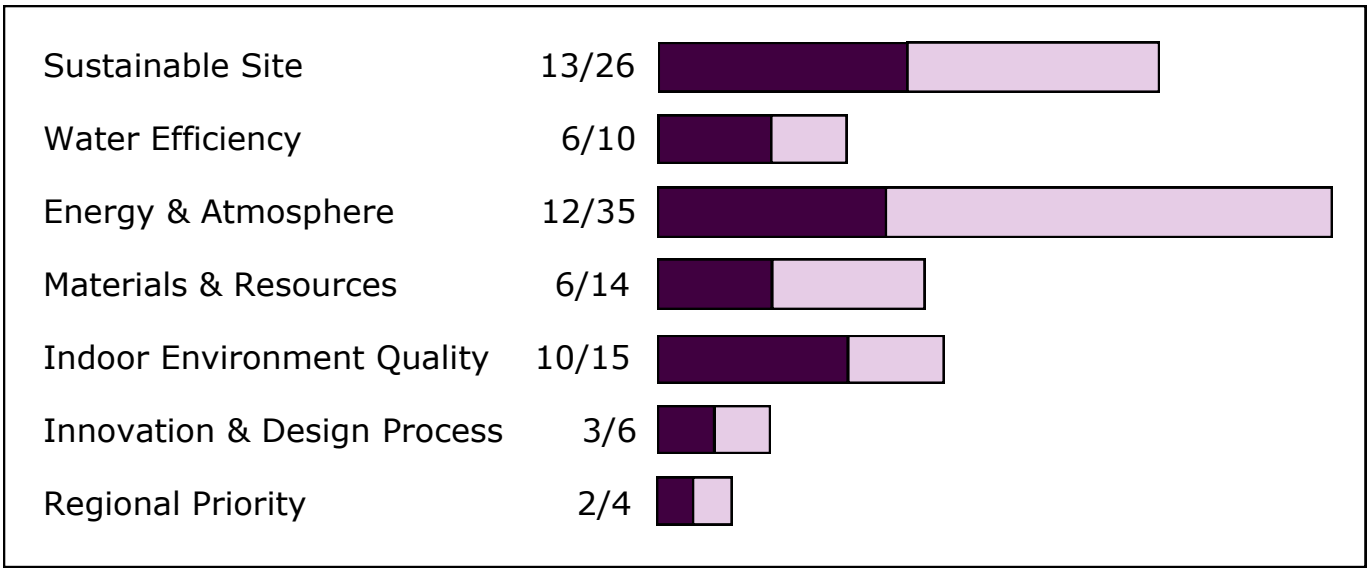


Fig 7. Summary of by points

The U.S. Army Corps. Of Engineers is striving for LEED Silver on the A.I.T. Barracks project. This is a typical objective for most U.S. Federal Government Buildings, making LEED Silver the appropriate level of certification to the client and project goals. This goal requires a minimum of 50 points in the categories shown in Figure 7. The project is currently on track to achieve a LEED Silver rating upon completion with a total of 52 points. All basic prerequisites were met to satisfy the criteria for certification.

Sustainable Site:

The sustainable sites category obtained 50% of the available points, this is due, to two large credits not being calculated into the total. One of the credits not obtained was the SS Credit 2: Development Density and Community Connectivity, which is worth 5 points. This credit is based on location and density; because most military bases are spread out it is hard to meet this criterion therefore it was not met.

LEED Evaluation

Water Efficiency:

The water efficiency category could be improved very easily as the WE credit 2: Innovative Wastewater Technologies worth 2 points, was not fulfilled. This credit required a reduction of portable water for building sewage by 50%. Many water-conserving fixtures can be purchased (i.e. water closets, and urinals) to satisfy this requirement. This suggestion would require a higher initial cost, however, in the long run the potential savings could be significant.

Energy & Atmosphere:

In the energy & atmosphere category over 65% of the points were not earned. EA Credit 1: Optimize Energy Performance is a credit that is based on the minimum energy cost savings. A baseline building performance is calculated then compared against the percent improvement in the proposed building performance. The A.I.T. barracks could possibly improve the energy-efficiency of the building by using compact fluorescent lamps and installing low-wattage fluorescent fixtures.

Materials & Resources:

The materials & resources category focuses on reducing waste/environmental impacts and conserving recourses. Improvement can be made in this category by recusing more materials. Almost all credits lost in this section were lost to the lack of building/material reuse.

Indoor Environment Quality:

In the indoor environmental quality category it was found that several points were lost due to the absence of daylight and views (IEQ Credit 8.1-8.2: Daylight and Views). These credits want to optimize daylighting in the regularly occupied spaces. This project did not optimize daylighting because the soldiers would not be spending much time in occupied spaces during the day.

Innovation & Design Process:

The innovation & design process category could have been ameliorated if more innovation was implemented into the design.

LEED Evaluation

Regional Priority:

The regional priority category credits are acquired by addressing geographically-specific environmental priorities. After a simple search on USGBC.org Figure 8 was found showing all the possible credits for the specified region. On this project SSc4.4 and SSc6.2 were achieved. In this category a maximum of 4 points can be identified as regional priority credits.

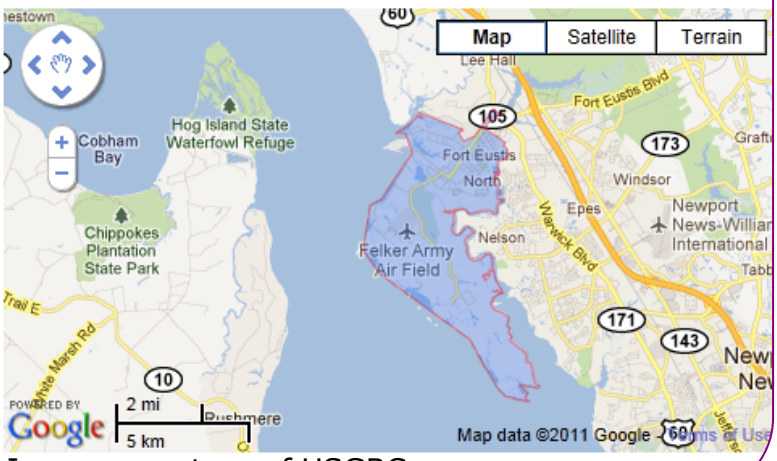
Country : US
Zip Code : 23604
Rating System : LEED 2009 for New Construction

View Details:

LEED 2009 for New Construction

Credit ID	Options	Threshold/Path
SSc4.1		
SSc4.4		
SSc5.1		
SSc6.2		
WEc2		
WEc3		40% Reduction

Please note: Project teams must meet or exceed the threshold listed to earn an RPC point.



Images courtesy of USGBC.org

Fig 8. Regional Priority data

BIM Use Evaluation

The Ft. Eustis A.I.T. Complex Barracks Building Information Modeling (BIM) Implementation Plan, defines the BIM responsibilities and deliverables of the Design/Build (DB) team. The plan describes how the team intends to provide BIM for this project and describes what will be included in the model(s), at various stages of design and construction, as well as the process and tools to be used to create the model(s).

1. Major BIM Goals/Objectives

BIM Goal	Description
Program & Design Validation	Review project requirements and facility needs to ensure compliance and value.
Design Coordination	Ensure high design quality.
Clash Detection	Verify systems are coordinated before fabrication and installation.
As-Build Modeling	Model of the building as-built records developed upon project completion.

2. BIM Uses

Operate	X	Construct	X	Design	X	Plan	X
				Design Authoring	X		
				Design Reviews	X		
		3D Coordination	X	3D Coordination	X		
		Record Modeling	X				

BIM Use Evaluation

See Appendix C for 11”x17” Level One Process Overview Map

1. Level One Process Overview Map

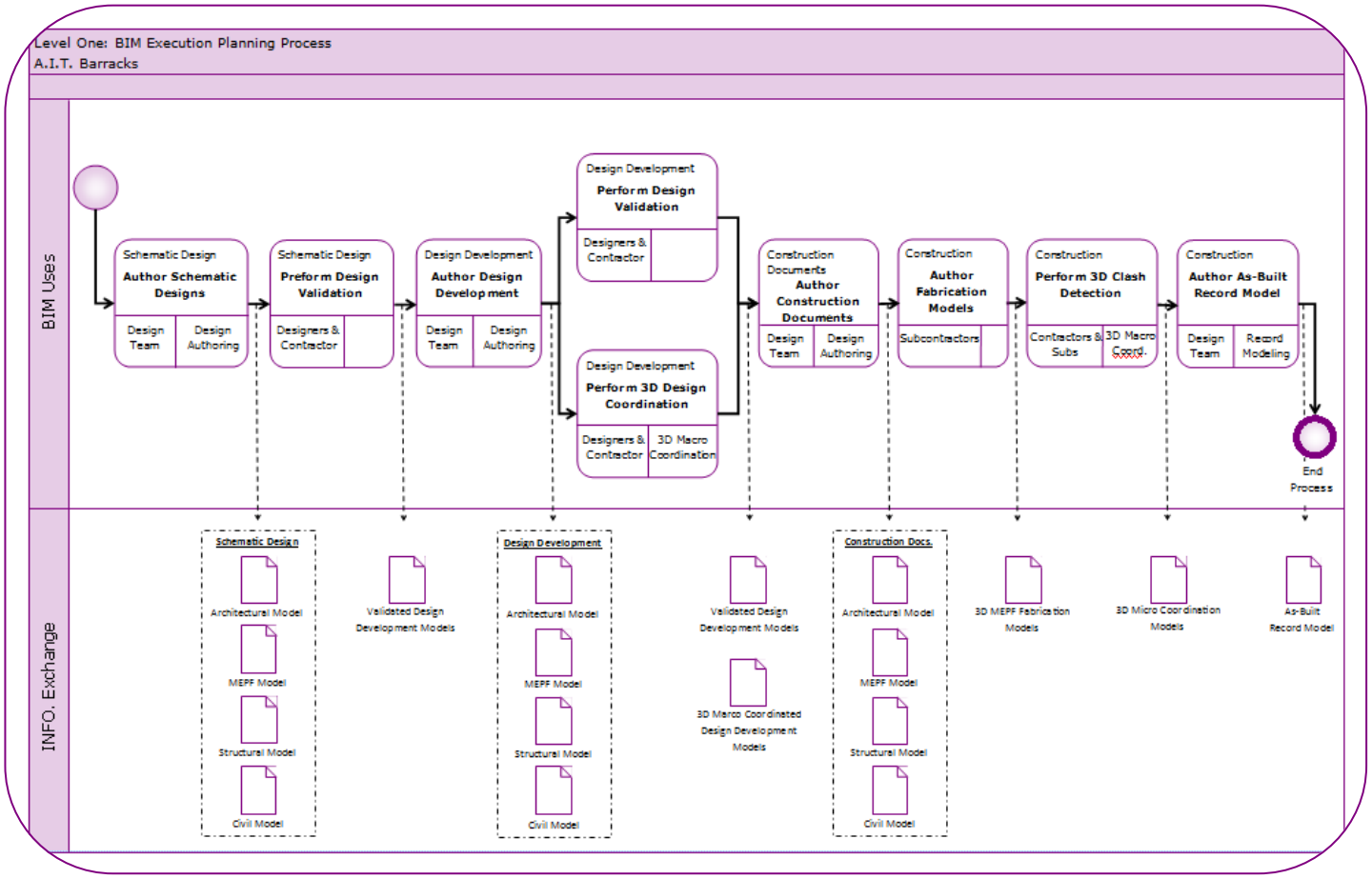


Fig 9. Level one Process Overview Map

BIM Use Evaluation

2. List of Level Two Detailed BIM Use Processes

Design Authoring:

Design models will consist of 3D components that include properties, parameters and other information specific to this project. Models will contain elements in accordance with this document.

- Models will generally be developed using elements, families and other data consistent with how they will be constructed (e.g., accurate partition heights, column heights and sizes, slab thicknesses, etc.)
- As a general rule, project components/objects which are typically depicted on a 1/4" =1' scale drawing may be spatially modeled. For example, a door will be model element, while door hardware will not be shown as 3D objects.
- 2D information to convey design intent annotated with drafting elements or included as parametric data as applicable to the design software and processes agreed upon in this plan.

Design Reviews:

Throughout the design process as models are being built, various "views" will be created to illustrate some aspect of the design. These views may be created directly in the model authoring software or may be exported out to other software for further enhancement. Final presentation will be in the form of a PDF fire or inserted into a slide in a PowerPoint presentation.

The Design Team will then use these images to conduct meetings with the intent of offering various solutions to the design problem at hand. Feedback and input from the Owner and the contractor is anticipated. This information becomes input back into the next iteration of the design process.

As the design is finalized, these views can be presented to offer proof of concept or validation that the design performs as expected and as discussed by all parties.

BIM Use Evaluation

3D Coordination (Design):

- The deign team develops models per the requirements in accordance with the modeling matrix.
- The individual models are exported as Navisworks cache files and combined by the using Navisworks for interference analysis.
- Spatial interferences will be reviewed with the Design Team, and interferences in need of correction will be assigned to the appropriate party.
- Each design discipline will adjust their models as necessary to correct the conflicts.

3D Coordination (Construction):

- All participatory subcontractors shall develop 3D models and provide them to the Contractor for coordination use.
- The contractor will incorporate all the individual models into NavisWorks and run the clash detection feature.
- Coordination meetings will be held between all parties to analyze the clashes discovered though NavisWorks and agree upon resolutions. Subcontractors should update their models after each coordination meeting.
- This process will continue until coordination is complete for the entire building.
- One the coordination is complete for each broken-down section of the building, the various trades will produce an accurate, coordinated set of shop drawings from the approved coordination model(s) to be submitted for approval and to be used for fabrication and installation.

BIM Use Evaluation

Recording Modeling:

During construction, record information will be captured daily by the Contractor at the jobsite on a field set of construction drawings. This information will be compiled and incorporated into the Design/Fabrication Models monthly, or as required to support the construction workflow. The Design Models will be maintained by the Design Team to reflect changes, corrections, alterations, adjustments, and modifications to the design and the fabrication models will be maintained by the subcontractors in order to do the same. The design model and the fabrication models will be managed by their respective owners throughout construction. Regular reviews by the deisgn and construction team are required to ensure adherence. This will allow for construction field information and design changes, such as RFI's, to be maintained in a single location.

At project completion, a Bentley BIM model will be developed to reflect a combination of:

- Field set of as-built construction drawings and submittals
- Design models
- Fabrication models
- RFI's, ASI's, and other design/construction changes

Existing project conditions will be reflected in the Bentley As-built models. Final "AS-built/Record documents" will be turned over at the close-out of each phase of construction in accordance with the close-out requirements. See the As-Built Workflow section in this document for additional information on the as-built process.

Once the Bentley As-built model is complete, the 2D.dgn format will be developed to meet A/E/C CAD standard release 4.0.

BIM Use Evaluation

Collaboration Strategy:

Constructware, an online database, will accommodate official communication between design partners, the contractor, and subcontractors. Document management including submittals and model archives will also be incorporated into the Constructware site. Constructware will be used to capture formal model submissions. Posting schedule will be determined by the team which allows for optimal efficiency of the team.

At each formal submittal, a permanent archive of the submittal documents will be created in a static formal (DWF, PDF, etc) and stored for future reference. These static documents will be posted to Constructware. The owner and all team members will have access to the files on Constructware throughout the duration of the project.

When evaluating both the appropriateness of BIM uses and the process for implementation this project was and continues to be very successful. The attention to detail was handled by each party involved very well as seen in Appendix C. Appendix C shows the model output matrix, this matrix can be used to better understand the graphical representation of each element needed on the project.

Involving both the design team and all participating sub-contractors was an excellent way to achieve the goal of design coordination. Having design coordination in this way not only ensures the highest quality of design but it encourages finding clash detection. The implementation of BIM in the field was very successful. BIM gave subcontractors another way to communicate in a positive manor. This positive and constructive collaboration led to fewer in field clashes and as-built drawings turned in on schedule.

All of the goals set by the BIM execution plan were met or are currently being met. The A.I.T. Barracks did an excellent and effective job using BIM, no missed opportunities were found at this time.

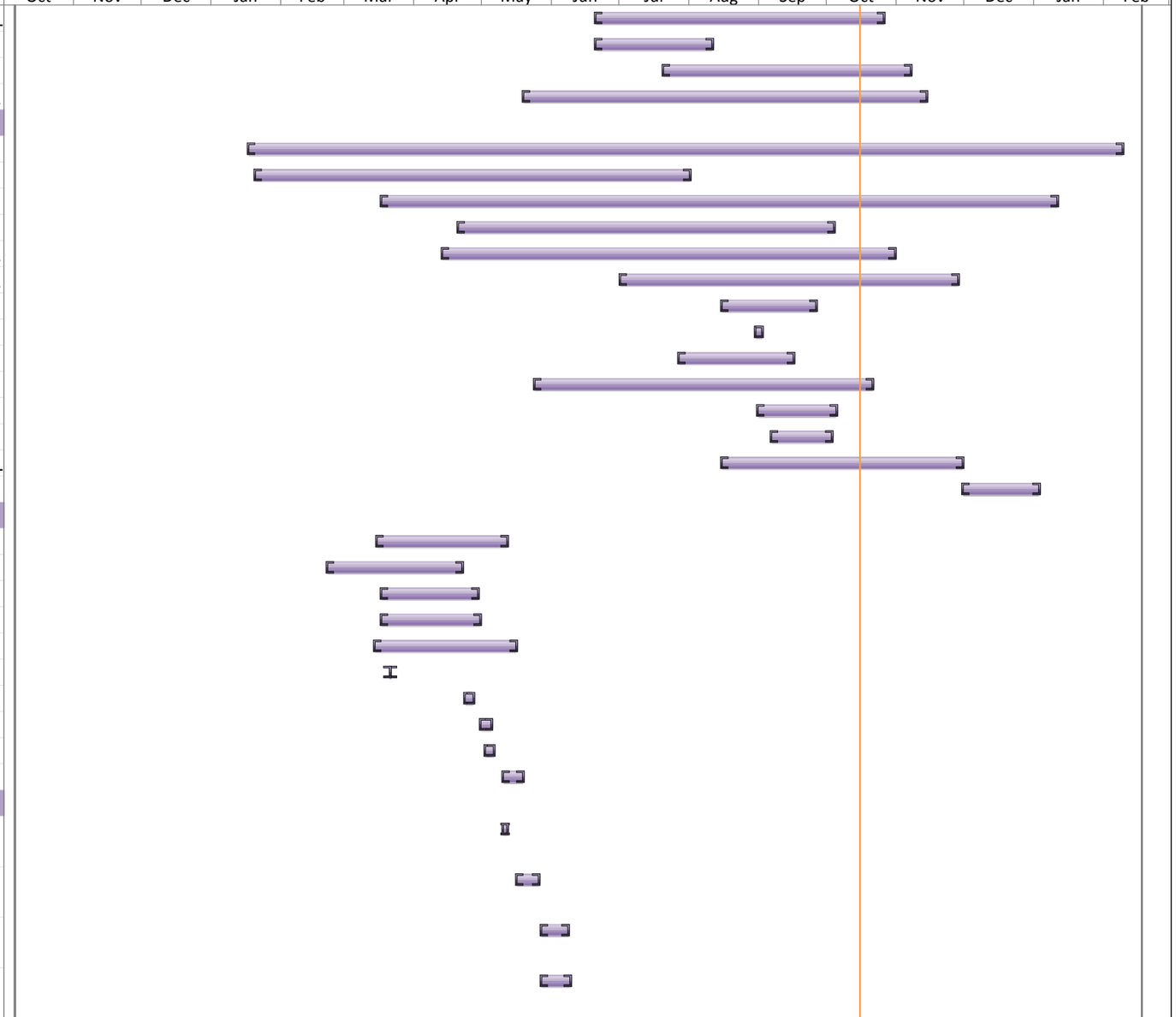
Appendix A
Detailed Project Schedule

ID	Task Mode	Task Name	Duration	Start	Finish
1					
2		NTP	0 days	Thu 10/14/10	Thu 10/14/10
3		Design Phase			
4		Geotechnical Survey and Analysis	100 days	Sun 11/14/10	Thu 3/31/11
5		Civil Design	89 days	Thu 10/14/10	Tue 2/15/11
6		Structural Design	137 days	Tue 10/19/10	Wed 4/27/11
7		Architectural Design	140 days	Thu 10/14/10	Wed 4/27/11
8		Design Packages - Building MEP/F	155 days	Thu 10/14/10	Wed 5/18/11
9		Final Design Documents Available	0 days	Wed 5/18/11	Wed 5/18/11
10		Bid and Award Phase			
11		Bid and Award Sitework	154 days	Mon 11/29/10	Thu 6/30/11
12		Bid and Award Foundations	31 days	Fri 12/17/10	Fri 1/28/11
13		Bid and Award Structure	74 days	Wed 1/12/11	Mon 4/25/11
14		Bid and Award Building Envelope	95 days	Mon 2/7/11	Fri 6/17/11
15		Bid and Award MEPF	78 days	Mon 11/15/10	Wed 3/2/11
16		Bid and Award Int. Framing & Finishes	176 days	Mon 11/15/10	Mon 7/18/11
17		Bid and Award Accessories	61 days	Fri 3/25/11	Fri 6/17/11
18		Bid and Award Commissioning	125 days	Mon 11/29/10	Fri 5/20/11
19		Pre-Construction Submittals			
20		Submit Cert. of Insurance, Bonds	0 days	Wed 10/6/10	Wed 10/6/10
21		SWPPP (Storm Water Plan)	71 days	Thu 10/14/10	Thu 1/20/11
22		Environmental Plan	46 days	Thu 10/14/10	Thu 12/16/10
23		Quality Control Plan	178 days	Thu 10/14/10	Mon 6/20/11
24		Network Anaysis System	195 days	Thu 10/14/10	Wed 7/13/11
25		Submital Register	107 days	Thu 10/14/10	Fri 3/11/11
26		List of Subs & Products	84 days	Mon 5/2/11	Thu 8/25/11
27		Accident Prevention Plan	62 days	Thu 10/14/10	Fri 1/7/11
28		Waste Management Plan	48 days	Mon 11/15/10	Wed 1/19/11
29		Health & Safety Plan	107 days	Thu 10/14/10	Fri 3/11/11
30		Fire Protection Specialist	28 days	Thu 10/14/10	Mon 11/22/10
31		Construction Submittals			
32		Utilities Submittals & Fabrication	28 days	Mon 2/14/11	Wed 3/23/11
33		Concrete Submittals & Fabrication	32 days	Mon 2/7/11	Tue 3/22/11
34		Structure Submittals & Fabrication	139 days	Mon 1/31/11	Thu 8/11/11
35		Building Envelope Submittals & Fabricatio	99 days	Mon 3/14/11	Thu 7/28/11
36		Glazing Submittals & Fabrication	99 days	Mon 3/14/11	Thu 7/28/11
37		Walls, Clgs, GWB, Doors, I.Wind	166 days	Mon 3/14/11	Mon 10/31/11
38		MEP Equipment Submittals & Fabrication	219 days	Thu 1/27/11	Tue 11/29/11
39		Landscaping Submittals	31 days	Fri 7/22/11	Fri 9/2/11

Project: Detailed Project Schedule
Date: Sun 10/16/11

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline	
Split	External Tasks	Inactive Summary	Manual Summary	Progress	
Milestone	External Milestone	Manual Task	Start-only		
Summary	Inactive Task	Duration-only	Finish-only		

ID	Task Mode	Task Name	Duration	Start	Finish
40		Milwork Submittals & Fabrication	93 days	Mon 6/20/11	Wed 10/26/11
41		Site Concrete Submittals	39 days	Mon 6/20/11	Thu 8/11/11
42		Tile Submittals & Fabrication	79 days	Wed 7/20/11	Mon 11/7/11
43		Finish Items	128 days	Thu 5/19/11	Mon 11/14/11
44		Sitework			
45		Pre-Earthwork	279 days	Mon 1/17/11	Thu 2/9/12
46		Earthwork	138 days	Thu 1/20/11	Mon 8/1/11
47		Storm	215 days	Thu 3/17/11	Wed 1/11/12
48		Underground Electrical	120 days	Wed 4/20/11	Tue 10/4/11
49		Underground Communication	144 days	Wed 4/13/11	Mon 10/31/11
50		Underground Sanitary	107 days	Fri 7/1/11	Mon 11/28/11
51		Underground Water	31 days	Mon 8/15/11	Mon 9/26/11
52		Underground Gas	4 days	Tue 8/30/11	Fri 9/2/11
53		Site Lighting	38 days	Wed 7/27/11	Fri 9/16/11
54		Covered Assembly Area	109 days	Tue 5/24/11	Fri 10/21/11
55		Dumpster Enclosure	26 days	Wed 8/31/11	Wed 10/5/11
56		Mechanical Enclosure	20 days	Tue 9/6/11	Mon 10/3/11
57		Site Paving	78 days	Mon 8/15/11	Wed 11/30/11
58		Fine Grade/Softscape	25 days	Wed 11/30/11	Tue 1/3/12
59		Foundations			
60		Rammed Agregate Piers	43 days	Tue 3/15/11	Thu 5/12/11
61		Area A (Footings)	45 days	Mon 2/21/11	Fri 4/22/11
62		Area B (Footings)	32 days	Thu 3/17/11	Fri 4/29/11
63		Area C (Footings)	33 days	Thu 3/17/11	Sat 4/30/11
64		Area D (Footings)	46 days	Mon 3/14/11	Mon 5/16/11
65		Concrete Mobilization	1 day	Mon 3/21/11	Mon 3/21/11
66		Area A (SOG)	4 days	Sat 4/23/11	Wed 4/27/11
67		Area B (SOG)	5 days	Sat 4/30/11	Thu 5/5/11
68		Area C (SOG)	5 days	Mon 5/2/11	Fri 5/6/11
69		Area D (SOG)	8 days	Tue 5/10/11	Thu 5/19/11
70		Structure			
71		Level 1 - Area A (Frame/Envelop/MEPS) Layout Steel	3 days	Tue 5/10/11	Thu 5/12/11
72		Level 1 - Area A (Frame/Envelop/MEPS) Steel Frame 1st Floor Walls Area A	9 days	Mon 5/16/11	Thu 5/26/11
73		Level 1 - Area B (Frame/Envelop/MEPS) Steel Frame 1st Floor Walls Area B	9 days	Fri 5/27/11	Wed 6/8/11
74		Level 1 - Area B (Frame/Envelop/MEPS) Steel Frame Beams & Columns Area B	10 days	Fri 5/27/11	Thu 6/9/11



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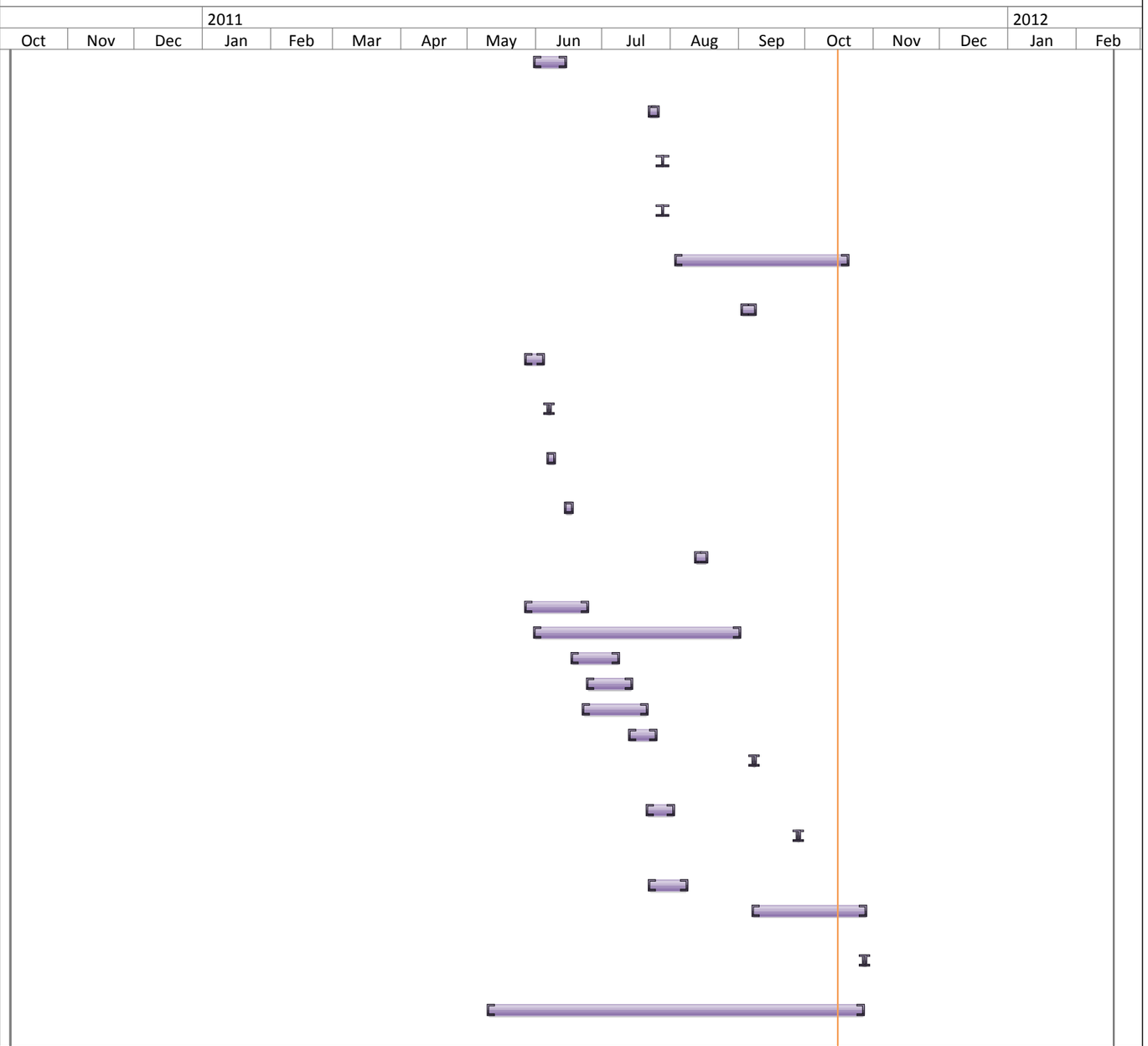
Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline	
Split	External Tasks	Inactive Summary	Manual Summary	Progress	
Milestone	External Milestone	Manual Task	Start-only		
Summary	Inactive Task	Duration-only	Finish-only		

ID	Task Mode	Task Name	Duration	Start	Finish
75		Level 1 - Area C (Frame/Envelop/MEPS) Steel Frame 1st Floor Walls Area C	11 days	Tue 5/31/11	Tue 6/14/11
76		Level 1 - Area D (Frame/Envelop/MEPS/Finishes) Steel	3 days	Fri 7/22/11	Tue 7/26/11
77		Level 1 - Area D (Frame/Envlope/MEPS/Finishes) Steel	1 day	Thu 7/28/11	Thu 7/28/11
78		Level 1 - Area D (Frame/Envlope/MEPS/Finishes) Grout	1 day	Thu 7/28/11	Thu 7/28/11
79		Level 1 - Area D (Frame/Envlope/MEPS/Finishes) CQC	57 days	Wed 8/3/11	Thu 10/20/11
80		Level 1 - Area D (Frame/Envlope/MEPS/Finishes) Install	5 days	Fri 9/2/11	Thu 9/8/11
81		Level 2 - Area A (Frame/Envelop/MEPS) Steel Frame 2nd Floor Joists/Deck Area A	7 days	Fri 5/27/11	Sat 6/4/11
82		Level 2 - Area A (Frame/Envelop/MEPS) Set Mech/Plumb Floor Sleeves	2 days	Mon 6/6/11	Tue 6/7/11
83		Level 2 - Area A (Frame/Envelop/MEPS) 2nd Floor Concrete on Metal Deck Area A	4 days	Mon 6/6/11	Thu 6/9/11
84		Level 2 - Area A (Frame/Envelop/MEPS) Steel Frame 2nd Floor Walls Area A	4 days	Tue 6/14/11	Fri 6/17/11
85		Level 2 - Area A (Frame/Envelop/MEPS) Install Stairs Area A	4 days	Fri 8/12/11	Wed 8/17/11
86		Level 2 - Area B (Frame/Envelop/MEPS)	21 days	Fri 5/27/11	Fri 6/24/11
87		Level 2 - Area C (Frame/Envelop/MEPS)	68 days	Tue 5/31/11	Thu 9/1/11
88		Level 3 - Area A (Frame/Envelop/MEPS)	16 days	Fri 6/17/11	Fri 7/8/11
89		Level 3 - Area B (Frame/Envelop/MEPS)	15 days	Fri 6/24/11	Thu 7/14/11
90		Level 3 - Area C (Frame/Envelop/MEPS)	22 days	Wed 6/22/11	Thu 7/21/11
91		Roof - Area A (Frame/Envelop/MEPS)	9 days	Wed 7/13/11	Mon 7/25/11
92		Roof - Area A (Frame/Envelop/MEPS) Install Window Wash Anchors Area A	2 days	Wed 9/7/11	Thu 9/8/11
93		Roof - Area B (Frame/Envelop/MEPS)	9 days	Thu 7/21/11	Tue 8/2/11
94		Roof - Area b (Frame/Envelop/MEPS) Install Window Wash Anchors Area B	2 days	Tue 9/27/11	Wed 9/28/11
95		Roof - Area C (Frame/Envelop/MEPS)	12 days	Fri 7/22/11	Mon 8/8/11
96		Roof - Area C (Frame/Envelop/MEPS) CQC instections Window wash Anchors	38 days	Wed 9/7/11	Fri 10/28/11
97		Roof - Area C (Frame/Envelop/MEPS) Install Window Wash Anchors Area C	2 days	Thu 10/27/11	Fri 10/28/11
98		Roof - Area D (Frame/Envelop/MEPS/Finishes) CQC	123 days	Tue 5/10/11	Thu 10/27/11



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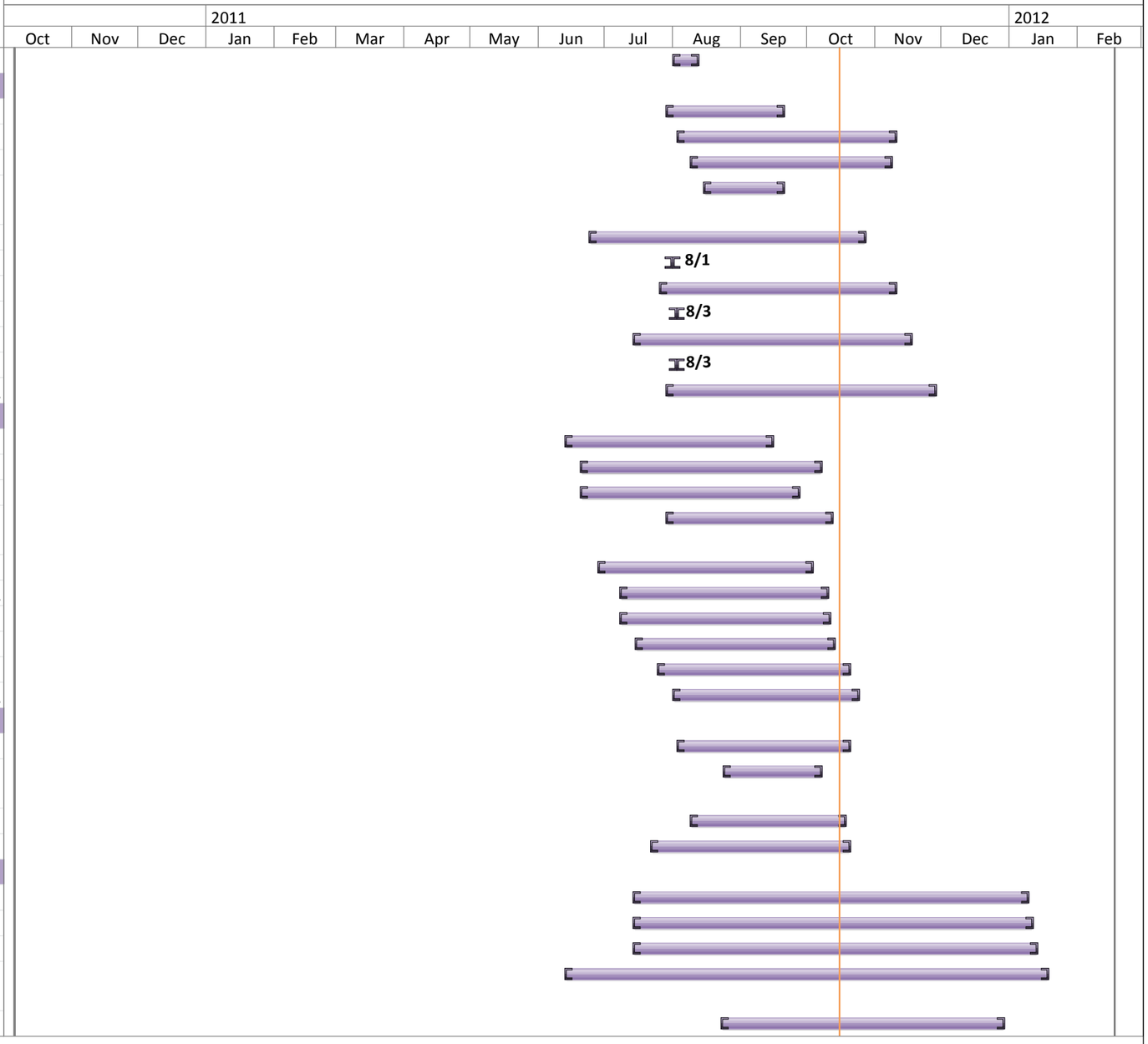
Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline
Split	External Tasks	Inactive Summary	Manual Summary	Progress
Milestone	External Milestone	Manual Task	Start-only	
Summary	Inactive Task	Duration-only	Finish-only	

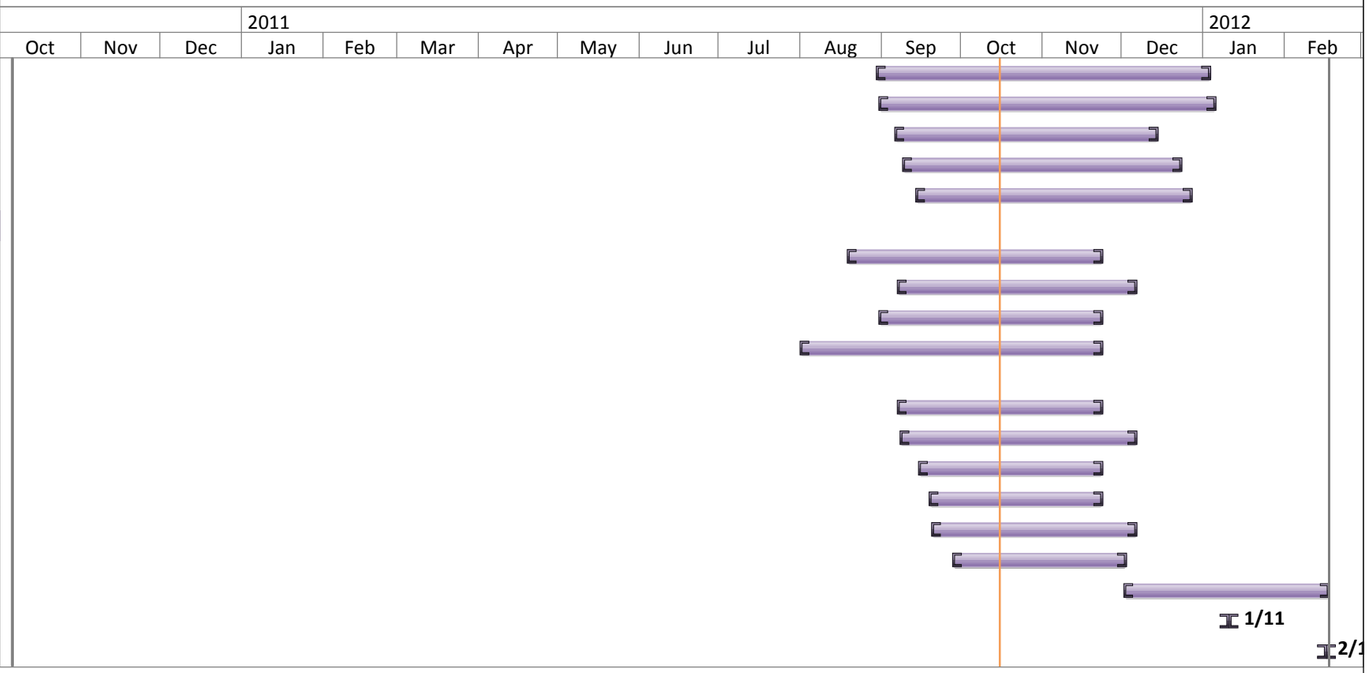
ID	Task Mode	Task Name	Duration	Start	Finish
99		Roof - Area D (Frame/Envelop/MEPS/Finis	10 days	Mon 8/1/11	Fri 8/12/11
100		Building Envelope			
101		Roof - Area A (Frame/Envelop/MEPS)	38 days	Fri 7/29/11	Tue 9/20/11
102		Roof - Area B (Frame/Envelop/MEPS)	72 days	Wed 8/3/11	Thu 11/10/11
103		Roof - Area C (Frame/Envelop/MEPS)	66 days	Tue 8/9/11	Tue 11/8/11
104		Roof - Area D (Frame/Envelop/MEPS/Finishes)	27 days	Mon 8/15/11	Tue 9/20/11
105		Area A (Frame/Envelop/MEPS)	90 days	Fri 6/24/11	Thu 10/27/11
106		Building Substantially Watertight - Area A	0 days	Mon 8/1/11	Mon 8/1/11
107		Area B (Frame/Envelop/MEPS)	78 days	Tue 7/26/11	Thu 11/10/11
108		Building Substantially Watertight - Area B	0 days	Wed 8/3/11	Wed 8/3/11
109		Area C (Frame/Envelop/MEPS)	91 days	Thu 7/14/11	Thu 11/17/11
110		Building Substantially Watertight - Area C	0 days	Wed 8/3/11	Wed 8/3/11
111		Area D (Frame/Envelop/MEPS/Finishes)	87 days	Fri 7/29/11	Mon 11/28/11
112		MEP Conventional Frame Inwall Rough in			
113		Level 1 - Area A (Frame/Envelop/MEPS)	69 days	Mon 6/13/11	Thu 9/15/11
114		Level 1 - Area B (Frame/Envelop/MEPS)	80 days	Mon 6/20/11	Fri 10/7/11
115		Level 1 - Area C (Frame/Envelop/MEPS)	72 days	Mon 6/20/11	Tue 9/27/11
116		Level 1 - Area D (Frame/Envelop/MEPS/Finishes)	54 days	Fri 7/29/11	Wed 10/12/11
117		Level 2 - Area A (Frame/Envelop/MEPS)	70 days	Tue 6/28/11	Mon 10/3/11
118		Level 2 - Area B (Frame/Envelop/MEPS)	67 days	Fri 7/8/11	Mon 10/10/11
119		Level 2 - Area C (Frame/Envelop/MEPS)	68 days	Fri 7/8/11	Tue 10/11/11
120		Level 3 - Area A (Frame/Envelop/MEPS)	65 days	Fri 7/15/11	Thu 10/13/11
121		Level 3 - Area B (Frame/Envelop/MEPS)	64 days	Mon 7/25/11	Thu 10/20/11
122		Level 3 - Area C (Frame/Envelop/MEPS)	61 days	Mon 8/1/11	Mon 10/24/11
123		MEP Overhead/Wall Rough in/Set Equipm			
124		Level 1 - Area B (Frame/Envelop/MEPS)	57 days	Wed 8/3/11	Thu 10/20/11
125		Level 1 - Area D (Frame/Envelop/MEPS/Finishes)	33 days	Wed 8/24/11	Fri 10/7/11
126		Level 2 - Area B (Frame/Envelop/MEPS)	51 days	Tue 8/9/11	Tue 10/18/11
127		Level 3 - Area B (Frame/Envelop/MEPS)	65 days	Fri 7/22/11	Thu 10/20/11
128		Interior Finishes			
129		Level 1 - Area A (Frame/Envelop/MEPS)	128 days	Thu 7/14/11	Mon 1/9/12
130		Level 1 - Area B (Frame/Envelop/MEPS)	130 days	Thu 7/14/11	Wed 1/11/12
131		Level 1 - Area C (Frame/Envelop/MEPS)	132 days	Thu 7/14/11	Fri 1/13/12
132		Level 1 - Area D (Frame/Envelop/MEPS/Finishes)	158 days	Mon 6/13/11	Wed 1/18/12
133		Level 2 - Area A (Frame/Envelop/MEPS)	93 days	Tue 8/23/11	Thu 12/29/11



Project: Detailed Project Schedule
Date: Sun 10/16/11

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline	
Split	External Tasks	Inactive Summary	Manual Summary	Progress	
Milestone	External Milestone	Manual Task	Start-only		
Summary	Inactive Task	Duration-only	Finish-only		

ID	Task Mode	Task Name	Duration	Start	Finish
134		Level 2 - Area B (Frame/Envelop/MEPS)	91 days	Tue 8/30/11	Tue 1/3/12
135		Level 2 - Area C (Frame/Envelop/MEPS)	92 days	Wed 8/31/11	Thu 1/5/12
136		Level 3 - Area A (Frame/Envelop/MEPS)	72 days	Tue 9/6/11	Wed 12/14/11
137		Level 3 - Area B (Frame/Envelop/MEPS)	76 days	Fri 9/9/11	Fri 12/23/11
138		Level 3 - Area C (Frame/Envelop/MEPS)	75 days	Wed 9/14/11	Tue 12/27/11
139		MEP Finishes			
140		Level 1 - Area A (Frame/Envelop/MEPS)	69 days	Fri 8/19/11	Wed 11/23/11
141		Level 1 - Area B (Frame/Envelop/MEPS)	65 days	Wed 9/7/11	Tue 12/6/11
142		Level 1 - Area C (Frame/Envelop/MEPS)	61 days	Wed 8/31/11	Wed 11/23/11
143		Level 1 - Area D (Frame/Envelop/MEPS/Finishes)	83 days	Mon 8/1/11	Wed 11/23/11
144		Level 2 - Area A (Frame/Envelop/MEPS)	56 days	Wed 9/7/11	Wed 11/23/11
145		Level 2 - Area B (Frame/Envelop/MEPS)	64 days	Thu 9/8/11	Tue 12/6/11
146		Level 2 - Area C (Frame/Envelop/MEPS)	50 days	Thu 9/15/11	Wed 11/23/11
147		Level 3 - Area A (Frame/Envelop/MEPS)	48 days	Mon 9/19/11	Wed 11/23/11
148		Level 3 - Area B (Frame/Envelop/MEPS)	56 days	Tue 9/20/11	Tue 12/6/11
149		Level 3 - Area C (Frame/Envelop/MEPS)	48 days	Wed 9/28/11	Fri 12/2/11
150		Punchlist	56 days	Fri 12/2/11	Fri 2/17/12
151		Quality Control Testing Complete	0 days	Wed 1/11/12	Wed 1/11/12
152		Project Substantial Completion	0 days	Fri 2/17/12	Fri 2/17/12



Project: Detailed Project Schedule
Date: Sun 10/16/11

Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline	
Split		External Tasks		Inactive Summary		Manual Summary		Progress	
Milestone		External Milestone		Manual Task		Start-only			
Summary		Inactive Task		Duration-only		Finish-only			

Appendix B
LEED Scorecard

LEED-NC

LEED-NC Version 2009 Registered Project Checklist

Project Name: Ft. Eustis AIT Barracks Complex

WOOLPERT

Yes	?	No			
13	**11**	**2**	**Sustainable Sites**		**26** Points
Y			Prereq 1	**Construction Activity Pollution Prevention**	Required
1			Credit 1	**Site Selection**	1
	5		Credit 2	**Development Density & Community Connectivity**	5
		1	Credit 3	**Brownfield Redevelopment**	1
	6		Credit 4.1	**Alternative Transportation**, Public Transportation Access	6
1			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
3			Credit 4.3	**Alternative Transportation**, Low-Emitting and Fuel-Efficient Vehicles	3
2			Credit 4.4	**Alternative Transportation**, Parking Capacity	2
		1	Credit 5.1	**Site Development,** Protect or Restore Habitat	1
1			Credit 5.2	**Site Development,** Maximize Open Space	1
1			Credit 6.1	**Stormwater Design,** Quantity Control	1
1			Credit 6.2	**Stormwater Design,** Quality Control	1
1			Credit 7.1	**Heat Island Effect,** Non-Roof	1
1			Credit 7.2	**Heat Island Effect,** Roof	1
1			Credit 8	**Light Pollution Reduction**	1
Yes	?	No			
6		**4**	**Water Efficiency**		**10** Points
Y			Prereq 1	**Water Use Reduction**, 20% Reduction	Required
2			Credit 1	**Water Efficient Landscaping**, Option1: Reduce by 50%	2
2			Credit 1	**Water Efficient Landscaping**, Option 2: No Potable Use or No Irrigation	2
		2	Credit 2	**Innovative Wastewater Technologies**	2
2			Credit 3	**Water Use Reduction**, 30% Reduction	2
		1	Credit 3	**Water Use Reduction**, 35% Reduction	1
		1	Credit 3	**Water Use Reduction**, 40% Reduction	1
Yes	?	No			
12		**23**	**Energy & Atmosphere**		**35** Points
Y			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Y			Prereq 2	**Minimum Energy Performance**, 10% new or 5% rennovation improvement	Required
Y			Prereq 3	**Fundamental Refrigerant Management**	Required
5		14	Credit 1	**Optimize Energy Performance** One additional point for every 2% improvement above EAp2	1 to 19
3		4	Credit 2	**On-Site Renewable Energy** 1% is one point, with one additional point for every 2% of energy cost offset	1 to 7
2			Credit 3	**Enhanced Commissioning**	2
2			Credit 4	**Enhanced Refrigerant Management**	2
		3	Credit 5	**Measurement & Verification**	3
		2	Credit 6	**Green Power**, 2 yr contract for 35% of builidng electricity	2
Yes	?	No			
6	**1**	**7**	**Materials & Resources**		**14** Points
Y			Prereq 1	**Storage & Collection of Recyclables**	Required
		3	Credit 1.1	**Building Reuse**, Maintain Existing Walls, Floors & Roof One additional point for 55%, 75%, and 95% building reuse	1 to 3
		1	Credit 1.2	**Building Reuse**, Maintain Interior Nonstructural Elements	1
1			Credit 2	**Construction Waste Management**, Divert 50% from Disposal	1
1			Credit 2	**Construction Waste Management**, Divert 75% from Disposal	1
		1	Credit 3	**Materials Reuse**, 5%	1
		1	Credit 3	**Materials Reuse**,10%	1
1			Credit 4	**Recycled Content**, 10% (post-consumer + ½ pre-consumer)	1
1			Credit 4	**Recycled Content**, 20% (post-consumer + ½ pre-consumer)	1
1			Credit 5	**Regional Materials**, 10% Extracted, Processed & Manufactured Regionally	1
1			Credit 5	**Regional Materials**, 20% Extracted, Processed & Manufactured Regionally	1
		1	Credit 6	**Rapidly Renewable Materials**, 2.5% of material value	1

Desirable
Preferable
Betterment

	1		Credit 7	**Certified Wood**, 50% of wood-based materials/products FSC
Yes	?	No		
10		5	**Indoor Environmental Quality**	
Y			Prereq 1	**Minimum IAQ Performance**
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**
1			Credit 1	**Outdoor Air Delivery Monitoring**
		1	Credit 2	**Increased Ventilation**
1			Credit 3.1	**Construction IAQ Management Plan**, During Construction
		1	Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy
1			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants
1			Credit 4.2	**Low-Emitting Materials**, Paints & Coatings
1			Credit 4.3	**Low-Emitting Materials**, Flooring Systems
1			Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products
1			Credit 5	**Indoor Chemical & Pollutant Source Control**
1			Credit 6.1	**Controllability of Systems**, Lighting
1			Credit 6.2	**Controllability of Systems**, Thermal Comfort
1			Credit 7.1	**Thermal Comfort**, Design
		1	Credit 7.2	**Thermal Comfort**, Verification
		1	Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces
		1	Credit 8.2	**Daylight & Views**, Views for 90% of Spaces
Yes	?	No		
3		3	**Innovation & Design Process**	
1			Credit 1.1	**Innovation in Design**: Expl. Perf: MRc4 Recycled Content (30%)
1			Credit 1.2	**Innovation in Design**: Expl. Perf: SSc5.2 Open Space
		1	Credit 1.3	**Innovation in Design**: Expl. Perf: MRc5 Regional Materials (30%)
		1	Credit 1.4	**Innovation in Design**: Low Mercury Lighting (LEED BOM)
		1	Credit 1.5	**Innovation in Design**: TBD
1			Credit 2	**LEED® Accredited Professional**
Yes	?	No		
2	1	1	**Regional Priority - SSc4.1, SSc4.4, SSc5.1, SSc6.2, WEc2, WEc3 (40%)**	
	1		Credit 1.1	**Regional Priority**: SSc4.1
1			Credit 1.2	**Regional Priority**: SSc4.4
		1	Credit 1.3	**Regional Priority**: SSc5.1
1			Credit 1.4	**Regional Priority**: SSc6.2
Yes	?	No		
52	13	45	**Project Totals (pre-certification estimates)**	

Certified 40-49 points **Silver** 50-59 points **Gold** 60-79 points **Platinum** 80-110 points

Desirable
Preferable
Betterment

Appendix C

Level One Process Overview Map

Level One: BIM Execution Planning Process
A.I.T. Barracks

BIM Uses

Schematic Design
Author Schematic Designs
Design Team | Design Authoring

Schematic Design
Preform Design Validation
Designers & Contractor |

Design Development
Author Design Development
Design Team | Design Authoring

Design Development
Perform Design Validation
Designers & Contractor |

Design Development
Perform 3D Design Coordination
Designers & Contractor | 3D Macro Coordination

Construction Documents
Author Construction Documents
Design Team | Design Authoring

Construction
Author Fabrication Models
Subcontractors |

Construction
Perform 3D Clash Detection
Contractors & Subs | 3D Macro Coord.

Construction
Author As-Built Record Model
Design Team | Record Modeling

End Process

INFO. Exchange

Schematic Design
- Architectural Model
- MEPF Model
- Structural Model
- Civil Model

Validated Design Development Models

Design Development
- Architectural Model
- MEPF Model
- Structural Model
- Civil Model

Validated Design Development Models

3D Marco Coordinated Design Development Models

Construction Docs.
- Architectural Model
- MEPF Model
- Structural Model
- Civil Model

3D MEPF Fabrication Models

3D Micro Coordination Models

As-Built Record Model

Appendix D
BIM and Facility Data Requirements

BIM Use Evaluation

BIM and Facility Data Requirements

1. Model Output Matrix

3D w/ facility data—3D graphical representation with associated intelligent at tribute data.

2D w/ facility data—2D graphical representation with associated intelligent at tribute data

2D w/o facility data—2D graphical representation without associated intelli gent attribute data

Model Element Breakdown	3D w/ facility data	2D w/ facility data	2D w/o facility data
Architectural/Interior Design			
Spaces			
Net Square Footage and Volumes		X	
Room Name and Number		X	
Programmatic Information		X	
Walls and Curtain Walls			
Wall Dimensions/Thickness	X		
Wall Type (A1,A2,B, etc.)	X		
Wall Composition (CMU, Concrete)	X		
Wall Rating (1 hr.,30 min.)	X		
Details			X
Sections			X

BIM Use Evaluation

Model Element Breakdown	3D w/ facility data	2D w/ facility data	2D w/o facility data
Doors, Windows, and Louvers			
Windows, Doors and Louvers	X		
Type	X		
Hardware Type, Frame Mat'l, Glass Type, Door Leaf		X	
Signage			X
Door Legend		X	
Head, Sill, Jam Details			X
Roof			
Roof Dimensional Information	X		
Type (EPDM, Standing Seam, etc.)	X		
Composition (Membrane, insulation, deck, etc.)	X		
Floors			
Floor Dimensional Information	X		
Rating			X
Finishes (Carpet, VCT, etc.)			X
Floor Composition (Concrete, Deck Joist, etc.)	X		

BIM Use Evaluation

Model Element Breakdown	3D w/ facility data	2D w/ facility data	2D w/o facility data
Ceilings			
Ceiling Plane/Dimensions	X		
Layout (grids, patterns, etc.)	X		
Composition (ACT, GWB, Exposed)	X		
Vertical Circulations			
Finished Dimensions of Openings	X		
Shaft Clear Dimensions	X		
Shaft Construction Materials	X		
Architectural Specialties and Woodwork			
Toilet Acc. (tp holder, garbage, paper towel)			X
Toilet Partition	X		
Dimensions	X		
Materials	X		
Grab Bars			X
Dimensions			X
Cabinets and Casework	X		
Dimensions	X		
Materials	X		

BIM Use Evaluation

Model Element Breakdown	3D w/ facility data	2D w/ facility data	2D w/o facility data
Trim (e.g. chair rail)			X
Countertops	X		
Dimensions	X		
Materials (Plam, Solid Surface, etc.)	X		
Signage			
Type			X
Mounting Height			X
Legend			X
Schedules			
Type, materials, and Finishes generated from Model		X	
Furniture			
Furniture Coordination			
Furniture Dimensions		X	
Type		X	
Electrical Needs		X	
Communication Needs		X	
Equipment			
Dimension	X		

BIM Use Evaluation

Model Element Breakdown	3D w/ facility data	2D w/ facility data	2D w/o facility data
Schedules			
Type, Materials, and Finishes generated from Model		X	
Structural			
Foundations			
Dimensional Info (L,W,D, Elevation)	X		
Ftg Type (e.g. F1, F2, etc)			X
Legend			X
Footing Schedule			X
Floor Slabs			
Slab Dimensional Info	X		
Composition			X
Sections and Details			X
Structural Steel			
Columns	X		
Dimensional Info	X		
Primary/Secondary/Roof Framing Members	X		
Dimensional Info	X		
Sections and Details			X

BIM Use Evaluation

Model Element Breakdown	3D w/ facility data	2D w/ facility data	2D w/o facility data
Floor Systems (Decks)	X		
Dimensional Info (L,W,D, Elevation)	X		
Sections and Details			X
Cast-in-Place Concrete			
Footing	X		
Stairs			
Dimensional Info	X		
Shafts and Pits			
Finished Dimensions	X		
Mechanical			
HVAC			
Equipment (AHU's, fans, VAV's, Boilers, Pumps)	X		
Ductwork	X		
Registers, Diffusers, Grilles, etc.	X		
Mechanical Piping			
Equipment (System specific pumps, tanks, etc.)	X		
Piping>=1.5"	X		
Piping<1.5"			X

A.I.T Barracks

Fort Eustis, VA

October 19, 2011

BIM Use Evaluation

Model Element Breakdown	3D w/ facility data	2D w/ facility data	2D w/o facility data
Plumbing			
Piping>=1.5”	X		
Piping<1.5”			X
Fixtures			
Toilets, Urinals	X		
Showers, Jan Sink, Drinking Fountains, DCVs	X		
Sinks	X		
Drains			X
Boiler Storage Tanks, Pumps	X		
Equipment Clearances			
Dimensions			X
Electrical/Telecommunications			
Interior Electrical Power and Lighting			
Lights	X		
Receptacles	X		
Panel Boards	X		
Cable Tray	X		
Conduit>1.5”	X		

BIM Use Evaluation

Model Element Breakdown	3D w/ facility data	2D w/ facility data	2D w/o facility data
Conduit<=1.5”			X
Special Electrical Systems			
Security	X		
Mass Notification	X		
Public Address	X		
Controls	X		
Grounding System			
Devices			X
Wire			X
Rebar			X
Communications			
Cable Tray	X		
Counduit>1.5”	X		
Conduit<=1.5”			X
Controls, Connections Racks	X		
Exterior Building Lighting			
Fixtures	X		

BIM Use Evaluation

Model Element Breakdown	3D w/ facility data	2D w/ facility data	2D w/o facility data
Equipment Clearances			
Dimensions			X
Fire Protections			
Fire Protection System			
Piping	X		
Fittings	X		
Pumps	X		
Tanks	X		
Sensors		X	
Panels	X		
Fire Alarms			
Devices			X
Civil			
Terrain (DTM)			
Site Conditions	X		
Grading	X		
Drainage			
Drain System	X		

Model Element Breakdown	3D w/ facility data	2D w/ facility data	2D w/o facility data
Storm Water and Sanitary Sewers			
Systems	X		
Utilities			
Systems	X		
Gas Lines			X
Roads and Parking			
Dimensions	X		
Composition	X		