Tubman African American Museum	Technical Assignment #2a	Chris Champagne
Atlanta, GA	Green Building	Mechanical

Green Building Certification Analysis-

The major categories of the U.S. Green Building Council LEED Certification are: Water efficiency, energy & atmosphere, materials & resources, indoor environmental quality. These were not major concerns in the design of the Tubman Museum. The indoor air quality (IAQ) and maintaining a single climate for the entire building that is the most effective environment for all the collection needs drove the design. Thermal and humidity control were both important. The constant volume units were not energy efficient, but they were necessary for the humidity control. There was zero use of CFC-based refrigerants, as the chillers used HCFC-22 as the refrigerant. There is a permanent carbon dioxide (CO_2) monitoring system that provides system feedback on space ventilation for the gallery areas.

Standard 90 Compliance-

From Table D-1 (U.S. Climate Data) of ASHRAE Standard 90, Table B-11 of the standard should be used for buildings in Atlanta, GA. The following is a summary of the design value and the actual values used in the Tubman Museum's envelope.

	DESIGN		ACTUAL	
Opaque Elements	**Assembly Maximum**	**Insulation Min. R-Value**	**Value**	**COMPLIANT?**
Roofs Metal Building	U = 0.065	R = 19.0	U = 0.040	Y
Walls, Above Grade Metal Building	U = 0.113	R = 13.0	U = 0.104	Y

	DESIGN		ACTUAL	
Fenestration	**Assembly Max. U (Fixed/ Operable)**	**Assembly Max. SHGC (All Orientations/ North-Oriented)**	**U Value/ SHGC Value**	**COMPLIANT?**
Vertical Glazing, % of Wall				
0-10%	U_{fixed} = 0.57	$SHGC_{all}$ = 0.39 $SHGC_{north}$ = 0.49	U=0.560 SHGC=0.35	Y Y

The lighting requirement of ASHRAE Standard 90 is summarized on the attached Table 9.3.1.2. All spaces in the museum are compliant.

Lost Rentable Space-

The building lost 2195 square feet of rentable design due to mechanical equipment rooms and vertical mechanical shaft space. The following is the break down by floor.

Floor Name	Sq. Ft. Lost
Ground	484
2nd	1,711
TOTAL	2,195

Verification of Mechanical Equipment Serviceability-

The layout of the equipment in the mechanical rooms on the ground floor and the second floor provide enough space for coil pulls and other related equipment maintenance. The boilers are located along the west wall of the first floor mechanical room. They are located side-by-side, but there is a minimum of four feet on each side of the boiler to the nearest wall. The pumps are located in two groups of three, with space for the piping entering and leaving them. Piping and the chilled water supply and return risers are positioned along the wall in order to provide unimpeded egress routes from the mechanical room. The two chillers are located in a separate space, called the mechanical court, with eight feet separating them and six feet to the exterior walls. The air handling units are located in the mechanical room on the second floor. They seem to be very closely separated, especially AHU-1A with is directly beside AHU-1B and only five feet to the wall. The AHUs are ten feet wide, so the coil is probably larger than five feet. AHU-1B and AHU-2 are provided with enough room for coil pulls and maintenance.

Mechanical System First Cost-

The bidding documents for the actual equipment were unavailable to me. Therefore, I came up with an initial cost based on the larger pieces of equipment of the mechanical system and typical costs from R.S. Means Mechanical Cost Data 2001. The following table summarizes the results.

Name of Equipment	Units	Cost Per Unit	Total Cost
121.5 Ton Air Cooled Water Chiller (Trane RTAA125)	2	$72,000	$144,000
AHU (CV - 25,000 cfm) (McQuay CAH074)	2	$11,000	$22,000
AHU (VAV - 18,000) (Trane MCC 35)	1	$9,000	$9,000
AC (1000 cfm)(Liebert MM36E)	1	$1,500	$1,500
Air Cooled Condenser (Liebert PFC037A)	1	$800	$800
Unit Heater (12.1 MBH) (Trane 38-S)	2	$795	$1,590
Gas Fired Boiler (1040 MBH) (Lochinvar IBV-1500)	2	$6,700	$13,400
Cabinet Unit Heater (11.1 MBH) (Trane FFCB-H200)	6	$795	$4,770
Cabinet Unit Heater (17.0 MBH) (Trane FFCB-E300)	2	$890	$1,780
Duct Electric Heater (62.0 lbs/hr) (Dri-Steam VM-25)	1	$2,900	$2,900
Duct Electric Heater (61.6 lbs/hr) (Dri-Steam VM-25)	1	$2,900	$2,900
Duct Electric Heater (15.7 lbs/hr) (Dri-Steam VM-8)	1	$2,050	$2,050
Duct Electric Heater (25.0 lbs/hr) (Dri-Steam VM-10)	1	$2,250	$2,250
Duct Electric Heater (6.3 lbs/hr) (Dri-Steam VM-4)	1	$2,050	$2,050
Duct Electric Heater (3.2 lbs/hr) (Dri-Steam VM-4)	1	$2,050	$2,050
Duct Electric Heater (38.5 lbs/hr) (Dri-Steam VM-16)	1	$2,425	$2,425
Hot Water Pump (90 GPM) (Bell & Gossett 1510-1 1/2 BB)	3	$1,225	$3,675
Chilled Water Pump (290 GPM) (B&G 1510-2 1/2 BB)	3	$2,075	$6,225
Exhaust Fan (750 cfm) (Cook ACE 100C 3B)	1	$300	$300
Exhaust Fan (600 cfm) (Cook ACE 100C 2B)	1	$275	$275
Exhaust Fan (175 cfm) (Cook ACE 60C 3B)	1	$200	$200
Terminal Box (150 cfm) (Enviro-Tech SDR-04)	1	$800	$800
Terminal Box (200-280 cfm) (Enviro-Tech SDR-05)	2	$875	$1,750
Terminal Box (300-500 cfm) (Enviro-Tech SDR-06)	8	$1,050	$8,400
Terminal Box (550-700 cfm) (Enviro-Tech SDR-08)	5	$1,125	$5,625
Terminal Box (820-1080 cfm) (Enviro-Tech SDR-10)	9	$1,325	$11,925
Terminal Box (1200-1530 cfm) (Enviro-Tech SDR-12)	8	$1,775	$14,200
Terminal Box (1700-2350 cfm) (Enviro-Tech SDR-14)	7	$2,025	$14,175
Terminal Box (2350 cfm) (Enviro-Tech SDR-16)	1	$2,025	$2,025

Hot Water Expansion Tank (34 GAL) (B&G D-120V)	1	$375	$375
Chilled Water Expansion Tank (11.3 GAL) (B&G D-60V)	1	$355	$355
Air Filter (Pleated 30% Efficiency) (Farr 30/30)	2	$26,000	$52,000
Air Filter (Pleated 65-95% Efficiency) (Farr Riga-Flo)	2	$35,000	$70,000
Air Filter (Carbon 85% Efficiency) (Purafil CPS-500)	1	$40,000	$40,000
Hot Water Air Separtor (B&G R-4)	1	$19,700	$19,700
Cold Water Air Separtor (B&G R-6)	1	$22,400	$22,400
Fan Coil Unit (1600 cfm) (Enviro-Tec H-16)	1	$1,200	$1,200
Sound Attenuator (Vibro-Acoustics)(25,000 CFM)	3	$1,800	$5,400
Sound Attenuator (Vibro-Acoustics)(21,150 CFM)	1	$1,500	$1,500
Sound Attenuator (Vibro-Acoustics)(5,455 CFM)	2	$695	$1,390
Sound Attenuator (Vibro-Acoustics)(14,545 CFM)	1	$955	$955
HVAC Misc. ($11.80 per sq. ft)	45,000	$11.80	$531,000
TOTAL	93	-	$1,031,315