

Building Design Background

HITT Contracting Headquarters is a four story, 135,000 square foot office building located next to the Capital Beltway in Falls Church, Virginia. The building consists of a variety of spaces including office, conference rooms, server space, café, fitness center and covered, under-building parking. HITT Contracting is a general contractor based in Northern Virginia and their current headquarters is located in Fairfax, Virginia.

Existing Design Objectives

The design team was given with the task to devise a building that included office, conference, storage, plotting and printing, and fitness spaces, all while aiming for LEED silver certification. The design of the mechanical systems for HITT Contracting Headquarters had the following requirements:

- Occupant controllability of the system
- Minimal use of usable square footage for mechanical systems
- Energy efficiency (LEED requires improvement upon baseline case)
- Meeting ASHRAE 62.1-2004 (LEED credit EQ 1 Minimum IAQ Performance)
- Meeting ASHRAE 90.1-2004 (Minimum Energy Efficiency Standards)

Structural System Background

The structural system of HITT Contracting Headquarters is of reinforced concrete design. The foundation system consists of a slab on grade 5" thick reinforced with W/ 6x6 W2.1xW2.1 WWF centered in slab depth that is placed upon 4" of VA DOT #56 Gravel . Floors one to three are comprised of 10" thick 2-way reinforced concrete slabs with 4 ½" deep drop panels around concrete columns. The columns are spaced in approximately a 16' by 16' grid. The roof system consists of a 10" thick 2-way concrete slab that forms a flat roof for the structure. The building façade is a curtain wall structure comprised of precast concrete panels with punched out fenestration hung from each floor.

Mechanical System Existing Conditions

Design Conditions & Assumptions

Since the building is currently under construction, no usage data could be obtained. As this was the case, Trane Trace 700 was used model the building heating and cooling loads and energy consumption rates. Listed in Tables 1, 2 and 3 below are the design condition and load assumptions used to create the energy model of HITT Contracting Headquarters.

Table 1 – ASHRAE Design Conditions

ASHRAE Outdoor Air Conditions (99.6% and 0.4%)	
Washington, DC	Temperature °F
Winter Dry Bulb	15
Summer Dry Bulb	95
Summer Wet Bulb	78

Table 2 – ASHRAE Indoor Design Conditions

Indoor Design	Temperature °F
Cooling Supply Dry Bulb	78F
Cooling Drift point	90F
Heating Supply Dry Bulb	72F
Heating Drift point	55F
Relative Humidity	50%

Table 3 – Load Calculation Assumptions

Load Calculation Assumptions	
Load Type	Loads
Lighting	1.1 Watts/SF
Misc. Loads	3.46 Watts/SF
People	250 Btu/Person Sensible
	250 Btu/Person Latent
Occupancy Density	114 SF/Person (Office)
	50 SF/Person (Conference)
	20 SF/Person (Fitness)
	50 SF/Person (Cafe)

Airside Systems

HITT Contracting Headquarters has seven 50 Ton AAON air-cooled packaged rooftop units with energy recovery wheels serving the four occupied floors; three above ground and one below grade. Each above ground floor has at total of two units that serve the North and South sections respectively. Parallel, series, and shut-off fan-powered Variable-Air-Volume (VAV) terminal units control the final supply temperature and flow to individual zones throughout the building. Three split-system air-conditioning units provide air for loads in fitness and café spaces. See Figure 1 for a schematic of a typical existing rooftop unit.

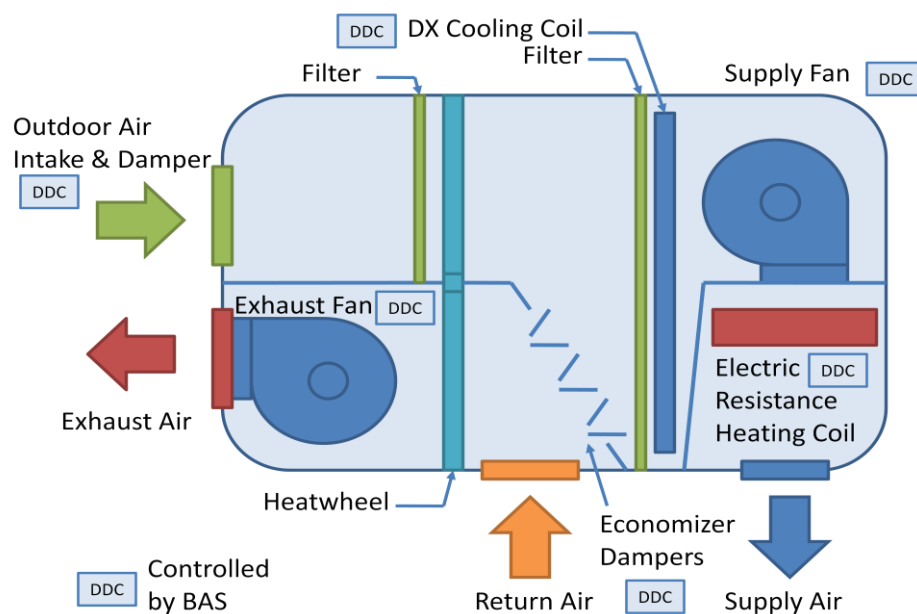


Figure 1 – Schematic of Typical Existing Rooftop Unit

Powered Roof Ventilators (PRV) provide exhaust for restroom and locker spaces throughout the building. Additional exhaust for storage and trash rooms is provided by ceiling mounted exhaust fans. Exhaust fans also exist in entry rooms from the parking garage to expel harmful vapors that enter from the parking area. See Figure 2 for a schematic of the entire existing airside system. Figure 3 is a rendering of the existing rooftop with rooftop units and screening.

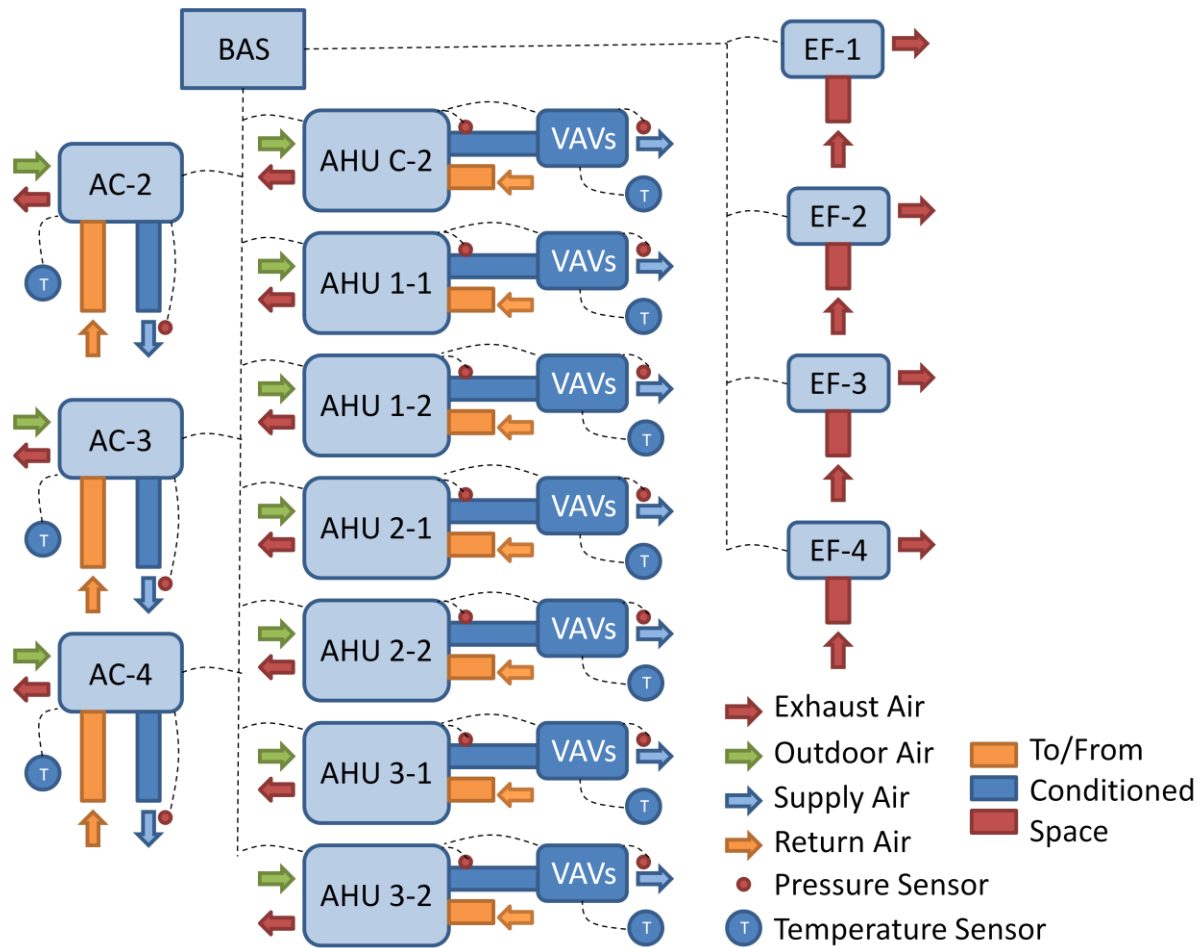


Figure 2 – Schematic of existing airside system

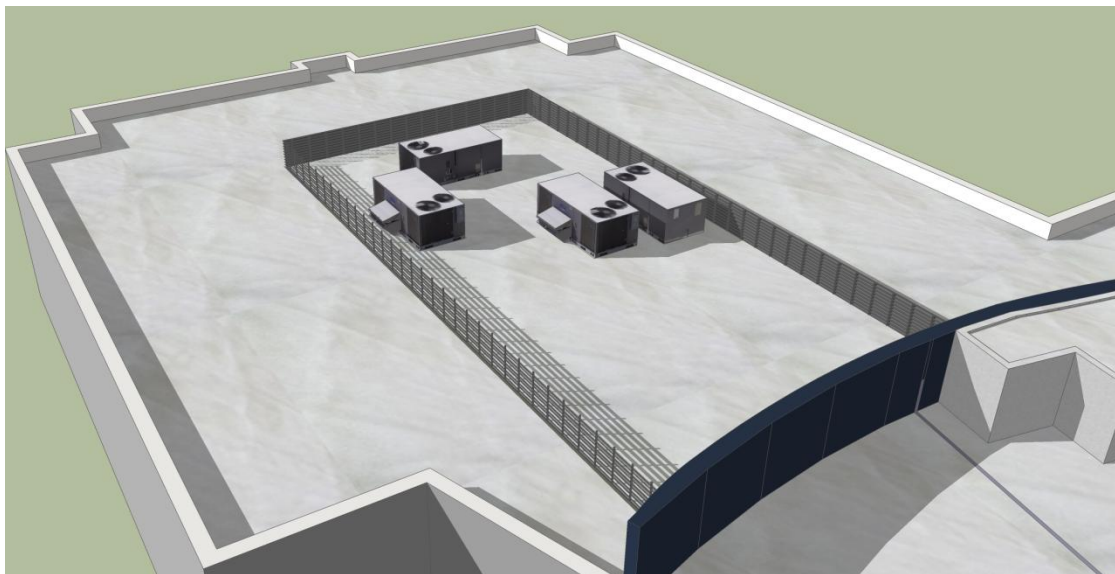


Figure 3 – Rendering of Existing Rooftop

Heating & Cooling Requirements

The peak Heating and cooling loads were calculated by Trane Trace 700 and are listed in Table 4 below for each of the rooftop air handling units and the supplemental air handlers for the café and fitness areas.

Table 4 – Cooling and Heating Loads

Cooling and Heating Loads		
	Cooling (tons)	Heating (MBH)
AHU 1-1	52.1	309.7
AHU 1-2	42.5	262.8
AHU 2-1	52.1	309.7
AHU 2-2	39.3	259.8
AHU 3-1	50.6	307.9
AHU 3-2	42	292.4
AHU C-2	63.3	264.1
Café	11.9	91.3
Fitness	10.6	129

Existing Building Energy Usage Summary

The monthly energy consumption as calculated by Trace 700 is displayed in Figure 4 below. The schedules noted in Appendix B were used for the energy consumption modeling. On peak demand was set to occur between the hours of 10am – 10pm from June to September and 7am-10pm from October to May. This, along with increased demand to satisfy the cooling loads, accounts for the spike in the off-peak demand during the summer months. The existing annual electricity consumption of HITT Contracting Headquarters was modeled to be 3,769,755 kWh or 27.9 kWh/ft². This usage leads to an annual energy cost of \$340,748 or \$2.52 per square foot with a cooling cost of \$0.50 per square foot. Figure 5 below describes how the total energy usage is broken down by type.

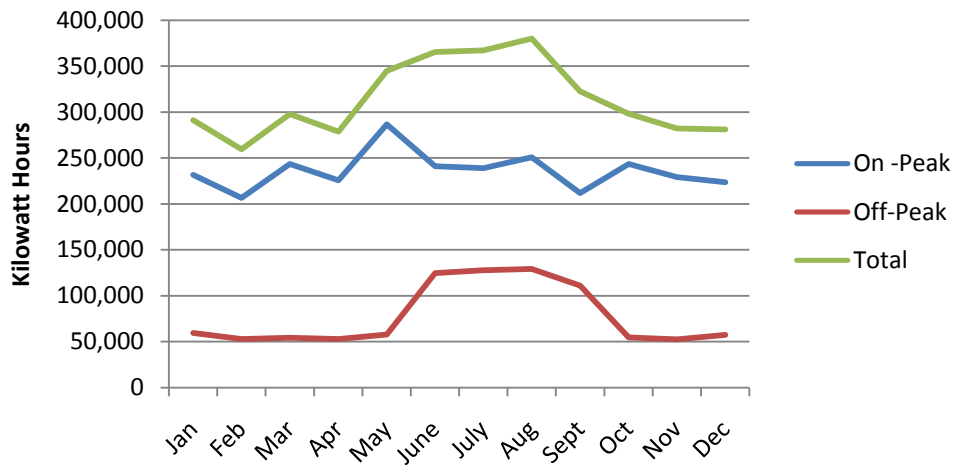


Figure 4 – Existing Monthly Electricity Usage

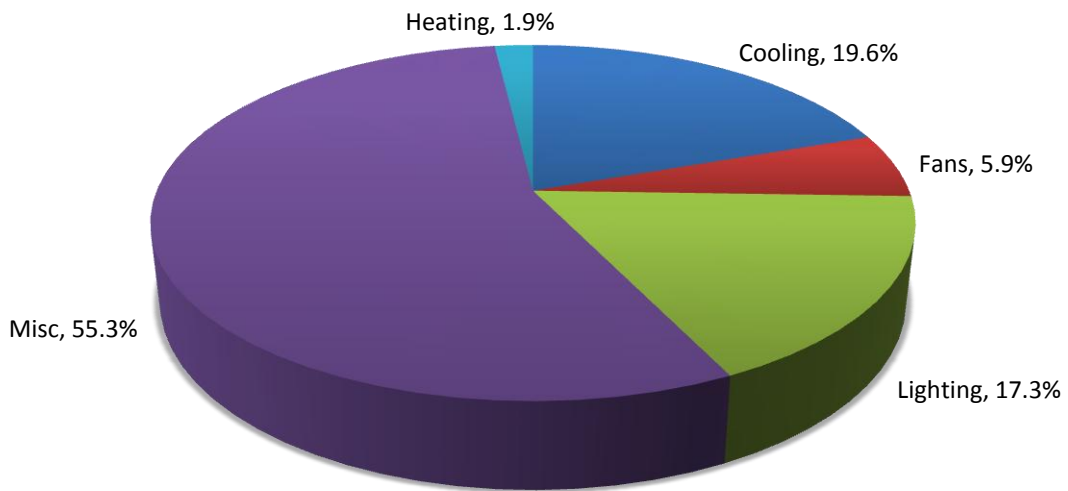


Figure 5 – Breakdown of Existing Electricity Consumption by Use