Glitch Works LLC is a chip manufacturing company located in Buena Vista, VA. Glitch Works LLC is a growing business and recently moved into a larger facility as part of their company expansion. The current HVAC system in the chip manufacturing room has been expensive to run and does not meet the heating and cooling needs of the space, resulting in uncomfortable working conditions. The purpose of our project was to design an HVAC system which provides adequate heating and cooling for the chip manufacturing room at Glitch Works LLC. As part of our project deliverables, the client requested that the heat and air unit be a rooftop unit. Additionally, the client requested as part of our design we recommend a replacement garage door and room isolation which will make the room more thermally efficient.

To start our project we did a heating and cooling load analysis to determine the energy required from an AC and heating unit to keep the room at a comfortable temperature. The heating and cooling analysis accounts for all sources of heat or cold that can change the climate of the room and transfers there values into overall heat transfer equations. Once the heating and cooling loads are found, the AC and heating unit can be chosen based on the found energies. The annual usage of energy was also found using the found cooling and heating loads and the found heating and cooling degree days.

Table 1: Heating and Cooling Loads

Heating Loads					
Control Temp (F)	Q room (Btu/hr)	Q foundation (Btu/hr)	Q total (Btu/hr)	Tonnage	
15	38540.77	12603.53	51144.30	4.26	
Cooling Loads					
Control Temp(F)	Q room (Btu/hr)	Q foundation (Btu/hr)	Total Additional Gains (Btu/hr)	Q Total (Btu/hr)	Tonnage
100	16621.74	394.86	53489.32268	70505.93	5.88

Table 2: Annual Energy Usage for Heating and Cooling

HDD	Climate HDD	Energy Usage (Btu)	Annual Energy Usage (Btu/yr)
50	2252.00	1.227E+06	5.528E+07
CDD	Climate CDD	Energy Usage (Btu)	Annual Energy Usage (Btu/yr)
35	2345.00	1.692E+06	1.134E+08

Once the unit is picked, a ducting design and analysis can be done. This process involves using fluid dynamics to analyze what size ducts are required to deliver the same air flow through each of the diffusers in the room. This is important because we cannot have one part of the manufacturing room be warmer or colder than other parts because it is getting more air flow rate from the ducts. This analysis is also conducted to make sure the unit and ducting system is capable of delivering the proper amount of outside air and air flowrate to meet basic human requirements of the number of people working in the room.

Table 3: Ducting Diameters Based on Ducting System Design and Unit

								decending	diffuser	diffuser	diffuser	diffuser	diffuser
Duct	A	B	D	F	I	K	L	M	C	E	G	H	J
v (ft/s)	31.18	57.30	38.20	6.24	19.10	38.20	6.24	42.44	33.95	19.10	33.95	33.95	33.95
l (ft)	5.00	5.00	5.00	5.00	10.00	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Diameter (in)	14.00	8.00	8.00	14.00	8.00	8.00	14.00	12.00	6.00	8.00	6.00	6.00	6.00
Diameter (ft)	1.17	0.67	0.67	1.17	0.67	0.67	1.17	1.00	0.50	0.67	0.50	0.50	0.50
e/D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Re	221818.74	232909.67	155273.12	44363.75	77636.56	155273.12	44363.75	258788.53	103515.41	77636.56	103515.41	103515.41	103515.41
A	3.25624E+21	2.42081E+21	1.5909E+21	3.25E+20	6.64491E+20	1.5909E+21	3.25154E+20	3.54249E+21	8.34623E+20	6.64491E+20	8.3462E+20	8.34623E+20	8.34623E+20
B	4.50905E-13	2.06565E-13	1.3568E-10	0.068803	8.89194E-06	1.3568E-10	0.0688027	3.82769E-14	8.91204E-08	8.89194E-06	8.912E-08	8.91204E-08	8.91204E-08
f	0.016	0.017	0.018	0.022	0.020	0.018	0.022	0.016	0.019	0.020	0.019	0.019	0.019
CFM	2000.000	1200.000	800.000	400.000	400.000	800.000	400.000	2000.000	400.000	400.000	400.000	400.000	400.000
ΔP	0.015	0.094	0.044	0.001	0.024	0.005	0.000	0.004	0.006	0.001	0.006	0.006	0.006

Once the ducting has been designed, a static structural analysis can be conducted. This is done by using the weight of the ducts, weight of the roof, and weight of the unit to evaluate the steel I-beams holding everything up. This is done because it is important to make sure the steel I-beams can support the load so the roof will not cave in.

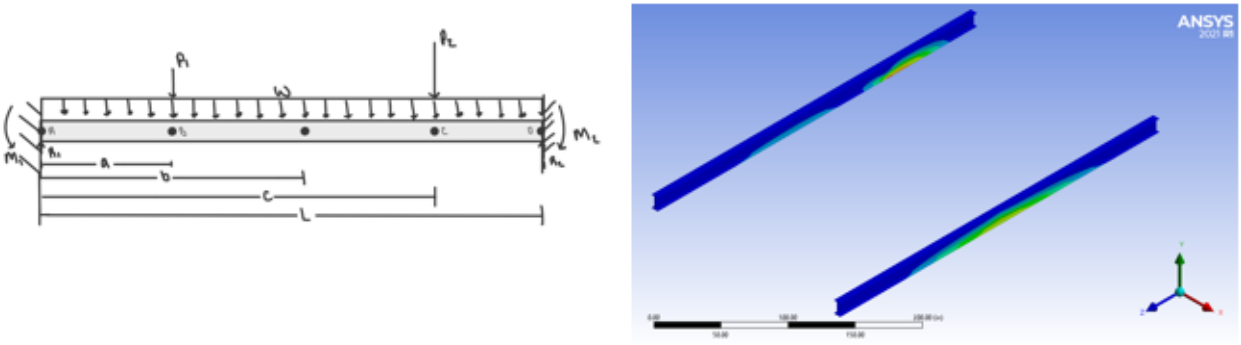

Figure 1: Static Structural Analysis

Finally, we conducted a cost analysis of our design. This involves the cost of all components like insulation, units, ducting, and electricity or gas prices. This also involves finding the annual energy consumption of the unit to determine the yearly cost of the electricity or gas. The cost analysis is important because it can tell us if the design is cost efficient and worth installation.