Executive Summary

The Variable Air Volume (VAV) and chilled beam alternatives analyzed in this report are intended to reduce the annual energy consumption of the mechanical system for the American Swedish Institute. Included in the VAV alternative analysis are the cooling and heating loads, annual energy consumption, annual utility breakdown, emission factors for utilities used, mechanical space occupied, initial annual costs, and the life-cycle cost of the system. The load and energy analysis completed for the VAV system shows the loads experienced on the equipment during peak operation, the equipment energy consumption for both electricity and natural gas and emissions for those utilities. First cost analysis of the equipment compares the variations between the VAV system and the existing heat pump system. 30 year life-cycle costs for the VAV system were compared to the original system based on the net present values of each.

An analysis similar to the VAV system was completed for the chilled beam system to compare the energy results to the original heat pump system. The chilled beam analysis includes the cooling and heating loads, annual energy consumption, annual utility breakdown, emission factors, mechanical space occupied, equipment selected, chilled beam calculations, initial costs, and 30 year life-cycle for the building. Load and energy analysis for the chilled beams illustrate the loads experienced on the building and equipment during peak operation and equipment energy consumption for both electricity and natural gas usage which are compared to the original system. The first cost analysis for the chilled beam system includes the equipment selected and was compared to the VAV and existing heat pump systems. A 30 year life-cycle cost was completed for the chilled beam alternative with the net present value calculated compared to the original system.

Both alternatives were compared to each other as well as to the original system to determine the best system based on loads, energy usage, first costs, and life-cycle costs. From the results analyzed in this report it was determined that the VAV alternative was the best solution for the American Swedish Institute. Below are the main points demonstrating the results for the depth analysis.

VAV Alternative:

- 68% reduction in fan and pump energy use compared to the existing heat pumps
- 15% decrease in energy use in comparison to the original heat pump system
- $427,371 additional costs for this alternative
- Annual energy savings of $12,992.50 per year

Chilled Beam Alternative

- 13% less building consumption per year than the original system
- 66% reduction in fan and pump energy than the existing heat pumps
- $517,122 additional investment with this option than the original
- Annual energy savings of $10,062.02 per year

The architectural and structural breadths were focused on the redesign of the walkway connecting the mansion and addition with an extensive or intensive green roof to replace the existing roof. After completion of all structural calculations, a final conclusion was made for the recommendation of an extensive green roof to replace the existing roof. An extensive green roof reflects the green roofs currently in place on the second story roof of the addition and demonstrate the Swedish landscape and sustainability concepts. The extensive green roof costs $7/sf less than the intensive option. Total loads experienced on the roof would increase by 6 psf in comparison to the existing roofing therefore not comprising the structural integrity. This new roof would use 3 inch 16 gauge steel roof deck which can handle a maximum load of 118 psf which is more than capable to handle the calculated load.