Executive Summary

The HVAC systems that were implemented in the Grunenwald Science and Technology Building provide innovative designs which resulted in an energy efficient building. The design engineers faced many challenges in the design to meet the efforts of Clarion University to achieve a LEED Gold or Platinum rated building. In this report, the original designs of the mechanical systems are evaluated, critiqued, and a redesign of the buildings systems is accomplished. The redesigns that were done in the Grunenwald Science and Technology Building were than compared to that of the original design.

The mechanical system does use sustainable ideas and energy consumption reduction as a basis for the initial design approach. The building does implement 5 VAV AHU's, 3 of which are 100 percent outdoor air, and the other 2 are standard VAV systems that use an economizer with CO2 measurement controlling the damper for outside air. The Grunenwald Science and Technology Building uses (2) 250 ton centrifugal chillers which are water cooled by 2 cooling towers. Hot water is produced by passing the campus generated steam through a plate and frame heat exchanger with water, and the water is used in the pre-heating and heating coils of the AHU's.

The Alternative Designs for the building include the implementation of a DOAS with parallel systems of radiant ceiling panels, active chilled beams, and passive chilled beams, and Geothermal Heat Pumps. The parallel systems ceiling area of the DOAS system was found to be only practical for the implementation of active and passive chilled beams, as the required ceiling area for the radiant ceiling is greater than that of the available area due to the lighting system and the diffusers used. The energy savings for the passive and active chilled beams were found using Trace 700 to be $13,177 and $10,284, respectively. The passive chilled beams had a payback period of 2.48 years while the payback period for the active chilled beams was calculated to be 6.45 years. The Geothermal heat pump was designed utilizing equations to calculate pipe length from Chapter 32 of the 2007 ASHRAE Handbook HVAC Applications. The Geothermal Heat Pump associated energy savings were found using Trace 700 to be $26,983 and $24,807 for different efficiency fluids in the ground source pipes. The payback periods were found to be 27.28 years for the higher efficient fluid compared to 29.67 for the standard fluid.

The Construction Management Breadth consists of the placement and possible schedule for the installation of the geothermal well field. The placement is an optimization of the borehole depths, number of boreholes, and the size required for the field. The cost for the installation of the geothermal system was found using RS Means cost data.

The Architectural Breadth consists of designing fixed horizontal shades on the South and Southwest Façade to the optimum depth in order to block the direct summer solar beams and allow the direct winter solar beam into the building. Sample spaces were constructed in Revit with the solar shade to compare the direct solar beam in the space for the two facades for the winter solstice, summer solstice, and equinoxes.