

Executive Summary

The goal of this analysis is to find methods that reduce the annual building energy consumption. Four alternatives were investigated to meet this goal.

The first alternative explored internal thermal mass. The goal of increasing the thermal mass, was to reduce the modeled heating and cooling loads, in order to reduce the size of mechanical equipment required to make more room for addition equipment that would be added in the fourth alternative.

Shifting heating and cooling loads from an all air system to partial VAV and radiant heating and cooling system was the second system explored. The goal of this system was to convert from fan power to pump power. This system also provided the opportunity to reduce the size of the AHUs to make room for equipment in the last alternative

Heat recovery units are the third system that was explored and added to each AHU to further reduce the annual energy consumption.

The fourth alternative considered was the addition of a solar thermal system that would provide supplemental heating and cooling to the radiant system. This system required additional equipment that required space which was provided by reducing other mechanical equipment sizes in the first two alternative systems. This system provides greater flexibility, because it can be altered to supplement heating and cooling loads, not only the radiant system, but also the AHUs or DHW if necessary.

Following the mechanical system alternatives, two breadth topics were studied: one, a structural analysis that considered the additional structure required from the load of solar panels on the roof and the weight of the internal thermal mass on the floors, and two, an electrical analysis that looked at the effects on the electrical distribution equipment from adding additional pumps and including a chiller and cooling tower into the system.

A brief summary of the findings in my mechanical depth are as follows:

- Thermal Mass
 - 3.5% reduction in the modeled cooling load and a 2.5% reduction in annual building energy consumption.
- Radiant System
 - 2% reduction in annual building energy consumption.
- Heat Recovery
 - 7.6% reduction in annual building energy consumption with a 23 year payback period.
- Solar Thermal System
 - 13% reduction in heating and 4% reduction in cooling energy consumption with a 23 year payback period.