Proposed Alternatives

The following is a list of options that were considered as possible areas of investigation for the Ed Roberts Campus. It is important to note that, while alternatives are being investigated, they are not suggesting that the current design is inadequate in any way. This is an academic exercise to explore energy use of different mechanical systems.

1. Implementation of on-site renewable energy sources
    a. Solar Panels (electricity or heating demand)
    b. Ground Source Heat Pump system
2. Use of a centralized air system with air-air heat recovery
3. Conversion to a Variable Refrigerant Flow System

Each of these alternatives would offer different challenges and comparisons with the current system, but need to be balanced to include an appropriate scope of work. Option 3, a Variable Refrigerant Flow system, will be selected as a primary investigation into the space condition of the building with a second investigation into a Solar Thermal system that could be used to address the radiant floor system.

Depth

Variable Refrigerant Flow

For the Mechanical Depth portion of the thesis project, I will look into the effects of converting the current mechanical system into a Variable Refrigerant Flow system. Initial research indicates that the current system is already set up well for conversion to such a system. The Water Source Heat Pumps installed around the building are similar to ceiling-mounted ducted units commonly available with VRF systems. New air-source condenser units will need to be installed on the roof to cool or heat refrigerant as the system demands, and new refrigerant lines to the fan coil units will need to replace old CHW/HW piping.

It will be useful to compare the energy use of this kind of system, which is immensely popular outside the United States, to the energy use of the current building. The new system will not require any equipment to cool/heat water so this equipment (cooling towers and boilers) could be removed from the rooftop mechanical room. The AHUs will no longer be supplied by cooling towers and boilers and could be replaced by single packaged units. These equipment changes, together with a good control and operations scheme, offer the possibility for great energy savings for the building. The tools required in this section of the thesis investigation will include energy modeling software, such as Trane Trace, to track the changes in mechanical system within the building.

Solar Thermal Hot Water

As a secondary consideration, I will look into the possibility of implementing a solar thermal heating system for hot water demand in the building. Solar Thermal is popular as a way to supply both domestic hot water and space heating water and the effects of a solar system on the energy use of the current hot water equipment will be investigated. It will be important to find the configuration and application of the system that allows for the most savings as well as a reasonable payback period. This part of the investiagation will utilize the solar thermal simulation program CombiSys.

Breadth

Structural Breadth

The removal of several types of chilled and hot water equipment from the rooftop mechanical room, as well as the addition of many VRF outdoor units, offer the possibility of redesigning the structure of the roof. The solar thermal system, depending on the weight of the panels and size of the panel array, could require a redesign of the roof structure. If the structure could be reduced in size there is the possibility of additional cost savings.

Electrical Breadth

Another possible effect of elimating equipment is an adjustment to the electrical system. The addition of a large amount of VRF equipment with different electric requirements could also require adjustments to the electrical system. This adjustment could mean redesigning a branch circuit, or the design of a completely new circuit, to suit the changing mechanical system. This change could result in a lower first cost for the electrical equipment, as well as a reduction in electricity use and monthly energy savings.