exhausted by exhaust fans located on the roof via duct risers. The diagram of this system can be seen below in Figure 10.

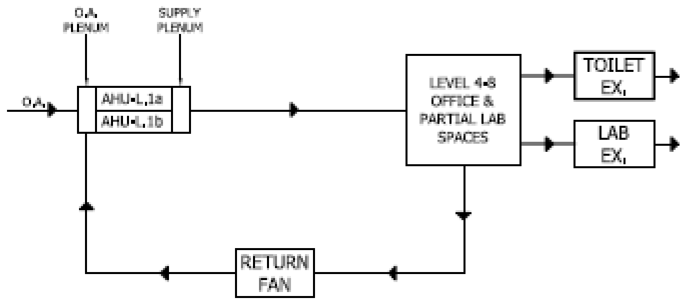

Figure 10

Proposed Redesign

Scope

The proposed redesign intends to address the energy consumption and indoor air quality issues of the building. Currently the solution to controlling the indoor air quality is to use 100% outdoor air systems which contribute to the energy consumption of the building. Using 100% outdoor air means there is no return air which means there is no energy savings through mixing of air. The basic premise of the redesign will be using air quality sensors placed before and after filters in what is currently the exhaust stream to track the air quality and then when it is acceptable either return the air or use an energy recovery device such as an enthalpy, sensible or desiccant wheel in an attempt to cut down on the energy consumption of the building.

The first issue to deal with will be implementation of filters and the indoor air quality controls. The system will need to be able to monitor what will become an exhaust/return stream and determine when the air is acceptable to use or when it needs to be exhausted. It appears as though this sort of system is somewhat rare.

A fair amount of information will need to be gathered to set up controls like this. The first bit of information will be what sort of particles do mice release since the main animal being used for experimentation is mice. Also information on what sort of toxins and particles are typically released during the types of experiments that are going to be conducted in the research labs. Information on particles and pollutants that are in the outdoor air in Houston, Texas should be gathered. Then it needs to be determined what are acceptable levels of each for occupants of the buildings then the control system can begin to be constructed.

Once this information is gathered the next issue to address will be to look into what would be the best device to use for energy recovery in the system. It needs to be determined whether a sensible wheel, enthalpy wheel, desiccant wheel, direct return or a combination of those energy recovery devices will need to be looked at.

The redesign looks to address the indoor air quality and energy consumption issues associated with research labs. The current answer to this is to ignore the energy consumption and go with a 100% outdoor air system to ensure there are no problems with indoor air quality. This redesign will look to see if active controls in indoor air quality monitoring is a better design idea.

Justification

The redesign will allow for an opportunity to learn more about controls in the less than ordinary application of indoor air quality monitoring. This will also allow for a look at research lab design from an “outside the box” perspective. Also the redesign looks to save energy consumption which will become a bigger issue as natural resources deplete.

Integration & Coordination

The biggest integration and coordination concern for the proposed redesign of the Margaret M. Alkek Building for Biomedical Research will be finding space and a location for the energy recovery devices. Currently the mechanical systems are on level 3. This means that the exhaust streams for levels 1-2 pass through the mechanical systems floor but not levels 4-8 exhaust streams. So to allow for energy recovery on all exhaust streams it is proposed that the top level (level 8) research floor be switched in place with the level 3 mechanical systems floor. This allows for the energy recovery devices to have access to all exhaust streams as well as the air handling units that supply all the lower levels.

Then there is the issue of saving space on this floor by consolidating the current 2x2 or one on top of the other stacked design of air handlers into one air handler for each of the 3 above air-side systems. This should allow for some more room for energy recovery devices and the extra duct risers that will run through this floor. Another possible idea for saving floor area is to look into placing radiant ceiling panels into spaces to cut down on some of the air handling units load for cooling and thus being able to size them down.

Breadth Areas of Redesign

A main point of the redesign will involve switching Level 8 which is currently a research lab with Level 3 which is currently the mechanical systems floor. The biggest concern here will be the moving of that load from a lower floor to the upper floor. Once new equipment is in place a structural analysis will need to be done to ensure that the structure can handle the redistributed load or if the structural members will need to be resized (whether larger or smaller).

The new equipment will need be analyzed from a cost perspective versus the existing design. The cost of the extra or changed equipment and the energy savings will be analyzed to see how much of a savings it presents. It will then be determined whether the proposed redesign would be a reasonable alternative, cost wise. Also, the building's electrical system may need to be looked at with the moving around of the equipment.

Alternate Redesigns Considered

There were two alternative redesigns considered before settling on the proposed redesign. The two ideas were first to use an absorption chiller instead of the campus chilled water loop and the other was a combined heat and power system.

The campus chiller plant has an 800 ton chiller that is replaced by a 1300 ton chiller to accommodate the extra load on the campus' chilled water system as well as to have some room for future expansion. The first redesign idea is to install an absorption chiller to produce the building's chilled water instead of replacing the 800 ton chiller in the north campus chiller plant and using the plate and frame heat exchanger to create the building's chilled water. The absorption chiller would have utilized the existing campus steam loop to drive it. This was considered not an indepth enough redesign to devote a semester to. The only areas to study would be cost and energy consumption of adding the absorption chiller versus the existing design. The mechanical floor also is very much full at this point so there is no room to place an absorption chiller.

The second alternative was to put in a combined heat and power system. There were several problems with this idea. Since the building has not been constructed yet there are no load profiles available. Energy analysis and other activities so far have been conducted under an assumed profile for comparison sake. For a combined heat and power system a detailed load profile needs to be available to test the feasibility of the system. Typically offices are not considered to have good profiles for a CHP system. Also it is assumed that a laboratory would have a similar load profile as an office. Also there is little room for a turbine and an absorption chiller within the building for this equipment. Another floor would have to be added or perhaps a penthouse for these systems which would cost way more than using an absorption chiller driven by exhaust gases would save over any number of years.

There was also two common problems with each of these redesign ideas. The first is that both designs take measures to remove the buildings mechanical systems from the existing campus loops. Since the building is being constructed on campus it does not make sense to remove it from the existing available loops. The main problem with both redesign ideas is that neither addresses the real issues involved with the building. The building, as with most research buildings, consumes a large amount of energy and indoor air quality is also a big concern. Neither of these designs takes any real measures to address these issues so neither was seriously pursued.

Mechanical Redesign

A variety of ideas were initially entertained during the redesign of the mechanical system for the Margaret M. Alkek Building for Biomedical Research, however after conducting more research, only some of the initially proposed ideas were implemented. The proposal called for a monitoring of indoor air quality in laboratory and vivarium spaces to determine when and how much air is to be exhausted and returned. This ended up not being a reasonable thing to do and will be discussed later in the report. A CO_2 based demand controlled ventilation system was explored