Proposed Thesis Depth

The 234,000 SF building features a large variety of departments that require considerable amount of exhaust in the studios and workshops. To handle this exhaust, additional ventilation is required which greatly increases the load of the building. The Tyler School of Art does not use any energy recovery technology because much of the exhaust is not centralized. The layout of the departments and the additional cost for energy recovery was not seen as beneficial by the university. There as an opportunity to recover the energy the Tyler School by the use of the technology available. Different energy recovery configurations will be considered further.

Temple University has a unique opportunity with the Tyler School of Art. The building is moving from the suburbs to the metropolitan cultural center of Philadelphia. As the face of the complete Arts Campus at Temple, the Tyler School can expand its reach to the campus and the city. The Tyler School is the most known arts school in the mid Atlantic region, and it has the opportunity to make an important architectural and energy conscious statement as its vision for the next century. The Tyler School could have the ability to not only affect the students in the school, but the rest of the campus and the surrounding community. An energy efficient building can set the tone for the vision of the school and the campus. As energy consumption becomes more of an issue in the future, universities should look to lead in educating students with the hope that the future will become brighter than the past and we will learn from our mistakes. Unfortunately, as a state funded university, Temple University often has to consider the first cost primarily in the construction process. Long term life of the building is not considered, although, in the case of higher education it should be one of the first issues because there will always be the same owner and occupant of the building.

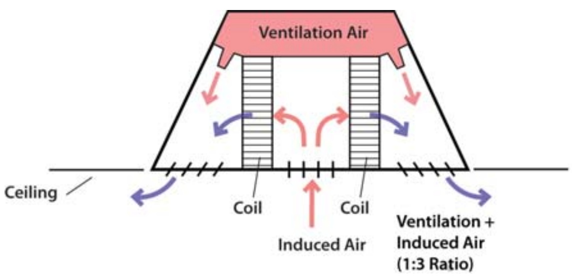
DOAS

The goal of this thesis is to improve the energy efficiency and consumption of the building. To achieve this goal, the VAVR system will be redesigned as a dedicated outdoor air system (DOAS). DOAS offers many advantages associated with building ventilation. The primary advantage of DOAS is the lower ventilation that translates to energy savings. Variable air volume (VAV) systems require a high minimum amount of airflow and the VAV system does not supply the proper ventilation air quantities to the spaces. The VAV box is sized based on the ventilation requirements in the room and a percentage of the ventilation air in the supply air. If the possible need for reheat in the VAV box is considered as well, the wasted energy load becomes even higher. The higher ventilation requirements coupled with the need to reheat this extra air justifies the consideration of DOAS.

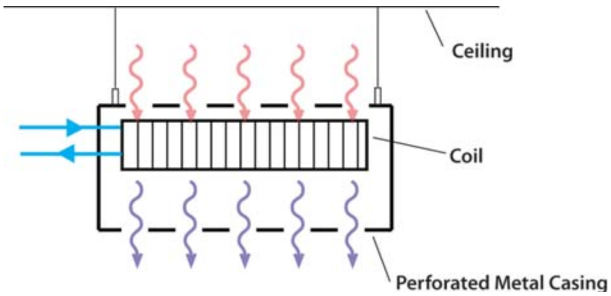
The use of DOAS separates the sensible and latent loads. DOAS handles the latent load and some of the sensible load. However, DOAS needs to be coupled with a system to handle the rest of the sensible load. The ability to separate these two loads is a great advantage in mechanical system design optimization. The main reason for the loads to be separated is the ability to avoid high relative humidity in the space at low sensible loads. The humidity issues leads to moisture problems which affect the overall indoor air quality of the space.

Chilled Beams

Chilled beams and radiant ceiling panels are two technologies that efficiently can be coupled with the DOAS and handle the sensible load of the building. The chilled beams will be the technology considered for its application in the Tyler School of Art. Chilled beam technology has been common place in Europe for quite some time; however, just recently the technology has increased in popularity here. The system offers energy savings and reductions in mechanical equipment and duct. Chilled beams can be a passive or active mechanical system. Active systems are connected to the supply air ductwork. The active chilled beams mix the supply air and the existing air that has been cooled. The passive system uses natural convection to cool the space. The warm air rises naturally into the system, which cools the air and then the air falls. The figure below shows the difference the active and passive systems.



Active Chilled Beam



Passive Chilled Beam

Specifically, chilled beams offer a variety of advantages that are summarized in the table below.

Potential Advantages	Disadvantages
Mechanical System and Duct Reductions	Noise
Reduced or Eliminated Reheat	Coordination w/ Lighting Equipment
Pump Energy Instead of Fan Energy	Rooms w/High Loads
Fit in Tight Space	Condensation
Free Cooling and Improved Chiller Efficiency	Cost

Energy Recovery

Various energy recovery configurations will also be considered. The use of enthalphy wheel, The three most common systems that will be evaluated for the Tyler School are enthalpy wheels, flat-plate heat exchangers, and refrigerant filled heat pipes. The heat exchanger is the most reliable system because it is a passive system. It usually transfers only sensible heat energy (temperature only) back into the outdoor supply air. For the system to work effectively, the temperature and humidity must be comparable to the treated space, and the exhaust airflow rate must be similar to the outdoor air flow rate entering the system. The enthalpy wheel or energy wheel rotates, mixing the sensible heat energy as well as the humidity with the outdoor air. They are more complex than heat exchangers because the mass and heat transfer are paired together. It is referred to as an enthalpy wheel because of its ability to transfer both heat and humidity into the supply side by the use of a desiccant coating. Energy wheels are usually used for high humidity climates and large ventilation systems.