Mechanical Analysis
Energy Recovery Ventilator

Introduction

A study was conducted to see if incorporating an Energy Recovery Ventilator (ERV) is a feasible opportunity to reduce the buildings cooling/exhaust operational costs. ERV Systems are strongly encouraged for areas such as Florida, where cooling loads place heavy demands on the building's HVAC system.

The current exhaust system employed in the Academic Villages is a Water Source Heat Pump (WSHP) system. There are two heat pumps on the ground floor bringing in 5050 cfm of outdoor air (*100 cfm to each room*) and 11 exhaust fans emitting a total 2880 cfm of exhaust (*60 cfm from each room*). The remaining 2170 cfm of air (*40 cfm from each room*) is lost through openings in the rooms (windows and doorways).

In the proposed ERV system, both the ventilator and the heat pump on located on the top floor. In order to simplify the calculations to make a comparison between the current WSHP system and proposed ERV system, it will be assumed that the only difference between the two systems are the two ventilators and exhaust fans. The heat pumps and piping will be the same for both systems. See Figures 16 and 17 for the layout of both systems. Also, see Appendix 5 for detailed calculations.

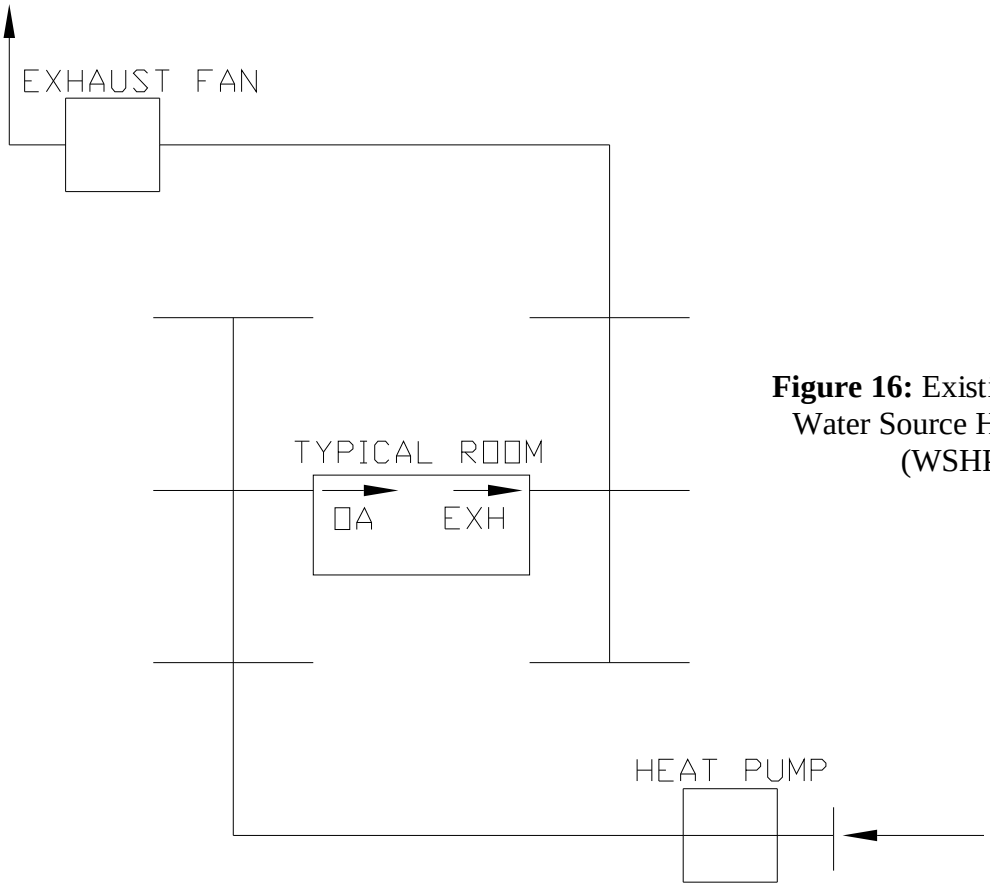

Figure 16: Existing System: Water Source Heat Pump (WSHP)

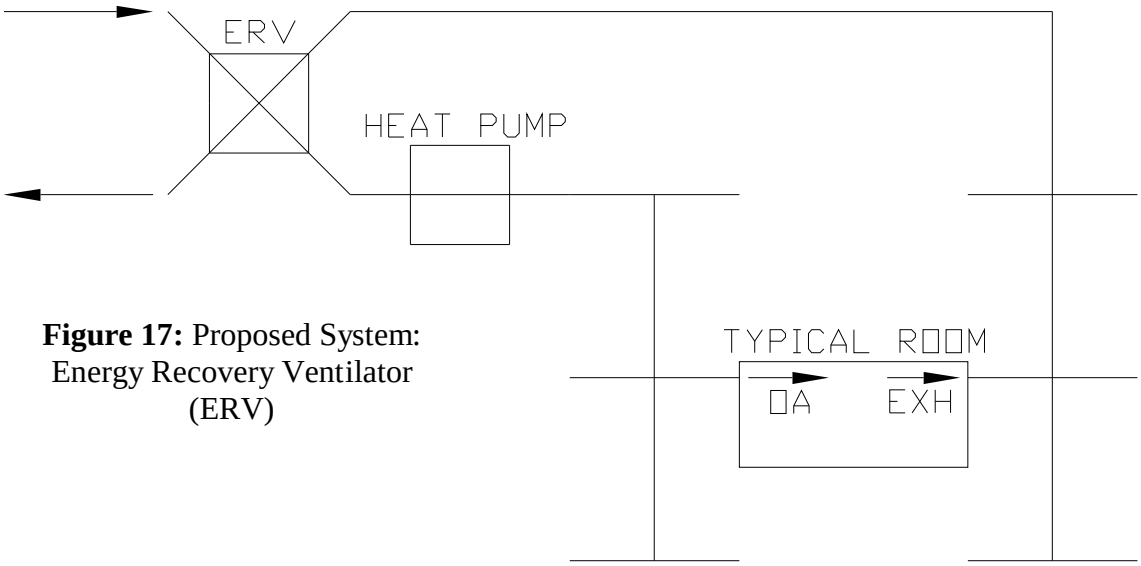

Figure 17: Proposed System: Energy Recovery Ventilator (ERV)

Solution

Using RS means to estimate the cost of the exhaust fans ($400 per 320 cfm), I found that the total cost for all 11 of the exhaust fans to be $3600. This is money saved when installing an ERV system. However, the estimated cost for the actual ERV unit plus installation from RS Means is $3200. Since a ventilator must be paired with each of the two heat pumps, two ventilators totals $6400. This is $2800 more than what would be saved from eliminating the exhaust fans. To find the amount of energy saved, the following formula was used for sensible heat:

$$q = 1.08 \times cfm \times \bullet T$$

The average temperature in Orlando for the summer months is around 90° F. Assuming that the indoor temperature will be about 70° F, the sensible heat for the existing exhaust system will be about 62,208 Btu/hr. Since the ERV is 50% more efficient than the existing system, 31,104 Btu/hr will be savings @ 1 kw per ton. Assuming the energy cost in Orlando is around $.10 per kw, approximately $0.26 per hour will be saved. This translates to 10,810 operating hours to make a profit using an ERV system. Further assuming that it is 90° F for 8 hours per day and there are about 150 days per year when it's at least 90 degrees in Orlando, it will take approximately 9-10 years before a profit is made using the Energy Recovery Ventilator system. This is a very feasible solution since the average life span of the ERV motor is approximately 100,000 hours, about 4 times the time it takes before savings take over.