6 Design Conditions

The following table shows design conditions for McKinstry Oregon HQ. See Technical Report II[a] for full assumptions about indoor conditions and Appendix D of this report for full outdoor design conditions for Portland, OR.

Table 6.1. Indoor and Outdoor Design Conditions

Design Condition	Indoor (occupied)	Indoor (unoccupied)	Outdoor
Heating	70°F	65°F	21.9°F (DB, 99.6%)
Cooling	74°F, 50%RH	78°F	90.8° F (DB, .4%)

7 Ventilation Requirements

ASHRAE Standard 62.1 – 2007[b] sets forth guidelines "to provide indoor air quality that is acceptable to human occupants and that minimizes adverse health effects." Section 6 of the ASHRAE Standard provides the Ventilation Rate Calculation Procedure. Analysis of McKinstry Oregon Headquarters found a minimum outdoor air of **5,109 CFM**, or 14% outdoor air. This is less than the air handling unit's minimum outdoor air supply of 5,500 CFM. In summary, McKinstry Oregon Headquarters complies fully with ASHRAE Section 62.1 – 2007. Complete analysis and calculation can be found in Technical Report I[a].

8 Dedicated Outdoor Air System Overview

The mechanical redesign for the headquarters is based around a dedicated outdoor air system (DOAS). DOAS reduces airflow throughout the building by providing only ventilation air. This will provide yearly energy savings from reduced fan usage. Because of lowered CFM, the AHU and ductwork can also be downsized. For calculations, all loads, square footages, and other values include the area of future expansion.

Previously there were series VAV units throughout the building to control airflow and provide reheat. While there will still need to be a damper for balance, the units are much less complex with no need for fans or piping. This will save significantly on first cost. Details are shown in Section 14.

Several new elements must be added to the system with the DOAS redesign. An enthalpy wheel recovers energy from exhaust air, thus saving energy on ventilation load. Also, at the end of the ductwork, diffusers must be replaced with high induction diffusers. Since incoming air is much lower temperature, 42F, high induction diffusers ensure good air mixing and eliminate draft in the space.

A separate system must be introduced to meet demand loads. This thesis report employs radiant ceiling panels. Located at ceiling level, the panels cool/heat the space with chilled/hot water from the central plant. The panels require large water flow which will upsize piping throughout the building –previously piping was only for hot water reheat in the VAV units.

Radiant panels cannot handle latent loads. To avoid condensation on the panel's coils, latent load must be handled from the supply air. During high humidity and summer conditions, ventilation air is cooled and dried to 42F. With a low humidity ratio, the dry air keeps condensation from forming on the radiant panels. Calculations can be found in Section 11.1. In addition an enthalpy wheel recovers energy from return air.

The central plant now splits into two separate units, one in the previous location, and one on the rooftop with the AHU. The main chiller and boiler only provide chilled and hot water for the radiant panels. The chiller on the rooftop conditions outdoor air to 42F for dehumidification. In heating mode it can heat the air up to 95F. Section 12 goes over plant details.

SPACE COMFORT

By eliminating the VAV system and providing 100% outdoor air, the DOAS system ensures that all spaces receive adequate ventilation air. In a VAV system, outdoor air mixes with return air, and each space receives supply air based on load, not ventilation. With DOAS, the system is designed to specifically provide proper ventilation. Proper ventilation is a definite plus for occupant comfort. In addition, DOAS provides better control of air humidity. This is because the mechanism for sensible cooling is separate from latent cooling. If a VAV system has a small sensible load, there is no way to do a large amount of latent cooling. With DOAS, sensible and latent cooling are totally separate[c].

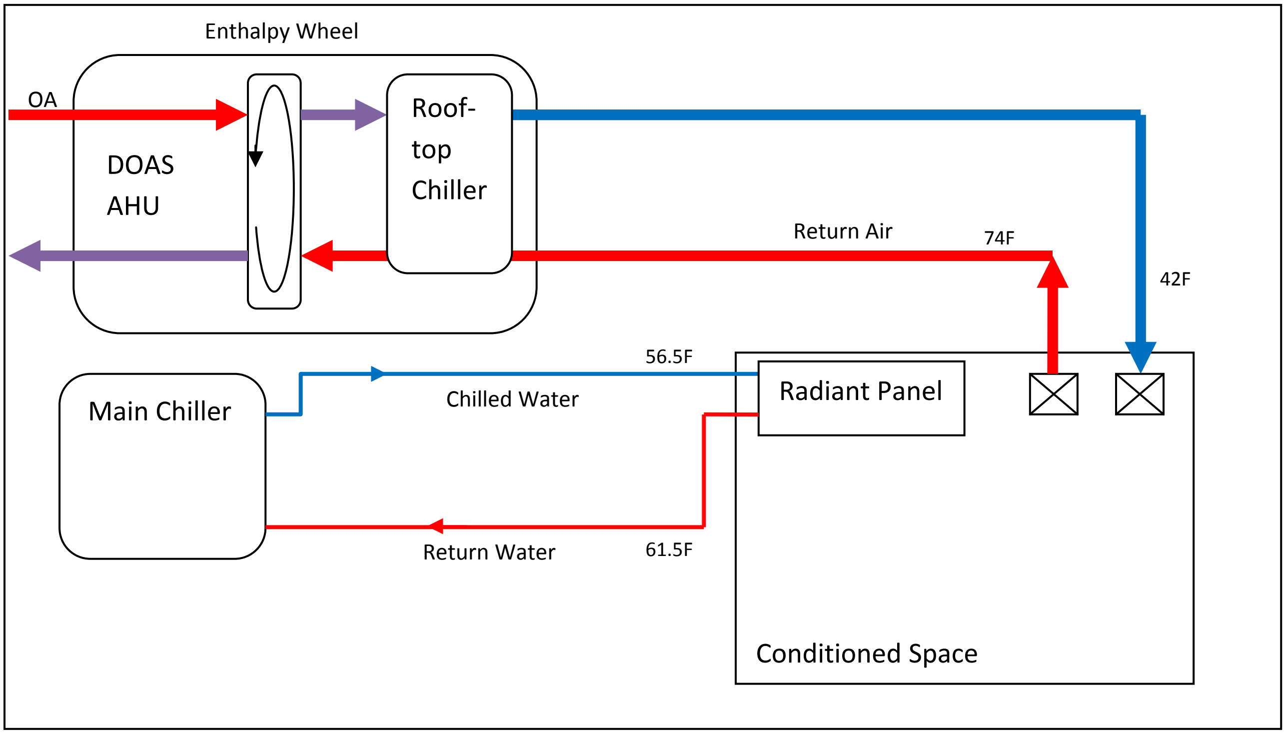

Figure 3.1. DOAS Schematic in Cooling Mode

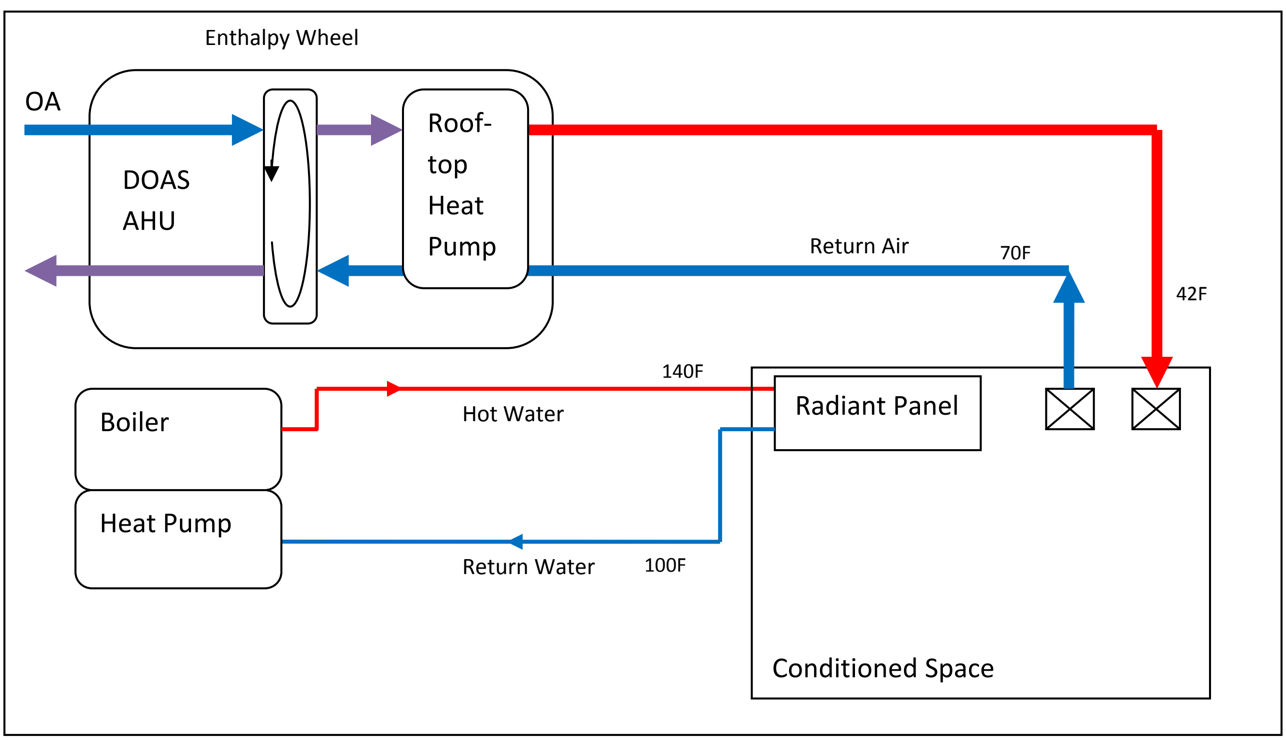

Figure 3.2. DOAS schematic in heating mode