

## 5.0 – ASHRAE Standards Analysis

### 5.1 – ASHRAE 62.1-2007

ASHRAE Standard 62.1-2007, Chapter 6, specifies the calculation methods for providing adequate ventilation to indoor spaces, as well as the required minimum ventilation rates. The Ventilation Rate Procedure was used to calculate the required outdoor air amounts for the entire building. The VRP is a fairly straightforward procedure, but requires some time and knowledge of system operation characteristics. The table below summarizes the results of these calculations; for a more detailed analysis, see Technical Report 1.

	Calculated OA	Minimum OA	Supply Minimum	Supply Maximum	62.1-2007 compliance
AHU-1	326,590	15,000	20,000	50,000	NO
AHU-2	77,880	15,000	20,000	50,000	NO
AHU-3	2,448	7,500	7,500	15,000	YES

AHU-3 easily meets the ventilation requirements of the standard because it is a 100% OA unit, and conditioning the spaces requires far more air than for ventilation only. AHU-1 and AHU-2 do not meet the ventilation requirements outright. This is due to a low minimum airflow for a select few zones through the building. During normal building operation, when these spaces are not occupied there will be adequate ventilation air provided. As soon as people occupy the spaces, the load imposed on the system because of their presence will require more conditioned air for delivery to the space to maintain the setpoint. This is the reason the room seems under-ventilated by just applying the standards. If further calculations are done, we can see that the least-ventilated room (the Lecture Hall) will actually have maximum ventilation provided the lights are on and more than 50 people are in the room. Since the room will be adequately ventilated when there are no people there and the lights are off, the room can accommodate up to 24 people without any supply air beyond the minimum set at the VAV boxes. The other rooms that prevent the systems from fulfilling the requirements outright are aquatic lab suites, which must be kept to minimum airflows to keep the delicate environments needed for these aquatic experiments. Since these rooms will not be occupied at all times, as noted on the lab access sheets for the 2007-2008 school year, some additional calculations show that they are in fact adequately ventilated.

The vivarium is greatly over-ventilated by AHU-3, and the energy associated with conditioning that much outdoor air will be reduced by the DOAS system proposed in the mechanical system redesign.

Chapter 5 of 62.1-2007 sets minimum standards for building's mechanical systems based on their location and climate, as well as standard good engineering practice. The building has met all of these requirements since the building is a very typically-built system, with standard details.

## 5.2 – ASHRAE Standard 90.1-2004

Standard 90.1 sets maximum “energy use” for a building. These values (such as minimum R-values for insulating walls) are minimum values, and may be exceeded at any time, provided the owner has the resources for this additional infrastructure. All the requirements are based on the building type and location, taking local climate conditions into account.

The building meets the vast majority of these requirements; however there are a few which are not met. The ones not met are the efficiency of the summer boiler on the roof and the ventilation of the building. Ventilation is taken care of by what was stated above, so a more detailed analysis than the minimum is required to fully understand the building’s system operation, and the assumptions of the VRP in 62.1. The boiler is outright short of the efficiency minimum. Since it is only used during the summer, a detailed analysis could be performed to show that the building is consuming an equivalent amount of resources of a building using a code-compliant boiler year round, but due to rising energy costs, environmental impacts, and the opinion of the author, minimum efficiency should be met unconditionally.

The lighting densities were calculated using the space-by-space method, and were above the recommended maximum values listed in 90.1. The building is a School/University building, limited to 1.2W/SF overall. The building is 62% over the maximum allowed power for lighting, which amounts to 63.1kW above the maximum allowed. The table below summarizes the results of the detailed analysis contained in Technical Report 2.

Building Lighting		
SF	Watts lights	Watts / SF
84,762	164,887	1.945