Executive Summary

ASHRAE Standard 62-2001, Ventilation for Acceptable Indoor Air Quality, sets the minimum ventilation rate and indoor air quality that is acceptable for human occupation and reduces the potential of spreading illness and allergens throughout a building. Due to the recognition of the fact that indoor air pollutants are generated by both building occupants and contents within the building, Addendum n was developed to include several new factors regarding a system's ventilation efficiency. Now we can insure a minimum ventilation rate regardless of occupancy level.

New House Residence Hall is a 72,000 sq. ft., five story above grade, dormitory supplied by 5 separate air handling units with design supply airflow rates ranging from 1,000 – 12,000 cfm. Air handling unit number 5 provides 100% outside air to each of the residing occupant's rooms, using a heat recovery wheel to exchange heat from the main bathroom exhaust air stream with the fresh outside air. Each of the units are continuous air circulation systems with increased air flow designed to meet ASHRAE Standard 62-99. After reviewing the original design condition criteria and comparing it with the new Addendum n calculations, it was found that each of the air handling units outside air requirements were identical to original design. This may be due to the fact that Addendum n was first introduced to the public in 1999. With calculations beginning in 2001, the New House Residence design is part of the green initiative in which each space is expected to exceed the code for indoor air quality.

Assumptions

- New House Residence design ventilation rates follow ASHRAE Standard 62-1999.
- Zone air distribution effectiveness (E_z) of 1.0 due to ceiling supply of cool air configuration.
- Ahu-5 is a 100% outdoor air system, therefore $V_{ot} = \sum V_{oz}$
- In order to compensate for humidity control, additional ventilation may have been added.

Systems and Building Analysis

Using current Addendum n of the ASHRAE Standard 62-2001, an evaluation of the current design was performed to ensure that adequate indoor air quality has been maintained within each zone. After determining square footage, occupancy, and design supply airflow rates, an ASHRAE standard based spreadsheet was used.

AHU-1

This air handling unit supplies the kitchen and dining area of the first floor. At approximately 840 sq. ft., this area is expected to be occupied by a large population of the tenants as well as kitchen equipment. Design allows for 38.3% of outdoor air to be supplied to this zone. That means 620 cfm is coming from outside air. Calculations prove that this system is compliant with Addendum n.

AHU-1			
Min OA [V_{OT}] scfm	**Design OA scfm**	**Total SA**	**Standard Compliant**
618	620	1620	yes

AHU-2

Air handling unit 2 covers the first floor area of the T.V. lounge, the recreation room, the front entry way, and the café/vending area. Again, anticipating a large population this unit allows for 38.8% of outdoor air to enter the zone. Small discrepancies in room occupants may have led to different outdoor air values, but with the percentage of minimum outdoor air being close, I have decided that this system is compliant with Standard 62-2001n.

AHU-2			
Min OA [V_{OT}] scfm	**Design OA scfm**	**Total SA**	**Standard Compliant**
1291	1270	3270	yes

AHU-3

Air handling unit 3 covers the reading room of the first floor only. Being the smallest unit in the building, AHU-3 supplies about 1000 scfm of air into the zone. Due to high volumes of occupancy, this room is designed to use about 25% outdoor air.

AHU-3			
Min OA [V_{OT}] scfm	**Design OA scfm**	**Total SA**	**Standard Compliant**
252	250	1000	yes

AHU-4

Air handling unit 4 is devoted to the entire basement level. Consisting of many storage rooms and mechanical and electrical rooms, this level is not expected to see very many occupants at any given time. Therefore the outdoor air percentage is approximately 15%.

AHU-4			
Min OA [V_{OT}] scfm	**Design OA scfm**	**Total SA**	**Standard Compliant**
1042	1050	7000	yes

AHU-5

Air handling unit 5 is a make-up air unit that provides 100% outdoor air to all of the residents of New House. Providing fresh ventilation to each occupant, AHU-5 definitely exceeds Standard.

AHU-5			
Min OA [V_{OT}] scfm	**Design OA scfm**	**Total SA**	**Standard Compliant**
12000	12000	12000	yes

Conclusion

In conclusion, each of the air handling units were almost identical to the calculations from which it was originally designed. Because New House is a green building, it was designed to be slightly over ventilated in each zone. This is due mostly to be part of the initiative to keep the occupants healthy and free of small colds through out the year.

Discussion on Major Differences and Applicability of VRP and IAQP

ASHRAE Standard 62 describes two independent methods of achieving adequate indoor air quality. The Indoor Air Quality Procedure (IAQP) is a procedure that ensures acceptable indoor air quality by directly controlling known air contaminants. It may result in overall ventilation rates that are more, or less, than those presented in the Ventilation Rate Procedure (VRP). The Ventilation Rate Procedure determines the ventilation rate of fresh outside air or filtered recirculated air delivered with adequate mixing. Though one method used more widely than the other, each procedure determines proper design indoor air quality.

The Indoor Air Quality Procedure focuses more along the guidelines of specific acceptable concentrations of contaminants within indoor air. Therefore, there are no ventilation rates or air treatment methods specified in this application. This procedure outlines airflow rate requirements based on various contaminant levels, allowing designers to use any amount of air acceptable for human occupation. The basis of this procedure was to allow buildings to now have reduced outside air requirements by recirculating air sufficiently cleaned with an air cleaning system. Now buildings could conserve energy without ignoring the importance of clean indoor air.

Many problems arise when using this method. Because the Indoor Air Quality Procedure incorporates both a quantitative and a subjective evaluation of restricting the concentration of all known contaminants, this has become only a concept of providing a direct solution in practice. When designing the quantitative evaluation, it is shown that not all of the potential or even unknown contaminants have defined limits and are accounted for. In realizing this, using the prescribed tables of concentration limits may not in fact ensure acceptable indoor air quality. Since there are numerous contaminants in which no limits have been defined, there is serious risk involved with using this procedure. It is also not practical to measure each potential element within a space. The subjective portion of this method accounts for the unacceptable intensity levels associated with irritation of ones eyes or throat. Because there are no objective means in assessing this acceptability, judgment lies solely on the impartial designer. When combining these two unstable evaluations, it may be safe to say that an experienced designer would not declare this a procedure for standard compliance. Very few practitioners are using Indoor Air Quality Procedure because of its indefinite nature, and most feel it is not even possible to "control" known contaminants in a given space.

The Ventilation Rate Procedure "prescribes the rate at which ventilation air must be delivered to a space and various means to condition that air." This implies that the indoor air quality will rely on ventilation air to dilute pollutant levels. The Ventilation Rate Procedure is a three-step approach. First one needs to determine the quality of the outdoor air and treat as necessary. Then determine the amount of outdoor air required in each space. This approach may seem simple, but can become very difficult in its application. Different spaces require different outdoor air requirements. When spaces are served with a common air supply, the challenge is to deliver the appropriate amount of outdoor air to each space. Using this method allows a designer to modulate the ventilation rates below the actual calculated design rate if occupancy is variable or intermittent. This can be done under a revised procedure, addendum 62n. Ventilation rates are now to be determined based on both occupant and space ventilation requirements. A base ventilation rate will be required, regardless of occupancy, to dilute any equipment contaminants. Other distinguishing factors of this procedure include a provision for zone distribution effectiveness, modification of the multiple spaces equation, consideration for varying operating conditions, and specific requirements for exhaust ventilation.

Overall the Ventilation Rate Procedure is intended to make it easier for designers to determine design ventilation rates and reduce the potential for over ventilation in some densely occupied spaces. The Indoor Air Quality Procedure makes an assumption that the zone is occupied a great portion of the time. Due to this procedure, the mechanical equipment needs significantly more monitoring and configuration during installation. Today, a majority of engineers use the Ventilation Rate Procedure rather than the Indoor Air Quality Procedure.