INTERPRETATION IC 90.1-2007-29 OF
ANSI/ASHRAE/IESNA STANDARD 90.1-2007
Energy Standard for Buildings Except Low-Rise Residential Buildings

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Reference: This request for interpretation refers to the requirements presented in ANSI/ASHRAE/IESNA Standard 90.1-2007, Informative Appendix G, regarding baseline HVAC systems for mid- to high-rise multifamily residential corridor make-up air units.

Background: A typical feature in a mid- to high-rise multifamily residential building is a make-up air unit (MAU). This unit provides outside air to serve multiple functions: (1) to replace air exhausted from bathrooms, dryers, trash rooms, etc., (2) to counteract stack effect, (3) to provide ventilation for the residential corridors, and (4) in some cases, to provide ventilation air to the residences, if required. In some jurisdictions, make-up air may be supplied via a pressurized corridor and transferred to the units via in-unit exhaust (e.g. fully ducted supply from the MAU to the units is not required).

Appendix G indicates that residential systems shall be modeled as System Type 1-PTAC or System Type 2-PTHP, based on the primary fuel source; however, no guidance is provided for how a corridor MAU and associated airflow shall be modeled in the Baseline Case. Although the corridor MAU is designed as a separate system, the unit provides outside air to the residences; therefore, it is unclear whether this system should be modeled in the Baseline Case as part of the residential system or whether it should be considered as a separate system serving the corridors.

Although corridor MAUs are typical design features, there are several common design configurations which vary slightly. In order to request comprehensive guidance, a few specific control strategies have been described below (hereafter referred to as "design cases"):
(1) Transfer Corridor MAU: In this configuration, the total outside airflow (OA) required for each residential floor (equal to the sum of exhaust air from that floor), is provided to a central corridor. This air is transferred to adjacent spaces (via transfer grills, undercuts on the entrance door, etc.). Since this air is delivered directly to the corridor, it must be dehumidified and supplied at a neutral temperature (for example, 70-75°F with 50 % RH); therefore, this unit must overcool the OA and reheat it to a comfortable temperature. The reheat may be accomplished through a reheat coil, heat pipe, or hot-gas bypass.
(2) Ducted MAU to Residences: This configuration is identical to that above; however, the OA is ducted to a central location in each residential unit, with a small airflow ducted to each corridor (for ventilation and stack effect) rather than the entire airflow. This will use the same cooling energy; however, this significantly reduces the airflow to any given space, so reheat may not be included in the MAU design, as over-cooling the corridor is not a risk.
(3) Ducted MAU to HVAC Unit: In this configuration, the treated OA from the MAU is ducted to the residential HVAC unit and is mixed with the return air before being provided to the space. A small amount of OA is ducted to each corridor (for ventilation and stack effect). This will use the same cooling energy as the two configurations above; however, the OA will be dehumidified only, and reheat is not included in the MAU design.

In order to save energy, MAUs are often installed with VFDs for variable volume control. Control is typically based on building pressurization, which relates to exhaust demand (e.g. a VFD fan on a common exhaust riser with individual fans bathroom exhaust fans connected to the bathroom light switch) but is also significantly impacted by stack effect. For MAUs also providing residential ventilation, the minimum OA may be dictated by OA requirements.

Background No.1: Based on Interpretation No.1, the following specific methodology will apply:

- The design supply airflow in the Baseline Case for the corridor unit shall be identical to that of the Proposed Case per Section G3.1.2.8 (with this methodology, the ventilation/make-up air *should* exceed the design supply airflow rate, although this would be verified for each application).
- In order to model identical temperature and humidity control setpoints per Table G3.1.1.b, the Baseline Case supply temperature from the corridor unit will be identical to that of the Proposed Case. Additionally, if the Proposed design includes reheat, the Baseline Case will include reheat controlled in the same manner (without reheat the Baseline Case would be incapable of providing identical temperature *and* humidity setpoints).
- The OA rates and schedules will be modeled identically in the Baseline and Proposed Case.
- The Baseline Case supply fan power will be calculated based on the design supply airflow for each space (therefore, this allowance will be calculated for the residential units and the corridors separately). Supply or exhaust fans serving any purpose other than ventilation, such as bathroom, trash room, or laundry exhaust, shall be considered process loads and modeled identical to the Proposed design. Credit may only be taken for the efficiency of these fans.

Because each design case MAU maintains building pressurization, and possibly required ventilation, the Baseline Case corridor supply fans must run continuously. The Baseline Case corridor OA damper will modulate to match the Proposed OA rates, the Baseline Case will include return air to the corridor unit, and the Baseline cooling coil will cycle to maintain the indoor temperature setpoint. The Baseline Case fans in the residential units will cycle with heating and cooling loads for design cases #1&2. For design case #3, in which the OA is ducted directly to the residential units, the Baseline Case residential fans will cycle in the same manner as the Proposed Case.

Interpretation No.1: The Baseline Case will be simulated *per the Energy Star Multifamily High Rise Program Simulation Guidelines Version 1.0, Revision 02 published in September 2013*. For each design case listed above, the Baseline Case will be simulated with OA provided in the same manner as the Proposed design (for design case #1, this will be provided to the residential corridors), and the residential corridors in the Baseline Case will be simulated as a separate System Type 1 or 2 (depending on the primary fuel source), including all applicable requirements for that system type.

Question No.1: Is this interpretation correct?

Answer No.1: No.

Comments No.1: Reason for "No" answer. Appendix G System Type 1 and 2 is a PTAC system type that assumes through the wall ventilation directly into the HVAC unit. Therefore treatment of OA is different than a Proposed Design using a MAU unit.

Background No.2: Based on Interpretation No.2, the following specific methodology will apply:

a. The design supply airflow shall be based on a 20°F temperature difference per Section G3.1.2.8 (with this methodology, the ventilation/make-up air should not exceed the design supply airflow rate, although this would be verified for each application).
b. The Baseline and Proposed Case will be modeled with identical temperature and humidity control setpoints per Table G3.1.1.b. (yes)
c. The OA rates and schedules will be modeled identically in the Baseline and Proposed Case, unless schedule differences are approved by the rating authority per the exception to Table G3.1.4 (Baseline). (yes)
d. For heating operation, the Baseline Case will be modeled with a preheat coil per Section G3.1.2.3, which will heat the incoming OA to the same temperature as the Proposed MAU heating supply temperature (typically, between 55-75°F). (no)
e. The Baseline Case total fan power will be calculated based on the design supply airflow for each space per Section G3.1.2.9 (therefore, this allowance will be calculated for the residential units and the corridors separately). The total fan power allowance for the residential units will be split between the supply and toilet exhaust fans, in the same ratio as in the Proposed design.

Because each design case MAU maintains building pressurization, and possibly required ventilation, the Baseline Case supply fans must run continuously. The Baseline OA damper will modulate to match the Proposed OA rates, and the Baseline cooling coil will cycle to maintain the indoor temperature setpoint.

Interpretation No.2: For each design case listed above, the Baseline Case will be simulated *with OA provided directly to the residential units or spaces that the airflow was designed to serve*, and the residential corridors in the Baseline Case will be simulated as a separate System Type 1 or 2 (depending on the primary fuel source), including all applicable requirements for that system type.

Question No.2: Is this interpretation correct?

Answer No.2: Yes.

Background No.3: Based on Interpretation No.3, the following specific methodology will apply:

- The design supply airflow in the Baseline Case for the corridor unit shall be identical to that of the Proposed design per Section G3.1.2.8 (with this methodology, the ventilation/make-up air *should* exceed the design supply airflow rate, although this would be verified for each application).
- In order to model identical temperature and humidity control setpoints per Table G3.1.1.b, the Baseline Case supply temperature from the corridor unit will be identical to that of the Proposed Case. Additionally, if the Proposed design includes reheat, the Baseline Case will include reheat, controlled in the same manner (without reheat the Baseline Case would be incapable of providing identical temperature *and* humidity setpoints).
- The OA rates and schedules will be modeled identically in the Baseline and Proposed Case, unless schedule differences are approved by the rating authority per the exception to Table G3.1.4(Baseline).
- The Baseline Case total fan power will be calculated based on the design supply airflow for each space per Section G3.1.2.9 (therefore, this allowance will be calculated for the residential units and the corridors separately). The total fan power allowance for the residential units will be split between the supply and toilet exhaust fans, in the same ratio as in the Proposed design.

Because each design case MAU maintains building pressurization, and possibly required ventilation, the Baseline Case supply fans must run continuously. The Baseline OA damper will modulate to match the Proposed OA rates, the Baseline Case will include return air to the corridor unit, and the Baseline cooling coil will cycle to maintain the indoor temperature setpoint. The Baseline Case fans in the residential units will cycle with heating and cooling loads for design cases #1&2. For design case #3, in which the OA is ducted directly to the residential units, the Baseline Case residential fans will cycle in the same manner as the Proposed Case.

Interpretation No.3: For each design case listed above, the Baseline Case will be simulated with OA provided in the same manner as the Proposed design, and the residential corridors in the Baseline Case will be simulated as a separate System Type 1 or 2 (depending on the primary fuel source), including all applicable requirements for that system type.

Question No.3: Is this interpretation correct?

Answer No.3: No.

Comments No.3: Reason for "No" answer. Appendix G System Type 1 and 2 are system types that assume through the wall outside air ventilation directly from the HVAC unit into the space. Therefore treatment of OA is different than a Proposed Design using a MAU unit.

Background No.4: Based on Interpretation No.4, the following specific methodology will apply:

- If the combined floor area of the corridors and common areas is less than 20,000 sf, the Baseline Case will be simulated as a System Type 1 or 2, since this would not meet Section G3.1.1 Exception A. Otherwise, the Baseline Case common areas will be System Type 3-8, based on the fuel source and total floor area. All applicable requirements for the Baseline Case system type will be met.
- The design supply airflow in the Baseline Case for the corridor unit shall be identical to that of the Proposed Case per Section G3.1.2.8 (with this methodology, the ventilation/make-up air *should* exceed the design supply airflow rate, although this would be verified for each application).
- If the Baseline Case corridor unit is System Type 1-4, the supply temperature will be identical to that of the Proposed Case; if the Proposed design includes reheat, the Baseline will include reheat, controlled in the same manner per Table G3.1.1.b.
- If the Baseline Case corridor unit is System Type 5-8, the supply temperature from the unit (for dehumidification) and the supply temperature to the space (for temperature control) will be identical to that of the Proposed Case.
- The OA rates and schedules will be modeled identically in the Baseline and Proposed Case, unless schedule differences are approved by the rating authority per the exception to Table G3.1.4 (Baseline).
- The Baseline Case total fan power will be calculated based on the design supply airflow for each space per Section G3.1.2.9 (therefore, this allowance will be calculated for the residential units and the corridors separately). The total fan power allowance for the residential units will be split between the supply and toilet exhaust fans, in the same ratio as in the Proposed design.

For Baseline System Types 1-4, the Baseline Case corridor supply fans will run continuously, the Baseline Case will include return air to the MAU, the OA damper will modulate to match the Proposed airflow rates, and the cooling coil will cycle to maintain the indoor temperature setpoint.

For Baseline System Types 5-8, the Baseline Case corridor supply fans will modulate according to the Proposed Case OA. The Baseline corridor system will dehumidify and reheat the OA in the summer, and the supply air temperature will be reset per Section G3.1.3.12. The Baseline Case fans in the residential units will cycle with heating and cooling loads for design cases #1&2. For design case #3, in which the OA is ducted directly to the residential units, the Baseline Case residential fans will cycle in the same manner as the Proposed Case.

Interpretation No.4: For each design case listed above, the Baseline Case will be simulated with OA provided in the same manner as the Proposed design, and the residential corridors in the Baseline Case will be simulated as a separate *System Type 1-8* (depending on the primary fuel source *and total floor area of the combined residential common areas*), including all applicable requirements for that system type.

Question No.4: Is this interpretation correct?

Answer No.4: No.

Comments No.4: Reason for "No" answer. Appendix G System Type 1 and 2 are system types that assume through the wall outside air ventilation directly from the HVAC unit into the space. Therefore treatment of OA is different than a Proposed Design using a MAU unit.

Background No.5: Based on Interpretation No.5, the following specific methodology will apply:

- The design supply airflow and supply air temperature in the Baseline Case corridor MAU shall be identical to that of the Proposed Case.
- If the Proposed design includes reheat, the Baseline Case will include identical reheat, controlled in the same manner (unless efficiency measures above standard practice are approved by the rating authority).
- The OA rates and schedules will be modeled identically in the Baseline and Proposed Case, unless schedule differences are approved by the rating authority per the exception to Table G3.1.4 (Baseline).
- The heating and cooling coils in the Baseline Case MAU will be oversized per Section G3.1.2.2, and the efficiencies will be determined based on the applicable capacity for a System Type 1 or 2, since multifamily is a residential building type, per the first note to Table G3.1.1A.
- The Baseline Case total fan power will be calculated based on the design supply airflow for each residential space per Section G3.1.2.9. *Since the MAU provides OA to the residential units, this system should be considered as part of the residential systems in the Baseline Case, and no additional fan power may be added for the MAU.* Therefore, the total fan power allowance for the residential units will be split between the supply, toilet exhaust, and corridor MAU fans, in the same ratio as in the Proposed design.

Since the Baseline and Proposed Case are controlled identically, credit may only be taken for improved efficiency of the heating and cooling equipment, and a penalty is applied to the Proposed Case MAU fan power.

Interpretation No.5: For each design case listed above, the Baseline Case will be simulated with OA provided in the same manner as the Proposed design, and *a separate corridor MAU will be simulated in the Baseline Case, identical to the Proposed Case per Table G3.1.12*.

Question No.5: Is this interpretation correct?

Answer No.5: No.

Comments No.5: Reason for "No" answer. Appendix G System Type 1 and 2 are system types that assume through the wall outside air ventilation directly from the HVAC unit into the space. Therefore treatment of OA is different than a Proposed Design using a MAU unit.