IMPROVING BUILDING IAQ REDUCES HVAC ENERGY COST

SLIDE 1 – Title Slide

In times when energy conservation is at the forefront of many peoples' minds, the Indoor Air Quality (IAQ) Procedure described in ASHRAE Standard 62.1 is an alternative and often neglected method for complying with the ventilation requirements of the standard while at the same time offering a considerable opportunity for energy conservation. Practical applications of the IAQ Procedure will be presented to show that recirculation used along with enhanced air cleaning can effectively provide acceptable air quality, reduce outdoor air requirements, and reduce energy costs. Examples will be presented that illustrate capital, HVAC equipment, and system renovation savings as well as energy savings possible by employing the IAQ Procedure.

SLIDE 2 – ASHRAE Definition of Acceptable IAQ

Before we get started, let me read for you ASHRAE's definition of acceptable indoor air quality.

"Air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction."

SLIDE 3 – Introduction

An important challenge today is how to improve and maintain IAQ in buildings while, at the same time, reducing their overall energy consumption. As energy conservation measures have been implemented, and energy consumption has decreased, IAQ has suffered. This one-sided tradeoff is no longer acceptable.

One cannot discuss the issue of IAQ without giving some attention to the role that energy conservation measures may play.

- Public sector energy conservation efforts have been primarily voluntary.
- Federal/state facilities have been mandated to reduce overall energy consumption.
- The quest to reduce energy costs has been criticized as the main cause of IAQ problems.

SLIDE 4 – Introduction (2)

Ventilation standards and mechanical codes have evolved to the point that those currently in place allow building designers/engineers the opportunity to address both IAQ and energy conservation.

Air cleaning technologies have similarly developed to the point that they may be used in conjunction with these standards to provide healthy and comfortable indoor environments while continuing to conserve energy.

There are ever-increasing numbers of applications for both particulate and gas-phase air filtration in HVAC system designs.

- Indoor Air Quality
- Odor Control
- Energy Conservation

Selecting and specifying the appropriate control strategies requires special consideration.

SLIDE 5 – Introduction (3)

Air cleaning – for both particulate and gas-phase contaminants - can be a critical component in achieving acceptable Indoor Air Quality as well as implementing energy conservation measures with ASHRAE Standard 62.1-2019.

SLIDE 6 – Contaminant Control Strategies

Most ventilation/dilution air would come from outside the building. The use of outdoor air alone is the simplest means for providing dilution. However, the use of large amounts of outdoor air to reduce contaminants is not energy-efficient or cost-effective. Dilution of internal contaminants depends on the quantity and quality of ventilation air used. To achieve an acceptable level of contaminant control economically, often a combined strategy of SOURCE, DILUTION, and REMOVAL CONTROL may be required.

SLIDE 7 – Air Cleaning Applications

SLIDE 8 – Air Cleaning Applications – General

Slide 9 – Typical Air Cleaning System

Particulate Air Filtration removes unwanted particulate matter or the "visible" contaminants and there are different technologies available. Filters can be made of cellulose, fabric, and glass fiber. There are also electrostatic precipitators (which may produce ozone) and many different types of electronic air cleaners. Most will not remove gaseous pollutants or odors, but may protect the gas-phase air filtration media.

Gas-Phase Air Filtration removes unwanted gases and odors or the “invisible” contaminants. Indoor and outdoor environments differ in types and levels of gaseous contaminants. This type of filtration can be effective against a wide range of indoor and outdoor contaminants. Generally, not effective against carbon monoxide (CO) or carbon dioxide (CO_2). Protects personnel and equipment.

Final Filter Section

SLIDE 10 – Air Cleaning Applications – Energy Conservation

SLIDE 11 – ASHRAE Standard 62.1

ASHRAE Standard 62-1973: Standard for Natural and Mechanical Ventilation

Provided a prescriptive approach to ventilation by specifying both minimum & recommended outdoor air flow rates to obtain acceptable IAQ for a variety of indoor applications.

ASHRAE Standard 62-1981: Ventilation for Acceptable Indoor Air Quality

“Recommended” rate category deleted. Two categories became smoking and non-smoking. Recommended outdoor air flow rates for both categories. Added alternate “IAQ” procedure to allow for the use of innovative energy conservation practices. Allowed for the use of whatever amount of outside air if shown that levels of indoor air contaminants could be maintained below recommended limits.

ASHRAE Standard 62-1989: Ventilation for Acceptable Indoor Air Quality

Tripled and quadrupled 1981 minimum non-smoking ventilation rates; did not distinguish between smoking and non-smoking. Retained the Ventilation Rate (VRP) and Indoor Air Quality (IAQ) Procedures for ventilation design.

- VRP - provided an indirect solution for the control of indoor air contaminants.
- IAQ Procedure - provided a direct solution by reducing and controlling the concentrations of contaminants through air cleaning.

Endeavored to achieve the necessary balance between energy consumption and indoor air quality.

ASHRAE Standard 62.1-2001: Ventilation for Acceptable Indoor Air Quality

Converted from Standard 62-1999. Minimum requirements code-language; not a code. Working under “Continuous Maintenance”. Previous versions of Standard 62 strived to achieve a balance between energy consumption and IAQ. Whereas the VRP focused primarily on assuring acceptable IAQ, the IAQ Procedure was intended to provide a way to reduce HVAC system operating costs while still providing a healthy environment.

ASHRAE Standard 62.1-2004: Ventilation for Acceptable Indoor Air Quality

Limited the applicability of the Ventilation Rate Procedure for energy conservation purposes to the use of recommended ventilation rates and measures other than reducing outside air. The IAQ Procedure provided an alternate, performance-based design approach. Outdoor air intake rates and other system design parameters are based on an analysis of contaminant sources, contaminant concentration targets, and perceived acceptability targets. The IAQ Procedure allowed credit to be taken in the form of a reduction of the outside air intake rate(s) for contaminant controls or for other design techniques that can be reliably demonstrated to result in indoor contaminant concentrations equal to or lower than those achieved using the VRP.

ASHRAE Standard 62.1-2016: Ventilation for Acceptable Indoor Air Quality

Looking to improve the acceptability and use of the IAQ Procedure, however, there are efforts to push this more towards a health-based standard rather than the comfort-based standard.

SLIDE 12 – ASHRAE Standard 62.1-2019

SLIDE 13 – ASHRAE Standard 62.1-2019 (2)

ASHRAE Standard 62.1-2019: Ventilation for Acceptable Indoor Air Quality

IAQ is based upon subjective criteria.

- Comfort based on the absence of odors.
- Carbon dioxide widely used as a surrogate indicator of IAQ.
- Increasing outside air may only substitute one (group of) contaminant(s) for another.

Ventilation Rate Procedure establishes:

- Minimum acceptable outdoor air quality.
- Outdoor air treatment, when necessary.
- Ventilation rates for residential, commercial, institutional, vehicular, and industrial spaces.
- Criteria for reduction of outdoor air quantities.
- Criteria for variable ventilation when air is used to dilute contaminants.

IAQ Procedure

- Acknowledges that air-cleaning, along with recirculation, is an effective means of controlling contaminants.
- Allows for both quantitative and subjective evaluation of the effectiveness of the air cleaning methods employed.
- Allows the amount of outside ventilation air to be reduced when air quality criteria are met.
- Allows a balance to be struck between IAQ and energy conservation.
    - Energy savings due to decreased load on the HVAC system.
    - Grants/rebates available for the implementation of energy-saving measures.

SLIDE 14 – ASHRAE Standard 62.1-2019 (3)

The indoor air quality procedure (IAQP) has a long history going back to the 1981 standard. It has flexibility.

For design, it requires (simplified version):

1. Identification if contaminants of concern
2. Determining indoor and outdoor sources
3. Identifying a concentration limit and exposure period
4. Specifying percentage of building occupants to be satisfied with perceived IAQ
5. Performing a mass balance analysis for selected compounds

Weaknesses in current requirements exist in items 1, 3, and 4 above. The percentage in item 4 may be specified to any quantity, i.e., the percentage of satisfied occupants can be set to zero. No measurement of any resulting concentration is currently required so the effectiveness of any design is not measured or verified.

This proposed addendum adds a minimum requirement of percentage of people satisfied and requirements for designing to specific limits for design compounds and particulate matter. The design compounds are specifically identified. Mixtures are specifically identified. Objective and subjective testing are added.

This draft was discussed in committee in 2017 and 2018. It was first approved by committee for first public review in May 2018 with subsequent changes in 2018 and 2019 leading to this fourth public review.

SLIDE 15 - IAQ Procedure Requirements (Addendum aa)

Design Compounds and $PM_{2.5}$ Sources - The system design shall be based on the Design Compounds (DC) and PM2.5 specified in Table 6.3.2.1. If there are additional outdoor sources identified from completing the process in Section 4.3, or Unusual Sources, the compounds associated with those sources shall be determined and documented. The compounds from those additional sources shall be added to the DC list if a design limit from a cognizant authority exists. For each DC and PM2.5, the emission rates from indoor sources from occupants, building materials, furnishings, equipment and other sources and the outdoor concentrations shall be determined.

Design Compounds and $PM_{2.5}$ Concentration - The concentration limits, referred to as Design Limits, shall be as specified in Table 6.3.2.1. Design ventilation shall be such that the calculated concentration of each DC, mixture of DCs, and PM2.5 does not exceed its Limit. For any compounds added to the DC list in Table 6.3.2.1, data from cognizant authorities shall be used to determine if the compound causes the effects listed in Table 6.3.2.2 and compounds having one or more of the mixture effects shall be added to the mixture list for that effect. For each mixture, the Mixed exposure sum (E_m) as determined by Equation 6.3.2 shall be less than 1.0.

Design Approach - Zone and system outdoor airflow rates shall be the larger of those determined in accordance with Sections 6.3.3.1 and 6.3.3.2.

Perceived Indoor Air Quality - Zone outdoor airflow rates shall be sufficient to assure that a substantial majority (80% or more) of the people exposed do not express dissatisfaction with the quality of the air when tested as required in Section 7.3.2.

Documentation - Design documentation shall include the list of PM2.5, DCs and DLs and mixtures thereof; outdoor source data; emission rates including citations; cognizant authorities for any additional DCs; mass balance calculations for each zone; and specifications for verification required by Section 7.3.

IAQP Verification - *Objective Evaluation*: Perform DC and $PM_{2.5}$ measurement in the completed building to verify that Design Limits are met. *Subjective Evaluation:* Using a subjective occupant evaluation conducted in the completed building, the survey test results shall demonstrate occupants' level of acceptability of 80% or more within each zone served by the system.

SLIDE 16 – The IAQ Procedure (IAQP)

Studies have reported that ventilation rates as high as 45 cfm (76 m3/h) per person, improve workers' and students' health, productivity, and learning; however, using these higher ventilation rates come with a significant energy penalty. This opposes the current trend for more sustainable, greener buildings, requiring higher energy efficiency, and higher ventilation rates are becoming too costly.

Another consideration is the elevated pollution levels in many parts of the world that make increasing the outdoor air ventilation rates undesirable. Standard 62.1 requires investigation of both regional and local air quality including an observational survey of the building site and immediate surroundings. If through these investigations, the outdoor air is judged to be unacceptable; there are requirements for additional air cleaning. When one has to apply air cleaning for compliance, the use of the IAQP could pay for upgrades to the air cleaning system AND provide for a reduction in overall HVAC operating costs.

For many buildings, the IAQP allows credit to be taken - in the form of a reduction of the outside air intake rates - for controls that remove contaminants that can be reliably demonstrated to result in indoor contaminant concentrations equal to or lower than those achieved using the VRP. As opposed to the VRP's indirect solution for the control of indoor contaminants, the IAQP can provide a direct solution by reducing and controlling the concentrations of contaminants using air cleaning.

Many different applications can be designed using the IAQP and those with the greatest potential for capital cost savings and operational cost reductions, involve new construction and renovation. This would be due to the potential reduction in size of the heating and cooling systems as well as a reduction in associated energy costs to operate these systems.

SLIDE 17 - The IAQ Procedure and Energy Savings

For many buildings, the IAQ Procedure is an option that provides improved indoor air quality as well as reduces the amount of energy used to condition the ambient air.

It also provides direct control of indoor air contaminants that is not possible under the Ventilation Rate Procedure.

Many different applications can be designed using the IAQ Procedure.

The most common applications, and those with the greatest potential for capital cost savings and operational cost reductions, involve new construction and renovation.

SLIDE 18 - Cost Considerations

As opposed to the $0.03 - 0.07 value some have reported, typical air cleaning systems employing granular adsorbents in trays or filter modules have an estimated annual cost closer to $0.20-0.40 per ft^2 per year. The large amount of media contained in these systems makes them attractive based on the longer times between media replacement, however, these systems often have substantial installation costs due to the additional hardware required.

The type of air cleaning system that can significantly reduce the annual operating and maintenance costs and avoid the front-end costs associated with granular media systems will be one that employs the new adsorbent-loaded combination media filters described above. These would add an estimated $0.07 - 0.10 per ft^2 per year.

SLIDE 19 – Cost Considerations (2)

Using these cost estimates for a typical 100,000 ft^2 office building, the HVAC O&M cost would be $125K per year. Assuming the use of 20% outdoor air and (approx.) 1 cfm or air per ft^2, air cleaning using with typical bulk granular media systems could add another $4-8K to this figure, assuming a 1-year media life. Use of the combination filters would add $5,600.00 to $8,000.00 to this figure, assuming using a standard 24x24x4" pleated filter with a quarterly changeout. It also assumes that this building was designed using the Ventilation Rate Procedure (VRP) from Standard 62.

SLIDE 20 – Cost Considerations (3)

As opposed to the VRP's indirect solution for the control of indoor contaminants, the IAQ Procedure provides a direct solution by reducing and controlling the concentrations of contaminants, through air cleaning, to specified acceptable levels. Standard 62 acknowledges that air cleaning, along with recirculation, is an effective means for controlling contaminants when using the IAQ Procedure. Employing this procedure allows the amount of outside ventilation air to be reduced below standard levels if it can be demonstrated that the resulting air quality meets the required criteria.

SLIDE 21 – Cost Considerations (4)

Using the IAQ Procedure and reducing the outdoor air volume from 20K cfm to 10K cfm and using air cleaning on the mixed air stream instead of the outdoor air alone, we can recalculate the annual air cleaning O&M costs and compare them to cleaning the outdoor air alone. This is shown in the table here.

SLIDE 22 – Example 1 - Movie Theater, New Construction

An engineer applied the IAQ Procedure in the construction of a movie theater where air cleaning (filtration) and recirculation would be used in an effort to reduce the outdoor air below the 20 cfm per person prescribed by the VRP. Design criteria showed that a reduction to 5 cfm per person would be possible. This design approach resulted in a much smaller HVAC system being specified for the theater and an immediate capital savings of US$68,000. A reduction in the amount of outside air also meant that less air would have to be tempered by the HVAC system and resulted in an additional operational savings of approximately US$15,000/year. This savings takes into account an energy cost savings of US $23,000/year (as compared to the VRP) and maintenance and energy costs for the air cleaning system of US$8,000/year.

SLIDE 23 – Example 2 - Office Building Renovation

An office building built in the mid-1970s was being renovated for a new owner. Applying current version of Standard 62.1, the VRP would have meant bringing in larger quantities of outdoor air to bring this building up to code. This would have required ***additional makeup air handlers*** along with ***associated ductwork*** and controls at an estimated ***cost of US $300,000.00***. The IAQ Procedure was recommended and a cost/benefit analysis was performed. The Owner could ***maintain current outdoor air intake rates*** and ***avoid the entire upgrade cost***. There would be ***no retrofit or extra hardware requirements*** to add the additional filtration required.

SLIDE 24 – Example 2 - Lecture Hall, New Construction

Design considerations:

- New construction
- Desired outdoor air intake rate of 5 cfm per person.
- Perceived IAQ acceptability of 80% of occupants.
- Air handler with constant outdoor and supply airflows.
- Filter (air cleaner) location in the supply (mixed) airstream.
- Supply airflow of 20,000 cfm.

For all of the contaminants of concern, **a 5 cfm per person provided space concentrations less than the target concentrations and therefore complied with the requirements of the IAQ Procedure**.

Summary of savings for reduction of conditioned outside air.

- **Capital Equipment Savings**: ***$8,643.00***
- **Operational Savings**: ***$1,136.00 / year***

SLIDE 25 – Example 3 - Retail Store, New Construction

A retail store design had the following space types: corridors, fitting rooms, and sales areas to be considered in the modeling of the IAQ Procedure.

As in Example 2, all of the contaminants of concern were less than the target concentration limits when using a mass balance analysis design approach. ***A total system outdoor airflow of 7 cfm per person*** based on total occupancy ***would comply with the requirements of Standard 62.1-2019***.

Summary of savings for reduction of conditioned outside air.

- **Capital Equipment Savings**: ***$8,845.00***
- **Operational Savings**: ***$2,641.00 / year***

SLIDE 26 – Example 5 – VA Medical Center – Cincinnati, Ohio

Concerned about rising HVAC operating costs, the Veterans Administration Medical Center in Cincinnati, Ohio embarked on an aggressive energy conservation program. Built in the 1950's, this 10-story facility is divided into three major zones each served by dedicated air-handling system. Under the existing system, 100% outside air was used to condition these areas. Having previous experience with gas-phase filtration, the VA pursued this technology further.

The South Wing was chosen to have its exhaust air filtered and recirculated on the basis of several factors; the general system layout, energy usage, and zone use characteristics. The 26,000-cfm delivered to this zone is split between patient rooms (70%), general support areas (20%), and restrooms (10%). This air was conditioned, circulated, and exhausted at the roof. By cleaning and recirculating 22,000 cfm, or 85 percent of the air previously exhausted, the hospital realized substantial energy savings.

Today, the conditioned air from this zone is no longer exhausted but is mixed with 4000 cfm of outside supply air and then routed through the gas-phase filtration system. The gas filter system consists of a particulate prefilter stage, a single stage of gas-phase air filtration medium, and a final particulate filter stage. The net effect is improved particulate filtration with the added benefit of gaseous contaminant control.

SLIDE 27 – Example 6 – Westin Peachtree Plaza Hotel

The Westin Peachtree Plaza in Atlanta, Georgia stands 73 stories tall and contains 1,100 guest rooms, nine restaurants and lounges, and two ballrooms. In all, roughly 1,150,000 ft2 of floor space has to be heated and cooled. Heating and cooling costs for a building of this size, as one might suspect, were tremendous.

In another retrofit application, hotel management, with the help of several consulting/engineering firms, cut HVAC energy costs by $25,000 per year after installing an energy retrofit system that substitutes a mixture of minimum outside air and heated recirculated air for 100% outside air. In the retrofit, the conditioned air from each individual room is no longer exhausted through the roof, but is now being routed through a gas-phase air filtration air system that removes odors and gaseous contaminants. The system saves more than 14 billion BTUs of energy a year, the equivalent of 100,000 gallons of oil, cutting the energy requirements of the original HVAC system by 10 percent.

Yearly energy savings due to the operation of this system were calculated to be as follows:

- Natural gas cost savings $ 3,430.00
- Fuel oil cost savings $13,070.00
- Cooling costs saved $14,020.00
- Water and chemical cost savings $ 970.00
- Total annual savings $31,490.00
- Dry-scrubbing air filtration medium and labor costs -($ 6,000.00)
- Net operating cost savings $25,490.00
- Simple payback 2.74 years

Additionally, the installation of this energy-managed system qualified for the investment tax credit and earned the hotel some tax relief under the government's energy conservation tax clause.

SLIDE 28 – Example 7 – Schools, New construction

SLIDE 29 – Energy Cost Comparisons

SLIDE 30 – Elementary Schools Additions Experience

SLIDE 31 – Example 7 – Conclusions

SLIDE 32 – HVAC Operational Cost / Energy Savings

Application of the IAQP is not limited to a specific building type or HVAC system design and can be applied to both new and existing buildings. In Atlanta, Georgia (USA), home to ASHRAE, there are dozens of buildings where the IAQP has been successfully applied with some dating back to the early 1980s. A study was commissioned to evaluate the performance of installed air cleaning systems and the ongoing energy savings for a number of sites in and around Atlanta.

Study sites were selected from varied building styles and usage to represent a cross-section of commercial facilities using air cleaning technology to attain acceptable IAQ while reducing energy usage from HVAC operation. All had enhanced air filtration systems consisting of gas-phase air filtration and higher efficiency particulate filters. Each of the selected sites was thoroughly characterized as to the nature of the ambient outdoor air, the performance of the air cleaning system, and the cleanliness and contaminant control levels attained within the occupied space.

Overall, there was a TVOC reduction of 38-74%, 0.5 µm particulate removal efficiency of 28-95%, and an ozone removal efficiency of 100%. Further, each building had annual operational cost savings ranging between US$9,600 and US$800,000 over and above the cost for the filter replacement and maintenance at the time these buildings were first occupied. These savings are adjusted for inflation and summarized here.

This field study established the parameters of dilution air compared with similar characteristics of air treated with particulate and gas-phase filtration. It also demonstrated that filtered air most often exceeds air quality that would be achieved from simple dilution with outdoor air. This study also provided additional documentation on energy savings possible as a direct result of a reduction in outdoor air ventilation rates and the ability to control specific contaminants of concern to provide for occupant safety and building security.

SLIDE 33 – The World According to 62.1

I have just provided a brief discussion of ASHRAE's side of the story with respect to IAQ and energy conservation. So, what about those other guys? The International Code Council and the U.S. Green Building Council?

SLIDE 34 – When the IMC is King

What about in jurisdictions where the International Mechanical Code (IMC) rules with respect to ventilation system design? Can we use ASHRAE Standard 62.1? Section 105.2 on alternative materials, methods, equipment and appliances states that "The provisions of this code are not intended to prevent the installation of any material or to prohibit any method of construction not specifically prescribed by this code, provided that any such alternative has been approved.

An alternative material or method of construction shall be approved where… the proposed design is satisfactory and complies with the intent of the provisions of this code…" The IMC does not preclude the use of the IAQ Procedure – but does not make it easy either.

In many locations one may have to apply for a variance in order to use Standard 62.1, and even then, approval may not be granted. However, based on the number of requests for variances to allow the use of Standard 62.1, many jurisdictions have modified local codes to show this as an approved ventilation system design approach.

SLIDE 35 – USGBC Green Building Program

The U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design, or LEED, Green Building Rating System promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: one being indoor environmental quality. The current version of the LEED rating system applicable to new commercial construction and major renovation projects, LEED-NC Version 4.0 (LEED v4), requires that the project must satisfactorily document achievement of all the prerequisites and a minimum number of points.

Under Indoor Environmental Quality (EQ), Prerequisite 1 is intended to establish the minimum IAQ performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of the occupants. The requirement to meet this prerequisite is to meet the minimum requirements of Sections 4 through 7 of ASHRAE 62.1. It goes on to state that the mechanical ventilation systems shall be designed using the VRP or the applicable local code, whichever is more stringent. The use of the IAQP was not specifically allowed.

In spite of more attention now being given to the quality of outdoor ventilation air, it is known that there are LEED certified buildings located in areas where additional air cleaning for ozone, PM10, and PM2.5 is required that are not in full compliance with these provisions of Standard 62.1 under EQ Prerequisite 1. Although the requirements for air cleaning are clear and the technologies to assure compliance are available, it is certain that more buildings will get LEED certification without full compliance to these requirements.

Engineers have asked "If during LEED certification I am required to use air cleaning for compliance with the VRP of Standard 62.1, why can't I use the IAQP to save energy?" While the use of this design approach can provide compelling savings in front-end equipment and ongoing operating costs, the widespread usage of the practice has been limited especially on projects going for LEED certification. However, this has not stopped resourceful building and HVAC design professionals from trying.

SLIDE 36 – The VRP = LEED Certified?

Given that there are requirements for outdoor air cleaning when using the Ventilation Rate Procedure, I would assume this to be the more stringent design criteria for mechanical ventilation systems.

However, I would also assume that it is safe to say that there are LEED certified buildings in non-attainment areas for PM_{10} as well as those parts of the country where ozone air cleaning is required that have totally ignored this aspect of the VRP. And with the pending change to include non-attainment areas for $PM_{2.5}$, and proposed changes for ozone air cleaning, it is probably safe to assume that even more buildings will get LEED certification without full compliance of the VRP.

The requirements for air cleaning are clear and the technologies to assure compliance are available.

SLIDE 37 – LEED-NC and the IAQP?

There are some who have asked "If I'm going for LEED certification and I'm required to use air cleaning for compliance with the VRP anyway, why can't I look at using the IAQ Procedure and see if I can take credit for this through a reduction in outdoor air amounts?" It's because there are questions about its application and some of the design considerations that have to be made. For instance, regarding the "Contaminants of Concern" to be used for design and/or modeling purposes some feel there is too much designer judgment involved in the choice of which and how many contaminants are chosen. Fears are that outcomes would not be very predictable and that IAQ would be more likely to be better using the VRP.

There are also questions about how can the performance of the air cleaning systems for gaseous contaminants be verified? ASHRAE Standards 52.1 and 52.2 provide rating systems for particulate air cleaning devices, and there now analogous standards to rate the performance of gaseous air cleaners. ASHRAE Standards Project Committee 145 has published standards for assessing the performance of loose granular media, air cleaning devices, and installed systems.

SLIDE 38 – LEED-NC and the IAQP? It Can Be Done (and has been done)!

In a landmark example, the Duke Energy Center in Charlotte, North Carolina (USA), a 54-story office building was designed using the VRP with 30% over ventilation to size the HVAC system. Through proper selection of equipment and controls, the HVAC system is operated at lower ventilation rates (with the required air cleaning) as determined using the IAQP. The office tower is 22 percent more energy efficient than a traditionally-built tower of comparable size, saving approximately 5 million kilowatt hours per year, equivalent to the annual energy use of about 450 homes or more than 3,500 metric tons of greenhouse gas emissions each year (Environmental Leader, 2010). In the end, this resulted in additional LEED credits for Energy and Atmosphere, IEQ, Innovation in Design, which ultimately earned a LEED Platinum certification for the owners.

SLIDE 39 – The IAQP: Current Work

ASHRAE Technical Resource Group (TRG 4), IAQ Procedure Development

TRG 4 is concerned with developing specific guidance to allow users to apply the IAQP method as defined under ASHRAE Standard 62.1. Committee results will be presented to the 62.1 Committee as submissions for inclusion in appendices of the Standard. Initial submissions will be for use of the IAQP in commercial applications and educational facilities, with a one-by-one follow-through until all spaces defined within the main body of the standard have been addressed.

ASHRAE Technical Group (TG2.RAST), Reactive Air and Surface Treatment

Advancing the knowledge, effectiveness, and safety of reactive air and surface treatment and associated technologies for air cleaning and surface disinfection.

USGBC IAQ Performance Testing Working Group (IAQP WG)

The IAQP WG is charged with developing a performance methodology for IAQ using the IAQP as outlined in ASHRAE 62.1 as a basis. The goal of this methodology is to create a compliance path for all related IEQ credits, including the Minimum IAQ Performance prerequisite. This working group is defining how the IAQP will fit into future versions of LEED for new construction and existing buildings.

SLIDE 40 - LEED Pilot Credit EQpc124

Intent: To contribute to the comfort and well-being of building occupants by establishing minimum standards for indoor air quality (IAQ). Pilot Closing 5/15/2018, New version available. Pilot Credit 68 closed on May 15, 2018.

A new pilot, Pilot Credit 124: Performance-based indoor air quality design and assessment is now available and addresses much of the feedback received from project teams on the original PC68. If you were interested in using PC68, please consider using this new pilot credit alternative instead.

Requirements: Meet the minimum requirements of ASHRAE Standard 62.1-2007, Sections 4 through 6, Ventilation for Acceptable Indoor Air Quality (with errata). Determine the minimum outdoor air intake flow for mechanical ventilation systems using the IAQ Procedure, or a local equivalent, whichever is more stringent. Combining the IAQP and VRP is not an acceptable means of compliance with this pilot prerequisite. Prohibit smoking in the building. Meet requirements for ventilation systems designed in accordance with Section 6.3 (now Section 6.1.2) for the IAQ Procedure.

LEED Pilot Credit EQpc124 - Performance-based IAQ design and assessment

- Tier 1: Contaminant-based indoor air quality design
- Tier 2: Baseline IAQ evaluation
  - Path a. LEED-specific contaminant list
  - Path b. Project-specific contaminant list
- Tier 3: Demonstrate IAQ Performance

SLIDE 41 – IAQ Procedure for LEED

SLIDE 42 – The Tools Are in Place…

SLIDE 43 - Summary and Conclusions

The **Indoor Air Quality Procedure** described in ASHRAE Standard 62.1-2019 may be **used as an alternative to the Ventilation Rate Procedure**. Using the VRP does not allow outdoor air ventilation rates to be reduced.

The **IAQ Procedure provides a direct solution for reducing and controlling contaminants** to specified acceptable levels through air cleaning. It provides a way to reduce HVAC system operating costs while still providing a healthy environment.

SLIDE 44 - Summary and Conclusions (2)

Whereas the Ventilation Rate Procedure of ASHRAE Standard 62.1-2019 focuses primarily on assuring acceptable indoor air quality, the **IAQ Procedure provides a way to reduce HVAC system operating costs while still providing a healthy environment.**

SLIDE 45 - Summary and Conclusions (3)

Applying the IAQ Procedure shows that **using as little as 5 cfm/person of outdoor air** can reduce the total space contaminant concentration to levels low enough to be below published guidelines, **provide *BETTER* indoor air quality, and meet the requirements of ASHRAE Standard 62.1-2019.**

SLIDE 46 – Speaker Contact Information