Public Comments and Responses for Ventilation and Air Quality Module Code and Annex after the First 60-day Review Period

Informational Copy: NOT Open for Public Comment

1. Gary Lochner, Unison Comfort Technologies (Minneapolis, MN)

1) *Comment:*
4.6.2.1 -- A definition of "building ventilation system" is needed for clarification throughout the Ventilation Module. The ASHRAE definition of "Ventilation" is "the intentional introduction of air from the outside into a building". The MAHC Ventilation Module uses the term "building ventilation system" in a much broader sense in 4.6.2.3 (Humidity Control), 4.6.2.4 (Mechanical Systems), and in 4.6.2.1.8 (Design Factors and Performance Requirements), encompassing the total air distribution system, not just the outside air.

It can be defined as the "air delivery system" in which the total airflow is comprised of two components – fresh air and recirculated air. A procedure for calculating the fresh air is given in 4.6.2.1.7. Guidelines for the total airflow should be added to 4.6.2.4, currently titled Mechanical Systems. I recommend changing the title of 4.6.2.4 to "Total Airflow & Air Distribution".

Changes to Module/Annex:
Partially Agree. Definition added. Code revised and reformatted , "Mechanical Systems" changed to " Performance Requirements for Air Handling System".

2) 4.6.2.1 -- The "key word" given of "Turnover Rates" is misapplied here. These are Fresh Air Requirements.

Changes to Module/Annex:
Agree. Code revised.

3) *Comment:*
4.6.2.1.7 -- Based on 15 years of field experience, I agree that the amount of outside air prescribed by ASHRAE 62.1 is not adequate to provide a healthy environment. The ASHRAE Applications Handbook Section 4.6 states that the ventilation requirement of 62.1 "may also prove inadequate for high-occupancy public or waterpark-type installations".

However, based on field experience I believe the Ro factors in Table 1 will result in significantly more outside air than necessary for a typical flat water pool, somewhat too much for a multi-venue facility like a community recreation center, and far too little for a

commercial waterpark. I believe that when current air distribution guidelines are used, with some air directed across the pool surface and captured at pool level to "wipe" the chloramine layer, lower Ro factors are appropriate.

Based on field experience, I recommend using Ro for Flat Water of 5. For Agitated Water, the Ro factor should be variable based on the number and type of water features. Mushrooms, large dump buckets, and waterfalls require significantly more fresh air than a slide, spray gun, bubbler, or lazy river. I recommend a minimum Ro of 10 (a few features) and a maximum Ro of 40 (full blown waterpark). The full waterpark will be 100% fresh air.

Changes to Module/Annex:

Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

4) *Comment:*
4.6.2.3.1 -- The 65% r.h. requirement is in agreement with ASHRAE 62.1 Section 5.10.1. At the elevated temperatures of pool spaces, I question whether this number is too high. The ASHRAE Applications Handbook recommends a 60% upper limit both for comfort of occupants and health of the building. Engineers familiar with pool design often reduce the upper limit when the design air temperature exceeds 85 deg F to keep the space dewpoint below 70 deg F. This section also uses a 24 hour averaged occupied period as the criterion. The great majority of pool spaces are not in occupied operation for 6-8 hours per day, which results in low humidity loads during those hours. It would be fairly easy to completely lose control of humidity during the day and make it up at night to meet this criterion. Also, the average is to be determined by multiple sensing points taken throughout the facility. It is often very impractical to find a single location for sensors in the facility that is not affected by sprayed water. I recommend "The system shall be capable of maintaining the relative humidity at 60% or less, averaged over the occupied hours of operation, as measured at the RA inlet to the air handling unit." – **REFERENCE:** ASHRAE Applications Handbook Section 4.6 , Environmental Control and Table 1.

Changes to Module/Annex:
Partially Agree. Section revised and the emphasis has been put on dew point.

5) Comment:
4.6.2.3.2 -- It is very simple for an air handling system to meet this requirement, but there is a very large associated change in the required dehumidification due to evaporation as well as a significant effect on bather comfort. Keeping the air temperature 2 degrees above the water temperature helps to limit the dehumidification load and keep swimmers from freezing as they exit the water. This recommendation is

in no way specific to any manufacturer or any type of system, and is a very important design parameter for both the design engineer and owner to understand. –
REFERENCE: ASHRAE Applications Handbook 4.6, Load Estimation

Changes to Module/Annex:
Requirement for air temperature has been deleted.

6) *Comment:*
4.6.2.4 -- The “Mechanical Systems” title does not really describe the content in this section. A more appropriate title is “Air System Distribution and Sizing” Sections 4.6.2.4.1 thru 4.6.2.4.3 address issues of Air Distribution. A few more sections should be added.

“INDOOR AQUATIC FACILITY ventilation system design shall provide airflow over the venue water surfaces to remove the highest concentration of airborne DISINFECTION BY-PRODUCTS by collection of a portion of return air near the water surface and directing a portion of the supply air toward/across the water surface.

If the MAHC is going to include the surface level collection of return air in the Performance Requirements in 4.6.2.1.8, it belongs in this section.

I don’t believe the MAHC can be the defining code for pool ventilation without addressing the total airflow required to effectively distribute the fresh air within the space, remove the contaminated air, eliminate condensation and dead spots where corrosion starts, and handle space sensible loads with an acceptable supply air temperature. I think it is fair to state that unhealthy pool spaces have been caused by too little ventilation air and ineffective air distribution. This has been exacerbated by the advent of recreational pools with new water features.

Total air volume is really about effective distribution. The greater the number of air changes, the less critical that the distribution system is perfectly designed. The guidelines provided by ASHRAE Applications on Air Delivery Rates (4-8 air changes) are appropriate if the MAHC would provide some better guidance on when to use the ranges. For instance, the higher range recommended for spectator spaces really makes little sense until you realize that the actual amount of fresh air is too low, so more total air needs to be delivered to increase the fresh air when spectators are included..

A sliding scale based on ceiling height would be more appropriate. A single story building would have higher air changes (8–10 Flat/Agitated, 12 for Hot Water). 20 foot ceilings would be 6 -8 for Flat/Agitated, 30 foot ceilings would have a range of 5-7 air changes for Flat/Agitated. For facilities with 40-50’ heights, 4 air changes would be recommended.

The recommendations could be increased if sensible loads caused too low a supply air

temperature. For 40-50' ceiling heights, temperature stratification can be a serious issue, and the use of High Volume Low Speed fans or other means should be considered to circulate the air downward.

Using an appropriate Total Airflow in combination with increased Fresh Air and effective air distribution will result in healthy pool spaces. Merely increasing the fresh air requirement without addressing total volume and the delivery/removal of the air replaces one incomplete code with another one. – **REFERENCE:** ASHRAE Applications Handbook 4.6, Air Delivery Rates, Duct Design

Changes to Module/Annex:
Partially Agree. Code revised and reformatted and have used the recommendations of the ASHRAE handbook for the number of air turns required within a space.

7) *Comment:*
4.6.2.4.2 -- This requirement is inconsistent with the desire of the MAHC to provide better guidance than is currently available, as illustrated with the second bullet point in 4.6.2 from the Annex which correctly notes that existing codes are "vague", have "very general language". In this requirement, the terms "minimize" and "reduce" are not defined. Further, this could be interpreted as being in conflict with 4.6.2.1.8 Item 8, which requires collection of return air near all venue surfaces. ASHRAE recommends not exceeding 30 fpm face velocity. Suggested new language – ""The INDOOR AQUATIC FACILITY ventilation system design shall have air velocity at deck level of no greater than 30 fpm to reduce direct drafts on bathers" **– REFERENCE:** ASHRAE Applications Handbook 2007 4.6 Duct Design

Changes to Module/Annex:
Partially agree. Drafts on bather deleted from this section.

8) *Comment:*
4.6.2.5.1 -- Purge modes are typically run after super-chlorination. The amount of time required to bring the venue back to safe levels is proportional to the amount of fresh air provided. If a facility needs to return to safe levels quickly (perhaps a rec center or health club), 100% OA/EA purge may make sense. If purge can be scheduled during unoccupied hours (a school or university), a 50% OA/EA purge would work well. There is a huge cost in the size of the heating system required to provide 100% OA/EA purge, even with energy recovery. Rather than state "an indefinite period", state that space temperature shall be maintained at its normal setpoint during purge mode. The design engineer and the owner can decide on the purge OA/EA percentage (50-100%).

Changes to Module/Annex:
Partially Agree. Code revised.

9) *Comment:*
ANNEX 4.6.2.1.6 Bullets – Bullet 1 – The language “still requires turnover” is unclear. The ASHRAE Applications Handbook Section 4.6 on Natatoriums makes recommendations on both fresh air and total air volume (determined in terms of air changes per hour). Both need to be determined to design a natatorium air delivery system. The term “Turnover” adds confusion to the discussion, and should be avoided.

The fresh air required will be calculated using 4.2.1.7.

The total air volume should be calculated in terms of air changes based on the ASHRAE recommendations but modified for building height. The total air volume is sized so meet all requirements of air distribution (removing chloramines, avoiding condensation and corrosion, distributing fresh air to swimmers and spectators, and handling heating/cooling loads with reasonable supply air temperatures) for the particular facility.

The fresh air volume should be based on bather load. Bather load is not a factor for the total air volume.

Bullet 2 – The use of the term ventilation is confusing here. By introducing the building size, the total required airflow is being discussed, not just the fresh (ventilation) air. The height of the facility does not affect the fresh air prescribed by either the current standards or the proposed MAHC code. Both are multiplying surface area by factors to obtain the amount of fresh air.

The height affects the total air volume in the current ASHRAE Handbook recommendations. It has nothing to do with release of contaminants, and therefore does not affect fresh air calculation.

Bullet 4 – ASHRAE 62 takes into account the number of users and square footages of pool, deck, and spectator areas. The ASHRAE Applications Handbook takes into account the building size.

Bullet 5 – This should be deleted. “ASHRAE fundamentals” does not require “turnover” of the volume of air. The ASHRAE Applications Handbook in section 4.6 makes recommendations on calculating the total air volume in terms of air changes per hour.

The MAHC will provide improved requirements for fresh air to provide more healthy spaces due to recognition that different venues have different contaminant loading and that ASHRAE 62 requirements for fresh air have been too low.

The MAHC needs to provide recommendations for Total Airflow that take into account building size (height) to be a comprehensive code that is more useful than the current codes and standards. The existing ASHRAE recommendations can be improved more easily than the fresh air calculations.

A sliding scale based on ceiling height would be more appropriate. A single story building would have higher air changes (8–10 Flat/Agitated, 12 for Hot Water). 20 foot ceilings would be 6 -8 for Flat/Agitated, 30 foot ceilings would have a range of 5-7 air changes for Flat/Agitated. For facilities with 40-50' heights, 4 air changes would be recommended.

The recommendations could be increased if sensible loads caused too low a supply air temperature. For 40-50' ceiling heights, temperature stratification can be a serious issue, and the use of High Volume Low Speed fans or other means should be considered to circulate the air downward

Water chemistry, fresh air, Bather load, and water surface area impact the contaminants in the space, and help determine the fresh air calculation. Distribution of air (preventing condensation, removing contaminants, preventing corrosion, distributing fresh air for occupants, and controlling temperature) is directly affected by the Total Air Volume. The "turnover" is merely a term to calculate and help easily think about the Total Air Volume. Total air volume is critical to creating a successful healthy pool space, and statements minimizing its importance minimize the value of the MAHC. – **REFERENCE:** ASHRAE Applications Handbook Section 4.6

Changes to Module/Annex:

Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

10) *Comment:*
ANNEX 4.6.2.1.7 -- Based on 15 years of field experience, I agree that the amount of outside air prescribed by ASHRAE 62.1 is not adequate to provide a healthy environment. The ASHRAE Applications Handbook Section 4.6 states that the ventilation requirement of 62.1 "may also prove inadequate for high-occupancy public or waterpark-type installations".

However, based on field experience I believe the Ro factors in Table 1 will result in significantly more outside air than necessary for a typical flat water pool, somewhat too much for a multi-venue facility like a community recreation center, and far too little for a commercial waterpark. I believe that when current air distribution guidelines are used, with some air directed across the pool surface and captured at pool level to "wipe" the chloramine layer, lower Ro factors are appropriate.

Based on field experience, I recommend using Ro for Flat Water of 5. For Agitated Water, the Ro factor should be variable based on the number and type of water features. Mushrooms, large dump buckets, and waterfalls require significantly more fresh air than a slide, spray gun, bubbler, or lazy river. I recommend a minimum Ro of 10 (a few features) and a maximum Ro of 40 (full blown waterpark). The full waterpark will be 100% fresh air.

Changes to Module/Annex:
Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

11) *Comment:*
ANNEX 4.6.2.3.1 -- The 65% r.h. requirement is in agreement with ASHRAE 62.1 Section 5.10.1. At the elevated temperatures of pool spaces, I question whether this number is too high. The ASHRAE Applications Handbook recommends a 60% upper limit both for comfort of occupants and health of the building. Engineers familiar with pool design often reduce the upper limit when the design air temperature exceeds 85 deg F to keep the space dewpoint below 70 deg F. This section also uses a 24 hour averaged occupied period as the criterion. The great majority of pool spaces are not in occupied operation for 6-8 hours per day, which results in low humidity loads during those hours. It would be fairly easy to completely lose control of humidity during the day and make it up at night to meet this criterion. Also, the average is to be determined by multiple sensing points taken throughout the facility. It is often very impractical to find a single location for sensors in the facility that is not affected by sprayed water. I recommend "The system shall be capable of maintaining the relative humidity at 60% or less, averaged over the occupied hours of operation, as measured at the RA inlet to the air handling unit." – **REFERENCE:** ASHRAE Applications Handbook Section 4.6 , Environmental Control and Table 1.

Changes to Module/Annex:
Agree. Code revised.

12) *Comment:*
ANNEX 4.6.2.3.2 -- It is very simple for an air handling system to meet this temperature requirement, but there is a very large associated change in the required dehumidification due to evaporation as well as a significant effect on bather comfort. Include a statement "Keeping the air temperature 2 degrees above the water temperature helps to limit the dehumidification load and keep swimmers from freezing as they exit the water." This recommendation is in no way specific to any manufacturer or any type of system, and is a very important design parameter for both the design engineer and owner to understand. This does not apply to Hot Water pools. – **REFERENCE:** ASHRAE Applications Handbook 4.6, Load Estimation

Changes to Module/Annex: Requirement for air temperature has been deleted..

13) Comment:

ANNEX 5.6.2.2.1 -- Air Quality can also affect water chemistry. Quoting the CDC, "Fresh air is important; super chlorination can be an effective way to rid the pool water of these by-products but will not work if the air is saturated with irritants and ventilation is not adequate." This takes the water chemistry further from the acceptable range. – **REFERENCE:** CDC Article on Irritants (Chloramines) and Indoor Pool Quality

Changes to Module/Annex: No change proposed by the commenter..

2. Ralph Kittler, Seresco Inc. (Decatur, GA)

1) *Comment:*

4.6.2-- If you are hoping design engineers consider your guidelines, then I would encourage you to talk to and partner with ASHRAE. ASHRAE and their handbooks are where design engineers around the world go for design guidance.

The last 10-15 years most Natatoriums have been designed with dehumidifiers that have 100% outdoor air capabilities. Even with 100% OA capabilities there are still many facilities with IAQ issues. There are many that have good IAQ. So, if a pool with 100% OA capabilities can still have IAQ issues, clearly more outdoor air alone is not the solution to pool IAQ issues.

The recommendations in the Air Quality module for more outdoor air than Standard 62 is not the silver bullet for IAQ issues. What it will do is dramatically change how HVAC/dehumidification equipment is sized and will also have a significant impact on first cost and operating costs. In the south the dehumidification load would get much larger. Up north that extra OA will result in spaces with RH levels under 30% in winter. Both would have significantly increased operating costs and you could easily still have IAQ issues.

Designers using the current Standard 62 OA requirement and following the lastest ASHRAE design guidelines can have every expectation of good IAQ in the space. The air distribution side of things is the key. There are plenty of pools out there using significantly more OA than required by Standard 82 (even in excess of what you call for) that still have air quality issues.

Proper Air distribution and reduction of chloramines will resolve the IAQ issue. Source capture of chemicals has proven very effective too. More OA alone will not get the job done unless the items above are addressed – if you are doing that, the recommended OA CFM requirements for Standard 62 have proven to be more than adequate but more testing would certainly be a good idea.

Changes to Module/Annex:

Agree. The committee agrees with you regarding distribution and control of chloramines. The MAHC module has flexibility built into it based on loading, movement of water, and the temperature of the water to address the control of chloramines. As for distribution, there are items that call for design of distribution based on load. In an effort to make the code as flexible as possible to account for the many types of facilities and types of air handling units, language was added to address this in particular.

As for increasing outside air, *Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.*

We certainly appreciate the use of other technologies to capture chloramines, to break them down before they reach the pool, and protocols that prevent them from forming in the first place. We have added line items that account for those additions

- *Comment, cont.:*
  I would be more than happy to discuss this further with you and also to let you know what the dehumidifier industry is doing (Seresco is a Natatorium dehumidifier manufacturer) to help with the IAQ issues in this market. I could also review what ASHRAE is suggesting to designers. I sit on two ASHRAE Technical Committees that cover this subject.

  I live in Decatur and could easily meet you at your convenience.

  Our ASHRAE summer meeting is coming up end of June and I would be happy to volunteer to be the liason between us if you like.

  Changes to Module/Annex:
  ASHRAE was contacted to participate, but did not respond.. We appreciate your input..

2) *Comment:*
   4.6.2.3.1 -- Average of 65% RH over a 24 hour period -- This recommendation would make is acceptable if the space is 100% RH for extended periods as long as the average is acceptable. This could have catastrophic consequences to the building envelope. ASHRAE gives guidelines that should be referenced.

   Changes to Module/Annex:
   Partially Agree. Section revised.

3) *Comment:*
4.6.2.3.2 -- The temperature range given is too broad and not useful for designers. ASHRAE publishes ranges to give a designer an approximation of operating conditions but a discussion with the end user to establish their intention is critical. – **REFERENCE**: ASHRAE gives guidelines that should be referenced.

Changes to Module/Annex:
Requirement for air temperature has been deleted.

4) *Comment:*
4.4.6.2.5.1 -- Purge for extended periods -- This would require the heating system capacity be increased by 500% in some cases if this is something you want to be able to happen on a winter design day. The cost of operating in this mode would be astronomical and the RH levels would fall below 20%.

Changes to Module/Annex:
Partially Agree. Code revised.

5) *Comment:*
4.6.2.4.2 -- This recommendation is incorrect. Air movement on the deck and into the breathing area is critical towards good IAQ. Your recommendation will have a negative impact on IAQ.

Changes to Module/Annex:
Agree.. Code revised.

3. Ken Cooper, PoolPak Technologies Corporation (York, PA)

1) *Comment:*
General – In the accompanying annex the following appears. "The committee had to use the experience of its members on what was working in the real world and what was not working to modify the formula used in ASHRAE 62. In other words, the committee had the final answer and developed a modified formula that yielded the desired results." -- I find this extremely unprofessional as well as misleading. It is obvious from this that the committee has already decided that the answer is "more outside air" and set about making a set of questions that provides this answer. The next column outlines what I believe to be the "real" problems and they do not involve more outside air. Rather they involve getting the air where it needs to be. – **REFERENCE:** My experience of nearly 25 years in this field as a manufacturer of mechanical dehumidification systems and many visits to "real" facilities have shown me that there are two main problems in most

natatoriums. The first problem is that everyone is expecting the 'minimum wage' pool life guard or building janitor to maintain the pool chemistry. The problem is compounded by cheap (deliberate word here) testing equipment, misinformation about how to interpret the test results and the lack of knowledge about how to actually get the pool chemistry correct. The result is very inconsistent results. Pool "shocking" is poorly understood and often improperly executed, compounding the above problem. The second problem is that most natatorium "air distribution" systems are not only poorly designed but often are made to make the architect happy and not to solve the problem of getting air to the proper places. A facility with 20 or 40 ft ceiling heights and an air distribution system in the ceiling area does NOT work like a normal air distribution system in a room with 8 to 10 ft ceiling heights. This means that air is not getting to the water surface in most cases, making the problem of poor water chemistry worse. There is more but this is a really terrible way to make a comment.

Changes to Module/Annex:

Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

2) *Comment:*
General -- As a member of the ASHRAE Standards Committee I am not aware that anyone associated with this effort has made any real attempt to work with the members of ASHRAE Standard 62.1 project committee to try and improve the standard. Conversations with ASHRAE Staff and the Chairman of the standard concur with my comment. -- ASHRAE Standard 62.1 is widely recognized in the industry and among code bodies and as such should be the first step.

Changes to Module/Annex:
Agree. ASHRAE was contacted several times to provide a member to participate on the committee, however no response from them was received..

3) *Comment:*
4.6.2.1.2 -- Ventilation design requirements shall apply to a new or modified INDOOR AQUATIC FACILITY including the area of the building's AQUATIC VENUES, the surrounding BATHER and spectator/stadium seating area, mechanical rooms, bath and locker rooms, and any associated rooms which have a direct opening to the AQUATIC FACILITY. -- Until the scope of required modifications is defined, eliminate this word. The sentence as constructed implies that a modification to any associated area would trigger changing the amount of outside air whether or not the change affects the aquatic venue. This cannot be true.

Changes to Module/Annex:

Agree. We have defined the term substantial modification to speak to an indoor setting and the air handling system

4) *Comment:*
4.6.2.1.7 -- AQUATIC FACILITY ventilation system design, construction, and installation shall supply the fresh outside air requirements outlined in Table 1, which include the minimum air of ASHRAE 62.1 and/or applicable local CODEs PLUS the additional amount of fresh outside air needed while the facility is occupied. These additional fresh outside air requirements depend on the types and areas of AQUATIC VENUES, deck, and spectator/stadium seating areas making up the AQUATIC FACILITY as outlined below -- No such thing as "fresh air" air. The best you can do is 'outside air'; Fix this everywhere the words "fresh air" exist

Changes to Module/Annex:
Agree - we have changed all references to OUTDOOR AIR.

Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

5) *Comment:*
4.6.2.1.7 -- ~~The Density factor in Table 1 may be increased, but not reduced may be changed to increase the number of people per area (smaller density factor) but not reduced~~ -- The words as written imply that you can make the density factor larger, which would decrease the number of people not increase it as I suspect was the intent. However, my actual thought is that this method of calculation, while addressing the "answer" that you proposed, does not actually solve any problems in the pool space. Thus my recommendation is to eliminate it entirely because I have suggested deleting that part of the equation in a separate comment below.

Changes to Module/Annex:
Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

6) Comment:
4.6.2.1.7 -- ~~Using the ASHRAE 62.1 definitions for outside air as a baseline and utilizing the ASHRAE method to determine the minimum outside air requirements and then adding additional fresh air~~ For each AQUATIC VENUE type, the number of cubic feet per minute (cfm) of ~~fresh~~ outside air for an AQUATIC FACILITY is: -- Strike the sentence as indicated. The formula below includes the effect of 62.1 (sort of, because it

doesn't include all of the things that 62.1 allows.) -- Unless you carefully read the statement you could be led to believe that you first calculate according to 62.1 and then apply the whole formula again. This would have the effect of doubling the outside air calculations of 62.1 and then adding the rest of the calculations. This cannot be what is intended.

Changes to Module/Annex:
Annex comment.
Suggestions incorporated into revised section wording

7) *Comment:*
4.6.2.1.7 -- ~~Aquatic venue area x (Ro/ Density factor for that type of area)~~
~~+~~
~~Deck area x (Ro/density factor for deck)~~
~~+~~
~~Stadium seating area x (Ro/density factor for seating)~~ -- The numbers that you get when applying the density factors to the areas shown imply ridiculous numbers of people in the water and deck areas. The premise that the committee started with causes this. In section 4.6.2.1.8 the following appears "Expected BATHER load and other building Occupants". This appears to be in direct conflict with the "density factor" calculation. Why would you not use the information requested for the design. I am submitting a separate example of the implications of this formula for an existing "flat water" facility. Conversations with the pool operator indicate that the maximum occupancy would only occur 6 or so days/year. Furthermore, during these days, while there are several hundred people in the pool area, only 8 – 10 people are swimming at one time – it is a swimming meet after all. At other times, the occupancy is much less. There is probably more pool agitation during swimming team practice than during swim meets although there are a lot less people in the pool area. The outside air requirements for this facility take the spectators into account even though normally the occupancy is much less. This facility has not had any complaints of problems for swimmers according to the operator.

Changes to Module/Annex:

Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

8) *Comment:*
4.6.2.1.7 -- ~~Although AQUATIC FACILITY ventilation system planning will include consideration of mechanical rooms, bath and locker rooms, and any associated rooms which have a direct opening to the AQUATIC FACILITY, these non-wet areas are not~~

~~included in the section 4.6.2.1.7 calculation.~~ The ventilation requirements apply only to the areas indicated. -- Normally a code specifies what is included and NOT what is not included.

Changes to Module/Annex:
Agree - code revised to clarify that these spaces are considered only for their effects on negative pressure, temperature, and contribution to air volume.

9) *Comment:*
4.6.2.1.8 -- ~~Known chemical, biological, and physical CONTAMINANTs,~~ -- Why would a "ventilation design engineer" (whatever that is) know about this. There is no facility so how would you predict something that hasn't happened yet, especially if you are not a chemist or other knowledgeable professional

Changes to Module/Annex:

Agree. Deleted.

10) *Comment:*
4.6.2.1.8 -- Add "Air distribution design to provide minimum air flow across the pool surface." -- See my initial general comment above.

Changes to Module/Annex:
Agree. Changed as suggested.

11) *Comment:*
4.6.2.1.9 -- ~~Ventilation system design fresh air calculations may include surge tank and gutter systems that introduce fresh air into the INDOOR AQUATIC FACILITY.~~ -- This statement seems to be pandering to a specific type of design which could give an unfair advantage to other manufacturers. If you want to include other things that may reduce the combined chlorine products, the place for it is in the calculation equation so people know how to deal with it and not as a separate clause.

Changes to Module/Annex:
Agree. Code revised to address other outdoor air introductions.

12) *Comment:*
4.6.2.1.11 -- ~~Ventilation system design may not consider retractable roofs as part of the fresh air calculations for the INDOOR AQUATIC FACILITY.~~ -- This is covered in the subsequent sections

Changes to Module/Annex:

Agree. Code revised and re-worded.

13) *Comment:*

4.6.2.1.14 -- ~~Ventilation system design for toilet, shower, and dressing rooms shall conform to applicable local CODEs. --~~ Again, codes do not normally include things that are NOT included

Changes to Module/Annex:

Agree. Code revised.

14) *Comment:*

4.6.2.1.15 -- ~~Ventilation system design for chemical storage rooms shall conform to the International Mechanical Code, International Fire Code, and any applicable local codes.~~ -- Again, codes do not normally include things that are NOT included

Changes to Module/Annex:
Agree. Code revised.

15) *Comment:*

4.6.2.1.19 -- ~~AQUATIC FACILITY ventilation system design engineer and/or the ventilation system manufacturer shall provide facility owner with notifications of relevant ventilation system recalls, part changes, or SAFETY alerts.~~ -- This requirement while seemingly serious cannot be accomplished nor can it be verified. It has no time limit which would make the mfgr and engineer responsible forever. How would a code inspector know if this section has been complied with. A design engineer and the manufacturer is hired (paid money) to make the design and provide the equipment. They are NOT paid to keep providing updates forever. Any required notifications for equipment recalls would be made in the normal course of business.

Changes to Module/Annex:
Agree. Code revised.

16) *Comment:*

4.6.2.2.1 -- INDOOR AQUATIC FACILITY ventilation system design shall provide outside air ~~turnover rates~~ that comply~~y~~ies with the ~~ASHRAE 62.1 and/or applicable local~~

~~CODEs plus additional fresh air~~ requirements specified in 4.6.2.1.7. -- Too Much Information. The actual calculation referenced here is the UNNUMBERED equation.

Changes to Module/Annex:
Agree. Code revised.

17) *Comment:*
4.6.2.2.2-- ~~INDOOR AQUATIC FACILITY ventilation system design shall provide fail safes to ensure that number of cubic feet per minute (cfm) of fresh outside air for an AQUATIC FACILITY is not less than the minimum calculated by…~~-- What are "fail safes"? This isn't defined. The best one can do is make the calculations in accordance with 4.6.2.2.1 and specify equipment that can do that. Once the facility is occupied, control reverts to the maintenance person and there is no way to prevent them from doing whatever they want.

Changes to Module/Annex:
Agree. Code revised to require system features to notify operator if outdoor air entering the Aquatic Facility is less than 0.48 cfm/ft2.
.

18) *Comment:*
4.6.2.2.5 -- ~~INDOOR AQUATIC FACILITY ventilation system design, construction, and installation shall include a conspicuous permanent data plate or label on the exterior of the equipment, which provides ventilation system information that affects health and SAFETY, including the minimum number of cubic feet per minute of fresh air furnished by each sub-unit of the INDOOR AQUATIC FACILITY's ventilation system.~~ -- What equipment? There may be several pieces of equipment including air handlers, dehumidifiers, exhaust fans etc. What is a "sub-unit"? Normally a data plate is put on by the equipment manufacturer. Any data plates that appear on the equipment imply responsibility for the information. Equipment manufacturers do not have the knowledge and ability to control this information.

Changes to Module/Annex:
Agree. Requirement for permanent data plate/label deleted..

19) *Comment:*
4.6.2.3.2 -- ~~INDOOR AQUATIC FACILITY ventilation system design shall be capable of maintaining the facility air temperature at no more than 8º above or 2º below the average AQUATIC VENUE water temperature,~~ -- This requirement would FORCE most pool designs to include some form of mechanical cooling. Pool facilities constructed on a limited budget or that are designed with equipment that may not be capable of

providing mechanical cooling would not be allowed. This would eliminate a whole class of equipment and cause a significant first cost and operating increase to the owner.

Changes to Module/Annex:
Requirement for air temperature has been deleted.

20) *Comment:*
4.6.2.4.1 -- INDOOR AQUATIC FACILITY ventilation system design should ~~shall~~ provide consistent air flow through all parts of the building that preclude any stagnant areas. -- The whole statement is a wish list and reminiscent of 'motherhood and apple pie'. You cannot FORCE this nor can you figure out whether it has been followed. My first thought was to eliminate this section entirely. However it is a good thought but one I suspect that the air distribution designer tries to do anyway – just doesn't succeed very often.

Changes to Module/Annex:
Partially Agree. Code revised to specify that the system shall be designed to provide consistent air flow.

21) *Comment:*
4.6.2.4.2 -- INDOOR AQUATIC FACILITY ventilation system design shall ~~minimize air velocities at deck level to reduce direct drafts on BATHERs.~~ Provide air velocities of 25 ft/ min at the deck level to eliminate off gassing contaminants. Higher values should be avoided to minimize the effect on water evaporation rate. -- Drafts are the least of a bather's worries. – **REFERENCE**: Manual SPS HVAC Design for Pools and Spas, ANSI/ACCA 10 Manual SPS-2010, ACCA, Arlington VA, pg 77

Changes to Module/Annex:
Agree. Drafts on bathers has been deleted from the code.

22) *Comment:*
4.6.2.4.4 -- ~~INDOOR AQUATIC FACILITY ventilation system design shall provide effective filtration of fresh and recirculated air that addresses the specific indoor and outdoor environmental considerations for the facility.~~ -- This is not code language! There is no way to either decide what "effective" is or any way to enforce it.

Changes to Module/Annex:
Agree. Code revised.

23) *Comment:*

4.6.2.5.1 -- ~~INDOOR AQUATIC FACILITY ventilation system design shall provide a complete building purge method that will allow for complete exhaust of the building's air volume and replacement with fresh air, with no air recirculation at full fan speed for an indefinite period~~ -- This provision would eliminate a whole class of equipment in common use today as well as force anyone who would be upgrading to change their equipment type with a resulting major cost penalty that could cause the pool operator to forego the upgrade entirely and/or go out of business. Some equipment types only include an exhaust fan that is capable of the required minimum amount of outside air. In this type of equipment a single fan is not capable of providing the range of airflow that would be required to encompass the purge. A second fan is required and existing equipment cannot be modified to include the second fan. There is equipment that does provide this feature either by providing a second 'purge' fan or a return fan. If the facility has a separate exhaust fan, the problem becomes worse.

Changes to Module/Annex:

Partially Agree. Code revised.

24) *Comment:*

5.6.2.1.1 -- ~~INDOOR AQUATIC FACILITY building ventilation systems shall be maintained and operated to protect the health of the building's occupants.~~ -- First a question. What is the difference between the space conditioning system and the ventilation system? Second, it seems quite self serving to only have the system worried about the occupants, most space conditioning systems are concerned with the building's health as well. If there is a difference between the two systems, where does one stop and the other begin? They are not normally totally separate systems.

Changes to Module/Annex:

Partially Agree. Code revised . " Ventilation System " changed to "Air Handling System" and is defined and "safety" added to address maintenance of the building.

25) *Comment:*

5.6.2.1.2 -- INDOOR AQUATIC FACILITY building ventilation systems shall be maintained and operated by the facility operator to comply with all requirements of the original system design, construction and installation. -- The designer has absolutely no control over either the maintenance or the operation of the system. The added words make it clear who is supposed to do this. While I don't actually believe that you can mandate (the word Shall) this, you can certainly try.

Changes to Module/Annex:

Disagree. Unnecessary as compliance with the operation and maintenance section of the MAHC is the responsibility of the aquatic facility owner/operator.

26) *Comment:*

5.6.2.1.3 -- ~~The ventilation operation and maintenance requirements shall apply to an INDOOR AQUATIC FACILITY including the AQUATIC VENUES, the surrounding BATHER and spectator/stadium seating area, mechanical rooms, bath and locker rooms, and any associated rooms which have a direct opening to the AQUATIC FACILITY.~~ -- This is really confusing because section 4 specifically eliminated this and there is no other reference on how to design the ventilation system. It doesn't belong here.

Changes to Module/Annex:
Agree. Code revised .

27) *Comment:*

5.6.2.1.5 -- ~~INDOOR AQUATIC FACILITY operator shall monitor, log and maintain ventilation system set-points and other operational parameters as specified by the AQUATIC FACILITY ventilation system design engineer and/or the ventilation system manufacturer.~~ -- What is the use of logging information if you are not going to do anything with it? This section is just busywork for the pool operator unless there is something for them to do with the information.

Changes to Module/Annex:
Disagree. Logs to be maintained and available for review by the AHJ.

28) *Comment:*

5.6.2.1.6 -- ~~INDOOR AQUATIC FACILITY operator shall implement a~~ The design engineer shall recommend an air distribution ~~ventilation~~ system cleaning program to remove CONTAMINANTs within the equipment.~~ in accordance with the AQUATIC FACILITY ventilation system design engineer's and/or the ventilation system manufacturer's recommendations.~~ -- This would add significant cost to the maintenance of the facility since the air distribution systems are often nearly inaccessible as they may be 30 ft off the deck or over the pool itself. The best you can hope for is to have the design engineer supply information that will aid the operator in maintaining the cleanliness of the air distribution system.

Changes to Module/Annex:
Partially Agree. This section deleted as cleaning/maintenance already included in another section.

29) *Comment:*

5.6.2.1.7 -- INDOOR AQUATIC FACILITY operator shall maintain a copy of the AQUATIC FACILITY ventilation system design engineer's original operating manuals and commissioning reports, including updates and modification specifications for any modifications. -- I presume you really mean that the operator has to have a copy available.

Changes to Module/Annex:
Agree. Code revised.

30) *Comment:*

5.6.2.2.1 -- INDOOR AQUATIC FACILITY operator shall develop and implement a plan to reduce combined chlorine compounds introduced into the building from operation of AQUATIC VENUES. -- What 'building'? I don't know what to change here. If you mean parts of the building that are connected to the aquatic venues then that is a function of the aquatic venue ventilation system. If you mean the aquatic venue itself then it would be more appropriate to talk about maintaining pool chemistry as the words as written are pretty wishy- washy.

Changes to Module/Annex:
Agree. Code revised.

31) *Comment:*

5.6.2.3.2 -- ~~INDOOR AQUATIC FACILITY operator shall develop and implement a public information and health messaging program to inform facility patrons of their impact on building air quality.~~ -- Until this actually says something useful, eliminate it. Where would an operator get such information? What kind of messages? What impact? Most pool operators would normally want to have the pool space in good condition otherwise patrons will stop coming.

Changes to Module/Annex:

Disagree. Annex contains explanatory information.

32) *Comment:*

5.6.2.5 -- ~~Natural Air~~ -- What is "natural air"? Eliminate the whole section. Is 'natural air' another of your euphemisms for 'fresh air' which is really outside air? Really confuses people.

Changes to Module/Annex:
Partially Agree. Section revised and reworded .

33) *Comment:*

5.6.2.5.1 -- ~~Operator shall develop an action plan including procedures for purging the building if necessary.~~ -- Action plan? What is that supposed to mean? Certainly isn't code language. This portion would not be applicable if my suggestion that section 4.6.2.5.1 is eliminated. How would some code official be able to interpret this requirement? There is no way they could know what a useful plan would be. The text as written only says you have to have a plan, nothing about using the plan for anything.

Changes to Module/Annex:
Partially Agree. Section revised.

ADDITIONAL INFO FROM KEN COOPER:

Facility:

Indoor competition pool – 9,000 sq ft. 8 lanes along length and 7 lanes side to side with a moveable divider.

Total pool and deck area approx 20,115 sq ft not including spectator seating. The general ceiling height is 23 ft giving an internal volume of 508,600 cu ft. The facility has locker rooms and a lobby surrounding three sides of the natatorium that are not included in the dimensions given. There are high windows on the two long sides of the facility.

Spectator seating area 2,000 sq ft.

Installed equipment 2 – 50 nominal ton Mechanical Dehumidifiers. Total design supply airflow 48,000 CFM, Design minimum outdoor airflow 10,420 CFM. The nominal air change rate is 5.66. The facility has been operational since the fall of 2008.

The air distribution system includes high perimeter outlets on both sides and one end. The return air inlets are low and at the opposite end of the natatorium.

Max natatorium occupancy 1420 per permit. According to facility operator, at the roughly two events per year currently scheduled for this facility, there could be more than 1,000 people in the pool area for the several hours of the meet. The design criteria were for an average of 648 people in attendance. Of course, during a meet only 8 to 15 people are in the water at any given time, everyone else is either in the stands, on the deck or in the lobby.

The facility operator estimates that such events would be unlikely to exceed 6 per year. At other times, there are daily swim team practices in the early morning and some open swimming that is not usually attended by less than 100 people.

According to the facility operator there have not been any complaints of respiratory distress amongst people using the facility.

ASHRAE 62.1 outside air design Section 6.2.2.1
wet area = (9,000 + 4,300) * 0.48 = 6384 CFM

Seating = 2000 * 0.06 = 120 CFM

Spectators = 648 * 7.5 = 4860 CFM

Total Design Outside air = 11, 364 CFM

(the difference in outside air is due to some minor changes in the assumptions between design and construction)

ASHRAE 62.1 also has a clause that allows a reduced number of people based on occupancy considerations. It has not been used here but could reduce the outside air requirements some.

Proposed MAHAC outside air design Section 4.6.2.1.7

Wet area = (9,000 + 11,115) * 0.48 = 9655 CFM

Seating = 2000 * 0.06 = 120 CFM

Spectators = 2000 * 7.5 / 6.6 = (303 people) * 7.5 = 2273 CFM

Swimmers = 9000 * 10 / 20 = (450 people) * 10 = 4500 CFM

Deck observers = 11,115 * 10 / 50 = (222 people) * 10 = 2223 CFM

Total Design Outside air = 18,770 CFM
Total estimated number of people = 975

If there were a modification to the facility requiring a change indicated by the MAHAC calculation several things would occur.

1. The total supply CFM would have to be increased from 48,000 CFM to 53,600 CFM to allow the additional outside air to be introduced. This is a function of the equipment design and is typical of this class of equipment that has a supply and return fan. It just happens that the change could be accommodated with the same equipment because of the design, however, there would be many more installations where the outside air change would require new equipment.

2. If this were a change to an existing facility there would be an increase in fan horsepower because of the increased air flow through the same duct work. Based on the original design the total fan horsepower would increase from 49.2 to 66.2 with a concomitant increase in operating cost of about 35% for the fans alone.

Additionally, the fan motors would have to be increased from 30 to 40 horsepower. This would require that the electrical wiring, circuit breakers and other electrical components such as contactors be changed. The increased electrical requirements on the building electrical service might prohibit such a change entirely.

If this were a newly constructed facility, the designer might make the ductwork larger to accommodate the increased airflow. In this case the fan horsepower would become 64 and only a 30% increase in operating cost for the fans.

3. There are other common types of equipment where this change could not be accommodated without replacing the entire dehumidification equipment. Such equipment typically will have an exhaust fan and a supply fan. While it might be possible to increase the supply air flow rate, the exhaust fan would have to be replaced because there are not fans currently made that will cover the range of air flow rates indicated by the MAHAC calculation.

   For these types of equipment, if they did not have a purge fan capability, one would have to be added, making the cost increase even more pronounced. It is not likely that even if the same equipment could be used, a purge fan ability could be easily added if at all.

4. Because more outside air would be required even though the facility is minimally occupied relative to the design values most of the time, there will be an increase in 'conditioning' costs for the additional outside air. Some classes of equipment could change the amount of outside air to accommodate this, however, for most installed equipment it would not be possible.

For this existing facility, changing the outside airflow rate to agree with the proposed MAHAC code would have a rather large first cost as well as a large continuing operating cost with no apparent improvement in occupant comfort or health since there haven't been any complaints that the facility operator is aware of.

4. Brian Kannady, ME Engineers (Wheat Ridge, CO)

1) *Comment:*
   4.6.2.3.1 – 24 hour average means what? Occupied days, weekends, summer, winter, etc. -- Suggest defining what is the maximum RH level.

   Changes to Module/Annex:
   Partially Agree. Code revised.

2) *Comment:*
   4.6.2.5.1 – This is a specific to a particular vendor's equipment. -- INDOOR AQUATIC FACILITY ventilation system design shall provide a complete building purge method that will allow for complete exhaust of the building's air volume and replacement with fresh air, with no air recirculation at full fan speed for an

indefinite period.

Changes to Module/Annex:
Disagree. However. code revised.

3) *Comment:*
4.6.2.1.2 – Vague reference as to when the Code applies. -- adding new aquatic features or venues (can this be quantified?) to an existing facility,

Changes to Module/Annex:
Agree. We have defined the term substantial alteration.

4) *Comment:*
4.6.2.2.2 – To what extent? i.e. during initial set up the HVAC system may be balanced to provide OSA quantities. Someone could change this. -- INDOOR AQUATIC FACILITY ventilation system design shall provide fail safes to ensure that number of cubic feet per minute (cfm) of fresh air for an AQUATIC FACILITY is not less than the minimum calculated by the formula in 4.6.2.1.7 for the facility during times the facility is occupied.

Changes to Module/Annex:
Agree. . Code revised to require system features to notify operator if outdoor air entering the Aquatic Facility is less than 0.48 cfm/ft2

5) *Comment:*
4.6.2.4.4 – Meeting the standard above will accomplish this? -- INDOOR AQUATIC FACILITY ventilation system design shall provide effective filtration of fresh and recirculated air that addresses the specific indoor and outdoor environmental considerations for the facility.

Changes to Module/Annex:
Agree. Code revised.

6) *Comment:*
4.6.2.1.7 – What is the validation for the matrix? Mandating this approach could have SIGNIFICANT economic impacts on the owner/operators. Example 1 noted increases the outside air quantity to the aquatic venue by a factor of 2+. This will increase not only the first cost of the equipment, but the operational cost of the facility. If this is the right approach, then the Code should mandate this quantity of outside air, however, to base the new outside air requirements with empirical data is not providing any health and safety benefits to the users. -- The

committee had to use the experience of its members on what was working in the real world and what was not working to modify the formula used in ASHRAE 62.…Design Professionals knew from experience where the final number needed to be, added in reasonable density factors…

Changes to Module/Annex:
Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

7) *Comment:*
4.6.2.1.7 – Outside air is typical Code language -- … ~~fresh~~ **outside** air … --
Reference: IMC

Changes to Module/Annex:
Agree. Code revised.

8) *Comment:*
4.6.2.1.8 – Is this section valid for a Code? i.e. the designer shall document…….. ”External environment, and infiltration and exfiltration concerns that would influence air quality in the INDOOR AQUATIC FACILITY.“

Changes to Module/Annex:
Partially agree. Code revised.

9) *Comment:*
4.6.2.1.10 – What is a paddle fan? -- Ventilation system design may not consider paddle fans as part of the fresh air calculations for the INDOOR AQUATIC FACILITY.

Changes to Module/Annex:
No change proposed by commenter. Note-A paddle fan is a mechanical fan used to push air within the space.

10) *Comment:*
4.6.2.1.16 – Suggest using a special inspector, similar to other IBC special inspections (i.e. smoke control or structural inspections). This could provide some unintended legal liability for the design professionals. -- AQUATIC FACILITY ventilation system design engineer shall commission the ventilation system in a manner to verify that the installed system is operating in compliance with the design intent.

Changes to Module/Annex:

Partially Agree. Code revised.

11) *Comment:*
4.6.2.1.19 – The designer would not have access to this information. -- AQUATIC FACILITY ventilation system ~~design engineer~~ ~~and/or~~ the ventilation system manufacturer shall provide facility owner with notifications of relevant ventilation system recalls, part changes, or SAFETY alerts.

Changes to Module/Annex:
Agree. This section has been deleted.

5. James Hogan, Dectron, Inc (Roswell, GA)

1) *Comment:*
4.6.2.1.7: re: Exception 1 - The present language is restrictive of advancement of the art. For example, gas-phase filtration has been demonstrated to remove disinfection by-products without the costs associated with excess ventilation.; re: Exception 2 – Continuous purge comes with a significant additional energy cost. The present language could be un-necessarily burdensome to some smaller special-purpose venues, such as pools for persons whose skin is allergic to contact with halogen sanitizers. Such pools may be sanitized with copper or silver ions, among other methods. This section should be reconciled with section 4.7.3 (Disinfection and Water Quality).-- Exception 1: Where other effective means of removing disinfection by-products from the natatorium air are used, the required ventilation rate shall be that required by ASHRAE 62.1.; Exception 2 – For smaller venues using alternative pool sanitizers, e.g. metal-ions that do not produce aggressive air-borne disinfection by-products, the required ventilation rate shall be that required by ASHRAE 62.1. – REFERENCE: Editorial, Studies & Practice -- See ACCA Manual SPS Chapter 5.

Changes to Module/Annex:

Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

Disagree regarding metal –ions as alternative pool sanitizers. The MAHC Disinfection and Water Quality requirements do not allow use in the absence of chlorine or bromine.

2) Comment:
4.6.2.3.2 – Exception 1: The design of facilities where the air temperature is to be maintained more than 2F below water temperature shall require special

engineering consideration of evaporation rates and heating of the air by the pool.

Exception 2: The design of facilities where the air temperature is to be maintained more than 8F above water temperature shall require special engineering consideration of maximum air temperatures for health.— re: Exception 1 - The present language unnecessarily restricts smaller special venues, especially those where the natatorium is used temporarily for other purposes, such as social gatherings. In this case, there may be multiple set points. Examples are available.

re: Exception 2 – The present language un-necessarily restricts smaller special venues, especially those involving cultural/religious uses, such as cold-plunge pools.

Changes to Module/Annex:
Requirement for air temperature has been deleted.

3) *Comment:*
4.6.2.5.1 – INDOOR AQUATIC FACILITY ventilation system design shall provide a complete building natatorium purge method that will allow for complete exhaust of the building's natatorium air volume and replacement with fresh air, with no air recirculation at full fan speed for an indefinite period.
Note 1: Separate devices operating in coordination to achieve the stated goal shall be acceptable.
Exception: Where other effective means of removing disinfection by-products from natatorium air are used, or where alternative pool sanitizers, e.g. metal-ions, that do not produce aggressive air-borne disinfection by-products are used, such purge mode shall be optional.-- re: "building" The word "building" could be misinterpreted as overly inclusive.
re: Note 1 – Smaller venues do not always have sufficient mechanical-room space to incorporate a single device with this capability.
re: Exception - The present language is restrictive of advancement of the art. For example, gas-phase filtration has been demonstrated to remove the disinfection by-products without the costs associated with excess ventilation.

Changes to Module/Annex: Partially Agee. Code revised.

4) *Comment:*
4.6.2.1.15 –(Refer to code section 4.9 for details.)-- There are other applicable standards, depending on type and quantity of chemicals stored. This paragraph

should be reconciled with section 4.9 (Design and Construction).

Changes to Module/Annex:
Agree. Code revised.

5) *Comment:*
4.6.2.2.1 – Exception 1: Where other effective means of removing disinfection by-products from the natatorium air are used, the required ventilation rate shall be that required by ASHRAE 62.1.
Exception 2 – For smaller venues using alternative pool sanitizers, e.g. metal-ions, that do not produce air-borne disinfection by-products, the required ventilation rate shall be that required by ASHRAE 62.1. -- re: Exception 1 - The present language is restrictive of advancement of the art. For example, gas-phase filtration has been demonstrated to remove disinfection by-products without the costs associated with excess ventilation.
re: Exception 2 – The present language could be un-necessarily burdensome to some smaller special-purpose venues, such as pools for persons whose skin is allergic to contact with halogen sanitizers. Such pools may be sanitized with copper or silver ions, among other methods. – **REFERENCE**: See ACCA Manual SPS Chapter 5.

Changes to Module/Annex: Partially Agree. With further research, other technologies can reduce the amount of outside air required.

6) *Comment:*
4.6.2.2.2 – INDOOR AQUATIC FACILITY ventilation system design shall provide fail safes (specify tolerances and responses) to ensure that number of cubic feet per minute (cfm) of fresh air for an AQUATIC FACILITY is not less than the minimum calculated by the formula in 4.6.2.1.7 for the facility during times the facility is occupied.
Exception 1: Where other effective means of removing disinfection by-products from the natatorium air are used, the required ventilation rate shall be that required by ASHRAE 62.1.
Exception 2 – For smaller venues using alternative pool sanitizers, e.g. metal-ions, that do not produce air-borne disinfection by-products, the required ventilation rate shall be that required by ASHRAE 62.1. -- re: “specify tolerances and responses” – “fail safe” has a specific (and expensive) (requires feedback, modifiers, compensators, etc.) meaning. Committee may wish to consider the word “alarm” rather than “fail safe”. If not, code should specify either an acceptable device, or an acceptable technology, e.g. damper-position, differential pressure, sail, turbine, positive displacement, etc., or at least specify the

allowable accuracy and tolerances. The response of the system to the failsafe device, e.g. alarm, should be specified.
re: Exception 1 - The present language is restrictive of advancement of the art. For example, gas-phase filtration has been demonstrated to remove disinfection by-products without the costs associated with excess ventilation.
re: Exception 2 – The present language could be un-necessarily burdensome to some smaller special-purpose venues, such as pools for persons whose skin is allergic to contact with halogen sanitizers. Such pools may be sanitized with copper or silver ions, among other methods.

Changes to Module/Annex:
Agree. Code revised to require system features to notify operator if outdoor air entering the Aquatic Facility is less than 0.48 cfm/ft2

7) *Comment:*
4.6.2.3.1 – Not all occupied periods are 24 hours long. -- INDOOR AQUATIC FACILITY ventilation system design shall be capable of maintaining the time-weighted average relative humidity ~~average~~ at less than 65% during occupied periods. Where occupied periods exceed 24 hours, the time-weighted average shall be taken over a 24-hour period. ~~in a 24 hour period when the building is occupied.~~

Changes to Module/Annex:
Partially Agree. Code revised.

8) *Comment:*
4.6.2.4.2 – The pool surface should have 10 to 50 FPM air speed to remove disinfection by-products. This may require non-zero air speed across the deck. -- To reduce direct drafts on BATHERs, INDOOR AQUATIC FACILITY ventilation system design shall minimize air velocities at deck level ~~to reduce direct drafts on BATHERs~~ to that necessary to produce proper air speed across the pool surface.

Changes to Module/Annex:
Agree. Drafts on bathers deleted from code.

9) Comment:
5.6.2.2.1 – Grammar, Clarification -- (depending on the intent of the committee) (Possibility 1) INDOOR AQUATIC FACILITY operator shall develop and implement a plan to ~~reduce combined chlorine compounds~~ minimize the amount of disinfection by-products ~~from~~ being introduced into other parts of the building from operation of AQUATIC VENUES.

(Possibility 2) INDOOR AQUATIC FACILITY operator shall develop and implement a plan to ~~reduce combined chlorine compounds~~ minimize the amount of disinfection by-products ~~from~~ being introduced into the ~~building~~ natatorium air from operation of AQUATIC VENUES through compliance with the pool-chemistry requirements of this code.

Changes to Module/Annex:
Partially Agree(Possibility 2). Code revised . Annex provides clarification.

10) *Comment:*
5.6.2.5.1 – The word "building" is overly inclusive. -- Operator shall develop an action plan including procedures for purging the natatorium ~~building~~ if necessary.

Changes to Module/Annex: Agree. Code revised.

6. Stephen Springs, Brinkley Sargent Architects (Dallas,TX)

1) *Comment:*
4.6.2.1.2 -- "Modified" is too broad. As written, minor revisions even outside the natatorium would arguably trigger a complete overhaul of the pool HVAC system. The annex does little to help thanks to the words "not limited to". -- Ventilation design requirements shall apply to a new or substantially altered or renovated… -- Another source for language in this context could be how the IECC scopes applicability of its code to renovations.

Changes to Module/Annex:
Agree. We have defined the term "substantial alteration".

2) *Comment:*
4.6.2.1.2 – Please clarify. Interpreted liberally, this could have unintended consequences. -- Does a "direct opening" include a door? I would suggest not.

Changes to Module/Annex:
Agree. Code revised.

3) *Comment:*
4.6.2.1.4 – Why not allow both? As in a pool open in the summer, but enclosed and heated in the winter. How should this code apply to air-supported dome structures that are seasonally erected and removed? -- Change "or" to "and/or"

Changes to Module/Annex:
Agree. Changed as suggested.

4) *Comment:*
4.6.2.1.7 – Avoid of a continuing cycle of reactions. ASHRAE already well-established and referenced by building codes. -- Philosophical question: Why not pursue a change to the ASHRAE standard instead of overlaying it? What happens when ASHRAE reacts? MAHC then reacts.

Changes to Module/Annex:

Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

5) *Comment:*
4.6.2.1.7 – We have witnessed dramatic improvements in air quality after installing UV systems in existing facilities. Evidentiary comment: We have had an HVAC equipment vendor provide extended coil warranty for systems installed in UV-fitted venues. -- Include some type of benefit for having a UV system. The MAHC should not recognize the benefits of UV, yet ignore it in application of the code. UV use should be incentivized, not penalized. Upsizing an HVAC system could easily cost more in capital and operations than a UV system. The scientific basis appears no more robust for the former than the latter.

Changes to Module/Annex:
Partially Agree. The Annex provides information and committee discussion regarding potential recognition of UV/ozone in fresh air system requirements.

6) *Comment:*
4.6.2.1.7 – There is a point of diminishing returns when it comes to air turnover rates. As turnover rate increases, efficacy decreases. At some point, this matrix could simply result in exponential expense without genuine benefit. -- I question the fundamental logic of piling on above and beyond the ASHRAE standard, which in fact allows for engineering discretion and professional judgment on its own. Has anyone studied representative projects to determine what the unit sizing and operational consequences of this would be? If this logic is to remain, consider an overall cap to the multipliers. – REFERENCE: Furr, A. Keith (ed.). Asymptotic Effect of Rate of Air Change. CRC Handbook of Laboratory Safety, 3rd Edition. Boca Raton, FL: CRC Press, Inc., 1989, p. 105.

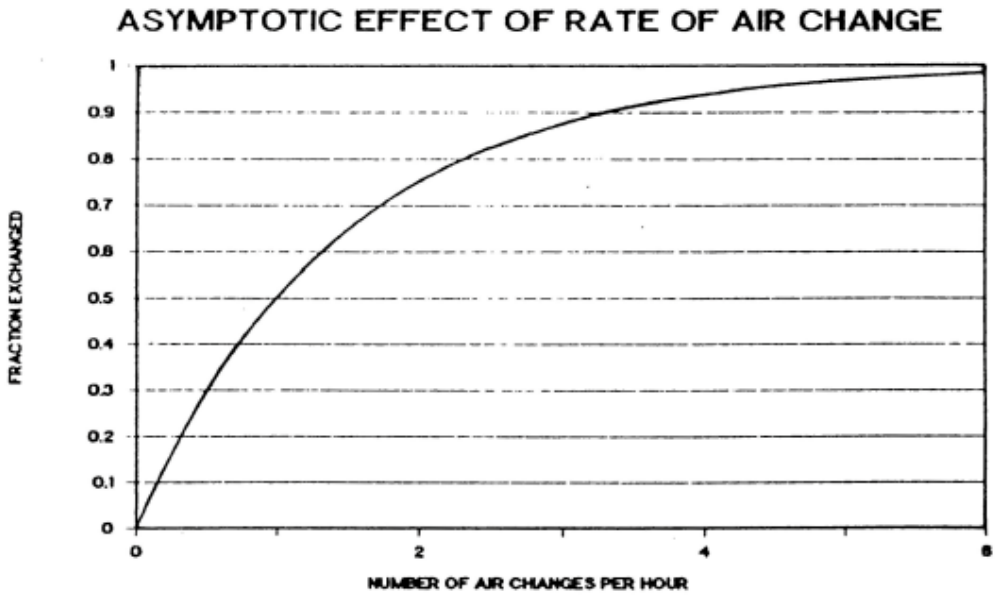

FIGURE 3.3. The effect of increasing the rate of air change diminishes as the rate increases.

Furr, A. Keith (ed.). CRC Handbook of Laboratory Safety, 3rd Edition. Boca Raton, FL: CRC Press, Inc., 1989, p. 105.

Changes to Module/Annex:
Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

7) *Comment:*
4.6.2.1.7.3 – Some areas relying solely on natural ventilation could exceed 90 degree air temp. -- Assume this is intended to be *water* temperature.

Changes to Module/Annex:
Agree. Changed as suggested.

8) *Comment:*
4.6.2.1.1.6 – Allowance should be provided for a some other licensed commissioning agent (other than the design engineer) to perform this commissioning. -- A *qualified, licensed professional engineer* shall commission the ventilation system… -- For example, the commissioning agent must be an

independent party from the design entity in projects seeking LEED™ Credit EA3, "enhanced commissioning".

Changes to Module/Annex:
Agree. (Note- incorrect code section cited-should be 4.6.2.1.16.) Code revised.

9) *Comment:*
4.6.2.1.1.7 – Same as above

Changes to Module/Annex:
Agree. (Note- incorrect code section cited-should be 4.6.2.1.17.) Code revised.

10) *Comment:*
4.6.2.1.1.9 – Requiring the design engineer to make such notifications is an unreasonable expectation and likely creates uninsurable professional liability. -- This should be sole responsibility of manufacturer. – REFERENCE: Recommend consulting professional liability insurance industry opinion on this.

Changes to Module/Annex:
Agree. (Note- incorrect code section cited-should be 4.6.2.1.19.) Code revised.

7. Scot Hunsaker, Counsilman-Hunsaker (St. Louis, MO)

1) *Comment:*
4.6.2.1.1 – The word protect has a much higher standard of care than the word support. The concern is that to protect someone in bad health or with special needs would elevate the standard to an undefined performance level. -- Aquatic Facility building ventilation systems shall be designed, constructed and installed to ~~protect~~ support the health of the building's occupants. – REFERENCE: Encarta Dictionary: Protect: to prevent somebody or something from being harmed or damaged; Support: to provide sufficient or the appropriate conditions or facilities to enable people to live or allow something to function

Changes to Module/Annex:
Agree. Changed as suggested.

2) *Comment:*
4.6.2.1.2 – What constitutes "modified?" The annex suggests that "adding a new aquatic feature" would constitute being "modified." So is it reasonable to assume

that installing a new $5000 spray feature to an existing facility would then require wholesale ventilation design modifications?

Owners of existing indoor aquatic facilities are not likely to upgrade their facility if it triggers a upgrade that is cost prohibitive. They may choose to invest elsewhere or leave the building unimproved, which leads to further deterioration.

The MAHC should not provide barriers to addressing a ventilation deficiency. If an owner voluntarily chooses to make upgrades, this should not trigger bringing the entire natatorium up to current code requirements.

MAHC should also consider a historic building criteria. The United States has some beautiful historic bath houses. A process to allow a building official to approve continued operation with alterations that do not constitute a distinct life safety hazard. -- Ventilation design requirements shall apply to a new or modified (defined as: alterations where the work area exceeds 50 percent of the aggregate area of the indoor aquatic facility). – REFERENCE: The International Code Council: International Existing Building Code 2009, Section 403, 404, 405,411. http://publicecodes.citation.com/icod/iebc/2009/index.htm

Changes to Module/Annex:
Agree. We have defined the term substantial alteration.

3) *Comment:*
4.6.2.1.2 – Why are locker rooms and pool mechanical rooms in the "aquatic facility?" These are typically on different air handling systems as they should be. -- Ventilation design requirements shall apply to a new or modified INDOOR AQUATIC FACILITY including the area of the building's AQUATIC VENUES, the surrounding BATHER and spectator/stadium seating area, ~~mechanical rooms, bath and locker rooms, and any associated rooms which have a direct opening to the AQUATIC FACILITY.~~

Changes to Module/Annex:
Agree. Code revised.

4) *Comment:*
4.6.2.1.7 #1 – All flat water should not be treated equally. Athletes training at a high level are ventilating 3 times what a person playing would be. Training/racing athletes also splash/release more DBP into the air compared to casual recreational users. Competition/training pools should have a higher factor than recreational flat water.

Flat water pools are often competitive in nature. Indoor pools with diving boards often have water agitators to allow divers to see the surface of the water and

sparger systems for training only. The use of these mechanical water agitators should not change the flat water classification.

Small tot pools often have a simple bubbler or water jet. When less than 7% of the flow rate, this should not change the status of the pool or natatorium type.

Agitated water will be eliminated in many instances depending on how strict the interpretation is from code officials. One bit of spray should not classify one as "agitated." -- 1) Flat Water – Aquatic Venue in which the water line is static except for movement made by users or by mechanical means of which the agitation is source is less than 7% of the filter recirculation water flow rate. Diving spargers do not void the flat water definition.

Changes to Module/Annex:
Partially Agree. Diving sparger addressed as suggested.

5) *Comment:*
4.6.2.1.7 – How does the committee know that increasing the ventilation rates will really make the IAQ satisfactory and overcome the consequences of an operator that just doesn't maintain adequate minimum pool water chemistry levels? The science behind these recommendations appears to be missing. A direct quantitative relationship between the increase in the ventilation rates and the measurable achievement of satisfactory IAQ should be presented. -- Using the ASHRAE 62.1 definitions for outside air as a baseline and utilizing the ASHRAE method to determine the minimum outside air requirements and then adding additional fresh air for each AQUATIC VENUE type, the number of cubic feet per minute (cfm) of fresh air for an AQUATIC FACILITY is:
Wet Area x Ra
+
Stadium seating Area x Ra
+
Aquatic venue area x (Ro/ Density factor for that type of area)
+
Deck area x (Ro/density factor for deck)
+
Stadium seating area x (Ro/density factor for seating)
Ra = cfm/ft2 required for the area WITHOUT OCCUPANTS
Ro = cfm/OCCUPANT
OCCUPANT = area in ft2 / density at peak occupancy (ft2/person) ----

Changes to Module/Annex:

Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

6) *Comment:*
4.6.2.1.7 – This approach is problematic from an engineering and scientific perspective. The data should not be manipulated to achieve a pre-determined goal. -- (ANNEX) ~~Design professional experience factored into the final cfm/ft2. Design Professionals knew from experience where the final number needed to be, added in reasonable density factors and then addressed the individual characteristics of the AQUATIC VENUES to include splashing at the surface and the temperature of the water.~~

Changes to Module/Annex:

Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

7) *Comment:*
4.6.2.1.7 – If the year of the standard is not referenced, this may have an unintended consequence of any changes that ASHRAE makes being multiplied by the MAHC. Be referencing the specific standard and year, the MAHC can make changes as appropriate and not be automatically impacted by ASHRAE changes. -- ASHRAE 62 and ASHRAE 62.1 are reference several times in this section. It is recommended that anytime ASHRAE is referenced that the standard year is included. For example: Using ASHRAE 62 -2001-1 definitions for outside air …. – REFERENCE: www.ashrae.org

Changes to Module/Annex:
Agree. Code revised.

8) *Comment:*
4.6.2.1.8 – It seems that UV, ozone and other secondary sanitizers are being held to a different standard as was applied to general ventilation design (see comments to 4.6.2.1.7 two rows prior). Most industry professionals would likely agree that adequately sized UV, ozone and other secondary sanitizers improve IAQ. So why can't these be considered as part of the overall design and ventilation calculations? -- (ANNEX) The efficacy of UV and ozone are well documented for their effect on biological CONTAMINANTs but the photochemistry taking place is a different reaction for DISINFECTION vs. controlling combined CHLORINE levels. Further research is needed to determine the effectiveness of UV and ozone on destroying DBPs before they can be included in the MAHC Ventilation Section. Guidance will be included in the MAHC for the use of UV and ozone for DISINFECTION. It is unknown at this time if the parameters for the equipment to achieve DISINFECTION will also result in the reduction of DBPs.

Changes to Module/Annex:

Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

9) *Comment:*
4.6.2.1.16 – This should not be the responsibility of the design engineer. -- AQUATIC FACILITY ventilation system ~~design engineer~~ manufacturer/installer shall commission the ventilation system in a manner to verify that the installed system is operating in compliance with the design intent.

Changes to Module/Annex:
Agree. Code revised.

10) *Comment:*
4.6.2.1.17 – This should not be the responsibility of the design engineer. -- AQUATIC FACILITY ventilation system ~~design engineer~~ manufacturer/installer shall provide a written statement of commissioning to facility owner.

Changes to Module/Annex:
Agree. Code revised.

11) *Comment:*
4.6.2.1.18 – This should not be the responsibility of the design engineer. -- AQUATIC FACILITY ventilation system ~~design engineer and/or ventilation system~~ manufacturer or installer shall provide facility owner with a ventilation system operating manual which includes:

Changes to Module/Annex:
Agree. Code revised.

12) *Comment:*
4.6.2.1.19 – This should not be the responsibility of the design engineer. -- AQUATIC FACILITY ventilation system ~~design engineer and/or the ventilation system~~ manufacturer or installer shall provide facility owner with notifications of relevant ventilation system recalls, part changes, or SAFETY alerts.

Changes to Module/Annex:
Agree. Code revised.

13) *Comment:*
4.6.2.2.1 – Reference ASHRAE standard year. -- Indoor Aquatic Facility ventilation system design shall provide air turnover rates that comply with ASHRAE 62-2001-1 … -- REFERENCE: www.ashrae.org

Changes to Module/Annex:
Agree. Code revised.

14) *Comment:*
4.6.2.3.1 – What is the scientific basis or justification for the 65% RH threshold? This likely requires a dehumidification system on all indoor aquatic facilities. There are current installations all over the country that operate without dehumidification – they just move a lot of outside air. Unoccupied facilities should only be required to maintain RH and temperatures when not in use (especially if the pool is covered). -- INDOOR AQUATIC FACILITY ventilation system design shall be capable of maintaining the relative humidity average at less than 65% in a 24 hour period when the building is occupied.

Changes to Module/Annex:
Agree. Code revised.

15) *Comment:*
4.6.2.3.2 – The standard as proposed does not address cold plunge pools. It is not uncommon for some therapy pools to be in the 40°F range. This would result in a room 48°F. -- Indoor Aquatic Facility ventilation system design shall be capable of maintaining the facility air temperature at no more than 8° above or 2° below the average Aquatic Venue water temperature, without including Aquatic venues that are below 65°F or exceed 90°F in this design calculation – REFERENCE: http://www.swimex.com/therapy/pools/hot_spa_cold_plunge.html

Changes to Module/Annex:
Requirement for air temperature has been deleted.

16) *Comment:*
4.6.2.4.2 – The words “minimize” and “reduce” are ambiguous and no measure of meeting the standard can be defined. There are gutter air return systems that pull through the gutter or at deck level that violate this language. This language is not in the best interest of the industry. -- ~~Indoor Aquatic Facility ventilation system design shall minimize the air velocities at deck level to reduce direct drafts on Bathers~~

Changes to Module/Annex:

Agree. Code revised.

17) *Comment:*
4.6.2.4.6 – This should not be the responsibility of the design engineer. -- AQUATIC FACILITY ventilation system ~~design engineer and/or the ventilation system~~ manufacturer or installer shall provide facility owner with recommendations for filter replacement type, frequency and pressure differential specifications.

Changes to Module/Annex:
Agree. Code revised.

18) *Comment:*
4.6.2.5.1 – This will have a significant capital cost implication. During extreme cold, heating the makeup air will require significant capital and operational investment. The coldest times that will drive design parameters will be during the night. Be limiting the requirement during occupancy, the design standard maybe more realistic. It's reasonable to think that in the very near future, natatorium air quality will be able to be monitored to bring in more or less outside air depending upon the readings. We can already read combined chlorine levels in the water. So could we require more outside air when these readings are elevated? Why not give the required scientifically-based result rather than stipulating how to design the system? -- Indoor Aquatic Facility ventilation system design shall provide a complete building purge method that will allow for complete exhaust of the building's air volume and replace with fresh air, with no air recirculation at full fan speed for during hours of occupancy.

Changes to Module/Annex:
Agree. Code revised.

19) *Comment:*
5.6.2.1.5 – This should not be the responsibility of the design engineer. -- INDOOR AQUATIC FACILITY operator shall monitor, log and maintain ventilation system set-points and other operational parameters as specified by the AQUATIC FACILITY ~~ventilation system design engineer and/or the~~ ventilation system manufacturer or installer.

Changes to Module/Annex:
Incorporated into revised section wording

20) *Comment:*
5.6.2.1.6 – This should not be the responsibility of the design engineer --

INDOOR AQUATIC FACILITY operator shall implement a ventilation system cleaning program to remove CONTAMINANTs within the equipment in accordance with the AQUATIC FACILITY ~~ventilation system design engineer's and/or the~~ ventilation system manufacturer's or installer's recommendations.

Changes to Module/Annex:
Partially Agree. This section deleted as cleaning/maintenance already included in another section.

21) *Comment:*
5.6.2.1.7 – This should not be the responsibility of the design engineer. -- INDOOR AQUATIC FACILITY operator shall maintain the AQUATIC FACILITY ventilation system ~~design engineer's~~ manufacturer's or installer's original operating manuals and commissioning reports, updates and modification specifications for any modifications.

Changes to Module/Annex:
Agree. Code revised.

22) *Comment:*
5.6.2.2.1 –"Reduce" is too vague. To what degree? A baseline standard should be defined as acceptable. -- INDOOR AQUATIC FACILITY operator shall develop and implement a plan to reduce combined chlorine compounds introduced into the building from operation of AQUATIC VENUES.

Changes to Module/Annex:

Agree. Code revised.

23) *Comment:*
5.6.2.4.1 – This should not be the responsibility of the design engineer -- INDOOR AQUATIC FACILITY operator(s) shall replace or clean, as appropriate, ventilation system air filters in accordance with the AQUATIC FACILITY ~~ventilation system design engineer's and/or the~~ ventilation equipment manufacturer's manufacturer's or installer's recommendations, whichever is most frequent.

Changes to Module/Annex:
Incorporated into revised section wording

8. Michael Keller, Keller HDAC/HVAC Consulting (St. Sauveur, Quebec)

1) *Comment:*
4.6.2.1.7 –1) Flat Water Description add text movement made by users **and/or circulating water.**

C*hanges to Module/Annex:*
Agree. Changed as suggested.

Comment:
4.6.2.1.7 – I'm certain that your group has or is developing a Model on Filtration but I think it extremely important to tie both areas together as the water is the source and cause of all the IAQ issues. The "Ventilation System" needs to control temperature and humidity but unfortunately it can only try to mask the problems that the water is creating! This suggestion is 100% Energy Conservation and an incentive to get owners to understand the importance of Water Filtration and Contaminant Control -- Table 1. An astrix should be note for Ra and Ro if the facility is using RMF [Regenerative Media Filtration] Water Filtration Technology. As we all know the water is the source of all the problems associated with these types of venues. The RMF is an excellent defense for controlling water contaminants especially with their single pass 1 micron performance compared to traditional sand 6-10 micron performance which undoubtedly would reduce the release of di and tri chloramines compounds in the air which get re-absorbed back into the water and continue the cycle. The astrix is simple a notation that if these RMF technology is used in the facility than the reduction of the amount of OA needed for Ra & Ro portion could be reduced if the "Ventilation System" gets feedback confirming that the Combined Chlorine Levels are at a ____ ppm acceptable level. If this level should increase than the "Ventilation System" shall proportionally increase the amount of OA until the calculated amount has been reached. – REFERENCE: Unfortunately, no actual studies have been made to specifically study the impact and address this synergy. On energy conservation, using this strategy would save large operational dollars per year without affecting the health of the occupants.

Changes to Module/Annex:

Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

2) *Comment:*
4.6.2.1.8 – The Designer needs to confirm that the main facility needs to be under a negative pressure and all adjoining rooms i.e. locker, mechanical and offices should be under positive pressure. While the chemical storage should have its own code.
1) Building size (___ sqft & ____cuft) and layout

2) Aquatic Facility size (___sqft & ____cuft)
8) add **or provide direct source capture exhaust techniques i.e. Hot Tubes/Spas.**

Changes to Module/Annex:
Agree. Code revised.

3) *Comment:*
4.6.2.1.16 – These types of facilities need to be commissioned twice once in the heating and again in the cooling season. This way the facility would be 100% protected from the design intend.

Changes to Module/Annex:
Agree. We have changed the section to read: A qualified, licensed professional engineer shall commission the ventilation system to verify that the installed system is operating properly in accordance with the system design.

4) *Comment:*
4.6.2.1.17 – Add **including all 3rd party reports such as AIR BALANCING and a copy of this must be sent to the Ventilation System Manufacturer before Initial Start-Up is performed.**

Changes to Module/Annex:
Partially Agree. Code revised

5) *Comment:*
4.6.2.2.1 – These air turnover rates i.e. Air Changes per Hour need to be stated: 4-6 Air Changes per Hour or 6-8 Air Changes per Hour for Spectator Areas. This should not be tied into section 4.6.2.1.7 as this is the amount of fresh air and that would only be a percentage of the actual air changes per hour. This is confusing and could lead to mis-calculation!

Changes to Module/Annex:
Agree. Code revised..

6) *Comment:*
4.6.2.2.2 – State Types of Acceptable Fail Safes. IE Air Flow Monitoring Stations can provide exact read out of CFM being introduced as Fresh Air and/or Exhaust Air. These have routinely been used in hospital applications for the last 25+ years.

Changes to Module/Annex:
Agree. Code revised to require system features to notify operator if outdoor air entering the Aquatic Facility is less than 0.48 cfm/ft^2.

7) *Comment:*
4.6.2.3.1 – Refer to copy of document titled "MICHAEL KELLER – ADDITIONAL INFO" as reference as well as my Bio describing my qualifications and back ground. -- This is extremely dangerous and needs to be change. First to state an average RH in a 24 hour period is flawed. RH is relative to something else i.e. dry bulb, wet bulb, dew point, etc. To allow this average 65%RH to pass will cause all sorts of other health related problems for the occupants. Please refer to the attached Arundel et Al "Optimum RH range for minimizing adverse health effects" This study and supporting graph has in my opinion been misapplied in the indoor natatorium field for the last 35 years. I have contacted Mr. Anthony Arundel and he has confirmed to me that this study was not done in an indoor natatorium environment and in fact he could not tell me what temperature i.e. Dry Bulb was the study and graph based on. The graph clearly indicates that the Optimum RH Zone is from 40% to 60% with 50% being the optimum RH. Assuming that study was in fact based on a 75F Dry Bulb Temperature the resulting 50% Optimum Zone would result in a 55F Dew Point! This is the standard AC Leaving Air Temperature that designers use when designing Residential, Commercial and Industrial AC applications. Considering that these Aquatic facilities Dry Bulb Temperatures vary from 82F to 86F allowing them to have an average 24 hour 65%RH will be catastrophic. The average 24 hour RH should never exceed 55%RH and in certain high temperature spaces should not exceed 52.5%! – REFERENCE: Arundel et Al 1988 "Optimum RH Range for Minimizing Adverse Health Effects"

Changes to Module/Annex:
Agree. Code revised.

8) *Comment:*
4.6.2.3.2 – Having such a large difference in dry bulb facility air is again very dangerous and will cause more problems and legal implication than what is trying to be accomplished. When you allow for the air to swing by 6 degrees and if the section above is not altered than when the ventilation system is designed for the 8F to maintain the 24 hour 65%RH and occupants complain about the chilling effect which they will certainly do, owner lowers the air temperature and ventilation system will be undersized dramatically and RH will soar over 70% to 75% for the same 24 hour period. I would strongly suggest that the above 2.6.2.3.1 be changed and the following wording be changed to: **facility air temperature at no more than 3F above or 0F below the average aquatic venue water temperature, I would also add the warning that the ventilation**

system design engineer and manufacturer provide performance information to the owner in writing as to the under or over performance of the proposed ventilation system to be specified and/or installed.

Changes to Module/Annex:
Requirement for air temperature has been deleted.

9) *Comment:*
4.6.2.4.1 – Add Recommendation of proving this with the use of CFD [Computational Fluid Dynamics] Technology

Changes to Module/Annex:
Partially agree. No code change but discussion added in Annex.

10) *Comment:*
4.6.2.4.2 – Add State FPM as guideline. Since ASHRAE evaporation formula are based on 10 FPM which again in my opinion is too low. 30 to 60 FPM should be a standard as I had mentioned before these facilities have two unique operating conditions 1] heating i.e. 30 fpm and 2] cooling 60 fpm. This has been discovered by the more than 6 CFD natatorium analysis's I have been part of since 2007 including Great Wolf Lodge Mason Ohio.

Changes to Module/Annex:
Agree. Drafts on bathers deleted from code.

11) *Comment:*
4.6.2.4.3 – Add **air flow that washes exterior walls, emergency door, skylights and windows with cover these areas with 5 cfm/per sift of treated supply air to eliminate condensation and mold growth. Ensure that the facility has a vapor barrier on all walls, roof and floor.**

Changes to Module/Annex:
Partially agree. Code revised. However, disagree with vapor barrier comment as a vapor barrier requirement is outside the scope of this section.

12) *Comment:*
4.6.2.4.4 – Recommend the use of specialized carbon chloramine air filtration as another means to lower fresh air requirements if the "Ventilation System" gets feedback confirming that the Combined Chlorine Levels are at a ____ ppm acceptable level. If this level should increase than the "Ventilation System" shall proportionally increase the amount of OA until the calculated amount has been reached.

Changes to Module/Annex:
This has been added to the annex as part of further research for reduction of outdoor air

13) *Comment:*
4.6.2.5.1 – Add Allow for 50% purges based on the following requirements:

- use of RMF and/or Specialized Carbon Air Filtration,
- mechanical controlled ventilation system,
- full or partial heat recovery on exhaust and fresh air,
- supply duct are capable to adjust air flow so that all exterior surfaces air flow has not been reduced.
- return ducts lower return is active while any high returns are reduce to handle new air flow i.e. 50%
- Mechanical system can reduce Supply Air through VFD and confirm Supply CFM and confirmation that Fresh Air is at the Supply CFM and Exhaust Fan is exhausting Fresh Air CFM x 1.1 to ensure Aquatic facility is at the recommended negative pressure. This could also be accomplished by a pressure differential sensor which regulates the exhaust fan to ensure this at all times. The new 50% purge can be programmed to run a predetermined amount of time based on the design air turnover air or air change rate or can be manual controlled for emergency evacuation.

This will allow the owner of the facility to save enormous amount of operating expenses associated with the standard purge techniques that have been incorporated for the last 10 to 15 years. This also will allow the owner to setup a preventative IAQ program that will allow the owner to execute this purge automatically at the end of each day or second day, or fifth day…according to the facility's loading. It has been poorly studied but the CDC involvement in the Great Wolf Mason OH incident has shown encouraging new data about these facilities and how, when and why they become problematic!

Changes to Module/Annex:
Partially Agree. Code revised.

14) *Comment:*
5.6.2.3.2 – Ventilation System Manufacturer must provide DDC control c/w logging of Space & Unit Entering Air: Temp & RH, OA/Fresh Air: Temp & RH, Exhaust Air Temp & RH, All Water In/Out Temps if applicable, Supply Air: Temp & RH, Fault Logging, System Alarm Notification, & Moisture Removal Lbs/hr or equivalent logging. Total, Free, & Combine Chlorine as well as PH logging from 3rd party controllers.

Changes to Module/Annex:
Comment unclear; doesn't correlate with cited code section.

15) *Comment:*
5.6.2.5.1 – Refer to above 4.6.2.5.1 suggestion……..

Changes to Module/Annex:
Partially Agree. Code revised.

9. Boyd Morgenthaler, ASHRAE Engineers (Anchorage, AK)

1) *Comment:*
GLOSSARY – The term "AQUATIC FACILITY" as written is confusing and limiting. What does " a single management structure" mean? Is a spectator area with an independent ventilation system and separated by a glass wall still part of the "AQUATIC FACILITY"? If a locker room opens to a hall that opens to the venue space with no intervening doors, is it still a direct opening to the AQUATIC FACILITY? If the pool equipment room is separated from the venue area without direct openings, is it still part of the "AQUATIC FACILITY"? -- Revise the term "AQUATIC FACILITY" as follows: "AQUATIC FACILITY" means a building or a subpart of a larger building that encloses AQUATIC VENUE and its bather and spectator areas, toilets, showers, lockets rooms, pool offices, public lobbies, ticketing, pool equipment rooms, storage rooms, mechanical and electrical rooms and other directly related spaces.

Changes to Module/Annex:
Disagree. Definition is common to all other modules within the MAHC.

2) *Comment:*
GLOSSARY – The term "AQUATIC FACILITY" includes spaces that may be properly ventilated independently from the ventilation and humidity control system(s) designed to serve the Aquatic Venue(s). Clarity of communication will be enhanced by using two different terms (AQUATIC FACILITY and NATATORIUM). Several requirements through this module apply to a Natatorium but are not appropriate for other rooms in an Aquatic Facility; for example, a complete ventilation purge (4.6.2.5.1) is not required for the mechanical and electrical rooms, Environmental separation by an engineered air flow systems allow the natatorium boundary to end at a hallway or room (such as an open life guard office) that is positively pressurized by DBP free makeup air that flows into the natatorium. -- Add the term "NATATORIUM" defined as follows: "NATATORIUM" means a defined area within an AQUATIC FACILITY that encloses one or more Aquatic Venue and is environmentally separated from

other spaces in the AQUATIC FACILITY by walls, doors, windows or an engineered air flow control system. Reviewer comment: Another word could be substituted for “Natatorium” as long as the same concept is conveyed.

Changes to Module/Annex:
Partially Agree. New definition added for “Indoor Aquatic Facility”.

3) *Comment:*
GLOSSARY – The terms ‘fresh air” is used interchangeably with “outdoor air” and “outside air”, but each is defined differently by ASHRAE. The intent of Standard 62 is to provide Outdoor air. -- Add the term “OUTDOOR AIR” defined as follows: “OUTDOOR” is air taken from outside a building or taken from outdoors and not previously circulated through the system, and that complies with the National Ambient Air Quality Standard. – REFERENCE: ASHRAE Terminology of Heating, Ventilation, Air Conditioning, & Refrigeration, Second Edition; ASHRAE Standard 62

Changes to Module/Annex:
Partially Agree. The term “outdoor air” is now used.

4) *Comment:*
4.6.2.1.2 – “INDOOR AQUATIC FACILITY” is not defined -- Delete the word INDOOR.

Changes to Module/Annex:
Partially Agree. Definition added.

5) *Comment:*
4.6.2.1.3 – Reader cannot find the definition of “Open Building” in the 2009 IBC. -- Research and revise as required

Changes to Module/Annex:
Agree. Code revised.

6) *Comment:*
4.6.2.1.5 -- This reference is unnecessary. The requirement to comply with adopted state and local building codes is a self-evident constraint. -- Delete this entirely

Changes to Module/Annex:

Agree partially but have kept reference to applicable codes.

7) *Comment:*
4.6.2.1.7 -- Clarity. See suggested definitions in earlier comments -- Replace the term “AQUATIC FACILITY” with “NATATORIUM” in five (5) places. Only the last paragraph should use both terms, as follows:

> Although AQUATIC FACILITY ventilation system planning will include consideration of mechanical rooms, bath and locker rooms, and any associated rooms which have a direct opening [connection] to the AQUATIC FACILITY [NATATORIUM], these non-wet areas are not included in the section 4.6.2.1.7 calculation.

Changes to Module/Annex:
Disagree. Code revised, terminology changed to indoor aquatic facility.

8) *Comment:*
4.6.2.1.7 -- Clarity. See suggested definitions in earlier comments. -- Replace the terms “fresh air” and “Outside Air” with “OUTDOOR AIR” in all cases.

Changes to Module/Annex:
Agree. Code revised.

9) *Comment:*
4.6.2.1.7 #4 & Table 1 -- Based on experience, an Occupant Density Factor of 20 for a Flat Water pool seems excessive from the perspective of actually occupancy. A high occupant density for ventilation calculations is conservative, but may be unrealistic for other applications -- Add: “Density Factors used in this Section are used for calculating Ventilation Requirements only, and are not intended for calculation of Exiting Requirements or for Surge Tank calculations.

Changes to Module/Annex:
Agree. Code revised.

10) *Comment:*
4.6.2.1.7 -- A very high concentration of Disinfection By-Products (DBP) often occurs during Breakpoint Chlorination when there is no bather load. At breakpoint the operator can be quickly exposed to rapidly released chlorine gas as the pool water comes to equilibrium, necessitating a high exchange rate of outdoor air. In cold climates it is generally difficult to provide a heating system to accommodate a higher exchange rate and three ACH appears to be adequate based on experience, however that is anecdotal. Three ACH provides a 20 minute turnover of air, which is relatively slow. If good scientific data is available to refine this solution it is most welcome, but lacking data a minimum ACH rate

should be established -- Add a introductory sentence to the first paragraph and reword the following sentences to convey the following:

> "The ventilation system for the NATAORIUM shall provide a minimum of three (3) air changes per hour (ACH) of OUTDOOR AIR or the minimum OUTDOOR AIR calculated in this section, whichever is greater."

Changes to Module/Annex:
Disagree. However Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

11) *Comment:*
4.6.2.1.8 --7) change "outside air" to "OUTDOOR AIR"; 9) Delete the word "INDOOR".

Changes to Module/Annex:
Agree. Code revised.

12) *Comment:*
4.6.2.1.9 -- This is an unnecessary statement that adds confusion. None of the previous or subsequent paragraphs describe HOW the ventilation air will be transported, so nothing in this model code as written would prohibit air transport via a new technology. Future technological developments may reduce the need for OUTDOOR AIR ventilation, but that should be addressed in the future after adequate experience is gained. -- Delete this entirely.

Changes to Module/Annex:
Agree. Code revised to be more general about other outdoor air introductions not associated with the ventilation system.

13) *Comment:*
4.6.2 -- Negative air pressurization of the NATATORIUM is required to inhibit DBP odor (trichloramine) from transferring to surrounding rooms. In northern climates this also reduces moisture flow into insulation and around exterior doors and is essential to reduce icing. -- Add: "Negative pressure 4.2.6.x.x The NATATORIUM shall be designed and controlled to maintain a negative air pressure relative to all surrounding spaces." – REFERENCE: 2007 ASHRAE APPLICATIONS p 4.6

Changes to Module/Annex:
Agree. Code revised.

14) *Comment:*
4.6.2.1.10 -- Change “fresh air” to “OUTDOOR AIR”. Delete the word “INDOOR

Changes to Module/Annex:
Partially Agree. All references to “fresh air” changed to OUTDOOR AIR.

15) *Comment:*
4.6.2.1.11 -- Change “fresh air” to “OUTDOOR AIR”. Delete the word “INDOOR

Changes to Module/Annex:
Partially Agree. All references to “fresh air” changed to OUTDOOR AIR.

16) *Comment:*
4.6.2.1.12 -- Delete the word “INDOOR AQUATIC FACILITY” with “NATATORIUM”

Changes to Module/Annex:
Disagree. The term Natatorium is too restrictive on defining the broad based application where the code will be used.

17) *Comment:*
4.6.2.1.13 -- Ambiguous as written. The Code should allow design flexibility in tropical and semi tropical climates. Daily operator control to account for varying winds and stack effect should be allowed, hence the wording “continuously controlled open” -- Delete entirely and replace with: “Natural ventilation of the NATATORIUM calculated in accordance with the ASHRAE Handbooks may be substituted for mechanical ventilation only if all the planned exterior openings will be continuously controlled open throughout every day of the year regardless of season.”

Changes to Module/Annex:
Agree. Code revised.

18) *Comment:*
4.6.2.1.16 -- The Code should only address WHAT should be done, not WHO does it. Other contractual requirements may preclude the design engineer from performing this task -- Revise to read as follows: “AQUATIC FACILTY ventilation systems shall be commissioned to verify that the installed system is operating properly in accordance with the system design.”

Changes to Module/Annex:

Partially Agree. Code revised and now indicates " …qualified , licensed professional shall commission…"

19) *Comment:*
4.6.2.1.17 -- Other contractual requirements may preclude the design engineer from performing this task. "Commissioning Authority" is the proper and current term of art. -- Replace "design engineer" with "Commissioning Authority" – REFERENCE: ASHRAE Terminology of Heating, Ventilation, Air Conditioning, & Refrigeration, Second Edition

Changes to Module/Annex:
Partially Agree. Code revised regarding submission of written statement.

20) *Comment:*
4.6.2.1.18 -- The Code should only address WHAT should be done, not WHO does it -- Reword the first sentence to read: "The facility owner shall be provided with a ventilation system operating manual which includes:"

Changes to Module/Annex:
Disagree. For clarity and enforceability, the responsible party must be designated. Code revised.

21) *Comment:*
4.6.2.1.19 -- This is impractical and unenforceable. The design engineer is not in a position to know about product changes or alerts and there may be dozens of equipment manufacturers associated with the job. This is a product liability issue that is outside the scope of a health code. – DELETE

Changes to Module/Annex:
Agree. Code revised.

22) *Comment:*
4.6.2.2.5 -- Tagging each piece of equipment is insufficient to communicate the entire picture to the operator; furthermore, designs and equipment might be changed in the future rendering the information on old tags obsolete. A one-line diagram is easy to maintain and update. -- Delete entirely and replace with: "Post a NATATORIUM ventilation system one-line diagram that diagrammatically shows and identifies the fans, ductwork, air intakes and exhausts, including controlled exterior openings and quantifies the OUTDOOR airflow CFM into the NATATORIUM and EXHAUST airflow CFM out of the NATATORIUM. The

diagram shall include the date of the design and identify the design engineer." Add definition "CFM means cubic feet per minute of airflow".

Changes to Module/Annex:
Agree. Requirement for permanent data plate/label deleted.

23) *Comment:*
4.6.2.2.1, 4.6.2.2.2, 4.6.2.2.3, 4.6.2.3.1, 4.6.2.3.2, 4.6.2.4.1, 4.6.2.4.2 -- Delete the word "INDOOR AQUATIC FACILITY" with "NATATORIUM"

Changes to Module/Annex:
Disagree. The term Natatorium is more restrictive than the intended applicability of the code. However, code revised to include definition for Indoor Aquatic Facility.

24) *Comment:*
4.6.2.4.1 – Wording created ambiguity. -- Replace "building that" with "space to"

Changes to Module/Annex:
Agree. Changed as suggested.

25) *Comment:*
4.6.2.4.3 -- Stating the health objective is more effective that attempting to dictate a solution that may not apply in all circumstances -- Delete and replace with: "NATATORIUM architectural and engineering design shall prohibit condensation and mold growth on building surfaces."

Changes to Module/Annex:
Disagree on wording but it has been revised.

26) *Comment:*
4.6.2.4.4 -- Sentence is meaningless. Filters are addressed in 4.6.2.4.5 -- Delete entirely.

Changes to Module/Annex:
Agree. Code revised.

27) *Comment:*
4.6.2.4.6 -- The Code should only address WHAT should be done, not WHO does it. -- Delete the words "engineer and/or ventilation system manufacturer shall provide facility owner" and substitute "shall include"

Changes to Module/Annex:
Disagree. For clarity and enforceability, the responsible party must be designated. However, code revised to specify it's the responsibility of the contractor installing the system.

28) *Comment:*
4.6.2.5.2 -- Three ACH provides a 20 minute turnover of air, which is relatively slow but appears to be adequate based on experience. If good scientific data is available to refine this solution it is most welcome, but lacking data a minimum ACH rate should be established. -- Replace "INDOOR AQUATIC FACILITY" with "NATATORIUM". Delete ", with no air recirculation at full fan speed" and substitute "at a minimum rate of three (3) air changes per hour of OUTDOOR AIR"

Changes to Module/Annex:
Section cited should be 4.6.2.5.1. Partially agree. Code revised.

29) *Comment:*
Section 5/general -- Delete "INDOOR" when referring to the "AQUATIC FACILTIY"

Changes to Module/Annex:
Disagree. Code revised to include definition for Indoor Aquatic Facility..

30) *Comment:*
5.6.2.1.7 – The design engineer may not be the entity providing the manuals and reports. -- Delete "design engineer's"

Changes to Module/Annex:
Partially Agree. Code revised.

10. Chris Adams, Adams Companies, Inc. (Mooresville, NC)

1) Comment:
4.6.2.1.18 --Purge is being promoted by several large Pool Equipment suppliers to handle "shocking" the pool. If maintained properly, purge is not required nearly to the extent claimed, and several studies indicate it is in many cases not effective.

Better control required, Purge is a band-aid approach -- I am not a proponent of requiring purge cycles in equipment at all. I don't feel this should be a requirement since it is more of a band-aid approach to begin with.

Changes to Module/Annex:
Disagree. The intent of the purge ability is to address maintenance of air quality under high load conditions and address emergencies. Code has been revised to clarify that it is not required to heat or otherwise treat this air, but to provide a method to quickly purge the building.

Comment:
4.6.2.1.7 & 8 -- This is a mandate that has up to 3X the amount of air necessary. Currently the way we design, we are over the current industry standard by 1.5 – 2X in some cases since we do review O/A and spectator load requirements, not just sq-ft like many pool equipment suppliers design. Going 3X does appear extreme as we have sites that are perfect air quality without the 3X stipulation. -- The true language is more research is necessary, not a whole new mandated method that takes up by 3X

Changes to Module/Annex:

Partially Agree. Code revised to delete additional outdoor air requirements and now specifies using ASHRAE standards for design of outdoor air requirements.

2) *Comment:*
4.6.2.2.1 -- This talks about fail safe? What does that mean? Is this 100% redundancy? Need more detail as to what is being proposed -- Clarification Needed

Changes to Module/Annex:
Agree. (Note section relevant to comment is 4.6.2.2.2.) Code revised to require system features to notify operator if outdoor air entering the Aquatic Facility is less than 0.48 cfm/ft2 Sentence reworded.

3) *Comment:*
4.6.2.2.5 -- Data tags on exterior fade and disappear. Equipment supplier should include this data on the interior as well in a control cabinet. -- Data tag required on interior in addition to exterior

Changes to Module/Annex:
Agree. *Requirement for permanent data plate/label deleted.*

4) *Comment:*
4.6.2.3.1 -- Cannot guarantee RH level for this style system. They are effective in some areas. Need a caveat to deal with it since this style system is at the mercy of mother nature. Does this mandate mechanical means are now also required? -- Need a section added for Ventilation only Systems

Changes to Module/Annex:

Partially Agree. Code revised

5) *Comment:*
4.6.2.3.2 -- Same as above, need caveat for ventilation only systems.

Changes to Module/Annex:
Requirement for air temperature has been deleted.

6) *Comment:*
4.6.2.4.3 -- Historically, this means blowing air on glass and walls. We have projects that have good air movement, limited "washing" and still maintain good air, but it does require good air distribution and mass flow. We have found a sweep method and source capture extremely effective. -- Need to specify proper air movement and distribution, not "washing"

Changes to Module/Annex:
Agree. Code revised.

7) *Comment:*
4.6.2.5.1 -- Purge should not be mandated. See comments above on 4.6.2.1.18

Changes to Module/Annex:
Disagree. The intent of the purge ability is to address maintenance of air quality under high load conditions and address emergencies. Code has been revised to clarify that it is not required to heat or otherwise treat this air, but to provide a method to quickly purge the building.

8) *Comment:*
Acronym -- Add DCV – Demand Control Ventilation. This is one area of study that is evolving and testing is happening to see about truly bringing in fresh air as necessary to eliminate chloramines contamination. We have a test site right now, but it will be some time before anything is ready in this area and more research is required, but would be good to have the acronym defined.

Changes to Module/Annex:
Disagree. Term not used in module so there is no need to include a definition.