

Appellants Response to Taylor Engineering Report by Larry Spielvogel, PE. FASHRAE, and Mark Lentz, PE.
June 5, 2010

Following is the exact text of the Taylor Engineering report starting with his Executive Summary. Taylor Engineering (Taylor) was engaged by the USGBC as an independent consultant. The independent consultant's comments are in black and red. Where shown in red, the independent consultant's verbatim comments support and confirm the allegations in the appeal. The detailed responses by the appellants are in blue and follow each item in the independent consultant's report. It should also be noted that the allegations shown by Taylor are not complete. For complete allegations, refer to the appeal.

It must be emphasized that LEED® Certification is granted on the design documents and completed construction. While changes may have been made post construction that might bring this project closer to compliance with the LEED® prerequisites, those changes cannot be considered as the basis for LEED® Certification. Therefore, as stated in the appeal, even a single instance of noncompliance with the ASHRAE Standards is conclusive grounds for not meeting the LEED® mandatory prerequisites, and thus not qualifying for LEED® Certification.

What really matters in the end is whether LEED® Certification really means something in the court of public opinion or whether it is viewed as an expensive, frivolous and meaningless pursuit of a valueless ornament to be displayed in someone's lobby.

Executive Summary

While I disagree with most of the complainants' claims, there were several violations of Standard 62.1 and Standard 90.1 requirements in the design as originally documented. As such, the original design did not meet Indoor Environmental Quality (EQ) Prerequisite 1 and Energy and Atmosphere (EA) Prerequisite 2 of LEED NC version 2.1. However, based on follow-up documentation provided by the design team in response to our comments, I feel the project provides a sufficient level of compliance with these Standards and hence the LEED prerequisites. While I am not fully confident the project merits all of the EA Credit 1 Enhanced Energy Performance points awarded to it, the design team diligently responded to several rounds of comments based on our detailed review of the DOE-2.2 simulations and it appears that they reasonably followed the modeling rules established by ASHRAE Standard 90.1. Hence I accept their EA Credit 1 claim of 7 points.

Appellant Response: The central thesis of the appeal is that the subject facility did not qualify for LEED® certification at any level because this facility, both as designed and as constructed, failed to comply with LEED® Prerequisite requirements. To award a LEED® NC 2.1 Gold Certification on the basis of a falsified application is a major embarrassment to USGBC and the profession that exposes the underlying weakness of the USGBC certification process. Instead of acknowledging the weaknesses and working to correct them, in January 2010, USGBC chose to put the appellants on notice that the certification of this facility would not be withdrawn. At that point, it was apparent

that USGBC would attempt to discredit the appeal. The problem with this high-risk strategy is that when dealing with legitimate issues, the parties involved must rely on misrepresentation and obfuscation, and they tend to get caught in their lies and misrepresentations. These are now on full display for the entire world to see with this document.

The published USGBC criteria provide clear and unambiguous requirements for LEED® Certification. For Standard 62.1 compliance, it even goes so far as to specify the precise computational methodology to be used to arrive at the required ventilation requirements. USGBC's published policy is that if the design does not meet the prerequisites, the facility does not qualify for Certification at any level. Nowhere in the USGBC criteria does it say, "Close is good enough" or "Oh, well, we messed up, they didn't qualify but they can keep the Certification, anyway." This kind of response, even once, undermines the core credibility of USGBC, devalues the work of those design and construction professionals who do try to meet their responsibilities, and devalues the accomplishments of the whole body of legitimate achievements.

- Paragraph four of the Introduction to the LEED® Green Building Rating System, Version 2.1, page I, states: "This rating system documentation states the basic intent, requirements and documentation submittals that are necessary to achieve each prerequisite and voluntary "credits." Projects earn one or more points toward certification by meeting or exceeding each credit's technical requirements. ***All prerequisites must be achieved in order to qualify for certification.*** Points add up to a final score that relates to one of four possible levels of certification."
- LEED® Version 2.1 compliance, Prerequisite Requirement EA-2 states: "***Design*** the building to comply with ASHRAE/IESNA Standard 90.1-1999 (***without amendments***), or the local energy code, ***whichever is more stringent.***" The prerequisite "Intent" states that the purpose of this requirement is to: "*Establish the minimum level of energy efficiency for the base building and systems.*"
- LEED® Version 2.1 compliance, Prerequisite Requirement EQ-1 states: "*Meet the requirements of voluntary consensus standard ***ASHRAE 62-1999, Ventilation for Acceptable Indoor Air Quality, and approved Addenda (See ASHRAE 62-2001, Appendix H, for a complete compilation of Addenda) using the Ventilation Rate Procedure.***" The Intent reads: "Establish minimum indoor air quality (IAQ) performance to prevent the development of indoor air quality problems in buildings, thus contributing to the comfort and well-being of the occupants."*

One focus thrust of the appeal was on the design of eight air handling systems employing variable air volume and terminal reheat. The design of the terminal air delivery systems for those air handling systems were very carefully evaluated for compliance with LEED® prerequisite requirements EA-2 and EQ-1 because it was readily apparent to the appellants that this portion of the system was incorrectly designed and constructed.

The violations of the prescriptive requirements were obvious and pervasive with 2,333 separate violations identified. The initial design utterly failed to comply with the prescriptive reheat restrictions of ASHRAE Standard 90.1-1999, Section 6.3.2.1. This was confirmed by the USGBC independent consultant on page 4 (allegations 9 and 13) of his report. The design also clearly failed to meet the ventilation requirements contained in Table 2 of Section 6.1.3, and did not employ the

Ventilation Rate Procedure defined in Section 6.1 and 6.1.3.1 of ASHRAE Standard 62.1-1999, as amended. This was also confirmed by the USGBC independent consultant on pages 4 (allegations 13 and 18), 6 (allegation 19) and 8 (allegation 25) of his report.

Ventilation Rate Procedure calculations are simple. They produce precise, predictable, and consistent results. These results should not vary substantially between consultants using the same base data and correct methodology. The same applies to the substandard ventilation rates that were until recently permitted under COMM 64.0403 of the Wisconsin Administrative Code. Ventilation calculations were carefully prepared by the appellants for the seven VAV systems using both methodologies to compare the results.

The method of computing ventilation rates at the air handling system permitted under the Wisconsin Code at the time is simply the larger of the sums of the minimum room ventilation air flows or the total amount of exhaust air served by the system. This was the same method permitted by ASHRAE Standard 62 prior to the adoption of ASHRAE Standard 62-1989. While “code legal” in Wisconsin at the time of design, this method does not comply with LEED® criteria which explicitly required the ANSI/ASHRAE Standard 62.1-1999 ventilation rate procedure to be used. The fact that the designers of Northland Pines High School used the disallowed methodology was verified by the fact that the appellants were able to reproduce, with no significant error, the same ventilation rates for each system as the designers did. As such, the appellants were able to precisely determine how the designers arrived at their ventilation numbers. Further evidence to this effect was the fact that the State of Wisconsin required the designers to reduce the minimum flows to all air terminal units served by three air handling units, with the new minimum air flows taken directly from documents provided to Safety & Buildings by the appellants, without deviation.

The problem with the old method, recognized more than 20 years ago, is that while ventilation is generally distributed within a facility on a basis that is proportional to the air flow rate and the amount of outdoor air is controlled thermally, the actual need for ventilation varies from one space to another and is completely independent of thermal considerations. VAV systems are a special case. They derive their thermal efficiency advantages by compromising ventilation and this is why they have been identified as poor IAQ systems in the ASHRAE Handbook since 1992. The total volume of air to each individual space is varied based on thermal requirements of that space which is also unrelated to the need for ventilation. This means that the actual amount of air delivered to any space served by these systems changes dynamically and the amount of outdoor air provided is affected by two separate control loops. This can reduce the actual rate of ventilation to as little as 4-6% of that required under some conditions of operation.

ASHRAE Standard 62-1989 introduced a new methodology to overcome this deficiency. The central thesis of ASHRAE Standard 62-1989 was that the HVAC system must introduce outdoor air in the amounts required in Table 2 to each occupied space under all conditions of occupancy and operation. This is the very same methodology required by Standard 62.1-1999, with addenda.

ASHRAE issued Interpretation IC 62-1999-28 [Appeal Appendix 9] which clarified the correct use of the Ventilation Rate Method with VAV systems, introducing two different possible methodologies

to address this deficiency. Interpretation IC 62-1999-28 was formally written into the standard with the issuance of Addendum N to Standard 62.1-2001, and published with the issuance of Standard 62.1-2004. While compliance with Addendum N is not a requirement for LEED® NC 2.1, compliance with Interpretation IC 62-1999-28 is required.

Ventilation calculations were carefully prepared by the appellants for all seven VAV systems comparing the air flow rates as designed with minimum and outdoor air flow rates consistent with the reheat restrictions of the local Code, ANSI/ASHRAE/IESNA Standard 90.1-1999, and Standard 62.1-1999, plus addenda. This permitted the appellants to not only establish what the correct ventilation rates should be, but also determine the basis upon which ventilation rates were actually computed. These prescriptive calculations also established the fundamental need for energy recovery on all seven systems for modeling purposes. These calculations are found in Appendix 1 of the Appeal.

The impact of the requirement for compliance with both ASHRAE Standard 62.1 and ASHRAE Standard 90.1 on the design of VAV air handling systems is significant. Standard 90.1 restrictions on reheat significantly reduce the permissible minimum rates of ventilation at the air terminal units while Standard 62.1, Table 2, increases minimum ventilation requirements are between 2-4 times those required by Wisconsin Code COMM 64.0403. The reduction in the minimum air flow requirements at the air terminal units increases the outdoor air fraction required for compliance. Because VAV systems reduce energy usage by actively compromising ventilation, ASHRAE Interpretation IC 62-1999-28 substantially increases the percentage of outdoor air required on VAV systems to comply with Standard 62.1. The initial design clearly failed to comply with the requirements of EA-2 and EQ-1. One of the consequences of this failure was that the increase in outdoor air fraction on all seven VAV systems triggered the exhaust air energy recovery requirements of ASHRAE Standard 90.1-1999, Section 6.3.6.1. Correcting these design errors will be extremely costly to the Northland Pines School District.

The USGBC independent consultant confirmed the above facts in his report. To effectively defend an apparent decision by USGBC to not revoke previously granted LEED® NC2.1 Gold certification, the independent consultant functionally needed to demonstrate compliance with Section 6.1 of ASHRAE Standard 62.1-1999 while decoupling the requirements for compliance of Section 6.3.2.1 of ASHRAE Standard 90.1-1999.

- For Standard 62.1 compliance, the independent consultant completely failed to address how or where the appellants' position may have been in error and took positions that were contrary to the formal ASHRAE interpretations included in the appeal.
- For Standard 90.1 compliance, the independent consultant alleges the use of the Energy Cost Budget Method and uses this to make wholesale denials of appeal points. There are multiple fatal flaws in his arguments. To restate, to qualify for Prerequisite EA-2, the design must “comply with ASHRAE/IESNA Standard 90.1-1999 (*without amendments*), or the local energy Code, *whichever is more stringent.*”
 - Section 11.4.3 of ASHRAE Standard 90.1-1999 requires that for modeling the *budget* system that “minimum volume setpoints for VAV reheat boxes shall be 0.4 cfm/ft² of floor area consistent with 6.3.2.1,” and that the minimum outdoor air ventilation rates be the same for

- both *budget* and *proposed* designs. If this is the case, the *budget* model used for comparison would be incorrect and the whole *Energy Cost Budget Analysis* on which compliance is claimed would be invalid and therefore technically worthless.
- Under Wisconsin Code COMM 63.1070, System Analysis Design, a building designed using system analysis design shall comply with IECC Section 806.
 - IECC 806.5 Documentation states that energy analysis and supporting documentation “shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. The information documenting compliance shall be submitted in accordance with Sections 806.5.1 through 806.5.4
 - Any representations to this effect needed to come from Mr. Bert Fredericksen, P.E., the engineer of record for this project. Since neither Mr. Mark Hanson nor Mr. Steven Taylor are registered design professionals in Wisconsin, and neither are employees of Mr. Fredericksen working under his direct supervision, these activities constitute the unlicensed practice of professional engineering in Wisconsin and are violations of the Wisconsin Administration Code, Section A-E 8, Code of Conduct. [Appeal Appendix 4] The governing statute concerning the practice of Professional Engineering without a license
 - <http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=stats&jd=443.02>
 - The Authority Having Jurisdiction must agree to each deviation from the prescriptive measures based upon the submitted documentation prior to the issuance of a building permit. Documentation required is as follows:
 - * 806.5.1 Annual energy use and associated costs. The annual energy use and costs by energy source of the Standard design and the Proposed design shall be clearly indicated.
 - * 806.5.2 Energy-related features. A list of the energy related features that are included in the proposed design and on which compliance with the provisions of the code are claimed shall be provided to the code official. This list shall include and prominently indicate all features that differ from those set forth in Section 806.4 and used in the energy analysis between the Standard design and the Proposed design.
 - * 806.5.3 Input and output report(s). Input and output report(s) from the energy analysis simulation program containing the complete input and output files, as applicable. The output file shall include energy use totals and energy use by energy source and end-use served, total hours that space conditioning loads are not met, and any errors or warning messages generated by the simulation tool as applicable.
 - * 806.5.4 Written explanation(s). An explanation of any error or warning messages appearing in the simulation tool output shall be provided in a written, narrative format.
 - This documentation is a matter of public record and may be reviewed by any interested party. For this project, no *Energy Cost Budget Analysis* documentation was submitted to the Authority Having Jurisdiction for the purpose of obtaining the required variances that were necessary for the deviations from the applicable energy codes. *ComCheck* was used to

prepare the documentation that was submitted to the Wisconsin Department of Commerce, Division of Safety & Buildings for this project, but no version of *ComCheck* was acceptable to the Authority Having Jurisdiction for that purpose under Wisconsin law.

Since the designers failed to submit the necessary analyses to obtain the variances from the local energy Code as required under Section 806.5 of the 2000 IECC, the plan approvals and construction permits were, as a matter of Wisconsin law, based on the Prescriptive Path. This means that the most restrictive of the prescriptive requirements of Standard 90.1-1999 and “local energy Code” governs and deviations from the prescriptive requirements of the 2000 IECC, as modified in COMM 63 and COMM 64 of the Wisconsin Administrative Code, become actual violations of the local energy code. Therefore, had the modeling been performed correctly, the modeling could be used to award additional LEED® points.

As such, the independent consultant’s assertion that the *Energy Cost Budget Method* can be used in lieu of prescriptive requirements is false and all additional energy conservation points awarded would have to be forfeit.

To quote the independent consultant verbatim, “there were several violations of Standard 62.1 and Standard 90.1 requirements in the design as originally documented. As such, the original design did not meet Indoor Environmental Quality (EQ) Prerequisite 1 and Energy and Atmosphere (EA) Prerequisite 2 of LEED NC version 2.1.” Moreover, unlike the appellants, the USGBC independent consultant provides no proof, no documentation, and no calculations to support his conclusions that can be reviewed and verified. Many of the arguments used by the independent consultant are contrary to documented fact, published Codes and Standards of Care, legal requirements associated with getting projects approved for construction, and formal interpretations issued by the applicable ASHRAE Standards writing committees. As such, on the basis the independent consultants own evaluation, the Northland Pines High School failed to comply with the above LEED® Prerequisites and therefore failed to qualify for LEED® Certification at any level. Also based on statements in the independent consultant’s evaluation and published USGBC policy, this project still fails to comply with LEED® Prerequisite Standards and therefore still fails to qualify for LEED® Certification at any level.

Finally, as a licensed professional engineer who has served on and was Chairman of SSPC 62.1 for the publication of ASHRAE Standard 62.1-1999, Mr. Taylor knew better, or should have known better, than to prepare a report attempting to justify the violations which were the subject of this appeal by misrepresenting the material content of the prerequisite standards and the local mechanical and energy codes. For a professional engineer licensed in Wisconsin, the preparation of a technically deficient report, especially one regarding issues of health and safety, the independent consultant’s attempts to justify violations of the prerequisite standards which the author knew, or should have known, were incorrect, or in violation of recognized standards of due professional care, is basis for a disciplinary action against the author’s professional license under the Wisconsin Administrative Code, Section A-E 8, Code of Conduct, paragraphs 8.03 (1) for gross negligence, 8.03 (2) (a) for incompetence, and 8.03 (3) (b) and © for misconduct.

Neither Steven Taylor, P.E., of Taylor Engineering, nor Michael C. English, P.E., CCP, LEED® AP or Paul M. Meyer, P.E., LEED® AP of Horizon Engineering Associates, LLP are licensed to practice engineering in Wisconsin, and thus are also in violation of Wisconsin statutes for practicing without a license.

Detailed Responses to Taylor Detailed Comments

The comments below are the allegations as summarized by Mr. Steven Taylor, USGBC independent consultant, regarding allegations of violations of LEED® NC 2.1 prerequisite requirements, ASHRAE Standard 62.1-1999, and addenda, and ANSI/ASHRAE/IESNA Standard 90.1-1999, with no addenda. Refer to the appeal and appendices for complete allegations. The independent consultant's comments were initially taken electronically from the report prepared by Mr. Taylor on his letterhead to preserve accuracy. Content is unaltered except to insert characters to highlight or separate points to facilitate rebuttal by the appellants. Rebuttals are provided following each review comment.

1. **Allegations:** Violation of Standard 90.1-1999 6.2 Mandatory Provisions (page 18). The complaint says the chiller does not meet minimum requirements.

Independent consultant review comments: Per Table 6.2.1C of the 1999 version, the minimum COP at ARI conditions is 2.8 and the minimum IPLV is 2.8. The chiller schedule on H1.1 shows a COP of 2.9. **It is not clear from the schedule if this is at ARI or design conditions.** The installed chiller per submittals has an ARI EER of 2.81. The IPLV is not scheduled, but if the full load efficiency is 2.8, it is almost certain that the IPLV will be higher. Thus, the chiller does meet Standard 90.1-1999. **(Note that the chiller efficiency in the energy model, according to EAp2 documentation, has a COP of 3.0, which is not consistent with the equipment schedule. This was corrected in a revision to the energy models starting with the version dated December 10, 2009 that USGBC requested to fix this and other inconsistencies between the model of the proposed design and the actual design.)** No apparent violation.

Appellant Rebuttal: Since we do not have the chiller submittals, it is not possible to determine the details of the chiller performance or the extent to which the chiller was derated by virtue of the glycol solution. Nor do we have the energy models. Since the independent consultant indicates the original model at the time of the USGBC application does not match the COP either on the drawings or on the submittals, the energy model is not correct. Making revisions to the energy model 4.5 years after the design should not and cannot be the basis for compliance with this prerequisite. The independent consultant also does not explain how a chiller and pump that can only deliver 780 gpm are capable of supplying HVAC units with a combined chilled glycol flow of 1,617 gpm, or how a chiller with a nominal capacity of 400 tons is able to serve HVAC units with 1,617 gpm of chilled glycol with a 13-degree Δt , or a combined cooling load of 875 tons.

2. **Allegation:** Violation of Standard 90.1-1999 6.2.2 Load Calculations (page 19).

Independent consultant review comments: The complainants have misread the requirements of Standard 90.1 with respect to load calculations. **Section 6.2.2 is the only section that addresses load calculations and it simply says to use “generally accepted engineering practices.”** In EAp2 documentation, a bullet states that loads were calculated using the ASHRAE CLTD/CLF approach. This approach is now outdated but it was a “generally accepted” load calculation method at the time this project was being designed. The complainants claim the system is oversized, but (even if true) that does not violate the Standard. However, the building energy simulation must be based on the specified equipment size so that any inefficiency caused by oversizing is reflected in the model. **The chiller size in the energy model was corrected in the revised model since the December 10, 2009 version.**

Appellant Rebuttal: The independent consultant misrepresents one issue raised in the appeal and fails to address the other concerns shown on page 20 of the appeal. The appellant’s original criticism is still correct and valid. The violations are clearly apparent.

The load calculations were not challenged on the basis of computational methodology. The load calculations were challenged on the basis of the outdoor design conditions employed and this is a violation of Standard 90.1-1999. The appellants did not have access to the engineers design files and therefore did not try to overreach. Over-design has long been recognized as a cause of excessive energy use. Over-design with VAV Reheat systems artificially and improperly increases design air flows and reheat loads at air terminal units, as well as primary heating and cooling equipment.

The independent consultant erred in his review comment about the appellants having misread the requirements of ASHRAE Standard 90.1 when he asserted “Section 6.2.2 is the only section that addresses load calculations.”

A. ASHRAE Standard 90.1-1999, Section **4.12 Other Laws** states: “The provisions of this standard shall not be deemed to nullify any provisions of local, state, or federal law. Where there is a conflict between a requirement of this standard and such other law affecting construction of buildings, precedence shall be determined by the *authority having jurisdiction.*” This permits more rigorous requirements to be established by state or local ordinance without violating Standard 90.1, which is the case here.

COMM 63.1023 of the Wisconsin Administrative Code [Appeal Appendix 5] in force at the time of design, establishes cooling and heating design conditions by zones in the state ***and mandates their use.*** The design conditions used violated the limitations of both ASHRAE Standard 90.1-1999 and ***is a clear violation of the local energy Code.***

The design temperatures for Zone 1, where Eagle River is located, were 86°Fdb, 75°Fwb cooling, -25°F heating.

The temperatures used by the designers were 95°Fdb, 75°Fwb cooling, -30°F heating.

B. ASHRAE Standard 90.1-1999, Section 3.2, Definitions, defines “**design conditions**” within the Standard. as follows:

1. “**cooling design temperature:** the outdoor drybulb temperature equal to the

temperature that is exceeded 1% of the number of hours during a typical weather year.”

2. “**cooling design wet-bulb temperature:** the outdoor wet-bulb temperature for sizing cooling systems and evaporative heat rejection systems such as cooling towers.”
3. “**heating design temperature:** the outdoor dry-bulb temperature equal to the temperature that is exceeded at least 99.6% of the number of hours during a typical weather year.”
4. These definitions establish a “cap” on what designers may properly use for “design conditions” to prevent over-design. Eagle River is located approximately half way between Marquette Michigan (82°Fdb, 67°Fwb cooling, -13°F heating) and Wausau, Wisconsin (85°Fdb, 70°Fwb cooling, -15°F heating). For this project, design conditions, as defined in ASHRAE Standard 90.1-1999 and taken from the 2001 ASHRAE Handbook of Fundamentals would nominally be 83°Fdb, 68°Fwb cooling, -14°F heating.

Under the above circumstances, the design conditions required in the Wisconsin Administrative Code, being the more rigorous, would govern. However, the conditions actually employed for the design were 95°Fdb, 75°Fwb cooling, -30°F heating. **These are violations of both the local energy code, COMM 63 and Standard 90.1-1999. Therefore they are a violation of ASHRAE Standard 90.1.**

These are major violations with far reaching implications for cooling loads, room air flow rates, air handling system design, Standard 62.1-1999 ventilation rate calculations, the need for energy recovery, primary heating and cooling plant capacity, and overall HVAC system design and energy use.

3. **Allegation:** Violation of Standard 90.1-1999 6.2.3.1.1 Deadband (page 21).

Independent consultant review comments: All DDC systems have the inherent capability of providing a deadband between heating and cooling given they have separate cooling and heating setpoints. The complainants acknowledge this so it is strange they list this as a violation. **The requirement for dual setpoint is addressed in spec section 15964B 3.5 B. No apparent violation.**

Appellant Rebuttal: The independent consultant failed to respond to the appellant’s criticism and misrepresented the allegation made. The violation is clearly apparent. The appellant’s allegation is correct and valid.

“Dead band” is defined in Section 3.2 of Standard 90.1-1999 as “the range of values within which a sensed variable can vary without initiating a change in the controlled process.” Standard 90.1-1999 has a mandatory requirement for a minimum 5°F dead band in Section 6.2.3.1.1. Neither addressed the need for a dead band function. This function is not called for anywhere either as a capability of the equipment in Section 15960B, or as a control parameter in Section 15964B of the specifications. Both the design documents and control

shop drawings for this building are deficient in that both failed to comply with Standard 90.1, Section 6.2.3.1.1.

The independent consultant is correct in his assertion that all DDC systems have the capability of providing a dead band between heating and cooling, however, that does not mean that the capability was required in the design and/or employed in construction for this building. The full capabilities of individual controllers are rarely used to their full potential in the real world.

Furthermore, the requirement in Specification Section 15964B 3.5 B is for a differential between heating and cooling season setpoints, not a dead band. Neither the design documents nor the Engineer approved Johnson Controls control shop drawings show any dead band requirement or capability.

Given that adding these functions without direction from the Engineer and a change order would be at the contractor's cost and could become a deviation for which the contractor could be held responsible. Adding the requirement post bid would require a change order for which the installing contractor would expect payment. Thus, lacking concrete evidence to the contrary, it is more than likely that the installed controls in this building do not comply.

Whether it was provided after the fact, or not, is irrelevant. The design and record documentation of construction at the time of submission were both deficient.

4. **Allegation:** Violation of Standard 90.1-1999 6.2.3.2 Off-hour Controls (page 21). The complaint states that the following controls are not provided: Setback, Optimum start, and Zone isolation.

Independent consultant review comments: Setback is addressed in spec section 15964 and also addressed on control shop drawings from Johnson Controls Inc. (JCI), e.g., see sheets 5.2, 6.2, 7.2, etc. Optimum start is required for systems greater than 10,000 cfm, so it applies to most of the AHUs on the project. **There was no specification section or sequence in the JCI shop drawings calling for optimum start.** However, optimum start was added by Construction Bulletin M1 of 6/09/2005. Zone isolation is required only for AHUs serving VAV zones totaling more than 25000 ft² of floor area so it does not apply. No apparent violation.

Appellant Rebuttal: The independent consultant is mistaken in his review comments, which are neither complete nor correct.

A careful review of those comments finds that setback is only mentioned in one place in the Specifications, Section 15964, 3.5, F., 2., where it "Notes" that the setback control function **is not** a part of the Unoccupied Cycle of the VAV box control.

The Specifications fails to require or define any sequence of control for terminal unit setback requirements for that function and refers the reader to the "night" cycle of the AC unit control.

While there is an "Unoccupied Cycle" defined in the AC and HRAC unit control

sequences, it refers only to air handling unit operation and fails to define, require or describe the control requirements for any terminal heating or cooling devices.

No “night” cycle is defined in any AC or HRAC unit temperature control specifications. JCI sheets 5.2, 6.2 and 7.2 address are panel drawings and do not address control functions. Those are addressed on drawings 5.4, 6.4 and 7.4 where they simply repeat, verbatim, the specification requirements from the Specifications.

If night setback functions were provided through a Construction Bulletin, this requirement is not indicated in the temperature control system record documents. This becomes a violation of LEED® record documentation requirements.

The appellant’s criticism is correct and valid. Neither the design nor the completed construction meets all of the requirements in 6.2.3.2 of Standard 90.1.

5. **Allegation:** Violation of Standard 90.1-1999 6.2.4.3 Duct Sealing (page 21).

Independent consultant review comments: Section 15890B 3.1E requires Seal Class A sealing for all ductwork upstream of VAV boxes, so those ducts are in compliance. Section 15890B 2.1A references SMACNA for sealing but SMACNA does not require any sealing below 2” Static Pressure Class and only requires Seal Class C for 2” Static Pressure Class. All ducts downstream of VAV boxes are specified to be 2” Static Pressure Class, so they would be sealed to Class C, but Standard 90.1 requires Class B and A in some locations. **Sealing of exhaust and return ducts do not appear to be addressed in the specs. Sealing in accordance with Standard 90.1 Table 6.2.4.3A does not appear to be required by the design documents.** However duct sealing is standard practice and in fact the contractor confirmed via emails on 12/09/2009 and 12/14/2009 that **Seal Class A was provided for all ducts.** No apparent violation in the final construction.

Appellant Rebuttal: The independent consultant’s conclusion contradicts his own observations after he provides a detailed explanation confirming the appellant’s allegation by explaining how and why the design of the duct systems is inadequate and deficient. Duct sealing is supposed to be standard practice. So are a lot of other things. That does not mean that they were done or were done correctly. Duct leakage sealing was not required in the contract documents. Therefore, the design documents were deficient.

Contractor e-mails claiming to have performed the required testing are irrelevant. While these emails from a contractor may allege that sealing was provided for all ducts, the absence of the required air leakage test reports undermines the credibility of any claim by the independent consultant that duct testing was performed or that the testing indicated that leakage was below the threshold limits required for compliance. The failure to be able to produce the test reports demonstrate a failure on the part of the contractor to comply with the requirements of Sections 6.5 and 6.6 of the SMACNA Air Duct Leakage Test Manual.

The project therefore fails to comply with Section 6.2.4.4 of ANSI/ASHRAE/IESNA

Standard 90.1-1999. The lack of required documentation means that the duct installation was deficient and/or incomplete.

Also, the low pressure duct downstream of the VAV boxes on this project is known to be of fiberglass duct board construction, not sheet metal. It is also known that pressure sensitive tape was employed instead of heat seal tape, that fiberboard duct is notorious for leakage, and that duct leakage has been a serious problem at this installation. Section 1.2 of the SMACNA HVAC Air Duct Leakage Test Manual as referenced in 6.2.4.3, 6.2.4.4, and Appendix E of Standard 90.1 states, “Consult the SMACNA Fibrous Glass Duct Construction Standards for fibrous glass duct assembly. Closures of joints and seams in fibrous glass ducts rely on taped adhesive systems to make connections, in contrast with metal ducts which use mechanical locks for connection and use sealants for supplemental leakage control.” The SMACNA Fibrous Glass Duct Construction Standards do not contain any procedures or rating system for sealing fiberboard ducts, which means that any representation that “all ducts” were sealed to a SMACNA Class A rating is simply false. A Class A seal simply could not have been provided for all ducts on this project.

In light of the known history of problems with duct leakage on this project, the types of materials used, the well known history that these materials have with respect to leakage performance, the independent consultant’s wishful position that there is no apparent violation in the final construction is simply unsupportable.

6. **Allegation:** Violation of Standard 90.1-1999 6.4.4.4 Duct Leakage Tests (page 22).

Independent consultant review comments: Only ducts “designed to operate at static pressures in excess of 3 in. w.c.” are required to be tested. While **Section 15890B 2.1 F. requires ducts upstream of VAV boxes to be built to 6” Static Pressure Class**, it is extremely unlikely that the ducts will actually operate above 3”. In fact only two AHUs have external static pressures greater than 3”, and this includes return air pressure as well so actual supply static pressure should be well less than 3”. So leakage testing is not required for any ducts on this project. In any case, **Construction Bulletin M1 of 6/09/2005 added leakage tests for ducts 3” and higher Static Pressure Class**. No apparent violation.

Appellant Rebuttal: The independent consultant’s conclusion contradicts his own observations.

The external pressure requirement for the various air handling units is irrelevant because the construction documents specifically called for all ductwork upstream of VAV boxes to be constructed to SMACNA standards for a 6-in pressure class. The independent consultant confirmed that the design was deficient with respect to ASHRAE Standard 90.1-1999, Section 6.4.4.4, in that it failed to call for the required duct pressure testing. Therefore, no matter how he tries to spin it, the design was deficient as represented in the appeal.

Whether ducts actually operate at greater than 3 in-w.c. is of no consequence. If the design shows the ducts are to be constructed for higher pressures, they must be leak tested to those pressures in accordance with Section 6.2.4.4 of Standard 90.1. That the independent consultant failed to obtain copies of the required duct leakage test reports conducted at the time of construction raises questions as to whether those tests were actually conducted and whether or not those ducts actually passed the leakage test requirements.

Absent actual contemporaneous test reports documenting compliance with 6.2.4.4 duct leakage limits, doubts must remain about compliance with this ASHRAE 90.1 prerequisite.

7. **Allegation:** Violation of Standard 90.1-1999 6.2.5.1 Record Drawings (page 22).

Independent consultant review comments: Record drawings are addressed in 01780 3.01 and in 15010 1.6C. No apparent violation.

Appellant Rebuttal: The independent consultant's conclusion contradicts his own observations. The independent consultant actually acknowledges and verifies the fact of this violation in Allegation 15, below, and other locations in his report where he uses the lack of record documentation to deny different violations. He cannot have it both ways.

The independent consultant acknowledges that the Contract Documents require the designers to provide record documents to the Northland Pines School District. He also repeatedly acknowledges the fact that required record documents were either erroneous or never provided. In this project, the Architect was also the Construction Manager, so the responsibility for these violations falls squarely on their shoulders.

The "record documents" used in the preparation of this Appeal were sought from the District using Freedom of Information requests. It was clear to the appellants that many the documents provided were not record documents. It was the District who claimed they did not have the documents requested.

This means one of two things; either the District was not provided with "Record Documents" or the District failed to produce those documents for the appellants, as required by state law.

8. **Allegation:** Violation of Standard 90.1-1999 6.2.5.3.3 Hydronic System Balancing (page 22). Complainants acknowledge system was balanced but note that balance was achieved by throttling pump discharge valves and question whether pump impellers were trimmed.

Independent consultant review comments: Section 15950B 3.2 B. requires that primary balance be accomplished via impeller trimming, not valve throttling, in accordance with the Standard 90.1 requirement. The Standard allows pump speed to be adjusted as an alternative to impeller trimming, so the secondary chilled and hot water pumps comply since they have variable speed drives. **The primary chilled water pump is constant speed and because the scheduled head is so excessive (I agree with the complainants in that regard), impeller**

trimming is likely to be required by the Standard – exception (b) is not likely to exempt this pump. But the design documents in fact call for valve trimming for the primary balance. Primary hot water pumps are below 10 HP so the requirement does not apply. No apparent violation.

Appellant Rebuttal: Impeller trimming is required whenever throttling losses exceed 5% of the motor horsepower. The design of the chilled water pump is so excessive that the pump was observed to be operating with the VFD in operation and the pump discharge valve 80% shut. While it is entirely possible that impeller trimming may have actually been performed, the pump discharge valves were observed to be throttled to 80% closed. VFD's would still be working against artificially high head pressures and significant energy would be wasted.

Under these circumstances, the pressure developed by seriously over-designed pumping system is sufficient to lift control valves off their seats, causing uncontrolled heating and cooling. This was observed to be happening in the field at multiple locations during the site visit by the appellants. This is a serious design and construction error that violated both the letter and intent of ASHRAE Standard 90.1-1999, Sections 6.2.5.3.3 and 6.3.4.1.

The independent consultant failed to demonstrate that the provisions of Section 6.2.5.3.3 have been met or that any of the exceptions to 6.2.5.3.3 apply. It is clear that these pumps do not comply with this provisions of Standard 90.1, either as designed or constructed. Nor has the independent consultant been able to demonstrate compliance with 6.3.4.1 of Standard 90.1 requiring that VFD's be able to reduce motor amp draw to no more than 30% of design wattage at 50% of design water flow. Finally, since the independent consultant acknowledges that pump design heads are excessive, this would call into question the validity of any design parameters of the system that may have been used to establish head requirements.

The violation of this LEED® prerequisite was more than apparent, it was obvious, even to the independent consultant.

9. **Allegation:** Violation of Standard 90.1-1999 6.3 Prescriptive Requirements (page 24).

Independent consultant review comments: The complainants used prescriptive requirements of ASHRAE Standard 90.1 as the basis of the alleged violations below. **Because it is necessary for LEED energy credits, the building showed compliance using the Energy Cost Budget approach, not the Prescriptive Approach, so prescriptive requirements do not strictly apply. However, where they were not met, the energy model of the proposed design must reflect these violations to be sure they are offset by other energy conservation measures. As noted in some cases below, that was not true in all cases in the original energy model. However, these oversights were corrected in the revised energy models.**

Appellant Rebuttal: If the energy model had demonstrated compliance with Standard 90.1, then the independent consultant should have been able to assert that the model prepared at the time of submission for Certification should have supported his conclusions.

Instead, the independent consultant acknowledges in his response to Allegation 13 that the modeling effort used to certify the project violated the requirements of Section 11 of Standard 90.1-1999.

Furthermore, the independent consultant's position is particularly disingenuous given that it is also a matter of record that the State of Wisconsin, Division of Safety and Buildings, required reductions in the design of the VAV air terminal unit minimum air flow settings that reduced the minimum air flow requirements for the air terminal units served by air handling systems AC-2 and 7, and HRAC-4 to the prescriptive values as identified in Appendix 1 of the appeal.

Therefore, the independent consultant's claim that the Energy Cost Budget Approach analysis relieved the designers of meeting the prescriptive requirements of Standard 90.1-1999 is false. By extension, any and all claims for enhanced energy performance claims in the LEED® certification application become invalid. This alone is prima facie evidence of a falsified LEED® certification application and sufficient cause to revoke Certification and forfeit all supplemental LEED® energy credits.

For the Energy Cost Budget Analysis, ASHRAE Standard 90.1-1999 requires that the *budget* model must meet the prescriptive requirements of the standard, specifically including the reheat restrictions of Section 6.3.2.1. Ventilation rates must also be the same for both budget and proposed designs. The independent consultant acknowledges this in his response to Allegation 13, and states that the original model (1) failed to meet these requirements and (2) had to be altered.

At very least, he should have documented his report with copies of the inputs and outputs for both versions of the *budget* model, and a list of deviations from the prescriptive requirements of Standards 62.1 and 90.1, as required under Section 11.3, 11.4 and 11.5 of Standard 90.1-1999. Given the independent consultant's acknowledgment that the original model failed to meet the requirements of Section 11.4, Standard 90.1-1999, his failure to provide any supporting documentation whatsoever raises serious questions as to whether the altered model either met those criteria or not.

Significantly, the appellants disagree with the independent consultant's claim that "prescriptive requirements do not strictly apply." While Energy Cost Budget Approach calculations must be used to justify additional LEED® Certification energy credits, under State of Wisconsin law, the same documents must be submitted to the Authority Having Jurisdiction to justify any deviations from the prescriptive requirements of the 2000 IECC, as amended by COMM 63, and the IMC and IBC as amended by COMM 64. This documentation must be submitted to the Wisconsin Department of Commerce, Division of Safety & Buildings for approval at the time the plans are submitted for approval. This simply did not happen.

It is a matter of public record that the design for this facility was submitted to the State of

Wisconsin with documentation of compliance provided using ComCheck. ComCheck-EZ may only be used to demonstrate envelope compliance with the Standard 90.1 and for purposes of making envelope tradeoffs. Furthermore, COMM 63.1016, [Appeal Appendix 5] System Standards Option, specifically states that the State of Wisconsin does not accept ComCheck-Plus for validation of energy code compliance:

“ComCheck–EZ is a computer program that may be used only for determining building envelope compliance. The ComCheck–EZ computer program may be downloaded at: <http://www.energycodes.gov/>. The federal Department of Energy has issued a computer package called ComCheck–Plus, which establishes tradeoffs between the building envelope, lighting, and HVAC equipment; however, this program has not been approved for use in Wisconsin since Wisconsin’s lighting allowances are not the same as those included in the program.”

Since no DOE-2 model, or other documentation approved for the purpose of justifying deviations from the prescriptive measures required for the budget model, was ever submitted to the Authority Having Jurisdiction, as a matter of Wisconsin law, this building was neither designed nor approved by the Authority Having Jurisdiction as an Energy Cost Budget Approach project. *Therefore, the prescriptive requirements of the 2000 IECC and COMM 63 legally govern. This also makes deviations from prescriptive provisions of either the 2000 IMC, 2000 IECC, COMM 63 or COMM 64 violations of the local energy and building Codes.*

This precludes LEED® Certification under the minimum code compliance provisions of EA-2 and EQ-1 Prerequisites.

10. **Allegation:** Violation of Standard 90.1-1999 6.3.1 Economizers (page 24). Complainants say that mixed air temperature control is used rather than supply air temperature control of economizer dampers and that a low limit will disable the economizer.

Independent consultant review comments: In fact specifications (e.g., 15964B 3.7B.3) and JCI shop drawings call for economizer dampers to be sequenced with heating and cooling valves to maintain supply air temperature setpoint on VAV systems (mixed air is OK on single zone units). **No low mixed air limit is indicated in sequences.** No apparent violation.

Appellant Rebuttal: The independent consultant seeks to dismiss multiple, serious violations by misrepresenting the allegation regarding the use of mixed air control and errs in his contention that no mixed air low limit is indicated in either the control sequences and the record temperature control drawings.

ASHRAE Standard 90.1-1999, Section 6.3.1.1.2, states:

“Economizer dampers shall be capable of being sequenced with the mechanical cooling equipment and shall not be controlled by only mixed air temperature.”

Only one exception to this requirement is permitted which states,

“The use of mixed air temperature limit control shall be permitted for systems controlled from space temperature (such as single-zone systems).”

Mixed air low limit controls were, in fact, specified for VAV Reheat systems AC-2, 6 and 7 in Specification Section 15964B, 3.7, D., 5., and are shown on the record temperature control drawings. The exception does not apply to AC-2, 6 or 7. Therefore, the independent consultant has erred in concluding “no apparent violation.” This is a clear and obvious violation of Section 6.3.1 of Standard 90.1-1999.

Section 6.3.1.1.2 states that mixed air controls, by themselves, are also unacceptable on VAV systems. This has nothing to do with supply air temperature control, as alleged by the independent consultant. The reason why this requirement is part of Section 6.3.1.1.2 of Standard 90.1-1999 is to satisfy Section 5.3 of ASHRAE Standard 62.1-1999 which states,

“When the supply of air is reduced during times the space is occupied (e.g., in variable-air-volume systems), provision shall be made to maintain acceptable indoor air quality throughout the occupied zone.”

Mixed air control is the process of mixing outdoor air with recirculated air to achieve and maintain a specific temperature prior to the application of supplemental heating or cooling. As ambient temperatures get colder in the heating season, the proportion of outdoor air introduced by mixed air control declines proportionally with temperature.

As total ventilation rates to zones decline, the proportion of primary air to the space that must be outdoor air must increase. This action is precisely the opposite action provided by mixed air control. With constant volume systems, this is manageable. However, with VAV systems, the amount of total air delivered to the space also declines with declining temperatures, and that further reduces the amount of outdoor air being delivered to individual spaces. When the amount of outdoor air required exceeds that actually being introduced by mixed air control, a different control strategy must come into play to assure adequate ventilation is provided.

The problem with this strategy is that the need for ventilation is unrelated to temperature. This requirement must also be taken in context with Section 5.3 of the ASHRAE Standard, as well as section 403.3.3 of the International Mechanical Code. All specifically require special controls be provided on VAV systems to assure that the critical VAV air terminal device delivers at least the minimum required amount of outdoor air ventilation to each zone whenever it is occupied.

To accomplish this, the temperature control system must be able to do several things:

1. The system must be able to identify which VAV air terminal device is serving the critical zone so it can identify the critical outdoor air fraction for each space. To do this, each VAV air terminal device must know how much outdoor air is required at each space and how much primary air is delivered. The controls for the air terminal units have all of the necessary hardware to accomplish this, but the necessary

programming was not specified in the control sequences or shown on the record control documents. This is a violation.

2. The air handling system must also minimally know how much outdoor air is being introduced into the system and what the total primary air flow of the system is so that it can override the mixed air control to deliver adequate ventilation to the critical space. This minimally requires that outdoor airflow be measured and that total flows at the VAV air terminal units be totalized.

The requisite amount of outdoor air ventilation required for any zone is not indicated anywhere in the construction documents. No control mechanisms are either specified in the design documents or indicated as having been provided in the record temperature control documents. This is are clear and obvious violations of Section 6.3.1 of Standard 90.1-1999 and Section 5.3 of Standard 62.1-1999. As this was both a program and Code requirement, the designer knew, or should have known this, and failed to incorporate this into his design. Therefore, the design is deficient.

If this requirement had been added as a result of a Construction Bulletin, as is alleged elsewhere in the independent consultant's report, the failure to make sure it was provided and documented would constitute a construction administration failure on the part of the Engineer of Record.

The record temperature control documents indicate that the installation provided was precisely what was specified in the Construction Documents. The appellants have seen no documentation presented that could be used to blame the contractor for these failures.

Even more unforgivable, the independent consultant knew, or should have known, that this is a health and safety issue under Section 1 of ASHRAE Standard 62.1-1999, and failed to properly address the allegation.

The following is apparent to anyone willing to review the documents. Neither the design nor the installation complied with LEED® prerequisite requirements at the time of the USGBC application and any claim of compliance given the absence of the minimal required control instrumentation makes any claim of current compliance technically unsupportable.

11. **Allegation:** Violation of Standard 90.1-1999 6.3.1.1.3 High Limit Shutoff (page 26).

Independent consultant review comments: The sequences require a fixed outdoor air drybulb economizer high limit of 75°F. Per Table 6.3.1.1.3B, the setpoint for this (intermediate) climate should be 70°F. According to the engineer, JCI implemented a differential temperature high limit, which is an acceptable approach in this climate per Table 6.3.1.1.3. **Note that the energy model was based on differential enthalpy high limits according to the EAp2 and c1 descriptions.** This was corrected in the December 10, 2009 revision. With this correction, there is no apparent violation.

Appellant Rebuttal: The independent consultant has verified the legitimacy of this allegation of violation of Standard 90.1 by verifying that it existed at the time LEED® Certification was granted and remained uncorrected for more than four years. That the HVAC systems, as designed and installed, required modification to correct the violation 4.5 years after construction was completed confirms the allegation that neither the design nor the installation complied with LEED® prerequisite requirements at the time of certification.

12. **Allegation:** Violation of Standard 90.1-1999 6.3.1.4 Heating System Impact (page 26).

Independent consultant review comments: The complainants have misread this requirement; it is intended to preclude the use of systems such as multizone and single-fan-dual-duct where use of an air economizer causes an increase in heating energy usage. The systems as designed meet this requirement. No apparent violation.

Appellant Rebuttal: The appellants strongly disagree. The violation identified in the appeal is obvious and apparent. It is the independent consultant who misrepresents the requirement. He also fails to address the violations identified in the appeal and seeks to dismiss the allegation through obfuscation and dissimulation. This is, in fact, a major violation with extremely high designer liability exposure resulting from the amplifying effect of multiple, cascading design errors. Section 6.3.1.4, Heating System Impact, simply states,

“HVAC system design and economizer controls shall be such that economizer operation does not increase the building heating energy use during normal operation.”

After minimum flows at the air terminal units are corrected to comply with of ASHRAE Standard 90.1-1999, Section 6.3.2.1 limitations, when the Prerequisite EQ-1 Ventilation Rate Procedure calculations are correctly computed in accordance with ASHRAE Standard 62.1, Section 6.1, Equation 6.1, and ASHRAE Interpretation IC 62-1999-28, the corrected design outdoor air fraction for all seven VAV air handling systems (HRAC-1,2,3, and 4, and AC-2, 6, and 7) require the use of 100% outdoor air. Because the outdoor air fraction exceeds 70%, this requires that the exhaust air energy recovery requirements of Standard 90.1-1999, Section 6.3.6.1 be employed. Because this is associated with basic ventilation requirements of the system in all cases and it exceeds 75% of the total air flow, none of the exceptions to this requirement apply.

As no air energy is recovered from any exhaust air stream at this facility, the design of the HVAC system caused the economizer of these systems to increase building heating energy usage. That increase was calculated to increase the overall heating plant capacity required by about 400% over the prescriptive requirements of Standard 90.1-1999. Since these are also violations of the prescriptive requirements of the local energy code, corrective changes could be ordered by the Authority Having Jurisdiction at any time.

These are major violations of the prerequisite Standards and major defects in design that will require major changes in the design of the facility and will cost the appellant’s community

millions of dollars to correct and substantially increase operating costs.

13. **Allegation:** Violation of Standard 90.1-1999 6.3.2.1 Simultaneous Heating & Cooling (page 26). There appears to be a violation of the reheat limitation: heating airflow setpoints on VAV box schedules on H1.2 are significantly above the limitations prescribed by Section 6.3.2.1 exception (a).

Independent consultant review comments: This section was modified by addendum shortly after the 1999 version was issued. The requirements are now as the complainants extracted in their complaint on page 26. However, their discussion following addressed the original wording from the standard that was eliminated in the addendum. In any case, there appears to be a violation of the reheat limitation: heating airflow setpoints on VAV box schedules on H1.2 are significantly above the limitations prescribed by Section 6.3.2.1 exception (a). In general this exception allows reheat provide the amount of air reheated is 30% or less of the maximum (cooling) airflow rate (there are other parts of this exception but the 30% criterion usually dominates). Instead heating airflow rates are scheduled to be about 67% of the cooling setpoints typically and range as high as 83%. This is a prescriptive requirement, so it need not be met since the Energy Cost Budget Approach was used, but these high minimum setpoints would have to be included in the energy model to ensure the inefficiency of these setpoints was properly offset by other energy conservation measures. This was not the case in the original energy model, according to the modeler. But the corrected minimums were entered in revised model, confirmed by our review of the input files. With these corrections, there is no apparent violation.

Appellant Rebuttal: The independent consultant's conclusion is contradicted by his own observations. The violations are obvious and apparent. The independent consultant acknowledges the violations of Section 6.3.2.1 of ASHRAE Standard 90.1.

The referenced addendum to ASHRAE Standard 90.1-1999 is irrelevant since the EA-2 criterion is for LEED® NC 2.1 compliance with ASHRAE Standard 90.1-1999, "without addenda." The addendum to Standard 90.1-1999 referenced by the independent consultant would have had a negligible impact on the underlying substance of the violations.

The violations to section 6.3.2.1, the restrictions on the use of reheat, were ignored in the design and construction of this building and were wholesale in nature. The independent consultant's argument to the contrary is rebutted in the appellants response to his comments in Allegation 9, above.

14. **Allegation:** Violation of Standard 90.1-1999 6.3.3.1 Fan Power Limitations (page 29).

Independent consultant review comments: A quick check of the AHUs with the highest static pressure drop indicated no violations. The heat recovery units may appear to be in violation but not after credit is taken for relief fans and heat recovery devices. In any case, this is a prescriptive requirement so any fan power can be used provided it is properly modeled

in the energy simulation of the proposed design. No apparent violation.

Appellant Rebuttal: The independent consultant's conclusion contradicts his own observations and his argument that compliance with the prescriptive requirements of Standard 90.1-1999 is not strictly necessary and is rebutted in the appellants response to his comments in Allegation 9, above.

The independent consultant not only failed to thoroughly analyze this allegation, he acknowledged that failure. The independent consultant admits to performing a casual "quick check" of only one system and arbitrarily concluded that there were "no violations" for all systems. It is important to note that two of the 14 air handling systems did meet the horsepower limitations of Section 6.3.3.1. For the independent consultant to make the claim he made, all he had to do was to select one of those two systems and he did have access to the appellants' calculations.

The appellants performed a *detailed* evaluation of all air handling system motor horse powers for compliance. The appellants' analysis was included in Appendix 10 of the Appeal and is based on the actual motor horsepowers installed on the items of equipment installed as documented in the final air balance reports. Since no qualifying air filtration equipment was specified to be provided anywhere on the project, this effort included computing credits for relief fans and air-to-air energy recovery equipment. These credits were computed in strict accordance with the formulae provided in ASHRAE Standard 90.1-1999, Section 6.3.3.1 ©. These credits are quite small while what energy recovery equipment is provided has a very large impact on the systems as designed and installed. By the equation published in Section 6.3.3.1 of Standard 90.1-1999, the credit for this equipment is not permitted to be based on the total air flow of the system, but only on the air flow through the heat exchanger.

The violations exist, remain uncorrected and are clearly and readily apparent.

15. **Allegation:** Violation of Standard 90.1-1999 6.3.3.2.3 Setpoint Reset (page 31). The system has direct digital controls and thus must reset static pressure setpoint based on zone demand (damper position).

Independent consultant review comments: I could not find any requirement for this in specs or in JCI shop drawings. However, static pressure setpoint reset was added by Construction Bulletin M1 of 6/09/2005.

Appellant Rebuttal: The independent consultant again validates the veracity of the allegation that the design failed to comply with the requirements of Section 6.3.3.2.3 of ASHRAE Standard 90.1-1999. While he contends that the function was added by Construction Bulletin in 2005, the function does not show up on the record temperature control documents and he provides no documentation that it was ever installed on the project. Based on this response, the design failed to comply with the prerequisite requirements and the required documentation is similarly deficient.

The independent consultant's response is a double-edged sword. In his effort to deny the violations identified in allegation 15, he acknowledges the legitimacy of the violation associated with Allegation 7, above. That the independent consultant again failed to find or produce any documentation to support the validity of a conclusion of no violation and raises legitimate questions regarding the performance of the independent consultant and on the veracity of the construction administration services provided by the Architect/Construction Manager and the Engineer of Record.

If, as the independent consultant claims, these provisions were included in "Construction Bulletin M1 of 6/09/2005," these changes should be documented in the record temperature control system shop drawings. They are not.

The absence of supporting documentation raises legitimate questions as whether this change, and many other changes he claims were made by this Bulletin, were actually incorporated in the project.

16. **Allegation:** Violation of Standard 90.1-1999 6.3.4.1 Hydronic Variable Flow Systems (page 31). The complainants say that the differential pressure sensor used to control pumps is not located "near the most remote heat exchanger" as required by this section.

Independent consultant review comments: According to JCI drawings, the sensors are located in room C212. HW pumps are located in F wing while CHW pumps are located in E wing. **The most remote heat exchangers would be the air handlers in B wing. However, the piping system is reverse return. Therefore, the DP sensor may be located at virtually any heat exchanger – they theoretically all see the same differential pressure.** No apparent violation.

Appellant Rebuttal: Generalized theory can be significantly different from reality when a system is poorly engineered. A reverse-return piping system can have relatively uniform pressure characteristics, but only when the pressure drops through the individual loops are relatively consistent and the pumping system is not obscenely over-designed as the independent consultant acknowledges in his response to Allegation 8.

During the appellant's visit to the site, prior to submitting the appeal, heating control valves were observed to be lifted off their seats on two air handling systems, causing uncontrolled heating. This is a sign of pumping over-pressure which indicating that the systems were not, in fact, under control.

Paragraph 6.3.4.1 of Standard 90.1 states,

"Differential pressure shall be measured at or near the most remote heat exchanger or the heat exchanger requiring the greatest differential pressure."

It does not provide any exceptions like that described by the independent consultant. Notwithstanding that the independent consultant's assumption might be correct, the design and

construction of the building does not comply with the explicit requirements of the Standard. Simply put, this is clearly a violation.

17. **Allegation:** Violation of Standard 90.1-1999 6.3.6.1 Exhaust Heat Recovery (page 32).

Independent consultant review comments: Heat recovery is not required since outdoor air is not above 70% for any AHU. Complainants argue that the units should have higher outdoor air rates, but that is a separate issue addressed below. They also agree that exception (h) makes it so heat recovery is not required. Since energy recovery is not required, any complaints about the details of the design are moot with respect to Standard 90.1 compliance. No apparent violation.

Appellant Rebuttal: As with the design engineer, the independent consultant failed to exercise appropriate care in his investigation. He is erroneously assuming that the prescriptive reheat restriction does not apply. The methodology he used to justify the ventilation rates conflict with EQ-1 Prerequisite requirements as his evaluation was admittedly based on an evaluation of only one of seven systems using a different ventilation rate procedure than required by LEED® NC 2.1, Prerequisite EQ-1. As such, one must question the numbers used by the independent consultant's in arriving at his conclusions. The incorrect methodology admittedly used by the independent consultant, while published by ASHRAE, does not check for Standard 90.1 compliance, and can be readily manipulated to show compliance where none exists. The output of the program is only valid when the reheat limitations of Standard 90.1 are observed, and then for Standard 62.1-2001, Addendum N and later versions of the Standard, which are less rigorous than the required method do not apply to this project.

Based on detailed Ventilation Rate Procedure calculations, using the correct computational procedures, prepared by the appellants after corrections to minimum air flow requirements were made for violations of ASHRAE Standard 90.1-1999, Section 6.3.2.1, using design air flow data from the final testing and balance report on VAV box performance, the design critical outdoor air fraction for all seven VAV systems was computed to require the use of 100% outdoor air just to meet minimum ventilation requirements. These detailed calculations are included in the ten pages of Appendix 1 of the Appeal. These results invoke the requirement for energy recovery on all seven VAV systems under Section 6.3.6.1 of Standard 90.1-1999 even though the largest single "exhaust" system is less than 70% of the total. Therefore, on the basis of the appellants calculations which are not contested by the independent consultant, exhaust energy recovery is, in fact, required on all seven VAV systems for ASHRAE Standard 90.1-1999 compliance.

Furthermore, since what minimal energy recovery was provided on this project (HRAC-1, 2, 3 and 4) does not take air from any exhaust air path but from air paths that would otherwise be recirculated. The actual design of the energy recovery is a technological misapplication that increases fan parasitic horsepower losses while producing no thermal benefits to the systems where they are installed whatsoever. As such, what energy recovery is installed fails to meet the energy recovery performance requirements of ASHRAE Standard 6.3.6.1. This

project has actually produced a textbook example of how not to design an energy recovery system.

18. **Allegation:** Violation of Standard 62-1999 4.1 Ventilation Rate Procedure (page 33).

Independent consultant review comments: The complainants made a few errors or misinterpretations in their assessment of compliance with Standard 62.1 ventilation rates (numbers are introduced by the appellants to separate sub-points for purposes of making responses):

- a. (1) The complainants' calculations appear to have assumed that spaces were occupied at the existing density listed in the building code. (2) Standard 62.1 requires that the designer provide a reasonable estimate of the number of occupants, or use default densities listed in the Standard which are generally much lower than existing densities.
- b. (1) The complainants' calculations do not include occupant diversity. It is not likely that every room served by the system will be full at design occupancy at the same time. (2) Standard 62.1 specifically allows occupant diversity to be taken into account.
- c. (1) The complainants' calculations assume that spaces are at the design heating (minimum) airflow setpoint when the spaces are fully occupied. This is not always a reasonable assumption – if the space is full of students, lights are on, etc., the space is likely to be in cooling mode and supply airflow will be closer to the design cooling rate, not the design heating rate. (The exception would be classrooms with significant glazing where winter heat losses offset internal heat gains.) (2) Standard 62 requires that reasonable scenarios be evaluated, not all scenarios that are physically possible. (For instance, it is physically possible to fit 100 people in a classroom if all packed in, but that is not reasonably likely to occur so Standard 62 does not require that it be accommodated in the design.)

It appears that the designer based his calculations on Standard 62-2001 rates (same as 1999), not the revised rates per Addendum 62n. Addendum 62n to Standard 62 was passed in July 2003. The design of this project was done well after (drawings are dated 2005). LEED NC Version 2.1 calls for compliance with Standard 62 plus all addenda. Hence rates should have been calculated using Addendum 62n. But 62n rates are generally much lower than prior versions of the Standard, so using the older rates is conservative.

The designer provided calculations showing that the “multiple spaces equation” was used to adjust rates. However, this was done only at design cooling conditions, not at any off-design conditions such as in heating mode. Ventilation (air change) effectiveness adjustments also were not made for the overhead supply/return system in heating mode, but the 1999 standard was not explicit in how to make that adjustment, and the complainants also did not address this in their calculations. It is arguable that it was common practice (although not technically correct) when implementing the 1999 and earlier versions of the standard to ignore air change effectiveness adjustments and to apply the multiple spaces equation only at design conditions. (In fact, arguably most designers ignored the multiple spaces equation entirely.) Therefore, outdoor air rate calculations arguably met the standard of care at the time of the design.

But moreover, outdoor air rates do appear to meet current Standard 62.1 requirements. **The lower Addendum 62n rates corrected for ventilation efficiency are very close to the design outdoor air rates scheduled on drawings. I checked one air handler (HRAC-1) using the 62MZCalc spreadsheet that is provided with the Standard 62.1-2007 User's Manual (which uses the same rates as Addendum 62n) and calculated only slightly higher outdoor air rates in both heating and cooling scenarios, rates that are essentially the same given the wide range of possible operating assumptions.**

So while **the calculation methodology did not strictly meet Standard 62.1**, outdoor air rates do appear to meet current Standard 62.1 requirements.

Appellant Rebuttal: This part of the independent consultant's report contains multiple points which require response. His representations regarding the occupant densities assumed, computation of diversity, and computational methodologies are factually incorrect. His excuses for the failure of the designers to employ the prerequisite computational requirements might be applicable on an ordinary project, but not in the case of an LEED® project where the methodologies are clearly specified program requirements and the practitioner knows, or is supposed to know, that compliance with the Standard is mandatory.

The version of Standard 62.1 required for LEED® NC 2.1 compliance is specified by USGBC as ASHRAE Standard 62.1-1999, and with the addenda "listed in Appendix H," not "all addenda" as represented by the independent consultant. The appeal comments are based upon these requirements. Addenda to ASHRAE Standard 62.1-2001, such as Addendum N, fall outside of the scope of the Prerequisite EQ-1 for this version of LEED®. Even if later addenda were required under Prerequisite EQ-1 requirements, which is not the case, the requirements of the International Mechanical Code, being more rigorous, would govern.

Throughout his response to this appeal, the independent consultant has consistently misrepresented the actual requirements for LEED® NC 2.1 Certification and uses that technique to create apparent technical disagreement. He also consistently ignores issues associated with compliance with the Wisconsin Building Code which are inconvenient to his arguments. This kind of action on the part of the independent consultant demonstrates either a critical lack of knowledge of applicable codes and standards, and LEED® NC 2.1 requirements, or worse, on the part of the independent consultant.

- a. (1) **The independent consultant's comment that "The complainants' calculations appear to have assumed that spaces were occupied at the exiting density listed in the building code" is false.**

The independent consultant never contacted the appellants to inquire what the basis for their occupant density was. The basis on which computations are made is central to the appeal. The independent consultant speculated, without basis, and erred as to the appellants basis for determination of ventilation rates.

In fact, every effort was made by the appellants to employ the same occupancy densities as the design team. The basis for occupancy was, in fact, based on occupancy density information taken directly from the Construction Documents.

These occupancy levels used by the appellants are generally consistent with normally anticipated occupant densities that would be expected in this type of facility and are, on average, approximately half the densities listed in ASHRAE Standard 62.1-1999, Table 2.

- a. (2) **The independent consultant's comment** that "Standard 62.1 requires that the designer provide a reasonable estimate of the number of occupants, or use default densities listed in the Standard which are generally much lower than existing densities" **is false.**

Standard 62.1-1999 has no such requirement. It does not require lower densities. It only *permits*, the designer to use a reasonable estimate of the number of occupants, if known, or the default densities listed in the Standard.

Under the Wisconsin Code however, occupant densities for compliance with ventilation and existing densities are the same. They use the same table.

Another major problem with the independent consultant's position **is in direct violation of Section 403.3.3 of the 2000 International Mechanical Code.** Occupant densities in Table 403.3 are taken directly from Table 2 of Standard 62.1-1999, and no "diversity" is permitted for purposes of design. This states, ***"The occupant load utilized for design of the ventilation system shall not be less than the number determined from the estimated maximum occupant load rate indicated in Table 403.3."***

Section 403.3.1 of the Mechanical Code states, ***"The minimum flow rate of outdoor air that the ventilation system must be capable of supplying during its operation shall be permitted to be based on the rate per person indicated in Table 403.3 and the actual number of occupants present."***

While this opens up the code for reducing actual operating ventilation rates, application of demand controlled ventilation and dynamic reset, it explicitly precludes the independent consultant's interpretation.

- b. (1) **The independent consultant's comment** that "The complainants' calculations do not include occupant diversity" is true, but used to imply something is a **falsehood.**

ASHRAE Standard 62.1-1999 does not "require" the designer to take into account "diversity." The multiple spaces equation does not even provide a methodology for doing so. The only option afforded the designer is found in Section 6.1.3, and that is to adjust design room occupancy levels.

Diversity, as a concept, does not appear in the computation requirements until the

publication of *Addendum n* to Standard 62.1-2001, a later version of the Standard. Based on the prerequisite requirements of EQ-1, this addendum explicitly does not apply to the LEED® NC 2.1 Certification process. As a practice, it would be unacceptable under all versions of the International Mechanical Codes between 1998 and the 2007 supplement.

- b. (2) **The independent consultant's comment** that “Standard 62.1 specifically allows occupant diversity to be taken into account” **is false**. See rebuttal to a. (2), above.
- c. (1) **The independent consultant's comment** that “The complainants' calculations assume that spaces are at the design heating (minimum) airflow setpoint when the spaces are fully occupied” is true. This practice is not only fully consistent with, but required by both ASHRAE Interpretation IC 62-1999-39 [Appeal Appendix 8] and Addendum N to Standard 62.1-2001. It is a matter of making sure that the system is able to deliver the requisite amount of ventilation to each space under all conditions of occupancy as required under Section 6.1.3.2 of Standard 62.1-1999

The independent consultant's position is in direct conflict with formal ASHRAE Interpretation IC 62-1999-28 [Appeal Appendix 9]. This interpretation identified two methods, key elements of which were later formally adopted in Standard 62.1-2001, through “Addendum n.”

The applicable methodology, covered under Section 6.4.2.1 of Addendum n, states that for the purpose of computing the *zone primary outdoor air fraction* (Z_p), “For VAV systems, V_{pz} is the minimum expected primary airflow.” This requirement of Addendum N is the very technique the independent consultant is criticizing but it has been a fundamental requirement for application of the multiple spaces equation for VAV system design under all versions of Standard 62.1 since 1995.

Section 6.1.3.4, Intermittent or Variable Occupancy states,

“Ventilating systems for spaces with intermittent or variable occupancy may have their outdoor air quantity adjusted by use of dampers or by stopping and starting the fan system to provide sufficient dilution to maintain contaminant concentrations within acceptable levels at all times.”

This opens the door to demand controlled ventilation (DCV) strategies. However, the challenge with DCV is coming up with a practical way to control the systems in a way that allows one to manage ventilation while otherwise meeting the requirements of the space. That invariably requires the use of specialized controls, like time of day, occupancy and air quality sensing (CO₂) controls.

Section 6.1.3.4 also states, ***“Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of operation of the system, provided the average occupancy used is not less than one-half the maximum.”***

This puts a functional limit on “diversity.” For facilities like schools, Interpretation IC 62-1999-39 holds that this kind of logic is inappropriate for classroom occupancies have relatively consistent usage whereas it may be applicable to occupancies like gymnasiums, field houses, auditoriums and cafeterias which do see significant variations in occupancy.

- c. (2) **The independent consultant’s comment** that “Standard 62 requires that reasonable scenarios be evaluated, not all scenarios that are physically possible” **is false**. Standard 62.1-1999 makes no such statement. Formal ASHRAE Interpretation IC 62-1999-28 [Appeal Appendix 9] directly contradicts the independent consultant’s stated position:

“If a variable air volume system is used, the system must be designed so that it will deliver the required amount of outdoor air to each space it serves not only under the conditions that prevail on the cooling design day, but under the full range of weather and load conditions that can be expected, and under the range of space ventilation rates and system airflows that the system will deliver to meet those loads.”

It would appear from the independent consultant’s statement, “*It **appears** that the designer based his calculations on Standard 62-2001 rates (same as 1999), not the revised rates per Addendum 62n*” that the independent consultant is unable to positively determine what criteria the designers used to meet the documentation requirements of ASHRAE Standard 62.1-1999. This is a problem because Section 5.2 of ASHRAE Standard 62.1-1999 states,

“The design documentation shall state assumptions that were made in the design with respect to ventilation rates and air distribution.”

Section 6 of ASHRAE Standard 62.1-1999 also states,

“Design documentation shall clearly state which assumptions were used in the design so that the limits of the system in removing contaminants can be evaluated by others before the system is operated in a different mode or before new sources are introduced into the space.”

Compliance with ASHRAE Standard 62.1 requires that this documentation be provided to the Owner so that it can be made available to others in the future, like the independent consultant for the purpose of this evaluation. The independent consultant’s confusion strongly suggests that it wasn’t. It might also be that the independent consultant is at a loss as to how to represent that the designer’s actual calculations followed the required ventilation rate procedure when they did not. Section 6.3 of ASHRAE Standard 62.1-1999 states,

“Design criteria and assumptions shall be documented and should be made available for operation of the system within a reasonable time after installation. See Sections 4 and 6 as well as 5.2 and 6.1.3 regarding assumptions that should be detailed in the

documentation.”

From a practical standpoint, alone, this information would have been needed by the installing contractors to properly balance and set up the controls for the system. The District needs it to properly operate his facility. This information was not provided as a part of the Construction Documents. Where is it? Does it even exist? Was it even prepared? The appellants should be able to obtain it from the District with a Freedom of Information request.

The independent consultant then states,

“The designer provided calculations showing that the “multiple spaces equation” was used to adjust rates. *However, this was done only at design cooling conditions, not at any off-design conditions such as in heating mode.*”

With this statement, the independent consultant confirmed that the designer clearly failed to properly compute the appropriate ventilation rates in accordance with the requirements of Standard 62-1999. This is a major design error that, in addition to the previously noted violations of Section 6.3.2.1 of ASHRAE Standard 90.1-1999, would have had significant implications for the amount of outdoor air required at the system using the multiple spaces equation. This fully explains why the designers erred in not employing 100% outdoor air on each of the seven (7) VAV reheat systems.

Standard 62.1-1999, Interpretation IC 62-1999-28 to Standard 62.1-1999 and Addendum N to Standard 62.1-2001 all directly contradicts the independent consultant’s written position in this matter.

The independent consultant goes on to state,

“Addendum 62n to Standard 62 was passed in July 2003. The design of this project was done well after (drawings are dated 2005). LEED® NC Version 2.1 calls for compliance with Standard 62 plus all addenda. Hence rates should have been calculated using Addendum 62n.”

The independent consultant’s comment regarding Addendum n is both incorrect and completely irrelevant. LEED® NC 2.1 calls for compliance with Standard 62.1-1999, and those addenda listed in Appendix H to Standard 62.1-2001. Addendum 62n is not among the required addenda.

Finally, one must also openly question the wisdom of the independent consultant’s statement,

“It is arguable that it was common practice (although not technically correct) when implementing the 1999 and earlier versions of the standard to ignore air change effectiveness adjustments and to apply the multiple spaces equation only at design conditions. (In fact, arguably most designers ignored the multiple spaces equation

entirely.) Therefore, outdoor air rate calculations arguably met the standard of care at the time of the design.”

In this one statement, the independent consultant devastates the USGBC refusal to revoke LEED® Certification *by affirmatively and explicitly acknowledging that the requirements of Prerequisite EQ-1 were not met.* His argument that “everybody does it” may be a common defense strategy in malpractice actions on conventional projects, but the designers knew, or should have known, that these calculations are a LEED® prerequisite. This a minimum contractual requirement. LEED® certification is not about accepting substandard care but a promise to deliver a project designed to a higher standard of care.

The stated Purpose of Standard 62.1-1999 is, “to specify minimum ventilation rates and indoor air quality that will be acceptable to human occupants *and are intended to minimize the potential for adverse health effects.*”

The Wisconsin Code of Conduct for Architects and Professional Engineers, A-E 8, [Appeal Appendix 4] defines “Gross Negligence” in Wisconsin as, “the performance of professional services by (a professional engineer) which does not comply with an acceptable standard of practice (ANSI/ASHRAE Standard 62.1-1999) that has a significant relationship to the protection of health, safety or public welfare and is performed in a manner indicating that the professional knew or should have known (compliance was a project prerequisite requirement), but acted with indifference to or disregard of, the accepted standard of practice.”

Falsely claiming to comply with that Standard to either the Northland Pines School District or to the USGBC, constitutes a fatal flaw in the opinion of the appellants.

19. **Allegation:** Violation of Standard 62-1999 5.3 (page 34).

Independent consultant review comments: This section effectively requires that airflow rates be measured and controlled on VAV systems. **Complainants point out, correctly, that none of the VAV air handling units includes airflow measuring devices on the outdoor air intakes.** CO2 sensors are provided in the return air of most units, with controls to increase outdoor air minimum damper position when CO2 rises above 800 ppm. **This helps compensate for the lack of airflow measurement and control, but it does not meet the Standard since there is no way that it can maintain the “building component” of the ventilation rate. So, without measurement and control of minimum outdoor air on VAV AHUs, the design does not comply with Standard 62.1.** VAV air handling units do not include airflow measuring devices on the outdoor air intakes and control sequences in the original design documents and JCI drawings do not address minimum outdoor airflow control. However, the engineers have stated that JCI implemented logic to reset minimum damper position based on fan speed, made a formal part of the design based on the Construction Bulletin dated 12-7-2009. This is not a precise airflow control approach, but it is considered acceptable in California and included as standard logic in many packaged VAV unit control systems. So the minimum outdoor air control, although not ideal, was apparently provided.

Appellant Rebuttal: The independent consultant's conclusion is contradicted by his own observations. The violations are obvious and apparent. The independent consultant first confirmed the validity of the allegation made in the appeal, and then weakly tries to dismiss it.

His conclusion is not supported by the Construction Documents or the temperature control record documents. CO₂ sensors were provided in the return air path of most units. *However, the temperature control documents are explicit in that they have no active control function.* This would be a violation of Wisconsin Code. Wisconsin does not permit CO₂ sensors in the return air path to be used for demand control ventilation on VAV systems as suggested by the independent consultant. They may only be used at the individual zone level.

The fact that the temperature control manufacturer would modify the controls in 2009, four years after construction, in naked attempts to bring about a necessary control function without the required sensing hardware in place, is an acknowledgment by the independent consultant that the allegation made in the appeal was valid.

20. **Allegation:** Violation of Standard 62-1999 5.5.1 Resistance to Mold Growth (page 35).

Independent consultant review comments: Specification section 15890B 2.5 B. states that duct liner must be faced with a "bacteria and fungi resistant" coating. **While the specific UL and ASTM sections are not listed,** I am confident all duct lining materials submitted to meet the specs would meet these standards – it is standard industry practice. This was confirmed by the contractor in 12/9/2009 email. No apparent violation.

Appellant Rebuttal: The independent consultant's conclusion is contradicted by his own observations. The violations are obvious and apparent. Standard industry practice or not, the independent consultant validated the fact that the design documents failed to comply with this requirement of Prerequisite EQ-1. The design of the facility was therefore deficient.

21. **Allegation:** Violation of Standard 62-1999 5.5.2 Resistance to Erosion.

Independent consultant review comments: **While the specific UL section is not listed in the specs,** I am confident all duct lining materials submitted would meet these standards – it is standard industry practice. This was confirmed by the contractor in 12/9/2009 email. No apparent violation.

Appellant Rebuttal: The independent consultant's conclusion is contradicted by his own observations. The violations are obvious and apparent. There are actually three failures here, each confirmed by the independent consultant.

He first confirms that the design documents were deficient in that they failed to require compliance with this prerequisite. The design is therefore deficient.

The second is, again, a clear failure to provide the required documentation by the designers and construction firms. The required information should have been included in the Owner's O&M manuals. The requirement for documentation is deficient.

The third is, again, that the independent consultant, whose job was to confirm or deny the allegations, again failed to produce any documentation to support his conclusions.

Fourth, the USGBC independent consultant reported no independent efforts to independently confirm whether in fact, the completed building complies.

22. **Allegation:** Violation of Standard 62-1999 5.8 Particulate Matter Removal (page 35).

Independent consultant review comments: Schedules indicate MERV 8 filters are to be used for construction and MERV 13 installed after construction. Both are above the minimum MERV 6 required. No apparent violation.

Appellant Rebuttal: In spite of conflicts between the plans and specifications, a review of the air balance report indicates that the appellants cannot legitimately contest the independent consultant's point on this matter.

23. **Allegation:** Standard 62-1999 5.10 Dehumidification Systems (page 36).

Independent consultant review comments: The quoted section was substantially revised by early addenda to the 1999 version so the version listed does not apply. The applicable 2001 section states: It is not readily apparent if the systems as designed meet this section. The VAV systems should meet it inherently since supply air temperatures are generally always low enough to dehumidify in cold weather. However, the constant volume units may not in some weather. This is a possible technical violation. But the school district has reported no visible or olfactory indications of microbial growth so it does not appear that high humidity has been an issue.

Appellant Rebuttal: The independent consultant incorrectly asserts that the requirements of this section were modified by addendum to the 1999 version of the Standard. There were, in fact, no significant modifications to the text of the requirements between the 1999 and 2001 versions of the Standard. The modifications the independent consultant refers to were, in fact, made to the 2001 version of Standard 62.1, not the 1999 version, and are not required here. Therefore, the requirements apply.

Mold infestations may take years to occur, but it is not uncommon and the likelihood increases with time due to the accumulation of dirt and spores that naturally collect in and on fiberboard duct and duct liner. No control or alarm logic was provided to prevent conditions that could lead to mold growth. The lack of availability of summer reheat, a specified design feature, would create conditions appropriate for the growth of mold to occur. Lack of operation of the refrigeration system would also promote similar conditions in humid weather. There are proven methods to prevent these problems without using reheat, but none were employed in the design

of this facility.

These facts contradict the independent consultant's review comment and are direct violations of design Prerequisite EQ-1.

24. **Allegation:** Violation of Standard 62-1999 5.11 (page 36).

Independent consultant review comments: The quoted section was substantially revised by early addenda to the 1999 version so the version listed does not apply. See previous comment.

Appellant Rebuttal: Again, the independent consultant's observation asserting that the requirements of this section were modified by addendum to the 1999 version is incorrect. There were no modifications to the text of the requirements between the 1999 and 2001 versions of the standard. The language the independent consultant makes reference to was, in fact, made to the 2001 version, therefore the requirements apply. The same comments made in item 23 apply.

25. **Allegation:** Standard 62-1999 6.1.3.1 (page 37).

Independent consultant review comments: The engineer used the multiple spaces equation according to their submitted calculations, but only at the cooling design condition. However, as noted in comment 18, the design appears to be in compliance with Addendum 62n.

Appellant Rebuttal: The independent consultant has consistently chosen to ignore the actual LEED® criteria and tries to apply inapplicable criteria. The requirement is for compliance with Standard 62.1-1999 plus the addenda listed in Appendix H of Standard 62.1-2001. Addendum n to Standard 62.1-2001 does not apply and is irrelevant to the Certification and the appeal.

The independent consultant's consistent failure to attach documentation supporting his conclusions makes them particularly incredible in the face of the detailed calculations provided by the appellants. Not one of the VAV systems complied with the Ventilation Rate Procedure computational requirements for LEED® NC 2.1 and the independent consultant has confirmed the basic reasons for this in previous allegations.

26. **Allegation:** Violation of Standard 62-1999 6.1.3.2 Recirculation Criteria (page 38).

Independent consultant review comments: This section was deleted in Addendum 62n.

Appellant Rebuttal: Compliance with Addendum n to Standard 62.1-2001 is irrelevant to this appeal. It is not a LEED® NC 2.1 criterion.

27. **Allegation:** Violation of Standard 62-1999 6.3 Design Documentation Procedures (page 39).

Independent consultant review comments: Documentation of design criteria is not available

in any of the documents provided. It normally is provided with the EQp1 documentation. However, it could have been provided to the owner in some other documents. This was confirmed by the design team. No apparent violation.

Appellant Rebuttal: The independent consultant's conclusion is contradicted by his own observations. The violation is obvious and apparent.

The independent consultant acknowledges the violation and fails to provide any legitimate reason to dismiss the allegation. The design team either could not, or would not, produce the required design documentation. And that says it all.

Section 5.2 of ASHRAE Standard 62.1-1999 states, *“The design documentation shall state assumptions that were made in the design with respect to ventilation rates and air distribution.”*

Section 6 of ASHRAE Standard 62.1-1999 states, *“Design documentation shall clearly state which assumptions were used in the design so that the limits of the system in removing contaminants can be evaluated by others before the system is operated in a different mode or before new sources are introduced into the space.”*

Section 6.1.3.1 of ASHRAE Standard 62.1-1999 states, *“Design documentation shall specify all significant assumptions about occupants and contaminants.”*

Section 6.3 of ASHRAE Standard 62.1-1999 states, *“Design criteria and assumptions shall be documented and should be made available for operation of the system within a reasonable time after installation. See Sections 4 and 6 as well as 5.2 and 6.1.3 regarding assumptions that should be detailed in the documentation.”*

Section 7.2.6 of ASHRAE Standard 62.1-1999 states, *“Documentation. The following ventilation system documentation shall be provided to the building owner or his/ her designee, retained within the building, and made available to the building operating personnel:*

- (a) An operating and maintenance manual describing basic data relating to the operation and maintenance of ventilation systems and equipment as installed.*
- (b) HVAC controls information consisting of diagrams, schematics, control sequence narratives, and maintenance and/or calibration information.*
- © An air balance report documenting the work performed for 7.2.2.*
- (d) Construction drawings of record, control drawings, and final design drawings.*
- (e) Design criteria and assumptions.”*

The computations required by Standard 62.1-1999 are neither complex nor difficult to prepare. The implications of those computations for the design of any facility is another matter entirely. If the required calculations had actually been prepared by the designers, and had been made a part of the permanent project records as required by Standard 62.1-1999, the required

documentation should have been readily available, it should closely agree with the actual project design parameters, and it should have been a very simple matter to attach it to the independent consultant's report. And that would have put an end to this part of the dispute.

The independent consultant has acknowledged that he was unable to procure the required documentation. To accept without independent verification the word of a party involved in certifying compliance with literally thousands of violations of prerequisite Standards is completely counter to his charge and responsibilities as an independent consultant. The USGBC independent consultant should have made an independent determination, and he did not.

The appellant's position on this matter is that their compliance computations conclusively demonstrated that it is mathematically impossible for the designers, or the independent consultant, to produce documentation arriving at the ventilation rates provided for this project using the computational methodologies required in Prerequisite EQ-1. The appellants provided their computations to that effect as a part of the appeal. The failure of the design team, and the independent consultant, to produce the requisite documentation simply confirms the validity of the allegations made in the appeal. Failure to comply with the documentation requirements of ASHRAE Standard 62.1-1999 is in itself a violation of the requirements of Standard 62.1-1999 as the excerpts from the Standard indicate. Nor did the USGBC independent consultant find any fault with any of the extensive calculations in the appeal.

This failure is prima facie evidence of an incorrectly certified application for LEED® Certification. Therefore, the designers failed to comply with the LEED® Prerequisite EQ-1. No documentation, no plaque.

28. **Allegation:** Violation of Standard 62-1999 7.1.3 Protection of Materials (page 39).

Independent consultant review comments: Section 15890B 3.1 N. requires protection of ductwork against dust and rain. No apparent violation.

Appellant Rebuttal: The independent consultant apparently failed to read the allegation, which states, "building materials," not just ductwork. That covers significantly more territory than Specification Section 15890B. The violation is apparent and stands.

29. **Allegation:** Violation of Standard 62-1999 7.2.6. Documentation (page 39).

Independent consultant review comments: Documentation is reasonably specified in sections 15010 1.6 B. and 15960B 1.5. No apparent violation.

Appellant Rebuttal: The independent consultant's position directly conflicts with numerous earlier statements having previously confirmed that not all required HVAC control sequences, construction record drawings, and design criteria were provided. The violation is apparent and valid.

30. **Allegation:** Joint Standard 62.1 and Standard 90.1 Issues (page 40).

Independent consultant review comments: The claim that VAV systems cannot simultaneously comply with Standards 62.1 and 90.1 is simply incorrect if reasonable operating assumptions are used in ventilation design scenarios, and Standard 62.1, relevant interpretations, and the User's Manual all allow using reasonable assumptions. I would agree that compliance using the Prescriptive Approach to 90.1 is difficult with a standard single duct VAV system, but not impossible.

Note also that 90.1 compliance in this case was shown via the Energy Cost Budget Method; hence strict compliance with prescriptive measures is not required provided the non-complying elements are properly included in the model. These issues are already addressed in previous comments.

Appellant Rebuttal: The independent consultant's conclusion is contradicted by his own observations. The violations are obvious and apparent. The independent consultant's arguments regarding the applicability of the prescriptive requirements were rebutted in the appellant response to his comments in Allegation 9, above.

The independent consultant agrees with the appellants that compliance with ASHRAE Standards 62.1 and 90.1 is extremely difficult with conventional single duct VAV systems. The independent consultant's argument that the appellants have claimed that recirculating VAV systems cannot simultaneously comply with Standards 62.1 and 90.1 is incorrect. This can occur in thermally dominated, low density occupancies, but not ventilation intensive educational facilities. It is readily achieved with 100% outdoor air VAV systems which is why the International Mechanical Code has contained the following language since 1998.

403.3.3 Variable air volume system control. Variable air volume air distribution systems, other than those designed to supply only 100-percent outdoor air, shall be provided with controls to regulate the flow of outdoor air. Such control system shall be designed to maintain the flow of outdoor air at a rate of not less than that required by Section 403 over the entire range of supply air operating rates.

Specific sensors and control features are required to meet the above control requirements for single duct VAV systems employing recirculation. Critical system sensors are absent on all of the VAV systems in this building, leaving the design unable to measure key parameters necessary to achieve the above control requirements. These devices and functions were not specified by the designers, did not appear on the Johnson Controls temperature control drawings and were not installed. As such, the actual capabilities of the HVAC systems as designed, as installed, and as indicated on the temperature control system "record" documents, do not and cannot match the modeled capabilities claimed by the independent consultant and the designers. Anyone who routinely models HVAC systems knows that they can make a model appear to be able to do anything by manipulating input variables to "fool" the program into giving them whatever answer they want.

When trying to comply with ASHRAE Standards, reliance on Users Manuals does not guaranty compliance with the specific requirements in the Standards. It has been previously shown that this building must comply with the prescriptive requirements in Standard 90.1, so using the Energy Cost Budget Method or Users Manual is not a valid option in this case.

Throughout his responses, the independent consultant's arguments are based on the presumption that the Energy Cost Budget method was or is permitted in this case. LEED® Version 2.1 compliance, Prerequisite Requirement EA-2 states:

“Design the building to comply with ASHRAE/IESNA Standard 90.1-1999 (**without amendments**), or the local energy code, **whichever is more stringent.**”

Deviations from the prescriptive requirements of the Wisconsin Energy Code (COMM 63.1070) must also be approved by the Authority Having Jurisdiction in accordance with the 2000 IECC, Section 8.06.5.2 which, among other things, states:

“A list of the energy related features that are included in the proposed design and on which compliance with the provisions of the code are claimed shall be provided to the code official. This list shall include and prominently indicate all features that differ from those set forth in Section 806.4 and used in the energy analysis between the Standard design and the Proposed design.”

This did not happen. It is a matter of public record that no such analysis was ever provided to the Authority Having Jurisdiction and that approval of construction was based on meeting the prescriptive requirements of the Wisconsin Code, ***only***. This leaves the independent consultant in the impossible position of attempting to defend violations of prescriptive requirements of the prerequisite standards and local energy Code on the basis of the required documentation that was never filed with the Authority Having Jurisdiction, and likely does not exist. Bringing this to the attention of the Authority Having Jurisdiction may just produce the result of the State of Wisconsin stepping in and requiring modifications to the subject facility to bring it in line with the prescriptive requirements. These facts, are extremely inconvenient to USGBC, to their independent consultants, and to the designers. They were specifically pointed out in the appeal. They have been systematically ignored by the independent consultant and the USGBC.

The independent consultant has, in fact, consistently verified that the facility was constructed in violation of minimum Wisconsin Code requirements, and in violation of Wisconsin law. He has also confirmed most of the allegations that this building fails to comply with the mandatory LEED® prerequisites. How the USGBC's independent consultant can claim there are no apparent violations of the LEED® prerequisites defies reason, the prerequisite Standards, basic engineering judgment, and common sense.