Osborn Hill Elementary School

760 Stillson Rd
Fairfield, CT 06824

Fairfield Public Schools Recommissioning (RCx) and Testing, Adjusting, & Balancing (TAB) Study

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FAIRFIELD PUBLIC SCHOOLS RECOMMISSIONING (RCX) AND TESTING, ADJUSTING, & BALANCING (TAB) STUDY

EXECUTIVE SUMMARY

Osborn Hill Elementary School was deemed to be school priority number nine by Fairfield Public Schools. The following report will indicate the compliance or non-compliance of this school with current International Mechanical Code (2015 IMC) regarding Ventilation for Acceptable Indoor Air Quality.

The School is located at 760 Stillson Road Fairfield, CT and serves as an educational facility for approximately 414 students as of the May 2022 census and up to 126 faculty and staff. Osborn Hill School was founded in 1955 and became the Town Central Administrative School Offices in 1981. It reopened as an elementary school in 1998 with a controls upgrade as well as air handling unit replacements in the years since.

The school ventilation systems comprise mainly of seven Trane RTUs, six York Heat pumps, and one Kitchen MAU-Exhaust on the roof. All Trane equipment is in good working condition. The MAU was electrically disconnected and it is not clear how long it has not been running. The York Heat Pumps are older (installed circa 2009) and could use some attention as they were dirty inside with unclear functionality. The classrooms are only served by exhaust fans, which provides no direct outside air to the spaces. As such this building would need to qualify under the IMC 2015 402/403 code sections that allow for exhaust in lieu of direct ventilation, but this will be expanded on later. The Building Automation (BAS) control system consists of an Alerton control system through ABS.

We performed our on-site RCx inspection starting in April 2022, and TAB review starting July 2022. The goal of this study is primarily focused towards addressing the outside air and outside air change rates of the occupied spaces. Although there are code exhaust air requirements for spaces like storage rooms, electrical rooms, mechanical rooms, etc., these spaces are often not directly ventilated with outside air, nor are they required to be since they typically have occupancy totals of zero (actual or expected). These spaces typically do not affect building occupants since they are typically provided with some form of exhaust which drives these spaces negative to the surrounding area. At worst, improper levels of exhaust would drive a negative building further negative, but it does not introduce air from these locations to classroom or office spaces. Should the district pursue additional work for the building including recommissioning, balancing, and controls upgrades, these spaces would be addressed as a component of that process.

Overall, the performance of the building with regard to ventilation was found to be poor, largely due to classrooms not being provided with their own outside air and multiple noted humidity issues throughout the building. Findings from the Retro-Commissioning (RCx) and air-side Testing Adjusting and Balancing (TAB) process found significant issues that should be addressed immediately to improve building environmental control, reduce energy usage, and improve building ventilation compliance with the 2015 version of the International Mechanical Code (2015 IMC). Although there are additional guidelines and recommendations put forward by organizations dedicated to the research and implementation of healthy buildings that have plenty of overlap with IMC 2015, these were not the driving factors for this assessment. Please be aware that many of these changes on their own will not reduce energy consumption, but rather will increase it; in some cases, this increase could be significant.

Measures should be considered that offset this additional energy use with control upgrades that adjust ventilation systems based on use and measured values. The remainder of this report will address these concerns directly and provide a path forward for Fairfield Public Schools.

EVALUATION

For the purposes of this study, the Fairfield Public Schools district had five primary questions about the capability and performance of each of the school buildings. Based on our findings, we have some insight into each of these below.

2015 International Mechanical Code (IMC) Compliance

As the accompanying spreadsheet indicates, many of the individual occupied spaces at this school do not fully comply with the applicable building codes or guidelines regarding indoor air quality and outdoor ventilation. The measured ventilation air being delivered into each occupied space would be considered a worst-case scenario only, and even at such, there are some areas within the building that do meet and exceed these ventilation requirements by a significant amount.

The supply of outside air to interior occupied spaces is governed by the 2018 Connecticut Building Code, which is based on the 2015 International Mechanical Code. This code prescribes the flow rate of outside air that must be supplied mechanically to occupied areas based on occupancy classifications. Depending on the type of use of a space, outdoor air flow rates in cubic feet per minute (CFM) per person are defined when the number of occupants within a space is known. When total occupants per space are unknown, the code defines occupant density for each classification type in number of occupants per space floor area. The final flow rate in CFM for every occupied space can thus be calculated. Please note that, although this is a school, some spaces like an office will not be indicated as being part of an "education" occupancy classification because the IMC does not distinguish between an office in an office building, a school, or anywhere else. This applies to nearly every space that is not considered a space for traditional classroom activities including, but not limited to, nurse and healthcare offices, gymnasium, assembly halls, etc.

As an alternative to providing outside air mechanically to occupied spaces, IMC 2015 also allows for outside air to enter occupied areas naturally through operable windows, doors, or other means but there are caveats. The area of operable windows for an occupied space needs to be at least 4% of the space's floor area in order for mechanical ventilation for that space to not be required by code. However, although spaces with sufficient operable window area may satisfy code requirements, this is not a realistic way of providing adequate ventilation during periods of cold or hot weather, and this often adversely affects the temperature and humidity levels within the building. Few occupants would be willing to keep the windows open year-round due to these comfort concerns, and energy consumption would be increased if the heating or cooling equipment is used in an attempt to condition the space appropriately. Additionally, even if the windows can be used at all times, none of the air introduced into the building this way is filtered, so exterior contaminants such as pollen, dust, and other allergens will have easy paths of infiltration directly into occupied zones. One final point regarding opening of windows would be a security concern for building occupants or for school property.

There are a few sections within IMC 2015 that address this issue specifically, and referenced below:

- **402.1 Natural Ventilation**: *Natural Ventilation* of an occupied space shall be through windows, doors, louvers, or other openings to the outdoors. The operating mechanism for such openings

shall be provided with ready access so that openings are readily controllable by the building occupants.
    - Although many classrooms in this building have exterior doors, for security reasons it is highly inadvisable that doors be propped open in any way to allow their use as part of the ventilation system.
- **402.2 Ventilation Area Required**: The minimum openable area to the outdoors shall be 4 percent of the floor area being ventilated.
    - Each of the major classrooms comes with large windows with an accompanying openable, smaller section towards the bottom (about 3 feet A.F.F.) that, if opened fully, would account for approximately 3.2 ft^2 area *per window*, totaling to 16 ft^2 openable area to the outside per standard classroom. There were notes on some windows indicating that they must remain open at all times while school is in session. This is highly advisable to continue this policy while this remains the only means of ventilation, but it persists as a long term issue.
    - The standard classroom comprises approximately 850 ft^2 floor area, which puts the percentage of openable area at a little more than 2% per space. Although there are exceptions in both directions, these are minor and no space in this building has the necessary 4% openable area as required by this section of code. These findings do *not* account for windows that are inaccessible, locked, broken, etc., though these would definitely have an impact on the performance of the building.
- **402.3 Adjoining Spaces**: Where rooms and spaces without openings to the outdoors are ventilated through an adjoining room, the opening to the adjoining rooms shall be unobstructed and shall have an area not less than 8 percent of the floor area of the interior room or space, but not less than 25 square feet. The minimum openable area to the outdoors shall be based on the total floor area being ventilated.
    - Should the windows for any particular space be closed, the air is drawn through from the corridor and potentially from other classrooms. The corridors are *not* provided with outside air in any sense except for what might be incidentally drawn into the building via negative pressure. In this case, the corridor would not count as an "adjoining space" for purposes of satisfying this component of the code.
- **403.3.1.2 Exhaust Ventilation**: Exhaust airflow rate shall be provided in accordance with the requirements of Table 403.3.1.1. Outdoor air introduced into a space by an exhaust system shall be considered as contributing to the outdoor airflow required by Table 403.3.1.1 (Note: this table was used to determine the airflow requirements used to develop the Ventilation Calculation spreadsheets included within Appendix 2)
    - A supplemental ventilation calculation spreadsheet that includes the exhaust rates is provided as part of this appendix. Although these exhaust fans run during occupied modes, the natural ventilation numbers <u>are not</u> considered as part of the "worst case" scenario for this report. The data is promising that it *could* be used, but it fully relies on the windows in each space being fully accessible (some of which are partially or completely blocked by school supplies) and opened at all times during occupancy (for which there is no guarantee since this relies on individual occupant action with no automation).

The amount of outside air supplied to occupied spaces is important for occupant comfort and health because contaminants generated by people and materials in the space must be removed or they will build

up to unhealthy levels. Diluting interior air with outside air reduces the concentration of various airborne contaminants, including viral particles that carry the COVID-19 virus and other viral and bacterial contaminants.

Outside Air Flow and Air Change Rate Findings

The "Ventilation Data Calculations" Appendix contains the data from all RCx findings and TAB measurements regarding ventilation within occupied spaces. This data conforms to the requirements within IMC 2015 and the results are calculated based on individual space classification and category. Additionally, these readings rely on the "worst case" scenario, whereby each space is considered fully occupied and the associated air handling units are operating with minimum outside air to satisfy the controlled parameters. The reason for using this method is to ensure that if a building is capable of maintaining required outside air flow in this minimum ventilation mode, it will definitely maintain them when more outside air is introduced. It does not necessarily mean that the units will handle thermal or humidity regulation in maximum ventilation modes. As a caveat, it is important to understand that forcing the worst case is not necessarily typical building operation but is necessary to discover root issues behind the ventilation control of the building. It is possible that correcting certain issues regarding outside airflow will cause different issues to be revealed, which in turn would need to be addressed.

For the occupied zones within this building, the total minimum required ventilation airflow came out to **13,662 CFM**. The following additional data will be broken out into purely filtered ventilation and accounting for exhaust:

- **For discounting the exhaust air (worst case):** The TAB process revealed that only **5,427 CFM** of outside air is delivered to the spaces, resulting in a **8,235 CFM** deficit or **39.7%** of the required minimum flow. Additionally, the ventilation calculations reveal that only **24.6%** of the occupied zones actually met the requirements (14 out of 56). A significant quantity of spaces received little or no ventilation, either because the associated unit damper is nonfunctional, because the outside air dampers could not open manually or through the controls, or because the space is served only by exhaust fans that do not provide direct ventilation air per the space requirements.

- **For including the exhaust air (potential consideration, but not suggested for Natural Ventilation code compliance through IMC 2015 section 402 & 403):** The TAB process revealed that **11,055 CFM** of outside air is delivered to the spaces or is exhausted from the spaces, resulting in a **2,607 CFM** deficit or **80.9%** of the required minimum flow. **66.1%** of the occupied zones (37 out of 56) met the flow requirements based on this setup, which means that even during the best consideration for code compliance 19 of the rooms, mostly classrooms, still do not provide adequate ventilation. However, this exhaust component requires the openings of windows or doors in each space used to provide ventilation be of sufficient area equal to a minimum of 4% of the total space floor area. As mentioned in the note within the executive summary regarding IMC 2015 section 402.2, none of these spaces had sufficient window opening *potential* to meet code, most of which having only about **2%** openable area. While each classroom has an exterior door, adding this into the openable area would bring most rooms above the minimum 4% *if* the doors were all propped completely open, which is a bad decision for security and safety reasons, as well as humidity concerns noted throughout the building. For a functioning natural ventilation system and associated protocol, these windows all need to be in good condition and easily accessible, with occupants opening them during occupied periods.

Adverse weather conditions that would dissuade the occupant from opening the windows (e.g., heat, cold, humidity, rain, etc.) are not exceptions to the requirements. A well-designed natural ventilation system either accounts for these conditions at the openings or has a backup purely mechanical system that can handle the entire building, neither of which are implemented here.

A common calculation used for measuring the amount of air flushed through the space every hour is the Air Change Rate (ACH), and for this analysis specifically we are concerned with the Outside Air Change Rate (OACH). At its core, this is a ratio of the volume of air that can theoretically completely fill the volume of each space and how many times it can do that every hour. For example, a 1000 ft^2 room with 10 ft ceilings will have a volume of 10,000 ft^3. If 250 CFM is delivered to this space, that results in 15,000 ft^3 of air. Every hour, the space will be flushed with that much air, resulting in an ACH of 1.5. This number on its own will not determine if a space satisfies code requirements and it does not mean that every molecule of the air in that space has been replaced after the hour, but it helps to give an idea into the type of performance that could be expected and there are guidelines for many space regarding the OACH. While general spaces like classrooms and offices are among the space categories that do not have outside air ACH requirements, these rates help to give some insight into overall performance. Current recommendations prescribe a total ACH of at least 3 throughout the building, without falling below the minimum outside air CFM. Taking the entire building volume and air delivered cycled through the building, which includes outside air and filtered, return air, this building was capable of achieving 2.749 ACH. This is close to the recommended 3 ACH, and with some changes to the way systems are controlled there is potential for the building to increase outside air where there is too little in order to meet some of the code requirements. This can be further broken out by spaces that meet or fail to meet code. Among the spaces that failed to meet code, the outside air ACH was 0.272; for spaces that at least met or exceeded code, the outside air ACH was 1.315; the combined outside air ACH for the entire building was 0.691. Special rooms such as a nurse's suite do require an outside air ACH of at least 2 and total ACH of 6, which <u>was not</u> met in this building. This is in addition to other recommendations or requirements such as negative pressure relative to adjacent spaces, extra filtration requirements for recirculated air, space pressure profiles for nurse suite spaces, etc..

IMC Code Type	Total ACH (RA + OA)	Total OACH (OA/EA)	OACH for zones that do <u>not</u> meet code	OACH for zones that meet Code
Excluding Exhaust per IMC 2015 section 401	2.749	0.691	0.272	1.315
Including Exhaust per IMC 2015 section 402 & 403	5.984	1.408	0.158	2.549

<u>Outside Air Flow Improvement Recommendations</u>

Immediate action should be taken for spaces receiving 0 CFM direct outside air, particularly many of the classrooms. All of the York Heat Pump units had issues with the associated outside air damper being blocked and would need mechanical adjustments to open them back up. The HVAC systems should holistically be rebalanced to current design requirements after the BAS control system has been reviewed

for sequence optimization and device recommissioning, since the latest revision is a couple of decades old.

Aside from the above, since the emergence of the COVID-19 virus in December 2019, the specific requirements and precautions taken regarding outside air have become more stringent. For example, ASHRAE has been continuously investigating the transmission of COVID-19 through HVAC systems and has made recommendations on how to adapt existing HVAC systems to minimize transmission of COVID-19. Changes to building systems to address the virus also positively improve the performance of the ventilation systems with handling the filtration of other particulate that directly impacts building air quality. On April 14, 2020, ASHRAE released a document "ASHRAE Position Document on Infectious Aerosols". This report was provided in an Appendix to ventilation summary reports previously provided to Fairfield Public Schools. ASHRAE also gave a presentation on June 16, 2020, regarding Recommendations and Activities for re-opening schools for the fall 2020 academic semester. These recommendations remain relevant as COVID and other contaminants that impact indoor air quality continue to remain a concern. Although this report is primarily concerned with meeting 2015 IMC for compliance, ASHRAE's insight into addressing the code is invaluable. Their recommendations for reducing the transmission of infectious aerosols through HVAC systems as they apply to schools are as follows:

- Increase outdoor ventilation rates (Dilution) for all zones with deficit minimum outside air by adjusting the outside air damper minimum position of the associated air handling equipment. Generally, more is better, but any changes should follow ASHRAE Standard 62.1 as a minimum and should not overpower the capability of the heating or cooling equipment so as to maintain temperature and humidity requirements in the occupied spaces.
- Filter changes should become more frequent. Current policy indicates a twice-annual filter change at all schools. The filters had been scheduled to be changed at the time of inspection as the last change recorded was October 2021, and almost all of them were very dirty, which decreases the filter's efficiency and forces the unit fans to run at higher speeds (more energy consumption) or to deliver less outdoor ventilation air to the space.
- Increase total air change rates to between 3 and 6 ACH where possible while still satisfying minimum OA ventilation.
- Flush or purge building before and after occupancy for at least two (2) hours, if possible.
- While all units appear to have MERV 13 filters now installed, units that have both final and pre-filters have MERV 13 filters in both positions. Having two of the same efficiency filters in series does not significantly improve the filtration efficiency and mostly just reduces total airflow. MERV 8 pre-filters can be used in double bank racks to act as an inexpensive shield for the more expensive MERV 13 or 14 filters.
- Consider installation of UV-C or bi-polar ionization to recirculating air systems where installation of these systems do not interfere with the unit construction or operation.
- Provide humidification to maintain 40% RH during the heating seasons, if possible.
- Provide dehumidification in the summer to maintain room RH below 60%.

- Supplement poorly or un-ventilated areas with portable HEPA filtration units in classrooms until such time as proper ventilation can be delivered to the space.
- Add low return / high supply airflow paths or utilize displacement ventilation where possible.
- Increase restroom exhaust where possible while maintaining a positive building pressurization to the exterior.
- Perform duct cleaning for existing systems.

Control Sequence Update Recommendations

Without a specific retro-commissioning of the BAS control system itself, it is not possible to tell exactly what systems and components of the BAS needs repair or upgrade, but a cursory review of what was available indicates great need to :

- Repair or replace any faulty equipment controllers and end Input/Output devices.
- Look to program units to provide a pre and post occupancy purge for all occupied spaces.
- Generally, increase airflow to each space or decrease if the supplied air is significantly beyond necessary levels. Decreasing air to some locations might seem counterintuitive but some zones are being supplied with significantly more than 100% of what is required, so backing these down will help move air to where it needs to go. This item should not be addressed without a certified TAB contractor to verify flow adjustments are correct.
- Increase the minimum OA damper position for each unit, where possible.
- Confirm that trending and alarms have been set up for all units and establish alarm points for units operating below required minimum ventilation levels during occupied modes
- Implement CO_2 and Demand Control Ventilation (DCV) sequences for units to adjust ventilation air being delivered automatically and efficiently based on actual individual space occupancy. Not only will these sequences save a substantial amount of money in energy costs, but they remove the guesswork for facilities and control personnel for how much air each space needs, and code/guidelines incorporate these capabilities into exceptions for blanket minimum outside air flow rates. The implementation of this control strategy is especially vital since increased ventilation to the building will increase all energy costs as it has a direct impact on the heating and cooling systems as well.

Equipment Upgrade or Replacement Recommendations

Where any building areas are not meeting ventilation requirements due to a lack of mechanical ventilation, undersized units or those that are otherwise are in a state of disrepair, or for any units that need to be replaced, we recommend considering Energy Recovery Ventilators (ERV). These do not need to be directly associated with a nearby unit, however, and can often come standalone with additional coils for heating and cooling. Energy Recovery Ventilators are packaged heat recovery units that mostly utilize an air to air heat exchanger to recover waste heat from the exhaust air and transfer it to the outside air, powered by supply and exhaust air fans. ERVs require ducted outside and exhaust air to the outside of the building; the inlet and exhaust air openings should be at least 10 feet apart to comply with the Building Code. Depending on the location, general exhaust fan ductwork could be repurposed for these units.

There are two main types of air-to-air energy recovery units: energy wheel and cross-flow heat exchangers. Energy wheel units tend to be more expensive and have some additional operating costs due to the wheel motor, but they have higher heat transfer efficiency than cross-flow units. Both styles of units require filters to protect the heat exchanger media and operate best during peak load conditions. Sometimes an existing unit can be retro-fit with some form of heat recovery system, but it is highly dependent on the unit configuration and requires engineering calculations to determine sizing, including if the current unit fans can accommodate the increased static pressure losses that would be incurred.

Generally, the more outside air that can be supplied to occupied areas, the better. Each existing air handler should have outside air flow rates increased above current setpoints if they can be obtained. Even units that currently meet code requirements for ventilation flow rates could be increased, but should not be increased beyond the capacity of the unit to heat or cool the air. Total space air change rates should also be increased to the extent possible along with increases in outside air flow to better remove contaminants from the air. If a unit at maximum fan speeds is still incapable of providing at least the minimum ventilation or ACH required, then the system should be evaluated further to determine the best solution such a total system modification, or the installation of a self-contained HEPA filtration unit in areas where increasing fresh air is limited.

Supplemental air cleaning technology, such as ultraviolet-C (UV-C) light or bi-polar ionization, is available could be considered if additional disinfection measures are desired. UV-C is short wavelength ultraviolet light that has been found to effectively kill COVID-19 particles. UV-C systems are already used in other HVAC systems where they are installed in air streams to kill bacteria and other harmful living organisms. These systems can be installed relatively easily in already constructed system ductwork or air handlers without major modifications. Bi-polar ionization systems are also installed in ductwork or air handlers and use an electric charge to create a concentration of positively and negatively charged particles in an airstream. These particles cause pathogens to stick to each other and become larger, thus increasing the probability of them being captured by air filters. The charged particles created also leave the ductwork and remain charged when they enter occupied spaces. If the particles come in contact with pathogens in the occupied space, the charge removes hydrogen from the pathogen so that it is no longer able to sustain itself. For this reason, bi-polar ionization is preferred to UV-C air cleaning because bi-polar ionization has the ability to decontaminate pathogens outside of the ductwork whereas UV-C only decontaminates pathogens that enter the ducts.

ASHRAE recommends relative humidity values between 40 and 65% as these values have been shown to hamper the ability of COVID-19 and other pathogens to travel and thrive. When cooling systems are in operation, ensure dehumidification is adequate to keep relative humidity below 65%. During heating system operation, relative humidity values are typically less than 40%. Adding humidification to the existing HVAC systems is often exceedingly difficult and costly; additionally, humidification for HVAC systems can be problematic if not well maintained and adds to operating costs. For this reason, recommendations discussed above should be enacted before humidification is considered. However, since the building is *currently* experiencing humidity concerns, recommendations for moderating the effects should be implemented sooner, at least before next Spring when temperature and relative humidity begins to rise once more.

In order to best confirm that the implementation of the above recommendations is met as well as other improvements, we recommend performing Recommissioning of the school. This is an extensive procedure that will help with fully documenting the building systems, their capabilities, and optimizes the control system to maintain the best performance while conserving the most energy. In general, Recommissioning should be performed approximately once every five years to keep the buildings operating smoothly.

For any unit that operates *only* with 100% outside air (e.g., makeup air units, dedicated outside air units, etc.) MERV 8 filters can be used instead of MERV 13s. This will allow for fan energy savings and increased ventilation without sacrificing indoor air quality. Where any of these units need to be replaced, we recommend considering a unit with some form of energy recovery (either a wheel or cross-flow heat exchanger). This will conserve additional energy and will still allow for systems to operate with more outside air.

Most units allow for some amount of recirculation, so the following are recommendations for upgrading the air handling units:

- Where any unit has a two filter racks where the first has room for 2" filters and the second has room for 4" or greater filters, the 2" filters can be MERV 8 for pre-filtering, but the larger filters should remain MERV 13.
- Based upon our observations HVAC unit filter changes should be performed more frequently. The party responsible for changing the filters should note which unit filters become dirty quicker and should further increase the frequency of changes to those units.
- Consider adding Bi-polar ionization or another means of air disinfection wherever possible.
- Consider investigating the potential of increasing the ventilation air flow rate wherever possible.
- For any defunct units or disabled units needing serious repair or replacement, consider replacing with a unit that has energy recovery (either a wheel or cross-flow heat exchanger). This might require changes to the ductwork or balance of the air system since replacing a mixed air unit with a 100% OA unit might result in less total airflow required.
- All of the items noted within the RCx and TAB field finding appendices should be addressed by the facilities personnel. These items are separated by category: IAQ/Ventilation items, Maintenance items, Control items, and Information Only. While these lists are not a substitute for a full-building commissioning service, these corrections contain many of the significant issues that will quickly improve indoor air quality and energy consumption rates. Some typical issues include, but are not limited to:
    - Damper cleaning and lubrication: All unit dampers should be cleaned and lubricated and tested throughout their movement range from the BAS. As dampers age, lubrication fails and dirt builds up causing the actuator to need to push harder to move the damper. Too much build-up can result in control actuators failures or broken damper hardware, which would need to be replaced.
    - Exterior Insulation: ductwork and piping insulation should have UV-resistant coating or shields. Typically, foil-faced aluminum insulation or banded aluminum jacketing works for this. For exposed refrigerant piping, these should be reinsulated with elastomeric insulation and coated with a UV-resistant paint. This will prevent deterioration from the sun and avoid costly repairs since almost all air handling and refrigerant equipment is located on the roof.
    - General Unit Cleanliness: All units should be cleaned to remove any dirt or debris that has accumulated. Units with loose paper, cardboard, and other materials inside can become a breeding ground for bacteria and molds should those materials absorb moisture.

Sections of units that have developed rust or corrosion should be kept dry and cleaned with appropriate chemicals for removing the build-up before repainting or repairs tasks.

- Fan Belt Tension and Wheel Alignment: All fan motor pulley's, sheaves and belts should be reviewed for proper alignment and tension. Some motors might need to be repositioned in the unit to fix the tension or adjust for alignment. Some fan wheels also wobble or pulleys could be misaligned. Consider adjust motor positions if out of alignment and installing belt tensioners where possible to extend intervals between belt changes without compromising unit efficiency as the belt wears.

CONCLUSIONS

Though Fairfield Public Schools has likely taken measures in the past to address identified deficiencies regarding the recommended proper filtration upgrades for indoor air quality (IAQ) improvements, this study found that the Osborn Hill Elementary School is challenged to fully meet the current minimum ventilation requirements per 2015 IMC mainly due to the lack of direct ventilation and humidity management. The van Zelm, Wings, and Fairfield Public Schools team will collectively discuss options and estimate costs for correcting issues and code deficiencies discovered as part of this study. The cost analysis portion will be a continual process.

While some recommendations will help improve performance, there are a number of key recommendations that should be implemented immediately since the school is currently occupied. These include bringing into proper operation the outside air dampers for all units, adding dedicated paths of ventilation to all classrooms, adjusting or adding controls and device that will help to mitigate humidity concerns, and generally increasing outside airflow throughout the building without adversely affecting the previous items. Given the results of this survey, we highly recommend further evaluation to be performed including whole-building Recommissioning, BAS controls upgrade and rebalancing, possibly including engineered ventilation calculations/modifications aid in code compliance and generally better working order.

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APPENDICES

APPENDIX 1 – Issues List

ISSUES LIST

Issue List General Discussion

The following sections within this appendix include observations we made as a part of the study. Some of these items directly impact Indoor Air Quality (IAQ) or Ventilation and, since this is the primary concern of the study, are recommended to be addressed immediately. Other items are overdue/improper maintenance, control system issues, or general observations. Just because an issue is not included in the IAQ/Ventilation sections does not necessarily mean that it will have no effect on improving the building environment, but it is more likely that the effects are minimal or would only indirectly address a concern. In some cases, these could potentially *reduce* overall building outside airflow, even if in such instances it would keep the associated spaces within code compliance. While this might seem counterintuitive, given the concerns, it is a way to manage a healthy, code-compliant building environment while also saving energy.

The nature of this process being one that affects almost the entire building means that a response to this issue list should be through a holistic approach. Any one issue correction on its own might locally improve the condition of the served areas, but if an adjacent, non-functioning unit is also not corrected then the positive effects will be diminished. The interconnectivity of the issues cannot be easily indicated due to the complexity of the built environment, but a thorough review of all issues and an implementation plan will provide better results overall for the building and its stakeholders.

It should be noted that the inspections we performed as part of this study were undertaken during the month of April 2022 , so it is possible that some noted concerns, particularly maintenance items or issues already known about could have been addressed prior to the distribution of this report. Ongoing discussions with Fairfield Public Schools will allow us to update these items as we continue through other schools and into the implementation phase later in the year.

To aid in the process of addressing and tracking these issues, we have included a column indicating when action has been taken by Fairfield Public Schools or a hired contractor to address any individual issues, and will allow the district to document and timestamp issues that have been corrected since the initial inspection.

Indoor Air Quality And Ventilation Issue Findings

Below is a compilation of findings from our commissioning indoor space evaluation, TAB verification effort, and the air handling equipment analysis that relate to indoor air quality or ventilation status of the building. These findings should be considered as a high priority for budgeting and action steps. Many of the listed issues might lend clarity as to why the ventilation findings of throughout were found to be deficient. Addressing these issues individually will not correct any systemic, unit, or building-wide issues related to the IAQ or ventilation of the building..

Action Taken	Status	Unit/Zone	Serving/Room Name	Indoor Air Quality And Ventilation Issue (30)
	Open	0.12 Media Center	Humidity	There were three dehumidifiers observed running in this space
	Open	0.12B Computer Lab	Humidity	There was one large dehumidifier observed running in this space
	Open	0.12B Computer Lab	Humidity	Computer room ceiling tiles were warped possibly due to high humidity.
	Open	0.15 Kitchen	Airflow	Since the MAU was not operating, the kitchen was also not being exhausted properly
	Open	10 Classroom	Humidity	Every window was found left open in this space
	Open	11 Classroom	Exhaust Fan	The exhaust fan serving this space as the primary means of ventilation was found not running. The switch and breaker were both on but the measured flow was 0 CFM.
	Open	12 Classroom	Humidity	Every window was found left open in this space
	Open	19 Classroom	Humidity	This room was empty but also had one dehumidifier observed running.
	Open	20 Classroom	Humidity	There was one dehumidifier observed running in this space
	Open	A1 Classroom	Cleaning	All of the grilles in this space are dirty, indicating circulating dust
	Open	A2 Classroom	Cleaning	All of the grilles in this space are dirty, indicating circulating dust

Action Taken	Status	Unit/Zone	Serving/Room Name	Indoor Air Quality And Ventilation Issue (30)
	Open	A3 Classroom	Cleaning	All of the grilles in this space are dirty, indicating circulating dust
	Open	A4 Classroom	Cleaning	All of the grilles in this space are dirty, indicating circulating dust
	Open	A5 Classroom	Cleaning	All of the grilles in this space are dirty, indicating circulating dust
	Open	Classroom	Airflow	Classrooms are only served by exhaust, though some have split AC units for cooling. As such, none of the classrooms have dedicated, filtered, ventilation air provided.
	Open	General	Humidity	Several dehumidifiers throughout the spaces indicating a generally high humidity level in the building. High humidity levels can promote an environment that encourages mold growth if left unchecked.
	Open	General	Humidity	Several windows left wide open after hours. Even if windows are being used as a component of the HVAC system, it is important that occupants follow proper policy and protocol to only open them when needed, and to otherwise keep them closed. This will reduced unwanted humidity and pollen infiltration or at least limit the points of entry.
	Open	General	RCx	All the York Heat Pumps appeared to have limited to no outdoor air as there appears to be a plate covering the O.A. intakes which might just be the damper. A full RCx effort would be able to determine the total functionality of these units
	Open	General	Coils	Some of the unit coils could use a wash to rid them of any excess dirt or debris. If filter changes are frequent enough, the coils should not get too dirty
	Open	HP	General	It was observed that the older York HPs (2009 units) could use some attention as they were dirty inside and their functionality is unclear.
	Open	MAU	Kitchen	The makeup air unit for the kitchen was not running at the time of testing

Action Taken	Status	Unit/Zone	Serving/Room Name	Indoor Air Quality And Ventilation Issue (30)
	Open	RTU-2	OA Screen	The outside air intake screen was plugged on this unit
	Open	RTU-7	OA Screen	The minimum outside air upper section intake screen was plugged on this unit
	Open	RTU-7	Access	RTU-7 while high on steel dunnage had poor accessibility and the metal pre-filters on the outdoor air are plugged with pollen and need to be replaced and or professionally cleaned.
	Open	HP-1	A4 Classroom	Non-Functional O.A. damper found blocked at the Factory Hood
	Open	HP-2	A3 Classroom	Non-Functional O.A. damper found blocked at the Factory Hood
	Open	HP-3	A2 Classroom	Non-Functional O.A. damper found blocked at the Factory Hood
	Open	HP-4	A1 Classroom	Non-Functional O.A. damper found blocked at the Factory Hood
	Open	HP-5	Offices	Non-Functional O.A. damper found blocked at the Factory Hood
	Open	HP-6	A5 Classroom	Non-Functional O.A. damper found blocked at the Factory Hood

Maintenance Issue Findings

Below is a compilation of findings from our commissioning indoor space evaluation, TAB verification effort, and the air handling equipment analysis that relate to indoor air quality or ventilation status of the building. The priority level of these findings will vary, and correcting any of them could improve the associated unit's performance, which might have an incidental effect on the indoor air quality or ventilation in the spaces. These issues do not necessarily explain reasons why the ventilation findings of the associated spaces were found to be deficient but should be corrected, nonetheless.

Action Taken	Status	Unit/Zone	Serving/Room Name	Maintenance Issue (17)
	Open	16 Classroom	Layout	Bookshelves in the locations that they are in this space are blocking the FTR air pattern, reducing unit efficiency
	Open	25 Classroom	Layout	Bookshelves in the locations that they are in this space are blocking the FTR air pattern, reducing unit efficiency
	Open	25.03 Boiler Room	Exhaust Fan	The exhaust fan serving this space was found not running
	Open	A.02 Girls	Exhaust Fan	There is an in-line exhaust fan that served just this space with no tags
	Open	A.04 Boys	Exhaust Fan	There is an in-line exhaust fan that served just this space with no tags
	Open	A.05 Toilet	Exhaust Fan	There is an in-line exhaust fan that served just this space with no tags
	Open	General	RCx	Retro Cx is recommended at this school to determine proper operation of existing equipment as the current heat recovery system does not lend itself to easy changes.
	Open	RTU-6	OA Screen	The outside air intake screen was damaged on this unit
	Open	HP-2	A4 Classroom	The drain pan was dirty and needed to be cleaned
	Open	HP-2	A3 Classroom	The drain pan was dirty and needed to be cleaned
	Open	HP-3	A2 Classroom	The drain pan was dirty and needed to be cleaned

Action Taken	Status	Unit/Zone	Serving/Room Name	Maintenance Issue (17)
	Open	HP-4	A1 Classroom	The drain pan was dirty and needed to be cleaned
	Open	HP-5	Offices	The drain pan was dirty and needed to be cleaned
	Open	HP-6	A5 Classroom	The drain pan was dirty and needed to be cleaned
	Open	MAU-1	Kitchen	Nameplate was destroyed
	Open	RTU-7	Gym	Crusty drain pan to be cleaned after coil wash.
	Open	RTU-7	Gym	The trap on condensate was cracked due to a previous freeze condition – removed plug, cleaned trap

Control Issue Findings

Below is a compilation of findings from our commissioning indoor space evaluation, TAB verification effort, and the air handling equipment analysis that relate to the status of the control system within the building. The priority level of these findings will vary, and correcting any of them could improve the associated unit's performance, which might have an incidental effect on the indoor air quality or ventilation in the spaces. Some control issues do affect whether or not facilities or maintenance personnel are informed of issues at systems or equipment, which can result in delays to maintenance or repairs that would otherwise have been quick to correct. These issues do not necessarily explain reasons why the ventilation findings of the associated spaces were found to be deficient but should be corrected, nonetheless.

Action Taken	Status	Unit/Zone	Serving/Room Name	Control Issue (13)
	Open	11 Classroom	Energy	The AC unit in this space was running though the space was unoccupied and adjacent space units were not running
	Open	BAS	Schedules	Verify that controls are upgraded and schedules are enabled.
	Open	BAs	Energy	Consider implementing better boiler and radiation control with a night setback strategy, which would save energy.
	Open	RTU	General	Unit economizer sections and modes need to be verified that this is enabled and working properly. Multiple units had issues with control
	Open	RTU-1	Dampers	The unit outside air damper was being commanded to 20% open but it was observed open to 5% instead.
	Open	RTU-1	BAS Integration	ABS was found not controlling this unit
	Open	RTU-2	BAS Integration	ABS was found not controlling this unit
	Open	RTU-3	Dampers	The unit outside air damper was being commanded to 20% open but it was observed open to 50% instead.
	Open	RTU-4	Dampers	The unit outside air damper was being commanded to 20% open but it was observed open to 45% instead.
	Open	RTU-4	BAS Integration	ABS was found not controlling this unit

Action Taken	Status	Unit/Zone	Serving/Room Name	Control Issue (13)
	Open	RTU-7	Dampers	The unit outside air damper was being commanded to 20% open but it was observed open to 5% instead.
	Open	RTU-7	BAS Integration	ABS was found not controlling this unit
	Open	RTU-7	Gym	System started 100% O.A, dampers look correct but no exhaust fan operation

Information Only Findings

Below is a list of the general "information only" findings from the room take-off measurements, TAB verification effort, and the air handling equipment analysis. If a correction can be made to these items, it will not affect improving the indoor air quality or ventilation for occupied spaces. Some of these items might actually speak to *reducing* outside airflow, particularly if a space is significantly overventilated or has inconsistent/large swings in occupancy, in which case their status has been indicated as "Energy Savings."

Action Taken	Status	Unit/Zone	Serving/Room Name	Information Only Findings (03)
	Open	23A Storage	Airflow	This space was labeled as a storage space on the plans but is being used as an office. Though this would normally mean it does not have appropriate ventilation, few other rooms do, too
	Open	General	Filters	All filters were dirty upon initial inspection but these were changed out prior to the balancing effort
	Open	RTU	Dampers	The minimum outside air damper position for all of the RTUs was found to be set with a 20% open signal regardless of operating condition or other requirements. This should be reexamined to better assess what the minimum position should be on a unit-by-unit basis

APPENDIX 2 – Ventilation Data Calculations

Project Name:	**Fairfield Public Schools RCx & TAB Study**
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Osborn Hill Elementary School

2A - Exhaust Excluded

VANZELM ENGINEERS

Zone Identification												IMC 2015 Ventilation Calculations									
Floor	**Room#**	**Room Name**	**Occupancy Classification**	**Category**	**Total Airflow**	**Unit Actual OA %**	**BAS OA Damper Cond**	**Served By**	**Zone Area, Az, per space**	**Ceiling Height**	**Volume, per space**	**Zone Population , Pz, per space**	**People OA Rate in Breathing Zone, Rp**	**Area OA Rate in Breathing Zone, Ra**	**Default Occupant Density**	**Min. Required Ventilation Airflow**	**ACTUAL MEASURED VENTILATION AIR FLOW**	**Excess Ventilation Air (negative indicates deficit)**	**Excess Ventilation Air Percentage**	**PASS/FAIL**	**Ventilation ACH**
					(cfm)	(%)	(%)		(sq.ft)	(ft)	(cu.ft)	Adult	(cfm/ person)	(cfm/sf)	(#/1000sf)	(cfm)	(cfm)	(cfm)	(%)		(AC/hr)
1	0.01	Main Office	Offices	Office spaces	**446**	17% - 292	20%	RTU-4	618	9	5562	4	5.0	0.06	5	57	**106**	49	85.7%	**Meets**	**1.143**
1	0.01A	Office	Offices	Office spaces	**180**	17% - 292	20%	RTU-4	45	8.2	369	1	5.0	0.06	5	8	**31**	23	302.6%	**Meets**	**5.041**
1	0.01B	Main Office Large Storage	Storage	Warehouses	**-84**	---	---	---	45	8.8	394	1	0.0	0.06	0	3	**---**	N/A		**N/A**	
1	0.02	Nurse	Hospitals nursing and convalescent homes	Patient rooms	**192**	17% - 292	20%	RTU-4	177	8.9	1575	2	25.0	0.00	10	50	**33**	-17	-34.0%	**Fails**	**1.257**
1	0.02A	Nurse Toilet	Public Spaces	Toilet rooms - public	**-62**	17% - 292	20%	RTU-4	65	8.9	579	1	0.0	0.00	0	0	**9**	9	0.0%	**N/A**	**0.933**
1	0.02B	Nurse Storage	Storage	Warehouses	**---**	---	---	---	5	8.9	45	0	0.0	0.06	0	0	**---**	N/A		**N/A**	
1	0.01C	Main Office Toilet	Public Spaces	Toilet rooms - public	**-30**	---	---	---	46	8.9	409	1	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	0.01D	Main Office Small Storage	Storage	Warehouses	**---**	---	---	---	7	8.9	62	0	0.0	0.06	0	0	**---**	N/A		**N/A**	
1	0.03	Principal	Offices	Office spaces	**405**	17% - 292	20%	RTU-4	235	8.9	2092	10	5.0	0.06	5	64	**69**	5	7.6%	**Meets**	**1.979**
1	0.04	Conference	Offices	Conference rooms	**229**	17% - 292	20%	RTU-4	145	9	1305	6	5.0	0.06	50	39	**39**	0	0.8%	**Meets**	**1.793**
1	0.05	Storage	Storage	Warehouses	**---**	---	----	---	133	8.75	1164	0	0.0	0.06	0	8	**---**	N/A		**N/A**	
1	01	Classroom	Education	Classroom (ages 5-8)	**-507**			---	890	8.9	7921	15	10.0	0.12	25	257	**0**	-257	-100.0%	**Fails**	**0.000**
1	02	Classroom	Education	Classroom (ages 5-8)	**-447**	---	---	AC	862	8.9	7672	18	10.0	0.12	25	283	**0**	-283	-100.0%	**Fails**	**0.000**
1	03	Classroom	Education	Classroom (ages 5-8)	**-428**	---	---	---	866	8.9	7707	18	10.0	0.12	25	284	**0**	-284	-100.0%	**Fails**	**0.000**
1	04	Classroom	Education	Classroom (ages 5-8)	**-537**	---	---	---	871	8.9	7752	18	10.0	0.12	25	285	**0**	-285	-100.0%	**Fails**	**0.000**
1	05	Kindergarten	Education	Classroom (ages 5-8)	**---**	---	---	AC	1028	9	9252	20	10.0	0.12	25	323	**0**	-323	-100.0%	**Fails**	**0.000**
1	5A	Toilet	Public Spaces	Toilet rooms - public	**-100**	---	---	---	61	8.9	543	1	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	05.01	Storage	Storage	Warehouses	**-211**	---	---	---	81	8.9	721	0	0.0	0.06	0	5	**---**	N/A		**N/A**	
1	06	Kindergarten	Education	Classroom (ages 5-8)	**-435**	---	---	AC	1052	8.9	9363	20	10.0	0.12	25	326	**0**	-326	-100.0%	**Fails**	**0.000**
1	06A	Toilet	Public Spaces	Toilet rooms - public	**-77**	---	---	---	21	8.9	187	1	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	06.01	Office	Offices	Office spaces	**-70**	---	---	---	120	8.9	1068	3	5.0	0.06	5	22	**0**	-22	-100.0%	**Fails**	**0.000**

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VANZELM ENGINEERS

Zone Identification												IMC 2015 Ventilation Calculations									
Floor	**Room#**	**Room Name**	**Occupancy Classification**	**Category**	**Total Airflow**	**Unit Actual OA %**	**BAS OA Damper Cond**	**Served By**	**Zone Area, Az, per space**	**Ceiling Height**	**Volume, per space**	**Zone Population, Pz, per space**	**People OA Rate in Breathing Zone, Rp**	**Area OA Rate in Breathing Zone, Ra**	**Default Occupant Density**	**Min. Required Ventilation Airflow**	**ACTUAL MEASURED VENTILATION AIR FLOW**	**Excess Ventilation Air (negative indicates deficit)**	**Excess Ventilation Air Percentage**	**PASS/FAIL**	**Ventilation ACH**
					(cfm)	(%)	(%)		(sq.ft)	(ft)	(cu.ft)	Adult	(cfm/ person)	(cfm/sf)	(#/1000sf)	(cfm)	(cfm)	(cfm)	(%)		(AC/hr)
1	06.02	Exterior Storage	Storage	Warehouses	**-175**	---	---	---	150	12	1800	0	0.0	0.06	0	9	**---**	N/A		**N/A**	
1	07	Kindergarten	Education	Classroom (ages 5-8)	**-362**	---	---	AC	1154	8.9	10271	22	10.0	0.12	25	358	**0**	-358	-100.0%	**Fails**	**0.000**
1	07A	Toilet	Public Spaces	Toilet rooms - public	**-94**	---	---	---	17	8.9	151	1	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	08	Kindergarten	Education	Classroom (ages 5-8)	**-514**	---	---	AC	1160	8.9	10324	10	10.0	0.12	25	239	**0**	-239	-100.0%	**Fails**	**0.000**
1	08A	Toilet	Public Spaces	Toilet rooms - public	**-117**	---	---	---	17	8.9	151	1	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	09	Classroom	Education	Classroom (ages 5-8)	**-437**	---	---	AC	878	9	7902	15	10.0	0.12	25	255	**0**	-255	-100.0%	**Fails**	**0.000**
1	10	Classroom	Education	Classroom (ages 5-8)	**-478**	---	---	---	874	9	7866	13	10.0	0.12	25	235	**0**	-235	-100.0%	**Fails**	**0.000**
1	0.06	Office	Offices	Office spaces	**129**	50% - 496	20%	RTU-3	116	8.3	963	5	5.0	0.06	5	32	**65**	33	103.4%	**Meets**	**4.051**
1	0.07	Office	Offices	Office spaces	**126**	50% - 496	20%	RTU-3	116	8.4	974	5	5.0	0.06	5	32	**63**	31	97.1%	**Meets**	**3.879**
1	0.08A	Toilet	Public Spaces	Toilet rooms - public	**-28**	---	---	---	59	8.9	525	1	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	0.08	Work Room	Workrooms	Copy, printing rooms	**402**	50% - 496	20%	RTU-3	303	9	2727	2	5.0	0.06	4	28	**201**	173	613.3%	**Meets**	**4.422**
1	0.09A	Toilet	Public Spaces	Toilet rooms - public	**-36**	---	---	---	59	8.9	525	1	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	0.09	Faculty	Public Spaces	Toilet rooms - public	**346**	50% - 496	20%	RTY-3	436	9	3924	6	0.0	0.00	0	0	**173**	173	0.0%	**N/A**	**2.645**
1	0.10	Girls	Public Spaces	Toilet rooms - public	**-205**	---	---	---	200	8.9	1780	3	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	0.11	Boys	Public Spaces	Toilet rooms - public	**-216**	---	---	---	200	8.9	1780	3	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	11	Classroom	Education	Classroom (ages 5-8)	**521**	---	5%	UV	660	8.9	5874	12	10.0	0.12	25	199	**0**	-199	-100.0%	**Fails**	**0.000**
1	0.12	Media Center	Education	Media Center	**2175**	9.9% - 292	20%	RTU-1	3384	9.7	32825	40	10.0	0.12	25	806	**215**	-591	-73.3%	**Fails**	**0.393**
1	0.12A	Reading	Education	Classroom (ages 5-8)	**399**	9.9% - 292	20%	RTU-1	348	8.6	2993	6	10.0	0.12	25	102	**40**	-62	-60.7%	**Fails**	**0.802**
1	0.12B	Computer Lab	Education	Computer lab	**1946**	16% - 308	20%	RTU-2	769	8.9	6844	25	10.0	0.12	25	342	**311**	-31	-9.1%	**Fails**	**2.726**
1	0.12C	Storage	Storage	Warehouses	**50**	9.9% - 292	20%	RTU-1	187	8	1496	1	0.0	0.06	0	11	**5**	-6	-55.4%	**Fails**	**0.201**
1	0.12D	Work Room	Workrooms	Copy, printing rooms	**208**	9.9% - 292	20%	RTU-1	223	8.8	1962	4	5.0	0.06	4	33	**21**	-12	-37.1%	**Fails**	**0.642**

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Zone Identification												IMC 2015 Ventilation Calculations									
Floor	**Room#**	**Room Name**	**Occupancy Classification**	**Category**	**Total Airflow**	**Unit Actual OA %**	**BAS OA Damper Cond**	**Served By**	**Zone Area, Az, per space**	**Ceiling Height**	**Volume, per space**	**Zone Population, Pz, per space**	**People OA Rate in Breathing Zone, Rp**	**Area OA Rate in Breathing Zone, Ra**	**Default Occupant Density**	**Min. Required Ventilation Airflow**	**ACTUAL MEASURED VENTILATION AIR FLOW**	**Excess Ventilation Air (negative indicates deficit)**	**Excess Ventilation Air Percentage**	**PASS/FAIL**	**Ventilation ACH**
					(cfm)	(%)	(%)		(sq.ft)	(ft)	(cu.ft)	Adult	(cfm/ person)	(cfm/sf)	(#/1000sf)	(cfm)	(cfm)	(cfm)	(%)		(AC/hr)
1	0.12E	Office	Offices	Office spaces	**107**	9.9% - 292	20%	RTU-1	137	9	1233	2	5.0	0.06	5	18	**11**	-7	-39.6%	**Fails**	**0.535**
1	0.12F	Storage	Storage	Warehouses	**55**	9.9% - 292	20%	RTU-1	115	8	920	3	0.0	0.06	0	7	**6**	-1	-13.0%	**Fails**	**0.391**
1	0.13	Gymnasium	Sports and amusement	Gym, stadium, arena (play area)	**5344**	21% - 1127	20%	RTU-7	2830	19.8	56034	25	0.0	0.30	0	849	**1122**	273	32.2%	**Meets**	**1.201**
1	0.13A	Storage	Storage	Warehouses	**62**	21% - 1127	20%	RTU-7	216	12	2592	0	0.0	0.06	0	13	**13**	0	0.3%	**Meets**	**0.301**
1	0.13B	Storage	Storage	Warehouses	**72**	21% - 1127	20%	RTU-7	216	12	2592	1	0.0	0.06	0	13	**15**	2	15.7%	**Meets**	**0.347**
1	0.13C	Exterior Storage	Storage	Warehouses	**---**	---	---	---	287	12	3444	0	0.0	0.06	0	17	**---**	N/A		**N/A**	
1	0.14	Cafetorium	Education	Multiuse assembly	**12245**	7.5% - 980	20%	RTU-5	2725	21	57225	220	7.5	0.06	100	1814	**918**	-896	-49.4%	**Fails**	**0.963**
1	0.14A	Platform	Education	Music/theater/dance	**586**	7.5% - 980	20%	RTU-5	493	19.6	9663	15	10.0	0.06	35	180	**44**	-136	-75.5%	**Fails**	**0.273**
1	0.14B	Storage	Storage	Warehouses	**161**	7.5% - 980	20%	RTU-5	60	7.6	456	0	0.0	0.06	0	4	**12**	8	233.3%	**Meets**	**1.579**
1	0.14C	Elec	Storage	Warehouses	**701**	7.5% - 980	20%	RTU-5	74	7.6	562	0	0.0	0.06	0	4	**6**	2	35.1%	**Meets**	**0.640**
1	0.15	Kitchen	Food and beverage service	Kitchens (cooking)	**2063**	100%	20%	AHU-6 + Kit Hood EF	522	9	4698	5	0.0	0.00	0	0	**2063**	2063	0.0%	**N/A**	**26.347**
1	0.15A	Kitchen Storage	Storage	Warehouses	**0**	---	---	---	65	8.9	579	0	0.0	0.06	0	4	**0**	-4	-100.0%	**Fails**	**0.000**
1	0.15B	Kitchen Toilet	Public Spaces	Toilet rooms - public	**-87**	---	---	Ceiling Mounted Broan	72	8.9	641	1	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	0.15C	Dish Washing	Food and beverage service	Kitchens (cooking)	**0**	---	---	---	194	8.75	1698	1	0.0	0.00	0	0	**0**	0	0.0%	**N/A**	**0.000**
1	0.15D	FRZR	Storage	Warehouses	**0**	---	---	---	57	7	399	0	0.0	0.06	0	3	**0**	-3	-100.0%	**Fails**	**0.000**
1	12	Classroom	Education	Classroom (ages 5-8)	**-471**	---	---	AC	1033	9.2	9504	20	10.0	0.12	25	324	**0**	-324	-100.0%	**Fails**	**0.000**
1	13	Classroom	Education	Classroom (ages 5-8)	**-479**	---	---	---	830	9	7470	20	10.0	0.12	25	300	**0**	-300	-100.0%	**Fails**	**0.000**
1	14	Classroom	Education	Classroom (ages 5-8)	**-447**	---	---	---	874	9	7866	18	10.0	0.12	25	285	**0**	-285	-100.0%	**Fails**	**0.000**
1	15	Classroom	Education	Classroom (ages 5-8)	**-525**	---	---	---	887	8.9	7894	20	10.0	0.12	25	306	**0**	-306	-100.0%	**Fails**	**0.000**
1	16	Classroom	Education	Classroom (ages 5-8)	**-529**	---	---	AC	800	8.9	7120	25	10.0	0.12	25	346	**0**	-346	-100.0%	**Fails**	**0.000**
1	17	Classroom	Education	Classroom (ages 5-8)	**-365**	---	---	---	831	9	7479	25	10.0	0.12	25	350	**0**	-350	-100.0%	**Fails**	**0.000**

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Osborn Hill Elementary School

2A - Exhaust Excluded

VANZELM ENGINEERS

Zone Identification												IMC 2015 Ventilation Calculations									
Floor	Room#	Room Name	Occupancy Classification	Category	Total Airflow	Unit Actual OA %	BAS OA Damper Cond	Served By	Zone Area, Az, per space	Ceiling Height	Volume, per space	Zone Population, Pz, per space	People OA Rate in Breathing Zone, Rp	Area OA Rate in Breathing Zone, Ra	Default Occupant Density	Min. Required Ventilation Airflow	ACTUAL MEASURED VENTILATION AIR FLOW	Excess Ventilation Air (negative indicates deficit)	Excess Ventilation Air Percentage	PASS/FAIL	Ventilation ACH
					(cfm)	(%)	(%)		(sq.ft)	(ft)	(cu.ft)	Adult	(cfm/ person)	(cfm/sf)	(#/1000sf)	(cfm)	(cfm)	(cfm)	(%)		(AC/hr)
1	18	Classroom	Education	Classroom (ages 5-8)	**-165**	---	---	---	811	9	7299	24	10.0	0.12	25	337	**0**	-337	-100.0%	**Fails**	**0.000**
1	19	Classroom	Education	Classroom (ages 5-8)	**-531**	---	---	---	766	8.9	6817	2	10.0	0.12	25	112	**0**	-112	-100.0%	**Fails**	**0.000**
1	20	Classroom	Education	Classroom (ages 5-8)	**-260**	---	---	---	756	9.1	6880	26	10.0	0.12	25	351	**0**	-351	-100.0%	**Fails**	**0.000**
1	21	Music Classroom	Education	Music/theater/dance	**-643**	---	---	AC	739	9	6651	26	10.0	0.06	35	304	**0**	-304	-100.0%	**Fails**	**0.000**
1	22	Classroom	Education	Classroom (ages 5-8)	**-328**	---	---	---	513	9.1	4668	25	10.0	0.12	25	312	**0**	-312	-100.0%	**Fails**	**0.000**
1	23	Art Classroom	Education	Art Classroom	**-603**	---	---	---	899	8.7	7821	25	10.0	0.18	20	412	**0**	-412	-100.0%	**Fails**	**0.000**
1	23A	Storage	Storage	Warehouses	**-60**	---	---	---	194	9	1746	2	0.0	0.06	0	12	**---**	N/A		**N/A**	
1	23B	Kiln	Storage	Warehouses	**196**	---	---	---	109	8.7	948	1	0.0	0.06	0	7	**---**	N/A		**N/A**	
1	24	Classroom	Education	Classroom (ages 5-8)	**-522**	---	---	AC	830	9.1	7553	25	10.0	0.12	25	350	**0**	-350	-100.0%	**Fails**	**0.000**
1	25	Classroom	Education	Classroom (ages 5-8)	**-451**	---	---	AC	875	9.1	7963	25	10.0	0.12	25	355	**0**	-355	-100.0%	**Fails**	**0.000**
1	25.01	Girls	Public Spaces	Toilet rooms - public	**-197**	---	---	AC	285	9.1	2594	5	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	25.02	Boys	Public Spaces	Toilet rooms - public	**-247**	---	---	AC	298	9.1	2712	5	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	25.03	Boiler Room	Storage	Warehouses	**-135**	---	---	A/C	974	12	11688	0	0.0	0.06	0	58	**---**	N/A		**N/A**	
1	25.04	Sprinkler Room	Storage	Warehouses	**---**	---	---	---	160	12	1920	0	0.0	0.06	0	10	**---**	N/A		**N/A**	
1	A1	Classroom	Education	Classroom (ages 5-8)	**916**	12%	NA	HP-4 annex	726	7.8	5663	25	10.0	0.12	25	337	**110**	-227	-67.4%	**Fails**	**1.166**
1	A2	Classroom	Education	Classroom (ages 5-8)	**947**	9%	NA	HP-3 annex	740	7.8	5772	20	10.0	0.12	25	289	**85**	-204	-70.6%	**Fails**	**0.884**
1	A3	Classroom	Education	Classroom (ages 5-8)	**928**	14%	NA	HP-2 annex	765	7.8	5967	20	10.0	0.12	25	292	**130**	-162	-55.4%	**Fails**	**1.307**
1	A.01	Cust	Storage	Warehouses	**50**	41%	NA	HP-1 annex	60	7.8	468	1	0.0	0.06	0	4	**21**	17	483.3%	**Meets**	**2.692**
1	A.02	Girls	Public Spaces	Toilet rooms - public	**181**	41%	NA	HP-1 annex +EF	200	7.8	1560	2	0.0	0.00	0	0	**74**	74	0.0%	**N/A**	**2.846**
1	A.03	Utility	Storage	Warehouses	**79**	41%	NA	HP-1 annex	109	9	981	0	0.0	0.06	0	7	**32**	25	389.3%	**Meets**	**1.957**
1	A.04	Boys	Public Spaces	Toilet rooms - public	**201**	41%	NA	HP-1 annex +EF	200	7.8	1560	2	0.0	0.00	0	0	**82**	82	0.0%	**N/A**	**3.154**

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Zone Identification												IMC 2015 Ventilation Calculations									
Floor	Room#	Room Name	Occupancy Classification	Category	Total Airflow	Unit Actual OA %	BAS OA Damper Cond	Served By	Zone Area, Az, per space	Ceiling Height	Volume, per space	Zone Population, Pz, per space	People OA Rate in Breathing Zone, Rp	Area OA Rate in Breathing Zone, Ra	Default Occupant Density	Min. Required Ventilation Airflow	ACTUAL MEASURED VENTILATION AIR FLOW	Excess Ventilation Air (negative indicates deficit)	Excess Ventilation Air Percentage	PASS/FAIL	Ventilation ACH
					(cfm)	(%)	(%)		(sq.ft)	(ft)	(cu.ft)	Adult	(cfm/ person)	(cfm/sf)	(#/1000sf)	(cfm)	(cfm)	(cfm)	(%)		(AC/hr)
1	A.05	Toilet	Public Spaces	Toilet rooms - public	**60**	41%	NA	HP-1 annex +EF	60	7.8	468	1	0.0	0.00	0	0	**25**	25	0.0%	N/A	**3.205**
1	A4	Classroom	Education	Classroom (ages 5-8)	**655**	0%	NA	HP-5 annex	749	7.8	5842	25	10.0	0.12	25	340	**9**	-331	-97.4%	**Fails**	**0.092**
1	A5	Classroom	Education	Classroom (ages 5-8)	**913**	0%	NA	Hp-6 annex	767	7.8	5983	15	10.0	0.12	25	242	**15**	-227	-93.8%	**Fails**	**0.150**

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2B - Exhaust Included

VANZELM ENGINEERS

Zone Identification												IMC 2015 Ventilation Calculations									
Floor	**Room#**	**Room Name**	**Occupancy Classification**	**Category**	**Total Airflow**	**Unit Actual OA %**	**BAS OA Damper Cond**	**Served By**	**Zone Area, Az, per space**	**Ceiling Height**	**Volume, per space**	**Zone Population, Pz, per space**	**People OA Rate in Breathing Zone, Rp**	**Area OA Rate in Breathing Zone, Ra**	**Default Occupant Density**	**Min. Required Ventilation Airflow**	**ACTUAL MEASURED VENTILATION AIR FLOW**	**Excess Ventilation Air (negative indicates deficit)**	**Excess Ventilation Air Percentage**	**PASS/FAIL**	**Ventilation ACH**
					(cfm)	(%)	(%)		(sq.ft)	(ft)	(cu.ft)	Adult	(cfm/ person)	(cfm/sf)	(#/1000sf)	(cfm)	(cfm)	(cfm)	(%)		(AC/hr)
1	0.01	Main Office	Offices	Office spaces	**446**	17% - 292	20%	RTU-4	618	9	5562	4	5.0	0.06	5	57	**106**	49	85.7%	**Meets**	**1.143**
1	0.01A	Office	Offices	Office spaces	**180**	17% - 292	20%	RTU-4	45	8.2	369	1	5.0	0.06	5	8	**31**	23	302.6%	**Meets**	**5.041**
1	0.01B	Main Office Large Storage	Storage	Warehouses	**-84**	---	---	---	45	8.8	394	1	0.0	0.06	0	3	**---**	N/A		**N/A**	
1	0.02	Nurse	Hospitals nursing and convalescent homes	Patient rooms	**192**	17% - 292	20%	RTU-4	177	8.9	1575	2	25.0	0.00	10	50	**33**	-17	-34.0%	**Fails**	**1.257**
1	0.02A	Nurse Toilet	Public Spaces	Toilet rooms - public	**-62**	17% - 292	20%	RTU-4	65	8.9	579	1	0.0	0.00	0	0	**9**	9	0.0%	**N/A**	**0.933**
1	0.02B	Nurse Storage	Storage	Warehouses	**---**	---	---	---	5	8.9	45	0	0.0	0.06	0	0	**---**	N/A		**N/A**	
1	0.01C	Main Office Toilet	Public Spaces	Toilet rooms - public	**-30**	---	---	---	46	8.9	409	1	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	0.01D	Main Office Small Storage	Storage	Warehouses	**---**	---	---	---	7	8.9	62	0	0.0	0.06	0	0	**---**	N/A		**N/A**	
1	0.03	Principal	Offices	Office spaces	**405**	17% - 292	20%	RTU-4	235	8.9	2092	10	5.0	0.06	5	64	**69**	5	7.6%	**Meets**	**1.979**
1	0.04	Conference	Offices	Conference rooms	**229**	17% - 292	20%	RTU-4	145	9	1305	6	5.0	0.06	50	39	**39**	0	0.8%	**Meets**	**1.793**
1	0.05	Storage	Storage	Warehouses	**---**	---	----	---	133	8.75	1164	0	0.0	0.06	0	8	**---**	N/A		**N/A**	
1	01	Classroom	Education	Classroom (ages 5-8)	**-507**			---	890	8.9	7921	15	10.0	0.12	25	257	**507**	250	97.4%	**Meets**	**3.840**
1	02	Classroom	Education	Classroom (ages 5-8)	**-447**	---	---	AC	862	8.9	7672	18	10.0	0.12	25	283	**447**	164	57.7%	**Meets**	**3.496**
1	03	Classroom	Education	Classroom (ages 5-8)	**-428**	---	---	---	866	8.9	7707	18	10.0	0.12	25	284	**428**	144	50.7%	**Meets**	**3.332**
1	04	Classroom	Education	Classroom (ages 5-8)	**-537**	---	---	---	871	8.9	7752	18	10.0	0.12	25	285	**537**	252	88.7%	**Meets**	**4.156**
1	05	Kindergarten	Education	Classroom (ages 5-8)	**---**	---	---	AC	1028	9	9252	20	10.0	0.12	25	323	**---**	N/A		**N/A**	
1	5A	Toilet	Public Spaces	Toilet rooms - public	**-100**	---	---	---	61	8.9	543	1	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	05.01	Storage	Storage	Warehouses	**-211**	---	---	---	81	8.9	721	0	0.0	0.06	0	5	**---**	N/A		**N/A**	
1	06	Kindergarten	Education	Classroom (ages 5-8)	**-435**	---	---	AC	1052	8.9	9363	20	10.0	0.12	25	326	**435**	109	33.3%	**Meets**	**2.788**
1	06A	Toilet	Public Spaces	Toilet rooms - public	**-77**	---	---	---	21	8.9	187	1	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	06.01	Office	Offices	Office spaces	**-70**	---	---	---	120	8.9	1068	3	5.0	0.06	5	22	**70**	48	215.3%	**Meets**	**3.933**

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					(cfm)	(%)	(%)		(sq.ft)	(ft)	(cu.ft)	Adult	(cfm/ person)	(cfm/sf)	(#/1000sf)	(cfm)	(cfm)	(cfm)	(%)		(AC/hr)
1	06.02	Exterior Storage	Storage	Warehouses	**-175**	---	---	---	150	12	1800	0	0.0	0.06	0	9	**---**	N/A		N/A	
1	07	Kindergarten	Education	Classroom (ages 5-8)	**-362**	---	---	AC	1154	8.9	10271	22	10.0	0.12	25	358	**362**	4	1.0%	**Meets**	**2.115**
1	07A	Toilet	Public Spaces	Toilet rooms - public	**-94**	---	---	---	17	8.9	151	1	0.0	0.00	0	0	**---**	N/A	0.0%	N/A	
1	08	Kindergarten	Education	Classroom (ages 5-8)	**-514**	---	---	AC	1160	8.9	10324	10	10.0	0.12	25	239	**514**	275	114.9%	**Meets**	**2.987**
1	08A	Toilet	Public Spaces	Toilet rooms - public	**-117**	---	---	---	17	8.9	151	1	0.0	0.00	0	0	**---**	N/A	0.0%	N/A	
1	09	Classroom	Education	Classroom (ages 5-8)	**-437**	---	---	AC	878	9	7902	15	10.0	0.12	25	255	**437**	182	71.1%	**Meets**	**3.318**
1	10	Classroom	Education	Classroom (ages 5-8)	**-478**	---	---	---	874	9	7866	13	10.0	0.12	25	235	**478**	243	103.5%	**Meets**	**3.646**
1	0.06	Office	Offices	Office spaces	**129**	50% - 496	20%	RTU-3	116	8.3	963	5	5.0	0.06	5	32	**65**	33	103.4%	**Meets**	**4.051**
1	0.07	Office	Offices	Office spaces	**126**	50% - 496	20%	RTU-3	116	8.4	974	5	5.0	0.06	5	32	**63**	31	97.1%	**Meets**	**3.879**
1	0.08A	Toilet	Public Spaces	Toilet rooms - public	**-28**	---	---	---	59	8.9	525	1	0.0	0.00	0	0	**---**	N/A	0.0%	N/A	
1	0.08	Work Room	Workrooms	Copy, printing rooms	**402**	50% - 496	20%	RTU-3	303	9	2727	2	5.0	0.06	4	28	**201**	173	613.3%	**Meets**	**4.422**
1	0.09A	Toilet	Public Spaces	Toilet rooms - public	**-36**	---	---	---	59	8.9	525	1	0.0	0.00	0	0	**---**	N/A	0.0%	N/A	
1	0.09	Faculty	Public Spaces	Toilet rooms - public	**346**	50% - 496	20%	RTY-3	436	9	3924	6	0.0	0.00	0	0	**173**	173	0.0%	N/A	**2.645**
1	0.10	Girls	Public Spaces	Toilet rooms - public	**-205**	---	---	---	200	8.9	1780	3	0.0	0.00	0	0	**---**	N/A	0.0%	N/A	
1	0.11	Boys	Public Spaces	Toilet rooms - public	**-216**	---	---	---	200	8.9	1780	3	0.0	0.00	0	0	**---**	N/A	0.0%	N/A	
1	11	Classroom	Education	Classroom (ages 5-8)	**521**	---	5%	UV	660	8.9	5874	12	10.0	0.12	25	199	**521**	322	161.5%	**Meets**	**5.322**
1	0.12	Media Center	Education	Media Center	**2175**	9.9% - 292	20%	RTU-1	3384	9.7	32825	40	10.0	0.12	25	806	**215**	-591	-73.3%	**Fails**	**0.393**
1	0.12A	Reading	Education	Classroom (ages 5-8)	**399**	9.9% - 292	20%	RTU-1	348	8.6	2993	6	10.0	0.12	25	102	**40**	-62	-60.7%	**Fails**	**0.802**
1	0.12B	Computer Lab	Education	Computer lab	**1946**	16% - 308	20%	RTU-2	769	8.9	6844	25	10.0	0.12	25	342	**311**	-31	-9.1%	**Fails**	**2.726**
1	0.12C	Storage	Storage	Warehouses	**50**	9.9% - 292	20%	RTU-1	187	8	1496	1	0.0	0.06	0	11	**5**	-6	-55.4%	**Fails**	**0.201**
1	0.12D	Work Room	Workrooms	Copy, printing rooms	**208**	9.9% - 292	20%	RTU-1	223	8.8	1962	4	5.0	0.06	4	33	**21**	-12	-37.1%	**Fails**	**0.642**

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Zone Identification												IMC 2015 Ventilation Calculations									
Floor	**Room#**	**Room Name**	**Occupancy Classification**	**Category**	**Total Airflow**	**Unit Actual OA %**	**BAS OA Damper Cond**	**Served By**	**Zone Area, Az, per space**	**Ceiling Height**	**Volume, per space**	**Zone Population, Pz, per space**	**People OA Rate in Breathing Zone, Rp**	**Area OA Rate in Breathing Zone, Ra**	**Default Occupant Density**	**Min. Required Ventilation Airflow**	**ACTUAL MEASURED VENTILATION AIR FLOW**	**Excess Ventilation Air (negative indicates deficit)**	**Excess Ventilation Air Percentage**	**PASS/FAIL**	**Ventilation ACH**
					(cfm)	(%)	(%)		(sq.ft)	(ft)	(cu.ft)	Adult	(cfm/ person)	(cfm/sf)	(#/1000sf)	(cfm)	(cfm)	(cfm)	(%)		(AC/hr)
1	0.12E	Office	Offices	Office spaces	**107**	9.9% - 292	20%	RTU-1	137	9	1233	2	5.0	0.06	5	18	**11**	-7	-39.6%	**Fails**	**0.535**
1	0.12F	Storage	Storage	Warehouses	**55**	9.9% - 292	20%	RTU-1	115	8	920	3	0.0	0.06	0	7	**6**	-1	-13.0%	**Fails**	**0.391**
1	0.13	Gymnasium	Sports and amusement	Gym, stadium, arena (play area)	**5344**	21% - 1127	20%	RTU-7	2830	19.8	56034	25	0.0	0.30	0	849	**1122**	273	32.2%	**Meets**	**1.201**
1	0.13A	Storage	Storage	Warehouses	**62**	21% - 1127	20%	RTU-7	216	12	2592	0	0.0	0.06	0	13	**13**	0	0.3%	**Meets**	**0.301**
1	0.13B	Storage	Storage	Warehouses	**72**	21% - 1127	20%	RTU-7	216	12	2592	1	0.0	0.06	0	13	**15**	2	15.7%	**Meets**	**0.347**
1	0.13C	Exterior Storage	Storage	Warehouses	**---**	---	---	---	287	12	3444	0	0.0	0.06	0	17	**---**	N/A		**N/A**	
1	0.14	Cafetorium	Education	Multiuse assembly	**12245**	7.5% - 980	20%	RTU-5	2725	21	57225	220	7.5	0.06	100	1814	**918**	-896	-49.4%	**Fails**	**0.963**
1	0.14A	Platform	Education	Music/theater/dance	**586**	7.5% - 980	20%	RTU-5	493	19.6	9663	15	10.0	0.06	35	180	**44**	-136	-75.5%	**Fails**	**0.273**
1	0.14B	Storage	Storage	Warehouses	**161**	7.5% - 980	20%	RTU-5	60	7.6	456	0	0.0	0.06	0	4	**12**	8	233.3%	**Meets**	**1.579**
1	0.14C	Elec	Storage	Warehouses	**701**	7.5% - 980	20%	RTU-5	74	7.6	562	0	0.0	0.06	0	4	**6**	2	35.1%	**Meets**	**0.640**
1	0.15	Kitchen	Food and beverage service	Kitchens (cooking)	**2063**	100%	20%	AHU-6 + Kit Hood EF	522	9	4698	5	0.0	0.00	0	0	**2063**	2063	0.0%	**N/A**	**26.347**
1	0.15A	Kitchen Storage	Storage	Warehouses	**0**	---	---	---	65	8.9	579	0	0.0	0.06	0	4	**0**	-4	-100.0%	**Fails**	**0.000**
1	0.15B	Kitchen Toilet	Public Spaces	Toilet rooms - public	**-87**	---	---	Ceiling Mounted Broan	72	8.9	641	1	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	0.15C	Dish Washing	Food and beverage service	Kitchens (cooking)	**0**	---	---	---	194	8.75	1698	1	0.0	0.00	0	0	**0**	0	0.0%	**N/A**	**0.000**
1	0.15D	FRZR	Storage	Warehouses	**0**	---	---	---	57	7	399	0	0.0	0.06	0	3	**0**	-3	-100.0%	**Fails**	**0.000**
1	12	Classroom	Education	Classroom (ages 5-8)	**-471**	---	---	AC	1033	9.2	9504	20	10.0	0.12	25	324	**471**	147	45.4%	**Meets**	**2.974**
1	13	Classroom	Education	Classroom (ages 5-8)	**-479**	---	---	---	830	9	7470	20	10.0	0.12	25	300	**479**	179	59.9%	**Meets**	**3.847**
1	14	Classroom	Education	Classroom (ages 5-8)	**-447**	---	---	---	874	9	7866	18	10.0	0.12	25	285	**447**	162	56.9%	**Meets**	**3.410**
1	15	Classroom	Education	Classroom (ages 5-8)	**-525**	---	---	---	887	8.9	7894	20	10.0	0.12	25	306	**525**	219	71.3%	**Meets**	**3.990**
1	16	Classroom	Education	Classroom (ages 5-8)	**-529**	---	---	AC	800	8.9	7120	25	10.0	0.12	25	346	**529**	183	52.9%	**Meets**	**4.458**
1	17	Classroom	Education	Classroom (ages 5-8)	**-365**	---	---	---	831	9	7479	25	10.0	0.12	25	350	**365**	15	4.4%	**Meets**	**2.928**

Project Name:	Fairfield Public Schools RCx & TAB Study
Project Number:	2020102.00.09
Scope	Ventilation Calculation by Building
Date	August 19, 2022

Osborn Hill Elementary School

2B - Exhaust Included

VANZELM ENGINEERS

Zone Identification												IMC 2015 Ventilation Calculations									
Floor	Room#	Room Name	Occupancy Classification	Category	Total Airflow	Unit Actual OA %	BAS OA Damper Cond	Served By	Zone Area, Az, per space	Ceiling Height	Volume, per space	Zone Population, Pz, per space	People OA Rate in Breathing Zone, Rp	Area OA Rate in Breathing Zone, Ra	Default Occupant Density	Min. Required Ventilation Airflow	ACTUAL MEASURED VENTILATION AIR FLOW	Excess Ventilation Air (negative indicates deficit)	Excess Ventilation Air Percentage	PASS/FAIL	Ventilation ACH
					(cfm)	(%)	(%)		(sq.ft)	(ft)	(cu.ft)	Adult	(cfm/ person)	(cfm/sf)	(#/1000sf)	(cfm)	(cfm)	(cfm)	(%)		(AC/hr)
1	18	Classroom	Education	Classroom (ages 5-8)	**-165**	---	---	---	811	9	7299	24	10.0	0.12	25	337	**165**	-172	-51.1%	**Fails**	**1.356**
1	19	Classroom	Education	Classroom (ages 5-8)	**-531**	---	---	---	766	8.9	6817	2	10.0	0.12	25	112	**531**	419	374.4%	**Meets**	**4.673**
1	20	Classroom	Education	Classroom (ages 5-8)	**-260**	---	---	---	756	9.1	6880	26	10.0	0.12	25	351	**260**	-91	-25.9%	**Fails**	**2.268**
1	21	Music Classroom	Education	Music/theater/dance	**-643**	---	---	AC	739	9	6651	26	10.0	0.06	35	304	**643**	339	111.3%	**Meets**	**5.801**
1	22	Classroom	Education	Classroom (ages 5-8)	**-328**	---	---	---	513	9.1	4668	25	10.0	0.12	25	312	**328**	16	5.3%	**Meets**	**4.216**
1	23	Art Classroom	Education	Art Classroom	**-603**	---	---	---	899	8.7	7821	25	10.0	0.18	20	412	**603**	191	46.4%	**Meets**	**4.626**
1	23A	Storage	Storage	Warehouses	**-60**	---	---	---	194	9	1746	2	0.0	0.06	0	12	**---**	N/A		**N/A**	
1	23B	Kiln	Storage	Warehouses	**196**	---	---	---	109	8.7	948	1	0.0	0.06	0	7	**---**	N/A		**N/A**	
1	24	Classroom	Education	Classroom (ages 5-8)	**-522**	---	---	AC	830	9.1	7553	25	10.0	0.12	25	350	**522**	172	49.3%	**Meets**	**4.147**
1	25	Classroom	Education	Classroom (ages 5-8)	**-451**	---	---	AC	875	9.1	7963	25	10.0	0.12	25	355	**451**	96	27.0%	**Meets**	**3.398**
1	25.01	Girls	Public Spaces	Toilet rooms - public	**-197**	---	---	AC	285	9.1	2594	5	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	25.02	Boys	Public Spaces	Toilet rooms - public	**-247**	---	---	AC	298	9.1	2712	5	0.0	0.00	0	0	**---**	N/A	0.0%	**N/A**	
1	25.03	Boiler Room	Storage	Warehouses	**-135**	---	---	A/C	974	12	11688	0	0.0	0.06	0	58	**---**	N/A		**N/A**	
1	25.04	Sprinkler Room	Storage	Warehouses	**---**	---	---	---	160	12	1920	0	0.0	0.06	0	10	**---**	N/A		**N/A**	
1	A1	Classroom	Education	Classroom (ages 5-8)	**916**	12%	NA	HP-4 annex	726	7.8	5663	25	10.0	0.12	25	337	**110**	-227	-67.4%	**Fails**	**1.166**
1	A2	Classroom	Education	Classroom (ages 5-8)	**947**	9%	NA	HP-3 annex	740	7.8	5772	20	10.0	0.12	25	289	**85**	-204	-70.6%	**Fails**	**0.884**
1	A3	Classroom	Education	Classroom (ages 5-8)	**928**	14%	NA	HP-2 annex	765	7.8	5967	20	10.0	0.12	25	292	**130**	-162	-55.4%	**Fails**	**1.307**
1	A.01	Cust	Storage	Warehouses	**50**	41%	NA	HP-1 annex	60	7.8	468	1	0.0	0.06	0	4	**21**	17	483.3%	**Meets**	**2.692**
1	A.02	Girls	Public Spaces	Toilet rooms - public	**181**	41%	NA	HP-1 annex +EF	200	7.8	1560	2	0.0	0.00	0	0	**74**	74	0.0%	**N/A**	**2.846**
1	A.03	Utility	Storage	Warehouses	**79**	41%	NA	HP-1 annex	109	9	981	0	0.0	0.06	0	7	**32**	25	389.3%	**Meets**	**1.957**
1	A.04	Boys	Public Spaces	Toilet rooms - public	**201**	41%	NA	HP-1 annex +EF	200	7.8	1560	2	0.0	0.00	0	0	**82**	82	0.0%	**N/A**	**3.154**

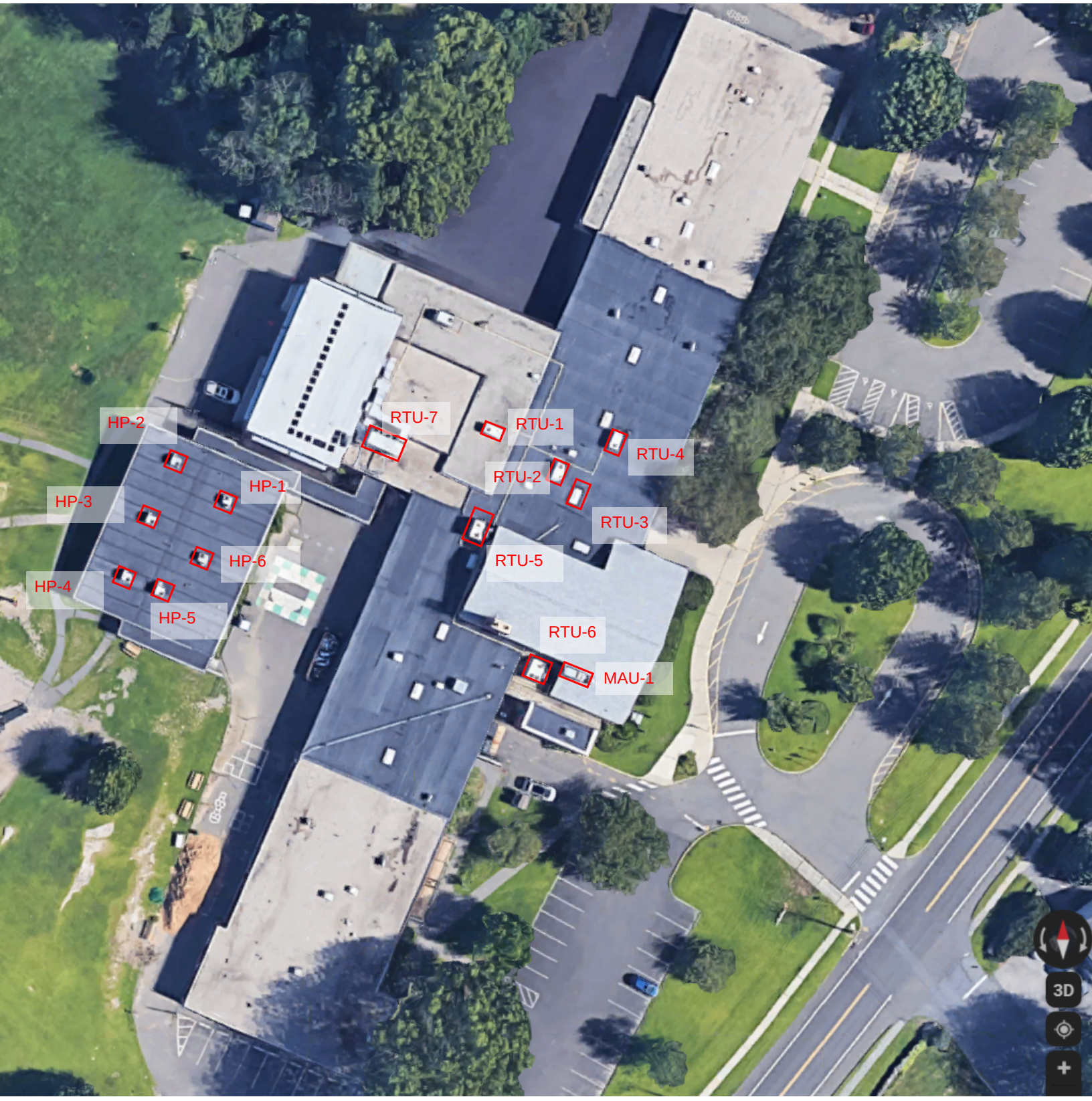
Project Name:	**Fairfield Public Schools RCx & TAB Study**
Project Number:	**2020102.00.09**
Scope	**Ventilation Calculation by Building**
Date	**August 19, 2022**

Osborn Hill Elementary School

2B - Exhaust Included

Zone Identification																				
												IMC 2015 Ventilation Calculations								
Floor	**Room#**	**Room Name**	**Occupancy Classification**	**Category**	**Total Airflow**	**Unit Actual OA %**	**BAS OA Damper Cond**	**Served By**	**Zone Area, Az, per space**	**Ceiling Height**	**Volume, per space**	**Zone Population , Pz, per space**	**People OA Rate in Breathing Zone, Rp**	**Area OA Rate in Breathing Zone, Ra**	**Default Occupant Density**	**Min. Required Ventilation Airflow**	**ACTUAL MEASURED VENTILATION AIR FLOW**	**Excess Ventilation Air (negative indicates deficit)**	**Excess Ventilation Air Percentage**	**PASS/FAIL**	**Ventilation ACH**
					(cfm)	(%)	(%)		(sq.ft)	(ft)	(cu.ft)	Adult	(cfm/ person)	(cfm/sf)	(#/1000sf)	(cfm)	(cfm)	(cfm)	(%)		(AC/hr)
1	A.05	Toilet	Public Spaces	Toilet rooms - public	**60**	41%	NA	HP-1 annex +EF	60	7.8	468	1	0.0	0.00	0	0	**25**	25	0.0%	N/A	**3.205**
1	A4	Classroom	Education	Classroom (ages 5-8)	**655**	0%	NA	HP-5 annex	749	7.8	5842	25	10.0	0.12	25	340	**9**	-331	-97.4%	**Fails**	**0.092**
1	A5	Classroom	Education	Classroom (ages 5-8)	**913**	0%	NA	Hp-6 annex	767	7.8	5983	15	10.0	0.12	25	242	**15**	-227	-93.8%	**Fails**	**0.150**

APPENDIX 3 – Roof Map


HP-2
RTU-7
RTU-1
RTU-4
RTU-2
HP-1
HP-3
RTU-3
HP-6
RTU-5
HP-4
HP-5
RTU-6
MAU-1
3D

APPENDIX 4 – TAB Airflow Survey Data

WING'S TESTING & BALANCING CO., INC.

Fairfield Public Schools

Osborn Hill Elementary

Ventilation Survey

* * * *

Van Zelm Engineers
Attn: Robert C. Marra
10 Talcott Notch Road
Farmington, CT 06032

July 15, 2022

94 North Branford Road • Suite One • Branford, CT 06405
(203) 481-4988 • Fax (203) 488-5634 • wings@wingstesting.com
SM-1 License #6803
www.wingstesting.com

WING'S TESTING & BALANCING CO., INC.

July 15, 2022

Van Zelm Engineers
Attn: William Donald
10 Talcott Notch Road
Farmington, CT 06032

Re: Fairfield Public School – Osborn Hill Elementary / Tab Data

Dear Bill,

HVAC Measurements of the above referenced location has been complete, as noted on our attached data sheets. We have noted that classrooms are inly served by exhaust; some have split wall mounted units for cooling. Classrooms do not have dedicated ventilation air. We measured OA flow rates for the 7 roof top units. We also tested other units found on the roof or shown on the BMS.

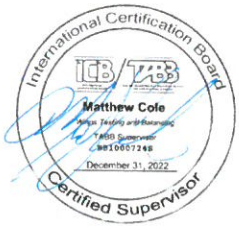
We have noted that the make-up unit for kitchen was not running at the time of testing. Minimum OA damper position for all RTU's were all found set for a 20% command signal.

The following pages are your record of current tested conditions. If you have any questions, or if we can be of further service, please do not hesitate to call.

Very truly yours,

Wing's Testing & Balancing Co., Inc.
ICB Certified Contractor for:
TABB—Commissioning—Fire/Life Safety L1&L2—Sound & Vibration

Marek Sadowski
Certified TABB Technician #BB1083468T
CT SM-2 License #7078
MA SM-2 4508
HVAC Fire Life Safety Level 1 Tech FLS11083468T
EPA Universal Technician AA2804U0003



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7/15/2022

Fairfield Public Schools
Osborn Hill Elementary School

FIELD WORK SHEET

Unit #	Filter Condition	Coil Condition	OA Setting	OA Actual
RTU-1	Good	Good	20%	5%
RTU-2	Good	Good	20%	20%
RTU-3	Good	Good	20%	50%
RTU-4	Good	Good	20%	45%
RTU-5	Good	Good	20%	20%
RTU-6	Good	Good	20%	20%
RTU-7	Good	Good	20%	5%
MUA	Not Running		100%	

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VELOCITY PRESSURE READINGS

PROJECT:	Osborn Hill Elementary School					**DATE:**	7/12/2022	
AREA SERVED:	1st Floor					**TECH:**	BS, MS	
TRAVERSE LOCATIONS	**DUCT SIZE "**	**AREA SQ.FT.**	**DESIGN**		**CENT. STAT. PRESS."**	**TEST**		**NOTES**
			FPM	**CFM**		**FPM**	**CFM**	
RTU-1								
Min OA	36"x16"	4	---	630	w/Velgrid	73	292	(1)
RTU-2								
Min OA	28"x12"	2.33	---	360	w/Velgrid	132	308	(1,2)
RTU-3								
Min OA	28"x12"	2.33	---	390	w/Velgrid	213	496	
RTU-4								
Min OA	28"x12"	2.33	---	270	w/Velgrid	195	454	(1)
RTU-5								
Min OA	36"x16"	4	---	N/D	w/Velgrid	245	980	
RTU-6								
Min OA	60"x18"	7.5	---	1690	w/Velgrid	275	2063	(3)
RTU-7								
Total	55"x48"	18.3	---	---	w/Velgrid	301	5508	
Min OA Upper	60"x30"	11.9	---	---	w/Velgrid	23	234	(1,2)
Min OA Lower	60"x30"	11.9	---	---	w/Velgrid	75	893	
			OA Total	2900		OA Total	1127	
MUA								
Total (100%)	30"x22"	4.6	---	N/D	w/Velgrid	---	---	(4)

REMARKS

Note: OA design flow rates taken from 2004 report
(1) ABS not controling this unit
(2) Ok intake screen plugged
(3) Broken OA intake screen
(4) Fan not running
NA Not Available | **ND** No Design | **DD** Direct Drive | **N/R** No Requirement

Project Name:	**Fairfield Public Schools RCx: Osborn Hill Elementary School**
Project Number:	*2020102.09*
Scope	**TAB Data**
Date	**July 11, 2022**

Zone Identification								
Floor	Room#	Room Name	TAB Measured (cfm)	Calc. OA CFM @ Min. (OA cfm)	Meas. unit OA % (OA cfm)	BAS Damper Command (pos. %)	Associated VAV & RTU/AHU Unit	Notes
1	0.01	Main Office/Corridor	446/180	106	17% - 292	20%	RTU-4	1683 Total - Summation of Distribution
1	0.01A	Office	180	31	17% - 292	20%	RTU-4	
1	0.01B	Main Office Large Storage	Ex 84	---	---	---	---	No Ventilation
1	0.02	Nurse	192	33	17% - 292	20%	RTU-4	
1	0.02A	NurseToilet	51, EX=62	9	17% - 292	20%	RTU-4	
1	0.02B	Nurse Storage	---	---	---	---	---	
1	0.01C	Main Office Toilet	EX 30	---	---	---	---	No Ventilation
1	0.01D	Main Office Small Storage	---	---	---	---	---	No Ventilation
1	0.03	Principal	405	69	17% - 292	20%	RTU-4	
1	0.04	Conference	229	39	17% - 292	20%	RTU-4	
1	0.05	Storage	---	---	---	----	---	No Ventilation
1	01	Classroom	EX 507	---			---	No Ventilation
1	02	Classroom	EX 447	---	---	---	AC	No Ventilation / Wall Split Unit
1	03	Classroom	EX 428	---	---	---	---	No Ventilation
1	04	Classroom	EX 537	---	---	---	---	No Ventilation
1	05	Kindergarten	---	---	---	---	AC	No Ventilation / Wall Split Unit
1	5A	Toilet	EX 100	---	---	---	---	No Ventilation
1	05.01	Storage	EX 211	---	---	---	---	No Ventilation
1	06	Kindergarten	EX 435	---	---	---	AC	No Ventilation / Wall Split Unit
1	06A	Toilet	EX 77	---	---	---	---	No Ventilaltion
1	06.01	Office	EX 70	---	---	---	---	No Ventilation
1	06.02	Exterior Storage	EX 175	---	---	---	---	No Ventilation
1	07	Kindergarten	EX 362	---	---	---	AC	No Ventilation / Wall Split Unit
1	07A	Toilet	EX 94	---	---	---	---	No Ventilation
1	08	Kindergarten	EX 514	---	---	---	AC	No Ventilation / Wall Split Unit
1	08A	Toilet	EX 117	---	---	---	---	No Ventilation

Project Name:	**Fairfield Public Schools RCx: Osborn Hill Elementary School**
Project Number:	*2020102.09*
Scope	**TAB Data**
Date	**July 11, 2022**

Zone Identification								
Floor	Room#	Room Name	TAB Measured (cfm)	Calc. OA CFM @ Min. (OA cfm)	Meas. unit OA % (OA cfm)	BAS Damper Command (pos. %)	Associated VAV & RTU/AHU Unit	Notes
1	09	Classroom	EX 437	---	---	---	AC	Wall Split Unit
1	10	Classroom	EX478	---	---	---	---	
1	0.06	Office	129 EX 0	65	50% - 496	20%	RTU-3	

Project Name:	**Fairfield Public Schools RCx: Osborn Hill Elementary School**
Project Number:	*2020102.09*
Scope	**TAB Data**
Date	**July 11, 2022**

Zone Identification								
Floor	Room#	Room Name	TAB Measured (cfm)	Calc. OA CFM @ Min. (OA cfm)	Meas. unit OA % (OA cfm)	BAS Damper Command (pos. %)	Associated VAV & RTU/AHU Unit	Notes
1	0.07	Office	126 EX 0	63	50% - 496	20%	RTU-3	
1	0.08A	Toilet	EX28	---	---	---	---	
1	0.08	Work Room	Supply 402 EX 148	201	50% - 496	20%	RTU-3	
1	0.09A	Toilet	EX36	---	---	---	---	
1	0.09	Faculty	346	173	50% - 496	20%	RTY-3	RTU total 1003 CFM summation of distribution
1	0.10	Girls	EX 205	---	---	---	---	
1	0.11	Boys	EX 216	---	---	---	---	
1	11	Classroom	521 EX 0	---	---	5%	UV	EX fan not running, switch, breaker on, measured 0 CFM on OA
1	0.12	Media Center	2175	215	9.9% - 292	20%	RTU-1	
1	0.12A	Reading	399	40	9.9% - 292	20%	RTU-1	
1	0.12B	Computer Lab	1946	311	16% - 308	20%	RTU-2	
1	0.12C	Storage	50	5	9.9% - 292	20%	RTU-1	Total 2939 CFM summation of distribution
1	0.12D	Work Room	208	21	9.9% - 292	20%	RTU-1	
1	0.12E	Office	107	11	9.9% - 292	20%	RTU-1	
1	0.12F	Storage	55	6	9.9% - 292	20%	RTU-1	
1	0.13	Gymnasium	5344	1122	21% - 1127	20%	RTU-7	Total 5508
1	0.13A	Storage	62	13	21% - 1127	20%	RTU-7	
1	0.13B	Storage	72	15	21% - 1127	20%	RTU-7	
1	0.13C	Exterior Storage	---	---	---	---	---	Electric heater only, no ventilation
1	0.14	Cafetorium	12245	918	7.5% - 980	20%	RTU-5	Total 13068 - summation of distribution
1	0.14A	Platform	586	44	7.5% - 980	20%	RTU-5	
1	0.14B	Storage	161	12	7.5% - 980	20%	RTU-5	
1	0.14C	Elec	701	6	7.5% - 980	20%	RTU-5	
1	0.15	Kitchen	2063	2063	100%	20%	AHU-6 + Kit Hood EF	
1	0.15A	Kitchen Storage	0	0	---	---	---	There is no ventilation to this space
1	0.15B	Kitchen Toilet	EX 87	---	---	---	Ceiling Mounted Broan	This space has exhaust only

Project Name:	**Fairfield Public Schools RCx: Osborn Hill Elementary School**
Project Number:	*2020102.09*
Scope	**TAB Data**
Date	**July 11, 2022**

Zone Identification								
Floor	Room#	Room Name	TAB Measured (cfm)	Calc. OA CFM @ Min. (OA cfm)	Meas. unit OA % (OA cfm)	BAS Damper Command (pos. %)	Associated VAV & RTU/AHU Unit	Notes
1	0.15C	Dish Washing	0	0	---	---	---	There is no ventilation to this space
1	0.15D	FRZR	0	0	---	---	---	There is no ventilation to this space
1	12	Classroom	EX 471	---	---	---	AC	Wall split unit, no ventilation
1	13	Classroom	EX 479	---	---	---	---	No AC
1	14	Classroom	EX 447	---	---	---	---	No AC
1	15	Classroom	EX 525	---	---	---	---	No AC
1	16	Classroom	EX529	---	---	---	AC	Wall split unit
1	17	Classroom	EX365	---	---	---	---	No AC
1	18	Classroom	EX 165	---	---	---	---	No AC
1	19	Classroom	EX 531	---	---	---	---	No AC
1	20	Classroom	EX 260	---	---	---	---	No AC
1	21	Music Classroom	EX 643	---	---	---	AC	Wall split unit
1	22	Classroom	EX 328	---	---	---	---	No AC
1	23	Art Classroom	EX 603	---	---	---	---	No AC
1	23A	Storage	EX60	---	---	---	---	
1	23B	Kiln	196 total	---	---	---	---	
1	24	Classroom	EX 522	---	---	---	AC	Wall split unit
1	25	Classroom	EX 451	---	---	---	AC	Wall split unit
1	25.01	Girls	EX 197	---	---	---	AC	
1	25.02	Boys	EX 247	---	---	---	AC	
1	25.03	Boiler Rm/Janitor	0 / EX 135	---	---	---	A/C	Fan not running boiler rm
1	25.04	Sprinkler Room	---	---	---	---	---	No ventilation. HW heater only
1	A1	Classroom	916	110	12%	NA	HP-4 annex	
1	A2	Classroom	947	85	9%	NA	HP-3 annex	
1	A3	Classroom	928	130	14%	NA	HP-2 annex	
1	A.01	Cust	50	21	41%	NA	HP-1 annex	

Project Name:	**Fairfield Public Schools RCx: Osborn Hill Elementary School**
Project Number:	*2020102.09*
Scope	**TAB Data**
Date	**July 11, 2022**

Zone Identification

Floor	Room#	Room Name	TAB Measured (cfm)	Calc. OA CFM @ Min. (OA cfm)	Meas. unit OA % (OA cfm)	BAS Damper Command (pos. %)	Associated VAV & RTU/AHU Unit	Notes
		Office	EX 266					Between classroom 21 & 22
1	A.02	Girls	181	74	41%	NA	HP-1 annex +EF	There is an in-line EF duct that serves just this space with no tags
1	A.03	Utility	79	32	41%	NA	HP-1 annex	
1	A.04	Boys	201	82	41%	NA	HP-1 annex +EF	There is an in-line EF that serves just this space with no tags
1	A.05	Toilet	60	25	41%	NA	HP-1 annex +EF	There is an in-line EF that serves just this space with no tags
1	A4	Classroom	655	9	0%	NA	HP-5 annex	
1	A5	Classroom	913	15	0%	NA	Hp-6 annex	

APPENDIX 5 – RCx Unit and Room Take-Off Data

Project Name:	**Fairfield Public Schools RCx**
Project Number:	*2020102.09*
Scope	**Room Take-Off Data**
Date	**April 11, 2022**
	Osborn Hill Elementary School

RCM, RA, JRK

Zone Identification

Floor	Room#	Room Name	Area (SF)	Ceiling Height (FT)	Volume	People	Notes	Identified Defficiencies	Pictures Y /N
1	0.01	Main Office	618	9	5562	4	3-Supplies FTR		
1	0.01A	Office	45	8.2	369	1	1-Supply, 1-Return/Exhaust, FTR		
1	0.01B	Main Office Large Storage	44.8	8.8	394	1	1-Supply,	Isolation Room	
1	0.02	Nurse	177	8.9	1575	2	1-Supply, 1-Return/Exhaust, FTR		
1	0.02A	Nurse Toilet	65	8.9	579	1			
1	0.02B	Nurse Storage	5	8.9	45	0			
1	0.01C	Main Office Toilet	46	8.9	409	1			
1	0.01D	Main Office Small Storage	7	8.9	62	0			
1	0.03	Principal	235	8.9	2092	10	2-Supply, 1-Return/Exhaust, FTR		
1	0.04	Conference	145	9	1305	6			
1	0.05	Storage	133	8.75	1164	0			
1	01	Classroom	890	8.9	7921	15	1-Return/Exhaust, FTR		
1	02	Classroom	862	8.9	7672	18	1-Return/Exhaust, FTR, 030 Mr. Slim		
1	03	Classroom	866	8.9	7707	18	1-Return/Exhaust, FTR		
1	04	Classroom	871	8.9	7752	18	1-Return/Exhaust, FTR		
1	05	Kindergarten	1028	9	9252	20	1-Return/Exhaust, FTR	Sanyo, 3.0 Tons?, Dehumidifier	x
1	5A	Toilet	61	8.9	543	1			
1	05.01	Storage	81	8.9	721	0			
1	06	Kindergarten	1052	8.9	9363	20	1-Return/Exhaust, FTR, 024 Mr. Slim	Dehumidifier	
1	06A	Toilet	21	8.9	187	1			
1	06.01	Office	120	8.9	1068	3	1-Return/Exhaust	Phycologist Office	
1	06.02	Exterior Storage	150	12	1800	0			
1	07	Kindergarten	1154	8.9	10271	22	1-Return/Exhaust, FTR, 036 Mr. Slim		

Project Name:	**Fairfield Public Schools RCx**
Project Number:	*2020102.09*
Scope	**Room Take-Off Data**
Date	**April 11, 2022**
	Osborn Hill Elementary School

RCM, RA, JRK

Zone Identification

Floor	Room#	Room Name	Area (SF)	Ceiling Height (FT)	Volume	People	Notes	Identified Defficiencies	Pictures Y /N
1	07A	Toilet	17	8.9	151	1			
1	08	Kindergarten	1160	8.9	10324	10	1-Return/Exhaust, FTR, 036 Daikin		
1	08A	Toilet	17	8.9	151	1			
1	09	Classroom	878	9	7902	15	1-Return/Exhaust, FTR, 030 Fujitso		
1	10	Classroom	874	9	7866	13	1-Return/Exhaust, FTR	(Every Window open)	
1	0.06	Office	116	8.3	963	5	1-Supply, 1-Return/Exhaust,	Speech/Language-Interior Space	
1	0.07	Office	116	8.4	974	5	1-Supply, 1-Return/Exhaust,	Interior Space	
1	0.08A	Toilet	59	8.9	525	1			
1	0.08	Work Room	303	9	2727	2	2-Supply, 1-Return/Exhaust,		
1	0.09A	Toilet	59	8.9	525	1			
1	0.09	Faculty	436	9	3924	6			
1	0.10	Girls	200	8.9	1780	3			
1	0.11	Boys	200	8.9	1780	3			
1	11	Classroom	660	8.9	5874	12	FCU on exterior wall, ventilation	Unit was running	
1	0.12	Media Center	3384	9.7	32825	40	7- Supplies, 1-Return	3- Dehumidifiers	x
1	0.12A	Reading	348	8.6	2993	6	1 Supply, 1-Return/Exhaust		
1	0.12B	Computer Lab	769	8.9	6844	25	4-Supplies, 1-Return, Clg. Tiles warped	23 Computers, 1-Large Dehumidifier	
1	0.12C	Storage	187	8	1496	1	1 Supply, 1-Return/Exhaust		
1	0.12D	Work Room	223	8.8	1962	4	2 Supply, 1-Return/Exhaust		
1	0.12E	Office	137	9	1233	2	1 Supply, 1-Return/Exhaust		
1	0.12F	Storage	115	8	920	3	1 Supply, 1-Return/Exhaust		
1	0.13	Gymnasium	2830	19.8	56034	25	Exposed Round Supplies, wall returns	Dedicated Trane RTU	
1	0.13A	Storage	216	12	2592	0			

Project Name:	**Fairfield Public Schools RCx**
Project Number:	*2020102.09*
Scope	**Room Take-Off Data**
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Zone Identification

Floor	Room#	Room Name	Area (SF)	Ceiling Height (FT)	Volume	People	Notes	Identified Defficiencies	Pictures Y /N
1	0.13B	Storage	216	12	2592	1	1- Supply off Trane RTU-7	Gym Teachers office	
1	0.13C	Exterior Storage	287	12	3444	0		Did not enter	
1	0.14	Cafetorium	2725	21	57225	220	5-Supplies,2-Returs,+ Kitchen hood, FTR	Maximum Occuppancy	
1	0.14A	Platform	493	19.6	9663	15			
1	0.14B	Storage	60	7.6	456	0			
1	0.14C	Elec	74	7.6	562	0			
1	0.15	Kitchen	522	9	4698	5	3-Supplies, 1-Exhaust + Hood	MAU-Exhaust operation unknown	
1	0.15A	Kitchen Storage	65	8.9	579	0			
1	0.15B	Kitchen Toilet	72	8.9	641	1			
1	0.15C	Dish Washing	194	8.75	1698	1			
1	0.15D	FRZR	57	7	399	0			
1	12	Classroom	1033	9.2	9504	20	1-Return/Exhaust, FTR	Windows all open	x
1	13	Classroom	830	9	7470	20	1-Return/Exhaust, FTR		
1	14	Classroom	874	9	7866	18	1-Return/Exhaust, FTR		
1	15	Classroom	887	8.9	7894	20	1-Return/Exhaust, FTR	Playroom	
1	16	Classroom	800	8.9	7120	25	1-Return/Exhaust, FTR, 030 Mr. Slim	Bookshelfs blocking FTR Air pattern	
1	17	Classroom	831	9	7479	25	1-Return/Exhaust, FTR		
1	18	Classroom	811	9	7299	24	1-Return/Exhaust, FTR		
1	19	Classroom	766	8.9	6817	2	1-Return/Exhaust, FTR	Room Empty Dehumidifier	
1	20	Classroom	756	9.1	6880	26	1-Return/Exhaust, FTR	Dehumidifier	
1	21	Music Classroom	739	9	6651	26	1-Return/Exhaust, FTR, 030 Mr. Slim		
1	22	Classroom	513	9.1	4668	25	1-Return/Exhaust, FTR		
1	23	Art Classroom	899	8.7	7821	25	1-Return/Exhaust, FTR		

Project Name:	**Fairfield Public Schools RCx**
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Zone Identification

Floor	Room#	Room Name	Area (SF)	Ceiling Height (FT)	Volume	People	Notes	Identified Defficiencies	Pictures Y /N
1	23A	Storage	194	9	1746	2	1-Return/Exhaust, FTR	Office	
1	23B	Kiln	109	8.7	948	1	Kiln Exhaust, Room Exhaust, Clg. FCU		
1	24	Classroom	830	9.1	7553	25	1-Return/Exhaust FTR		
1	25	Classroom	875	9.1	7963	25	1-Return/Exhaust FTR 036 Fujitsu	Bookshelfs blocking FTR Air pattern	
1	25.01	Girls	285	9.1	2594	5			
1	25.02	Boys	298	9.1	2712	5			
1	25.03	Boiler Room	974	12	11688	0			
1	25.04	Sprinkler Room	160	12	1920	0			
1	A1	Classroom	726	7.8	5663	25	12 Grilles, 4, returns, 8 supplies	All grilles are dirty	
1	A2	Classroom	740	7.8	5772	20	12 Grilles, 4, returns, 8 supplies	All grilles are dirty	
1	A3	Classroom	765	7.8	5967	20	12 Grilles, 4, returns, 8 supplies	All grilles are dirty	
1	A.01	Cust	60	7.8	468	1			
1	A.02	Girls	200	7.8	1560	2			
1	A.03	Utility	109	9	981	0	1 Exhaust	Room located off rm 23	
1	A.04	Boys	200	7.8	1560	2			
1	A.05	Toilet	60	7.8	468	1			
1	A4	Classroom	749	7.8	5842	25	12 Grilles, 4, returns, 8 supplies	All grilles are dirty	
1	A5	Classroom	767	7.8	5983	15	12 Grilles, 4, returns, 8 supplies	All grilles are dirty	

PROJECT: 2020102.09 FAIRFIELD PUBLIC SCHOOLS – OSBORN HILL ELEMENTARY SCHOOL
EQUIPMENT DATA SHEET

Unit Tag	**HP-1**	**Addition comments descriptions**
Location	Roof	
Serving	Classroom A4	
Config/Style	Packaged Heat Pump	
Mfr.	York	
Model #	B6HX036A25A	
Serial #	W1A4338020	
Age (years)	06/2009	As-Builts
System CFM		
Max OA CFM		
V/Hz/Ph	208-230/60/3	
SF Qty/HP	(1) ¾ Direct Drive	
SF VFD Data	ECM	
RF Qty/HP	N/A	
RF VFD Data	N/A	
Filter Data (Size Quantity)	(2) 14x22x1	Last Change 9/24/21
Filter Status	Dirty	
Controls Type	Factory DDC	
Controls Mfr.	York/Honeywell	
Economizer	No	
CO_2 DCV		
Damper Styles	Factory	
Damper Status	Non-Functional O.A. Blocked @ Factory Hood	
Heating Type	H.P. w/Electric Resistance	
Heating Coil Condition		Dirty
Cooling Type	DX Package	
Cooling Coil Condition	Same	
CU Mfr.		
CU Model		
CU Serial		
Drain Pan Status	Dirty	
Notes:		

Photos

PROJECT: 2020102.09 FAIRFIELD PUBLIC SCHOOLS – OSBORN HILL ELEMENTARY SCHOOL
EQUIPMENT DATA SHEET

Unit Tag	**HP-2**	**Addition comments descriptions**
Location	Roof	
Serving	Classroom A3	
Config/Style	Packaged Heat Pump	
Mfr.	York	
Model #	B6HX036A25A	
Serial #	W1G4871849	
Age (years)	06/2009	As-Builts
System CFM		
Max OA CFM		
V/Hz/Ph	208-230/60/3	
SF Qty/HP	(1) ¾ Direct Drive	
SF VFD Data	ECM	
RF Qty/HP	N/A	
RF VFD Data	N/A	
Filter Data (Size Quantity)	(2) 14x22x1	Last Change 9/24/21
Filter Status	Dirty	
Controls Type	Factory DDC	
Controls Mfr.	York/Honeywell	
Economizer	No	
CO_2 DCV		
Damper Styles	Factory	
Damper Status	Non-Functional O.A. Blocked @ Factory Hood	
Heating Type	H.P. w/Electric Resistance	
Heating Coil Condition	Dirty	
Cooling Type	DX Package	
Cooling Coil Condition	Same	
Drain Pan Status	Dirty	
Notes:		

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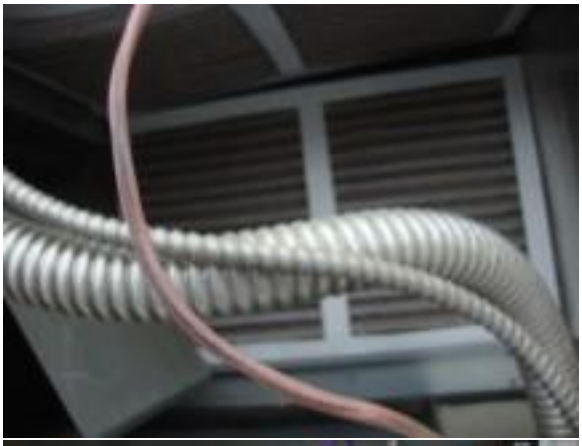
EQUIPMENT DATA SHEET

Photos



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EQUIPMENT DATA SHEET

Unit Tag	**HP-3**	**Addition comments descriptions**
Location	Roof	
Serving	Classroom A2	
Config/Style	Packaged Heat Pump	
Mfr.	York	
Model #	B6HX036A25A	
Serial #	W1G4871853	
Age (years)	06/2009	As-Builts
System CFM		
Max OA CFM		
V/Hz/Ph	208-230/60/3	
SF Qty/HP	(1) ¾ Direct Drive	
SF VFD Data	ECM	
RF Qty/HP	N/A	
RF VFD Data	N/A	
Filter Data (Size Quantity)	(2) 14x22x1	Last Change 9/24/21
Filter Status	Dirty	
Controls Type	Factory DDC	
Controls Mfr.	York/Honeywell	
Economizer	No	
CO_2 DCV		
Damper Styles	Factory	
Damper Status	Non-Functional O.A. Blocked @ Factory Hood	
Heating Type	H.P. w/Electric Resistance	
Heating Coil Condition	Dirty	
Cooling Type	DX Package	
Cooling Coil Condition	Same	
Drain Pan Status	Dirty	
Notes:		

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EQUIPMENT DATA SHEET

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PROJECT: 2020102.09 FAIRFIELD PUBLIC SCHOOLS – OSBORN HILL ELEMENTARY SCHOOL
EQUIPMENT DATA SHEET

Unit Tag	**HP-4**	**Addition comments descriptions**
Location	Roof	
Serving	Classroom A1	
Config/Style	Packaged Heat Pump	
Mfr.	York	
Model #	B6HX036A25A	
Serial #	W1A4338020	
Age (years)	06/2009	As-Builts
System CFM		
Max OA CFM		
V/Hz/Ph	208-230/60/3	
SF Qty/HP	(1) ¾ Direct Drive	
SF VFD Data	ECM	
RF Qty/HP	N/A	
RF VFD Data	N/A	
Filter Data (Size Quantity)	(2) 14x22x1	Last Change 9/24/21
Filter Status	Dirty	
Controls Type	Factory DDC	
Controls Mfr.	York/Honeywell	
Economizer	No	
CO_2 DCV		
Damper Styles	Factory	
Damper Status	Non-Functional O.A. Blocked @ Factory Hood	
Heating Type	H.P. w/Electric Resistance	
Heating Coil Condition	Dirty	
Cooling Type	DX Package	
Cooling Coil Condition	Same	
Drain Pan Status	Dirty	
Notes:		

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Unit Tag	**HP-5**	**Addition comments descriptions**
Location	Roof	
Serving	Toilets, Office, Corridor	
Config/Style	Packaged Heat Pump	
Mfr.	York	
Model #	B1HX048A25A	
Serial #	N0C965854A	
Age (years)	06/2009	As-Builts
System CFM		
Max OA CFM		
V/Hz/Ph	208-230/60/3	
SF Qty/HP	(1) ¾ Direct Drive	
SF VFD Data	ECM	
RF Qty/HP	N/A	
RF VFD Data	N/A	
Filter Data (Size Quantity)	(2) 14x22x1	Last Change 9/24/21
Filter Status	Dirty	
Controls Type	Factory DDC	
Controls Mfr.	York/Honeywell	
Economizer	No	
CO_2 DCV		
Damper Styles	Factory	
Damper Status	Non-Functional O.A. Blocked @ Factory Hood	
Heating Type	H.P. w/Electric Resistance	
Heating Coil Condition	Dirty	
Cooling Type	DX Package	
Cooling Coil Condition	Same	
Drain Pan Status	Dirty	
Notes:		

Photos

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Unit Tag	**HP-6**	**Addition comments descriptions**
Location	Roof	
Serving	Classroom A5	
Config/Style	Packaged Heat Pump	
Mfr.	York	
Model #	B6HX036A25A	
Serial #	W1G48718151	
Age (years)	06/2009	As-Builts
System CFM		
Max OA CFM		
V/Hz/Ph	208-230/60/3	
SF Qty/HP	(1) ¾ Direct Drive	
SF VFD Data	ECM	
RF Qty/HP	N/A	
RF VFD Data	N/A	
Filter Data (Size Quantity)	(2) 14x22x1	Last Change 9/24/21
Filter Status	Dirty	
Controls Type	Factory DDC	
Controls Mfr.	York/Honeywell	
Economizer	No	
CO_2 DCV		
Damper Styles	Factory	
Damper Status	Non-Functional O.A. Blocked @ Factory Hood	
Heating Type	H.P. w/Electric Resistance	
Heating Coil Condition	Dirty	
Cooling Type	DX Package	
Cooling Coil Condition	Same	
Drain Pan Status	Dirty	
Notes:		

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Unit Tag	**MAU-1** Name tag destroyed	**Addition comments descriptions**
Location	Kitchen Roof	
Serving	Kitchen	
Config/Style	Heating and Ventilation Rooftop Unit	
Mfr.	Ares	Exhaust Fan: Captive air EX11
Model #	SC-1-DE1D	
Serial #		
Age (years)		
System CFM		
Max OA CFM		
V/Hz/Ph		
SF Qty/HP		
SF VFD Data		
RF Qty/HP		
RF VFD Data		
Filter Data (Size Quantity)		
Filter Status		
Controls Type		
Controls Mfr.		
Economizer		
CO_2 DCV		
Damper Styles		
Damper Status		
Heating Type		
Heating Coil Condition		
Cooling Type		
Cooling Coil Condition		
Drain Pan Status		
Notes:		

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Unit Tag	**RTU-1**	**Addition comments descriptions**
Location	Upper West Roof	
Serving	Media Center	
Config/Style	Air Conditioning Rooftop Unit	
Mfr.	Trane	
Model #	YSC090H3RHA0000	
Serial #	181011426L	
Age (years)	03/2018	
System CFM	2000	
Max OA CFM		
V/Hz/Ph	208-230/60/3	
SF Qty/HP	(1) 3.0 Belt (1) AX32	
SF VFD Data	N/A	
RF Qty/HP	N/A	
RF VFD Data	N/A	
Filter Data (Size Quantity)	(4) 15x25x2	Last Change Date 9/23/21
Filter Status	Dirty	
Controls Type	DDC Electronic	
Controls Mfr.	Trane/Alerton	
Economizer	Yes	
CO_2 DCV		
Damper Styles	Factory	
Damper Status	OK	
Heating Type	Gas	
Heating Coil Condition	Burner	
Cooling Type	DX 410-A	
Cooling Coil Condition	OK	
Drain Pan Status	Clean	
Notes:		

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Unit Tag	**RTU-2**	**Addition comments descriptions**
Location	~~Upper West Roof~~	
Serving	~~Special Ed~~	
Config/Style	Air Conditioning Rooftop Unit	
Mfr.	Trane	
Model #	YSC060G3RLB0000	
Serial #	202410221L	
Age (years)	06/2020	
System CFM		
Max OA CFM		
V/Hz/Ph	208-230/60/3	
SF Qty/HP	(1) 1.0 Direct	
SF VFD Data	ECM	
RF Qty/HP	N/A	
RF VFD Data	N/A	
Filter Data (Size Quantity)	(2) 20x20x2 (2) 16x20x2	
Filter Status	Dirty	Change Date 9/23/21
Controls Type	DDC- Electronic	
Controls Mfr.	Trane Alerton	
Economizer	Yes	
CO_2 DCV		
Damper Styles	Factory	
Damper Status	OK	
Heating Type	Gas	
Heating Coil Condition	Burner	
Cooling Type	DX R-410A	
Cooling Coil Condition	OK	
Drain Pan Status	Clean, U-Bent trap	
Notes:		

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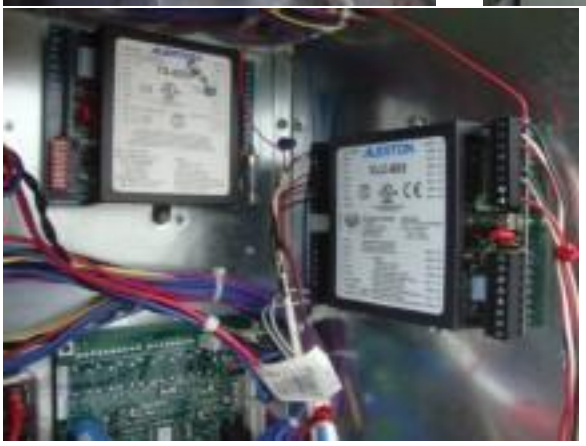
Photos



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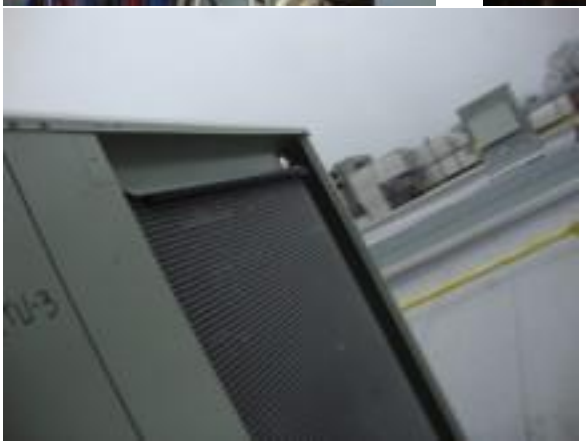
Unit Tag	**RTU-3**	**Addition comments descriptions**
Location	Upper West Roof	
Serving	Computer Room?	
Config/Style	Air Conditioning Rooftop Unit	
Mfr.	Trane	
Model #	YSC036G3RMB03D	
Serial #	1926 14407L	
Age (years)	06/2019	
System CFM		
Max OA CFM		
V/Hz/Ph	208-230/60/3	
SF Qty/HP	(1) 0.75 Direct drive	
SF VFD Data	ECM	
RF Qty/HP	N/A	
RF VFD Data	N/A	
Filter Data (Size Quantity)	(2) 20x20x2 (2) 16x20x2	
Filter Status	Dirty	Last Changed 9-23-21
Controls Type	DDC- Electronic	
Controls Mfr.	Trane Alerton	
Economizer	Yes	
CO_2 DCV		
Damper Styles	Factory	
Damper Status	OK	
Heating Type	Gas	
Heating Coil Condition	Burner	
Cooling Type	DX R-410A	
Cooling Coil Condition	OK	
Drain Pan Status	OK Trap ok	
Notes:		

Photos



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Unit Tag	**RTU-4**	**Addition comments descriptions**
Location	Center Main Roof	
Serving	Administration	
Config/Style	Air Conditioning Rooftop Unit	
Mfr.	Trane Precedent	
Model #	YSC 060 C3RHB04	
Serial #	2020 13442L	
Age (years)	05/2020	
System CFM	2000	
Max OA CFM		
V/Hz/Ph	208-230/60/3	
SF Qty/HP	(1) 1.0 DIRECT DRIVE	
SF VFD Data	ECM	
RF Qty/HP	N/A	
RF VFD Data	N/A	
Filter Data (Size Quantity)	(2) 20x20x2 (2) 16x20x2	
Filter Status	Dirty	Last Changed 9-23-21
Controls Type	DDC- Electronic	
Controls Mfr.	Trane Alerton	
Economizer	Yes	
CO_2 DCV		
Damper Styles	Factory	
Damper Status	OK	
Heating Type	Gas	
Heating Coil Condition	Burner	
Cooling Type	DX R-410A	
Cooling Coil Condition	OK	
Drain Pan Status	Clean, single piece trap, u-bend	
Notes:		

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Unit Tag	**RTU-5**	**Addition comments descriptions**
Location	Lower East Roof	
Serving	Cafe	
Config/Style	Air Conditioning Rooftop Unit	
Mfr.	Trane	
Model #	YCSC120H3RHA0000	
Serial #	202410515L	
Age (years)	06/2020	
System CFM	-	
Max OA CFM		
V/Hz/Ph	208-230/60/3	
SF Qty/HP	(1) 2.75 Direct Drive	
SF VFD Data	N/A	
RF Qty/HP	N/A	
RF VFD Data	N/A	
Filter Data (Size Quantity)	(4) 20x25x2	Last Change Date 9/24/21
Filter Status	Dirty	
Controls Type	DDC Electronic	
Controls Mfr.	Trane/Alerton	
Economizer	Yes	
CO_2 DCV		
Damper Styles	Factory	
Damper Status	OK	
Heating Type	Gas	
Heating Coil Condition	Burner	
Cooling Type	DX 410-A Dual Compressors Dual Circuit	
Cooling Coil Condition	OK	
Drain Pan Status	Clean	
Notes:		

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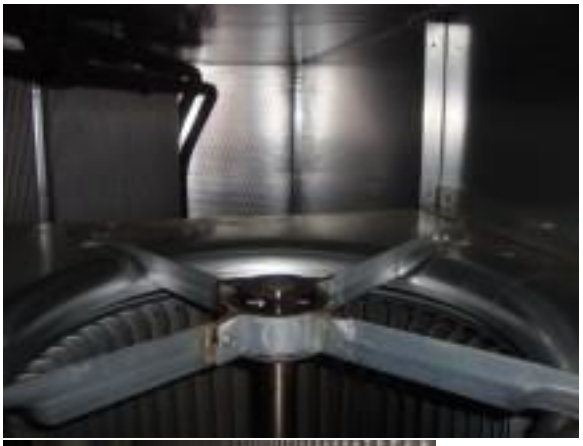

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Unit Tag	**RTU-6**	**Addition comments descriptions**
Location	Roof	
Serving	Kitchen	I
Config/Style	Air Conditioning Rooftop Unit	
Mfr.	Trane	
Model #	YSH180G3RHA0000	
Serial #	201310372D	
Age (years)	03/2020	
System CFM		
Max OA CFM		
V/Hz/Ph	208-230/60/3	
SF Qty/HP	(1) 3.0 Belt (1) BX77	
SF VFD Data	N/A	
RF Qty/HP	N/A	
RF VFD Data	N/A	
Filter Data (Size Quantity)	(8) 20x25x2 Angle Rack	
Filter Status	Dirty	
Controls Type	DDC Electronic	
Controls Mfr.	Trane/Alerton	
Economizer	Yes	
CO_2 DCV		
Damper Styles	Factory	
Damper Status	OK	
Heating Type	Gas	
Heating Coil Condition	Burner	
Cooling Type	DX 410-A Dual Compressors	
Cooling Coil Condition	Dual Condenser fans	
Drain Pan Status	Clean	
Notes:		

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Photos

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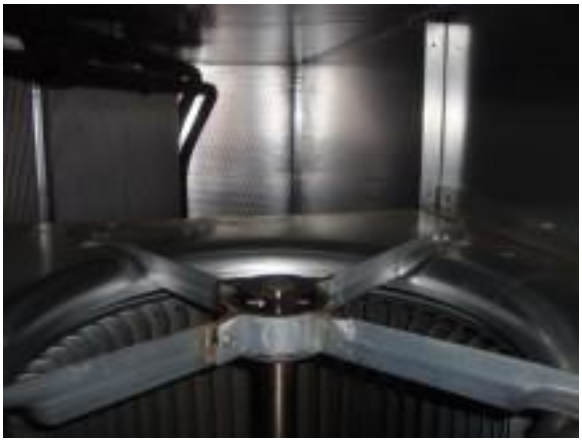

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Unit Tag	**RTU-7**	**Addition comments descriptions**
Location	Steel Dunnage Roof	No Access, No platform, No railing
Serving	Gym	
Config/Style	Packaged Gas/Dx	
Mfr.	Trane	
Model #	OA30540A3-D1A1ADJT-A1N00AG1JN-00283B000	
Serial #	0A235420-1	
Age (years)		
System CFM		
Max OA CFM		
V/Hz/Ph	208-230/60/3	
SF Qty/HP	(1) 10.0	
SF VFD Data	VFD Direct drive (Mitsubishi)	
RF Qty/HP	(1) 5.0	
RF VFD Data	VFD- Direct drive (Mitsubishi)	
Filter Data (Size Quantity)	(9) 20x24x2 Filters whistle, due to P.D. = plugged metal pre	(10) 24x16x2 Metal Pre-filter O.A These filters are plugged solid and need to be changed out
Filter Status	Changed 4-8-22 Already pollen laden	
Controls Type	Factory DDC	System started 100% O.A, dampers look correct but no exhaust fan operation,
Controls Mfr.	Trane	
Economizer	Available but not witnessed	
CO_2 DCV		
Damper Styles	Parallel	
Damper Status	OK, Clean adjust and lubricate	
Heating Type	Gas	
Heating Coil Condition	Burner	
Cooling Type	DX 3-Compressors 4-Condenser fans	
Cooling Coil Condition	Dirty, should be washed	Trap on condensate cracked due to freeze condition – removed plug, cleaned trap
Drain Pan Status	Crusty, clean after coil wash.	
Notes:		

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