mechanicalservicecorporation

41 South Jefferson Road
Whippany, New Jersey 07981
Tel > 973.884.5000
Fax > 973.884.5060

www.mscnj.com

Project Report

3/3/14 Project number: 14-00192

Overview

The Fiber Tower is a four story room within a lab facility. The building construction is steel frame on a concrete slab with additional floors being poured concrete on corrugated decking. The two exterior walls in the fiber tower room are block walls with large glass window arrays. The two interior walls are conventional sheetrock walls that run from the floor to the bottom of the roof deck.

The fiber tower is served by an Innovent roof mounted constant volume desiccant dehumidification unit equipped with mechanical DX precooling and post cooling coils and natural gas fired heat. The unit (via an onboard controller) operates all functions to satisfy the desired space conditions. The desired space conditions are reported to be 70° dry bulb and a maximum permitted space relative humidity of 30% with the space in a positive pressure relative to surrounding spaces and to outdoors. No requirement for space humidification during winter months was reported.

The work performed under this assignment is the initial investigative work. Space temperature and humidity data loggers were installed in the space during this assignment and they will be retrieved in the coming weeks when they time out.

Reported problem(s)

1. During the summer months and shoulder seasons, the relative humidity in the fiber tower rises above the permitted limit of 30%. No specific outdoor conditions were provided.
2. The fiber tower is in a negative pressure relative to surrounding spaces and to outdoors.
3. Operating outside of the specified limits and with the space in a negative affects the product.

Assignment

1. Determine the reason or reasons for the fiber tower exceeding the maximum relative humidity limit.
2. Determine the reason(s) for the fiber tower operating in a negative pressure.
3. Provide recommendations for corrective actions.

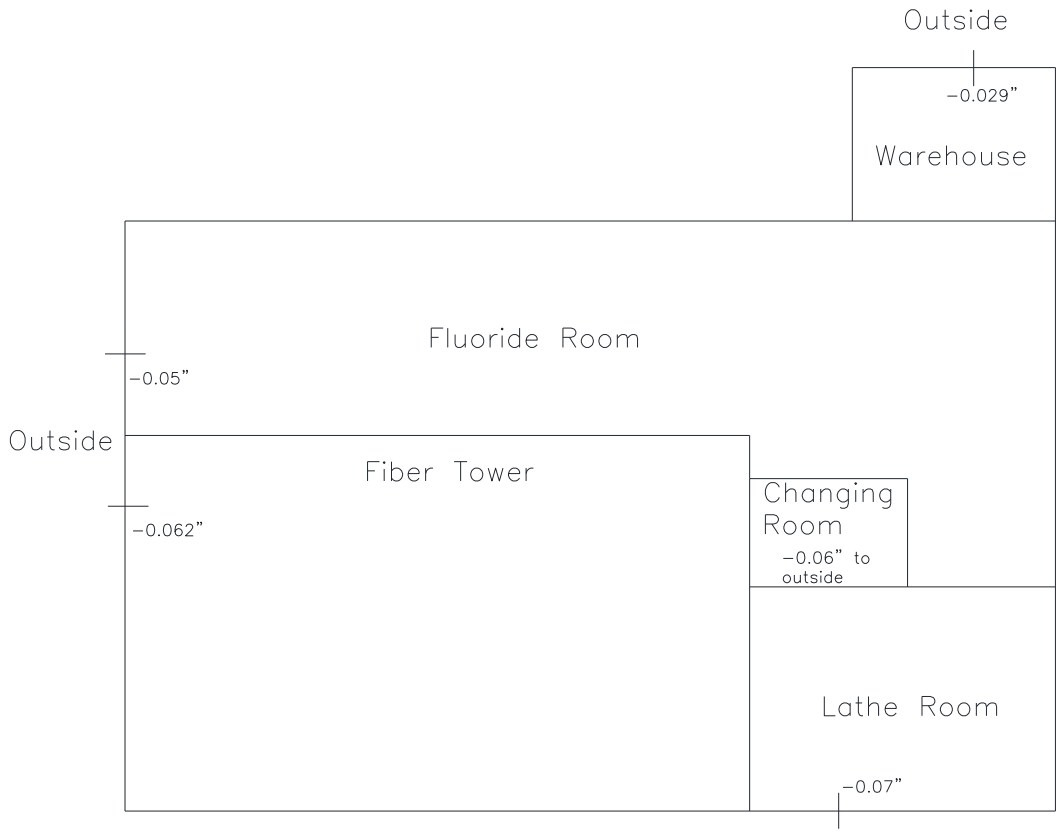
Observations and technical notes

Innovent unit (main unit supplying the fiber tower)

1. The unit was found upon arrival to be set (in the unit controller) to 72°F and 35% RH. This condition is in excess of the conditions noted to us.
2. A balance report was not available for the fiber tower and lathe room. Air flow readings were not taken during this assignment.
3. The Innovent unit is equipped with two parallel gas furnaces in the reheat position capable of 320 MBH (total) output with a turndown of 8:1. At 10,000 CFM, this provides a temperature rise of 29.5°F at full fire.
4. The supply fan was provided as an across the line start device and is not equipped with a VFD.
5. The Innovent rooftop desiccant air handler is a constant volume system.
6. One VAV terminal is tapped from the Innovent supply duct to serve the lathe room. This terminal has a reported minimum of 180 CFM and a reported maximum of 1,800 CFM. A single return to the Innovent unit is installed from the lathe room to the Innovent return duct.
7. Innovents' design criteria calls for a supply of 10,000 CFM, at 52.2°F DB and 32.2 grains/lb. humidity ratio. Barring any internal moisture gains from the space or infiltration from other areas, this will result in a space RH of 30% at approximately 70°F2°F.
8. The designed equipment entering air condition (combination of outside and return air) is specified in the submittal as 78.6°F DB and 65.2°F WB.
9. Calculations indicate that the design appears to have been based around ASHRAE 2% conditions for July dehumidification wet bulb and mean coincidental dry bulb (77.9°F /89.2°F respectfully) with an approximate outdoor air percentage of 35%-40% (3,500 - 4,000 CFM). The design drawings indicate that the unit was intended to introduce 3,400 CFM of outdoor air and return 6,600 CFM of return air from the space.
10. The Innovent unit was observed with a 100% call for outdoor air but with a 5.5 VDC signal limit on the outdoor air damper. This represents a command of approximately 44% outside air. The OA and RA signals are individually adjustable (and limited) in the controller and were likely adjusted during balancing.
11. A field pressurization test was performed with all space exhausts operating, the return damper fully closed and the outside air damper fully open. During this test the space pressure increased from -0.062"w.c. to +0.12"w.c. The position and air volume of the VAV terminal serving the lathe room was not observed during this test.
12. Assuming the supply fan was delivering the specified 10,000 CFM during the field pressurization test, and the total exhaust from the fiber tower was 5,210 CFM (design totals for the installed fans), we can approximate the following. Note that these are initial observations. Any equipment changes will require field measurements.
    a. The space can achieve a positive pressure as built and with the existing unit supply fan.

b. Approximately 4,790 CFM of outdoor air (or air from an indoor source external to the space) is required to pressurize the space as it is currently constructed in additional to the 5,210 CFM required to offset the existing mechanical exhaust.

13. The space will not be able to maintain the specified temperature and humidity conditions with the Innovent unit operating with 100% outside air.
14. The illustration below shows the pressure differentials measured during our testing during the normal "as found" system operation with the zero reference being outdoors. All readings are in inches of water column ("wc).



15. Innovent notes that there may be an issue in their software that causes building pressure control to be disabled when the desiccant wheel is not operating. Weather conditions during our inspection had the desiccant wheel locked out and Mike did observe that building pressure control was disabled.
16. When operating the Innovent unit with 100% outside air, the lathe room exhausts and fume hood exhausts were being drawn into the OA intake of the Innovent unit due to their close proximity to the unit.
17. When the desiccant wheel was put into regeneration override, the regeneration side of the unit operated properly.
18. When pressure control was forced on for testing with the desiccant wheel in operation (manually), and the voltage signals for OA and RA were changed to factory settings (2-10VDC), the RA damper output went to 9VDC and the OA went to 3VDC. This appears

to be operating in reverse. With the dampers in this position, the building pressure read 0"wc on a digital test instrument. During this time, the controller building pressure setpoint remained as found at +0.12"w.c.

19. Mike took the unit out of space pressure override, (desiccant wheel still enabled) and the outside air command went to 100% (10VDC) and return air went to 0% (2VDC). This indicates either that space pressure override is intended to disable space pressure control or the controller is commanding in reverse. Confirmation with Innovent will be required. The unit was returned to the originally found set points at the completion of this test.
20. The Dwyer Static Pressure transmitter installed in the Innovent unit was not "zeroed" and was reporting a lower space pressure than what was measured with our instruments. Mike zeroed the device and checked it against our instrument. This condition was not currently affecting space pressure.

Fiber Tower (notes internal to the fiber tower room)

1. The wall mounted Vaisala humidity and temperature sensor located adjacent to the control panel is not wired to the Innovent unit. All signal wiring passes through to the Mamac humidity and temperature transmitter located adjacent to the Vaisala device.
2. The space humidity and temperature inputs to the Innovent unit are from commercial grade wall mounted devices installed on the wall adjacent to the entrance from the gowning room. Comparison of the temperature and humidity values being reported to the Innovent controller by the installed devices, differ from the readings reported by our NIST traceable test instruments when measured at the same location.
3. The location of the space humidity and temperature sensors may not accurately represent the space conditions.
4. The "Emergency VAV Cooling" switch on the control panel enables two VAV terminals supplied by RTU-3. One is installed on the first floor in the fluoride room and the other is on the second floor in a closet. The thermostats for these terminal units are on the wall adjacent to the Innovent panel. The supply and returns to and from both devices have been temporarily disabled by being taped over with duct tape.
5. Exposed joints and cracks in the building construction are a source of air and moisture infiltration. Locations include where ductwork penetrates sheet rock walls (in some locations you can see the adjacent room through the penetration) and the areas where the sheetrock interior walls meet the corrugated metal decking. The wall bases are not sealed where the walls meet the concrete slab. Additionally, some expansion joints in the tower room floor slab are not correctly sealed to prevent moisture infiltration.
6. Doorways into and out of the tower room and lathe room are conventional steel doors with no sweeps installed to provide a seal to the adjacent space or to outdoors. Emergency exit door (#6) in the tower room to the outside is not sealed along its edges and a draft is evident. Daylight can be seen under the door and water entered the space during a recent light rain.
7. The equipment installed differs from what is shown on the design drawing we received. Examples are:
    a. Several of the installed fans are larger than those shown on the design drawings.
    b. Additional exhaust systems were added.

c. Some smaller exhausts were eliminated and accounted for in the larger fans noted in “a” above

8. The lathe room was originally to be supplied by RTU-3 but was connected to the Innovent unit supplying the fiber tower. The original return tor RTU-3 is currently capped in the space. A filtered 14"x22" transfer duct exists from the fluoride room where the RTU-3 supply was to enter.

Supply and Exhaust

Fiber Tower

1. The Fiber Tower Innovent unit has an original design supply volume of 10,000 CFM. Of this, 1,800 CFM (variable) was diverted to the lathe room where a single VAV terminal supplies the space. This leaves the fiber tower with a net supply volume of 8,200 CFM when the lathe room requires cooling or heating.
2. The design general exhaust for the fiber tower was 3,360 CFM. Two Penn-Barry roof mounted exhaust fans were provided with one being redundant (EF-4 and EF-5). These fans are powered via two VFD’s with selection between fans being accomplished by a selector switch.
3. A common suction serves EF-4 & EF-5. These fans serve as general exhaust for the fiber tower and draw from the first and second floor of the catwalk.
4. On the control panel just inside the fiber room entrance from the gowning room, a switch is installed and labeled that it serves EF-1 or EF-2. This selector switch actually serves EF-4 or EF-5 (single fan operation with redundancy). Both fans are powered through wall mounted variable frequency drives with a manual percentage dial to control the speed of each fan. The wiring was traced to confirm.
5. EF-4 and EF-5 nameplate data indicate that each fan is to exhaust 3,360 CFM.
6. A fume hood is installed and is served by a roof mounted exhaust fan with a nameplate rating of 810 CFM.
7. The push-pull ventilation system serving the towers themselves is an independent system of fans for each tower. The plans indicate two push fans and two pull fans per tower with the pull fans drawing 110 CFM from the surrounding space in addition to the air supplied by the push fans. The net from the space for all push/pull fans for both towers is 440 CFM.
8. The total labeled mechanical exhaust volume for the fiber tower is as follows:
    a. 3,360 general exhaust (EF-4 & EF-5).
    b. 810 CFM fume hood exhaust.
    c. 600 CFM transfer for the HEPA fan to the gowning room.
    d. 440 CFM for the push/pull process system.
    e. Total currently installed fiber tower exhaust (not measured): 5,210 CFM

Gowning Room

1. A HEPA fan powered filter box is installed in the gowning room ceiling and the fan inlet is ducted from the tower room. The design documents indicate that this fan is intended to

transfer 600 cfm to the gowning room from the Fiber Tower. Air volume measurements for the HEPA device were not available.

2. Two transfer grilles are installed in the gowning area to relieve air from the gowning room to the bottle storage rooms. Any excess relief air required to maintain the gowning room negative to the Fiber Tower room is currently relieved through the doors to the Fluoride room or through other non-planned paths.
3. With the system as installed, it is expected that the gowning area will be positive to the tower room if the HEPA fan/filter is operated at the noted 600 CFM.

Lathe Room and Bottle Storage Rooms

1. The lathe room currently receives supply air via a variable volume VAV terminal supplied by the Innovent Fiber Tower unit. The supply volume is labeled as a minimum of 180 CFM and a maximum of 1,800 CFM. The design also calls for a heating volume of 900 CFM with reheat being provided by an 8.5 KW electric heater.
2. The design exhaust volume for the lathe room was:
    a. Lathe exhaust: 170 CFM (EF-FT-2).
    b. Fume hood exhaust: 1,500 CFM (EF-FT-3).
    c. Control room exhaust: 100 CFM (EF-FT-6).
    d. Control room exhaust: 250 CFM (EF-FT-7).
    e. Total: 2,020 CFM
3. EF-FT-2 serving the lathe exhaust was measured as exhausting 2,112 CFM when it was replaced and when operating at 100% speed.
4. EF-FT-3 which serves the fume hoods (2) and the bottle rooms (3) has a nameplate volume of 2,000 CFM. Ef-FT-3 is a constant volume fan.
5. The total lathe room exhaust between these two fans is 4,112 CFM.
6. A possible air transfer path exists from the Tower Room to the lathe room via the common return duct to the tower room Innovent unit. Transfer flow volume is dependent on the pressure differential between the spaces and the return duct.
7. The lathe room currently has three transfer ducts installed between the lathe room and the fluoride room. The three transfers are as follows:
    a. Two unfiltered 14”x14” transfers.
    b. One 14”x22” transfer with a pleated filter.
8. The two bottle rooms adjacent to the gowning room each have a 50 CFM exhaust inlet served by the EF-FT-3 exhaust fan that also serves the two fume hoods installed in the lathe room. Additionally one 6” x 6” transfer duct is installed from each of these rooms to the lathe room.
9. The third bottle room has three 100 CFM exhaust inlets (from EF-FT-3) and four wall mounted transfer grilles between the bottle room and the lathe room.
10. Currently, other than the transfer ducts noted in (7) above, there appears to be no other makeup for the lathe room.

Conclusions

1. General:
   It appears that the fiber tower and the equipment serving it, as they are installed today

will not be able to achieve the desired space design conditions of 70°F dry bulb and 30% maximum relative humidity, nor will the space be able to be maintained in a positive pressure relative to surrounding spaces and to outdoors. Additionally the general construction of the room is not conducive to maintaining the required conditions due to infiltration.

2. Temperature control:
   Temperature control in the tower room is currently reported as acceptable.
3. Humidity Control:
   Humidity control in the fiber tower room is not acceptable. The primary reason for this is infiltration (via mechanical and natural means) of untreated air into the space. The dehumidification load and the heating and cooling load exceeds the capability of the installed equipment under the current operating conditions.
4. Space pressure control:
   Maintaining the fiber tower room in a positive pressure relative to surrounding spaces and to the outdoors while maintaining the space temperature and humidity within the specified limits is not possible with the installed equipment operating under the observed conditions.

Recommended Path Forward:

1. Confirm internally the conditions that must be maintained in the Fiber Tower room, the Lathe room and the Gowning room.
2. Consider reducing the exhaust from the Fiber Tower room. Determine internally what the minimum exhaust volume is for the fiber tower room. The goal is to reduce the space exhaust as much as possible to get closer to matching the capacity of the existing equipment. Consider the following:
   a. Relocate the currently installed fume hood to an adjacent space.
   b. Abandon plans to install additional fume hoods or exhaust sources in the fiber tower room.
   c. Reduce the general exhaust as much as possible.
3. Retain a general contractor to seal the space including doors, walls, floor expansion joints, gaps between the walls and decking etc. Seal around all penetrations.
4. Remove the emergency supply ducts from other units and seal the openings. Provide other duct modifications as may be required.
5. Remove the VAV terminal serving the lathe room from the Innovent unit and seal the return from the lathe room to the Innovent unit. This step assumes that the lathe room does not require the same conditions as the Fiber Tower room. Consider providing supply air to the lathe room from another unit (RTU-3 possibly) or providing room temperature makeup air from the warehouse.
6. Once the basic sealing and duct modifications have been performed, perform a space pressure test (with the remaining exhaust running) and air volume measurements to determine the quantity of outdoor air required to offset mechanical exhaust and overcome space leakage to achieve a suggested space pressure of +0.10”w.c. to the surrounding areas and to outdoors.

7. Once the new makeup air volume is determined for the Fiber Tower room, perform equipment modifications or additions as required. These may include control changes, adding capacity, adding equipment, etc. The same should be done for the lathe room.
8. Relocate any roof exhaust discharges that may be entering the outdoor air intake on the Innovent unit.
9. Add a DDC control system to tie all of the system pieces together and provide reliable operation.

Mechanical Service Corp.

Harry Hartigan
President
Phone (direct): 973-929-6125
E-mail: Hhartigan@mscnj.com