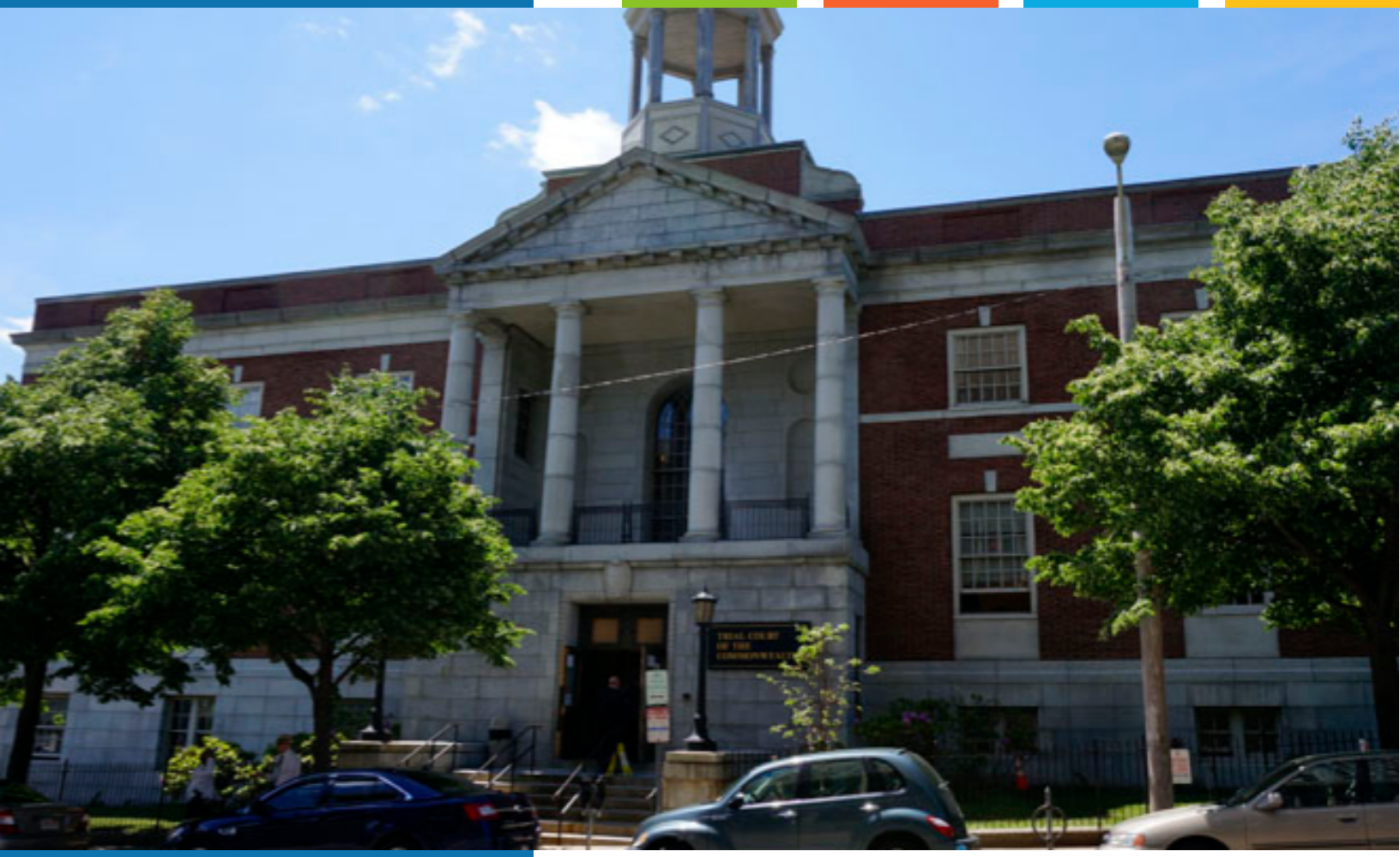

Cambridge Juvenile Court
Cambridge, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

November 28, 2023

Tighe&Bond

100% Recyclable

Section 1
Existing Conditions & Site Observations

Tighe & Bond visited the Cambridge Juvenile District Courthouse on March 17, 2021. While on site we inspected the air handling equipment located in the mechanical rooms and toured the facility to determine if the spaces generally matched usages noted on the architectural plans.

Site Visit Attendees:

- *Office of Court Management:*
  - Michael Stack Courthouse Facilities Staff
- *Tighe & Bond*
  - Ryan Ablondi, Senior Mechanical Engineer
  - Matt Mancini, Staff Mechanical Engineer

1.1 Existing Ventilation System

The Cambridge Juvenile Courthouse was constructed in 1933 and was renovated in 1989 and again in 2013. The courthouse is approximately 28,000 square feet in size.

One rooftop air handling unit provides ventilation air to the entire building. The unit contains a VFD controlled supply and return fan, refrigerant (DX) cooling coils, gas-fired heating coils, and 12" MERV 13 cartridge filters. The rooftop unit (RTU) operates as a constant volume system providing ventilation air throughout the building. Heating and cooling in each individual zone is provided by ceiling hung or floor mounted fan coil units.

The rooftop unit was installed in the 2013 renovation and is in very good condition. The outside air and return air dampers and actuators are in very good condition. The heating and cooling coils are a little dirty. The rooftop air handler is a constant volume unit, directly supplying ventilation air into zones throughout the building.

According to the drawings provided to Tighe & Bond, there are 10 exhaust fans serving the building. 3 fans serve toilet rooms, one fan serves the lockup area and the rest are serving the various electrical rooms throughout the building. At the time of our site visit, the lockup area exhaust fan was running, but only one of the three toilet exhaust fans was running. Based upon our review of the 2013 design drawings, it appears that each holding area is intended to be negatively pressurized.

Three AERCO gas-fired hydronic boilers, rated at 960 MBH each, provide hot water to finned tube radiation, and fan coil units. An 85.4 ton, air-cooled water chiller located in the basement mechanical room provides chilled water to all fan coil units.

Table 1 summarizes the air handling units' designed airflow rates, the MERV rating of the installed filters, and the condition of the units.

TABLE 1
Existing Air Handling Units

Unit	Original Design Airflow (CFM)	Original Design Min. O.A. (CFM)	Filters	Condition
RTU-1	13,000	1,300	12" MERV-13	Very Good

Photo 1 – Representative Air Handler

1.2 Existing Control System

The HVAC equipment is controlled by a Building Management System (BMS). The air handler, exhaust fans, boilers, chiller, and pumps are all tied into the system. The rooftop air handling unit is designed with full airside economizer and a demand control ventilation (DCV) sequence of operation, where outdoor ventilation air is increased when CO2 levels rise above a setpoint based upon CO2 sensors located within the return air duct and in densely occupied zones.

Section 2
Recommendations

Below is a list of recommendations for the Cambridge Juvenile District Courthouse. Please refer to the "Master Recommendation List" for further explanation and requirements of the stated recommendations.

Building areas without adequate ventilation and filtration significantly increase the risk of spreading viruses like COVID-19, especially areas with high occupant density and where people occupy the same space for relatively long periods of time. Consider significantly reducing occupancy or relocating occupants to other areas with adequate ventilation.

2.1 Filtration Efficiency Recommendations

The filters in the air handler has already been upgraded with 2" MERV 13 filters. The use of 2" MERV 13 meets the minimum ASHRAE recommendations for filtration during the pandemic. We recommend that a testing and balancing contractor test and document the airflow and static pressure profile of the air handler, as outlined in recommendation RF-1 in the Overview of Recommendations document. This will help determine if the equipment can accommodate the increase in system static pressure associated with the addition of the MERV 13 filters.

We recommend the following measures be implemented for the existing air handling units:

RF-1: *MERV-13 filters.*

> We recommend the continued use of MERV-13 pre and final filters as they meet ASHRAE's minimum recommended MERV rating. The existing pre and final filters should be checked to ensure that they are within their recommended service life, and that they have been installed correctly. Filter racks should be inspected and adjusted to ensure that filters fit tightly and that end spacers are in place to minimize filter bypass.

2.2 Testing & Balancing Recommendations

The air handling units are approximately 7 years old and it is unknown to Tighe & Bond when the last time the units were tested and balanced. Also, the code requirements to determine the outdoor air flow rates that were used to design the original system may be different than the 2015 International Mechanical Code (IMC) and current ASHRAE Standard 62.1 requirements.

We recommend the following testing and balancing measures be implemented:

RTB-1: *Test and balance air handling unit supply air and minimum outdoor air flow rates.*

> We recommend testing and balancing the outdoor air flow rates for the air handling unit to the recommended minimum O.A. rate listed in Table 2.

TABLE 2
Recommended Air Handler O.A. Flow Rates

Unit	Original Supply Airflow (CFM)	Original Design Min. O.A. (CFM)	Current Code Min. O.A. Requirements (CFM)	Recommended Minimum O.A. (CFM)
AHU-1	13,000	1,300	6,300	**3,855**

Note: Although the ASHRAE Position Document on Infectious Aerosols recommends using the latest published standards and codes as a baseline for minimum ventilation, the mechanical code in effect at the time the HVAC systems were designed and constructed is what governs the required outdoor air flowrate for the HVAC equipment, if there have been no additions, renovations, alterations or changes in occupancy to the building. The 2015 International Mechanical Code does not prevent the continued use of existing systems.

Our ventilation air analysis discovered that many spaces were not receiving the correct quantity of outdoor air based on today's code requirements at full occupancy. Our calculations showed that the quantity of outdoor air required per code would result in a significant increase in outdoor air for the air handler, increasing the load on the heating and cooling coils. These loads appear to exceed the capacity of the unit. We recommend temporarily reducing the occupancy of the spaces that are not receiving the code required ventilation air. Table 3 lists the spaces that would require a reduced occupancy. The recommended outdoor air flow rates listed in Table 2 reflect the outdoor air requirements based on a reduced occupancy shown in Table 3.

The DCV allows for the unit to provide down to 40% of the schedule design minimum OA flow which would be 520 CFM. We recommend revisiting this sequence and the minimum DCV setpoint prior to resuming normal occupancy to ensure the code required amount of outside air is provided to all spaces.

TABLE 3
Recommended Occupancy During COVID-19 Pandemic

Room & Associated AHU	***2015 IMC Permitted Occupancy (# of People)***	***Recommended Occupancy (# of People)***
RTU-1		
Juvenile Courtroom 1	153	31
Juvenile Courtroom 2	63	13
Probate and Family/ Juvenile Courtroom	91	14
Probate and Family Courtroom 209	58	10
Probate and Family Courtroom 205	63	10
Courtroom 2 Conference	10	2
Conference Room/ Library 130	20	3
Hearing Room 117	18	5

Where we recommend increasing the outdoor air beyond the original design, it appears the cooling and heating coils should be able to provide leaving air

conditions similar to the original design under peak outdoor air conditions, assuming the coils are clean and their performance has not degraded significantly over time. Supply air temperatures during the heating and cooling season should be monitored to ensure they are not dropping below design values. If the supply air temperature does drop below design values, the outdoor airflow rate should be reduced, but not below the originally designed outdoor air flow rates.

The average airflow rate per person is shown below in Table 4. These values are based on the original full design supply airflow rate and the recommended outdoor airflow rates shown in Table 2. The airflow rate per person assumes a diversity factor of 70%, meaning the maximum number of occupants assumed to be in all zones at all times equates to 70% of the code required occupancy.

TABLE 4
Average Airflow Rate per Person

	All spaces	***Courtrooms***	***Non-Courtroom Spaces***
Total Occupancy (People)	430	300	130
Total Supply Air (CFM/Person)	30	7	84
Outdoor Air (CFM/Person)	3	0.7	8.4

The airflow rate per person for each Courtroom and the Jury Pool Room is shown below in Table 5. These values are based on full occupancy without taking diversity into account, the original full design supply airflow rate, and the recommended outdoor airflow rate. The airflow rate per person assumes the full supply airflow is being delivered to the room.

TABLE 5
Airflow Rate per Person (Full Occupancy)

		Total Air		Outdoor Air	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outdoor Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Juvenile Courtroom 1	153	900	5.9	90	0.6
Juvenile Courtroom 2	63	300	4.75	30	0.5
Probate and Family/ Juvenile Courtroom	91	400	4.5	40	0.5
Probate and Family Courtroom 209	58	250	4.3	25	0.5
Probate and Family Courtroom 205	63	250	4.0	25	0.4
Hearing Room 117	18	150	8.3	15	0.9

Note: Courtroom occupant density is based on 70 people/1,000 square feet, per the 2015 International Mechanical Code

The airflow rate per person for each Courtroom and the Jury Pool Room, based on a reduced occupancy schedule determined by the Office of Court Management, is shown below in Table 4a. The airflow rate per person assumes the full supply airflow is being delivered to the room.

TABLE 4a
Airflow Rate per Person (Reduced Occupancy)

		Total Air		Outdoor Air	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outdoor Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Juvenile Courtroom 1	31	900	29	90	2.9
Juvenile Courtroom 2	13	300	23	30	2.3
Probate and Family/ Juvenile Courtroom	14	400	28.5	40	2.9
Probate and Family Courtroom 209	10	250	25	25	10
Probate and Family Courtroom 205	10	250	25	25	10
Hearing Room 117	5	150	30	15	3.0

Note: If occupancy is further reduced, the airflow rate per person will increase, assuming full airflow is being delivered to the space.

RTB-2: *Rebalance system return air flow rate.*

We recommend testing and balancing the return fan airflow rate to ensure the correct quantity of return air is being delivered to the air handler.

RTB-5: *Test and balance all air inlets and outlets.*

If the airflow to each space has not been recently tested, we recommend testing the airflow rates for any mechanical equipment (i.e. air handling units, fan coil units, exhaust fans, etc.) serving holding cells, control room, Courtrooms, Jury Pool room, and other densely occupied areas as a minimum. These systems are old and the airflow rate delivered to and returned from these spaces may not match the original design intent.

If specific areas within the Courthouse experiences regular cooling and heating comfort complaints this may be an indication of a lack of airflow to the space. We recommend testing and balancing the air inlets and outlets serving those spaces to the designed values. Prior to rebalancing the building, we recommend verifying the boiler and chilled water plants are maintaining the correct supply water temperature. Incorrect supply water temperature may be contributing to the temperature control complaints instead of a lack of airflow.

RTB-6: *Test and balance all air handler DX and hot water coils.*

Confirm that the air handler's refrigerant system is operating correctly to ensure the DX coil is receiving full refrigerant flow.

2.3 Equipment Maintenance & Upgrades

We recommend the following equipment maintenance and upgrades:

RE-1: *Test existing air handling system dampers and actuators for proper operation*.

Replace dampers and actuators that are not functioning properly.

RE-2: *Clean air handler coils and drain pans.*

2.4 Control System Recommendations

We recommend the following for the control system:

RC-1: *Implement a pre and post-occupancy flush sequence.*

We recommend implementing a sequence that starts the air handler and exhaust fans each day before the building enters its occupied mode, and allows them to run for a period of time following occupancy. The start and stop times should be early and late enough to allow for a minimum of three complete air changes of ventilation air before and after the building is normally occupied. The systems should also be run in occupied mode while cleaning staff are in the building.

RC-4: *Confirm the economizer control sequence is operational.*

RC-5: *Disable demand control ventilation sequences.*

For the duration of the COVID-19 pandemic, we recommend disabling any DCV sequences that may reduce the volume of outdoor air into spaces with reduced occupancy.

2.5 Additional Filtration and Air Cleaning

We recommend the installation of the following air cleaning devices:

RFC-1: *Install portable HEPA filters.*

If the Courthouse is to operate at a high capacity (i.e. 50% occupancy or greater), we recommend installing portable HEPA filters in high traffic areas, such as entrance lobbies. They should also be considered for Courtrooms, depending on the occupancy of the room and how much noise is generated from the filters. The noise levels will vary depending on the manufacturer. HEPA filters should be installed in the main lobby on both the first and second floors as these spaces are currently not receiving ventilation air.

2.6 Humidity Control

Installing duct mounted or portable humidifiers can help maintain the relative humidity levels recommended by ASHRAE. The feasibility of adding active humidification is determined by the building envelope. Buildings that were not designed to operate with active humidification can potentially be damaged due to a lack of a vapor barrier, adequate insulation, and air tightness.

Duct mounted humidifiers must be engineered, integrated into the building control system, tested, and commissioned. They are available in many configurations but require substantial maintenance and additional controls. They also run the risk of adversely affecting IAQ from growing microorganisms, or leaking water through poorly sealed ductwork damaging insulation and ceilings. Portable humidifiers are easier to install and require less maintenance, but still have the potential to damage the building envelope.

While active humidification is not recommended as a whole building solution due to high installation costs, operational costs, potential to damage the building envelope and adversely affect poor IAQ, it may be warranted as a temporary solution in some areas.

2.7 Other Recommendations

2.7.1 Repair or Replace Holding Cell and Toilet Exhaust Fans

As mentioned above, during our walkthrough it was noted that some toilet exhaust fans were not operating. We recommend repairing or replacing any holding cell and/or toilet exhaust fans that are not working or are not exhausting the proper airflow rate.

2.7.2 Add Ventilation to All Occupied Areas

Based on the drawings, the first and second floor lobbies do not have any mechanical ventilation nor do they have operable windows. Consider adding a ventilation system or tying into the existing ventilation system to serve these areas.

2.7.3 Replace Fan Coil Units

We also recommend the replacement of the fan coil units as part of a capital improvement plan. Assuming the existing fan coil units are from the 1989 renovation, they are 32 years old and are past their normal life expectancy of 25-30 years.

This recommendation does not increase the indoor air quality of the building.

Section 3
Testing & Balancing Results

The Courthouse replaced the existing RTU with a 100% outdoor air energy recovery unit (ERU). Milharmer Associates visited the Cambridge Juvenile Courthouse on September 8th, 2023 to test the airflow rates of the ERU and exhaust fans. A summary of the tested airflow rates versus the design airflow rates are shown below in Tables 5 and 6. The full testing and balancing report is attached.

TABLE 5
Air Handler Airflow Testing & Balancing Results

	Design			Actual		
Unit	Total Supply Fan Airflow (CFM)	Recommended Outdoor Airflow (CFM)	Return Airflow (CFM)	Supply Fan Airflow (CFM)	Outdoor Airflow (CFM)	Return Airflow (CFM)
ERU-1	8,000	8,000	7,800	8,297	8,297	7,416

TABLE 6
Exhaust Fan Testing & Balancing Results

Unit	Serving	Design Return/Exhaust Airflow (CFM)	Actual Return/Exhaust Airflow (CFM)
TEF-1	Restroom	550	540
TEF-2	Restroom	600	595
TEF-3	Restroom	500	512
EF-1	Storage	300	283
EF-2	Storage	500	505
EF-3	Electrical	500	494
EF-4	Holding Cells	750	752
EF-5	Holding Cells	300	322*

* Listed airflow was measured at grilles. Total airflow from duct traverse was tested at 475 cfm.

The typical balancing tolerance for air systems is ±10% of the design airflow.

In reviewing the airflow report data, the following should be noted:

1. ERU-1 supply and return are operating within the acceptable airflow range.

2. TEF-1, 2, and 3 and EF-1, 2, and 3 are all operating within the acceptable airflow range.
3. EF-4 is operating within the acceptable airflow range based on the design cfm listed in the TAB report.
4. EF-5 is operating well above the acceptable airflow range based on the airflow reading obtained by reading the main duct traverse. The TAB contractor also tested the grilles served by EF-5 and found the total airflow to be 322 cfm. Some duct leakage is expected, but the tested airflows show a duct leakage rate of 43%. While EF-5 is providing design exhaust airflow to the spaces served, sealing the exhaust duct may result in some energy savings if the fan is equipped with a means of speed control.

Disclaimer

Tighe and Bond cannot in anyway guarantee the effectiveness of the proposed recommendations to reduce the presence or transmission of viral infection. Our scope of work is intended to inform the Office of Court Management on recommendations for best practices based on the guidelines published by ASHRAE and the CDC. Please note that these recommendations are measures that may help reduce the risk of airborne exposure to COVID-19 but cannot eliminate the exposure or the threat of the virus. Implementing the proposed recommendations will not guarantee the safety of building occupants. Tighe & Bond will not be held responsible should building occupants contract the virus. The Office of Court Management should refer to other guidelines, published by the CDC and other governing entities, such as social distancing, wearing face masks, cleaning and disinfecting surfaces, etc. to help reduce the risk of exposure of COVID-19 to building occupants.

Submittal Transmittal

HDR Architecture, Inc. | 99 High Street Boston MA 02110-2305 United States

PROJECT:	DCAMM 3rd St Court_DCP1921 HD3 10196946	DATE SENT:	10/25/2023
SUBJECT:	09/08/2023 BALANCE REPORT	SUBMITTAL ID:	230001-23.0
TYPE:	Submittal	TRANSMITTAL ID:	00726
PURPOSE:	Approved	VIA:	Info Exchange
SPEC SECTION:	230001		

FROM

NAME	COMPANY	EMAIL	PHONE
Cuixi Ren	HDR Architecture, Inc.	cuixi.ren@hdrinc.com	617-357-7700

TO

NAME	COMPANY	EMAIL	PHONE
Michael Crowley		mcrowley@tracbuilders.com	

REMARKS:

CONTENTS

QUANTITY: 1 DATED: 10/19/2023 NUMBER:

DESCRIPTION:
230001-23.0 9-8-23 Balancing Report_IMEG-APP.pdf

ACTION:
REMARKS:

Project #: 19059.00
IMEG Submittal No.: 230001 23.0

SUBMITTAL REVIEW COMMENTS

RETURNED TO:

COMPANY:	HDR	DATE:	October 19, 2023
ATTN:	Alan Fried, Cuixi Ren	REVIEWED BY:	H. Bustillo
SENT VIA:	Email		

PROJECT NAME:	Third Street Courthouse	CONTRACTOR:	TRAC Builders
PROJECT #:	19059.00	CTR. SUBMITTAL #:	230001 23.0
SECTION NO.:	23 00 01	SUBMITTAL DATE:	September 14, 2023
DESCRIPTION:	Balancing 9/8/23 Report	DATE RECEIVED:	October 19, 2023

This review is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Notations made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the contract documents. Approval of a specific item shall not include approval of an assembly of which the item is a component. The contractor is solely responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordination of his or her work with that of all other trades; and performing all work in a safe and satisfactory manner.

ACTION KEY:

A	APPROVED					
	B	NOTATIONS, NO RESUBMITTAL (REFER TO NOTATIONS)				
		C	REVISE & RESUBMIT (REFER TO NOTATIONS)			
			F	REJECTED (REFER TO NOTATIONS)		
				NS	NOT SUBMITTED	
					ITEM	NOTATIONS
X					Balancing 9/8/23 Report	No Exceptions

THESE COMMENTS ARE TO BE ATTACHED TO ALL COPIES OF THE SUBMITTAL REFERENCED ABOVE.

Project: 21-0901 Cambridge Courthouse
121 Third Street
Cambridge, Massachusetts 02141

Submittal #230001-23.0 - Balancing 9/8/23 Report
230001 - HEATING, VENTILATION, & AIR CONDITIONING (FSB)

Revision	0	**Submittal Manager**	Dakota Melvin (TRAC Builders)
Status	Open	**Date Created**	Sep 14, 2023
		Spec Section	230001 - HEATING, VENTILATION, & AIR CONDITIONING (FSB)
Responsible Contractor	CAM H.V.A.C. & Construction Inc.	**Received From**	Nicholas Morra (CAM H.V.A.C. & Construction Inc.)
Final Due Date	Oct 5, 2023	**Lead Time**	
		Cost Code	
Location	Cambridge Courthouse	**Type**	Report
Approvers	Michael Crowley (TRAC Builders), Alan Fried (HDR)		
Ball in Court	Alan Fried (HDR)		
Distribution	Tisha Bodden (Architectural Engineers Inc.), Terrence Forbes (DCAMM), Susan Wisler (Architectural Engineers Inc.), Nicholas Morra (CAM H.V.A.C. & Construction Inc.), Mike Doyle (IMEG Corp), Michelle Fish (DCAMM), Michael Kolvek (Architectural Engineers Inc.), Michael Crowley (TRAC Builders), John Corcoran (DCAMM), Jay Crowe (TRAC Builders), Hugo Bustillo (Architectural Engineers Inc.), Cuixi Ren (HDR), Catherine Walsh (DCAMM), Carmen Warner (TRAC Builders), Alan Fried (HDR) , AEI Submittals (Architectural Engineers Inc.)		
Description	Balancing 9/8/23 measured after ASI#17R change order work complete and ERU-1 filters replaced.		

Submittal Workflow

Name	Sent Date	Due Date	Returned Date	Response	Attachments
General Information Attachments					230001- Balancing 9.8.23 Report - NEW 9.14.23.pdf
Michael Crowley	Sep 14, 2023	Oct 5, 2023	Sep 15, 2023	Forwarded For Review	230001- Balancing 9.8.23 Report - NEW 9.14.23.pdf (Current)
Comment	*please see atatached final air T&B report*				
Alan Fried	Sep 15, 2023	Sep 16, 2023		Pending	

Printed On: Oct 19, 2023 09:31 AM EDT

CAM H.V.A.C. & Construction, Inc.

TRANSMITTAL
No. 00022

116 Lydia Ann Rd.
Smithfield, RI 02917

PROJECT: Cambridge Court House

DATE: 9/14/2023

TO: TRAC Builders
28 Wolcott Street
Providence, RI 02908

REF: Submittals

ATTN: Michael P. Crowley

WE ARE SENDING:	SUBMITTED FOR:	ACTION TAKEN:
☑ Shop Drawings	☑ Approval	☐ Approved as Submitted
☐ Letter	☑ Your Use	☐ Approved as Noted
☐ Prints	☑ As Requested	☐ Returned After Loan
☐ Change Order	☑ Review and Comment	☐ Resubmit
☐ Plans		☑ Submit
☐ Samples	**SENT VIA:**	☐ Returned
☐ Specifications	☑ Attached	☐ Returned for Corrections
☑ Other: Balancing 9/8/23 Report	☐ Separate Cover Via: Mail	☐ Due Date:

ITEM	PACKAGE	SUBMITTAL	DRAWING	REV.	ITEM NO.	COPIES	DATE	DESCRIPTION	STATUS
SUB	230001	Balancing9/8/2:		001	1	1	9/14/2023	Balancing 9/8/23 Report	NEW

Remarks: Sent electronically via email. Balancing readings measured after ASI#17R change order work complete and ERU-1 filters replaced.

CC:

Signed: _____
Nicholas Morra

CAM H.V.A.C. & Construction, Inc.

116 Lydia Ann Rd.
Smithfield, RI 02917

SUBMITTAL
NO. Balancing9/8/23
PACKAGE NO: 230001

TITLE: Balancing 9/8/23 Report
PROJECT: Cambridge Court House
DRAWING:
STATUS: NEW
BIC: TRACBLDR

REQUIRED START: 9/14/2023
REQUIRED FINISH: 9/21/2023
DAYS HELD: 0
DAYS ELAPSED: 1
DAYS OVERDUE: -7

RECEIVED FROM	SENT TO	RETURNED BY	FORWARDED TO
MILH	TRACBLDR	TRACBLDR	MILH

Revision No.	Description / Remarks	Received	Sent	Returned	Forwarded	Status
001	Balancing 9/8/23 Report Sent electronically via email. Balancing readings measured after ASI#17R change order work complete and ERU-1 filters replaced.	9/13/2023	9/14/2023			NEW

MILHARMER ASSOCIATES, INC.
534 New State Highway, Route 44, Suite 3
Raynham, MA 02767
Tel.: 508-823-8500; Facsimile: 508-823-8600

TEST AND BALANCE REPORT

Project: **TRC Cambridge Courthouse Envelope Repairs**
121 Third St., Cambridge, MA

Project No.: **22-108** **Project Date:** **9/8/2023**

MECHANICAL CONTRACTOR

CAM HVAC

3384

A N.E.B.B. Certified Company

Project:	TRC Cambridge Courthouse Envelope Repairs		
Address:	121 Third St., Cambridge, MA		
Date:	9/8/2023	**Project No.**	22-108

CERTIFICATION

Submitted & Certified by:

Milharmer Associates, Inc.

Certification No.: ***3384*** Certification Expiration Date: **12-31-23**

The data presented in this Report is a record of system measurements and final adjustments that have been obtained in accordance with the current edition of the ***N.E.B.B. Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.*** Any variances from design quantities which exceed N.E.B.B. tolerances, are noted in the Test-Adjust-Balance Report Project Summary.

N.E.B.B. Qualified TAB Supervisor Name: **Scott F. Miller**

N.E.B.B. Qualified TAB Supervisor Signature:_____

Firm Certification

MILHARMER ASSOCIATES, INC.

HAS MET ALL REQUIREMENTS FOR NEBB CERTIFIED STATUS IN THE FOLLOWING DISCIPLINE

Testing, Adjusting and Balancing of Environmental Systems

3384

NEBB Certification Number

December 31, 2023

Expiration Date

NEBB President

NEBB President-Elect

Certification

SCOTT F. MILLER

HAS MET ALL REQUIREMENTS FOR NEBB CERTIFIED PROFESSIONAL STATUS IN THE FOLLOWING DISCIPLINE

Testing, Adjusting and Balancing of Environmental Systems

This Certificate, as well as individual affiliation with a NEBB Certified Firm and associated NEBB Certification Stamp are REQUIRED to provide a NEBB Certified Report. Participation in the NEBB Quality Assurance Program requires the Certificant be affiliated with a NEBB Certified Firm

CP-23541

NEBB Certification Number

December 31, 2023

Expiration Date

NEBB President

NEBB President-Elect

Project:	TRC Cambridge Courthouse Envelope Repairs		
Address:	121 Third St., Cambridge, MA		
Date:	9/8/2023	**Project No.**	22-108

TABLE OF CONTENTS

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

INSTRUMENT SHEET

The following is a list of Instruments owned and operated by Milharmer Associates, Inc. and used on this project.

Instrument ID Number	Instrument	Calibration Date	Calibration Due Date
1	ADM-870 Digital Multimeter	8-20-23	8-20-24
2	Shortridge Flow Hood	8-20-23	8-20-24
3	Ampmeter	8-20-23	8-20-24
4	Tachometer	8-20-23	8-20-24
5	Airflow Anemometer	8-20-23	8-20-24
6	Digital Thermometers	8-20-23	8-20-24
7	Shortridge Water Meter	8-20-23	8-20-24
8	Sound Meter	8-20-23	8-20-24
9	Vibration Meter	8-20-23	8-20-24

Please Note: Instruments are tested annually at the M.A.I. Lab. and sent back to the factory if deviation exceeds manufacturing tolerance.

Technician:

SYMBOL SHEET

AHU	Air Handling Unit	HEATER O.L.	Thermal Overload Protection For Motors Located at Starter Motor
AC or ACU	Air Conditioner Unit		
ACCU	Air Cooled Condensing Unit		
ADJ P.D.	Adjusted Pitch Diameter		
AMP	Amperage	HEPA	High Efficiency Particulate Arrestance
AVG	Average		
A.D.	Air Density	HOA	Hand/Off/Auto Switch
		H.P.	Horsepower
B.H.P.	Brake Horsepower	HPS	High Pressure Steam
		HRC	Heat (Recovery or Recliam) Coil
CFM	Cubic Feet Per Minute	HVAC	Heating, Ventilation and Air Conditioning
CH	Chiller		
CHWR	Chilled Water Return	HWR	Hot Water Return or Heating Water Return
CHW or CHWS	Chilled Water Supply		
CT	Cooling Tower	HWS	Hot Water Supply or Heating Water Supply
CWR	Condenser Water Return		
CW or CWS	Condenser Water Supply	HX	Heat Exchanger
DB	Dry Bulb	I.D.	Inside Diameter
D.D.	Direct Drive		
DIA	Diameter	LAT	Leaving Air Temperature
		L.D.	Linear Supply Diffuser
EAT	Entering Air Temperature	LPS	Low Pressure Steam
EDC	Electric Duct Coil	L.T.	Light Troffer
EDH	Electric Duct Heater	LWT	Leaving Water Temperature
EF	Exhaust Fan		
EMS	Energy Mgt System	MAU/MUA	Make Up Air Unit
EWT	Entering Water Temperature	MBH	1,000 BTU's per Hour
FCU	Fan Coil Unit	N.A.	Not Accessible
FH	Fume Hood	N/A	Not Applicable
F.L.A.	Full Load Amperage	N.I.	Not Installed
FPB	Fan Powered Box	N.L.	Not Listed
FPM	Feet Per Minute		
FT. HD.	Feet of Head		
GPM	Gallons Per Minute		

SYMBOL SHEET CONTINUED

O.D.	Outside Diameter	TAB	Testing, Adjusting, and Balancing
OA Min	Outside Air Minimum	TSP	Total Static Pressure
OAT	Outside Air Total	TP	Thermally Protected
PF	Power Factor	UH	Unit Heater
PHC	Preheat Coil		
PH	Phase(s)	V	Volts
PSI	Pounds Per Square Inch	VAV	Variable Air Volume
P.T.	Pitot Traverse	VD	Volume Damper
		VFD	Variable Frequency Drive
RA	Return Air	VP	Velocity Pressure
RF	Return Air Fan		
R.G.	Return Grille	W	Watts
RHC	Reheat Coil	WB	Wet Bulb
RPM	Revolutions per Minute	W.D.	Water Density
		W.G.	Water Guage
SA	Supply Air		
SAT	Supply Air Temperature	F	Degrees Fahrenheit
S.D.	Supply Diffuser		
SEF	Smoke Exhaust Fan	ΔP	Differential (Delta) Pressure or Pressure Drop
SF (AIR)	Supply Fan		
S.F.(Elect)	Service Factors		
SHC	Steam Heating Coil	ΔT	Differential (Delta) Temperature, Net Temperature Decrease or Increase
S.P. "W.C."	Static Pressure Measured in Inches of Water Column	#	PSI or Pounds Per Square Inch Decrease or Increase

Project:	TRC Cambridge Courthouse Envelope Repairs		
Address:	121 Third St., Cambridge, MA		
Date:	9/8/2023	**Project No.**	22-108

REPORT SUMMARY

Chilled Water Flow read at Chilled Water Pumps in basement with Ultrasonic Meter:

4" Pipe = 228 GPM Actual.

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

FAN DATA SHEET

	FAN NO. ERU-1		FAN NO. EXHAUST	
Serves / Location:	Courthouse	Roof	Courthouse	Roof
Manufacturer:	GREENHECK		GREENHECK	
Model Number:	RVE1507430H2510		RVE1507430H2510	
Size:	NL		NL	
Serial Number:	19339991		19339991	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	BALDOR	NL	BALDOR
Frame Number:	NL	184T	NL	182T
Horsepower:	7.5 x 2	5	5 x 2	3
Brake Horsepower:	NL	NA	NL	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	230/460/3	NA	230/460/3	NA
Motor Amperage:	13.2/6.6	18.6	8.4/4.2	15.92
Motor RPM:	1750	DIRECT DRIVE	1765	DIRECT DRIVE
Speeds:	VFD	43.76 Hz	VFD	70 Hz
Heater Size:	NL	NA	NL	NA
Heater Amps.:	NL	NA	NL	NA
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:	8000	8297		
Return Air CFM:				
Exhaust Air CFM:			7800	7416
Outside Air CFM:	8000	8297		
Suction Pressure:	NL	-1.44	NL	-3.25
Discharge Pressure:	NL	1.09	NL	0.39
Fan Static Pressure:	4.6	+/- 2.53	3.4	NA
External Pressure:	2	-0.22 / +/- 1.31	2	3.64
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Motor Drive:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Motor Size/Bore:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Fan Drive:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Fan Size/Bore:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Belt Size / Number:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Shafts C-C:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Turns Open:	NL	DIRECT DRIVE	NL	DIRECT DRIVE

Comments:

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

TRAVERSE DATA

SYSTEM: ERU-1 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Coil

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	86	" WIDTH x	56 1/4 " DEPTH	Sq Ft =	33.59

AIR DENSITY DATA

STATIC PRESS @ CL:	-1.44	InWg.	DESIGN CFM =	8000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	8293
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**8268**

AIR DENSITY RATIO CORRECTION = 1.00
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	281	213	216	238	187	360	
B	331	227	257	242	204	324	
C	333	209	243	238	198	290	
D	324	192	219	214	204	331	
E	270	205	195	175	170	316	
F							
G							
H							
I							

NO. OF READINGS = 30 AVERAGE FPM = 247

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Steve Duval

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

TRAVERSE DATA

SYSTEM: ERU-1 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Crawlspace

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	77	" WIDTH x	13	" DEPTH	Sq Ft =	6.95

AIR DENSITY DATA

STATIC PRESS @ CL:	-2.64	InWg.	DESIGN CFM =	7800
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	7416
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**7372**

AIR DENSITY RATIO CORRECTION = 0.99
SCFM CORRECTION FACTOR 0.99
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	1414	1036	806	427	227	345	439
B	1095	994	685	408	259	368	424
C	1268	782	677	588	1275	1893	1735
D	1551	1802	603	1746	1573	1953	1845
E							
F							
G							
H							
I							

NO. OF READINGS = 36 AVERAGE FPM = 1067

J	557	1874					
K	569	1785					
L	749	2057					
M	737	1861					
N							
O							
P							
Q							
R							

TECHNICIAN: Dave Burns

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

AIR DISTRIBUTION

SYSTEM: RTU
SUPPLY [X] RETURN [ ] EXHAUST [ ]

ROOM OR LOCATION	UNIT NUMBER	UNIT SIZE	AREAxK FACTOR	DESIGN FT/MIN	TEST FT/MIN	DESIGN CFM	TESTED CFM
GC04	1	12X6	AK=.41	975	923	400	378
Clerks Exit	2	6X6	FH	NA	NA	100	94
G20	3	8X4	AK=.16	625	609	100	97
Bsmt Waiting	4	6X6	FH	NA	NA	100	102
Maint. G16	6	6X6	FH	NA	NA	100	96
G17	7	9X9	FH	NA	NA	100	95
					TOTALS:	900	862

Comments:

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

FAN DATA SHEET

	FAN NO. TEF-1		FAN NO. TEF-2	
Serves / Location:	Toilets	Roof	Toilets	Roof
Manufacturer:	GREENHECK		GREENHECK	
Model Number:	G-098-4-VG-1-19-X		G-098-4-VG-1-19-X	
Size:	NL		NL	
Serial Number:	19312274		19312286	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	BROAD OCEAN	NL	BROAD OCEAN
Frame Number:	NL	K00270002	NL	K00270002
Horsepower:	0.25	1/4	0.25	1/4
Brake Horsepower:	0.15	NA	0.17	NA
Safety Factor:	NL	1.25	NL	1.25
Volts/Phase:	120/1	120	120/1	120
Motor Amperage:	2.85	NA	2.85	NA
Motor RPM:	300 - 1750	DIRECT DRIVE	300 - 1750	DIRECT DRIVE
Speeds:	VARIABLE	70%	VARIABLE	77%
Heater Size:	NL	NA	NL	NA
Heater Amps.:	NL	NA	NL	NA
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	550	540	600	595
Outside Air CFM:				
Suction Pressure:	NL	-0.21	NL	-0.32
Discharge Pressure:	NL	NA	NL	NA
Fan Static Pressure:	NL	-0.21	NL	-0.32
External Pressure:	0.75	NA	0.75	NA
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1601	DIRECT DRIVE	1667	DIRECT DRIVE
Motor Drive:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Motor Size/Bore:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Fan Drive:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Fan Size/Bore:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Belt Size / Number:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Shafts C-C:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Turns Open:	NL	DIRECT DRIVE	NL	DIRECT DRIVE

Comments:

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

FAN DATA SHEET

	FAN NO. TEF-3		FAN NO.	
Serves / Location:	Toilets	Roof		
Manufacturer:	GREENHECK			
Model Number:	G-098-4-VG-1-19-X			
Size:	NL			
Serial Number:	19312289			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	BROAD OCEAN		
Frame Number:	NL	K00270002		
Horsepower:	0.25	1/4		
Brake Horsepower:	0.15	NA		
Safety Factor:	NL	1.25		
Volts/Phase:	120/1	120		
Motor Amperage:	2.85	NA		
Motor RPM:	300 - 1750	DIRECT DRIVE		
Speeds:	VARIABLE	70%		
Heater Size:	NL	NA		
Heater Amps.:	NL	NA		
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	550	512		
Outside Air CFM:				
Suction Pressure:	NL	-0.2		
Discharge Pressure:	NL	NA		
Fan Static Pressure:	NL	-0.2		
External Pressure:	0.75	NA		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1537	DIRECT DRIVE		
Motor Drive:	NL	DIRECT DRIVE		
Motor Size/Bore:	NL	DIRECT DRIVE		
Fan Drive:	NL	DIRECT DRIVE		
Fan Size/Bore:	NL	DIRECT DRIVE		
Belt Size / Number:	NL	DIRECT DRIVE		
Shafts C-C:	NL	DIRECT DRIVE		
Turns Open:	NL	DIRECT DRIVE		

Comments:

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

AIR DISTRIBUTION

SYSTEM: Existing
SUPPLY [ ] RETURN [ ] EXHAUST [X]

ROOM OR LOCATION	UNIT NUMBER	UNIT SIZE	AREAxK FACTOR	DESIGN FT/MIN	TEST FT/MIN	DESIGN CFM	TESTED CFM
	EF-1						
G15D Storage	1	10X8	0.37	811	765	300	283
	EF-3						
G15B	1	8X6	0.21	476	NA	100	101
G15C	2	10X12	0.58	690	NA	400	393
					TOTAL:	500	494
	EF-?						
G15 Elec	1	10X8	0.56	893	901	500	505

Comments: *1 Single speed direct drive fan.

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

FAN DATA SHEET

	FAN NO. EF-4		FAN NO.	
Serves / Location:	Corridor & Cell	Corridor		
Manufacturer:	COOK			
Model Number:	80 DB DB-8			
Size:				
Serial Number:	025SK64663-00/0000701			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	NL		
Frame Number:	NL	NL		
Horsepower:	NL	0.25		
Brake Horsepower:	NL	NA		
Safety Factor:	NL	NL		
Volts/Phase:	115/1	115/1		
Motor Amperage:	NL	NA		
Motor RPM:	1494	DIRECT DRIVE		
Speeds:	NL	1		
Heater Size:	NL	CB		
Heater Amps.:	NL	CB		
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	750	752		
Outside Air CFM:				
Suction Pressure:	NL	-0.37		
Discharge Pressure:	NL	0.09		
Fan Static Pressure:	NL	NA		
External Pressure:	0.5	0.46		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	DIRECT DRIVE		
Motor Drive:	NL	DIRECT DRIVE		
Motor Size/Bore:	NL	DIRECT DRIVE		
Fan Drive:	NL	DIRECT DRIVE		
Fan Size/Bore:	NL	DIRECT DRIVE		
Belt Size / Number:	NL	DIRECT DRIVE		
Shafts C-C:	NL	DIRECT DRIVE		
Turns Open:	NL	DIRECT DRIVE		

Comments:

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

AIR DISTRIBUTION

SYSTEM: EF-4

SUPPLY ☐ RETURN ☐ EXHAUST ☒

ROOM OR LOCATION	UNIT NUMBER	UNIT SIZE	AREAxK FACTOR	DESIGN FT/MIN	TEST FT/MIN	DESIGN CFM	TESTED CFM
G65 MECH	1	20X6	0.83	482	500	400	415
CORRIDOR	2	7.25X5.25	0.26	481	450	125	117
CELL CORRIDOR	3	5.25X5.25	0.19	658	655	125	124
CELL CORRIDOR	4	5.25X5.25	0.19	526	505	100	96
					TOTALS:	750	752

Comments:

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

FAN DATA SHEET

	FAN NO.	EF-5	FAN NO.	
Serves / Location:	Jail Cell Exh.	Storage GC05		
Manufacturer:	COOK			
Model Number:	NL			
Size:	NL			
Serial Number:	NL			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	NL		
Frame Number:	NL	NL		
Horsepower:	NL	NL		
Brake Horsepower:	NL	NA		
Safety Factor:	NL	NL		
Volts/Phase:	115/1	115/1		
Motor Amperage:	NL	NA		
Motor RPM:	NL	DIRECT DRIVE		
Speeds:	VARIABLE	100%		
Heater Size:	NL	CB		
Heater Amps.:	NL	CB		
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	300	*1		
Outside Air CFM:				
Suction Pressure:	NL	-0.58		
Discharge Pressure:	NL	0.06		
Fan Static Pressure:	NL	NA		
External Pressure:	NL	0.64		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:		DIRECT DRIVE		
Motor Drive:	NL	DIRECT DRIVE		
Motor Size/Bore:	NL	DIRECT DRIVE		
Fan Drive:	NL	DIRECT DRIVE		
Fan Size/Bore:	NL	DIRECT DRIVE		
Belt Size / Number:	NL	DIRECT DRIVE		
Shafts C-C:	NL	DIRECT DRIVE		
Turns Open:	NL	DIRECT DRIVE		

Comments: ***1 Traverse = 475 cfm**

Inlet total = 322 cfm

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

TRAVERSE DATA

SYSTEM: EF-5 TRAVERSE NUMBER : T1
Branch to G-11 A & B TRAVERSE LOCATION: Storage GC-05

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	8	" WIDTH x	8	" DEPTH	Sq Ft =	0.44

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.25	InWg.	DESIGN CFM =	200
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	341
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**341**

AIR DENSITY RATIO CORRECTION = 1.00
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	136	455					
B	748	1126					
C	1016	1127					
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 6 AVERAGE FPM = 768

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Dave Burns

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

TRAVERSE DATA

SYSTEM: EF-5 TRAVERSE NUMBER : T2
Branch to G-11 TRAVERSE LOCATION: Storage GC-05

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	8	" WIDTH x	6	" DEPTH	Sq Ft =	0.33

AIR DENSITY DATA

STATIC PRESS @ CL:	0.36	InWg.	DESIGN CFM =	100
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	112
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**112**

AIR DENSITY RATIO CORRECTION = 1.00
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	340	338					
B	349	330					
C	331	321					
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 6 AVERAGE FPM = 335

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Dave Burns

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

AIR DISTRIBUTION

SYSTEM: EF-5

SUPPLY ☐ RETURN ☐ EXHAUST ☒

ROOM OR LOCATION	UNIT NUMBER	UNIT SIZE	AREAxK FACTOR	DESIGN FT/MIN	TEST FT/MIN	DESIGN CFM	TESTED CFM
G11	1	6X6	FH	NA	NA	100	104
G11A	2	6X6	FH	NA	NA	100	109
G11B	3	8X8	FH	NA	NA	100	109
					TOTALS:	300	322

Comments:

CAM H.V.A.C. & Construction, Inc.

TRANSMITTAL
No. 00022

116 Lydia Ann Rd.
Smithfield, RI 02917

PROJECT: Cambridge Court House

DATE: 9/14/2023

TO: TRAC Builders
28 Wolcott Street
Providence, RI 02908

REF: Submittals

ATTN: Michael P. Crowley

WE ARE SENDING:	SUBMITTED FOR:	ACTION TAKEN:
☑ Shop Drawings	☑ Approval	☐ Approved as Submitted
☐ Letter	☑ Your Use	☐ Approved as Noted
☐ Prints	☑ As Requested	☐ Returned After Loan
☐ Change Order	☑ Review and Comment	☐ Resubmit
☐ Plans		☑ Submit
☐ Samples	**SENT VIA:**	☐ Returned
☐ Specifications	☑ Attached	☐ Returned for Corrections
☑ Other: Balancing 9/8/23 Report	☐ Separate Cover Via: Mail	☐ Due Date:

ITEM	PACKAGE	SUBMITTAL	DRAWING	REV.	ITEM NO.	COPIES	DATE	DESCRIPTION	STATUS
SUB	230001	Balancing9/8/2:		001	1	1	9/14/2023	Balancing 9/8/23 Report	NEW

Remarks: Sent electronically via email. Balancing readings measured after ASI#17R change order work complete and ERU-1 filters replaced.

CC:

Signed: _____
Nicholas Morra

CAM H.V.A.C. & Construction, Inc.

116 Lydia Ann Rd.
Smithfield, RI 02917

SUBMITTAL
NO. Balancing9/8/23
PACKAGE NO: 230001

TITLE: Balancing 9/8/23 Report
PROJECT: Cambridge Court House
DRAWING:
STATUS: NEW
BIC: TRACBLDR

REQUIRED START: 9/14/2023
REQUIRED FINISH: 9/21/2023
DAYS HELD: 0
DAYS ELAPSED: 1
DAYS OVERDUE: -7

RECEIVED FROM	SENT TO	RETURNED BY	FORWARDED TO
MILH	TRACBLDR	TRACBLDR	MILH

Revision No.	Description / Remarks	Received	Sent	Returned	Forwarded	Status
001	Balancing 9/8/23 Report Sent electronically via email. Balancing readings measured after ASI#17R change order work complete and ERU-1 filters replaced.	9/13/2023	9/14/2023			NEW

MILHARMER ASSOCIATES, INC.
534 New State Highway, Route 44, Suite 3
Raynham, MA 02767
Tel.: 508-823-8500; Facsimile: 508-823-8600

TEST AND BALANCE REPORT

Project: **TRC Cambridge Courthouse Envelope Repairs**
121 Third St., Cambridge, MA

Project No.: **22-108** **Project Date:** **9/8/2023**

MECHANICAL CONTRACTOR

CAM HVAC

3384

A N.E.B.B. Certified Company

Project:	TRC Cambridge Courthouse Envelope Repairs		
Address:	121 Third St., Cambridge, MA		
Date:	9/8/2023	**Project No.**	22-108

CERTIFICATION

Submitted & Certified by:

Milharmer Associates, Inc.

Certification No.: ***3384*** Certification Expiration Date: **12-31-23**

The data presented in this Report is a record of system measurements and final adjustments that have been obtained in accordance with the current edition of the ***N.E.B.B. Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.*** Any variances from design quantities which exceed N.E.B.B. tolerances, are noted in the Test-Adjust-Balance Report Project Summary.

N.E.B.B. Qualified TAB Supervisor Name: **Scott F. Miller**

N.E.B.B. Qualified TAB Supervisor Signature:_____

Firm Certification

MILHARMER ASSOCIATES, INC.

HAS MET ALL REQUIREMENTS FOR NEBB CERTIFIED STATUS IN THE FOLLOWING DISCIPLINE

Testing, Adjusting and Balancing of Environmental Systems

3384

NEBB Certification Number

December 31, 2023

Expiration Date

NEBB President

NEBB President-Elect

Certification

SCOTT F. MILLER

HAS MET ALL REQUIREMENTS FOR NEBB CERTIFIED PROFESSIONAL STATUS IN THE FOLLOWING DISCIPLINE

Testing, Adjusting and Balancing of Environmental Systems

This Certificate, as well as individual affiliation with a NEBB Certified Firm and associated NEBB Certification Stamp are REQUIRED to provide a NEBB Certified Report. Participation in the NEBB Quality Assurance Program requires the Certificant be affiliated with a NEBB Certified Firm

CP-23541

NEBB Certification Number

December 31, 2023

Expiration Date

NEBB President

NEBB President-Elect

Project:	TRC Cambridge Courthouse Envelope Repairs		
Address:	121 Third St., Cambridge, MA		
Date:	9/8/2023	**Project No.**	22-108

TABLE OF CONTENTS

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

INSTRUMENT SHEET

The following is a list of Instruments owned and operated by Milharmer Associates, Inc. and used on this project.

Instrument ID Number	Instrument	Calibration Date	Calibration Due Date
1	ADM-870 Digital Multimeter	8-20-23	8-20-24
2	Shortridge Flow Hood	8-20-23	8-20-24
3	Ampmeter	8-20-23	8-20-24
4	Tachometer	8-20-23	8-20-24
5	Airflow Anemometer	8-20-23	8-20-24
6	Digital Thermometers	8-20-23	8-20-24
7	Shortridge Water Meter	8-20-23	8-20-24
8	Sound Meter	8-20-23	8-20-24
9	Vibration Meter	8-20-23	8-20-24

Please Note: Instruments are tested annually at the M.A.I. Lab. and sent back to the factory if deviation exceeds manufacturing tolerance.

Technician:

SYMBOL SHEET

AHU	Air Handling Unit	HEATER O.L.	Thermal Overload Protection For Motors Located at Starter Motor
AC or ACU	Air Conditioner Unit		
ACCU	Air Cooled Condensing Unit		
ADJ P.D.	Adjusted Pitch Diameter		
AMP	Amperage	HEPA	High Efficiency Particulate Arrestance
AVG	Average		
A.D.	Air Density	HOA	Hand/Off/Auto Switch
		H.P.	Horsepower
B.H.P.	Brake Horsepower	HPS	High Pressure Steam
		HRC	Heat (Recovery or Recliam) Coil
CFM	Cubic Feet Per Minute	HVAC	Heating, Ventilation and Air Conditioning
CH	Chiller		
CHWR	Chilled Water Return	HWR	Hot Water Return or Heating Water Return
CHW or CHWS	Chilled Water Supply		
CT	Cooling Tower	HWS	Hot Water Supply or Heating Water Supply
CWR	Condenser Water Return		
CW or CWS	Condenser Water Supply	HX	Heat Exchanger
DB	Dry Bulb	I.D.	Inside Diameter
D.D.	Direct Drive		
DIA	Diameter	LAT	Leaving Air Temperature
		L.D.	Linear Supply Diffuser
EAT	Entering Air Temperature	LPS	Low Pressure Steam
EDC	Electric Duct Coil	L.T.	Light Troffer
EDH	Electric Duct Heater	LWT	Leaving Water Temperature
EF	Exhaust Fan		
EMS	Energy Mgt System	MAU/MUA	Make Up Air Unit
EWT	Entering Water Temperature	MBH	1,000 BTU's per Hour
FCU	Fan Coil Unit	N.A.	Not Accessible
FH	Fume Hood	N/A	Not Applicable
F.L.A.	Full Load Amperage	N.I.	Not Installed
FPB	Fan Powered Box	N.L.	Not Listed
FPM	Feet Per Minute		
FT. HD.	Feet of Head		
GPM	Gallons Per Minute		

SYMBOL SHEET CONTINUED

O.D.	Outside Diameter	TAB	Testing, Adjusting, and Balancing
OA Min	Outside Air Minimum	TSP	Total Static Pressure
OAT	Outside Air Total	TP	Thermally Protected
PF	Power Factor	UH	Unit Heater
PHC	Preheat Coil		
PH	Phase(s)	V	Volts
PSI	Pounds Per Square Inch	VAV	Variable Air Volume
P.T.	Pitot Traverse	VD	Volume Damper
		VFD	Variable Frequency Drive
RA	Return Air	VP	Velocity Pressure
RF	Return Air Fan		
R.G.	Return Grille	W	Watts
RHC	Reheat Coil	WB	Wet Bulb
RPM	Revolutions per Minute	W.D.	Water Density
		W.G.	Water Guage
SA	Supply Air		
SAT	Supply Air Temperature	F	Degrees Fahrenheit
S.D.	Supply Diffuser		
SEF	Smoke Exhaust Fan	ΔP	Differential (Delta) Pressure or Pressure Drop
SF (AIR)	Supply Fan		
S.F.(Elect)	Service Factors		
SHC	Steam Heating Coil	ΔT	Differential (Delta) Temperature, Net Temperature Decrease or Increase
S.P. "W.C."	Static Pressure Measured in Inches of Water Column	#	PSI or Pounds Per Square Inch Decrease or Increase

Project:	TRC Cambridge Courthouse Envelope Repairs		
Address:	121 Third St., Cambridge, MA		
Date:	9/8/2023	**Project No.**	22-108

REPORT SUMMARY

Chilled Water Flow read at Chilled Water Pumps in basement with Ultrasonic Meter:

4" Pipe = 228 GPM Actual.

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

FAN DATA SHEET

	FAN NO. ERU-1		FAN NO. EXHAUST	
Serves / Location:	Courthouse	Roof	Courthouse	Roof
Manufacturer:	GREENHECK		GREENHECK	
Model Number:	RVE1507430H2510		RVE1507430H2510	
Size:	NL		NL	
Serial Number:	19339991		19339991	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	BALDOR	NL	BALDOR
Frame Number:	NL	184T	NL	182T
Horsepower:	7.5 x 2	5	5 x 2	3
Brake Horsepower:	NL	NA	NL	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	230/460/3	NA	230/460/3	NA
Motor Amperage:	13.2/6.6	18.6	8.4/4.2	15.92
Motor RPM:	1750	DIRECT DRIVE	1765	DIRECT DRIVE
Speeds:	VFD	43.76 Hz	VFD	70 Hz
Heater Size:	NL	NA	NL	NA
Heater Amps.:	NL	NA	NL	NA
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:	8000	8297		
Return Air CFM:				
Exhaust Air CFM:			7800	7416
Outside Air CFM:	8000	8297		
Suction Pressure:	NL	-1.44	NL	-3.25
Discharge Pressure:	NL	1.09	NL	0.39
Fan Static Pressure:	4.6	+/- 2.53	3.4	NA
External Pressure:	2	-0.22 / +/- 1.31	2	3.64
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Motor Drive:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Motor Size/Bore:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Fan Drive:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Fan Size/Bore:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Belt Size / Number:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Shafts C-C:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Turns Open:	NL	DIRECT DRIVE	NL	DIRECT DRIVE

Comments:

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

TRAVERSE DATA

SYSTEM: ERU-1 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Coil

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	86	" WIDTH x	56 1/4 " DEPTH	Sq Ft =	33.59

AIR DENSITY DATA

STATIC PRESS @ CL:	-1.44	InWg.	DESIGN CFM =	8000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	8293
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**8268**

AIR DENSITY RATIO CORRECTION = 1.00
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	281	213	216	238	187	360	
B	331	227	257	242	204	324	
C	333	209	243	238	198	290	
D	324	192	219	214	204	331	
E	270	205	195	175	170	316	
F							
G							
H							
I							

NO. OF READINGS = 30 AVERAGE FPM = 247

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Steve Duval

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
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TRAVERSE DATA

SYSTEM: ERU-1 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Crawlspace

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	77	" WIDTH x	13	" DEPTH	Sq Ft =	6.95

AIR DENSITY DATA

STATIC PRESS @ CL:	-2.64	InWg.	DESIGN CFM =	7800
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	7416
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**7372**

AIR DENSITY RATIO CORRECTION = 0.99
SCFM CORRECTION FACTOR 0.99
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	1414	1036	806	427	227	345	439
B	1095	994	685	408	259	368	424
C	1268	782	677	588	1275	1893	1735
D	1551	1802	603	1746	1573	1953	1845
E							
F							
G							
H							
I							

NO. OF READINGS = 36 AVERAGE FPM = 1067

J	557	1874					
K	569	1785					
L	749	2057					
M	737	1861					
N							
O							
P							
Q							
R							

TECHNICIAN: Dave Burns

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

AIR DISTRIBUTION

SYSTEM: RTU
SUPPLY [X] RETURN [ ] EXHAUST [ ]

ROOM OR LOCATION	UNIT NUMBER	UNIT SIZE	AREAxK FACTOR	DESIGN FT/MIN	TEST FT/MIN	DESIGN CFM	TESTED CFM
GC04	1	12X6	AK=.41	975	923	400	378
Clerks Exit	2	6X6	FH	NA	NA	100	94
G20	3	8X4	AK=.16	625	609	100	97
Bsmt Waiting	4	6X6	FH	NA	NA	100	102
Maint. G16	6	6X6	FH	NA	NA	100	96
G17	7	9X9	FH	NA	NA	100	95
					TOTALS:	900	862

Comments:

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
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FAN DATA SHEET

	FAN NO. TEF-1		FAN NO. TEF-2	
Serves / Location:	Toilets	Roof	Toilets	Roof
Manufacturer:	GREENHECK		GREENHECK	
Model Number:	G-098-4-VG-1-19-X		G-098-4-VG-1-19-X	
Size:	NL		NL	
Serial Number:	19312274		19312286	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	BROAD OCEAN	NL	BROAD OCEAN
Frame Number:	NL	K00270002	NL	K00270002
Horsepower:	0.25	1/4	0.25	1/4
Brake Horsepower:	0.15	NA	0.17	NA
Safety Factor:	NL	1.25	NL	1.25
Volts/Phase:	120/1	120	120/1	120
Motor Amperage:	2.85	NA	2.85	NA
Motor RPM:	300 - 1750	DIRECT DRIVE	300 - 1750	DIRECT DRIVE
Speeds:	VARIABLE	70%	VARIABLE	77%
Heater Size:	NL	NA	NL	NA
Heater Amps.:	NL	NA	NL	NA
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	550	540	600	595
Outside Air CFM:				
Suction Pressure:	NL	-0.21	NL	-0.32
Discharge Pressure:	NL	NA	NL	NA
Fan Static Pressure:	NL	-0.21	NL	-0.32
External Pressure:	0.75	NA	0.75	NA
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1601	DIRECT DRIVE	1667	DIRECT DRIVE
Motor Drive:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Motor Size/Bore:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Fan Drive:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Fan Size/Bore:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Belt Size / Number:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Shafts C-C:	NL	DIRECT DRIVE	NL	DIRECT DRIVE
Turns Open:	NL	DIRECT DRIVE	NL	DIRECT DRIVE

Comments:

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
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FAN DATA SHEET

	FAN NO. TEF-3		FAN NO.	
Serves / Location:	Toilets	Roof		
Manufacturer:	GREENHECK			
Model Number:	G-098-4-VG-1-19-X			
Size:	NL			
Serial Number:	19312289			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	BROAD OCEAN		
Frame Number:	NL	K00270002		
Horsepower:	0.25	1/4		
Brake Horsepower:	0.15	NA		
Safety Factor:	NL	1.25		
Volts/Phase:	120/1	120		
Motor Amperage:	2.85	NA		
Motor RPM:	300 - 1750	DIRECT DRIVE		
Speeds:	VARIABLE	70%		
Heater Size:	NL	NA		
Heater Amps.:	NL	NA		
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	550	512		
Outside Air CFM:				
Suction Pressure:	NL	-0.2		
Discharge Pressure:	NL	NA		
Fan Static Pressure:	NL	-0.2		
External Pressure:	0.75	NA		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1537	DIRECT DRIVE		
Motor Drive:	NL	DIRECT DRIVE		
Motor Size/Bore:	NL	DIRECT DRIVE		
Fan Drive:	NL	DIRECT DRIVE		
Fan Size/Bore:	NL	DIRECT DRIVE		
Belt Size / Number:	NL	DIRECT DRIVE		
Shafts C-C:	NL	DIRECT DRIVE		
Turns Open:	NL	DIRECT DRIVE		

Comments:

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
Date: 9/8/2023 **Project No.** 22-108

AIR DISTRIBUTION

SYSTEM: Existing
SUPPLY [ ] RETURN [ ] EXHAUST [X]

ROOM OR LOCATION	UNIT NUMBER	UNIT SIZE	AREAxK FACTOR	DESIGN FT/MIN	TEST FT/MIN	DESIGN CFM	TESTED CFM
	EF-1						
G15D Storage	1	10X8	0.37	811	765	300	283
	EF-3						
G15B	1	8X6	0.21	476	NA	100	101
G15C	2	10X12	0.58	690	NA	400	393
					TOTAL:	500	494
	EF-?						
G15 Elec	1	10X8	0.56	893	901	500	505

Comments: *1 Single speed direct drive fan.

Project: TRC Cambridge Courthouse Envelope Repairs
Address: 121 Third St., Cambridge, MA
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FAN DATA SHEET

	FAN NO. EF-4		FAN NO.	
Serves / Location:	Corridor & Cell	Corridor		
Manufacturer:	COOK			
Model Number:	80 DB DB-8			
Size:				
Serial Number:	025SK64663-00/0000701			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	NL		
Frame Number:	NL	NL		
Horsepower:	NL	0.25		
Brake Horsepower:	NL	NA		
Safety Factor:	NL	NL		
Volts/Phase:	115/1	115/1		
Motor Amperage:	NL	NA		
Motor RPM:	1494	DIRECT DRIVE		
Speeds:	NL	1		
Heater Size:	NL	CB		
Heater Amps.:	NL	CB		
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	750	752		
Outside Air CFM:				
Suction Pressure:	NL	-0.37		
Discharge Pressure:	NL	0.09		
Fan Static Pressure:	NL	NA		
External Pressure:	0.5	0.46		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	DIRECT DRIVE		
Motor Drive:	NL	DIRECT DRIVE		
Motor Size/Bore:	NL	DIRECT DRIVE		
Fan Drive:	NL	DIRECT DRIVE		
Fan Size/Bore:	NL	DIRECT DRIVE		
Belt Size / Number:	NL	DIRECT DRIVE		
Shafts C-C:	NL	DIRECT DRIVE		
Turns Open:	NL	DIRECT DRIVE		

Comments:

Project: TRC Cambridge Courthouse Envelope Repairs
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AIR DISTRIBUTION

SYSTEM: EF-4

SUPPLY [ ] RETURN [ ] EXHAUST [X]

ROOM OR LOCATION	UNIT NUMBER	UNIT SIZE	AREAxK FACTOR	DESIGN FT/MIN	TEST FT/MIN	DESIGN CFM	TESTED CFM
G65 MECH	1	20X6	0.83	482	500	400	415
CORRIDOR	2	7.25X5.25	0.26	481	450	125	117
CELL CORRIDOR	3	5.25X5.25	0.19	658	655	125	124
CELL CORRIDOR	4	5.25X5.25	0.19	526	505	100	96
					TOTALS:	750	752

Comments:

Project: TRC Cambridge Courthouse Envelope Repairs
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FAN DATA SHEET

	FAN NO.	EF-5	FAN NO.	
Serves / Location:	Jail Cell Exh.	Storage GC05		
Manufacturer:	COOK			
Model Number:	NL			
Size:	NL			
Serial Number:	NL			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	NL		
Frame Number:	NL	NL		
Horsepower:	NL	NL		
Brake Horsepower:	NL	NA		
Safety Factor:	NL	NL		
Volts/Phase:	115/1	115/1		
Motor Amperage:	NL	NA		
Motor RPM:	NL	DIRECT DRIVE		
Speeds:	VARIABLE	100%		
Heater Size:	NL	CB		
Heater Amps.:	NL	CB		
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	300	*1		
Outside Air CFM:				
Suction Pressure:	NL	-0.58		
Discharge Pressure:	NL	0.06		
Fan Static Pressure:	NL	NA		
External Pressure:	NL	0.64		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:		DIRECT DRIVE		
Motor Drive:	NL	DIRECT DRIVE		
Motor Size/Bore:	NL	DIRECT DRIVE		
Fan Drive:	NL	DIRECT DRIVE		
Fan Size/Bore:	NL	DIRECT DRIVE		
Belt Size / Number:	NL	DIRECT DRIVE		
Shafts C-C:	NL	DIRECT DRIVE		
Turns Open:	NL	DIRECT DRIVE		

Comments: ***1 Traverse = 475 cfm**

Inlet total = 322 cfm

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TRAVERSE DATA

SYSTEM: EF-5 TRAVERSE NUMBER : T1
Branch to G-11 A & B TRAVERSE LOCATION: Storage GC-05

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	8	" WIDTH x	8	" DEPTH	Sq Ft =	0.44

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.25	InWg.	DESIGN CFM =	200
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	341
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**341**

AIR DENSITY RATIO CORRECTION = 1.00
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	136	455					
B	748	1126					
C	1016	1127					
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 6 AVERAGE FPM = 768

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Dave Burns

Project: TRC Cambridge Courthouse Envelope Repairs
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TRAVERSE DATA

SYSTEM: EF-5 TRAVERSE NUMBER : T2
Branch to G-11 TRAVERSE LOCATION: Storage GC-05

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	8	" WIDTH x	6	" DEPTH	Sq Ft =	0.33

AIR DENSITY DATA

STATIC PRESS @ CL:	0.36	InWg.	DESIGN CFM =	100
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	112
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**112**

AIR DENSITY RATIO CORRECTION = 1.00
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	340	338					
B	349	330					
C	331	321					
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 6 AVERAGE FPM = 335

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Dave Burns

Project: TRC Cambridge Courthouse Envelope Repairs
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AIR DISTRIBUTION

SYSTEM: EF-5

SUPPLY [ ] RETURN [ ] EXHAUST [X]

ROOM OR LOCATION	UNIT NUMBER	UNIT SIZE	AREAxK FACTOR	DESIGN FT/MIN	TEST FT/MIN	DESIGN CFM	TESTED CFM
G11	1	6X6	FH	NA	NA	100	104
G11A	2	6X6	FH	NA	NA	100	109
G11B	3	8X8	FH	NA	NA	100	109
					TOTALS:	300	322

Comments: