

COMMISSIONING REPORT
STEDMAN LECTURE HALL
YORK UNIVERSITY, TORONTO, ON

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PARTNERING TO PROVIDE QUALITY CONTROL

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APPENDICIES

APPENDIX A – Commissioning Sheets

1 INTRODUCTION

This report details the results of functional performance testing of the existing HVAC systems, utilizing the existing Johnson Controls building automation system (BAS) and stand-alone controls where applicable.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Re-Opening Schools & Universities Guideline dated August 20, 2020, recommends to provide filters with a Minimum Efficiency Reporting Value (MERV) of MERV 13 or higher in air handling/ventilation systems where possible. As well as increasing ventilation run times and increasing the amount of outdoor air brought into the buildings.

The practical measures for the improvement process are generally categorized into two types: a) operation & maintenance measures and b) capital improvement measures, which will be identified throughout this report where observed during the point-to-point testing of each mechanical system and the functional testing of its associated sequence of operations.

1.1 Acronyms

OA	Outside Air
RA	Return Air
SA	Supply Air
CFM	Cubic feet per minute
PD	Pressure Drop
SF	Supply Fan
RF	Return Fan
EF	Exhaust Fan
MERV	Minimum Efficiency Reporting Value
AHU	Air Handling Unit
OAT	Outdoor Air Temperature
MAT	Mixed Air Temperature
SAT	Supply Air Temperature
DAT	Discharge Air Temperature
VFD	Variable Frequency Drive
N/A	Not Applicable
NA	Not Available

1.2 HVAC Systems

Stedman Lecture Hall is a 2 storey + basement and Penthouse Mechanical room, **XX,XXX** square foot building. The building was constructed in 1965. There have been several renovations over the years. The HVAC system consists of 2 constant air volume, recirculation air handling unit and 3 constant volume, recirculation multizone air handling units. Fifteen percent of the AHU's and teaching spaces were verified, 1 AHU and 1 lecture hall.

Miscellaneous hydronic heaters serve local areas and are locally controlled.

Miscellaneous exhaust fans serve local areas and are controlled by local switches.

2 RETRO-COMMISSIONING METHODOLOGY

The retro commissioning process for this project is based on industry standards, ASHRAE and BCxA standards.

2.1 Conducting a Site Inventory

The CxA reviewed the drawings provided to prepare an inventory of mechanical equipment within the building. We interviewed the building staff to capture any concerns they are experiencing.

2.2 Developing Systems Functional Test Procedures

The CxA developed the Functional Performance Testing (FPT) forms for each of the major system/ equipment to be commissioned. FPT forms will be based on the provided sequence of operations.

2.3 Verifying System Performance

The CxA performed various system checks and functional tests on mechanical systems as follows:

2.3.1 Sensor Checks

Verify the location and calibration of sensors. Sensors are monitoring devices within a system that measure equipment's operational conditions, such as temperature.

2.3.2 Device Checks

Verify the equipment's ability to respond correctly to a signal sent by the associated controller (whether a BAS or a local switch). *For example, when a damper is commanded to modulate via the BAS, the field observation should match the open or close signal that is sent to the damper actuator.*

2.3.3 Functional Performance Tests (FPT)

FPT follows verification that the controller or BAS is communicating correctly with the equipment. It confirms that equipment responds correctly to inputs as specified by the up-to-date sequence of operations. *For example, if the discharge temperature falls below the discharge air temperature setpoint, the sequence of operation may call for the heating valve to modulate open until the discharge air setpoint is satisfied.*

2.4 Reporting & Prioritizing Issues and Opportunities to the Owner

Following verification of system performance, the CxA prepared a report outlining issues exposed through the commissioning process. This report will document issues found, planned resolutions, and priority of resolutions.

3 OWNER'S OPERATING REQUIREMENTS

Requirement	Classrooms / Office Space	Mechanical / Electrical / Storage	
Space Temperature – Heating	Occupied: 21.5°C Unoccupied: NA	N/A	
Space Temperature – Cooling	Occupied: 22.5°C (est.) Unoccupied: n/a	N/A	
Humidity	NA	N/A	
Ventilation (Outdoor Air)	10% of SF volume	N/A	
Max. CO2 Level	N/A	N/A	

4 TESTING, OBSERVATIONS AND RECOMMENDATIONS - HVAC

4.1 AIR HANDLING UNIT – AHU-3

4.1.1 Design Intent and System Description

System: AHU-3, serves Seminar 107, Lecture Hall E and Lecture Hall F.

Location: Mechanical Room, 201A

Service: Provides tempered ventilation air to the above noted areas.

System Description: A contact volume, recirculation multi zone, air handling unit with hot and cold deck provides tempered ventilation. The unit consists of the following:

- Common outdoor air with steam preheat coil
- Supply fan and vfd
- Return fan and vfd
- Steam heating coil
- Cooling coil

Supply Fan: NA CFM @ NA inches
NA HP fan motor

Return Fan: NA CFM @ NA inches
NA HP fan motor

Heating Coil: Unknown

Steam: NA

Air: Entering / Leaving: unknown

Cooling Coil: Unknown

Water: NA GPM @ NA ft. w.c.
EWT: n/a°F, LWT: n/a°F

Air: Entering / Leaving: unknown

4.1.2 Sequence of Operations

See the attached testing form.

4.1.3 Time of Day Schedule

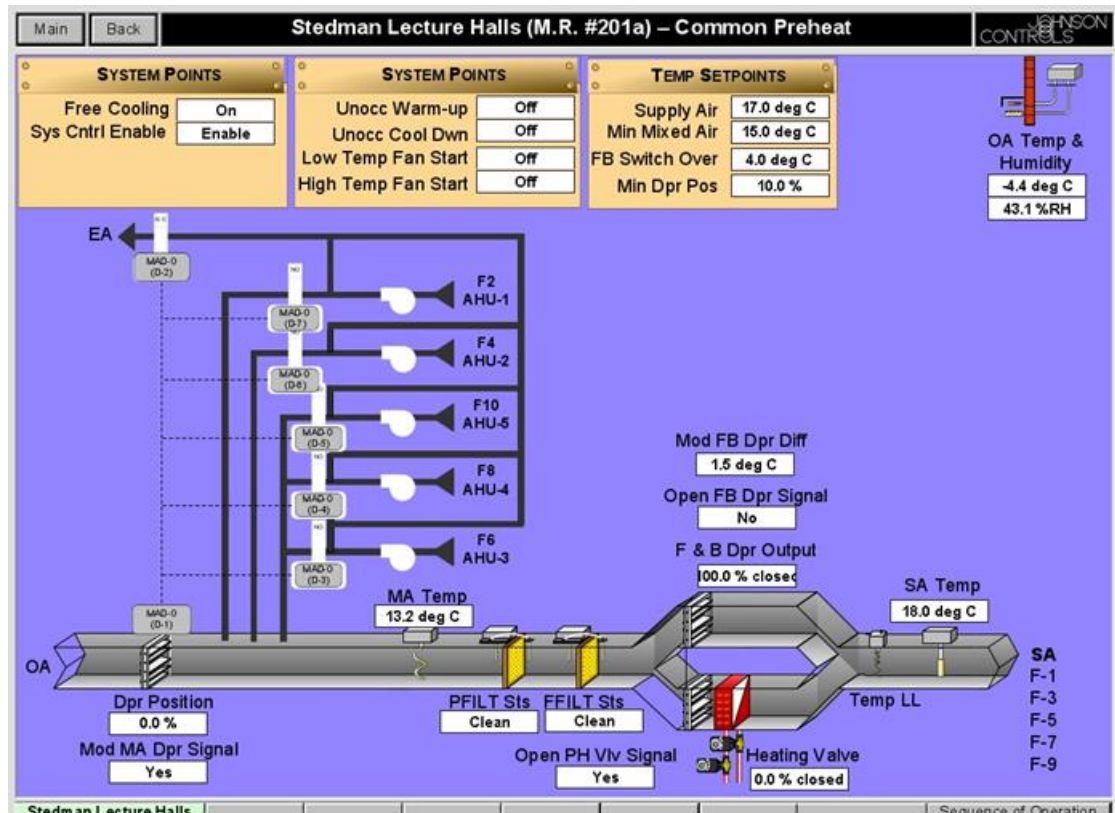
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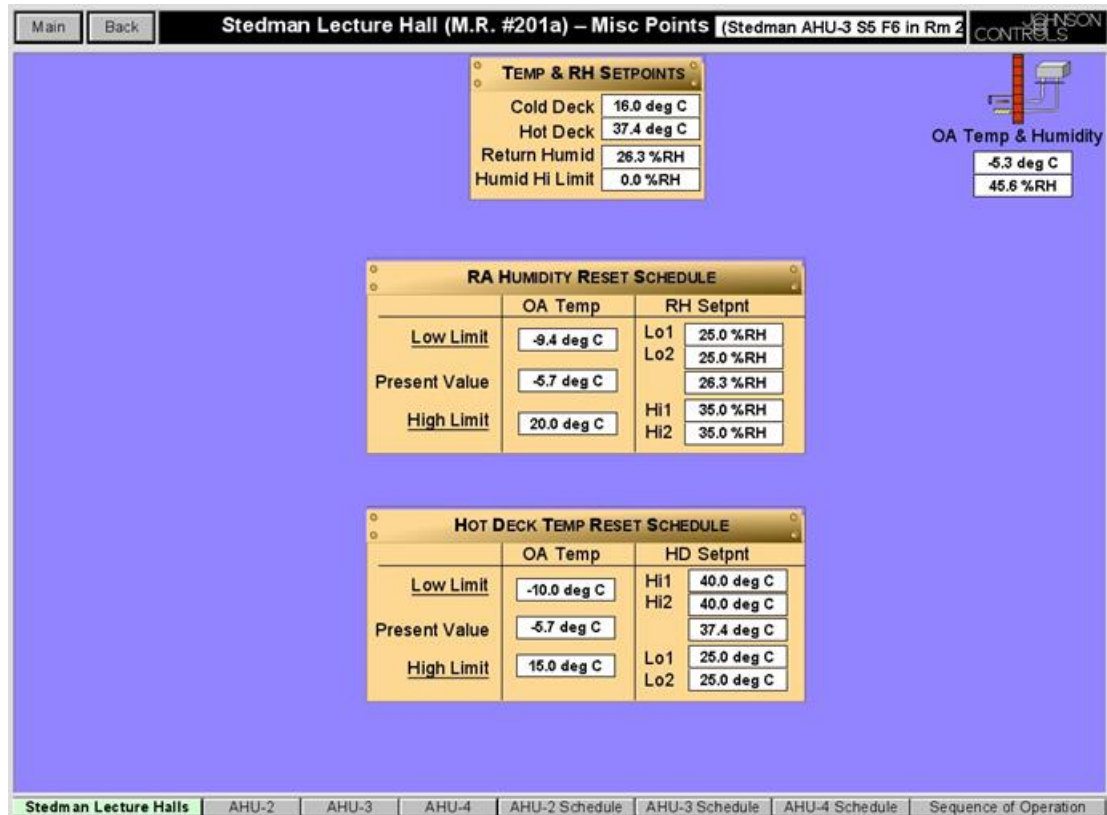
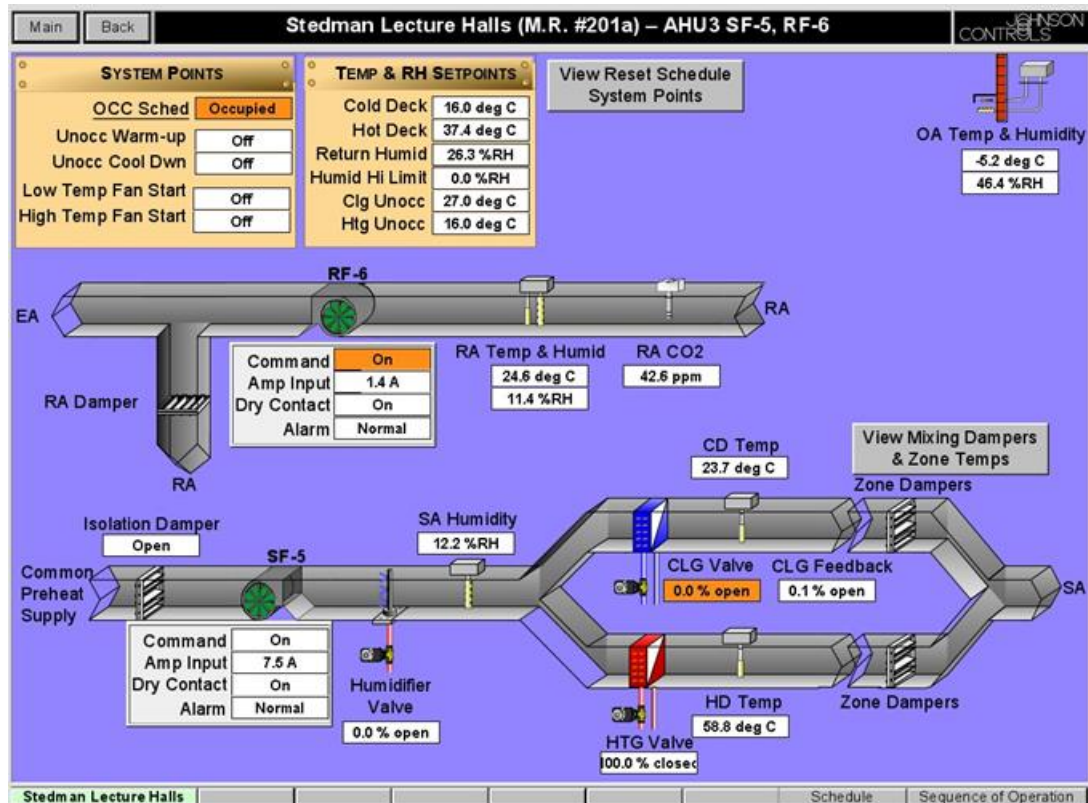
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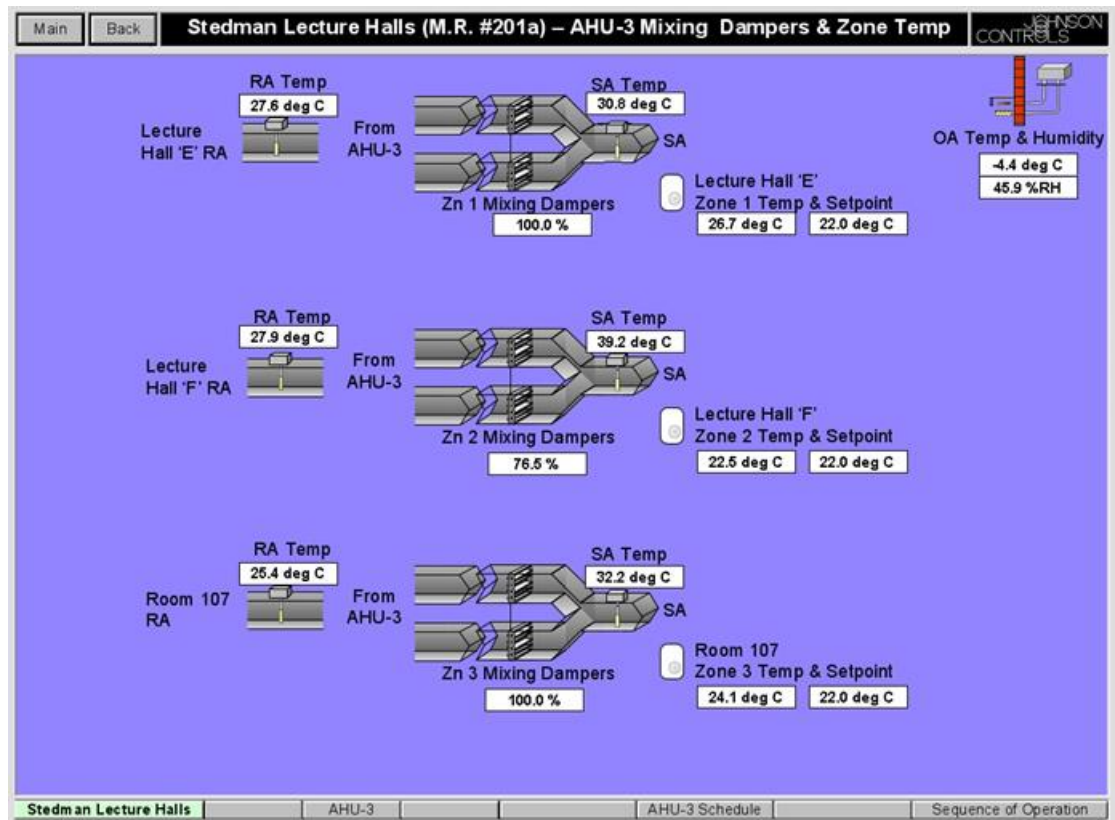
4.1.4 Setpoints

Hot Deck Setpt	reset from outdoor temperature
Cold Deck Setpt	16 degC

4.1.5 BAS Graphic







4.1.6 Recommendations / System Improvements

Repairs		
No.	Issue	Solution
1	The common OA damper did not close completely when commanded.	To be repaired.
	The preheat coil steam valve appears to be passing.	To be replaced / replaced.
	The heating steam valve appears to be passing.	To be replaced / replaced.

Adjustments		
No.	Issue	Solution
1	The unit is currently running 24 hours per day, 7 days per week.	Use time of day scheduling to start the air handling equipment based on space occupancy. Start the units 2 hours before occupancy.

4.2 TEACHING SPACES

4.2.1 Design Intent and System Description

System:	Multi zone unit with zone dampers
Location:	Various areas throughout the building
Service:	BAS and local heating and temperature control
System Description:	The spaces are heated and cooled by modulating the zone dampers on the hot and cold decks at the units.

4.2.2 Sequence of Operations

The zone dampers are modulated to maintain the space temperature setpoint. On a call for heating the damper opens to the hot deck and closes to the cold deck. On a call for cooling the damper closes to the hot deck and opens to the cold deck.

4.2.3 Time of Day Schedule

Based on the AHU TOD schedule.
N/A – Radiation heating, UH, and Entrance Heaters operate on local controls.

4.2.4 Recommendations / System Improvements

Repairs		
No.	Issue	Solution
	The spaces are overheating.	Ensure the zone dampers are operating correctly. And verify the BAS program is correct.

Adjustments		
No.	Issue	Solution
	NA	NA



Pre-Functional Verification / Functional Test Procedure

Project:	Stedman Lecture Hall, York University
System:	AHU-3, Room 201A, serving Seminar 107, Lecture Hall E and Lecture Hall F.
Date of Test:	February 23, 2022

Visual Inspection

MERV Filters Installed

X

Comments

We were unable to verify the AHU temperature sensors as there was not access.
The common outdoor air damper operation was verified. The OA damper did not close completely when commanded. There was no access to the return air or AHU OA damper.

Supply Fan Data:

Return Fan Data:

Temperature Sensor Verification

	BAS	Actual
RAT	24.6	N/A
Preheat DAT	18.0	26.0
HDT	58.8	N/A
CDT	23.7	N/A

Damper control

The damper control was verified.

Heating control

Not verified.



AHU-1 Control Sequence

All BAS commands are to be selected and initiated via the BAS.

1.0 Equipment Enable

Unit enabled on time of day schedule or if room temperature falls below the night setpoint during unoccupied periods. YES NO

Comments:

The unit is currently operating 24/7.

1.1 Mixed Air Dampers

Dampers are closed to outside air during unoccupied periods when fan is off. YES NO

During occupied periods, dampers modulate in sequence with the heating valve to maintain discharge air temperature at setpoint. YES NO

Dampers will not close beyond the user adjustable minimum damper setting of 5%. YES NO

Comments:

The common OA dampers did not close completely when commanded to 0%
We were unable to verify the operation of the RA, EA or the unit OA dampers.

1.2 Pre Heat Coil

The face and bypass dampers and preheat coil control valve are modulated to maintain preheat temperature. YES NO

Comments:

The preheat valve was closed but the preheat discharge temperature was 26 degC. The preheat temperature sensor was not reading correctly.

1.3 Hot Deck

During the heating season, the heating valve modulates to maintain the hot deck discharge air setpoint. YES NO

Hot deck discharge air setpoint is reset based on the outdoor air temperature as per the schedule below. YES NO

Initial values are:

OAT	HDT
-10.0 degC	40.0 degC



15.0 degC

25.0 degC

Comments:

The heating valve was commanded closed but the HDT was above setpoint..

1.3 **Cold Deck**

The cooling valve modulates to maintain the cold deck discharge air setpoint. YES NO

Cold deck discharge air setpoint is reset based on the zone temperature as per the schedule below. YES NO

The setpoint is: YES NO
16.0 degC

Comments:

1.4 **System Alarms**

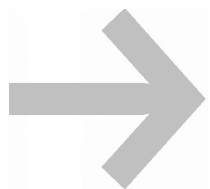
The building automation system will initiate an alarm under the following conditions:

- If fan status is lost for more than 1 minute during equipment operation indicating equipment failure. YES NO

Comments:

END OF FUNCTIONAL TESTING – Return the system to the required operating mode.

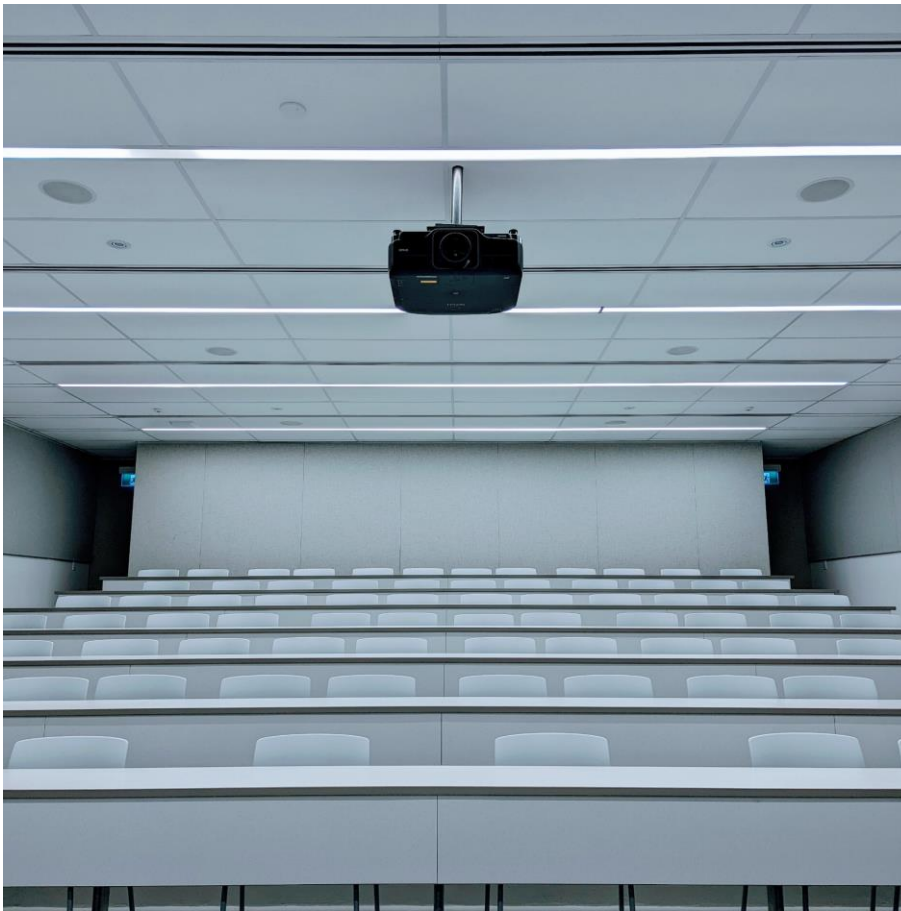
<u>Attested By:</u>	<u>Name</u>	<u>Signature</u>	<u>Date</u>
Mechanical Contractor:	_____	_____	_____
Controls Contractor:	_____	_____	_____
CFMS Consulting:	_____	_____	_____



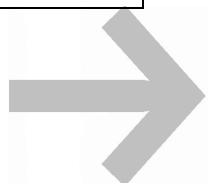
Pre-Functional Verification / Functional Test Procedure

Project:	Stedman Lecture Hall, York University
Date of Test:	February 23, 2022

Lecture Hall E *served by AHU 3*



	<u>BAS</u>	<u>Actual</u>
Space Temperature	26.5 degC	26.1 degC
SAT	30.8 degC	N/a
Air Flow reading	N/A	N/A
Air Flow L/s (from Mechanical Dwg)	N/A	5300cfm (2501 L/s)
Room Volume	N/A	Not measured (35,200 est)
Air changes per hour	N/A	9 (est)



Comments

The space has been renovated. The above air flow was taken from the original mechanical drawings. The room volume was calculated by scaling the original mechanical drawings and assuming an average ceiling height of 20 ft. If the ceiling height were 30 ft with the same assumptions, the ACH would be 6.

The space temperature setpoint was 22 degC. The space temperature was 26.5 degC. The zone dampers are not controlling correctly.

