AABC Commissioning Group

AIA Provider Number 50111116

Preserving the World's Art and Artifacts through Existing Building Commissioning

Course Number: CXENERGY1724

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April 27, 2017

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Course Description

Installing a cutting-edge HVAC system goes a long way in successfully controlling temperature and relative humidity in any space, but there are still opportunities for complications to arise. The Brooklyn Museum, one of the oldest and largest museums in the U.S., experienced the challenges associated with gallery climate control following a phased renovation project. To diagnose the issues leading to unstable temperature and relative humidity in gallery spaces, an Existing Building Commissioning (EBCx) process was successfully implemented on their gallery HVAC systems.

Learning Objectives

At the end of this course, participants will be able to:

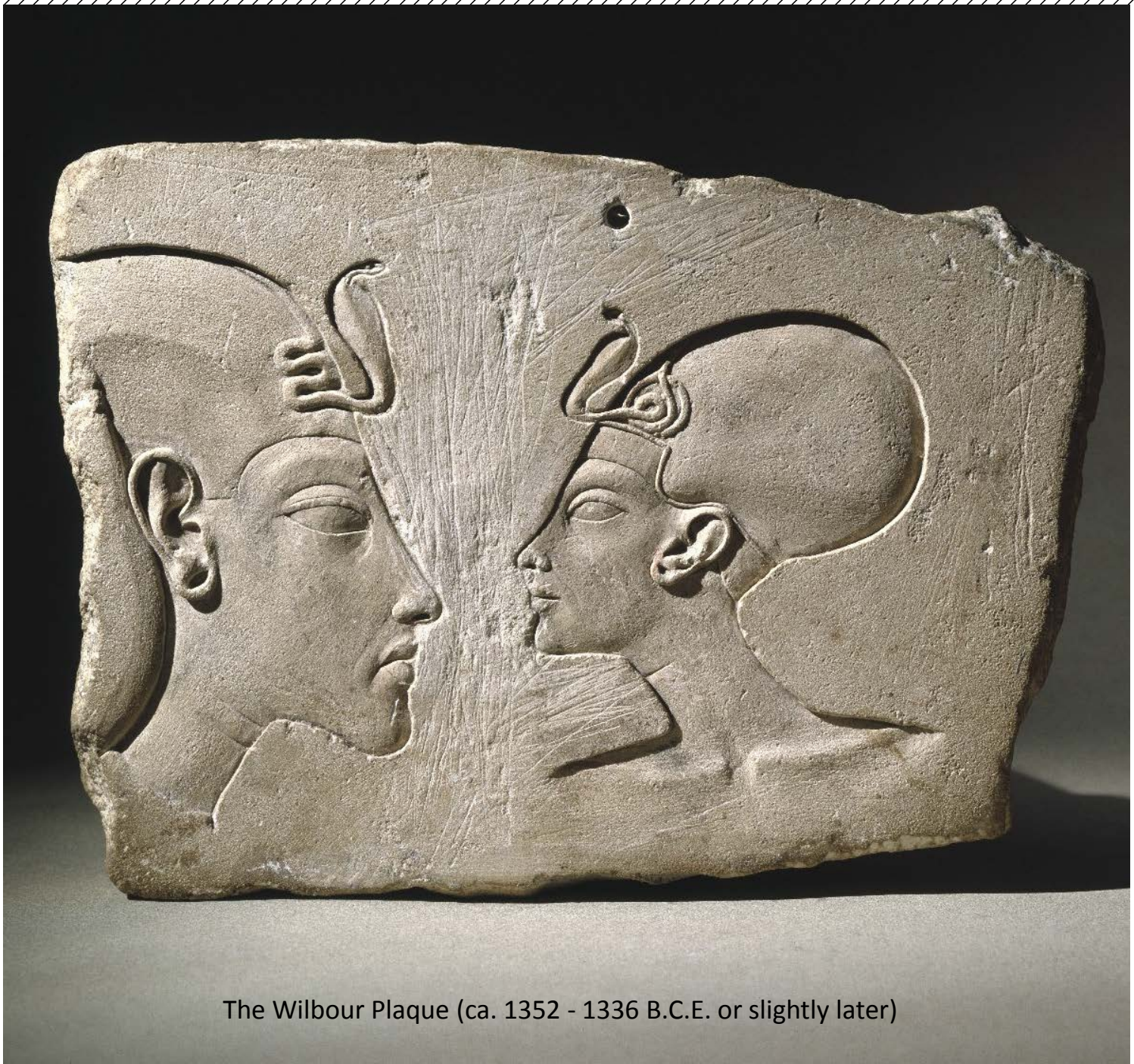
1. Identify how structured phasing during construction leads to gaps in mechanical and electrical system operation.

2. Identify common construction shortcuts taken and the process by which to remedy the deficiencies found.

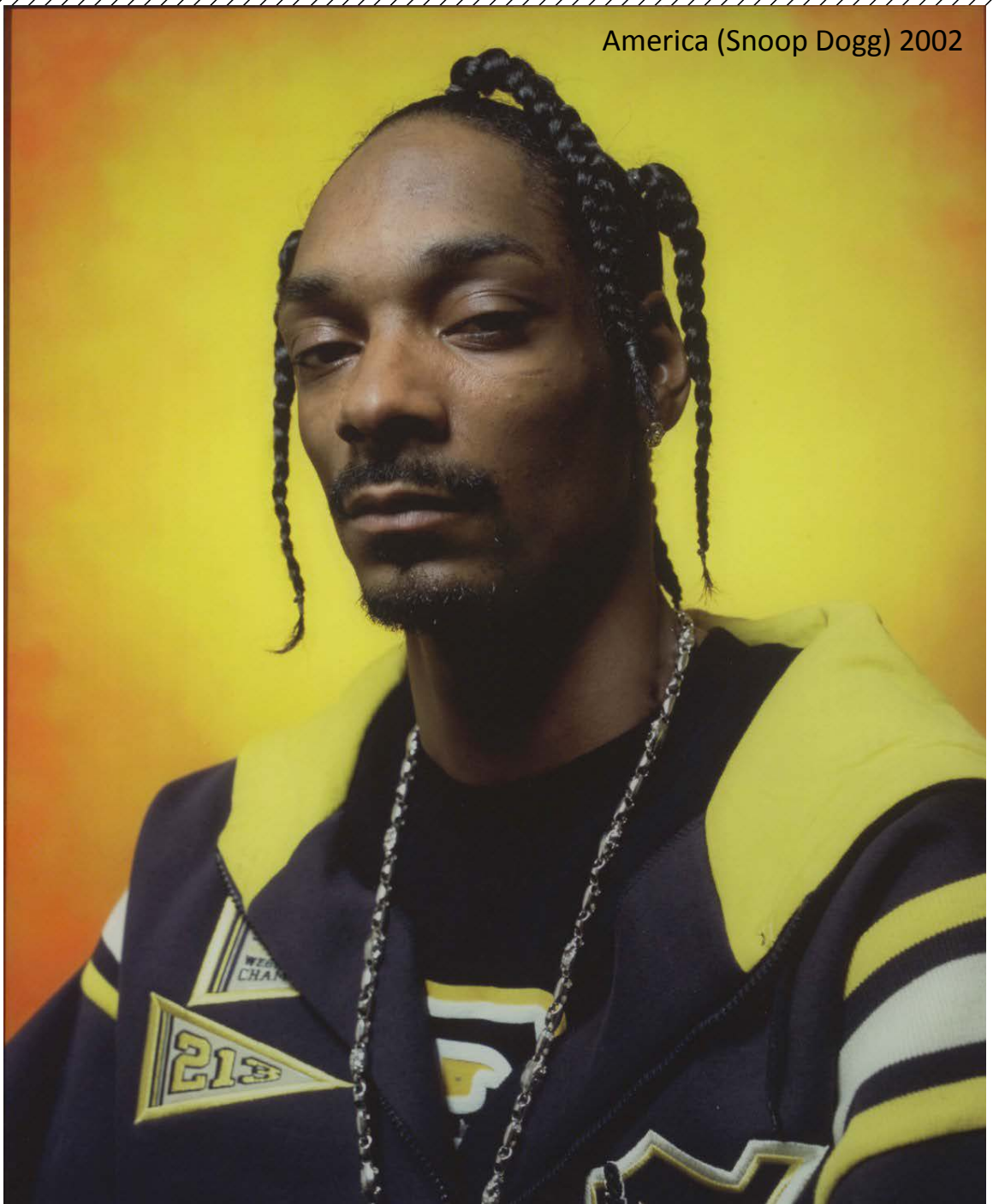
3. Understand the importance of systematic testing.

4. Identify inconsistencies in system operation through monitoring, which can identify potential underlying deficiencies.

Bowl with Peacock Motif (ca. 1200 - 1230)



The Wilbour Plaque (ca. 1352 - 1336 B.C.E. or slightly later)



America (Snoop Dogg) 2002

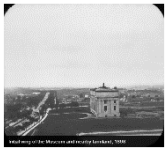

CONTINUING EDUCATION
AIA

Project Background:
Brooklyn Museum

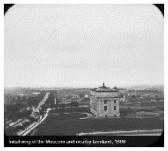
One of the Oldest and Largest Art Museums in the United States

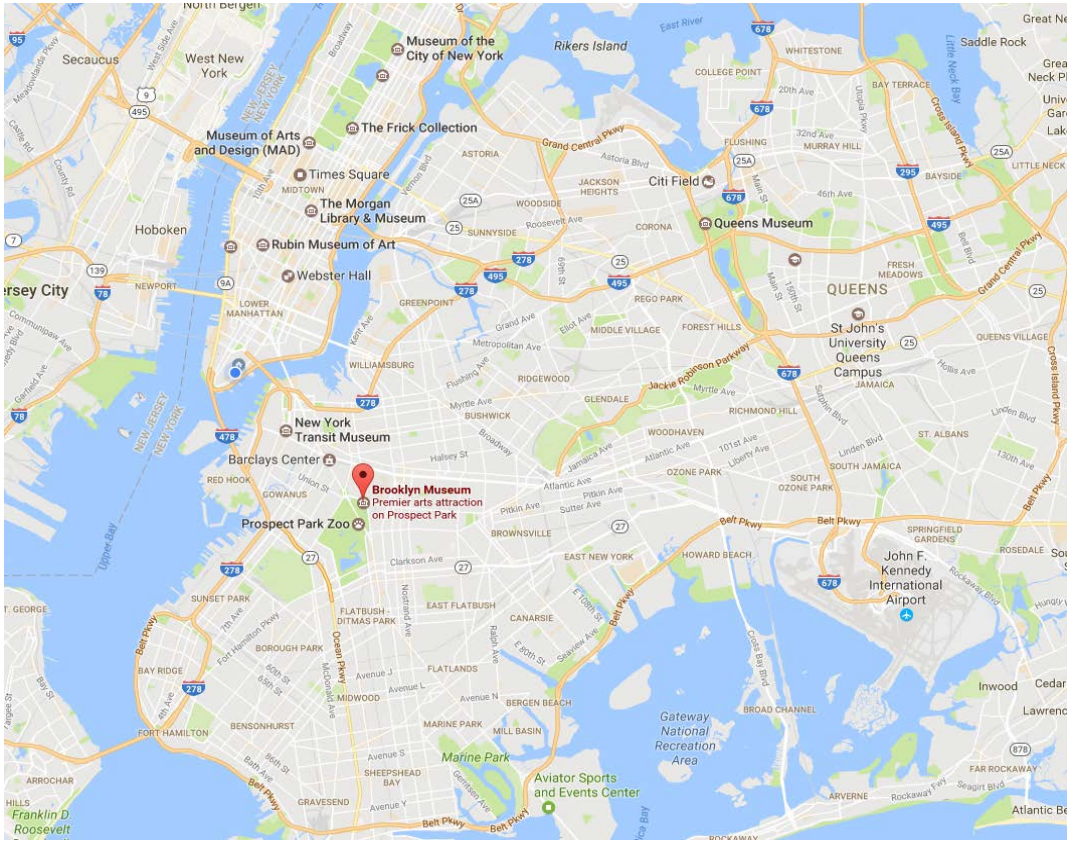
- Originally part of a larger vision: The Brooklyn Institute of Arts and Sciences
- Museum division became known as Brooklyn Museum
    - Built in phases starting in the 1890's
- Home to an extensive collection, both on display and in holding
- Long history of renovations and improvements to the base building to support the conservation of the collection
    - 2001 - Present: Redesigned galleries

Project Background:
Brooklyn Museum


Project Background:
Brooklyn Museum

Project Background:
Brooklyn Museum





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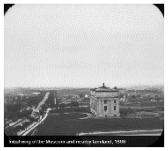


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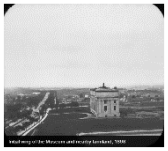


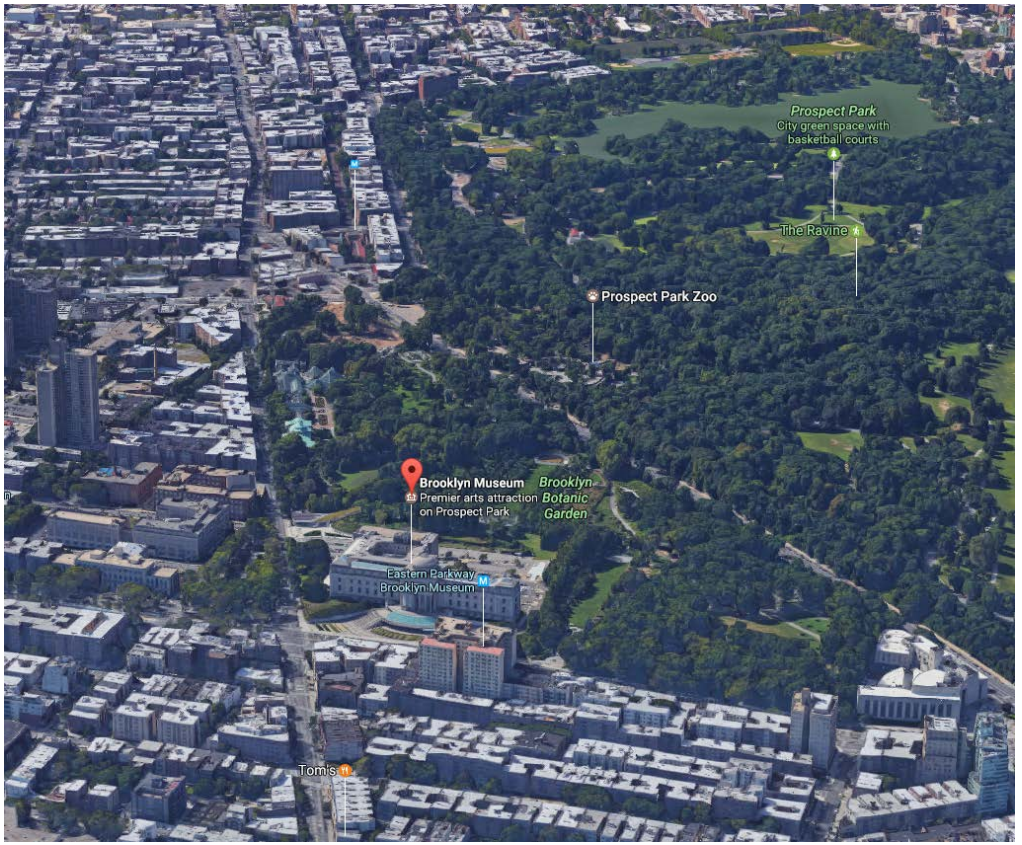

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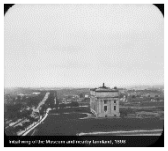
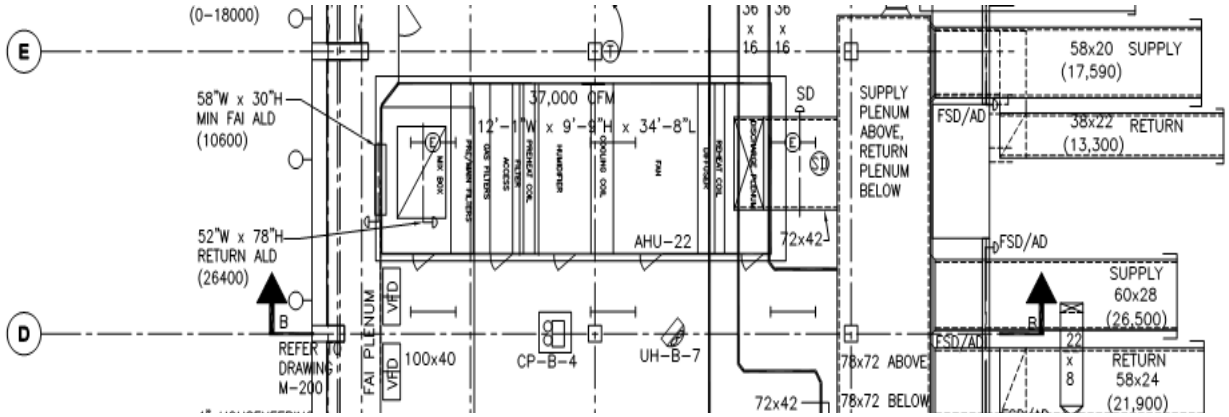



Project Background: Brooklyn Museum

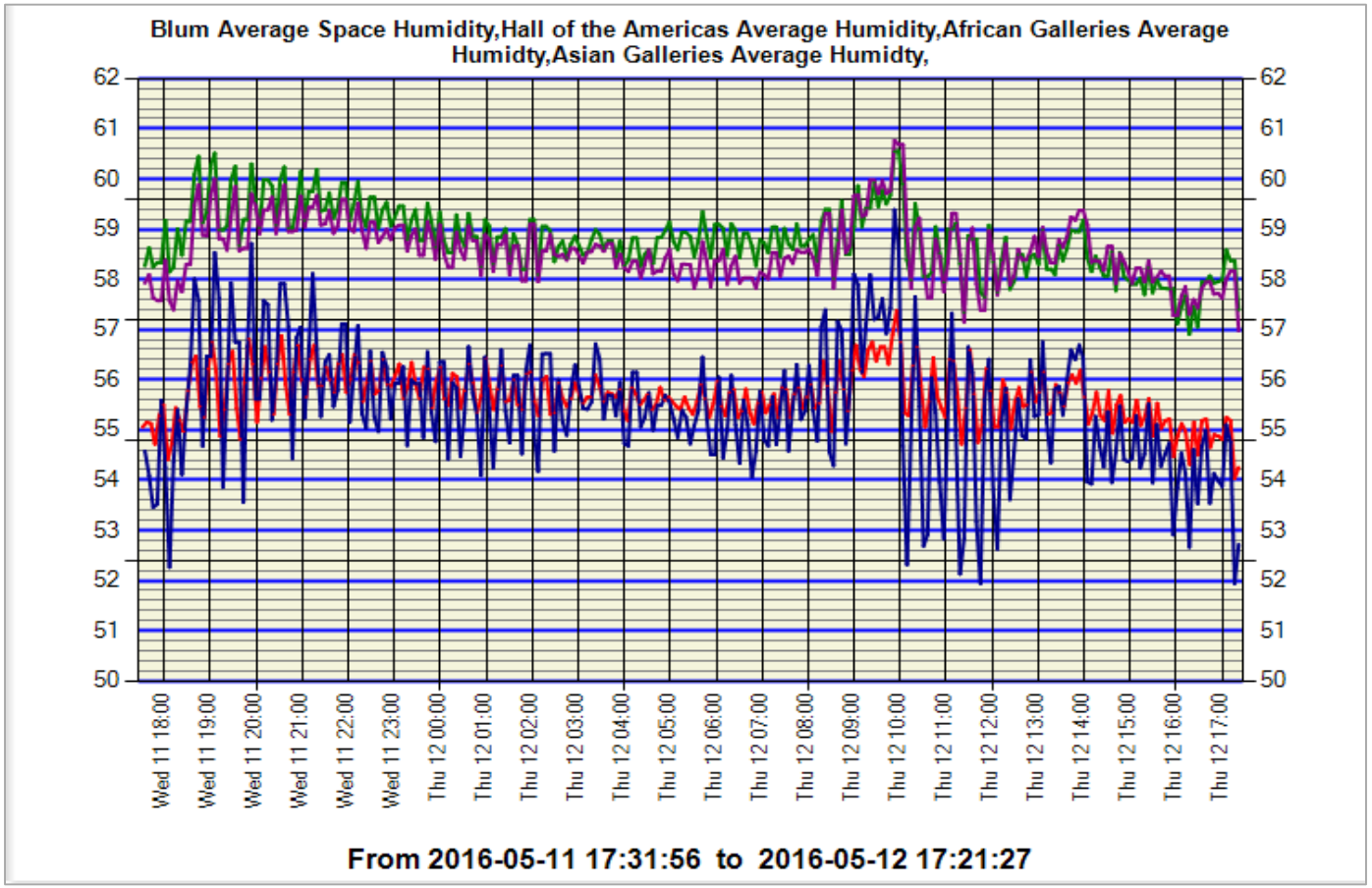
Gallery HVAC Upgrades from 2008 - 2016



- New centralized custom-built air distribution system
  - Headered variable air volume AHU's with RF's
  - Network of VAV's with hot water reheat capabilities
  - Automated temperature controls with monitoring
- Multiple phases completed by different teams of CM's, Contractors, Balancers
- System startup and implementation in phases to keep Museum in operation

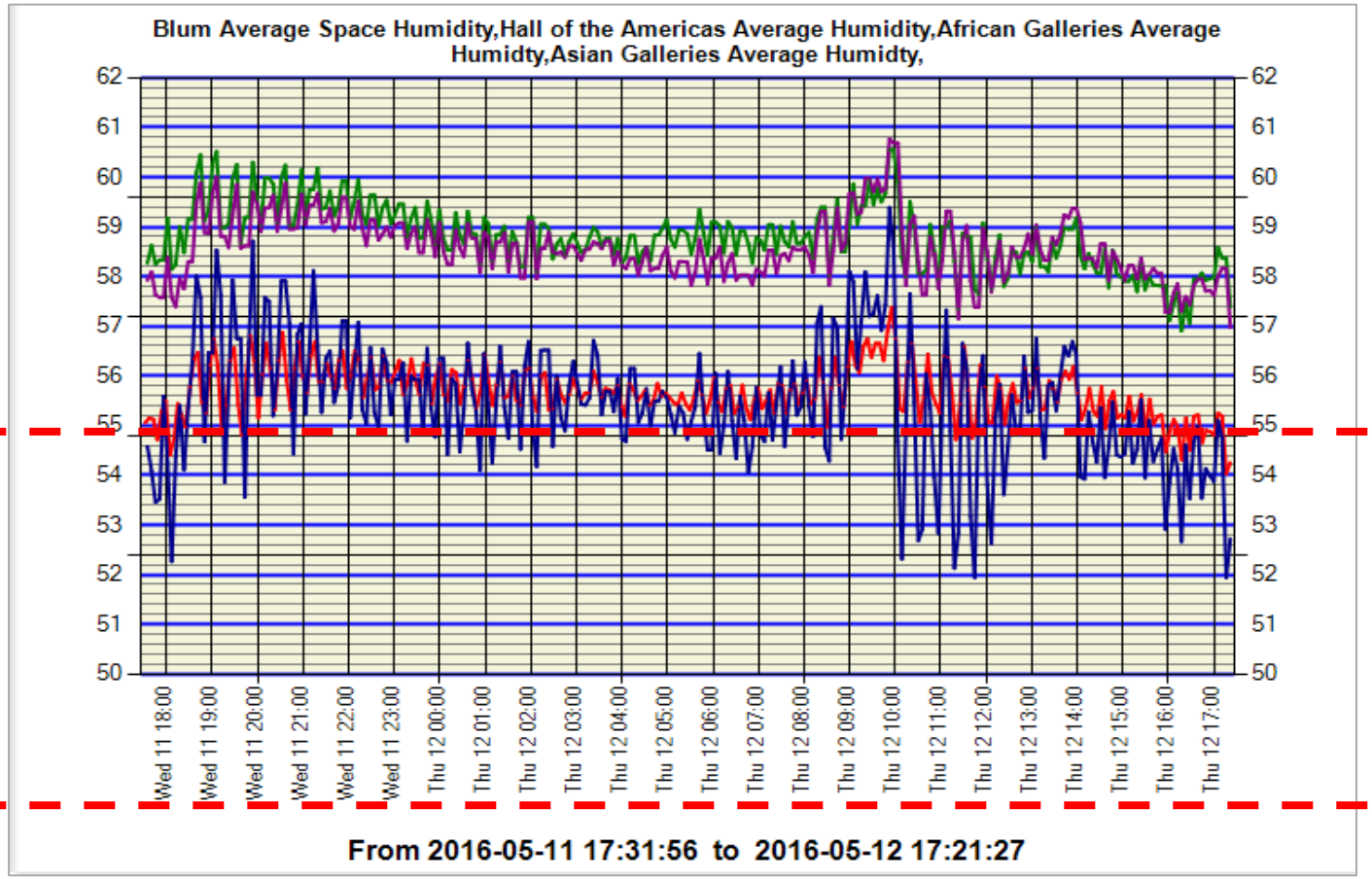
Project Background:
Brooklyn Museum

Humidity Concerns After Systems Are Turned Over



Project Background: Brooklyn Museum

Humidity Concerns After Systems Are Turned Over



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Existing Building Commissioning (EBCx) Process - Overview

Brooklyn Museum Hires JB&B for EBCx of Gallery Air Distribution System

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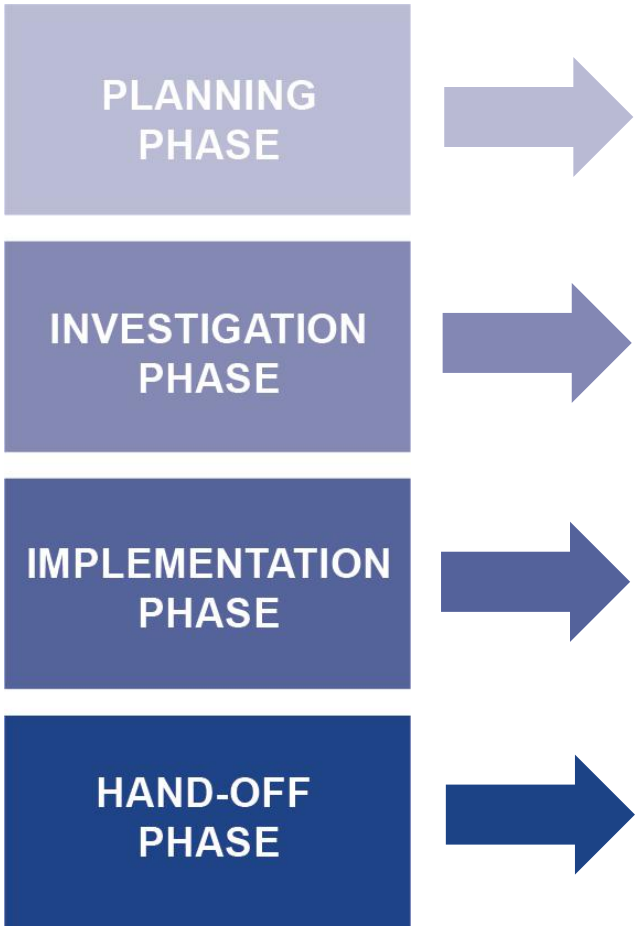
Brooklyn Museum Hires JB&B for EBCx of Gallery Air Distribution System



- Meet with Museum staff
- Try to understand existing conditions and operations

Existing Building Commissioning (EBCx) Process - Overview

Brooklyn Museum Hires JB&B for EBCx of Gallery Air Distribution System

PLANNING PHASE

- Meet with Museum staff
- Try to understand existing conditions and operations

INVESTIGATION PHASE

- Visual inspections
- Sensor accuracy verification
- Functional testing
- Balancing verification

IMPLEMENTATION PHASE

HAND-OFF PHASE

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- Identify corrective actions
- Implement corrective actions
- Verify outcomes

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- Implement corrective actions
- Verify outcomes

HAND-OFF PHASE

- Develop preventative maintenance plans

Existing Building Commissioning (EBCx) Process - Planning Phase

- Meet with Museum staff
- Try to understand existing conditions and operations

Existing Building Commissioning (EBCx) Process - Planning Phase

CFR and Review of Existing Documentation

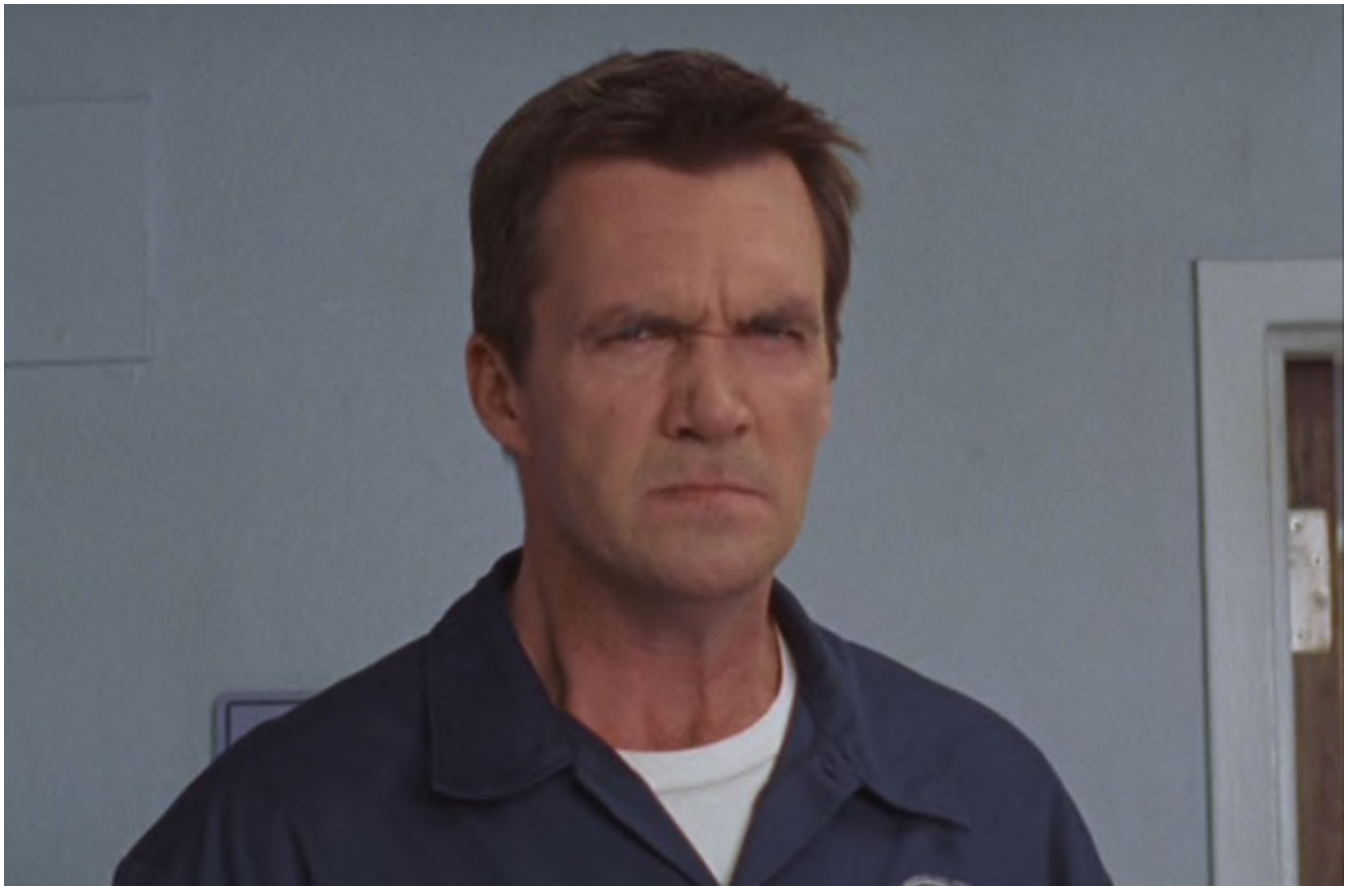
- No CFR but need to understand space requirements/deliverables
- Review of EOR design drawings from various phases
- Interviews with museum staff and BMS service provider
- Initial site walk-through
- Creation of EBCx plan

Existing Building Commissioning (EBCx) Process - Planning Phase

Challenges/Limitations: Documentation (or Lack Thereof)

Existing Building Commissioning (EBCx) Process - Planning Phase

Challenges/Limitations: O&M Staff



Existing Building Commissioning (EBCx) Process - Planning Phase

Challenges/Limitations: Equipment Degradation

Existing Building Commissioning (EBCx) Process - Planning Phase

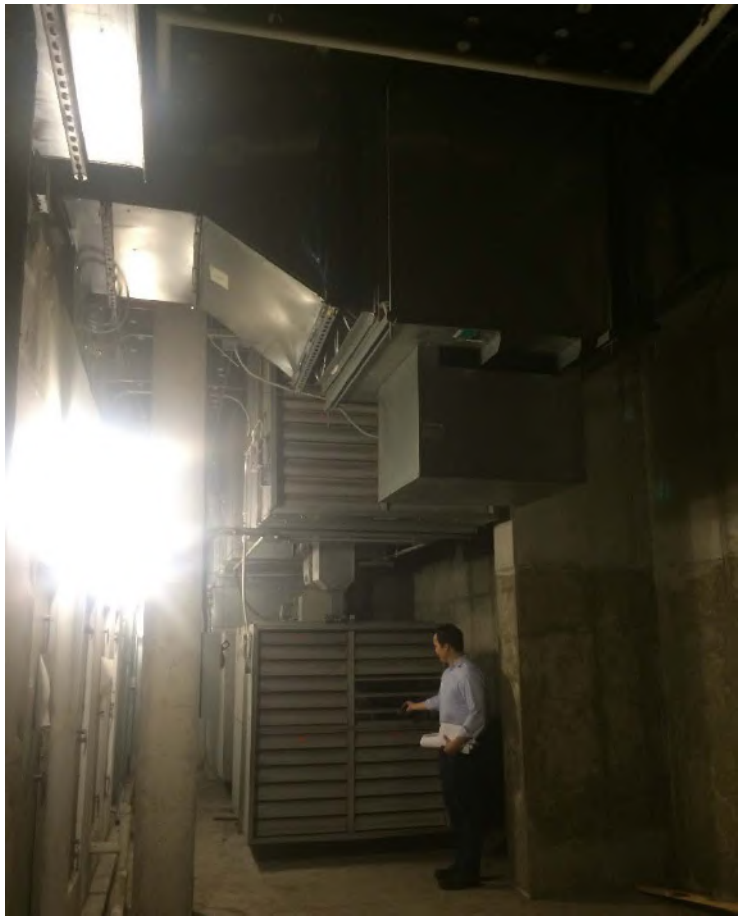
Challenges/Limitations: Equipment Degradation

Existing Building Commissioning (EBCx) Process - Investigation Phase

- Visual inspections
- Sensor accuracy verification
- Functional testing
- Balancing verification

Existing Building Commissioning (EBCx) Process - Investigation Phase

Visual Inspections



Existing Building Commissioning (EBCx) Process - Investigation Phase

Sensor Accuracy Verification

- Temperature/humidity control at AHU's is only as good as the data at controlling devices
- Visited every temperature- and humidity-controlling sensor
- Compared measured value with BMS value
  - Utilized a calibrated temperature/humidity device
  - Temperature within +/- 5% of device reading
  - Humidity within +/- 2% of device reading

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Sensor Calibration Verification for the Brooklyn Museum

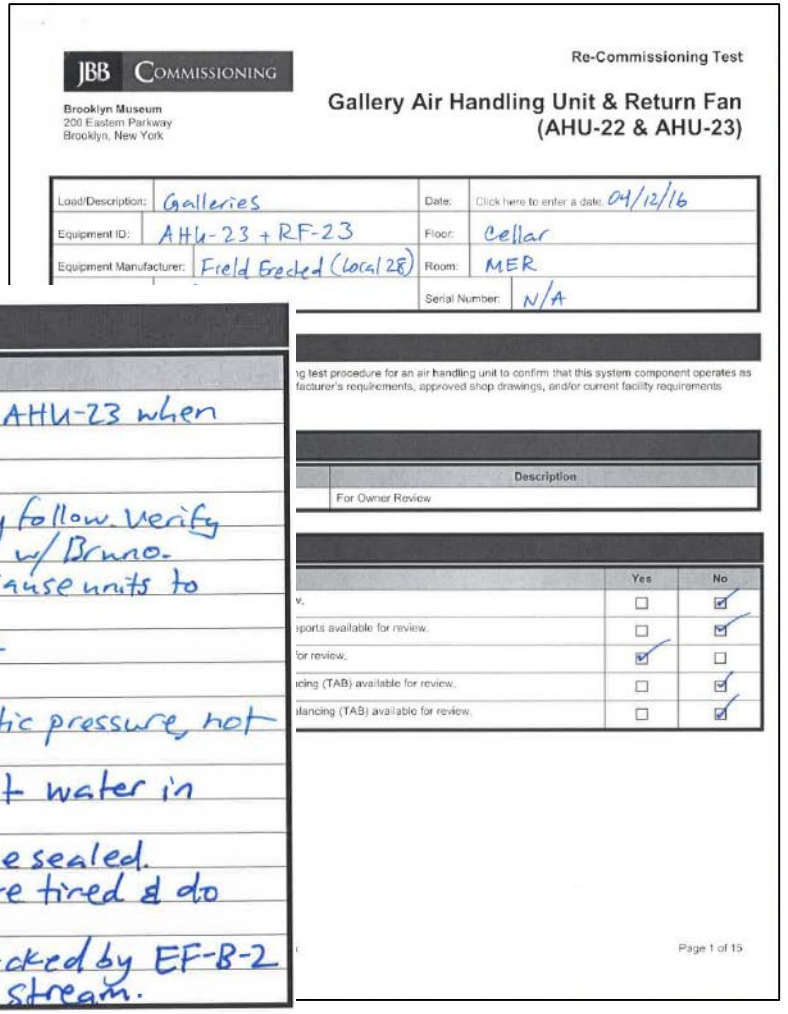
Equipment ID	Sensor Type	Service	Controlling Sensor	Verifying Agency	Status	Date Verified	Remote Value (BMS)	Measured Value (Calibrated Device)	AVG	Delta	Acceptable Min	Acceptable Max	Pass
RF-22	Temp Sensor	Common Return Air Plenum	Y	JBB	Verified	4/12/2016	54.78	72.56		17.78	68.93	76.19	FALSE
RF-22	Humidity Sensor	Common Return Air Plenum	Y	JBB	Verified	4/12/2016	39.37	38.46		0.91	36.46	40.46	TRUE
AHU-22	Temp Sensor	Preheat Discharge Lower	Y	JBB	Verified	4/12/2016		63.60					
AHU-22	Temp Sensor	Preheat Discharge Middle	Y	JBB	Verified	4/12/2016	55.00	69.20	68.30	13.30	60.42	71.72	FALSE
AHU-22	Temp Sensor	Preheat Discharge Upper	Y	JBB	Verified	4/12/2016		72.10					
AHU-22	Temp Sensor	Cooling Coil Discharge	Y	JBB	Verified	4/12/2016	58.40	72.50		14.10	68.88	76.13	FALSE
AHU-22	Temp Sensor	Supply Air	Y	JBB	Verified	4/12/2016	55.90	72.50		16.60	68.88	76.13	FALSE
AHU-22	Humidity Sensor	Supply Air	Y	JBB	Verified	4/12/2016	38.80	34.40		4.40	32.40	36.40	FALSE
AHU-22	Static Pressure Sensor	Duct Static at Fan Discharge	Y	JBB	Verified	4/12/2016	2.74	2.80		0.06	2.66	2.94	TRUE
AHU-22	Static Pressure Sensor	Duct Static 2/3 Down Duct	Y	Balancer									
AHU-22	Airflow Station	Supply Air	Y	Balancer									
AHU-22	Airflow Station	Return Air	Y	Balancer									
AHU-22	CO2 Sensor	Return Air	N	JBB			507.00	TBD					
RF-23	Temp Sensor	Common Return Air Plenum	Y	JBB	Verified	4/12/2016	73.00	71.90		1.10	68.31	75.50	TRUE
RF-23	Humidity Sensor	Common Return Air Plenum	Y	JBB	Verified	4/12/2016	47.00	44.50		2.50	42.50	46.50	FALSE
AHU-23	Temp Sensor	Preheat Discharge Lower	Y	JBB	Verified	4/12/2016		59.50					
AHU-23	Temp Sensor	Preheat Discharge Middle	Y	JBB	Verified	4/12/2016	58.00	58.60	59.37	1.37	56.53	62.34	TRUE
AHU-23	Temp Sensor	Preheat Discharge Upper	Y	JBB	Verified	4/12/2016		60.00					
AHU-23	Temp Sensor	Cooling Coil Discharge	Y	JBB	Verified	4/12/2016	67.10	65.10		2.00	61.85	68.36	TRUE
AHU-23	Temp Sensor	Supply Air	Y	JBB	Verified	4/12/2016	73.50	71.50		2.00	67.93	75.08	TRUE
AHU-23	Humidity Sensor	Supply Air	Y	JBB	Verified	4/12/2016	57.80	47.80		10.00	45.80	49.80	FALSE
AHU-23	Static Pressure Sensor	Duct Static at Fan Discharge	Y	JBB	Verified	4/12/2016	2.60	2.70		0.10	2.57	2.84	TRUE
AHU-23	Static Pressure Sensor	Duct Static 2/3 Down Duct	Y	Balancer									
AHU-23	Airflow Station	Supply Air	Y	Balancer									
AHU-23	Airflow Station	Return Air	Y	Balancer									
AHU-23	CO2 Sensor	Return Air	N	JBB			508.00	TBD					
VAV-B-21	Temp Sensor	African Galleries/Hall of the Americas	Y	JBB	Verified	4/18/2016	74.80	72.50		2.3	68.88	76.13	TRUE
	Humidity Sensor		Y	JBB	Verified	4/18/2016	55.00	54.00		1	52.00	56.00	TRUE
	Airflow Sensor		Y	Balancer									
VAV-B-18	Temp Sensor	African Galleries	Y	JBB	Verified	4/18/2016	73.65	69.80		3.85	66.31	73.29	FALSE
	Humidity Sensor		Y	JBB	Verified	4/18/2016	58.70	56.30		2.4	54.30	58.30	TRUE
	Airflow Sensor		Y	Balancer									
VAV-B-34	Temp Sensor	African Galleries	Y	JBB	Verified	4/18/2016	71.70	70.10		1.6	66.60	73.61	TRUE
	Humidity Sensor		Y	JBB	Verified	4/18/2016	63.50	56.20		7.3	54.20	58.20	FALSE
	Airflow Sensor		Y	Balancer									
HoA Zone 1	Temp Sensor	Hall of the Americas	Y	JBB	Verified	4/18/2016	73.30	71.40		1.9	67.83	74.97	TRUE
	Humidity Sensor		Y	JBB	Verified	4/18/2016	39.00	52.10		13.1	50.10	54.10	FALSE
	Airflow Sensor		Y	Balancer									
HoA Zone 2	Temp Sensor	Hall of the Americas	Y	JBB	Verified	4/18/2016	72.60	70.30		2.3	66.79	73.82	TRUE
	Humidity Sensor		Y	JBB	Verified	4/18/2016	48.50	56.20		7.7	54.20	58.20	FALSE
	Airflow Sensor		Y	Balancer									
HoA Zone 3	Temp Sensor	Hall of the Americas	Y	JBB	Verified	4/18/2016	72.80	71.60		1.2	68.02	75.18	TRUE
	Humidity Sensor		Y	JBB	Verified	4/18/2016	44.90	52.10		7.2	50.10	54.10	FALSE
	Airflow Sensor		Y	Balancer									
VAV-B-22/23	Temp Sensor	Asian Galleries	Y	JBB	Verified	4/18/2016	74.50	71.70		2.8	68.12	75.29	TRUE
	Humidity Sensor		Y	JBB	Verified	4/18/2016	58.20	55.20		3	53.20	57.20	FALSE
	Airflow Sensor		Y	Balancer									
VAV-B-16/17/19	Temp Sensor	Asian Galleries	Y	JBB	Verified	4/18/2016	74.70	71.60		3.1	68.02	75.40	TRUE
	Humidity Sensor		Y	JBB	Verified	4/18/2016	56.70	53.40		3.3	51.40	55.40	FALSE
	Airflow Sensor		Y	Balancer									

* Temperature sensors must be within +/- 5% of the calibrated test gauge value.

* Humidity sensors must be within +/- 2% RH of the calibrated test gauge value.

Existing Building Commissioning (EBCx) Process - Investigation Phase

Functional Testing of Individual Assets



JBB COMMISSIONING

Re-Commissioning Test

Brooklyn Museum
200 Eastern Parkway
Brooklyn, New York

Gallery Air Handling Unit & Return Fan (AHU-22 & AHU-23)

Load/Description:	Galleries	Date:	Click here to enter a date. 04/12/16
Equipment ID:	AHU-23 + RF-23	Floor:	Cellar
Equipment Manufacturer:	Field Erected (Local 28)	Room:	MER
		Serial Number:	N/A

g test procedure for an air handling unit to confirm that this system component operates as facturer's requirements, approved shop drawings, and/or current facility requirements

	Description
	For Owner Review

	Yes	No
v.	☐	☑
eports available for review.	☐	☑
for review.	☑	☐
ncing (TAB) available for review.	☐	☑
alancing (TAB) available for review.	☐	☑

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3.0 NOTES AND COMMENTS

Item #	Comments
NOTE	AHU-22 is the Lead/Master unit & controls AHU-23 when in operation.
(1)	~~OA damper is wrecked.~~
(2)	AHU-22 ramps up first w/ AHU-23 to quickly follow. Verify Both shouldn't ramp @ exactly the same rate w/ Bruno.
(3)	Each unit has its own set of sensors - may cause units to run in separate modes.
(4)	AHU-23 humidifies while AHU-22 does not ↳ 76% 12H vs 37% RH
(5)	System always controls to AHU-22 duct static pressure, not lesser of two values.
(6)	Cutout in concrete floor is full of stagnant water in OA plenum.
(7)	Penetrations into supply air ductwork to be sealed.
(8)	Backdraft dampers on both return fans are tired & do not open fully (directing air down)
(9)	Return air transfer duct to AHU-22 is blocked by EF-B-2
(10)	Humidifiers should be directed into air stream.

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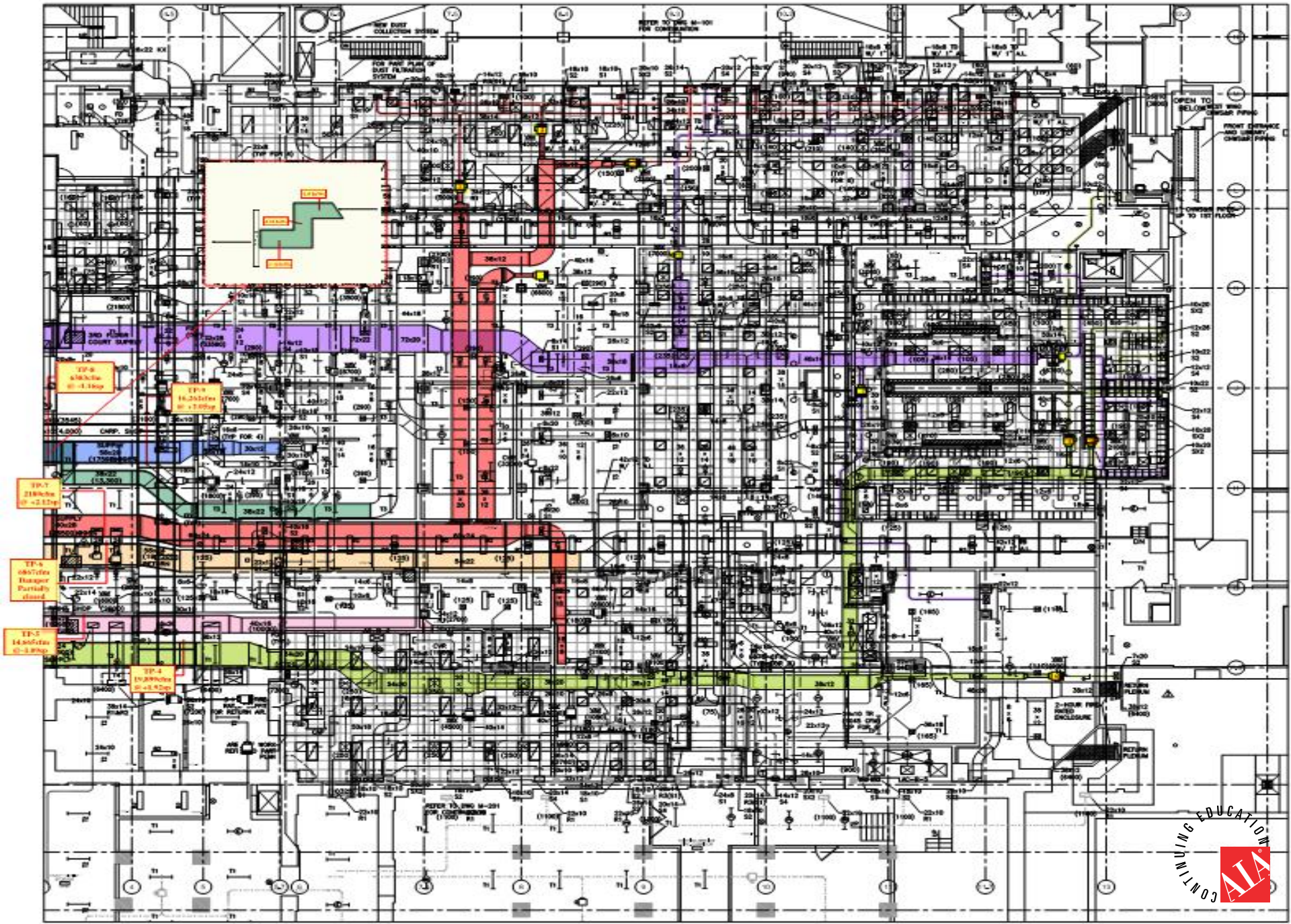
Existing Building Commissioning (EBCx) Process - Investigation Phase

Balancing Verification

TAB Traverse Data Summary					
TAB Measurement Location	Service	Design	Measured	Offset	Notes
AHU-22	Supply Main	37,000	35,600	1,400	
AHU-23	Supply Main	37,000	35,550	1,450	
Totals		***74,000***	***71,150***	***2,850***	
RF-22	Return Main	33,300	35,597	(2,297)	
RF-23	Return Main	33,300	34,482	(1,182)	
Totals		***66,600***	***70,079***	***(3,479)***	
TP-1	Supply Branch	1,800	1,800	-	To Loading Dock VAV-11
TP-2	Supply Branch	7,060	7,211	(151)	To 1st Floor Expansion
TP-4	Supply Branch	23,300	19,899	3,401	
TP-7	Supply Branch	26,500	21,800	4,700	
TP-9	Supply Branch	17,590	16,262	1,328	
Totals		***76,250***	***66,972***	***9,429***	
TP-3	Return Branch	6,354	6,290	64	From 1st Floor Expansion
TP-5	Return Branch	19,980	14,665	5,315	
TP-6	Return Branch	19,120	6,867	12,253	
TP-8	Return Branch	13,300	6,383	6,917	
Totals		***58,754***	***34,205***	***24,549***	

TAB Airflow Sensor Calibration		
CFM (Uncalibrated)	CFM (Calibrated)	CFM Offset
1,670	1,500	(170)
400	400	-
1,750	1,550	(200)
2,600	2,780	180
3,600	4,000	400
1,300	1,700	400
1,700	2,100	400
1,800	2,400	600
1,900	1,900	-
960	960	-
1,300	1,250	(50)
1,600	1,600	-
570	570	-
2,300	2,100	(200)
4,500	5,100	600
3,600	4,000	400
3,600	4,500	900
2,500	2,500	-
6,300	5,200	(1,100)
5,800	4,800	(1,000)
290	275	(15)
560	550	(10)
530	525	(5)
-	130	-
-	120	-
260	250	(10)
-	260	-
240	-	-
-	-	-
410	420	10
1,800	1,800	-
	790	790
1,070	1,100	30
400	500	100
55,310	***57,630***	***2,320***


TP-6
TP-7
TP-5
TP-4
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Existing Building Commissioning (EBCx) Process - Investigation Phase

Findings

- O&M on existing assets could use improvement
- Control schemes for AHU operation were inconsistent with design documents
- Approx. 37% of JB&B-verified sensors were out of calibration
- Approx. 58% of return air was “missing” from the return side of the distribution system
- Approx. 2,300 cfm of air was distributed incorrectly at VAV boxes

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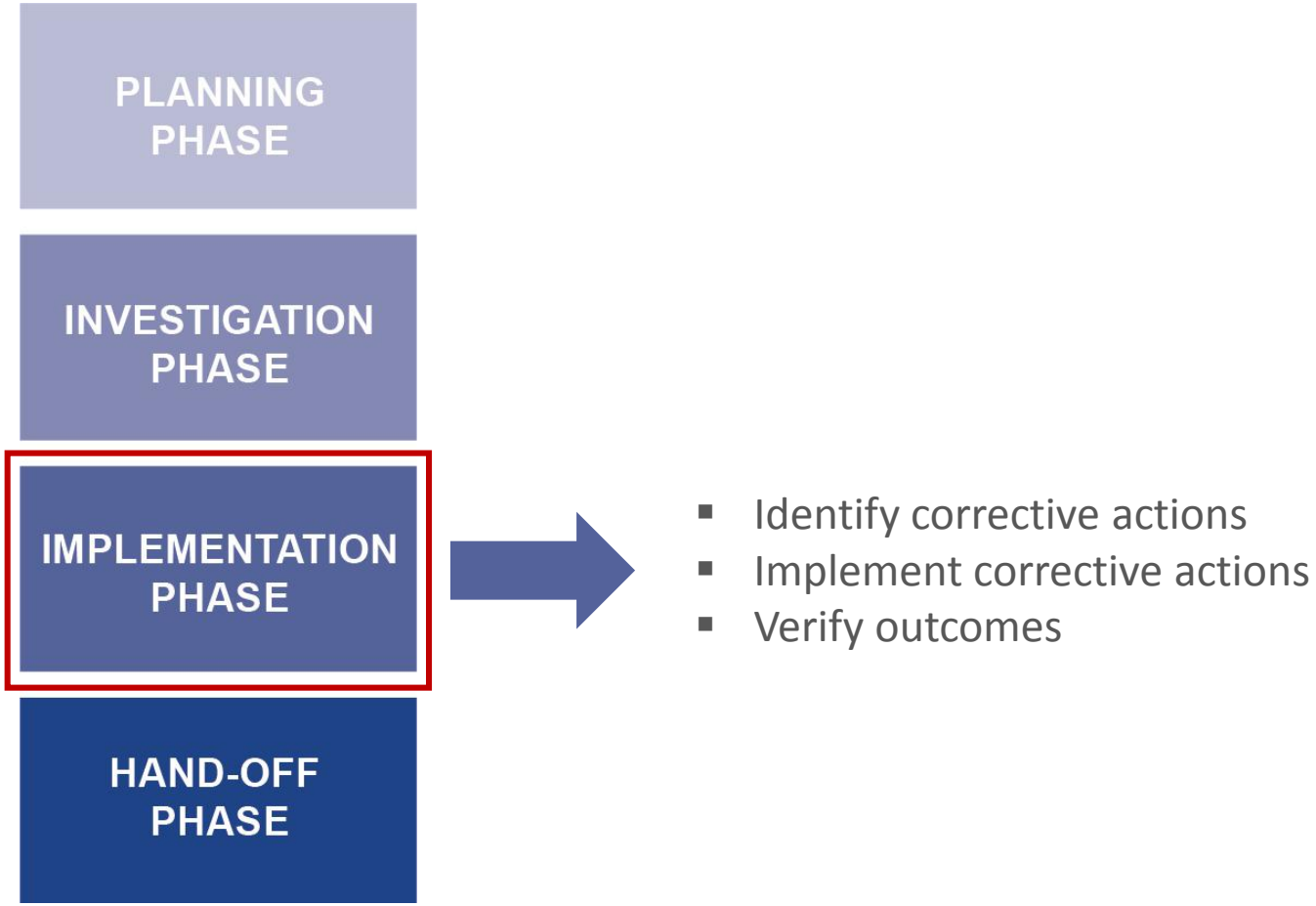
BUT NOW WHAT?!

Existing Building Commissioning (EBCx) Process - Implementation Phase



- Identify corrective actions
- Implement corrective actions
- Verify outcomes

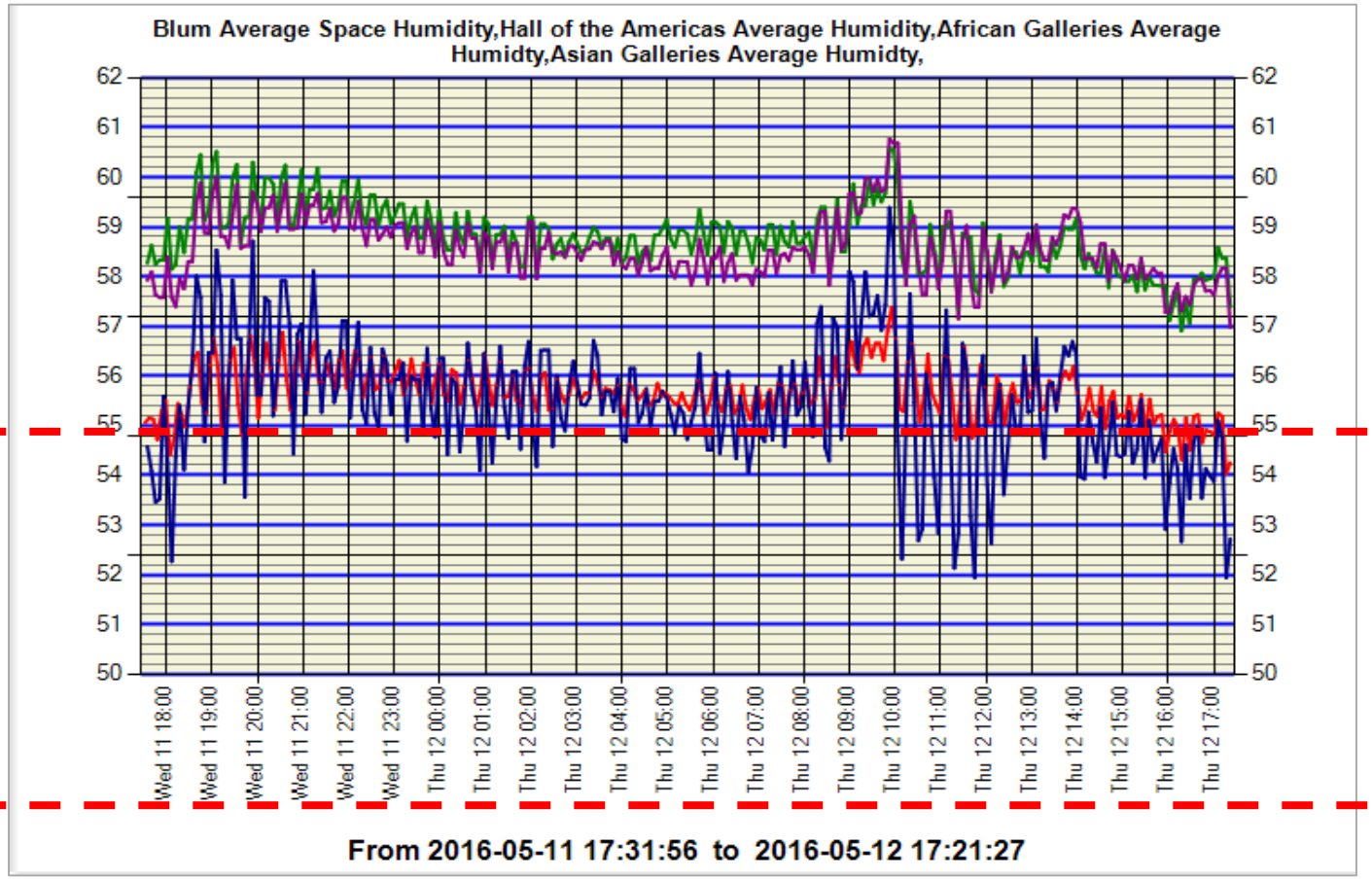
Existing Building Commissioning (EBCx) Process - Implementation Phase

Corrective Actions and Improvements

- Worked with O&M staff to address simple RCM's – cleanliness/repair
- Worked with BMS service provider to return SOO to design or better
  - Optimized control parameters
  - Tuned PID loops
- Recalibrated/replaced inaccurate temperature/humidity sensors
- Adjusted balance of system to distribute air correctly
- Created implementation plans for more costly corrective actions

Existing Building Commissioning (EBCx) Process - Implementation Phase

Remember Our Starting Point?



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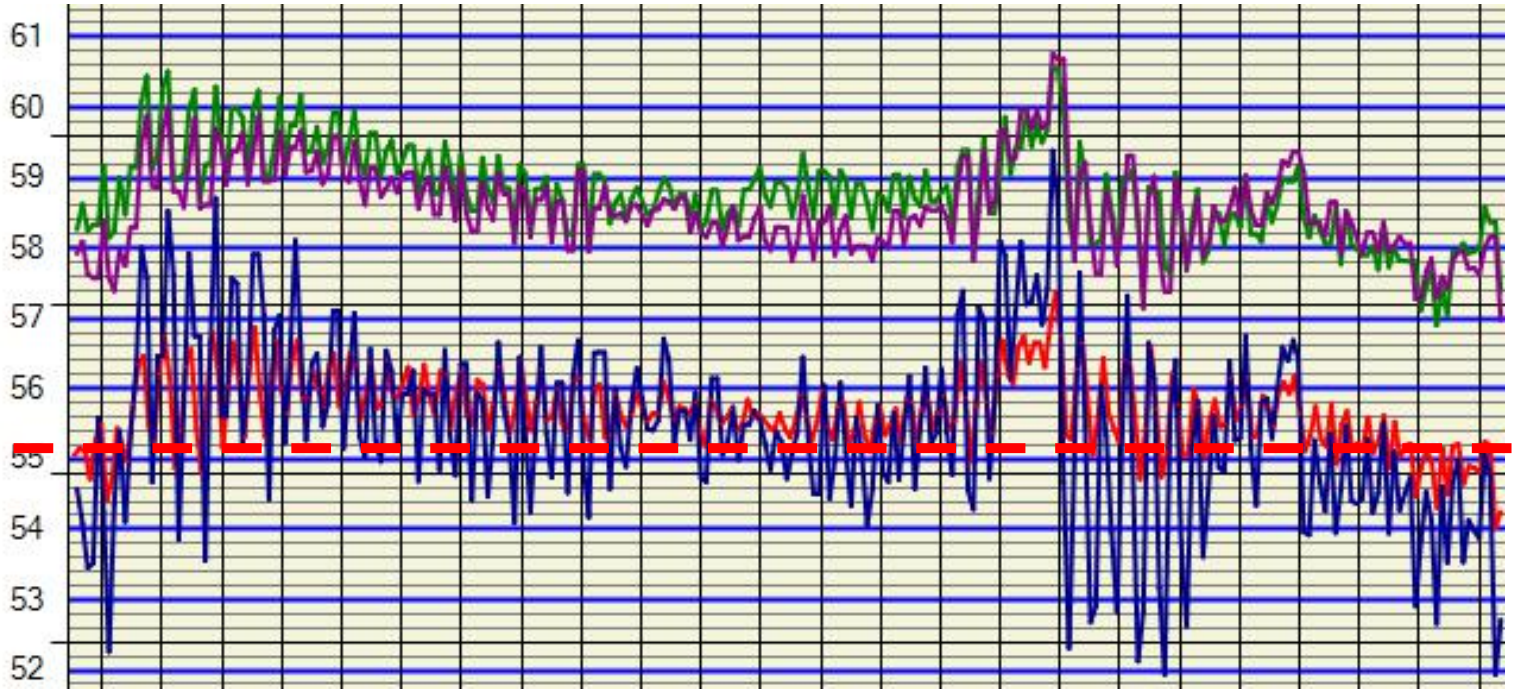
Existing Building Commissioning (EBCx) Process - Implementation Phase

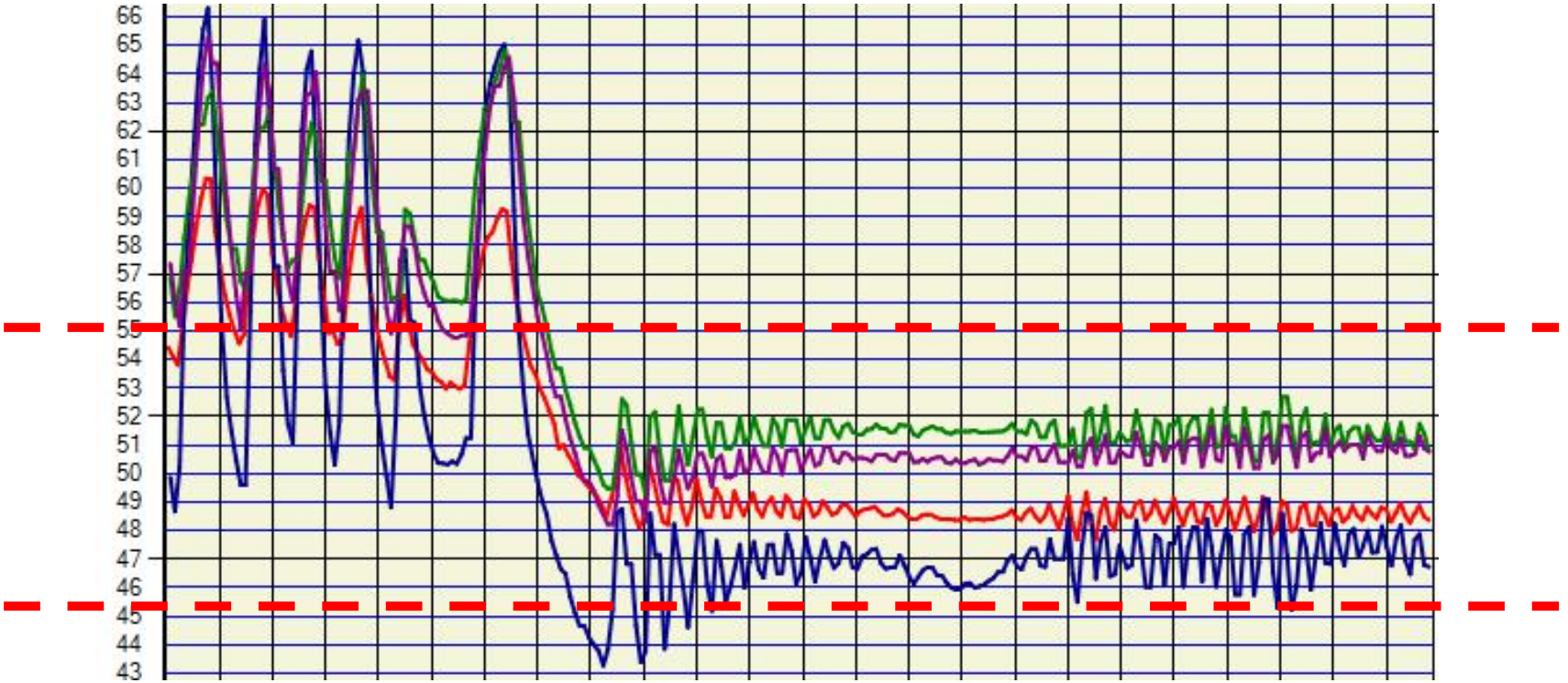
Humidity in Galleries May 12, 2016



Noisy and Outside of Acceptable Range

Existing Building Commissioning (EBCx) Process - Implementation Phase

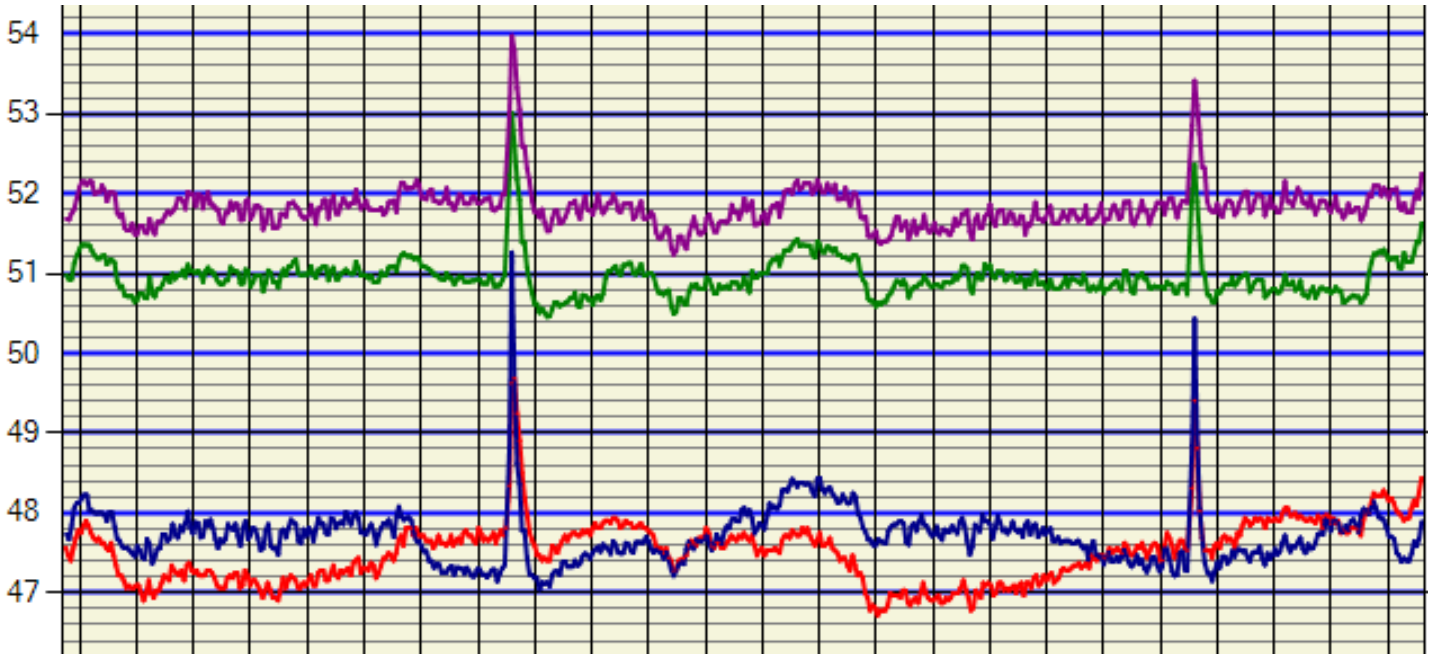
Humidity in Galleries May 20, 2016



Still Noisy, but Closer to Acceptable Range

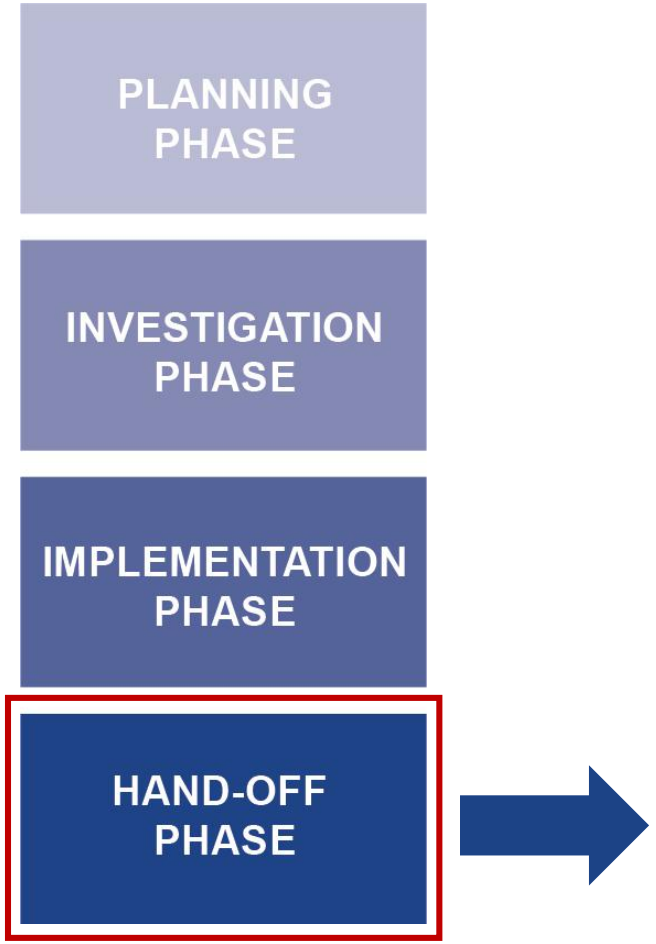
Existing Building Commissioning (EBCx) Process - Implementation Phase

Humidity in Galleries June 6, 2016



Tuned and Within Acceptable Range

Existing Building Commissioning (EBCx) Process - Hand-Off Phase



- Develop preventative maintenance plans

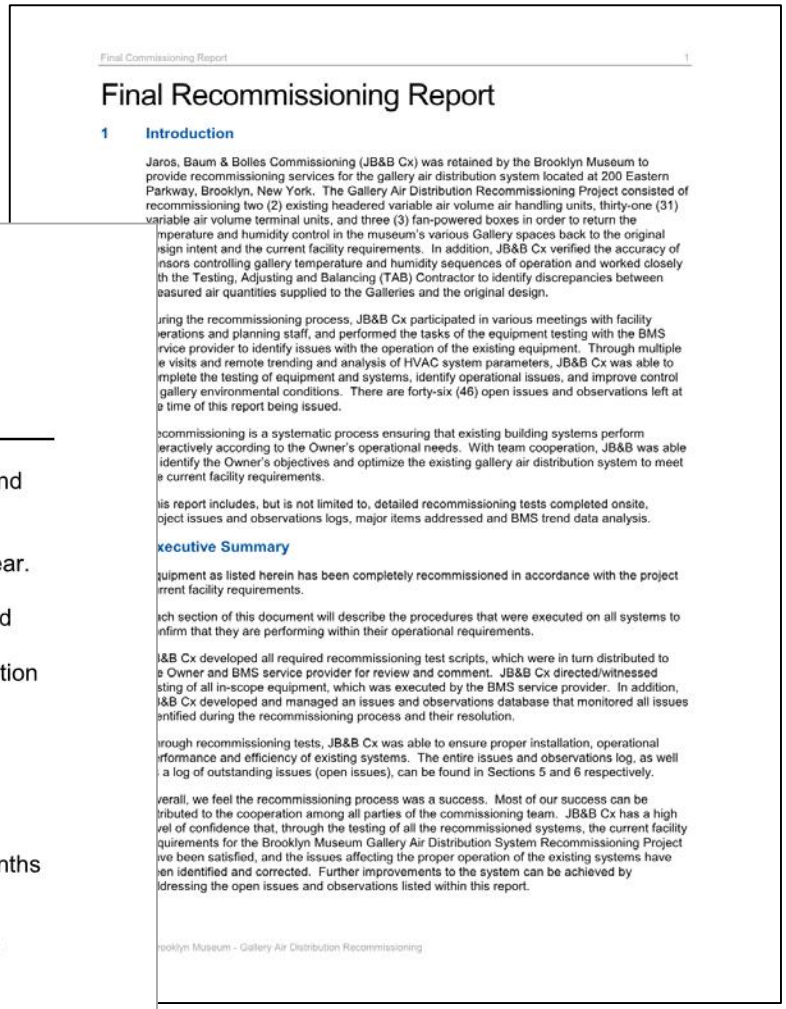
Existing Building Commissioning (EBCx) Process - Hand-Off Phase

Preventative Maintenance and Upkeep

JBB COMMISSIONING

Preventive Maintenance Items

Maintenance Item (In Order of Importance)	Suggested Action
Item 1: Maintaining accuracy of controlling temperature and humidity sensing devices. a. Temperature sensor readings within +/- 5 °F of a calibrated test device b. Humidity sensor readings within +/- 2% RH of a calibrated test device.	**Action 1:** Have all temperature and humidity sensors checked for accuracy and recalibrated as necessary every 6 months to a year. **Action 2:** Protect temperature and humidity sensors with coverings during any construction or renovation work in gallery spaces.
Item 2: Optimizing flow through Gallery AHUs.	**Action 1:** Change filters every 6 months. **Action 2:** Clean coils every 6 months to a year.
Item 3: Optimizing Humidification at the Gallery AHUs.	**Action 1**: Clean all scale build-up from steam dispersion tubes and nozzles every 3 - 6 months.



Final Commissioning Report 1

Final Recommissioning Report

1 Introduction

Jaros, Baum & Bolles Commissioning (JB&B Cx) was retained by the Brooklyn Museum to provide recommissioning services for the gallery air distribution system located at 200 Eastern Parkway, Brooklyn, New York. The Gallery Air Distribution Recommissioning Project consisted of recommissioning two (2) existing headered variable air volume air handling units, thirty-one (31) variable air volume terminal units, and three (3) fan-powered boxes in order to return the mperature and humidity control in the museum's various Gallery spaces back to the original sign intent and the current facility requirements. In addition, JB&B Cx verified the accuracy of nsors controlling gallery temperature and humidity sequences of operation and worked closely th the Testing, Adjusting and Balancing (TAB) Contractor to identify discrepancies between easured air quantities supplied to the Galleries and the original design.

uring the recommissioning process, JB&B Cx participated in various meetings with facility erations and planning staff, and performed the tasks of the equipment testing with the BMS rvice provider to identify issues with the operation of the existing equipment. Through multiple e visits and remote trending and analysis of HVAC system parameters, JB&B Cx was able to mplete the testing of equipment and systems, identify operational issues, and improve control gallery environmental conditions. There are forty-six (46) open issues and observations left at e time of this report being issued.

commissioning is a systematic process ensuring that existing building systems perform eractively according to the Owner's operational needs. With team cooperation, JB&B was able identify the Owner's objectives and optimize the existing gallery air distribution system to meet e current facility requirements.

is report includes, but is not limited to, detailed recommissioning tests completed onsite, oject issues and observations logs, major items addressed and BMS trend data analysis.

xecutive Summary

uipment as listed herein has been completely recommissioned in accordance with the project rrent facility requirements.

ch section of this document will describe the procedures that were executed on all systems to nfirm that they are performing within their operational requirements.

&B Cx developed all required recommissioning test scripts, which were in turn distributed to e Owner and BMS service provider for review and comment. JB&B Cx directed/witnessed sting of all in-scope equipment, which was executed by the BMS service provider. In addition, &B Cx developed and managed an issues and observations database that monitored all issues ntified during the recommissioning process and their resolution.

rough recommissioning tests, JB&B Cx was able to ensure proper installation, operational rformance and efficiency of existing systems. The entire issues and observations log, as well a log of outstanding issues (open issues), can be found in Sections 5 and 6 respectively.

verall, we feel the recommissioning process was a success. Most of our success can be tributed to the cooperation among all parties of the commissioning team. JB&B Cx has a high vel of confidence that, through the testing of all the recommissioned systems, the current facility quirements for the Brooklyn Museum Gallery Air Distribution System Recommissioning Project ve been satisfied, and the issues affecting the proper operation of the existing systems have en identified and corrected. Further improvements to the system can be achieved by ldressing the open issues and observations listed within this report.

ooklyn Museum - Gallery Air Distribution Recommissioning

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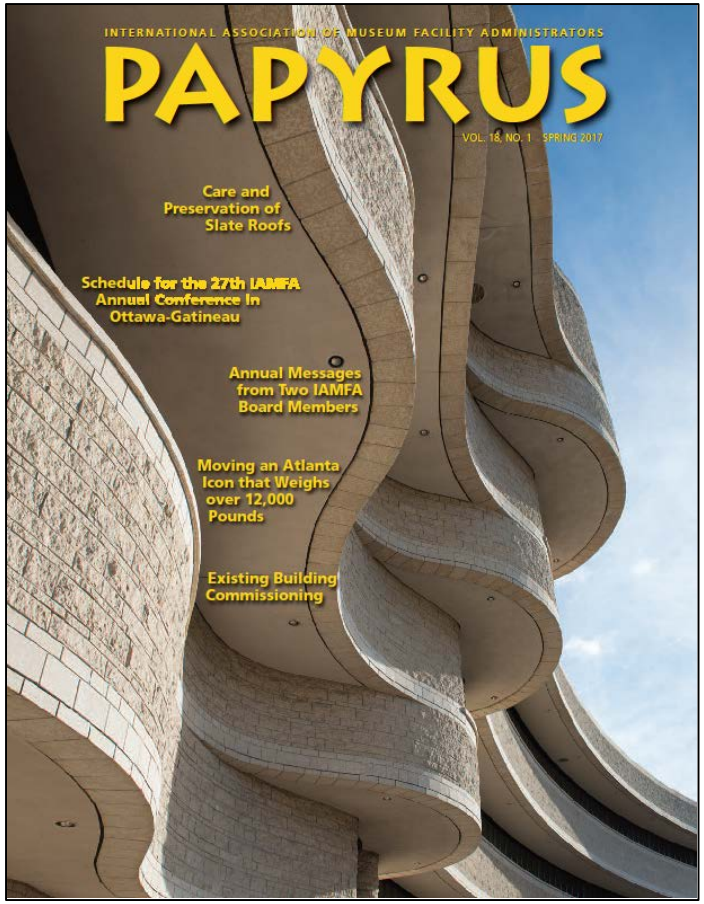
Conclusions

Takeaways from a Successful EBCx Process

- Collaboration of EBCx team goes a long way toward implementing EBCx successfully
- Systematic investigation, analysis and optimization of Museum systems led to improved operation and gallery climate control
- Preventative maintenance plan and lessons-learned exercise with Client positions Museum for continuous improvement of systems

Case Study

From *Papyrus*, the magazine of the International Museum Facility Administrators (IAMFA)



Existing Building Commissioning

A Case Study

By Ryan Lean and Molly Dee

The Brooklyn Museum—one of the oldest and largest in the United States—experienced the challenges associated with gallery climate control firsthand, following a phased renovation. Seeking to resolve unstable temperature and relative humidity in gallery spaces, the Museum underwent existing building commissioning.

As it relates to a building's heating, ventilation and air conditioning (HVAC) system, commissioning is a quality-assurance procedure confirming that the building is fully prepared to operate as intended. For an existing building, this systematic process verifies that existing building systems perform interactively according to the owner's operational needs and Current Facility Requirements (CFR). From visual checks to system-wide testing, existing building commissioning (EBCx) helps achieve operational objectives while optimizing performance and energy efficiency.

Nowhere is this more important than in a museum, where the robustness and reliability of HVAC systems are critical to providing stable environments for galleries and exhibition spaces.

The Wilbour Plaque, ca. 1352–1336 B.C.E. or slightly later. Limestone, 6-3/16 x 8-11/16 x 1-5/8 in. (15.7 x 22.1 x 4.1 cm). Brooklyn Museum, Gift of Evangeline Wilbour Blashfield, Theodora Wilbour, and Victor Wilbour honoring the wishes of their mother, Charlotte Beebe Wilbour, as a memorial to their father, Charles Edwin Wilbour, 16.48. Creative Commons-BY.

KENNETH KURTZ, AIA, MUSEUM ARCHITECT

The Brooklyn Museum

Brooklyn Museum—Case Study Background

Founded in 1895, the Brooklyn Museum completed an eight-year renovation in 2016. The Museum added several new galleries to showcase collections ranging from Ancient Egyptian masterpieces to contemporary art. During its renovation, the Museum installed a state-of-the-art HVAC system with automated temperature controls for new and existing spaces. The renovation was completed in phases in order to spread costs across several years, and to ensure that the Museum remained open throughout the project.

Different teams of construction managers, contractors, and subcontractors completed the renovation across four distinct phases. Upon completion of all planned work, the African, Asian, Great Hall, and Blum galleries were built, and the following components of the new HVAC system were installed:

- Two custom-built headered variable-air-volume air-handling units (AHUs) equipped with preheat coils, chilled water cooling coils, hot-water-reheat coils, and atomizing steam humidifiers. The AHUs are served by two variable-air-volume (VAV) return fans.
- Thirty-one VAV terminal units with hot-water-reheat coils for additional temperature control.
- Three fan-powered boxes (FPBs) with interlocks to hot-water fin-tube radiation serving the perimeter of the building.
- Five supply-air distribution ducts tied to a dedicated header fed from the AHUs.
- Four return-air branch ducts tied to a common return-air plenum serving the return fans.

As each phase of the project was finished, new equipment from that phase was placed into operation. Bringing the various components of the system online in this staggered manner left room for error where one phase ended and another began. When the renovation was complete,

This concludes the American Institute of Architects Continuing Education Systems course.

Jaros, Baum & Bolles

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