

**Building Cx at the  
University of North  
Carolina – Chapel Hill**

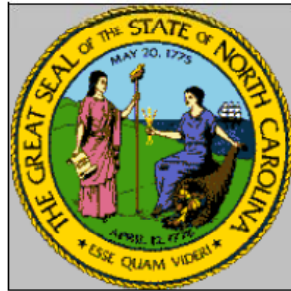
# UNC Campus Facts



- 19.4 million gross sq ft
- 28,300 students
- Since 2001 campus expansion and renovations funding - \$1.8 billion
- \$1.7 billion in FY2009-2011
- FY 2011 research funding - \$788 million
- Energy costs \$85.5 million in FY 2011

# State Construction Office CX Guideline

[http://www.nc-sco.com/documents/guidelines/BLDG\\_COMMISSIONING.pdf](http://www.nc-sco.com/documents/guidelines/BLDG_COMMISSIONING.pdf)




## **BUILDING COMMISSIONING**

by the

**Sustainable, Energy Efficient Buildings  
Advisory Committee**

in re

**N.C.G.S. 143-135.35 thru 143-135.40  
(Senate Bills 668 and 1946)**



# State of NC - SB 668/1946

## *Performance Standards for Sustainable, Energy-Efficient Buildings*

- Reduce energy consumption by 30% over ASHRAE 90.1-2004 and reduce water consumption by 20%.
- Integrated design approach will be used and energy modeling is required. Verification of building performance is required.
- All new buildings and major renovations over 20,000 sq ft will be commissioned.



# State of NC - SB 6668/1946

## *Commissioning Guidelines Include:*

- Commissioning will start in the design (SD) phase of the project and continue through the construction and warranty phases. All energy and water systems are required to be Cx.
- Independent 3<sup>rd</sup> party commissioning agents will be used. Cx agent provides Cx specs, helps maintain the OPR.
- Designer maintains the basis of design document (BOD) and gives BOD training at end of project. Provides a M&V plan.
- Owner's facility personnel required to participate in the entire Cx process. At 12 months the owner is required to compare M&V results against energy model and report findings.



# UNC's Cx Approach Includes

- RFQs will be issued for each major Cx project. Open end Cx agreements for Cx agents used for smaller retroCx projects.
- Cx agent's contract will be in two parts, design part and post bid CD part (for construction and warranty Cx phases).
- Typical Cx scope is MEP systems. Also including building envelope Cx in complex bldgs.

# UNC Cx Project Example Science Complex I



Chapman Hall



Caudill Labs



## Commissioned in all phases of project

- Design
- Construction and Acceptance
- Occupancy and Warranty

Project consisted of approximately 260,000 gross sq ft. Construction costs were \$83.5 million. Cx cost approximately 0.4% of construction costs.



# Acceptance Phase Cx

- Specifications required a “Ready to Commission” letter from the contractors.
- Following this the Cx testing commenced and found 277 issues in Chapman and 299 issues in Caudill.

To expedite the testing process not all Cx items documented (many issues fixed with contractors present), otherwise found issues log would have been larger.

# Independent point to point verification



# TAB Verification



Team approach used in testing, contractor's participation required per Cx specs



Team is better able to resolve problems with all contractors present



# PC time during Cx verification



# Lab secondary containment Cx verification



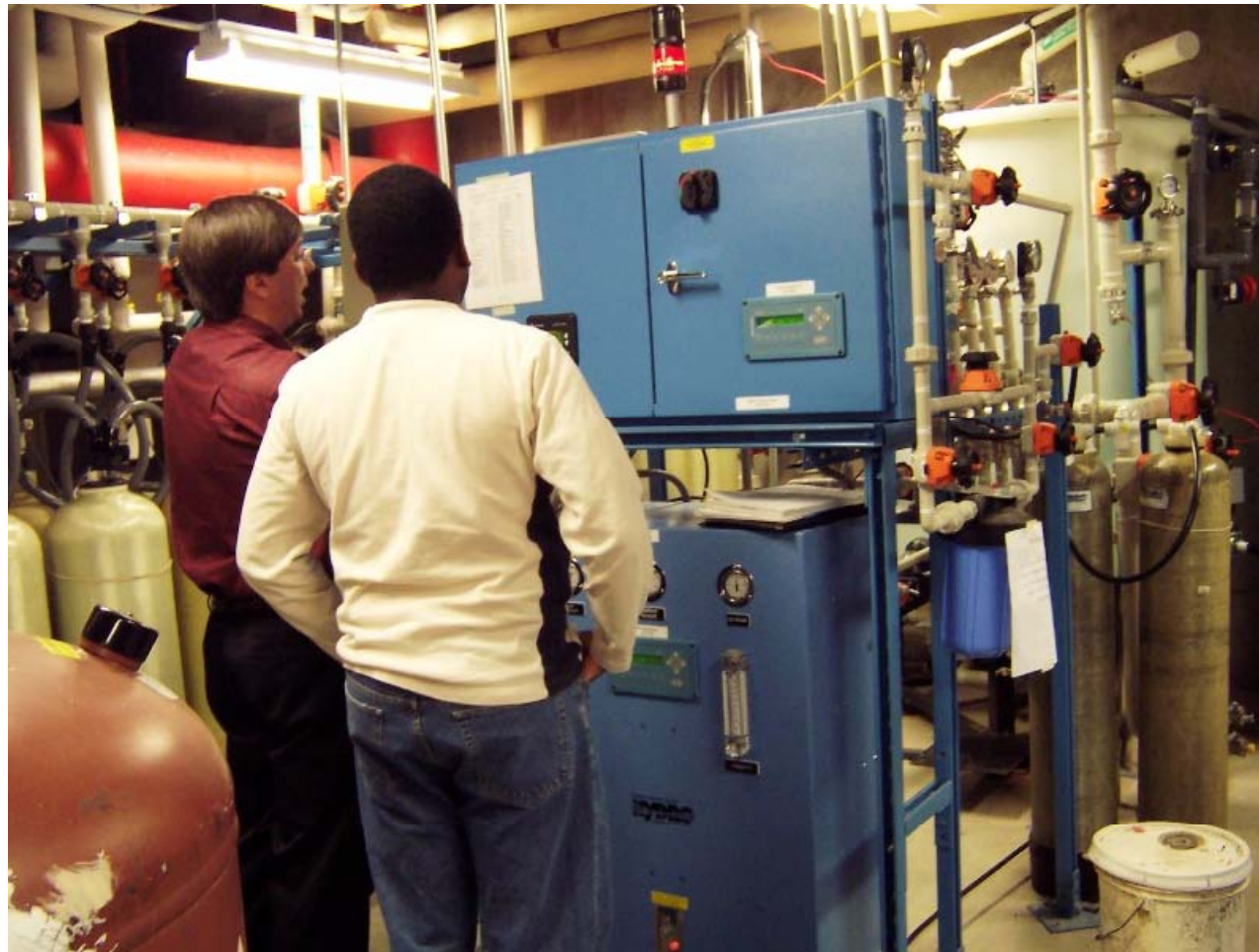
# Can any dummy do lab Cx?



# ASHRAE 110 Fume Hood Testing



# Skid mounted equipment verification with vendor

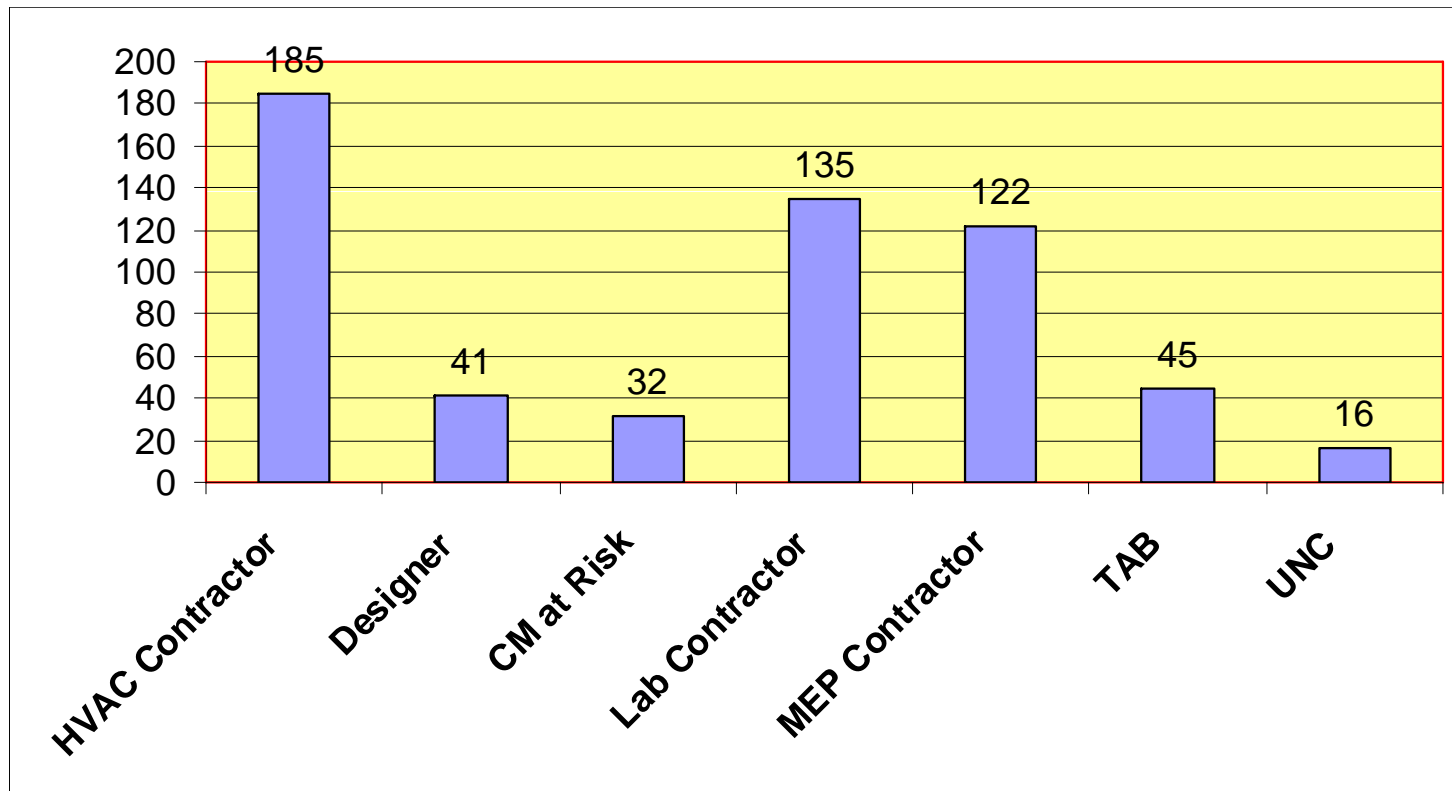




# Typical Cx problems found

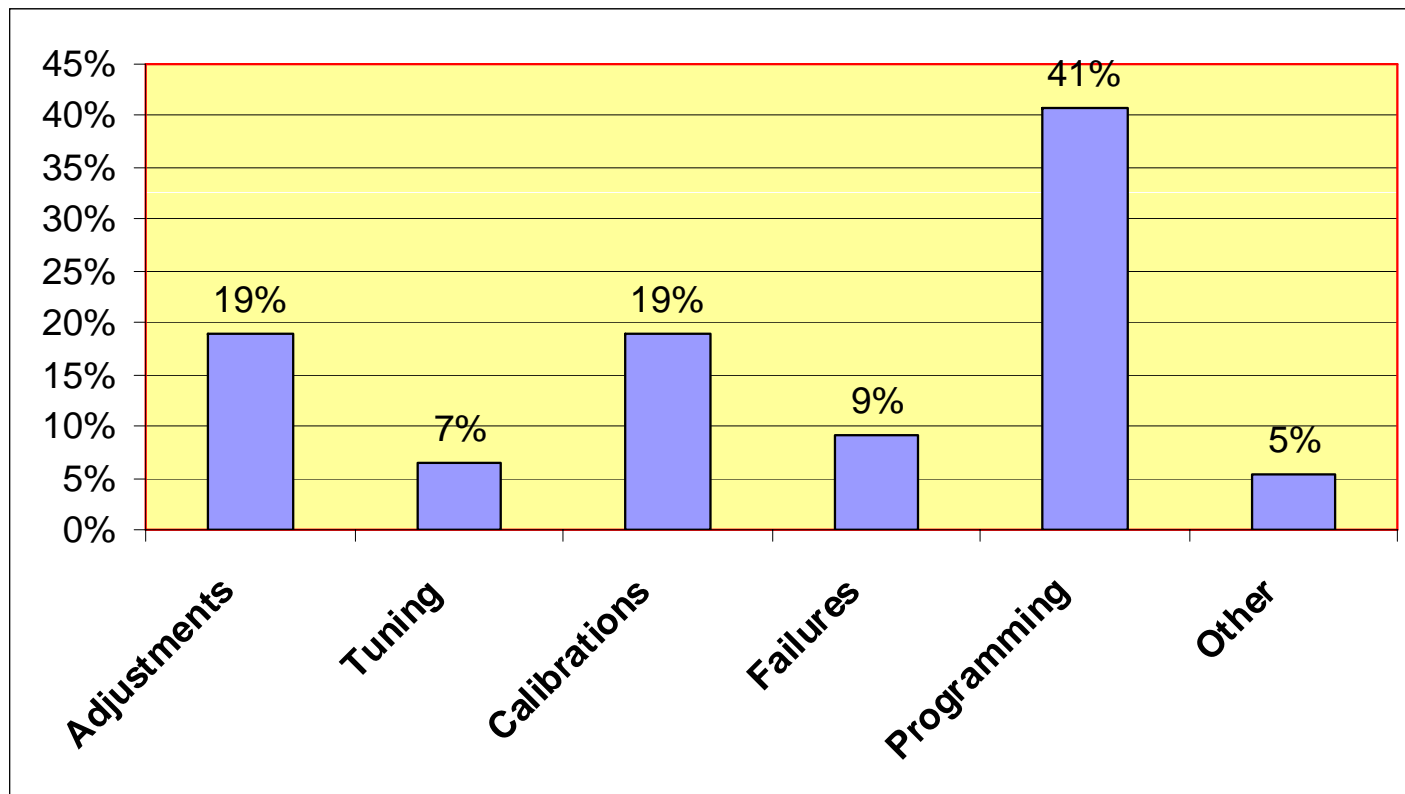
- Omissions or errors in design schedules and control sequences
- Issues with achieving rated heating, cooling or flow
- Missing sensors or valves
- Unstable operations, valve cycling
- Sensor calibrations off by a large %
- TAB errors or wrong assumptions
- Wrong scaling of flow sensors entered in controls programming

# Mechanical, HVAC & lab Cx issues 576 items – *that were documented*



Acceptance Phase Issues

# Building HVAC controls contactor issues found (185 items)

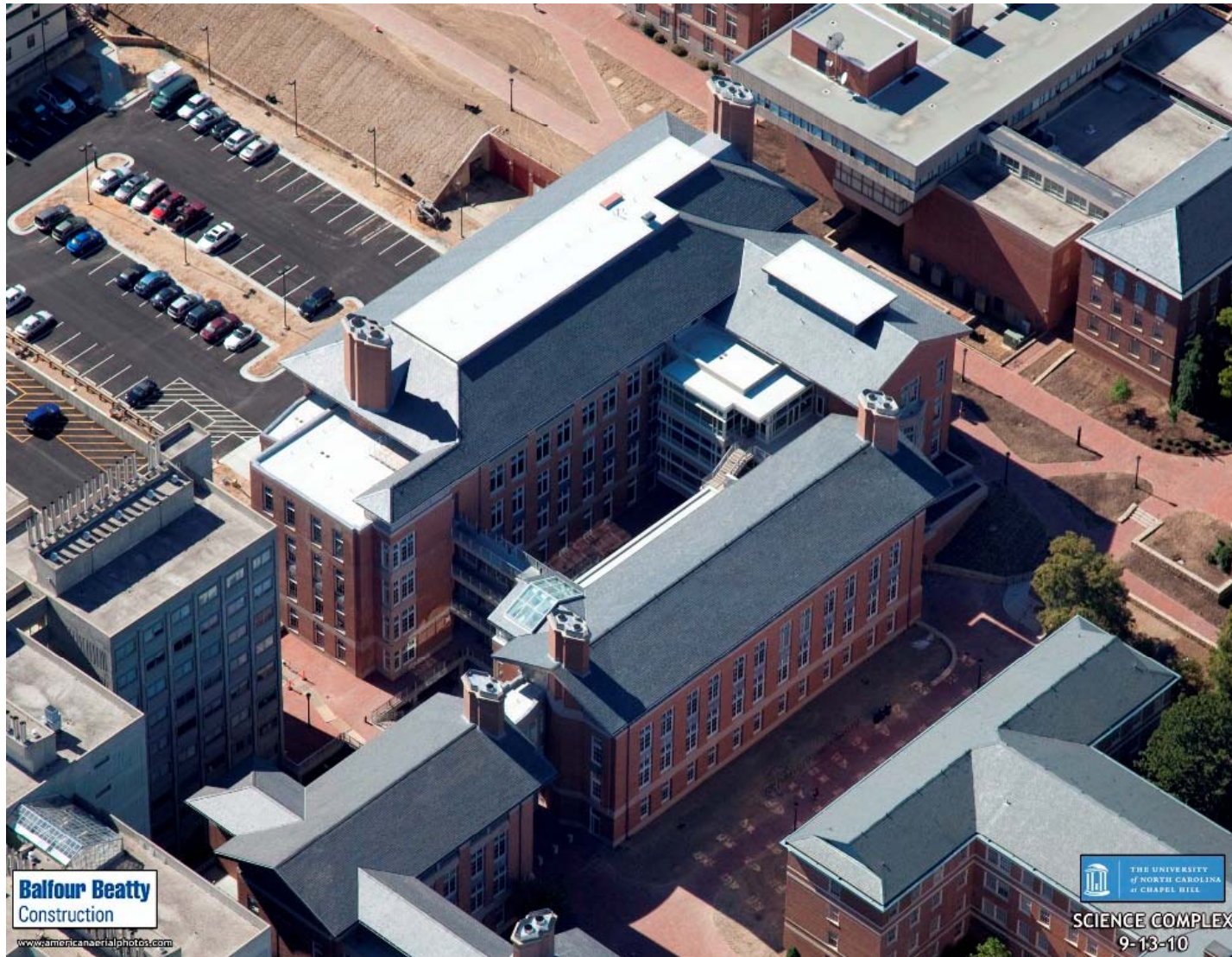




# Acceptance Phase Cx Hours

- CxA spent approximately **1775** man hours (over **44** man-weeks) during the acceptance phase of commissioning.

# Murray and Venable Halls





# Cx Project Costs

Design phase \$40,028

Construction phase \$66,639

Acceptance phase \$177,534

Warranty \$20,181

Total \$309,816

Additional scope \$13,100

Cx cost as % of construction costs = 0.46%

# Cx Cost on Largest 3 Projects

	Design			Construction			Project
Project	MEP	Envelope	Total	MEP	Envelope	Total	Total
Dental Sciences	\$ 51,147	\$ 6,500	\$ 57,647	\$411,216	\$ 18,000	\$429,216	\$ 504,886
Bell Tower	\$ 47,140	\$ 20,350	\$ 67,490	\$376,230	\$200,850	\$577,080	\$ 644,570
Imaging Research	\$ 58,486	\$ 32,500	\$ 90,986	\$455,180	\$325,023	\$780,203	\$ 871,189
Waterproof					\$225,440		\$ 1,096,629



# Lessons Learned in Cx Process

- Start Cx early in design and follow the guidelines.
- If using a small Cx firm make sure if a key person becomes unavailable that they have backup CxA staff to cover the project. Emphasis should be on controls and O&M experience when selecting the CxA.



# Lessons Learned in Cx Process

- Owner involvement with staff from the operations and maintenance organizations is important, rather than only staff from design and construction organization.
- For major submittals such as HVAC controls have a submittal comment review meeting with designer, contractor, CxA and owner.



# Lessons Learned in Cx Process

- Envelope Cx can become expensive so choose wisely, Cx design review is important. Do full size mockup of window assemblies; if not possible do testing of the first window assemblies very early on. Have an onsite curtain wall construction coordination meeting.
- Involve CxA in some above ceiling inspections even if owner staff is involved.

Training - consider delaying some of the required training until the 10 month warranty inspection so the staff will better “know what they don’t know”.





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