

Golden Gate and Redwood
Chapters of ASHRAE

*Commissioning for New and Exist
Green Buildings*



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What is Commissioning?

Commissioning is
Quality Assurance
in Building Construction



Commissioning is:

- > A Quality Process
- > Owners Project Requirements
- > Basis of Design
- > Construction Documents
- > Verify and Document
- > Fine Tuning



Cx, RCx and EBCx

“Commissioning” (Cx) = Process Applied to New Buildings

“Re-Commissioning” (RCx) = Process Repeated for Buildings That Have Been Commissioned

“Existing Building Commissioning” (EBCx) = Process Applied to Existing Buildings Not Previously Commissioned (replaces the older term “Retro-commissioning”).



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I Have a Design/Construction Team Why Do I Need Commissioning ?



- High Performance Buildings
 - Energy Efficient, Sealed, Secure
- Cutting Edge Equipment
 - Microprocessor Controlled
- Intermixing Systems

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The Commissioning Agent/Authority



The Commissioning Authority (CxA) has Overall Responsibility for Commissioning

- The Process is executed by the independent CxA
- Ideally, employed by Owner or Rep
- Direct communications is a must
- Independence is the key

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Managing the New Building Cx Project 3 Stages

- Design
- Construction
- Occupancy



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Cx During Planning/Design

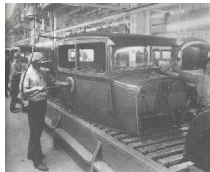
- Owner's Project Requirements
- Commissioning Plan
- Drawing Reviews
- Commissioning Specifications
- Pre-Bid Conference



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Cx During Construction

- Contractor Kick-off Meeting
- Submittal Review
- Static Inspection / Start-up
- Functional Testing
- O&M Manual Verification
- Training Verification



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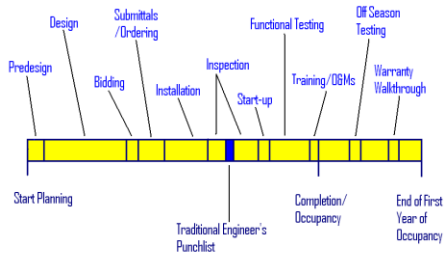
Cx During Occupancy

- The Commissioning Report
- Trend-logging
- Stand-Alone Data-Logging
- Off-season Testing
- Warranty Review



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Cx is Not a Punchlist



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\$ Savings: LBL Evan Mills Existing Building Cx Study 2009

- Updated from 2004 study
- 643 buildings in 26 states
- 100 million SF
- Median Cost \$3.00 / SM for EBCx
- Median Payback 1.1 years
- \$11.60 / SM for New Cx
- Median Payback 4.2 years



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\$ Savings: PECI/LBL 2009 Study on Energy Savings and Measure Cost Effectiveness of EBCx

- 11 utilities
- 122 projects
- Under 2 year payback on EBCx
- <http://resources.cacx.org/library/holdings/Annex%20Report%20Final.pdf>



CA Cost Guidelines

- 2.5% of mechanical construction cost plus 1.5% of electrical construction cost is a rule of thumb
- Large jobs--\$.70 per sf for basic HVAC systems, \$1.20 per sf for more complicated systems and \$1.50-\$3.00 per sf for labs, hospitals, etc.



LEED 2009 (v3) Rating Systems



- New Construction (NC)
- Existing Buildings: Operations & Maintenance (EB: O&M)
- Commercial Interiors (CI)
- Core & Shell (CS)
- Schools (SCH)
- Retail
- Healthcare (HC)
- Homes
- Neighborhood Development (ND)

Scope of LEED Cx

- Energy Using Systems
 - HVAC
 - Lighting Controls
 - Domestic Water Heating
- Green Systems
 - Rainwater Reuse
 - Renewable Energy
 - Daylighting



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HVAC Equipment

- Central Plant
 - Boilers, Chillers, Pumps, Cooling Towers
- Air Handling Units
 - Supply and Exhaust Fans, Make-up Air Units
- Terminal Units
 - VAV Boxes, Reheat Coils, Fan-Coils
- Packaged AC
 - Lodging Rooms, Variable Refrigerant Flow, Split System AC
- DDC Controls and Building Management Systems



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Lighting Controls

- Occupancy Sensors
 - Programming, Delays, Sensitivity
- Daylight Harvesting
 - Photocells, Programming and Controls
- Central Timer Panels
 - Douglas, ASCO Panels, Override Systems



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Domestic Water Heating Equipment

- Boiler Side-Arm Loops and Tanks
- Heat Exchangers
- Unitary Tank/Heaters
Industrial, Commercial, Residential
- Circulating Pumps
- BMS or Local Control Systems



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Examples of Renewable Energy Systems

- Solar Photovoltaic
Panels, Connections, Inverters, Tracking
- Solar Thermal
Tanks, Controls
- Wind Turbines
Controls, Storage
- Rainwater Harvesting
Tanks, Pumps, Filters, Disinfection



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Pre-I-Fundamental Systems Cx

1. Designate a CxA
2. Owner does Owner's Project Requirements (OPR), CxA reviews
3. Design Team does Basis of Design (BOD), CxA reviews
4. Develop and incorporate Cx specs
5. Develop and implement Cx plan
6. Verify installation and performance (FPTs)
7. Complete a summary commissioning report



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Credit 3 - Enhanced Commissioning

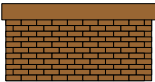


1. Designate an Independent CxA
2. Review OPR, BoD and Design Documents
3. Review Contractor Submittals
4. Develop a Systems Manual
5. Verify Training of O&M Personnel
6. Post Occupancy Review and Plan

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Credit 3 – Envelope Commissioning—New!

- Credit 3 for all three of the New Construction LEED programs now offers an additional point for envelope commissioning.
- Process must be conducted according to a planned and systematic method.
- Includes pressure testing, moisture intrusion, infra-red scans and mock-up testing and observation.



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Pre-1 and Cre-3 Combined = ASHRAE GL 0-2005

<u>Prerequisite 1</u>	<u>Credit 3</u>
Engage a CA	
Review OPR & BOI	CD Review
Cx in Specs	Submittal Review
Cx Plan	Systems Manual
Installation/Function	Verify Training
Cx Report	Post Occ Review

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New for Leed v4

PCD4

Fundamental Cx:

- Added O&M Plan
- Systems Narrative
- PM Plan
- Ongoing Cx Plan



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New for Leed v4

PCD4

Enhanced Cx

Enhanced Cx Raised to 3 Points

- Mostly same as before
- Added Verification of Training Effectiveness

Monitoring Based Cx Earns 4 Points

- Automated Fault Diagnosis
- Sub-Metering
- Frequency of Analysis

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New Cx for Leed v4

PCD4

Enhanced Cx

Add 2 Points: Do Enhanced Cx + Envelope Cx per National Institute of Building Sciences (NIBS) Gdl 3-2006

Data Centers:

- 2 Design Reviews for Smaller Centers
- 3 DRs for Larger Centers

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Commissioning Existing HVACR Systems

Same as New Building Cx Except

- No Design to Check
- OPR Becomes CFR
- No Contractor on Site
- O&M Staff Involvement
- Energy Audit Included



Commissioning Existing HVACR Systems

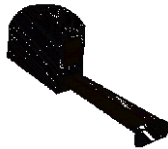
The Model EBCx Process: Five Stages

- Strategic---Which Buildings Are to be Done
- Pre-Investigation---How Are They to be Done
- Investigation
- Implementation
- Occupancy



Strategic---Which Facilities and Scope

- > Selection by Energy Star
- > Selection by Satisfaction
- > Selection by Capital plan
- > Incentive Programs
- > Establish Equipment Scope
- > Evaluate, Negotiate and Award



Assessment

- Define the Team
- Access, Safety and Security
- Schedule
- Current Facilities Requirements
- All Aspects of the Building



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Investigation

- Energy and O&M Records
- Envelop Inspection and Functional Testing
- Major Equipment—Chillers/AHUs/VFDs
- Room-by-Room Temperatures, Addressing
- Small Deficiencies Corrected Immediately



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Implementation

- Re-Test---Functional, Blower Door, Infra-red
- Re-draft As-Built One-line Drawings
- Train Staff and Occupants---DVDs
- Revise PM Schedules
- Set Up Trend Logs



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Occupancy

- Convene EBCx Lessons Learned Workshop
- Verify Upkeep of Documentation and Signage—replace as required
- Complete Seasonal Testing as Required
- Check Trend Logs
- Conduct Spot Tests



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LEED for Existing Buildings Operations and Maintenance



- 2009 V2 as of June, 2009
- Pre-1, Pre-2
- EA Credit 2.1—Investigation and Analysis
- EA Credit 2.2---Implementation
- EA Credit 2.3---Ongoing Commissioning

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LEED for Existing Buildings Operations and Maintenance

Prerequisite 1

- Building Operating Plan
- Systems Narrative
- PM Narrative
- Energy Audit



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LEED for Existing Buildings
Operations and Maintenance

Prerequisite 2

- Energy Star Score of 69 or higher
- 19% better than average
- Energy Star performance method



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LEED EB: O&M

EA Credit 2.1— Investigation and Analysis

Option A:

- EBCx plan---conduct investigation and analysis
- Breakdown energy use from Pre-Req 1 Energy Audit
- List occupant problems and capital improvements

Option B:

- Conduct an ASHRAE Level II Energy Audit



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LEED EB: O&M

EA Credit 2.2— Implementation

- Implement low-cost / no-cost projects from Credit 2.1
- Provide staff training
- Demonstrate savings from measures
- Update the building operating plan



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LEED EB: O&M

EA Credit 2.3— Ongoing Commissioning

- Implement a continuous commissioning program
- Cycle less than 24 months
- Complete at least half of work before applying for LEED-EB
- Update the building operating plan



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LEED for Existing Buildings Sneak Preview



LEED EB O&M V4 PCD3

- Schools, Retail, Data Centers, Hospitality, Warehouse and Distribution Centers
 - Investigation and Analysis (2 Points)
 - Implementation (2 Points)
 - Ongoing Commissioning (3 Points-Includes Trend Logging and AFD)

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**In Closing, if you Haven't had Enough!
Training for the CA**

- University of Wisconsin / Building Commissioning Association
- Association of Energy Engineers
- National Conference on Building Commissioning pre-Conference Workshops
- NEBB and AABC Commissioning Groups



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Golden Gate and Redwood Chapters of ASHRAE

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Thank You for Your Time!



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