

**Better Buildings By Design Conference  
Burlington, Vermont February 11-12.**

# COMMISSIONING for *LEED*

## New and Existing Buildings

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# What is Commissioning?

**The Commissioning Process  
is  
Quality Assurance  
in  
Building Construction**



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# Why Commissioning Now?



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



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# Changing Roles in Construction

- Buildings Built 95% Complete
- O&M Staff Fixes the Rest
- Engineers Rely on Sales Reps
- Sales Reps Rely on the Factory
- Factories are “Beta-Testing Equipment



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# Will Occupants Commission Your Building?



- Low Productivity
- Poor Morale
- Absenteeism
- Sick Leave
- Medical Claims
- Litigation



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# Managing the Cx Project 3 Stages

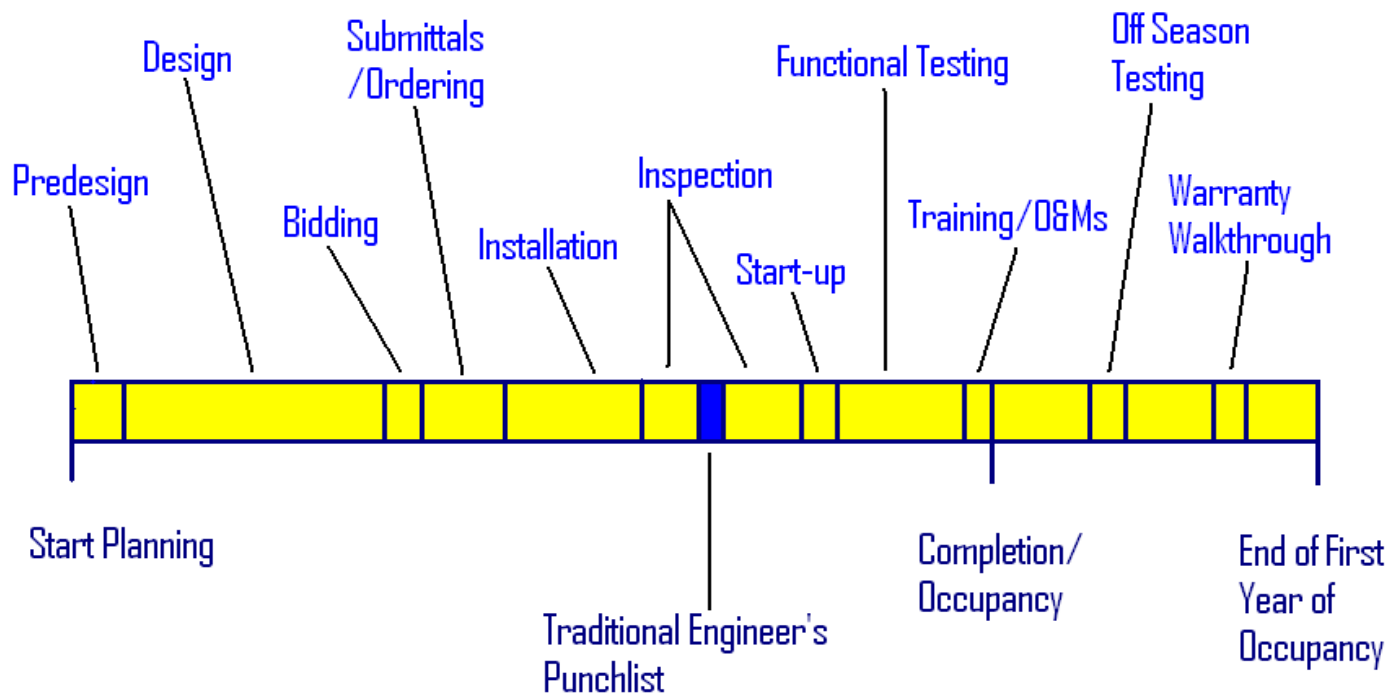
- Design
- Construction
- Occupancy



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# Cx is Not a Punchlist



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# ASHRAE Cx During Planning/Design



- Design Intent
- Commissioning Plan
- Drawing Reviews
- Commissioning Specifications
- Pre-Bid Conference

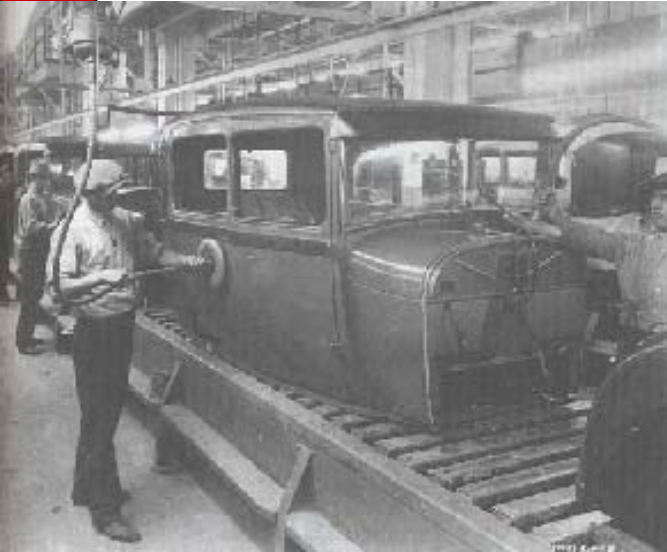


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# Cx During Construction



- Contractor Kick-off Meeting
- Submittal Review
- Static Inspection / Start-up
- Functional Testing
- O&M Manuals
- Training—Videotaped by CxA



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# Cx During Occupancy

- The Commissioning Report
- Trend-logging
- Off-season Testing
- Warranty Review



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# Commissioning Benefits

## Berkeley National Laboratory Study

- 224 Buildings
- 30 million sf Floor Area
- 21 States
- 6800 Deficiencies Found and Corrected



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# NEEA Building Study

- 13 New Commissioning projects
- 1.4 million square feet
- Offices, schools, hospitals, prisons
- 5 states, 1998-2003
- 5.6 year payback not including productivity, sick leave or liability



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# Leadership in Energy and Environmental Design

- Current Programs:

LEED-NC

LEED-EB

LEED-CI

LEED-CS

LEED for Schools

- Pilot Phase or Public Comment programs:

- LEED for Retail—New Construction
- LEED for Retail—Commercial Interiors
- LEED for Healthcare
- LEED for Homes (No Cx)
- LEED for Neighborhood Development (No Cx)



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# The LEED Rating Systems

- Sustainable Sites
- Water Efficiency
- Energy & Atmosphere
  - Pre-1-Fundamental Systems Cx
  - Cre-3-Additional Cx
- Materials & Resources
- Indoor Environmental Quality
- Innovation & Design Process



# Pre-1-Fundamental Systems Cx

## New Construction

1. Designate a CxA to lead the Cx process
2. Owner documents the Owner's Project Requirements (OPR), design team develops the Basis of Design (BOD), CxA reviews
3. Develop and incorporate Cx specifications
4. Develop and implement Cx plan.
5. Verify the installation and performance (training moved)
6. Complete a summary commissioning report.



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# Primary Responsibility

<b>Designate a CxA to lead the Cx process</b>	<b>Owner and Design Team</b>
<b>Owner's Project Requirements (OPR)</b>	<b>Owner, Design Team, CxA</b>
<b>Basis of Design (BOD)</b>	<b>Design Team</b>
<b>Develop and incorporate Cx specifications</b>	<b>CxA, Design Team</b>
<b>Develop and implement Cx plan</b>	<b>CxA</b>
<b>Verify install'n and perf (training moved)</b>	<b>CxA, Contractors</b>
<b>Complete a summary commissioning report</b>	<b>CxA</b>
<b>Focused design review prior to CD phase</b>	<b>CxA, Design Team</b>
<b>Review the CDs before completion</b>	<b>CxA, Design Team</b>
<b>Selective review of submittals</b>	<b>CxA, Contractors</b>
<b>Develop a Re-commissioning manual</b>	<b>CxA, Contractors</b>
<b>Contract for post occupancy review</b>	<b>CxA, Owner</b>





# Designate the CA

1. Designate an individual as the Commissioning Authority (CxA) to lead, review and oversee the completion of the commissioning process activities.

As early as possible, ideally during pre-design.

Experience with two other projects of similar managerial and technical complexity. CxA responsible for:

- directing the commissioning team and process in the completion of the commissioning requirements
- coordinating, overseeing, and/or performing the commissioning testing and
- reviewing the results of the systems performance verification



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# Owner Documents Project Req'ments

The Owner shall document the Owner's Project Requirements.

The design team shall develop the Basis of Design.

The CxA shall review these documents for clarity and completeness.

The Owner and design team shall be responsible for updates to their respective documents.



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# Insert Cx Specifications

Develop and incorporate commissioning requirements into the construction documents. Typically the project specifications are used to inform the contractor(s) of their responsibilities in the commissioning process.

- Avoid telling the contractor the work of others
- Includes Divisions 1, 15, 16 and 17
- Reference each section with commissioned equipment



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# Prepare a Cx Plan

Overview of Cx as Quality Assurance

Systems to be Commissioned

Team Members

Commissioning Activities



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# Verify Installation and Performance

Installation Checklists

Installation Back-checks

Pre-Start Checks

Start-up

Functional Checks



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# Summary Cx Report

- Executive summary of the process
- A history of any system deficiencies
- Systems performance test results and evaluation
- Supporting information

In addition, for projects pursuing EA Credit 3

- A summary of the design review process
- A summary of the submittal review process
- A summary of the O&M documentation and training process

# Credit 3—Enhanced Commissioning

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





# Designate the CxA

Prior CD phase, designate an independent CxA

- The CxA shall have documented CxA experience in at least two building projects
- The individual serving as the CxA shall be independent
- The CxA shall report directly to the Owner.
- This requirement has no deviation for project size
- CxA shall perform Tasks 2, 3 and 6. Other team members may perform Tasks 4 and 5



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# Review Construction Documents

Review specifications and plans prior to “CD” phase

Back-check prior to completion of design



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# Review Contractor Submittals

Review contractor submittals applicable to systems being commissioned for compliance with the OPR and BOD.

- Meeting the OPR and BOD
- Operation and maintenance requirements
- Facilitating performance testing

The CxA review of contractor submittals does not, typically, substitute or alter the scope or responsibility of the design team's obligations to approve or reject submittals. Not for any other design team responsibilities, either!



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# Systems Manual

Develop a systems manual that provides future operating staff the information needed to understand and optimally operate the commissioned systems.

In addition to the O&M Manuals submitted by the Contractor  
Focuses on operating, rather than maintaining the equipment  
Particularly interactions between equipment.

System single line diagrams

Operating instructions for integrated building systems



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# Verify Training

Verify that the requirements for training operating personnel and building occupants are completed.

Based on the particular project, establish and document training expectations and needs with the Owner. Ensure that operations staff and occupants receive this training and orientation.

Pay particular attention to new or uncommon sustainable design features that may have a potential to be over-ridden or removed because of a lack of understanding. Document that the training was completed according to the contract documents.



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# Post Occupancy Review

Assure the involvement by the CxA in reviewing building operation within 10 months

Interview with O&M staff and occupants

Plan for resolution of outstanding issues



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# LEED for Existing Buildings Operations and Maintenance

- Passed by vote of members, January, 2008
- EA Credit 2.1—Investigation and Analysis
- EA Credit 2.2---Implementation
- EA Credit 2.3---Ongoing Commissioning
- Pre-1, Pre-2, credits 1, 3.1, 3.2, 3.3 (M&V), 4.1-4.4 (Renewable) & IEQ Credits also require Cx



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# LEED EB: O&M

## EA Credit 2.1— Investigation and Analysis

Intent—Develop an understanding of the building's systems

### Option A:

- EB Cx plan and conduct investigation and analysis
- Breakdown energy use from Pre-Req 1, ASHRAE Level I Energy Audit
- List occupant problems and capital improvements

### Option B:

- Conduct an ASHRAE Level II Energy Audit
- Savings and cost analysis of all practical measures—fit owner's programs
- List capital improvements that provide cost-effective savings



# 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 EB: O&M

## Plus Other Credits Requiring Cx

- Pre-1, Pre-2
- Credit 1 (energy)
- Credits 3.1, 3.2, 3.3 (M&V)
- Credits 4.1-4.4 (Renewable)
- IEQ Credits



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***Thank You For Coming!***

COMMISSIONING for  
***LEED***

New and Existing Buildings

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