abaa 2025 building enclosure conference

Building Enclosure Commissioning (BECx): Fundamentals, Standards, and Essential Practices

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AIA Continuing Education Provider

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Building Enclosure Commissioning (BECx): Fundamentals, Standards, and Essential Practices

This session provides a summary of Building Enclosure Commissioning (BECx), focusing on its role in delivering the building owner's vision by achieving a high-performing, durable building envelope.

It explores the structured BECx process, outlining how BECx providers, contractors, architects, and owners collaborate to meet performance goals throughout each project phase.

Emphasizing the critical role of air barriers, the session highlights their functions and illustrates how BECx supports air barriers in performing as intended.

abaa building enclosure conference

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Alessandra is a **Building Science Consultant** at **Stantec** and serves on the **Board of Directors** of the Building Science Association of Ontario (**BSAO**), formerly known as OBEC.

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Learning Objectives

1. Describe the Roles and Responsibilities in a BECx Project.
2. Outline Key Documentation and Verification Methods in BECx.
3. Discuss Relevant Standards and Guidelines for BECx.
4. Identify BECx's role in addressing deficiencies in the building enclosure.

Agenda

- BUILDING ENVELOPE
- BUILDING ENCLOSURE COMMISSIONING (BECx)
- BECx vs MECHANICAL COMMISSIONING
- AIR BARRIER
- BECx PROCESS

BUILDING ENCLOSURE COMMISSIONING (BECx)

What I Expected:

A classic, familiar choice – just like clear project expectations

What I Got:

A surprising result – when expectations aren't clearly communicated

BUILDING TYPES

Evolution of Buildings

Source: photo by author

EVOLUTION OF BUILDINGS:

- Buildings are getting **taller**
- Construction is getting **faster**
- Materials **advancing**
- Climate is **changing**

On the left:

Sagrada Familia, 1882 – 2026, Barcelona, Spain.

On the right:

Dubai Frame, 150 meters (492 ft) high, 2013-2018, Dubai, United Arab Emirates.

BUILDING ENVELOPE

BUILDING ENCLOSURE COMMISSIONING (BECx)

BECx vs MECHANICAL COMMISSIONING

AIR BARRIER

BECx PROCESS

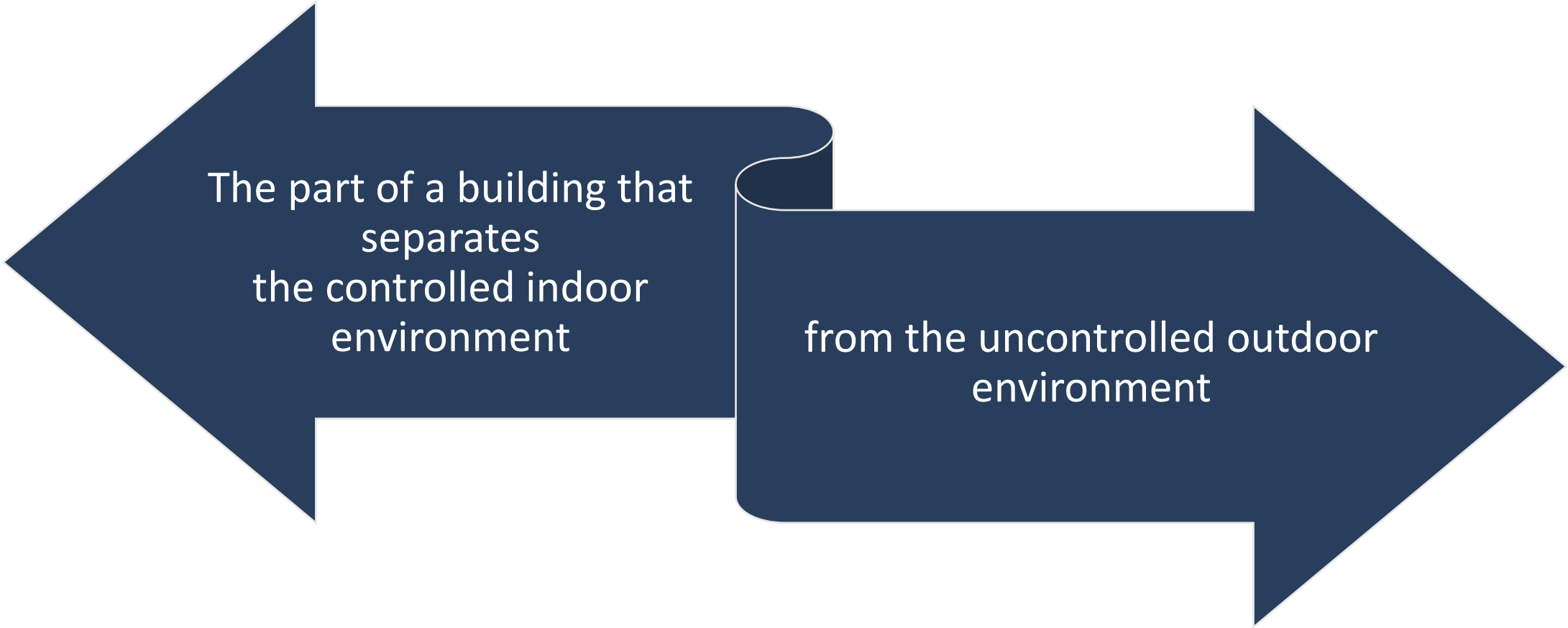
BUILDING ENVELOPE

Line of Defense

Source: internal MH presentation

WHAT IS BUILDING ENVELOPE?

Definition



Source: MH internal presentation

WHAT IS BUILDING ENVELOPE?

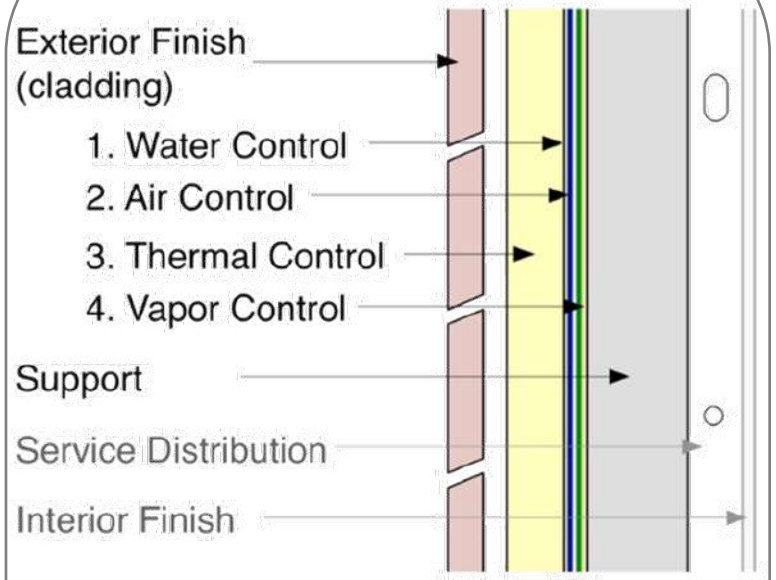
Envelope Layers

FUNCTIONAL LAYERS

- Finish
- **Control Continuity**
  - **Rain Control Layer**
  - **AIR CONTROL LAYER**
  - **Thermal Control Layer**
  - **Vapor Control Layer**
- Support Connected
- Fire Control
- Sound Control

CONTROL LAYERS

- Water Control Layer (WRB)
- Air Control Layer (**AIR BARRIER**)
- Vapor Control Layer (Vapor Retarder)
- Thermal Control Layer (Insulation)



PRACTICAL RULES

- Provide a Continuous Plane of Rain Control
- Provide Continuous **Air Barriers** and Insulation

Source: Schumacher, Chris (2024). Building Science Fundamentals. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison.

BUILDING ENVELOPE

BUILDING ENCLOSURE COMMISSIONING (BECx)

BECx vs MECHANICAL COMMISSIONING

AIR BARRIER

BECx PROCESS

WHAT IS BUILDING COMMISSIONING?

Definition

WHAT IS BUILDING COMMISSIONING

"A structured **quality process** intended to verify that a **building**, when delivered, meets the **owner's project requirements**."*

*Source: ASHRAE Guideline 0-2005, The Commissioning Process

WHAT IS NOT BUILDING COMMISSIONING

- NOT an "event"
- NOT a short-term "task"
- NOT just a "punch list" clearance
- NOT functional performance testing

Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison.

WHAT IS BUILDING COMMISSIONING?

Attributes

VERIFICATION

- Using principles of a quality process, everything is **verified** to provide a high level of confidence that the desired building and quality is achieved.
- Must verify **goals** are achieved during **predesign**, **design**, **construction**, **testing**, and **occupancy**.

NOT THE SAME AS **"ENSURE"**

- The BECxP **can verify** (or corroborate) that others are providing the desired level of quality
- The BECxP **cannot ensure** or guarantee that others will do anything

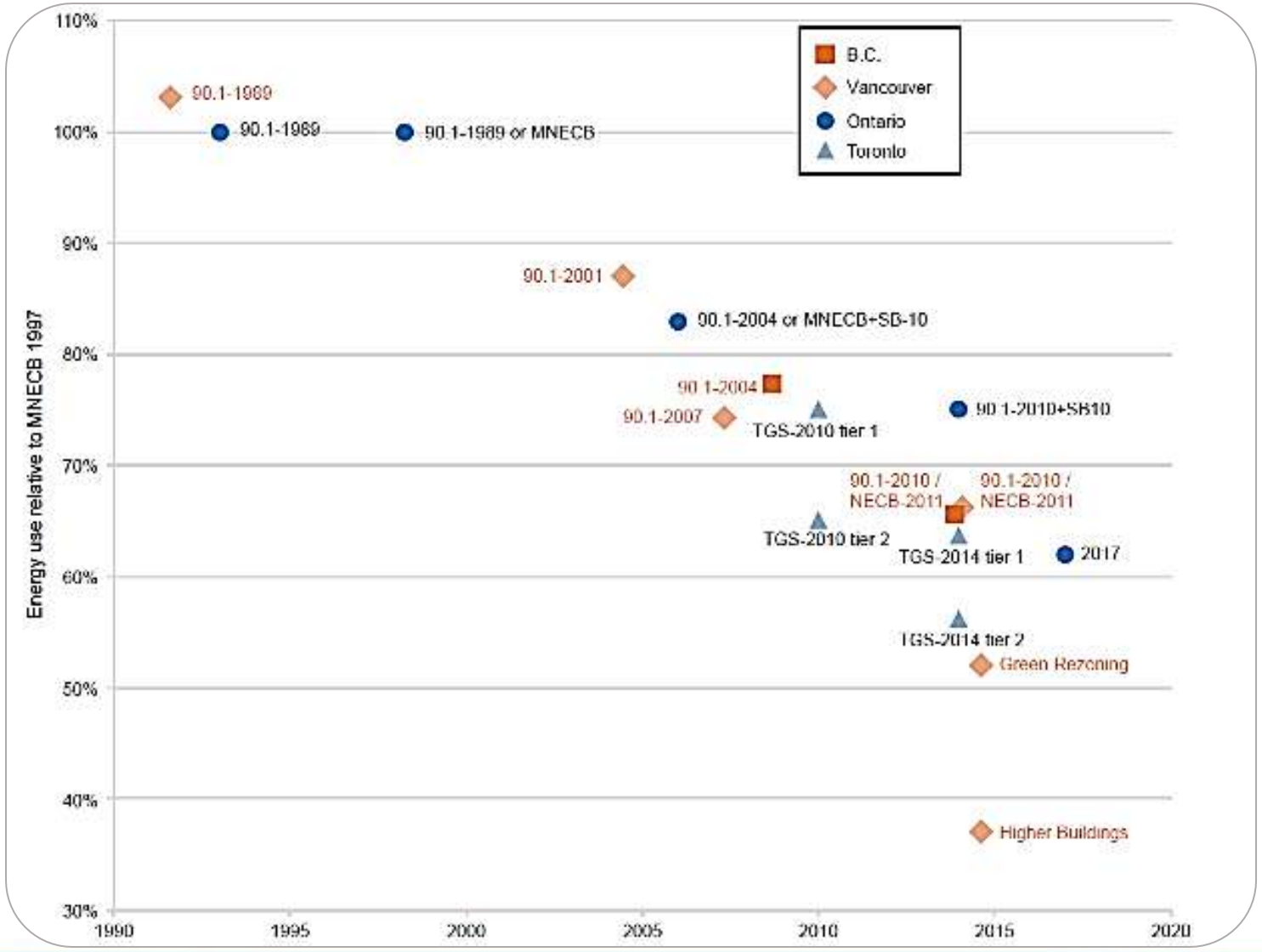
Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison. | Photo source: MH internal presentation

WHAT IS BUILDING COMMISSIONING?

Attributes

WHY SHOULD WE COMMISSION THE ENVELOPE?

The Ever-Changing Code



EVOLUTION OF ENERGY PERFORMANCE REQUIREMENTS

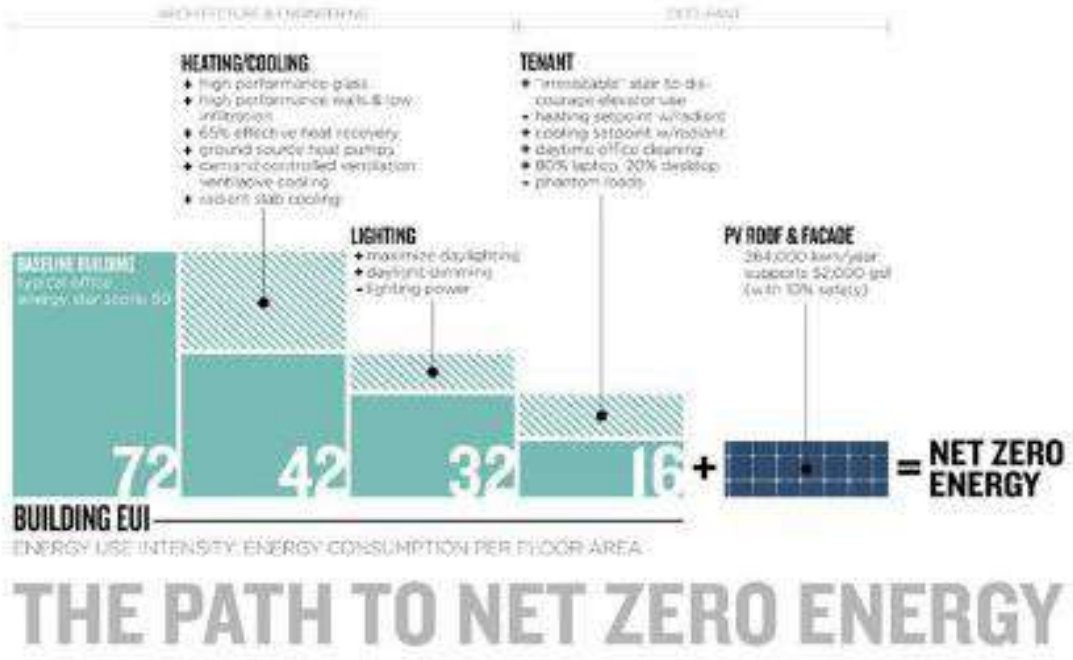
As **energy efficiency** becomes increasingly critical in project considerations, the **building envelope** assumes a vital role in the transition towards passive design principles.

Source: MH internal presentation

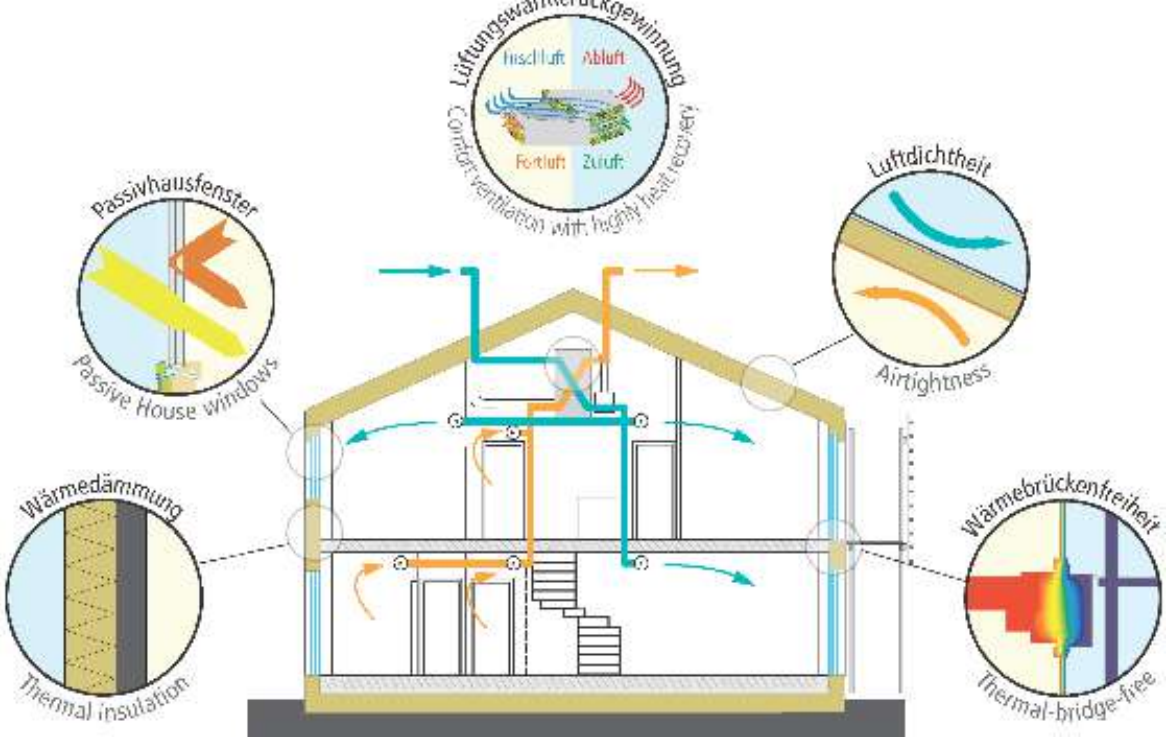
WHY SHOULD WE COMMISSION THE ENVELOPE?

Net Zero & Passive House

HIGH PERFORMANCE WALLS

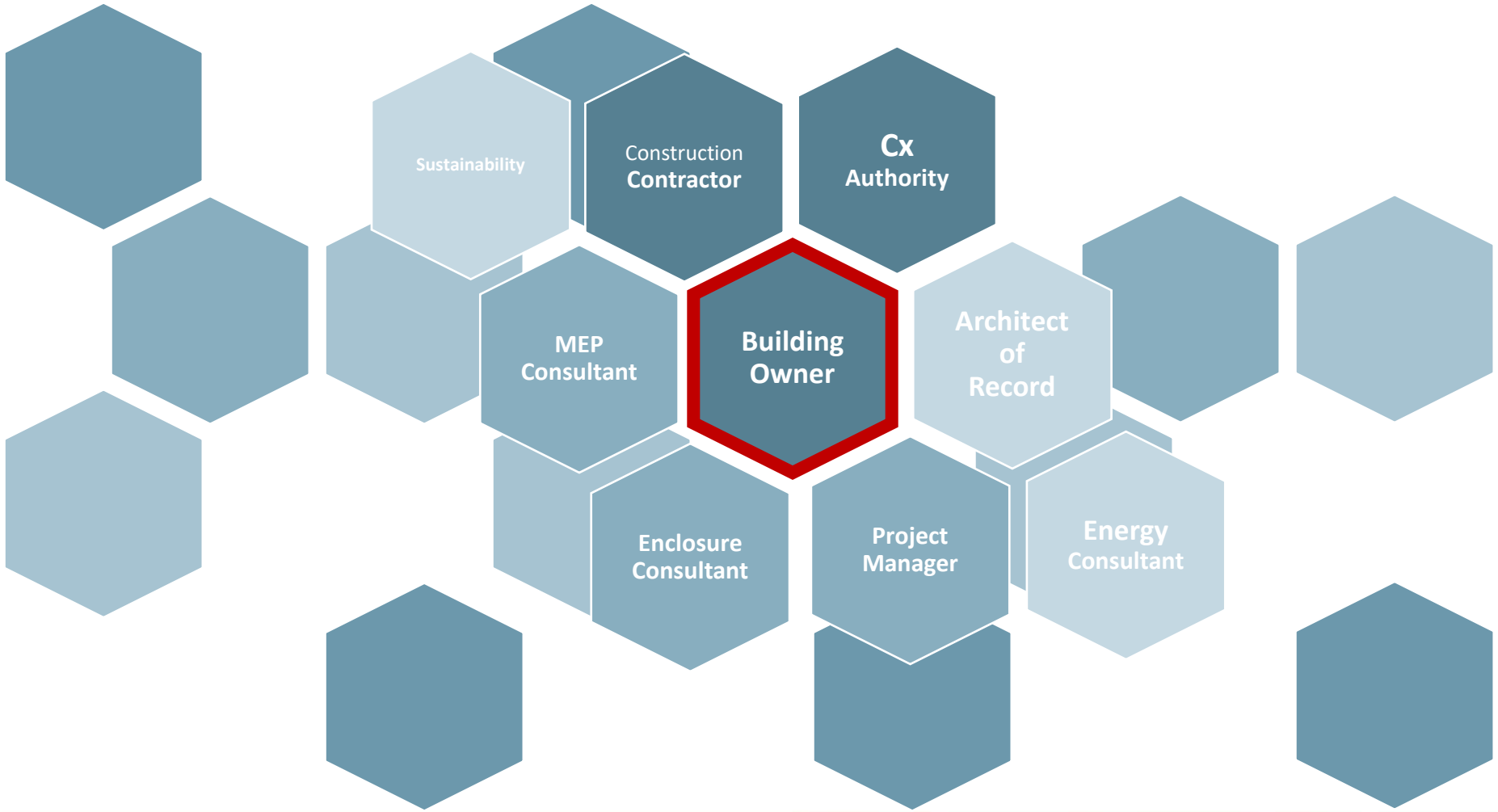


THERMAL BRIDGE-FREE



WHY SHOULD WE COMMISSION THE ENVELOPE?

Demand for Specialized Expertise



WHY SHOULD WE COMMISSION THE ENVELOPE?

Isn't This Already Done?

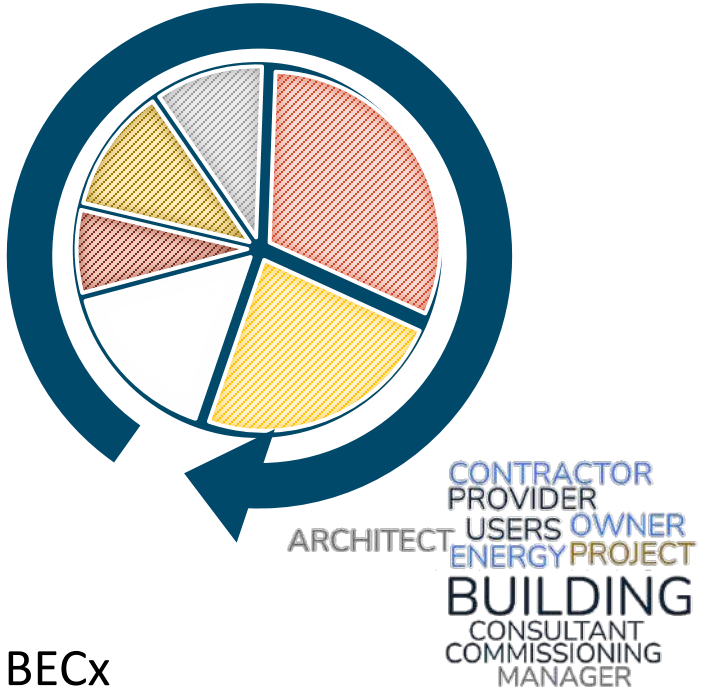
PURPOSE INCLUDES

- Establish **Team** and **Expertise**
- Align **Goals**
- Define **Roles** and **Responsibilities** (Including BECx)
- Plan for **Success**

STRATEGIES FOR SUCCESS

- Open **Communication** among all Stakeholders
- Align **Expectations** Across Stakeholders
- Clear Documentation of **Requirements** and Expectations
- Regular **Meetings** and Coordination During all Project Phases
- Utilize **Lessons Learned** for Future Projects

MINIMIZING OVERLAPS, GAPS AND CONFLICTS



BECx

- Fill in Gaps
- Encompasses "ALL"

BECx: ROLES AND RESPONSIBILITIES

"Quality is delivered by an expert team, not by a team of experts"*

OWNERS

- Establish Building **Goal**
- Engage **BECxP** Early
- **Support** Process
- Contracts to **Incorporate** BECx

ARCHITECT

- Involve BECxP **Early**
- Establish Assemblies and **Baseline Performance Requirements**
- **BECx Specification** - Project Manual
- Review **Submittals** Comments

BECx PROVIDERS

- Assist Owners with Building Envelope **OPR**
- Develop **BECx** Requirements
- **Review** Building Envelope Assemblies

CONTRACTORS

- QA/QC plan
- **Coordinate** Submittals
- **Schedule**: Building Envelope Testing
- Walk the Job Site with BECxP
- Checklists
- Issues Log
- Close Out documents

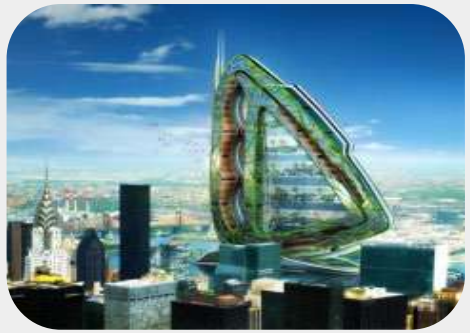
*Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison.

BECx: COMMISSIONING ALL?

Adaptable Process

DO WE HAVE TO DO IT ALL?

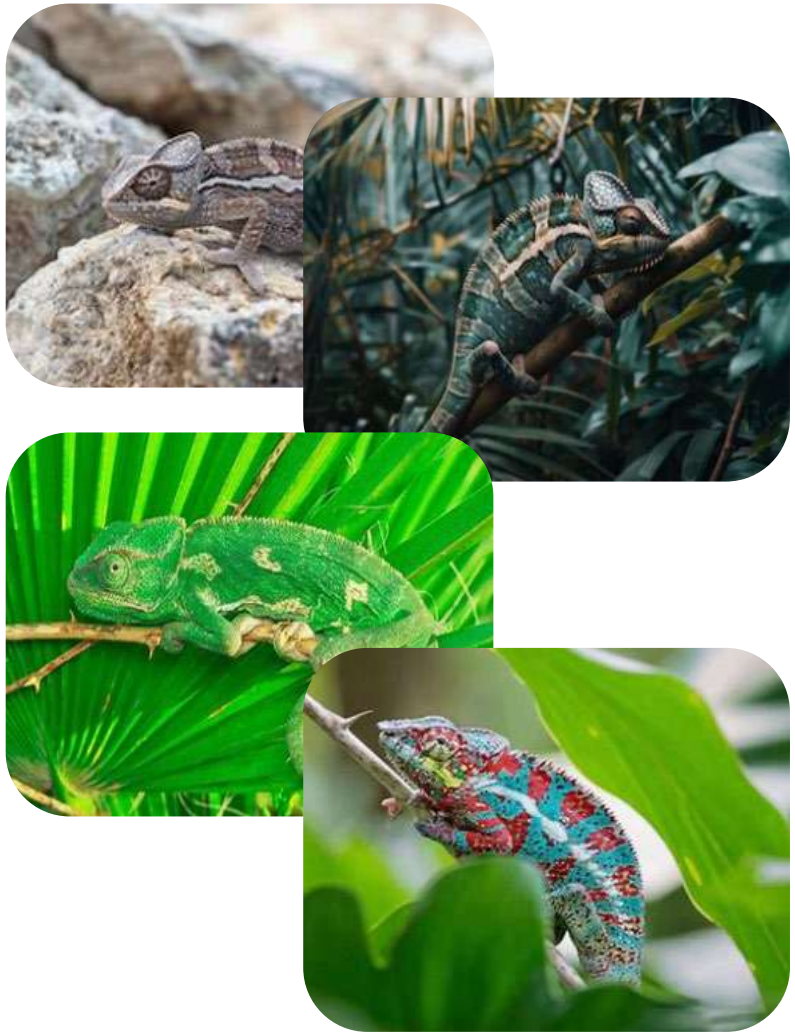
Unique and Untested



New to Market

THE COMMISSIONING OBJECTIVES … CAN VARY TREMENDOUSLY

- Every building and Commissioning project is **different**
- The scope of work will **vary**
- Depending on the **size** of the project, **system** complexity, **budget**, and the owner's **risk tolerance**
- **Adapt** the process to meet the project's specific goals



Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison. | MH internal slides | Photos: by naturetrek | tandemglobal.org |

BECx: WHAT ARE THE MAIN GOALS?

Project Success

HELPS ACHIEVE THE OWNER'S VISION, and:

- **High-performing** and Durable Building Envelope
- **Verification** of Material Selection
- **Compliance** with Codes
- Reducing Long-term Operational and Maintenance Costs
- Identifying Potential Failure Points **Early**
- Verifying Adherence to Best Practices and Industry Standards

MINIMIZES RISKS ASSOCIATED WITH:

- Air Leakage
- Water Infiltration
- Material Failures
- Energy Inefficiencies

Frank Gehry's concept for Toronto, ON, Canada

Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison. | MH internal slides

HOW DID WE GET HERE?

Standards and Guidelines

1996: ASHRAE Guideline 1-1996: The HVAC Commissioning Process

2005: ASHRAE Guideline 0-2005: The Commissioning Process

2006: NIBS Guideline 3 – 2006 (Technical Requirements for the Commissioning Process)

2007: ASHRAE Guideline 1.1 – 2007: HVAC&R Technical Requirements for the Commissioning Process

2011: CSA Guideline Z320-11 – 2011: Building Commissioning Standard (Whole-Building)

2012: **NIBS Guideline 3-2012** (Building Enclosure Commissioning Process BECx)

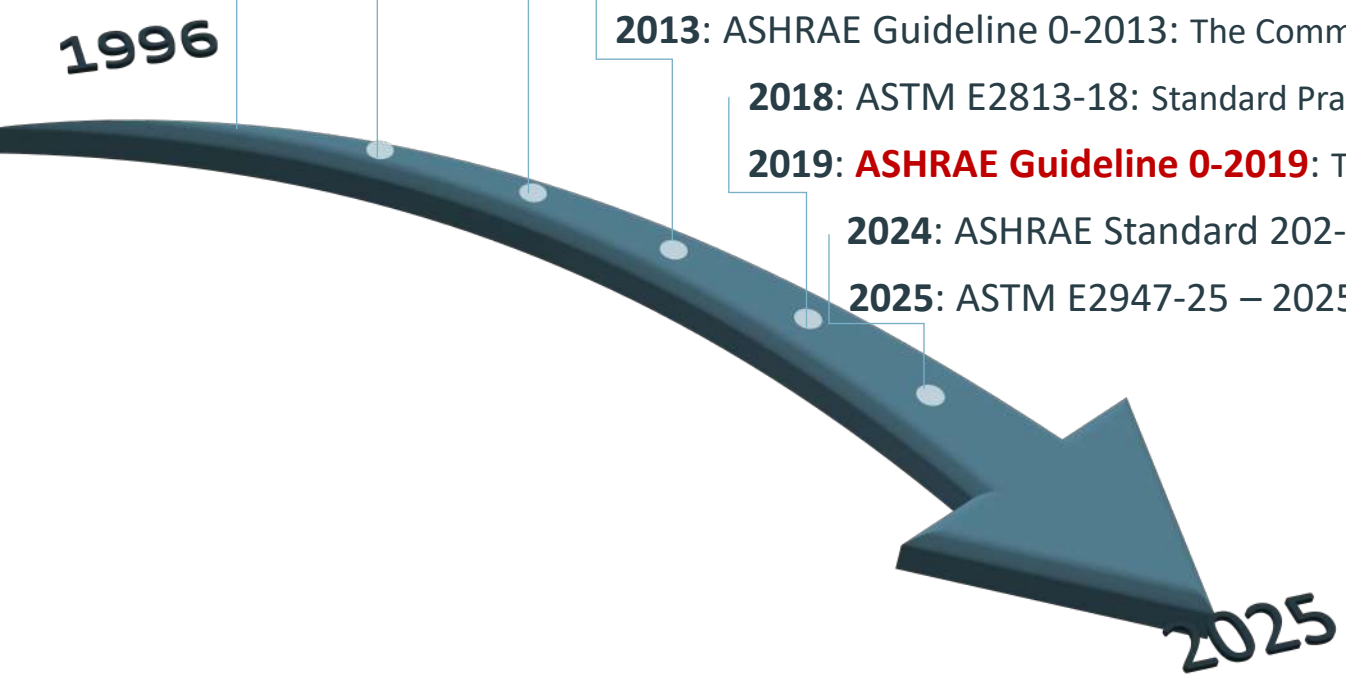
2013: ASHRAE Guideline 0-2013: The Commissioning Process

2018: ASTM E2813-18: Standard Practice for Building Enclosure Commissioning

2019: **ASHRAE Guideline 0-2019**: The Commissioning Process

2024: ASHRAE Standard 202-2024: The Commissioning Process Requirements for New Buildings

2025: ASTM E2947-25 – 2025: A Standard Guide for Building Enclosure Commissioning



Guideline 0 – Defines the **process**.
Guideline 3 – How to **apply** the process to enclosure elements.

Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison - ADAPTED

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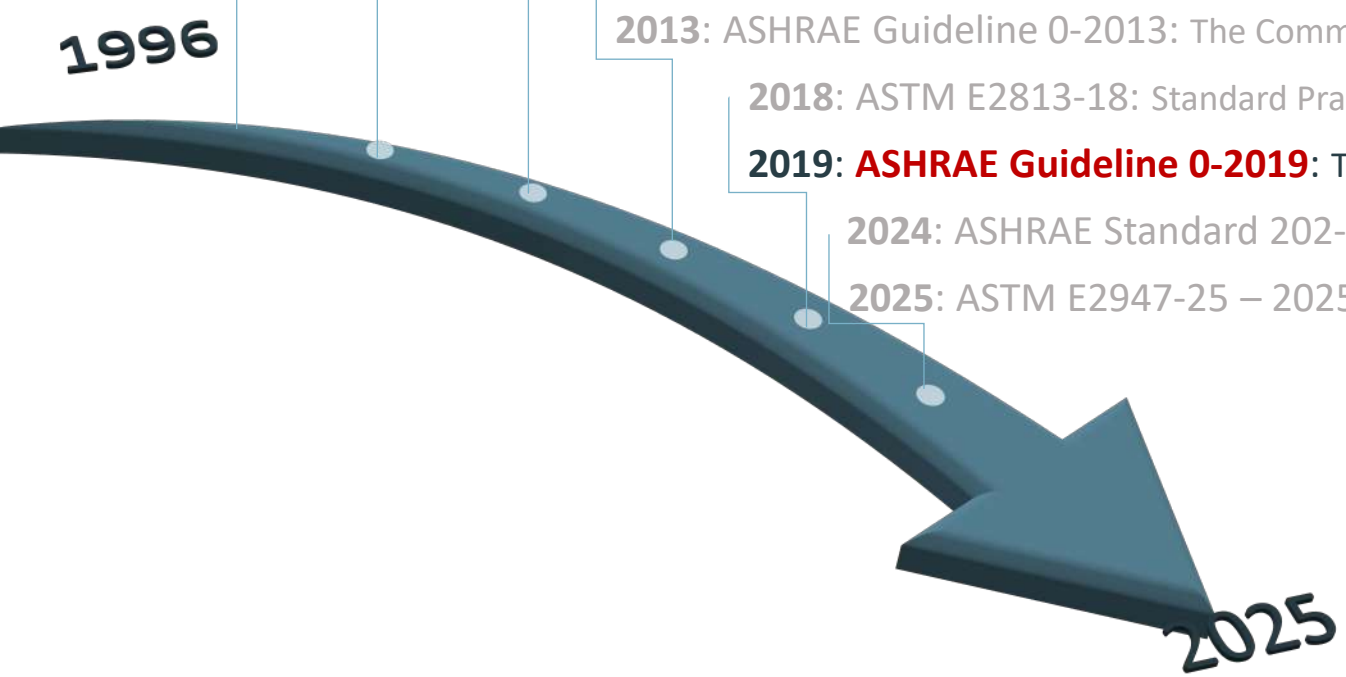

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HOW DOES IT KEEP EVOLVING?

Professional Groups and Associations

- ASHRAE
  www.ashrae.org
- Building Commissioning Association (BCA)
  www.bcxa.org
- AABC Commissioning Group (ACG)
  www.commissioning.org
  (AABC is Associated Air Balancing Council)
- NIBS
  www.nibs.org
- California Commissioning Collaborative
  www.cacx.org
- And others…

Source: MH internal slides

WHEN SHOULD BECxP GET INVOLVED?

Savings *vs.* Cost

BENEFITS AND COST SAVINGS POTENTIAL *vs.* COST TO IMPLEMENT OR CHANGE

Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison - ADAPTED

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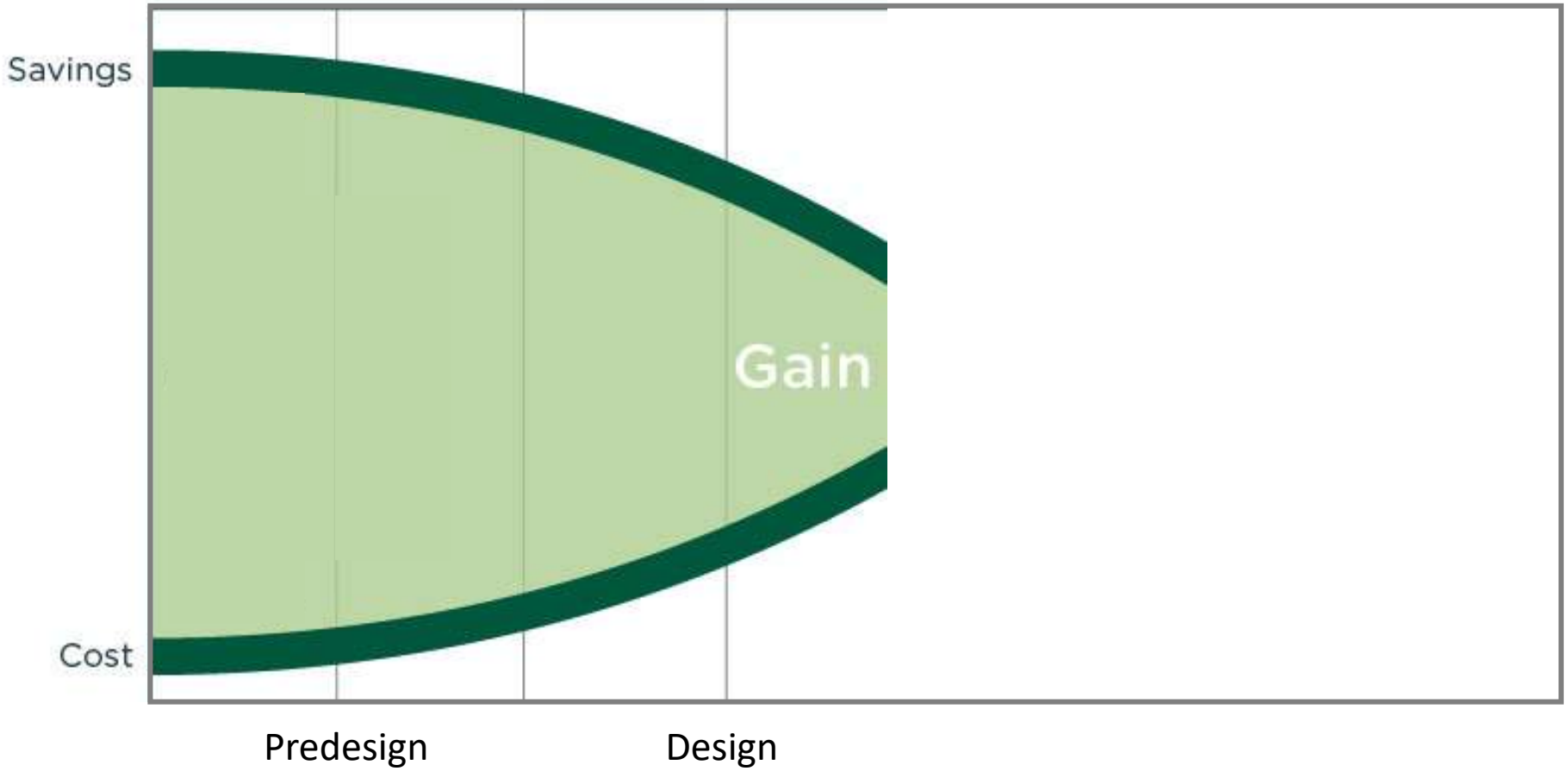

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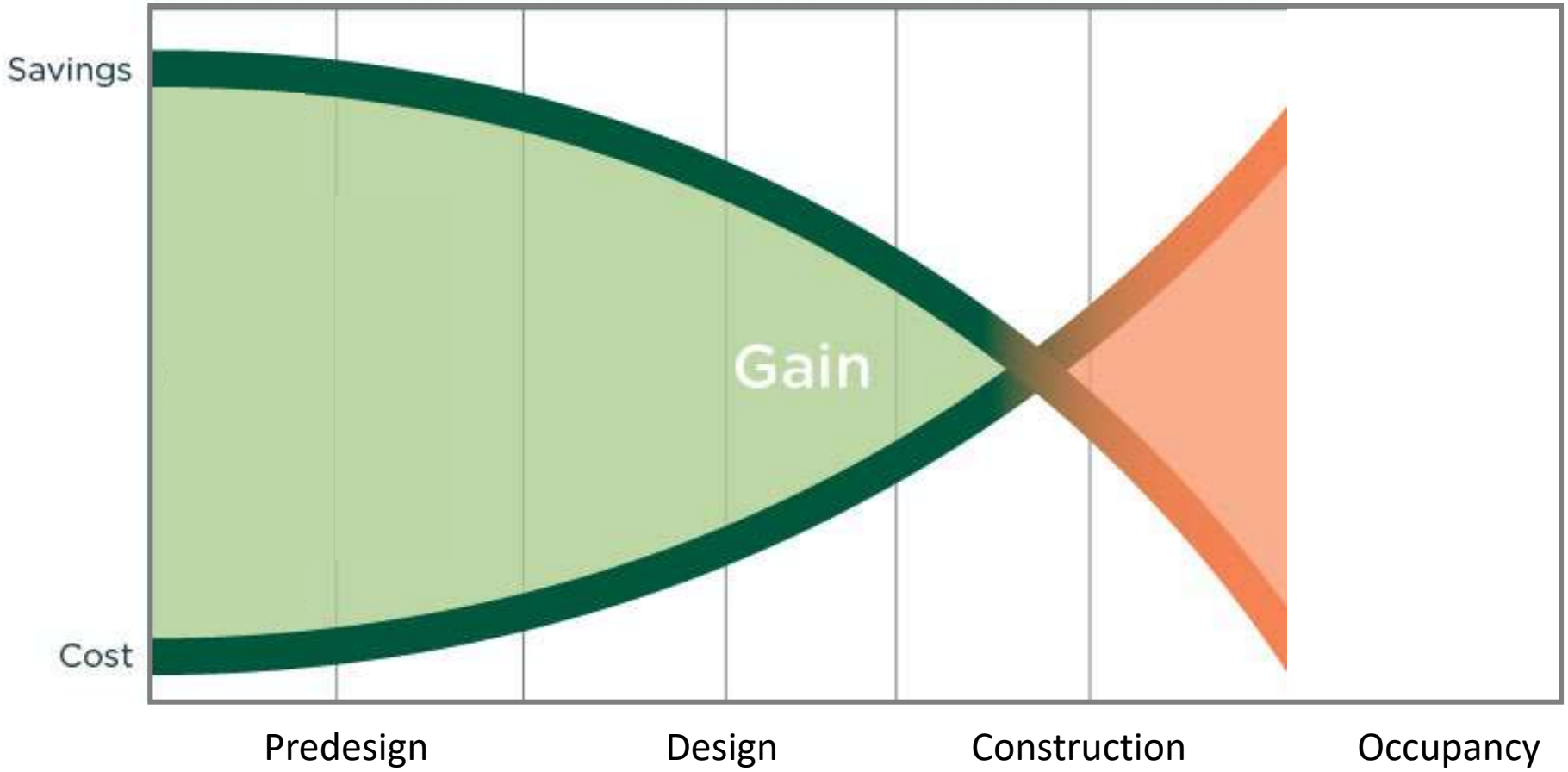

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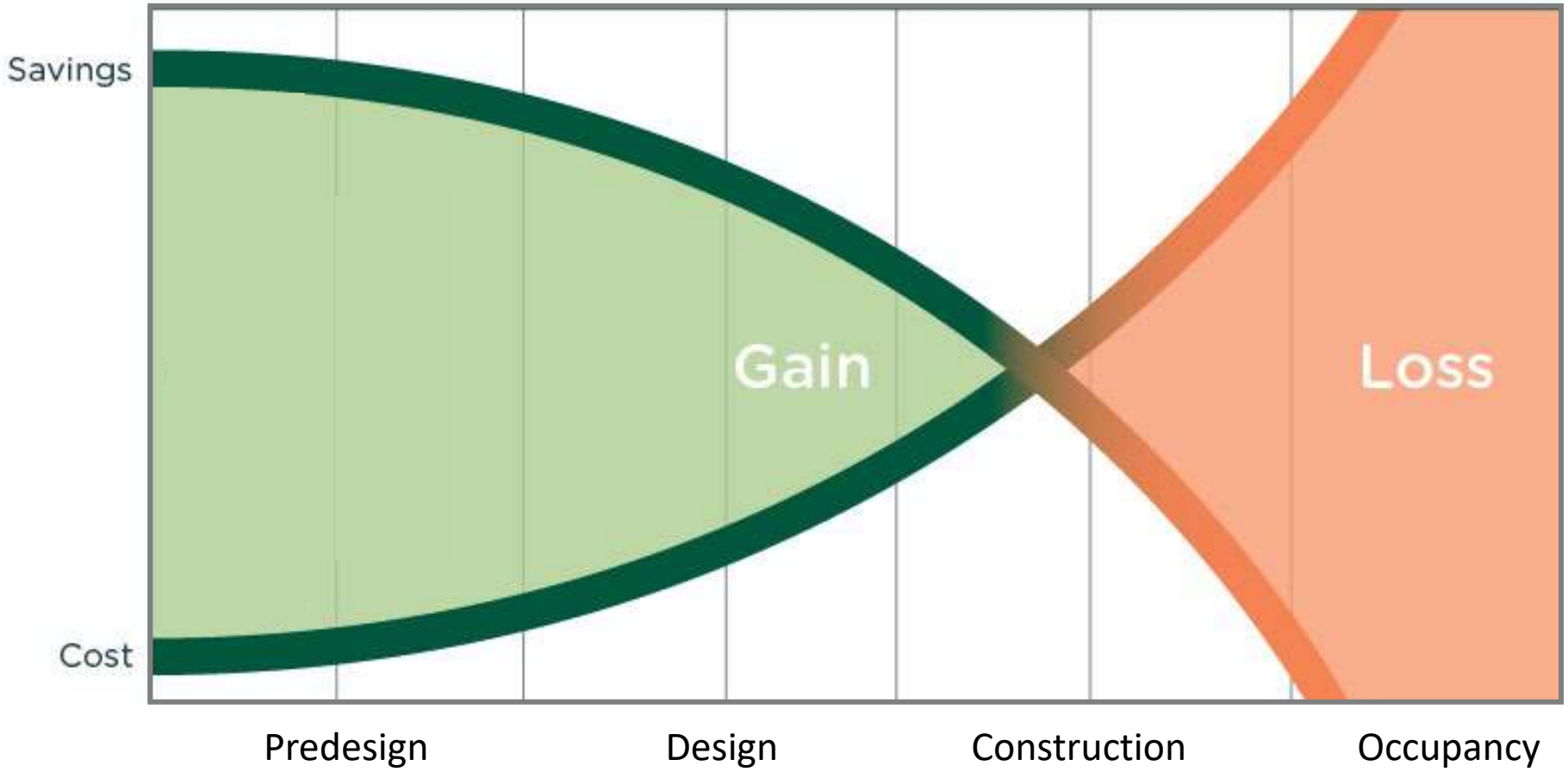

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BUILDING ENVELOPE

BUILDING ENCLOSURE COMMISSIONING (BECx)

BECx *vs* MECHANICAL COMMISSIONING

AIR BARRIER

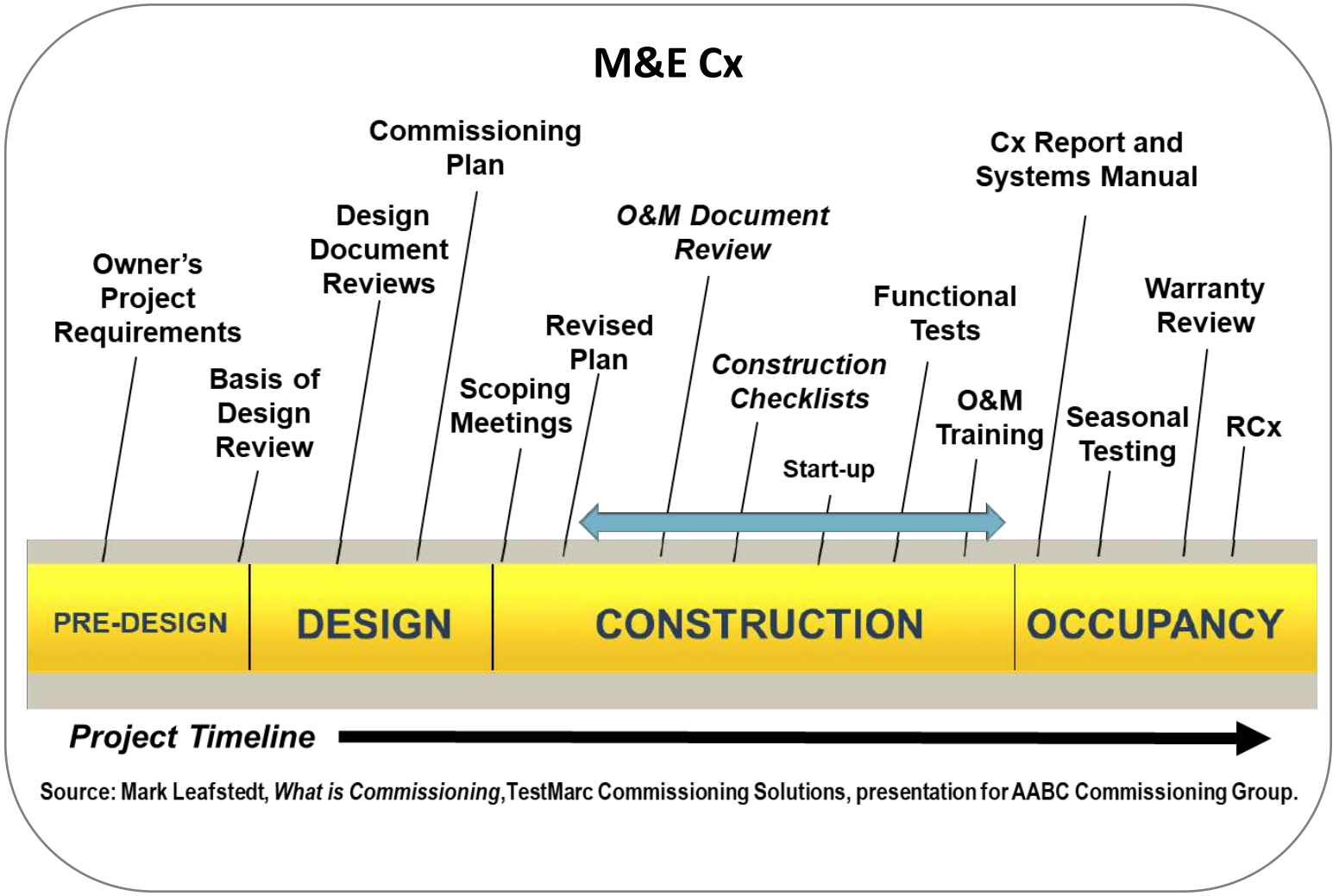
BECx PROCESS

HOW IS BECX DIFFERENT FROM MECHANICAL CX?

Similar Steps as M&E Cx, but:

BECx

- **Systems Are Different**
- More Often **"Site-built"** Assemblies
- Often Built in **Problematic Weather**
- **Multiple Manufacturers** and **Trades** at **One Location**
- **Can Not** Wait Until the End to Test



Source: Mark Leafstedt, *What is Commissioning*, TestMarc Commissioning Solutions, presentation for AABC Commissioning Group.

BUILDING ENVELOPE

BUILDING ENCLOSURE COMMISSIONING (BECx)

BECx vs MECHANICAL COMMISSIONING

AIR BARRIER

BECx PROCESS

COMMISSIONING – **AIR BARRIER**

Air Leakage Problems

WINDOW INTERFACE

FAILURE AT ROOF PARAPET

FAILURE AT SOFFITS AND DECKS

AIR BARRIERS

What is It and Why Does It Matter?

WHAT IS AN AIR BARRIER

- Assembly Installed to Provide a **Continuous Barrier** to the Movement of Air Across the Building Envelope

AIR BARRIER PERFORMANCE

- **Component** Air Tightness
- **System** Air Tightness
- **Assembly** Air Tightness

CONSEQUENCES OF POOR CONTROL

- Poor **Thermal** Comfort Interstitial Condensation
- **Durability** / Corrosion / Mold
- Freeze-thaw **Damage**
- Potential Adverse Effect On Indoor **Air Quality**
- Increased **Sound** Transmission

ROLE OF BECxP

- Verify the **Performance** of the **Air Barrier** System/Assembly During the Process of Construction
- Identify **Deficiencies** and Improvements in **Materials**, **Methods,** and **Sequencing**
- Document **Revisions**
- Implement **Approved Process** on a Widespread Basis.

AIR BARRIERS

Building Type: Effective Air Barrier - Do All Buildings Require a High-Performance Air Barrier?

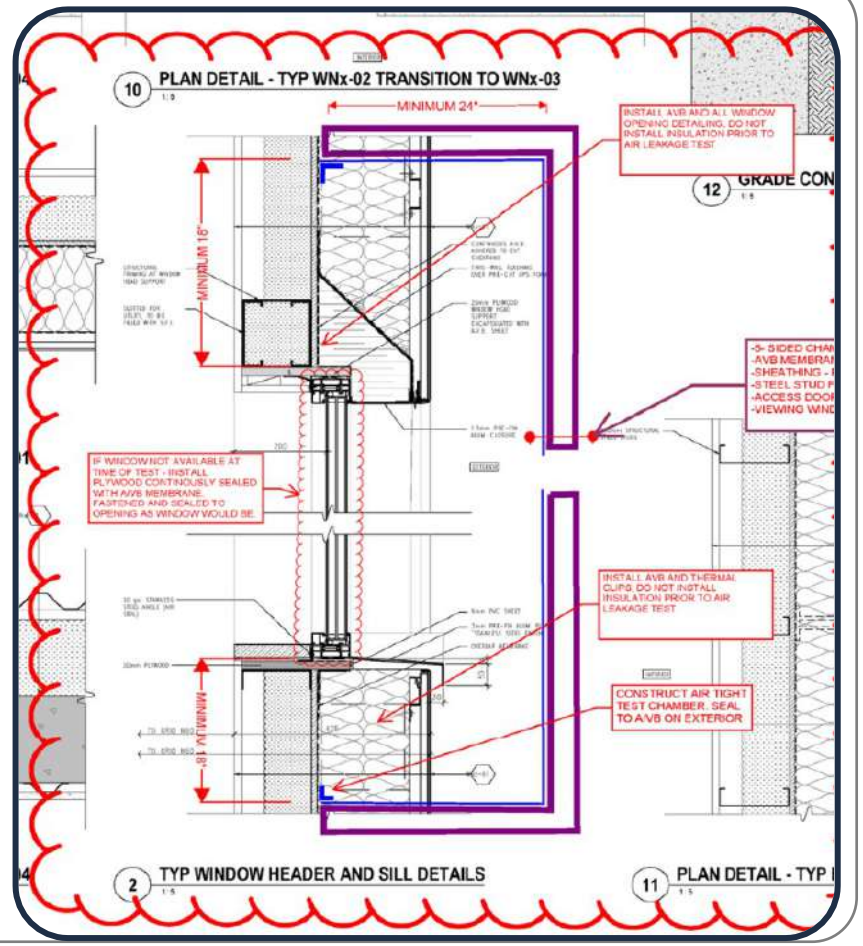
AIR BARRIERS

- Owners **Requirements**
- Project **Location**
- Building **Function**
- **Occupancy**
- Environmental **Conditions**

AIR BARRIERS

Performance

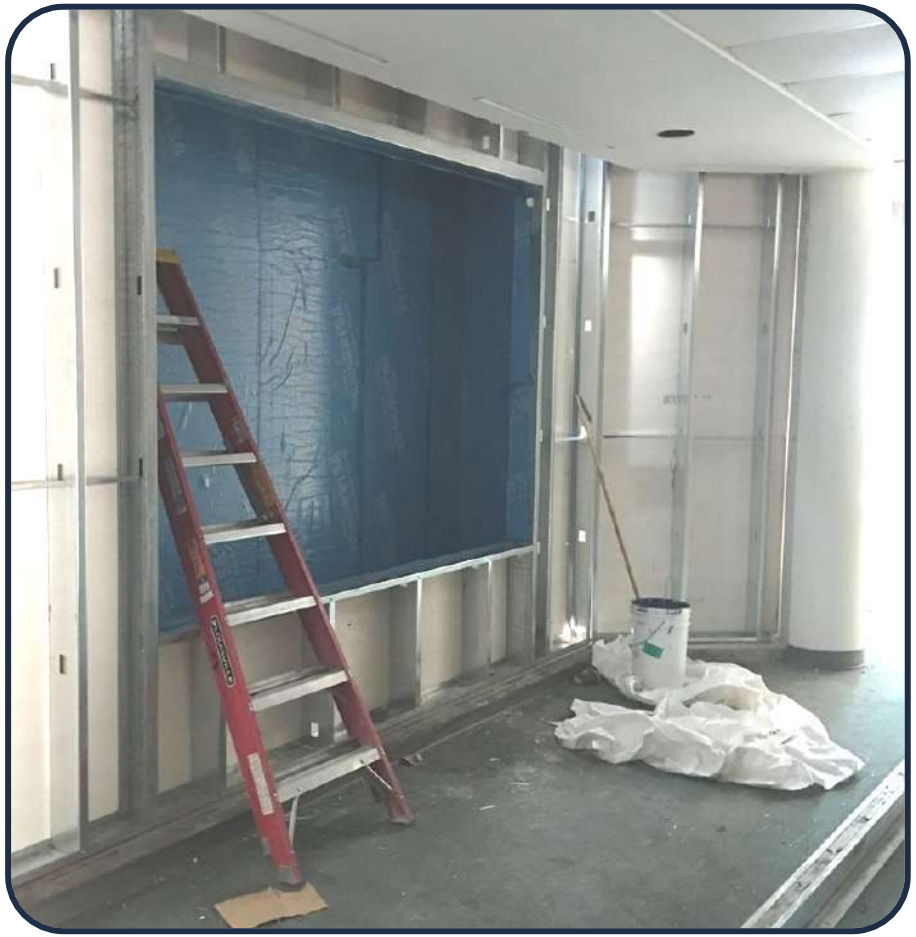
- Component Air Tightness
- System Air Tightness
- Assembly Air Tightness



AIR BARRIERS

Performance

- Installation **Process** and **Sequence**
- **Air Test** the Completed **Mock-Up** Installation
- Approve **Installation** Process and **Materials** Based on Successful Test



BUILDING ENVELOPE

BUILDING ENCLOSURE COMMISSIONING (BECx)

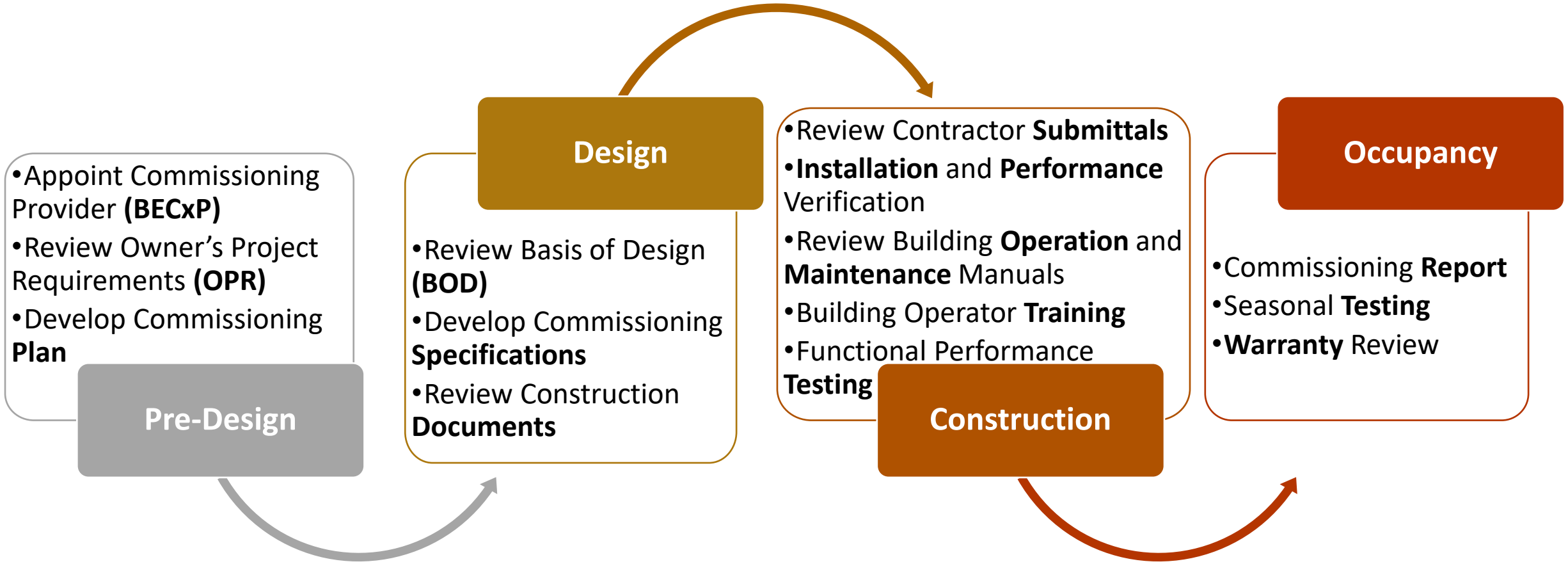
BECx vs MECHANICAL COMMISSIONING

AIR BARRIER

BECx PROCESS

BECx Process

Project Phases



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BECx Process

Pre-Design:

DEFINE PROJECT EXPECTATIONS

- APPOINT COMMISSIONING PROVIDER (BECXP)
- REVIEW OWNER'S PROJECT REQUIREMENTS (OPR)
- DEVELOP COMMISSIONING PLAN (BECx PLAN)

OWNER'S PROJECT REQUIREMENTS (OPR)

- Durability
- **Air / Water Leakage Criteria**
- Vapour Control
- Thermal Performance
- Fire Resistance
- Acoustic Performance
- **Testing Requirements**
- Energy
- Define Quality

COMMISSIONING PLAN (BECX PLAN)

- **Roadmap**
- Align **Goals**
- **Guidance on Systems** to be Commissioned
- Define **Roles and Responsibilities** (including BECxP)
- **Dynamic Document**
- Plan for Success

Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison.

BECx Process

Design:

QUALITY ASSURANCE

- Review Basis of Design (BOD)
- Develop Commissioning Specifications (BECx Specifications)
- Review Construction Documents

BASIS OF DESIGN (BOD)

- Document Created by the Design Team
- Includes **Design Decisions**
- Describes How Design Team Transformed the OPR Into an Actual Design
- Critical For **Long-term Performance** and Future Renovation

COMMISSIONING SPECIFICATIONS

- **Testing Requirements** (Manufacturer or On-site, Pass/Fail Criteria, etc.)
- Shop Drawing **Submittal Requirements**
- **Material** Submittal Requirements
- Mandatory **Mock-ups**
- Includes **Key Milestones**

CONSTRUCTION DOCUMENTS

- **Compliance** with OPR
- Detailing Issues
- **Material** Compatibility
- Reviews Should Include:
  - **Air leakage**
  - Vapor Diffusion
  - Heat Transfer
  - Water Penetration

Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison.

BECx Process

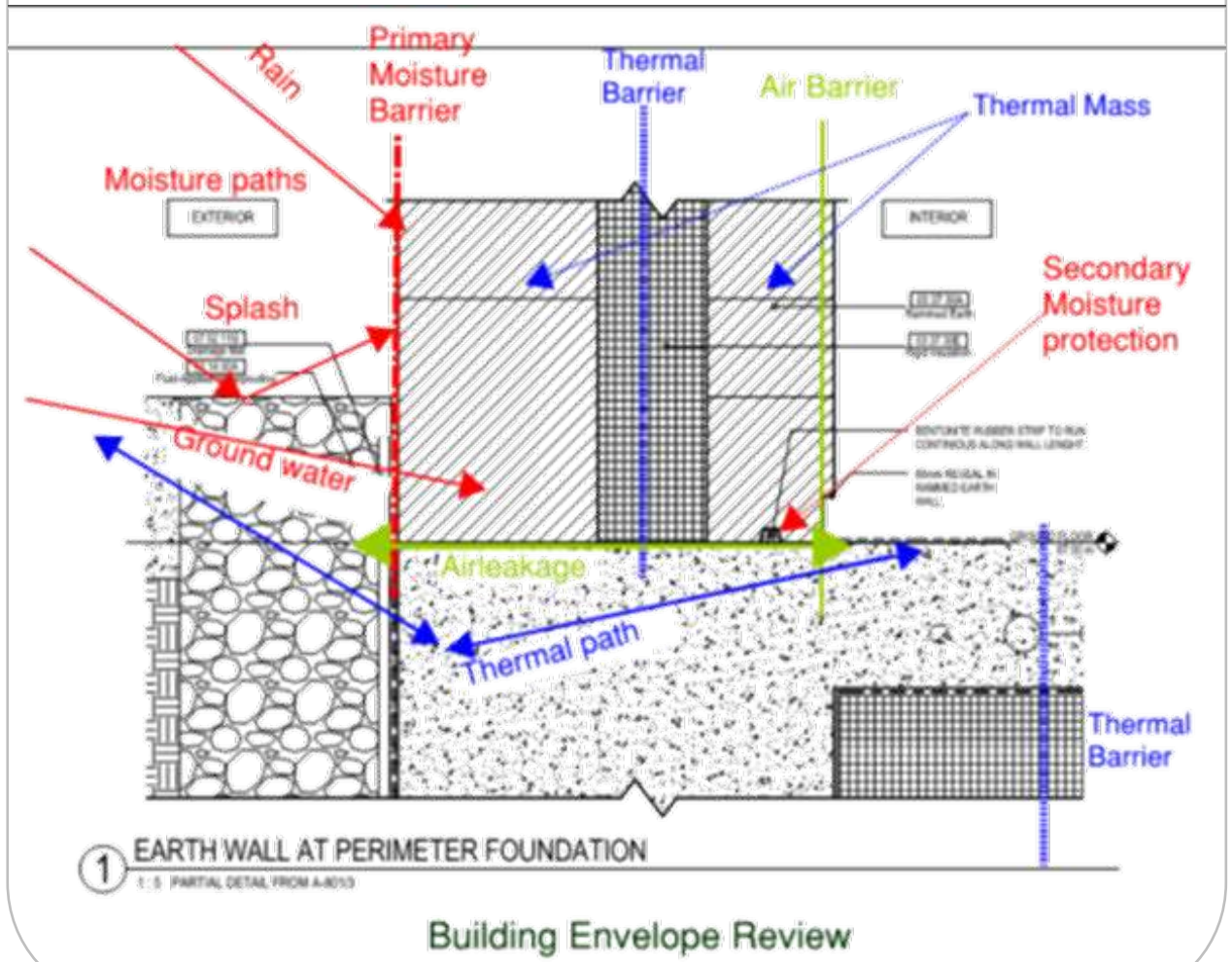
Design

QUALITY ASSURANCE

DESIGN REVIEWS MAY INCLUDE

- References to Practice Guides or Design Reference Documents
- Marked-up Drawings & Specs
- Meeting Minutes
- Review of Similar Buildings

REVIEW OF DESIGN



Building Envelope Review

Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison.

BECx Process

Construction

QUALITY CONTROL and VERIFICATION

- Start-up Meeting
- Review Contractor Submittals
- Installation and Performance Verification
- Review Building Operation and Maintenance Manuals
- Building Operator Training
- Field Functional Performance Testing

START-UP MEETING

- Transfer Design Information to the Contractor and Trades
- **Review BECx Plan**
- **Establish Roles** During Construction
- Establish Quality Control & Quality Assurance Activities

SUBMITTAL REVIEW

- Independent Review to Verify Submittals And Substitutions Meet OPR
- Accomplished Concurrently With **Design Team** and **Owner Review**
- **Input** Provided to Design Team for Integration With Their Comments

INSTALLATION and PERFORMANCE VERIFICATION

- **Site Visit** Reports, **Issues** Log, Field or Laboratory **Mock-ups**
- **GOAL: Avoid Rework**
- Trades use **Checklists** to Avoid Systemic Errors
- Identify Accordance with Contract Documents
- Provide Owner with Record of Progress

Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison.

BECx Process

Construction

QUALITY CONTROL and VERIFICATION

CONSTRUCTION CHECKLISTS

- Development of Checklists with the Assistance of Trades
- Individual Trade Pre-Construction Meetings
- Collaboration Between Contractor, Subcontractor, and BECxP Quality-Oriented Review of Work

BECx PROVIDER VERIFICATION CHECKLIST

Prestart Requirements

❑ Notified BECxP prior to start

❑ Weather, humidity, and surface are manufacturer compliant

Material

❑ Product on site matched Design Team approved submittal

❑ Substrate reviewed and ready for install

Surface Preparation

❑ Substrate swept, blown, wiped, no visible defects

Installation Verification

❑ Product applied without voids or exposed substrate

Membrane Protection

❑ Protected from prolongued exposure

Repair or Finish Work

❑ Repairs in compliance with Manuf. Spec

❑ No dissimilar materials present and used for repairs

Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison.

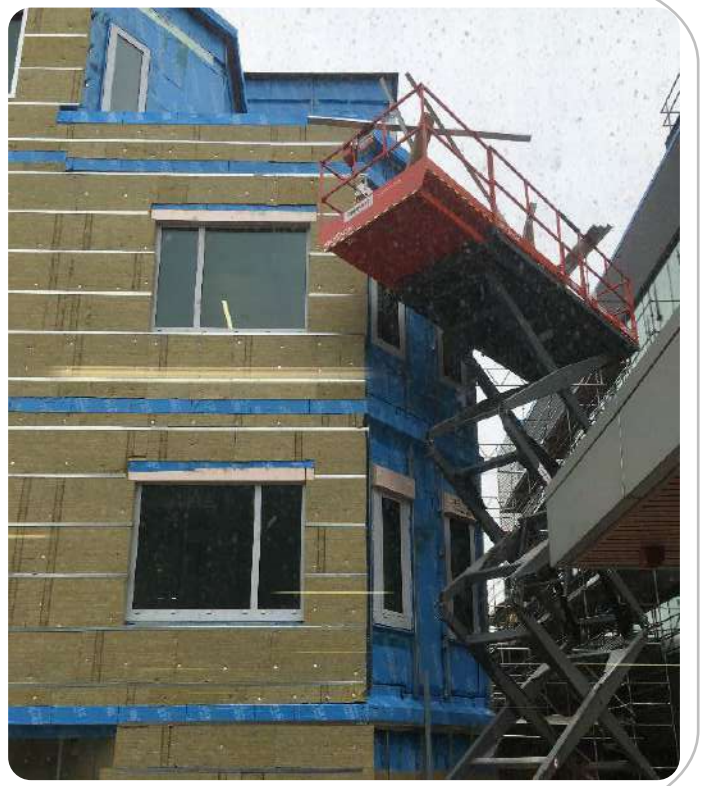
BECx Process

Construction

QUALITY CONTROL and VERIFICATION

FIELD MOCK-UPS REVIEW DEMONSTRATE:

- Sub-contractor's Workmanship & **Quality Control**
- Potential **Transition Issues**
- Contractor's **Quality Assurance Activities**
- **Expected** Quality of Installation
- **Roles and Responsibilities** of the Team Members
- **Comfort Level** for Future Installations



Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison. | Photo: MH internal slides

BECx Process

Construction

QUALITY CONTROL and VERIFICATION

BECx TESTING

- **Right Amount**
- **Early Identification** of **Air Barrier Deficiencies**
- Typical Air Barrier Field Functional Performance Testing
- **Qualitative Air Testing**
  - Detect the location of air leaks, not measure how much air leaks (smoke pencil, Infrared Thermography, bubble gun test).
- **Quantitative**
  - Water and Air Penetration Resistance Testing

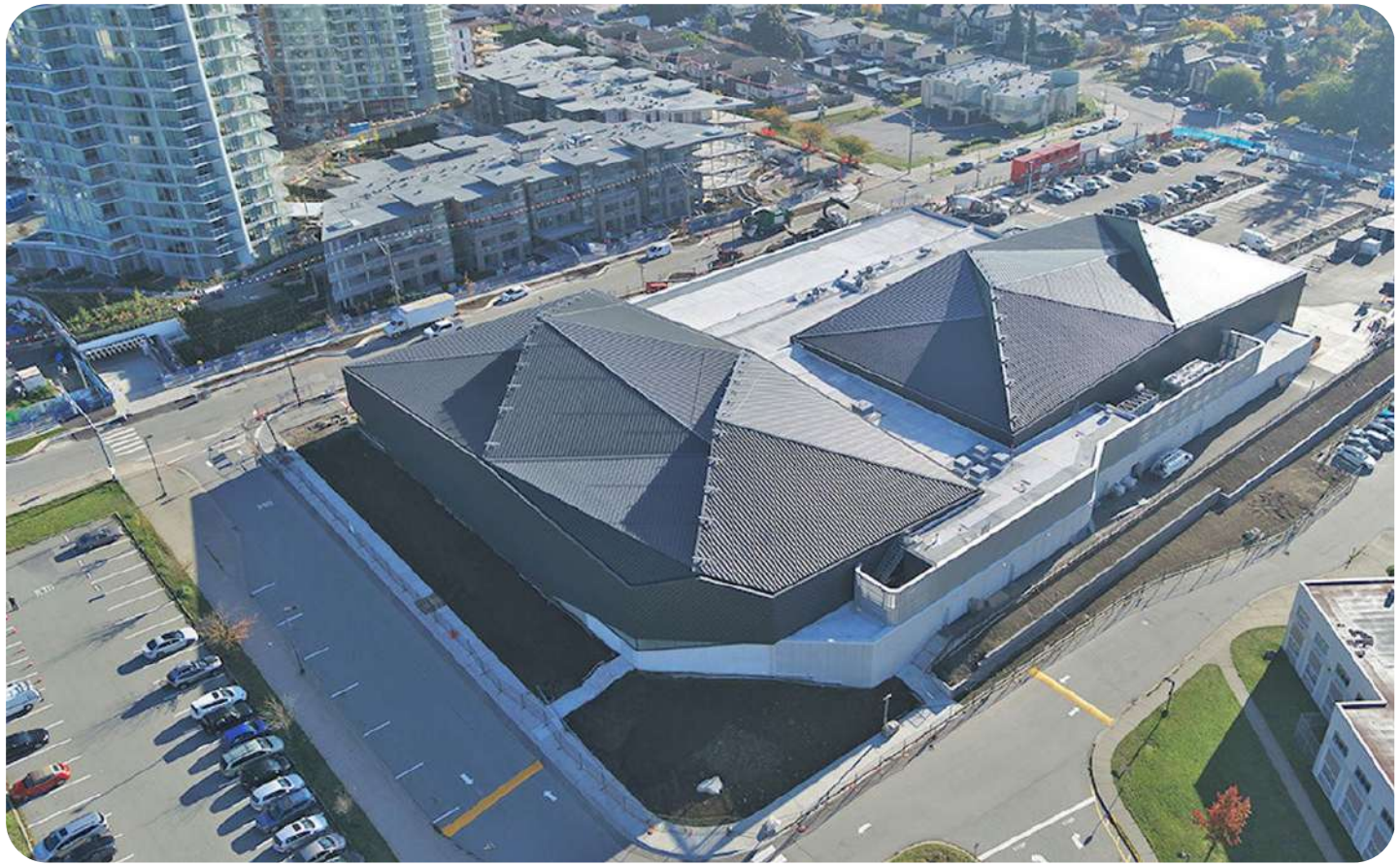
Source: McIntosh, Ian. (2024). The Commissioning Process: A Review of Concepts, Terminology, Tasks, and Deliverables. Commissioning Building Enclosure Assemblies and Systems. University of Wisconsin-Madison. Photo: MH internal slides

BECx Process

Close Out Phase

OCCUPANCY AND OPERATIONS

- Perform Pre-warranty Site Visit: A 10-month Review
- Review O&M Submittals
- **Provide Final BECx Report**
- Training: Collaborations with Owner and Contractor (to Educate Engineering Staff on Enclosure Maintenance and Operations)
- Ongoing Commissioning



Conclusion & Key Takeaways

QUALITY AND PERFORMANCE THROUGHOUT THE BUILDING LIFECYCLE

SIMPLY
SET GOALS, CHECK GOALS, MEET GOALS

AIR BARRIER IS ESSENTIAL

“THE COMMISSIONING OBJECTIVES … CAN VARY TREMENDOUSLY…”

DESIGN IT RIGHT,
TEST TO CHECK

TIMING IS CRITICAL

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THANK YOU

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