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Celebrating the Past – Focusing on the Future

RCI

30th Anniversary

1983 - 2013

Rosen Shingle Creek Resort
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Building Envelope Commissioning

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Objectives

- **Define “NIBS” Building Envelope commissioning, that grew out of ASHRAE commissioning, originally intended only for mechanical systems.**

- **Provide a case study of where the Building Envelope Commissioning process was used in a rapid paced, fast track Apartment project.**

- **Walk step by step thru this building envelope commissioning process.**

Why Building Envelope Commissioning?

- Reduce risk of leaks, disruption, law suits, loss of rents and remedial construction
- Substantially reduce long term operating costs – of the total cost of a building over its life, up to 80% is operating costs.
- Complete fast track projects even earlier, by early identification and resolution of issues.
- Generate rental revenue earlier, reducing substantial cost of carrying construction money, loans, etc.

Building Envelope Commissioning Process

- Building Envelope Commissioning process is integrated with design and quality assurance services.
- Commissioning starts with the schematic design, continuing through construction quality assurance services.
- Clarification of objectives from the very beginning.
- Better planning and proper selection of systems to meet client objectives such as costs, sequencing and scheduling.

Commissioning Defined

A Little History

- **1982 – American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) begins work on commissioning guidelines.**
- **1989 – First ASHRAE guideline on commissioning of mechanical systems.**
- **2005 – Publication (continuously amended) of ASHRAE guideline on The Commissioning Process for the whole building.**
- **2006 – Publication (continuously amended) of National Institute of Building Sciences (NIBS) Exterior Enclosure Technical Requirements For the Commissioning Process.**

A Little History - Continued

- **2011 – California Green Building Standards Code, including Commissioning, Codified into Title 24.**

- **2012 – Latest publication of NIBS exterior enclosure technical requirements for the commissioning process.**

- **2012 - ASTM International and NIBS announce their agreement to collaborate on developing a building-enclosure commissioning process that the organizations said would facilitate improved building-enclosure design and commissioning programs.**
  - As part of the agreement, NIBS Guideline 3 will be developed and published as an ASTM Standard Guide by ASTM Subcommittee E06.55 on Building Enclosure Performance, part of ASTM Committee E06 on Performance of Buildings.

Building Commissioning Process

According to ASHRAE and the National Institute of Building Sciences (NIBS), the building commissioning process is:

- A quality oriented way of achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets owner-defined objectives, from concept to operations and maintenance.

- A system by which owners, architectural programmers, designers, contractors, and operations and maintenance personnel are fully accountable for the quality of their work.

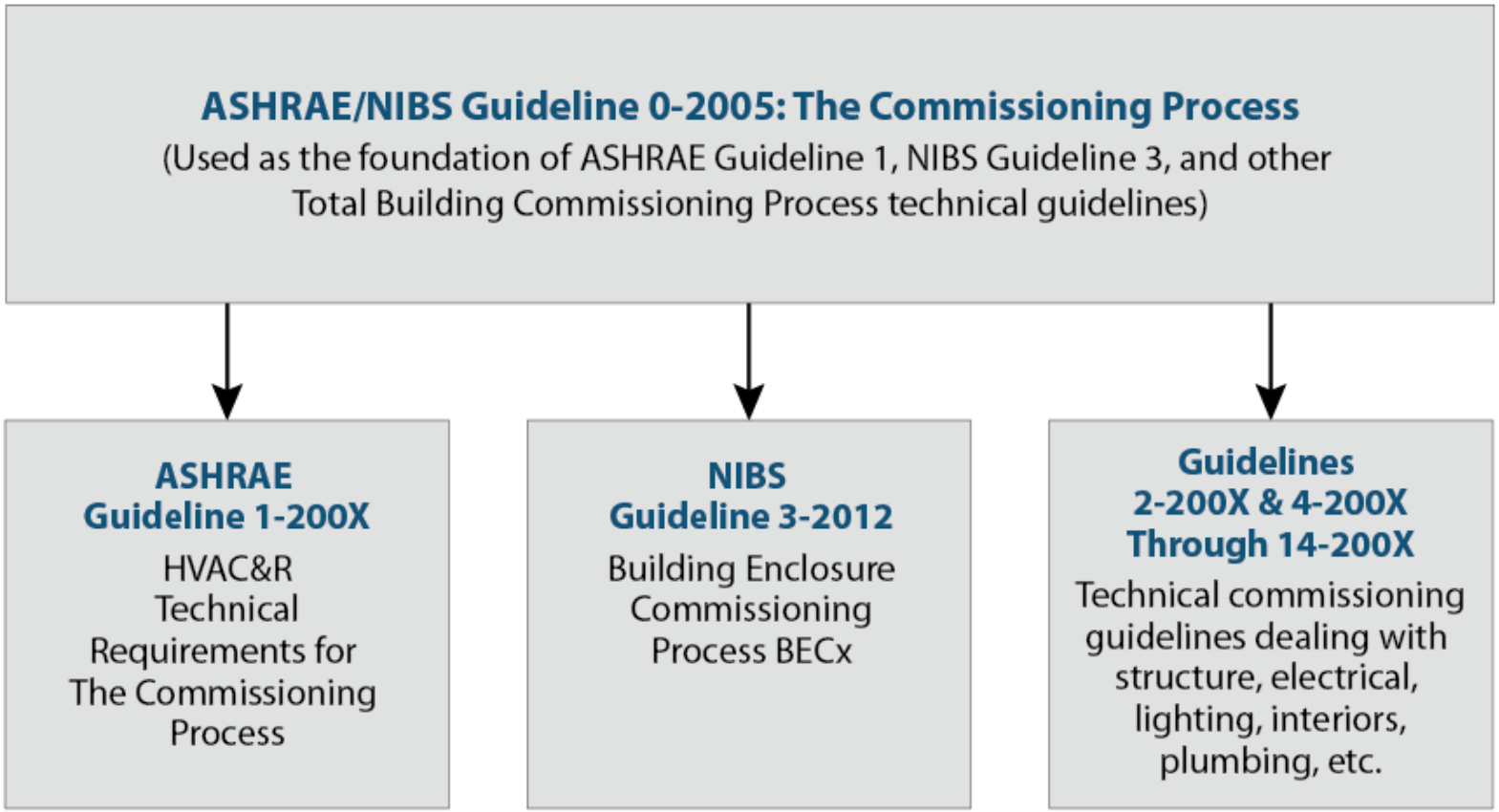
Commissioning Objectives

- Document the owner's requirements, to improve the quality of design deliverables.
- Verify that systems and assemblies perform according to owner's requirements as stated in the Owner's Project Requirements (OPR).
- Memorialize the design requirements in a Basis of Design (BOD) letter.
- Confirm that proper verification is provided to the owner, before, during, and after construction.
- Verify that operating staff are trained in proper operation of the facility.

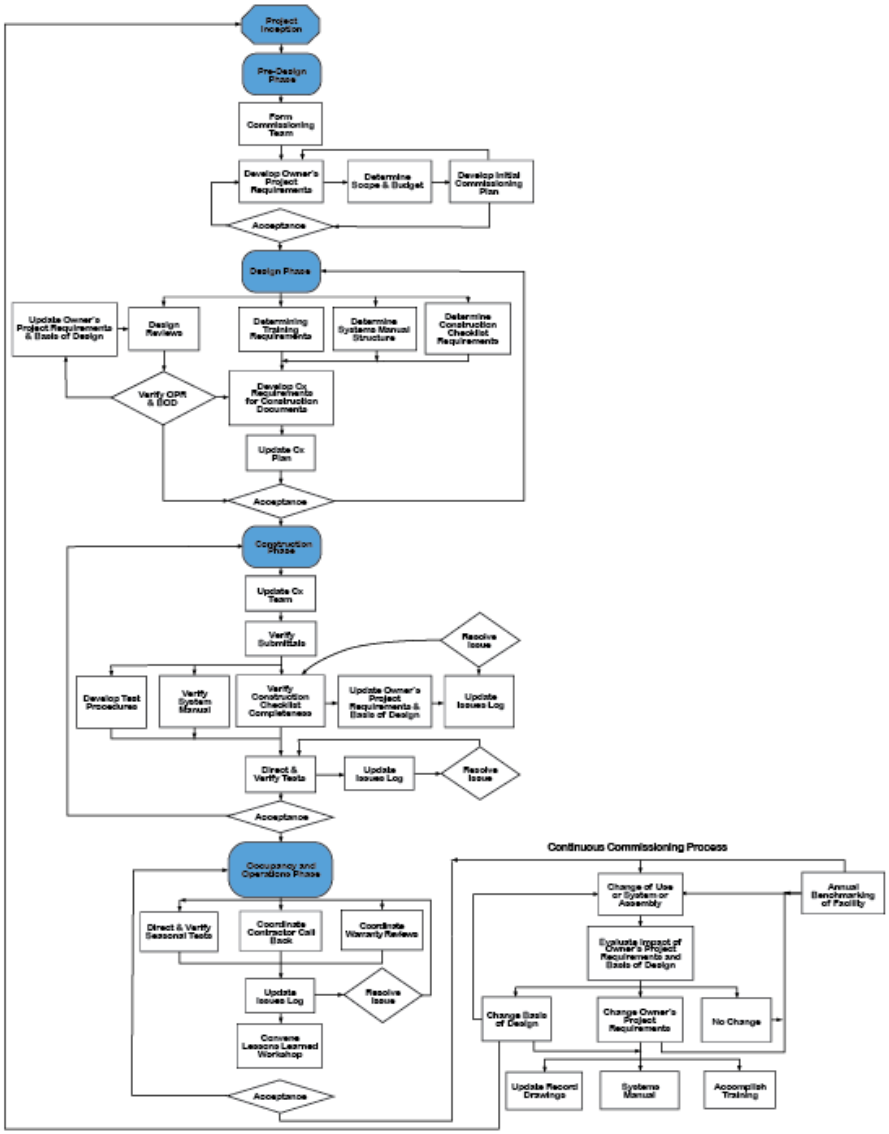
Short Version – The Steps

- Initiate Conceptual Pre-design Consulting with Team.
- Prepare an Owner's Project Requirements (OPR).
- Conduct Design Peer Review at determined design stages.
- Supervise Mock Up Construction and Testing; carrying forward any lessons learned.
- Devise Performance Testing standards.
- Provide Construction Period Commissioning including inspection and testing.
- Develop a Commissioning Report.

The ASHRAE / NIBS Process

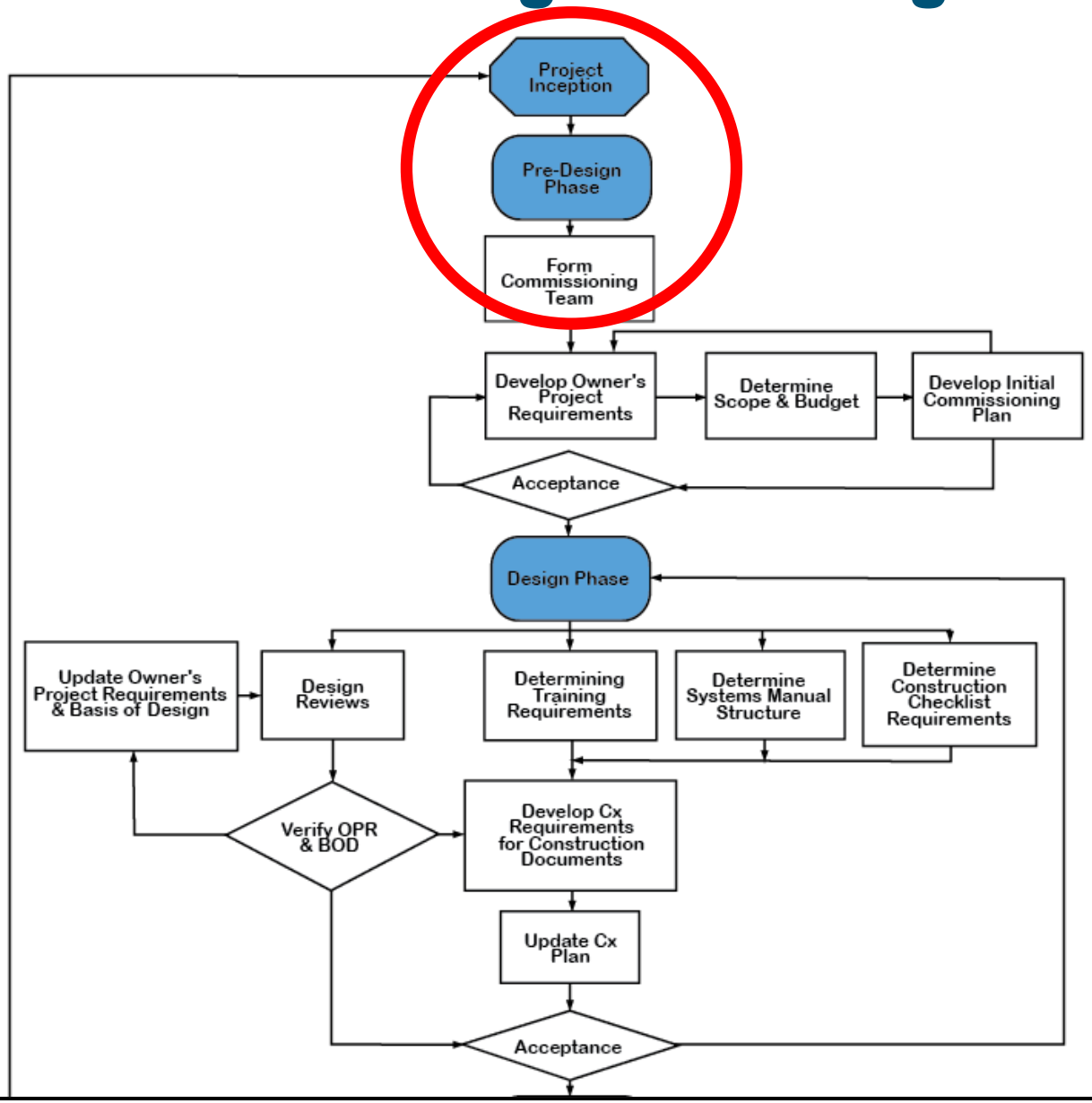


A “Simple” Flow Chart of Every Step



Pre-Design Consulting

Where Pre-Design Consulting Occurs



Pre-Design Consulting – For Any Project

- Ascertain the owner's financial and building performance goals.
- Propose Building Enclosure Systems and Assemblies that match their intended use.
- Determine if the Building Enclosure meets the climate conditions.
- Review if the Building Enclosure meets the heating and cooling needs and Owner's life cycle expectations.
- Confirm that the selected systems meet Owner's budget requirements.

Case Study:

Crescent Village
San Jose, California

Crescent Village Project Overview

- **1,800+ for-rent residential units built in phases.**
- **Four wood framed levels over concrete podium.**
- **Rapidly changing design and fast paced construction process.**
- **Followed a Commissioning process:**
  - Met with the owner early on to understand the Owner's Project Requirements.
  - Developed a Basis of Design Letter.
  - Suggested assemblies to meet owner's budget goals.
  - Modified design of assemblies to fast track construction.
  - Utilized design development phase documents for final pricing and budgeting.
  - Prepared a construction quality assurance program including observations and testing protocols.

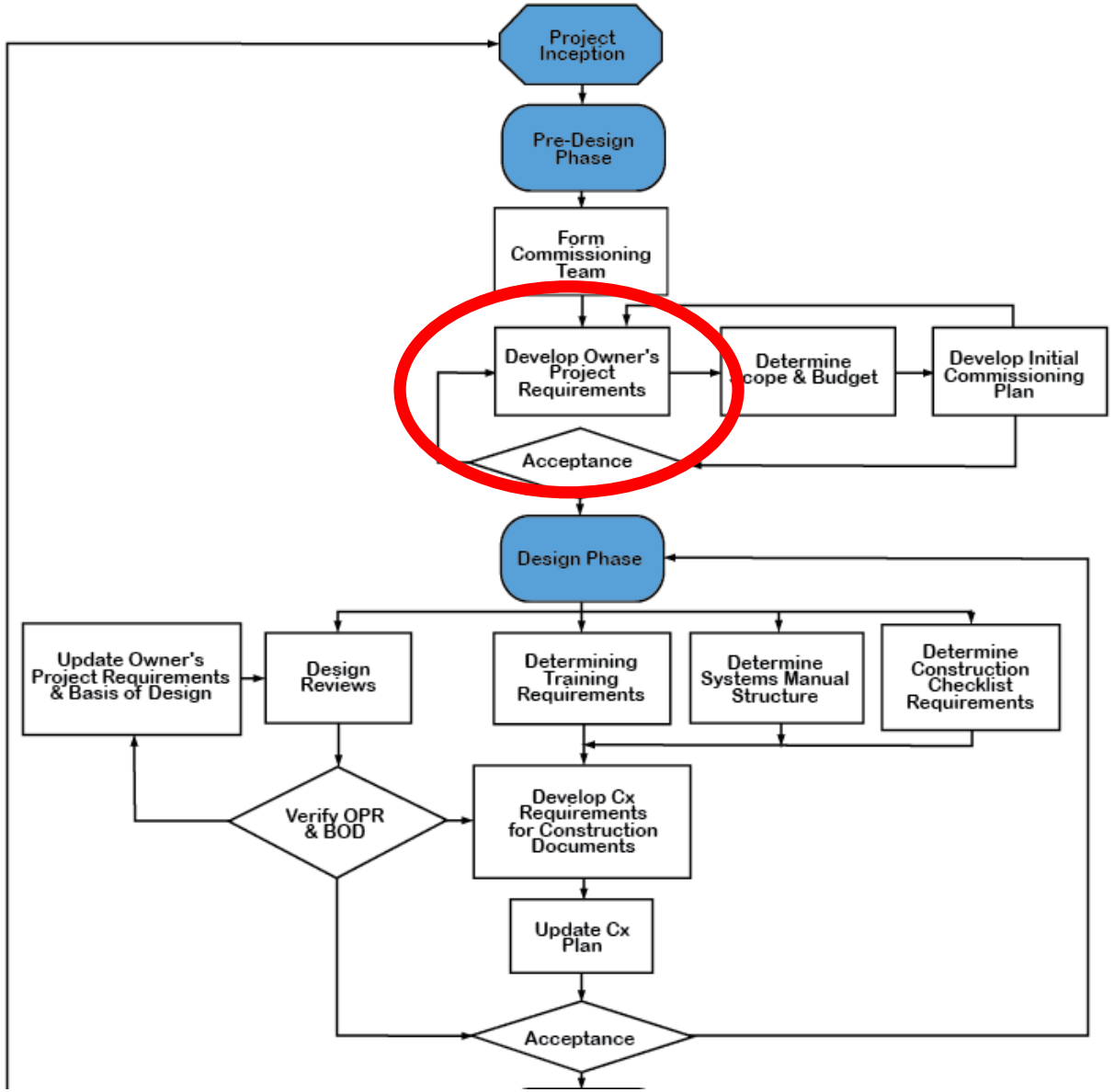
Aerial View of Crescent Village

Building Envelope Components Commissioned

- Below-grade Waterproofing
- Landscaping Planter Waterproofing
- Pedestrian Bridges / Catwalks
- Podium Waterproofing
- Private Deck Waterproofing
- Exterior Wall Assembly
- Windows
- Doors
- Roofs

Owner’s Project Requirements

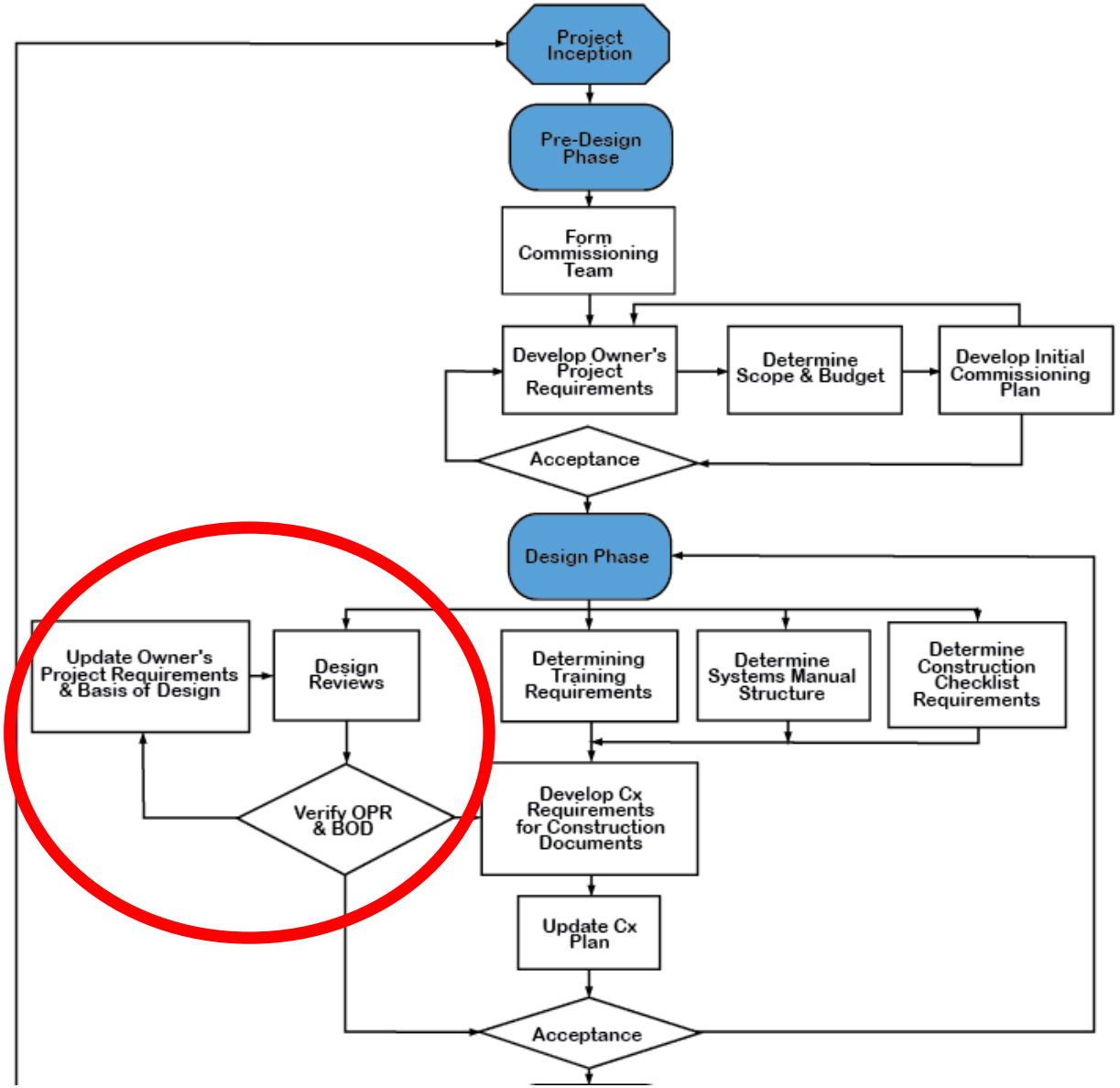
Where the "OPR" Is Developed



Crescent Village: Owner's Project Requirements

- Build and hold property for life.
- Build and operate a sustainable, maintainable property.
- Reduce construction defects and reduce risk of leaks and failure.
- Fastest possible construction pace – bring every unit to "revenue status" as soon as possible.
- Enclose the building as soon as possible.
- Use a small number of suppliers and manufacturers.

Where the Basis of Design Is Developed



Original Building Envelope Basis of Design

Letter to Owner and Architect:

- **Basis of Design Letter:**
  - 1817 01 System Selection Letter- Final (3).pdf

Basis of Design Review - Budgeting

- The owner had conflicting information about pricing – much higher per square foot prices than ABB's experience for Hot Rubberized Asphalt.
- ABB developed construction details to get actual numbers before construction.
- During Schematic phase, Contractor conveyed to owner that Cold Polyurethane was under $6/SF whereas Hot Rubber was over $11/SF.
- Pricing was higher for Hot Rubber, because sub-contractor didn't install Hot Rubber.

Change to Hot Rubber Example

- Cold process waterproofing on podium has a history and reputation of longer lasting at lower cost.
- Cold process can blister, and leak.
- Hot rubber to some, has a history of higher prices.
- The team reviewed and agreed on details, went out for pricing to local waterproofing contractors.
- After bids, hot rubber pricing similar to that of cold process, owner agreed to change to hot rubber.
- Both priced between $5.50 per SF to $6 per SF.

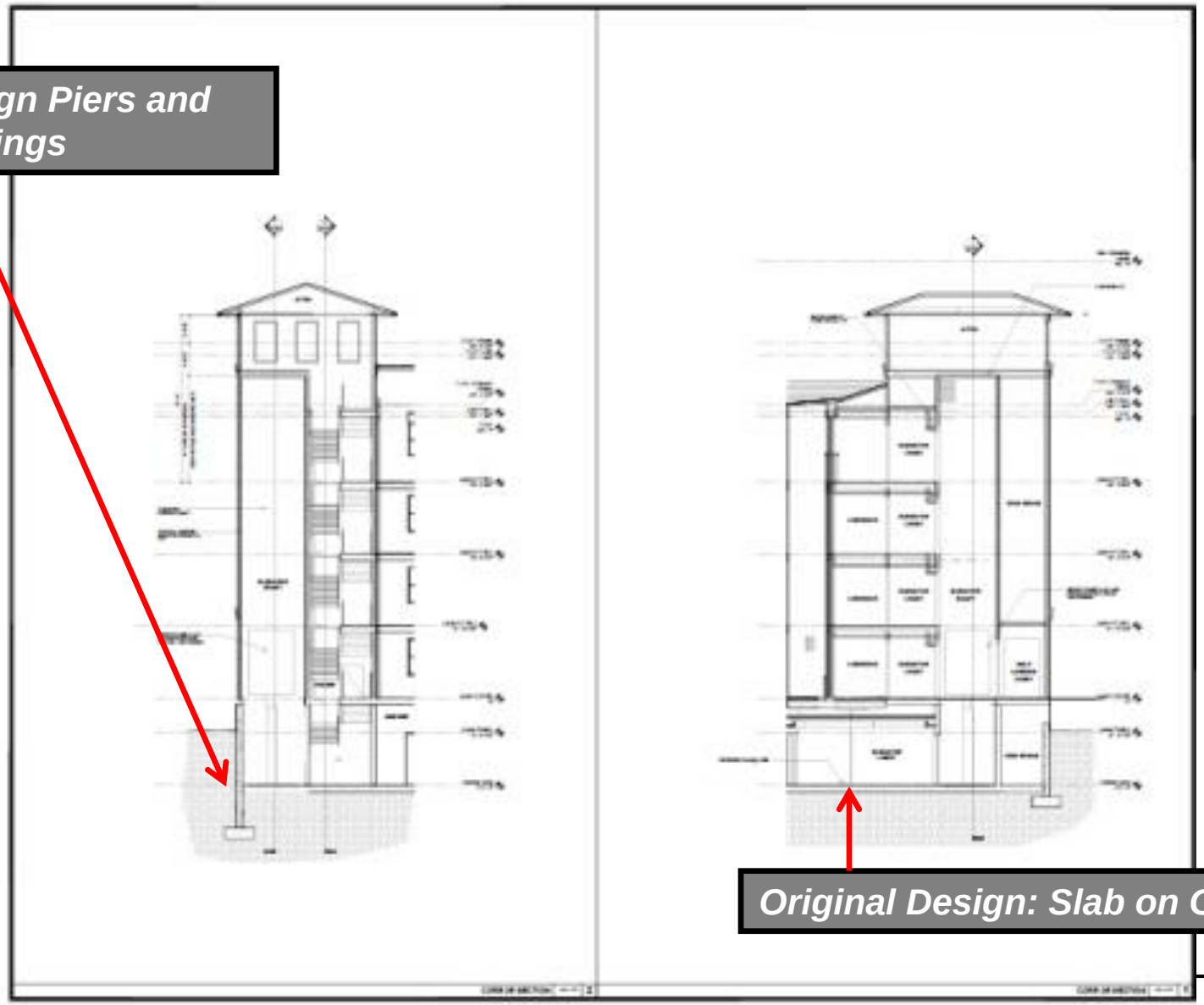
BUR w/Gravel Selected Because of Longevity

- Built up Roofing
- Perma Mop Asphalt

Structural Design, Before Commissioning

- Original structural design called for spread footings and slab on grade.
- There is a method of waterproofing specific to this foundation system.
- Waterproofing applied in stages, with curing periods.
- Very complex construction both in phasing and in waterproofing. Some portions of these systems can not be waterproofed.
- Complexity = lengthier construction = increased general conditions + OH = more $$$
- Switched to mat slab with Bentonite panels.

Original Design at Project Concept Stage

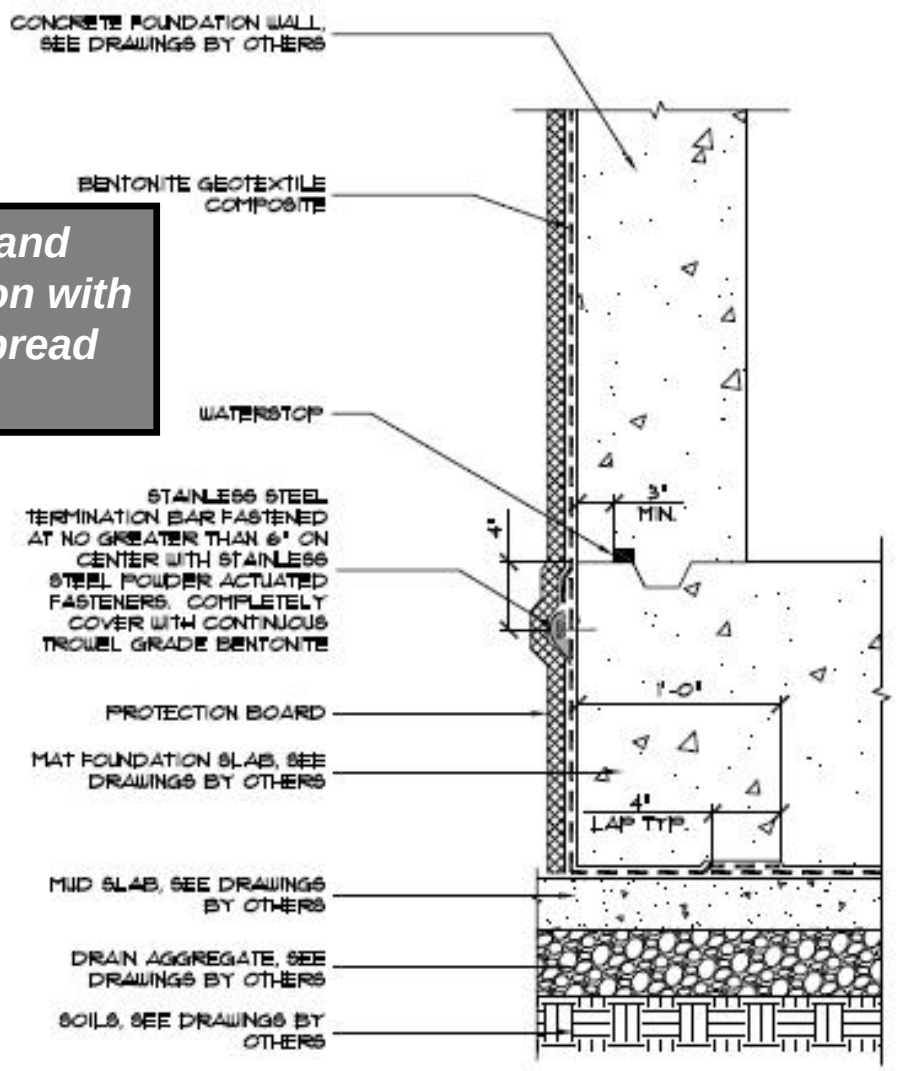


Original Design Piers and Footings

Original Design: Slab on Grade

Design Change for Below Grade Waterproofing

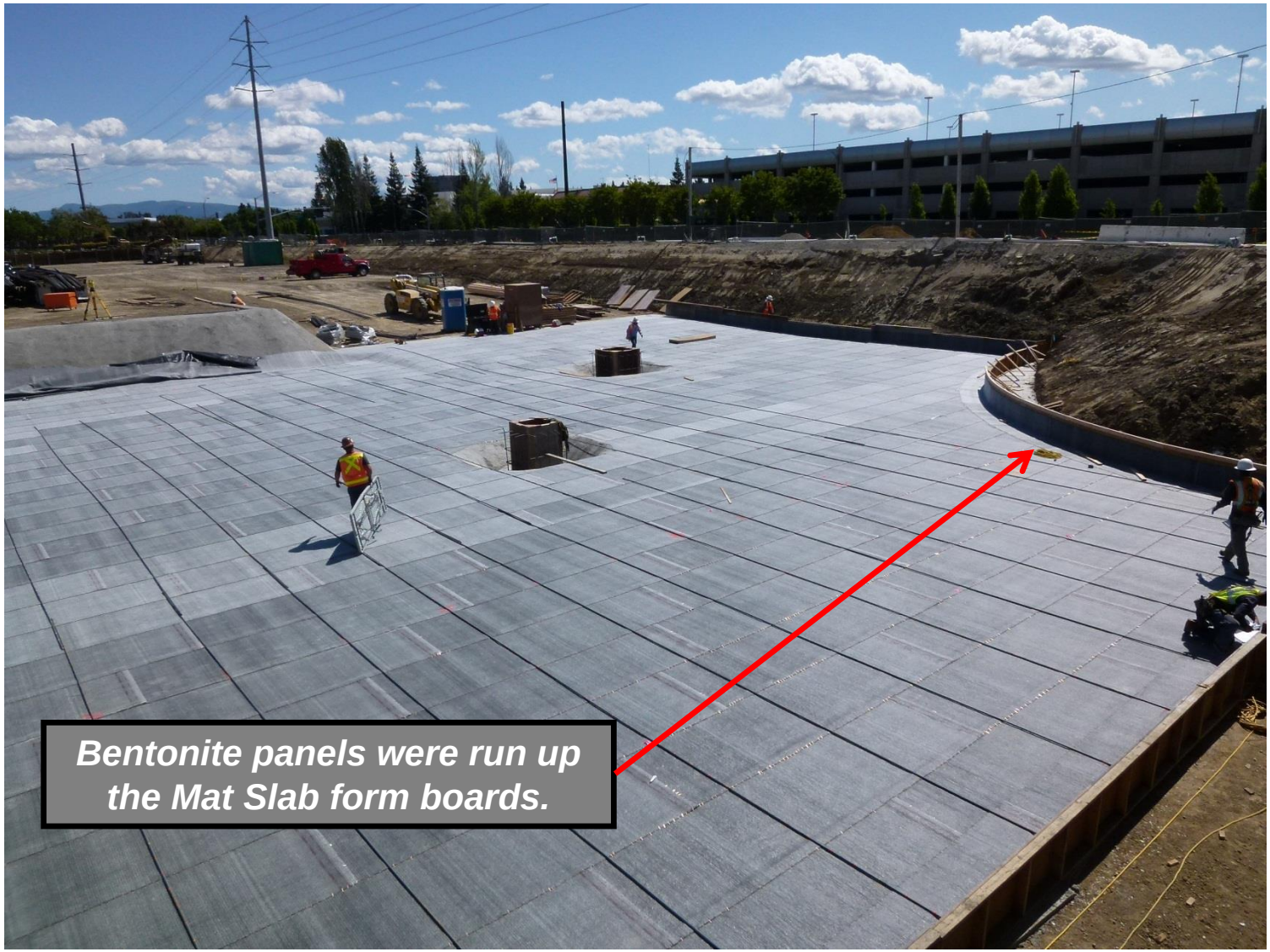
It was faster to build and waterproof the foundation with Mat slab rather than spread footing



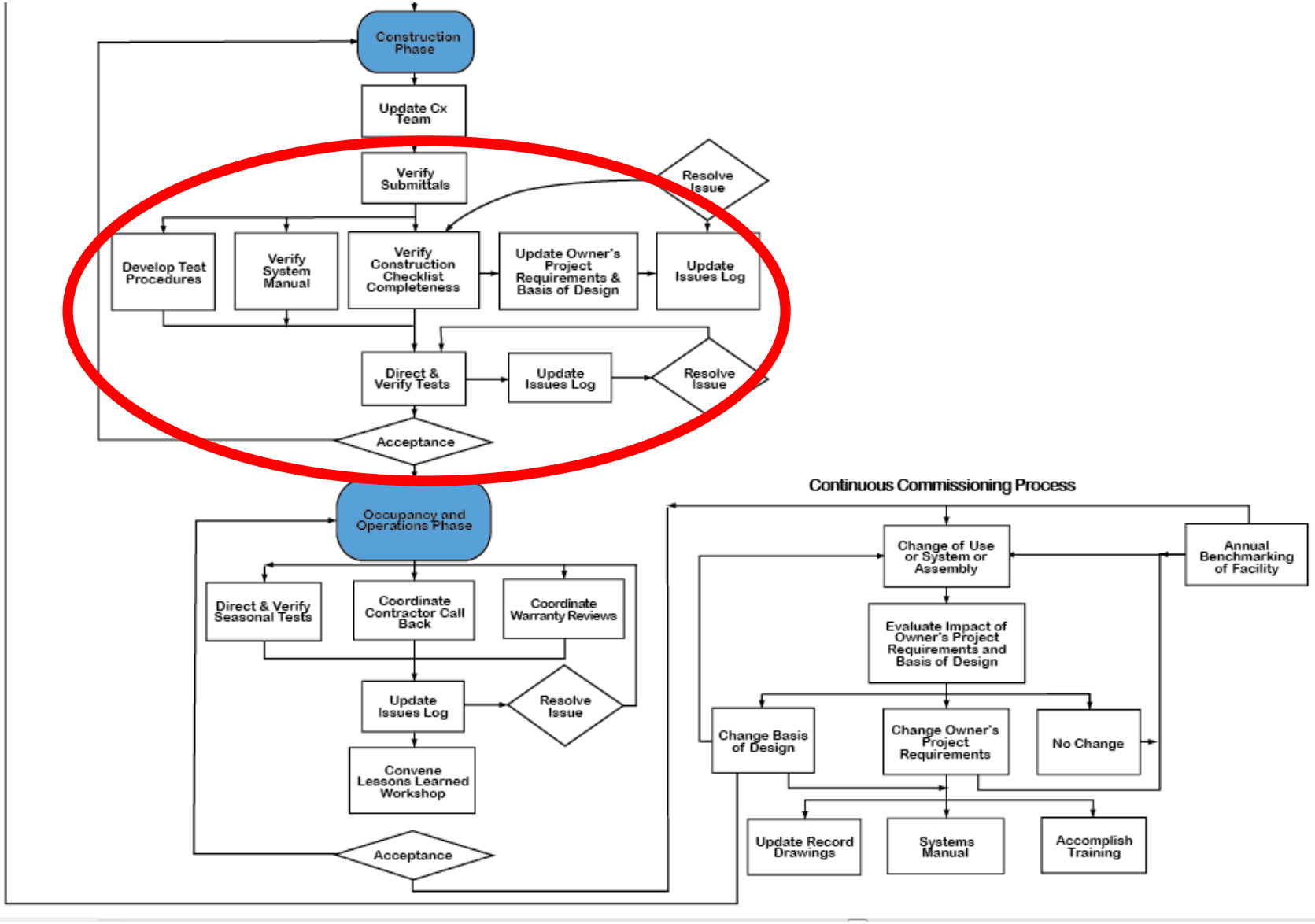
Below Grade, Under Construction

Bentonite panels at this project laid over rat slab, before mat slab pour.

Below Grade



Where Construction Commissioning Happens

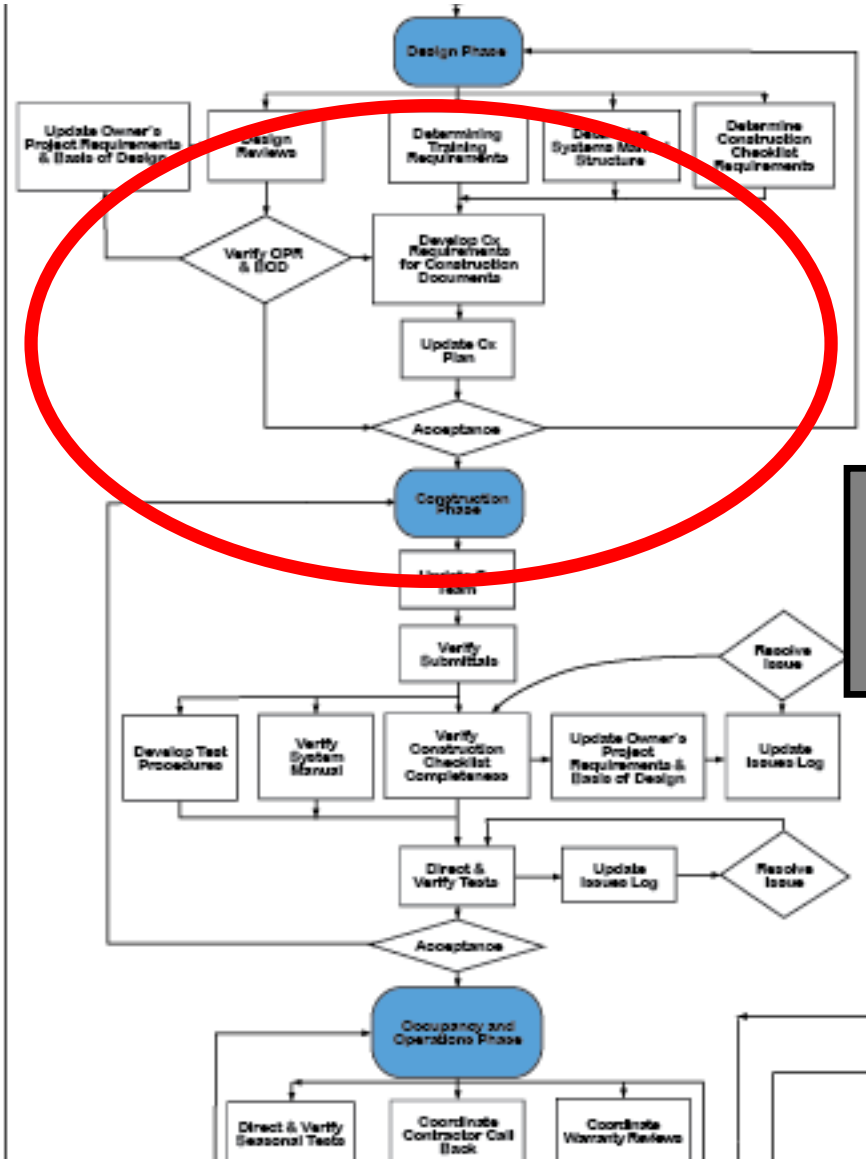


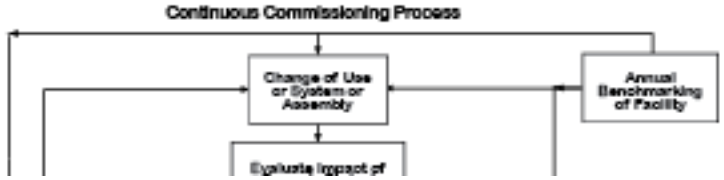
Construction Commissioning Steps

- Performance Mock Up(s)
- Visual Mock Up(s)
- Material Testing
- Continuous / Part-Time Inspection
- System Testing
- Field Review and Observation
- Compliance Testing
- Wind Uplift and Wind Load Testing
- Seismic Testing
- Vibration Testing
- Membrane Adhesion Performance Testing

Build Mock Up

Where the Mock Up Was Built





Mock-up were used as a tool to verify OPR, BOD, and assist during construction.

Full Scale Mock Up Location

Constructed on site by the crews for use in reviewing and adopting best construction practices.

Full Scale Mock Up of Plaster and Window

Materials

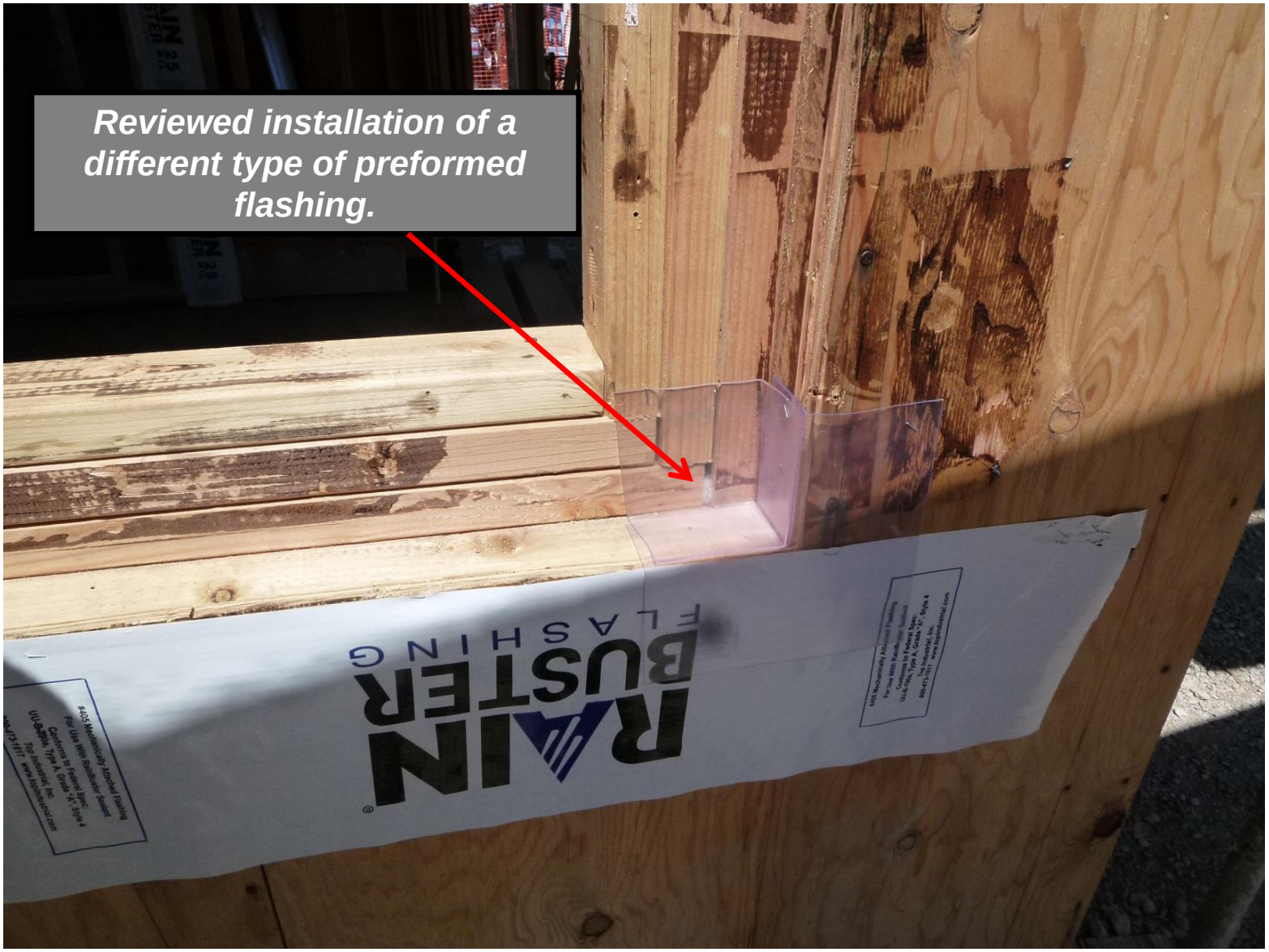
Needed to use actual materials specified.

Mock Up Conditions

Proper kettle temperature – the goal is to match actual project conditions as much as possible.

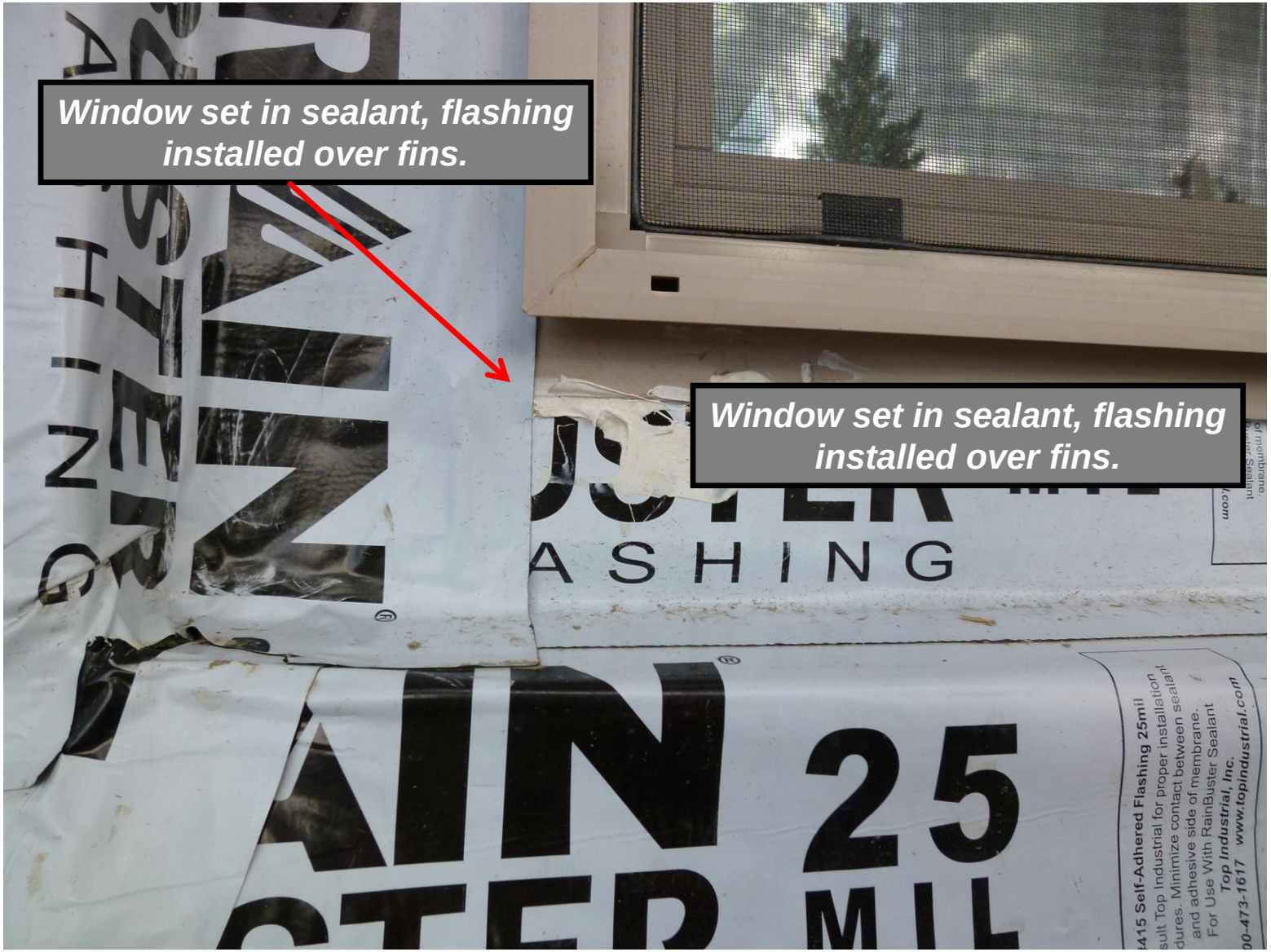
Window Mock Up

Mock Up Allowed Testing of Alternate Methods



Recessed Window

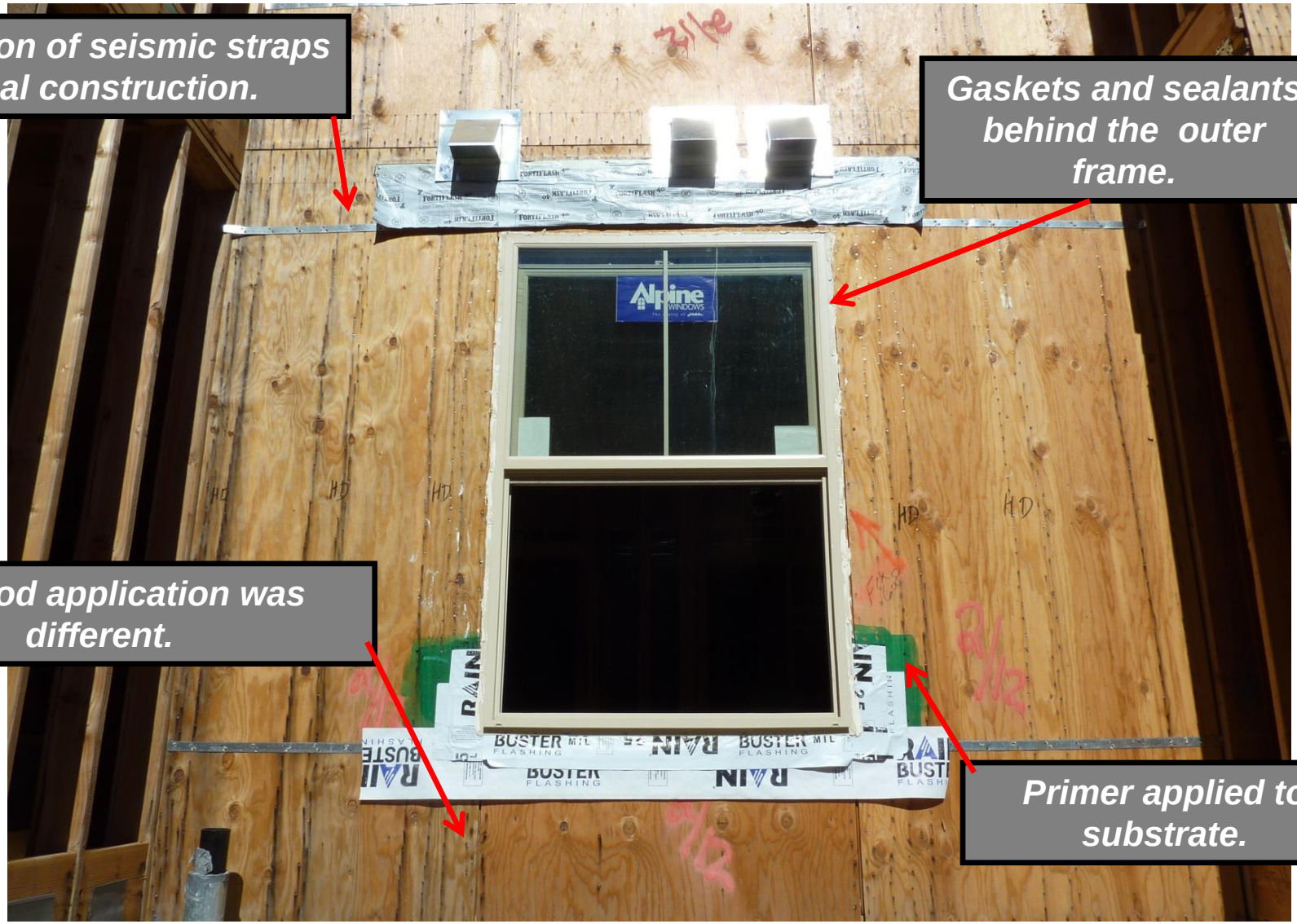
Window Mock Up



Window Mock Up

Flexible flashing at head is last to be installed.

Field Applications Evolved



Mock Up for Sheet Metal

Mock Up – HRA Fluid Applied on Wood Decks

Mock Up – Fluid Applied on Wood Decks

HRA Mock Up – Striping Perimeter

HRA Mock Up – Striping Plywood

Mock Up

Mock Up – Fluid Applied Transitions

Mock Up – Fluid Applied on Concrete

Mock Up – Fluid Applied on Concrete

Mock Up – Fluid Applied – Corner Reinforcing

HRA Mock Up – Field Application

Mock Up – Fluid Applied

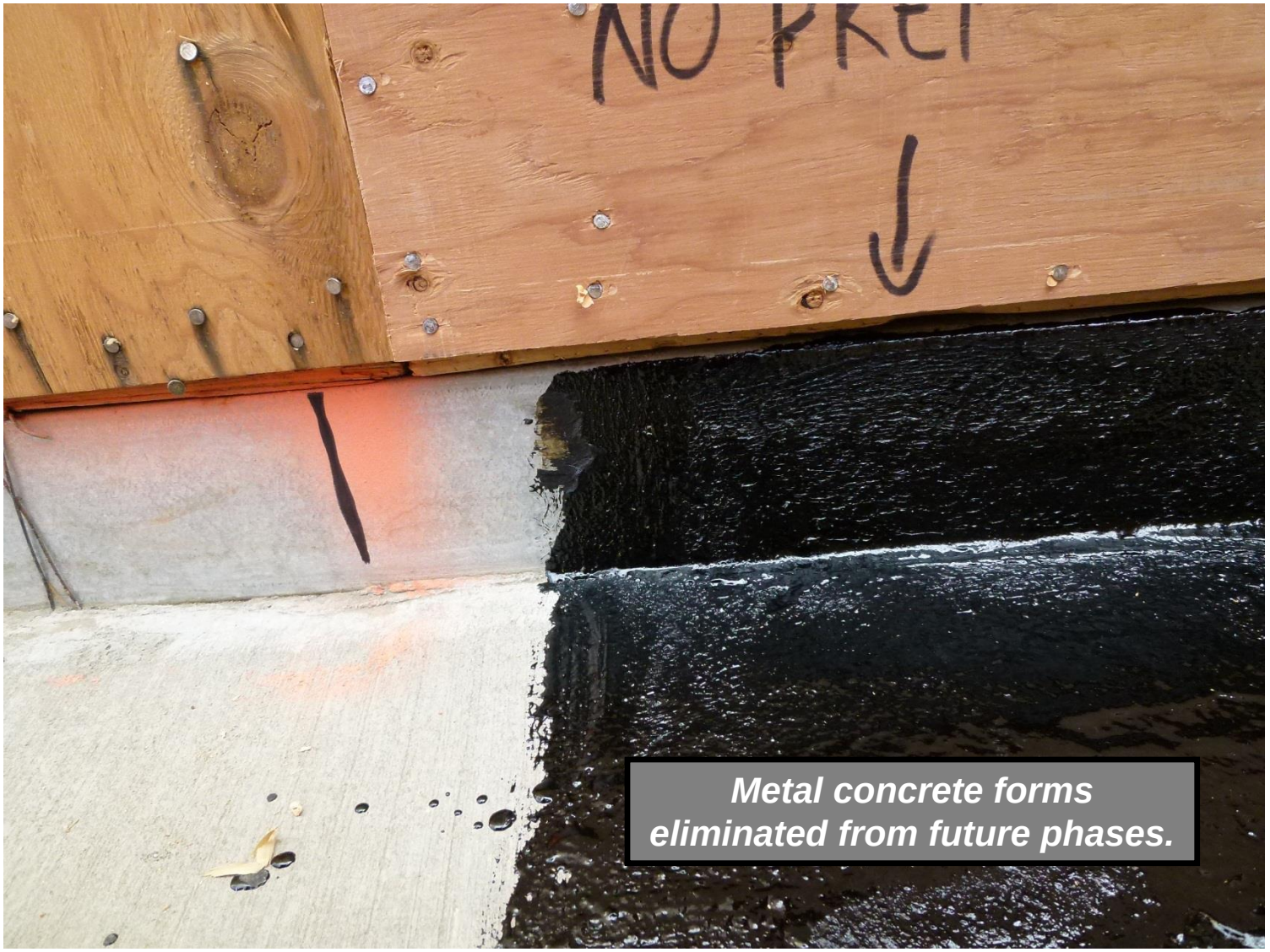
Mock Up – Fluid Applied – Protection Mat

Water Testing Mock Up

Adhesion Testing Over Metal Formwork

Adherence test for metal step down.

Adhesion Testing Over Metal Formwork



Hot Water Heater Closet - Mock Up

Mock Up Lessons Learned

- The mock up supports the evolution of designs.
- The mock up creates a baseline for rapid and ongoing resolution of installation issues.
- The mock up enabled chemical compatibility testing and adhesion testing.
- Resolved dimension issues.
- The size of mock up limited the conditions that can be tested and created tight working areas.
- The mock up is not a panacea for resolving every issue.

Construction Quality Assurance

Construction Commissioning Tools

- **CETCO Check List**
  - 2011-09-19 Cetco report checklist.pdf
- **Field Report**
  - 2012-02-17 Report 66.pdf
- **Field Report**
  - 2012-04-05 Report 92.pdf
- **Substitution request**
  - CSI Form 01-5C - Substitution Request - Copy.pdf
- **Commissioning Manual**
  - WP_MANUAL_FINALv5.pdf

Benefits Realized from the BECx Process

- 1,800 units fully occupied equals approximately $4 - 5 million / month.
- Many system selections were made that saved installation time. (time = money)
- Standardization of waterproofing systems reduced complexity of installation.
- Building was made weather-tight faster, reducing the risk of weather damage.
- Strategic system selections allowed for faster construction sequencing.

Early Stages of Construction

Forming of the Mat Slab

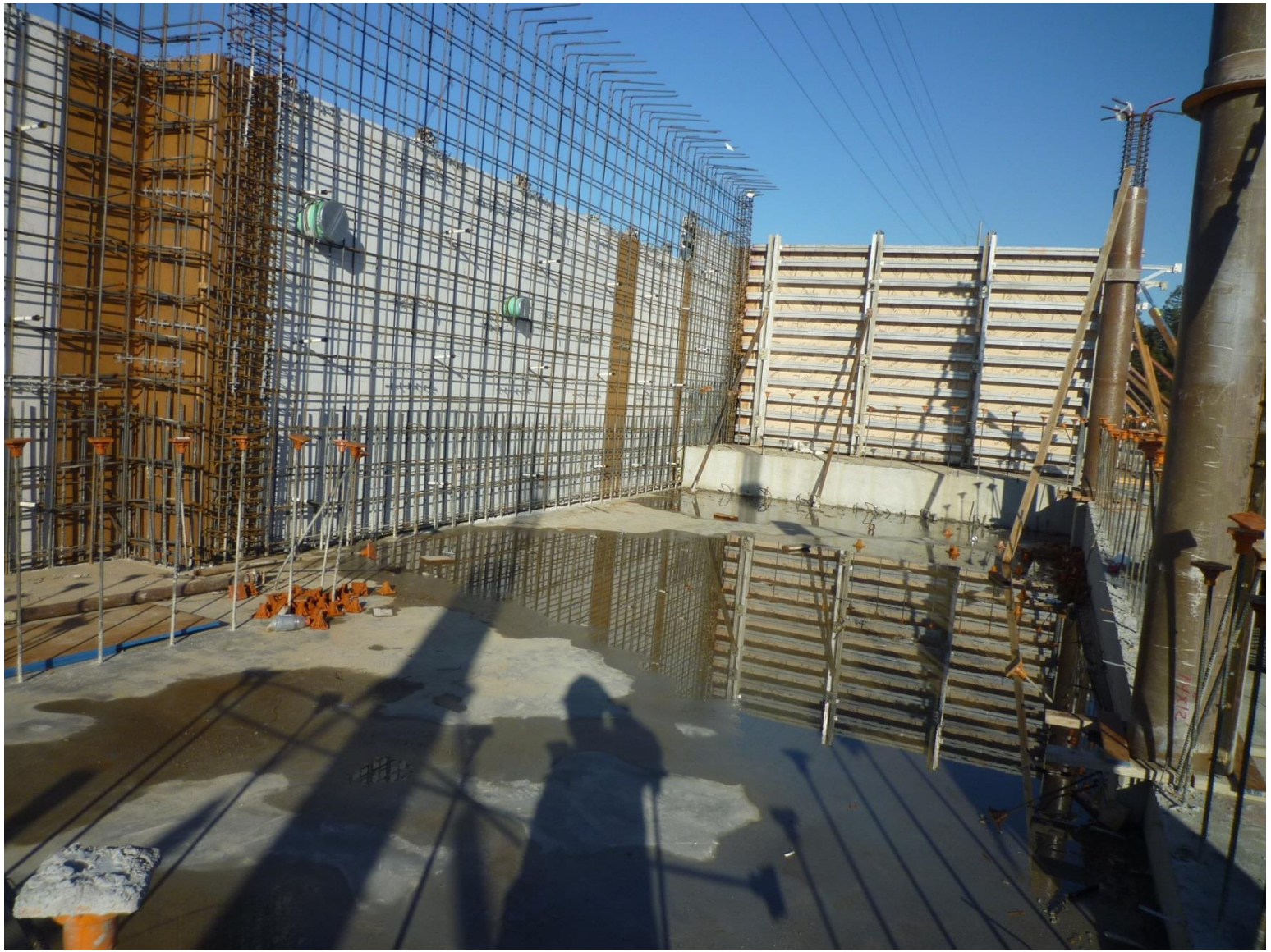
Placing Steel

Placing Steel

Pouring Concrete

Pouring Concrete

Forming Podium Walls



Waterproofing Below-grade Podium Walls

Form Boards for Podium Floor

PT Cables

Pouring Concrete on Podium

Below Grade Wall Waterproofing

Podium Complete – Starting to Frame

Framing

More Framing

Pool and Pool Deck

Waterproofing Protection and Planter Wall

Planter Sequencing

CMU block wall constructed over waterproofing; slab poured inside new walls.

Planter Ready for Waterproofing

Planters Filled With Soil

Planters Finished

Window Installation

Steep Slope Roof Felt

Stucco Installation

Finished Stucco

Construction Almost Done

Fast Tracked – Ready to Rent!

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- **CETCO Check List**
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Thank you!

Questions?