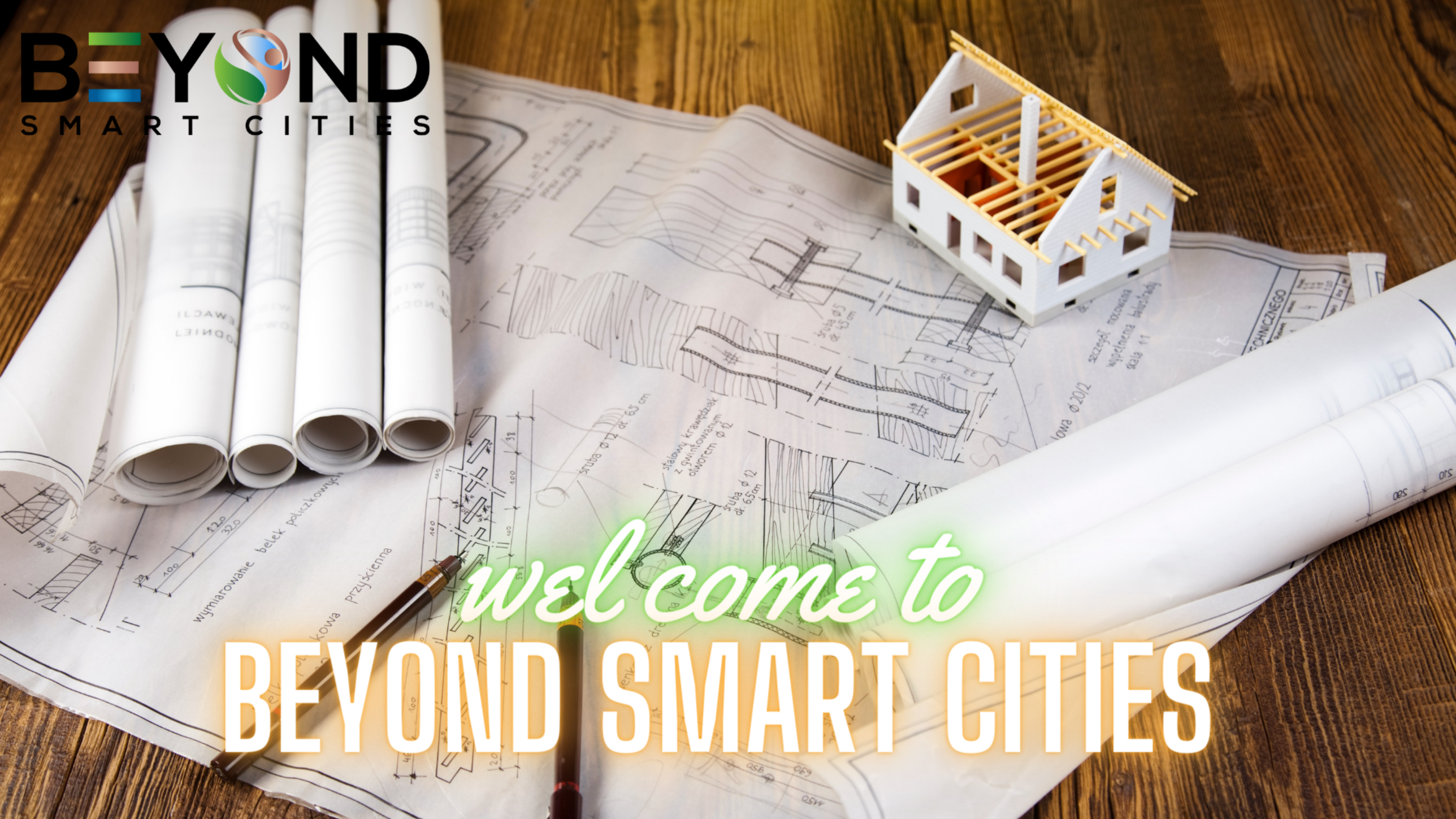

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MODULE

09 - E

Issues and Resolution Log and FPT Development

KRISHNAJI PAWAR - CEO & FOUNDER

LEED AP(BD+C),GSAS CGP,GCP,ISO 14001

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CERTIFIED COMMISSIONING MANAGER - CCM TRAINING OVERVIEW

The construction phase commissioning process involves installation, start-up, functional testing, documentation, and training to ensure standardized operation of equipment, systems, and assemblies, providing performance benchmarks and acceptance criteria.

Learning Objectives

- System Verification Checklists (SVC's)
- TAB HVAC Systems:
- Building Automation System (BAS):
- Lighting Controls:
- Emergency Power Systems:
- Developing Functional Performance Tests (FPT's)
- Training
- Performing Tests
- Integrated Systems Testing
- Operational Sustainability Reporting
- Commissioning Test Procedures

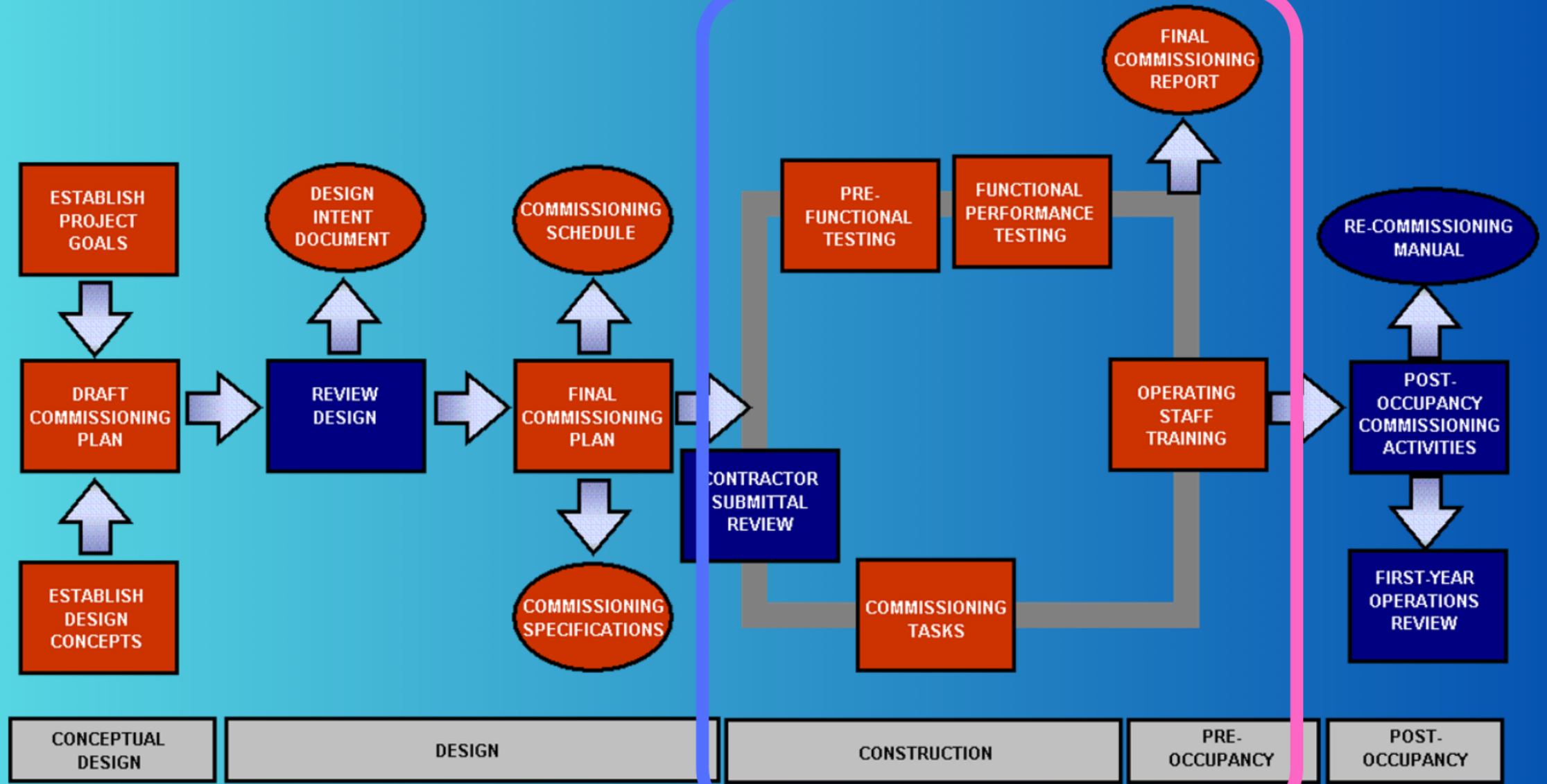
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INTRODUCTION

- The CxP leads the larger Commissioning Team (Cx Team) to complete commissioning activities correctly and efficiently as scheduled, and the smaller Commissioning Provider Group (CxP Group) to assist and prepare commissioning deliverables.
- During construction, the CxP updates the commissioning plan, assists with revising the owner's project requirements (OPR) or current facility requirements (CFR), reviews construction submittals for compliance, distributes checklists for contractors to complete, observes building equipment and system installations, and develops and manages various tests.
- After equipment and system start-up, including installation and acceptance tests and testing, adjusting, and balancing (TAB), the CxP coordinates and schedules FPT and IST with the Cx Team.
- The Issues and Resolution Log and Systems Manual, started during design, are maintained by the CxP during construction.
- Verifying building system compliance with the OPR or CFR is a top CxP priority during construction.
- The CxP and CxP Group draft many deliverables during this phase.
- Daily reports, occasional commissioning progress reports, and the preliminary commissioning report that forms the basis for the final commissioning report are CxP deliverables.

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COMMISSIONING AND THE BUILDING DEVELOPMENT PROCESS



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COMMISSIONING PLAN UPDATE

- Although the Commissioning Provider (CxP) creates the Commissioning Plan (Cx Plan) during the Design Phase and may begin to frame it during the Project Initiation Phase, the CxP should revise it throughout the project.
- During construction, the CxP should add details to the Cx Plan that were not available earlier.
- Real-world challenges or owner requests can require project changes that the CxP must reflect in the Cx Plan.
- Owners and design teams should review CX Plan updates that need approval.



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COMMISSIONING PLAN UPDATE +

- The CxP should emphasize the Cx Plan's living nature and address update sharing with the Cx Team during the construction phase commissioning kickoff meeting.
- The CxP should update the Cx Plan to reflect the installation sequence and include new, amended, and previously unknown or unavailable information as construction progresses.
- The Cx Plan should be updated periodically, not all at once.
- To avoid missing important changes, the Cx Plan must be updated regularly.

ISSUES AND RESOLUTION LOG

- Throughout a building systems commissioning project, the Commissioning Provider (CxP) creates and maintains the crucial Issues and Resolution Log.
- As its name suggests, the Issues and Resolution Log provides a method for recording and monitoring the resolution of critical path issues pertinent to the commissioning of building systems.
- The chief objective of the CxP in administering the Issues and Resolution Log is to ensure that issues are properly documented and resolved.
- Items listed in the Issues and Resolution Log are not marked as resolved by the CxP until their resolution has been verified by the CxP and approved by the owner.
- As with the Commissioning Plan (Cx Plan) and the Systems Manual, the CxP must begin the Issues and Resolution Log no later than the Design Phase.





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ISSUES AND RESOLUTION LOG +

- Also, like those other documents, the CxP continues to update the Issues and Resolution Log through the conclusion of the project.
- The Issues and Resolution Log is essential not only during the construction phase, but also during the occupancy and operations phases.
- If the CxP utilizes stand-alone Commissioning Design Review documents to follow up on previously reviewed items during the Design Phase, the Issues and Resolution Log may be initiated during the Construction Phase instead of the Design Phase.



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ISSUES AND RESOLUTION LOG +

- The CxP creates and updates the Issues and Resolution Log, but other Commissioning Provider Group (CxP Group) members may add items.
- Commissioning Progress Reports from the CxP and CxP Group during site activities are a major log contributor.
- In addition to Commissioning Progress Reports, the CxP logs critical path findings from meetings, project communications, design documents, and site observations.
- A matter may be discussed with the entire Commissioning Team (Cx Team) or just the CxP Group.
- Issue relevance to the Cx Team's roles and responsibilities usually determines whether to share.
- The CxP may limit issue details to Cx Team members who need them for work.



COMMISSIONING PROVIDER (CXP) CHECKLISTS

- The majority of team members on a new construction or existing building project utilize checklists.
- During the construction phase, the commissioning provider (CxP) creates and manages checklists to help him or her fulfill his or her building systems commissioning responsibilities.
- The owner and various members of the design and construction teams may have their own checklists, but it is not the purpose of this section to introduce and describe them.
- The CxP customizes checklists for particular building systems and the materials, components, and equipment that make up those systems.



COMMISSIONING PROVIDER (CXP) CHECKLISTS +

CxP checklists are quality control tools used by the CxP to document that materials, components, and equipment received and placed onsite conform to construction documents, written instructions from the design team, including the Basis of Design (BoD), Owner's Project Requirements (OPR), or Current Facility Requirements (CFR).

CONSTRUCTION OBSERVATION

- Observed deficiencies should be discussed with the appropriate commissioning team (Cx Team) or project team members in accordance with the communication protocols previously established for the building systems commissioning process.
- The CxP must possess the technical knowledge and expertise required to complete each phase of the commissioning process for each building system.
- In many projects, rather than performing the work alone, the CxP directs a Commissioning Provider Group (CxP Group) to increase the available staff resources.
- The CxP oversees and manages the CxP Group.



CONSTRUCTION OBSERVATION +





- The CxP is the Cx Team's primary point of contact and should coordinate and participate in observations.
- The CxP should be on-site frequently to work with the project team to help identify and resolve construction issues as they arise.
- Although the CxP is responsible for ensuring that observations are performed in accordance with the Cx Plan, the CxP may delegate the actual performance of observations to other members of the CxP Group.
- To coordinate the assignment of professional resources with the sequence of installation activities, the CxP must have a comprehensive understanding of the CxP Group network.

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SITE ACTIVITIES

- The Commissioning Plan (Cx Plan) developed by the Commissioning Provider (CxP) outlines the site activities that CxP and Commissioning Provider Group (CxP Group) members must attend, observe, or perform.
- The owner-CxP professional services contract should guide the Cx Plan's roles and responsibilities. CxP and CxP Group participation in site activities and commissioning services must be specified in commissioning contracts.
- Each visit to the project site should begin with a brief meeting to discuss activities and objectives.
- A representative of each trade being observed may accompany the CxP on the site visit. Certain projects' project manual specifications or contract documents may require representatives to join the CxP. The CxP can immediately address installation means and methods questions with representatives, which may help them prepare the site observation report.



SITE ACTIVITIES+

- At the conclusion of each site visit, a brief, informal meeting should be held to review the findings.
- The CxP should draft a site observation report using the notes taken during the visit and the communication shared during the meeting.
- Generally speaking, the CxP lacks the authority to direct installing contractors to perform work.
- Instead, suggestions and recommendations for corrective actions should be directed to the project's GC, CM, or other relevant team members.

CONTROLS POINT-TO- POINT VERIFICATION

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- Point-to-point verification of building controls verifies that control-point wiring has been correctly installed and terminated, and that all field devices are functioning properly.
- Typically, the automatic temperature control (ATC) contractor is responsible for performing the tasks and documenting the results in projects involving point-to-point verification of controls.
- The Commissioning Provider (CxP) does not play a significant role in controlling point-to-point verification, but the CxP places a high premium on the success of this process.





CONTROLS POINT-TO- POINT VERIFICATION+



- The CxP must validate the point-to-point verification results reported by the ATC contractor and include this information in both the preliminary and final commissioning reports.
- In this age of wireless controls, point-to-point verification is not a novel concept.
- As the cost of control decreased, the number of control points increased, and the time and effort required for point-to-point verification increased.
- Internet connectivity and wireless capabilities have enhanced the flexibility and accessibility of building control systems over the past two decades.
- In addition to enhancing the performance and capabilities of the installed BAS or BMS, modern information technology streamlines the point-to-point verification process for the construction team.

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FUNCTIONAL PERFORMANCE TESTING

- Construction phase building systems commissioning includes functional performance testing (FPT) after installation and startup.
- Functional performance testing is sometimes called "functional testing" or "performance testing" for simplicity or "functional and performance testing" to distinguish between function and performance.
- Owners may call FPT performance demonstration testing.
- The CxP may encounter these or other field terms that are meant to be synonymous with FPT, depending on the owner's preferences.
- Before starting FPT, the CxP must ensure that a building system is ready for testing after installation and start-up.
- Documenting the building system's testing readiness helps the CxP schedule FPTs.

INTEGRATED SYSTEMS TESTING

- Functional performance testing (FPT) is extended to multiple interconnected building systems through integrated systems testing (IST).
- Individual building system FPT must be completed before IST can commence.
- As with FPTs, the documented results of ISTs should be included in both the preliminary commissioning report and the final commissioning report.
- The acronym "IST" may be used to refer to both "integrated systems testing" and an individual "integrated test."
- ISTs are exceptional in that they also represent the conclusion of the commissioning process.



INTEGRATED SYSTEMS TESTING +





- Successful ISTs demonstrate the integration of diverse materials, components, devices, controls, equipment, and systems.
- The interfaces and interactions between building systems introduce capabilities that are not possible with isolated systems.
- To develop project documentation, including the project manual specifications and the Cx Plan, both the design team and the CxP must have a solid grasp of the required ISTs.
- Before the owner engages the CxP, there should be some discussion of ISTs, as the CxP and owner must agree on the general scope of commissioning services during contract negotiations.
- The CxP must confirm with the owner in advance which ISTs are required.

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INTEGRATED SYSTEMS TESTING +

If the owner does not or cannot provide the CxP with a list of preferred ISTs, the CxP may make IST recommendations based on design intent and the building systems to be commissioned using professional experience and industry requirements.



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RESOLUTION TRACKING FORMS (RTF'S)

Log and Track Issues throughout Construction & Acceptance Phases

Issue						Resolution			
No	Date	Discipline	Assoc. Equipment	Issue Description	Responsible Company	Resolution / Follow-up	Resolution Date	Signed Resolution Form Required	Status
37	1/19/16	Mechanical	AHU-2-1	AHU does not have a magnehelic for the final-filter bank factory installed into the case of the unit as all the other AHUs do.	CMS			No	Open
38	1/21/16	Mechanical	AHU-1-3	Outside airflow meter has not been calibrated. Controls manually commanding damper to 50% open until calibration is complete.	Pro-Tech	01/21/16 - TLC CxA: TAB work in progress.		No	Open
39	1/21/16	Mechanical	AHU-1-3	Pre-filter and final-filter DP sensors (BAS and local magnehelic) appears to be off. Final-filter sensors are significantly off (BAS: .228" WC, MAG: .5+"WC)	CMS			No	Open
40	1/21/16	Mechanical	EF-1-3-1	Fan makes a lot of noise and vibration when in operation. Balancing of the fan wheel needs to be verified.	CMS			No	Open
41	1/21/16	Mechanical	VAV-1-3-12	Local zone thermostat for VAV is located on the opposite side of a full height wall from the area the terminal unit actually serves.	TLC Design	01/21/16 - TLC CxA: Thermostat is located where noted on construction drawings, but needs to be moved to the other side of the wall to actually control the VAV. 01/27/16 - TLC Design: Will address issue with construction team.		No	Open
42	1/21/16	Mechanical	VAV-1-3-14	VAV has a faulty re-heat valve and is not producing the	Trane			No	Open

SYSTEM VERIFICATION CHECKLISTS (SVCS)

- Is equipment properly installed and ready to be started?
- Contractor Start-up
- Factory start-up
- Component vs. SystemTest
- Complete all SVCs prior to functional testing.



TAB HVAC SYSTEMS:





- Systems are started properly.
- Systems under total command
- Interface between hardware and software
- Coordination with other professions, particularly TCC
- Accessibility to space

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BUILDING AUTOMATION SYSTEM (BAS):

- Installation is complete in accordance with the submittal or drawings.
- A new venture executed and recorded
- Project-specific programming pass programming
- Detail-by-detail checklists
- Safety tests and documentation



LIGHTING CONTROLS



- Installation and building specifications
- Sensor, timer, and programmable control confirmation, sensitivity, and timeout
- Hardware and software are adjusted, calibrated, and programmed

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EMERGENCY POWER SYSTEMS

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- Completion of installation per construction documents
- Programmable Start-up / Load Shed Sequences of Operation
- Load Bank Evaluation
- All Generator, Paralleling, ATS, and Fuel System Systems Have Been Examined





DEVELOPING FUNCTIONAL PERFORMANCE TESTS (FPT'S)



- After Submittals Received
- Control Submittals and Sequences of Operation are important for HVAC FPTs.
- Collaboration with OR,Contractors
- Repeatable, documentable testing with expected results

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