CON 494/598 **Advanced Building Commissioning**

Arizona State University | Del E. Webb School of Construction
Course Syllabus

COURSE INFORMATION

Semester: Spring 2021
Time/Location: Tuesday, 6 – 8:30 pm | CAVC 559
Virtual: Zoom Id is on your Canvas
Website: Blackboard (https://myasucourses.asu.edu)

INSTRUCTOR INFORMATION

Instructor: Marcus Myers, CxA, CEM, LEED v4 BD+C, Associate AIA, LFA, LBC Ambassador
Office: CAVC 521
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Email: marcus.myers@asu.edu
Office Hours: Tuesdays after class, by appointment (email or text to schedule an appointment)

Marcus has worn many hats throughout his career, and each has helped him become a more rounded and patient person and leader. When dealing with conflict or issues; whether it's construction, mechanical, architectural or human in nature, one must slow down to speed up and think your way through a situation. This is what he loves, hoping his passion for it shines through to friends, colleagues, clients, and his students. He has "LEARNED" to take a holistic approach to life and his career that deals with the perfectly imperfect world of buildings, building performance and engineered, qualitative assessments. His passion, or obsession as it seems at times, is about understanding building performance through sustainable and building science approaches. The goal is to get it right, not just done. And getting it right is to deliver high quality results to clients that Marcus is proud of and stands behind. To Marcus, being trusted and having integrity in this business is the most important characteristic one could have both professionally and personally. When passion and integrity is shared within a team, there is no better place as it gives one a sense of belonging and a family. Here, we are part of something bigger than ourselves, making truly great things possible.

Marcus leads the Commissioning and Energy Services Department in the US West Region for Stantec Consulting Inc. He is Responsible for project management, business development and integration of all MEP & Envelope/Enclosure Commissioning/Energy Projects. The Stantec community unites approximately 22,000 employees working in over 400 locations across six continents. We collaborate across disciplines and industries to bring buildings, energy and resource, environmental, and infrastructure projects to life. Our work—engineering, architecture, interior design, landscape architecture, surveying, environmental sciences, project management, and project economics, from initial project concept and planning through design, construction, and commissioning—begins at the intersection of community, creativity, and client relationships.

Marcus works closely with MEP engineers, architects, contractors, sub-contractors and owners in field coordination of the trades. Throughout the commissioning process, Marcus provides the support to lead the coordination process. This process focuses upon verifying and documenting that all of the commissioned systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements (ASHRAE Std. 202-2013). In addition to commissioning and full-time field management, Marcus oversees the field construction documentation and verifies that the facility systems also meet the functional and operational needs of the building's owners and occupants.

Mr. Myers is currently an AIA Associate, NCARB accredited, CxA (Certified Commissioning Authority), CEM (Certified Energy Manager), LEED AP BD+C v4, LFA (Living Future Accredited). Mr. Myers is on a licensing track to become a registered Architect in the State of Arizona, and his other short term professional goals include achieving national certification in the fields of Building Energy Modeling, Building Envelope/Enclosure Commissioning, and WELL AP. Mr. Myers has earned a Bachelor of Science (B.S.) in Marketing, Bachelor of Science (B.S.) in Architecture and two Master Degrees in Architecture (MArch) and Building Energy Systems (MSBE) from Arizona State University. He is an active member of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) where he is currently sits on many Technical Committees and in the past was the AZ Chair of the Student Activities and Co-Chair of Grassroots Government Advocacy Committees. He is also an active member of Arizona United States Green Building Council (USGBC) and sits on the Arizona

USGBC Board where he is also the Arizona Student Activities Chair for colleges and universities. Marcus is also one of the founding members of the Phoenix Chapter of the International Building Performance Simulation Association (IBPSA) and the Co-Chair for the Living Building Challenge AZ Sonoran Collaborative. And Most Recently Marcus was elected to the Board of Directors for the Building Commissioning Association Southwest Chapter two years ago. Marcus is very active in the Advocacy, Membership, and Online Training committees.

OVERALL PROGRAM GOALS

Construction management professionals combine knowledge of innovative technologies, construction principles and business management to lead a wide variety of construction projects from residential and commercial buildings to infrastructure projects. The DEWSC program goals are to teach students how to become responsible leaders in the construction industry through organization, leadership, and current/innovative management techniques. The American Council for Construction Education (ACCE) states that it is essential that every Constructor be capable of effectively managing personnel, materials, equipment, costs, and time. The Constructor must be able to effectively communicate and understand their role as a member of a multi-disciplinary team, the assessment of project risk, and the alternate methods that can be used to structure the owner-designer-constructor team.

COURSE DESCRIPTION

This course is part two to Building Commissioning classes taught where students will have an opportunity to discover the importance of Commissioning and take this knowledge directly with them right into a job and having this knowledge will not only benefit their own skills, but the company they work for will see the direct benefit as well.

From the introduction course students would have received the basic knowledge of the sections below and the second advanced class will go deeper into each area with more focus on each part of the commissioning process.

- What commissioning is and what it is not!
- Types of Commissioning - Three main types of commissioning are listed below:
    - Commissioning relates to the initial commissioning process for new construction or existing buildings.
    - Continuous Commissioning is an ongoing process that resolves problems and improves the quality and energy use of existing buildings. Tests are scheduled periodically to ensure that original standards are continuously met over time.
    - Retro-commissioning - is the systematic process of commissioning on a building that has had retrofits or other major changes from the system's original designs. It is recommended throughout the lifespan of the building to ensure building systems are properly functioning to the best of their ability.
- Benefits of Commissioning - What are the long and short term benefits of commissioning
- Economics of Commissioning – The questions of With Commissioning or Without Commissioning cost impacts
- Why the commissioning process is the most cost-effective, successful, and popular quality method for buildings and constructed projects, and for enhancing productivity of existing buildings
- Elements of the commissioning process
- Phases of Commissioning
- Understanding and Navigating commissioning requirements of Codes, Standards, Guidelines and Rating Systems
    - ASHRAE Guideline-0-The-Commissioning-Process
    - ASHRAE Standard 202 Commissioning Process for Buildings and Systems
    - LEED Commissioning Process - Leadership in Energy and Environmental Design
    - IECC - International Energy Conservation Code

The introduction course provided a look at Building commissioning (Cx) and enhanced the students understanding of what commissioning is and how this process will be used in every type of construction that one will venture into.

Building commissioning is a quality-focused process necessary for both non-complex and complex modern construction projects. Normally the initial commissioning team and a team leader (typically known as the commissioning authority or CA) is involved from project initiation through one year of occupancy. In many cases and ideally, there is an ongoing building enhancing and commissioning program and team for the life of the building. While the service method can vary from owner to owner and project to project, the basic formula for a successful building commissioning process involves a synergy team from pre-design to develop the owner's project requirements (OPR), commissioning scope and plan, including benchmarks for success, review of design documents and checklists for achieving the Owner's Project Requirements (OPR), development of checklists and verifying a sample of construction checklists and submittals, developing training needs and evaluating training delivered by the contractors, witnessing and verifying construction phase tests, and periodic site observations during the construction phase, and performing commissioning functional testing as the project nears completion.

While the practice of building commissioning process is still new in the construction industry, it has quickly become common practice as building owners and developers try to get more out of their investment. The commissioning process main goal is to improve a project from the design phase through post construction and occupancy.

Part Two – Advanced Building Commissioning

Part two will cover not only basic MEP commissioning, but we will go into Building Enclosure Commissioning (BECx) (sometimes 'envelope' is used instead of 'enclosure').

BECx is a strict quality-focused process wherein the energy performance of a facility, system or assembly is evaluated and verified against defined objectives and criteria. The process itself is carried out by a commissioning team which uses reliable and accurate measures to verify that the project is meeting specific quality requirements outlined by the owner of the project. The commissioning process begins at project inception and runs through different construction phases, which include a pre-design phase, pre-construction phase and construction phase. Once the construction is finished, the commissioning process continues and becomes an ongoing routine in the life of the facility. Specific information regarding the commissioning process is outlined in the ASHRAE Guideline 0-2005: The Commissioning Process. This and several other technical support guidelines to the Guideline 0-2005 document provide specific information related to the commissioning process.

Envelope Commissioning Guidelines and Standards include ASHRAE 202P, NIBS Guideline 3, ASTM E2813, and LEEDv4 Enhanced Commissioning credit requirements.

Typical Commissioning Objectives for BECx:

- Heat Flow
- Air Flow
- Noise
- Fire
- Light
- Infrared
- Ultraviolet
- Rain Penetration
- Moisture
- structural performance
- Durability
- Security
- Reliability
- Aesthetics
- Value
- Constructability
- Maintainability
- Sustainability

The areas that will be will covered more in detail in Part two:

- Owner Project Requirements

- Commissioning Specification
- Commissioning Plan
- Field Observation Reports
- Meeting Minutes
- Issues log/deficiency List
- Sequence of Operation
- Equipment Submittals and Reviews
- Manufacturer's O&M Data (Systems Manual for operating staff)
- TAB Report Preliminary and Final (Review and verify measurements are +/- 10%)
- Re-Commissioning Plan
- Pre-Functional Checklists (Blank copies of PFC for future)
- Functional Checklists (Blank copies of FPT for future)
- Training Plan (Review & Verify training plan from start to final training)
- As-Built Drawings (Include in Enhanced report)
- Trend Data (BAS to provide 3 day (minimum) trends - 15min intervals

1. **COURSE LEARNING OUTCOMES**
2. Students will be able to:
3. 1. **Create** written communications appropriate to the construction/commissioning discipline
4. 2. **Create** oral presentations appropriate to the construction/commissioning discipline.
5. 5. **Create** construction/commissioning project schedules
6. 6. **Analyze** professional decisions based on ethical principles
7. 7. **Analyze** construction documents for planning and management of construction/commissioning processes.
8. 8. **Analyze** methods, materials, and equipment used to construct projects.
9. 9. **Apply** construction/commissioning management skills as a member of a multidisciplinary team.
10. 10. **Apply** electronic-based technology to manage the construction/commissioning process.
11. 12. **Understand** different methods of project delivery and the roles and responsibilities of all constituencies involved in the design and construction/commissioning process
12. 13. **Understand** construction/commissioning risk management.
13. 15. **Understand** construction/commissioning quality assurance and control.
14. 16. **Understand** construction/commissioning project control processes.
15. 17. **Understand** the legal implications of contract, common, and regulatory law to manage a construction/commissioning project.
16. 18. **Understand** the basic principles of sustainable construction/commissioning
17. 20a. **Understand** the basic principles of construction/commissioning of mechanical, electrical, and piping systems.
18. 20b. **Understand** the basic principles of construction/commissioning of mechanical, electrical, and piping systems.
19.
20. **ABET Applied and Natural Science Commission (EAC) Student Outcomes:**
21. This course covers the following ABET ANSAC Student Outcomes:
22. (4) an ability to communicate effectively with a range of audiences. (CLO 3)
23. (5) An ability to understand ethical and professional responsibilities and the impact of technical and/or scientific solutions in global, economic, environmental, and societal contexts. (CLO 4, 5)
24. (6) An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty. (CLO 3, 5)
25.
26. **American Council for Construction Education (ACCE) Student Learning Outcomes:**
27. This course covers the following ACCE SLO:
28. 6. Analyze professional decisions based on ethical principles. (CLO 4, 6)
29. **Discovering** construction/commissioning issues, **documenting** issues, **reporting** issues, and **deducing** a solution to how the issues could or should have been closed out before building was turned over.
30. **Communication, verification** and **documentation** are the fundamental parts of commissioning.

TEXTBOOKS, REFERENCES AND NEEDED CLASS MATERIAL

Building Commissioning Association (BCA) Student Memberships will need to be purchased for $50

We will be referencing the BCA website throughout the class and it is a needed element of this class.
This is the only cost that there will be as I will provide much of the below material to the class in the class files.

The Recognized Authority on Building Commissioning.
Website: **https://www.bcxa.org/about-us/**
The Building Commissioning Association (BCxA) is an international nonprofit organization with more than 1,200 members from the commercial building industry who are committed to the highest standards and practices for the commissioning process. We're here to raise awareness of building commissioning and to empower commissioning providers, building owners, and others to optimize the built environment so families and communities can live, work, and play in buildings that are safe, efficient, and resilient.

PDF Documents below will be provided at first class.

ASHRAE Guideline-0-The-Commissioning-Process

ASTM E2813, Standard Practice for Building Enclosure Commissioning
ASTM E2947, Standard Guide for Building Enclosure Commissioning
NIBS Guideline 3

ASHRAE Standard 202-2013 -- Commissioning Process for Buildings and Systems
(ANSI Approved; IES Co-sponsored)

Located on the BCA Website (Included in the student membership)
BCA-Best-Practices-Commissioning-Existing-Construction
BCA-New-Const-Best-Practices-2018-05-14-V2.0

GRADING POLICY
The following criteria, weights, and grading scale will be used to calculate the Final Grade (the Instructor may modify/adjust as necessary):

* Assignments are subject to change based on the instructors perspective

Weight	**Assignment**
10 pts - 10 %	Attendance and Participation – This will be important as class participation is required and class participation will be documented and weighed in final grade ➢ Homework or in-class work must be made up. ➢ A quiz must also be made up or it is a 0. The instructor will give many chances to make up the quiz and the student must schedule a time to talk about what will be used to substitute a missed quiz.
50 pts - 25 %	10 Homework Assignments throughout the semester - Each HW worth 5 points
100 pts - 25 %	10 Quizzes or One-page papers throughout the semester - Each worth 10 points
40 pts - 20 %	Midterm – Undergrads
30 pts - 20 %	Midterm – Graduate (Strict adherence on the Process Approach to Writing Research Paper)
10 pts - 5%	Midterm – Graduate (Mandatory - 10 minute in class power-point presentation)
40 pts - 20 %	Final

Bonus Point Opportunities will be made available throughout semester 3-5 times that are out of class opportunities.

Completing extra Tech Talks from the BCA website and other ideas as you bring them forward.

Attending up to (3) ASU ASHRAE or USGBC or other Student Chapter meetings that are talked about with me will be approved and turning in a typed single spaced. 10 font half page summary of what was covered at chapter meeting and on the tour.

Grading Scale	
A	**93 – 100%**
A−	**90 – 92%**
B+	**87 − 89%**
B	**83 − 86%**
B−	**80 − 82%**
C+	**77 − 79%**
C	**73 − 76%**
C−	**70 − 72%**
D+	**67 − 69%**
D	**63 − 66%**
D−	**60 − 62%**
E	**< 60**

COURSE POLICIES, PROCEDURES, AND REQUIREMENTS

Classroom Procedures – Please turn off your cell phones prior to attending class. Cell phone usage in class is not allowed (this includes texting). If you are caught texting, typing, or using cell phones during class, you may be asked to leave and your departure will count as an unexcused absence. During graded exercises, students may not use the calculator function of a wireless communication device such as a cell phone.

Virtual Zoom Calls
When using Zoom, you will be required to have your Zoom Camera on during class.
You will be required to have a camera and reliable internet access. If you do not have these resources, contact me immediately after the first-class meeting and I will connect you to the right people at ASU.

General Responsibilities – The responsibility for learning rests with each student. The professor or lecturer will assist by making the classroom environment one conducive to learning but your preparation is essential. The student is responsible for completing all reading assignments and assigned homework problems and seeking assistance if needed. Students are expected to bring relevant texts, readings, required notes and handouts, appropriate writing materials, and a willingness to engage to every class.

Attendance and Participation – Class attendance is mandatory. Attendance will be taken regularly. Punctuality, class attendance, participation and preparation are explicit reflections of the student's interest in the course. Grading will reflect the student's individual effort and knowledge. Absence from class will result in the loss of participation points. Attending lectures, turning in homework, and completing online assignments is expected behavior and will result in participation points for the course. To score a high participation grade you must engage the instructor and other students regarding the lesson material.

Make-Up Policy – Prior notice, when possible, will be given to the instructor when a class will be missed. Only under the most extreme circumstances, supported by written documentation, will a make-up oral presentation be given. The final decision rests with the instructor. When a class is missed, it is the student's responsibility to obtain notes and assignments from fellow classmates.

Assignments – Assignments are due at the time posted on blackboard (typically the beginning of class). Late submissions will not be graded and will receive a score of zero. All writing requirements must be completed using a word processor, spell and grammar checked and well written with a logical flow.

Grade Contestation Window – For 24 hours from the time at which a grade is posted to blackboard, students may not see the instructor regarding the specific grading of the assignment. Students will have one week starting after the 24 hours is over to question the grade that was given. Once this week has past, the grade is considered final.

Professional Work – To receive credit for your work, it is imperative the work be organized, readable, and professional (part of your grade will be based on presentation of your work). Plagiarism of any type will not be tolerated. At the first occurrence, your work will be returned to you to re-do. Following occurrences will result in the instructor reporting this lack of academic integrity to university administrators. If you are unclear about how to cite the work of others, **please ask!**

Course Requirements – When assigned a reading, please complete it before the lecture so that the class discussion will be more meaningful. The importance of keeping current in reading assignments cannot be overemphasized. You are responsible for all assigned reading materials, whether or not the exact topics are discussed directly in the lecture. A course of this nature depends highly upon faculty - student discussion and student participation. Open discussion is authorized and encouraged on all graded work, but each student must formulate his or her own answers because grades are based on the original work of each student. Use of published references is authorized but must be properly cited.

Official E-mail – An official ASU e-mail is established for each student, faculty member, and staff member. All university communications sent via e-mail will be sent to this ASU e-mail address. You are required to check your e-mail daily.

Laptops and Tablets – If you will be using a laptop or tablet, you must sit in the front row, and I will make a note of those students at the beginning of class. If you bring your laptop or tablet to class, you are required to e-mail your notes to me immediately after class. Failure to do so will result in an absence.

> *Recent studies suggest that students who bring laptops to class perform worse than their non-laptop using peers and are much less likely to pay attention in class. Laptops can also be a distraction for other students. One increasingly popular option is to ban laptops in the classroom, but this policy accommodates students who can efficiently use a laptop in class for note taking. As an added bonus, it helps me be a better teacher by giving me a sample of what students take down as notes.*

UNIVERSITY POLICIES

Academic Integrity - All students in this class are subject to ASU's Academic Integrity Policy (available at http://provost.asu.edu/academicintegrity) and should acquaint themselves with its content and requirements, including a strict prohibition against plagiarism. All violations will be reported to the Dean's office, who maintain records of all offenses. Students are expected to abide by the FSE Honor Code (http://engineering.asu.edu/integrity/).

Student Code of Conduct - The Student Code of Conduct sets forth the standards of conduct expected of students who choose to join the university community. Students who violate these standards will be subject to disciplinary sanctions (http://students.asu.edu/srr/code).

Classroom Behavior - The use of recording devices is not permitted during class. Any violent or threatening conduct by an ASU student in this class will be reported to the ASU Police Department and the Office of the Dean of Students.

Absence & Make-Up - Accommodations will be made for religious observances provided that students notify the instructor at the beginning of the semester concerning those dates. Students who expect to miss class due to officially university-sanctioned activities should inform the instructor early in the semester. Alternative arrangements will generally be made for any examinations and other graded in-class work affected by such absences. The preceding policies are based on ACD 304–04, "Accommodation for Religious Practices" and ACD 304–02, "Missed Classes Due to University-Sanctioned Activities."

Disability Accommodations - Suitable accommodations will be made for students having disabilities and students should notify the instructor as early as possible if they will require same. Such students must be registered with the Disability Resource Center and provide documentation to that effect.

Sexual Discrimination - Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of

sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs.

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling, is available if you wish discuss any concerns confidentially and privately.

Academic Calendar - The academic calendar (https://students.asu.edu/academic-calendar) contains important dates that students should be aware of, including: the first and last day of class, drop/add deadlines, withdrawal deadlines, and observed holidays.

Copyright Protection - All contents of these lectures, including written materials distributed to the class, are under copyright protection. Notes based on these materials may not be sold or commercialized without the express permission of the instructor.

Syllabus Changes - Any information in this syllabus may be subject to change with reasonable advance notice.

DETAILED CLASS SCHEDULE
Class sessions will be in accordance with the schedule posted on blackboard that we develop as a class. The instructor reserves the right to modify and/or adjust the schedule.

CON 494/598 Advanced Building Commissioning

Readings are located in the files folder on the class Canvas Site.

The Building Commissioning Process and ASHRAE Guideline 0 is the main reading for the introduction class and will be in the file for reference.
More reading can and will be added to the folder periodically when Mr. Myers thinks it is relative to the topic the class is covering that week.

- Readings for each week will consist of 20-25 pages.
- Tech Talks for each week will consist of approximately 30-60 minutes of video watching.
- Homework from the Readings/tech talks will consist of each student creating 5 questions and answers and/or a half to full page summation that must be added to the discussion board for each reading section on Canvas. (This is graded and will be 5pts for each posting)
- Homework is a huge component of this class!

There will be a Quiz or a one page Paper on each section and the Quiz will be made up of the Questions that students post to the discussion board.

Definition of Commissioning Process from ASHRAE Guideline 0-2005 will be on every test and it must be memorized word for word and will be a question on every quiz and test.

Week Topic

1 **HW #1** Introductions of all in class and the first HW assignment will be to create a LinkedIn page and to link add me.

In class overview of Commissioning

- What commissioning is and what it is not – Background

What Is Building Commissioning?
Definition of Commissioning Process: A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements. (*ASHRAE Guideline 0-2005)*

We will be keeping a digital binder copy of each piece below and it will be turned in at the end of the semester for half the final grade.
This binder is a living document and will be updated every week with material. The material will be your in class notes, thoughts, questions, email correspondence. This is something that you will be doing everyday as a future construction, engineering, architecture, or sustainability expert. Learning how to be organized now will be incredibly beneficial to your and the firm you do or will eventually work for.

Key terms to be identified and definitions are to be looked up and posted to the Discussion Boards for each Student and to file to be uploaded to assignment page.

- Owner Project Requirements
- Commissioning Specification
- Commissioning Plan
- Field Observation Reports
- Meeting Minutes
- Issues log/deficiency List
- Sequence of Operation
- Equipment Submittals and Reviews
- Manufacturer's O&M Data (Systems Manual for operating staff)
- TAB Report Preliminary and Final (Review and verify measurements are +/- 10%)
- Re-Commissioning Plan
- Pre-Functional Checklists (Blank copies of PFC for future)
- Functional Checklists (Blank copies of FPT for future)
- Training Plan (Review & Verify training plan from start to final training)
- As-Built Drawings (Include in Enhanced report)
- Trend Data (BAS to provide 3 day (minimum) trends - 15min intervals

Key documents of commissioning that must be understood:

- Owners Project Requirements (OPR)
- Basis of Design (BOD)
- The Commissioning Plan
- The Issues Log
- Systems Manual
- Final Commissioning Process Report

Key terms of commissioning and a construction project that must be understood:

- Sequence of Operations (SOO)
- Fundamental Commissioning
- Enhanced Commissioning
- Monitoring Based Commissioning
- Ongoing Commissioning
- Hard Cost
- Soft Cost
- Construction Project Delivery Methods (4 types – CMAR, DBB, DB, IPD)
- Issued for Construction (IFC)
- Gross Maximum Price (GMP)
- Authority Having Jurisdiction (AHJ)
- Special Inspection (SI)
- Inspection and Test Plan (ITP)
- Pre-Functional Checklist (PFC)
- Functional Performance Test (FPT)
- IECC Section 408

Typical Commissioning Objectives for BECx that must be defined in your binder:

- Heat Flow

- Air Flow
- Noise
- Fire
- Light
- Infrared
- Ultraviolet
- Rain Penetration
- Moisture
- structural performance
- Durability
- Security
- Reliability
- Aesthetics
- Value
- Constructability
- Maintainability
- Sustainability

BECx is a quality assurance process that focuses on building envelope components, such as:

- Exterior Walls: Air and Vapor Barriers, Insulation, Through-Wall Flashings, Masonry Ties, Exterior Cladding and Finishes, Sealant Joints, Expansion Joints, and Exterior Attachments
- Fenestrations (Openings): Window Flashings, Storefront Windows, Operable Windows, Curtain Wall Window Systems, Doors, and Skylights
- Roofing: Roof Decking, Vapor Barriers, Insulation, Roofing Systems and Accessories, Drainage Systems, and Sheet Metal Flashings
- Waterproofing: Below-Grade, Plaza Decks, Balconies, Railings, and Planters
- Slab on Grade: Vapor Barrier, Penetrations, Reinforcements, and Pre-Pour Inspections.

2 HW #2 OPR
- Post on Discussion Board on Canvas and Quiz or Paper #1 will be on what is and OPR and what all needs to be included in the OPR

3 HW #3 BOD
- Post on Discussion Board on Canvas and Quiz or Paper #2 will be on what is and BOD and what all needs to be included in the BOD

4 HW #4 Commissioning Plan, Meeting Minutes, Issues log/deficiency List
- Post on Discussion Board on Canvas and Quiz or Paper #3 will be on the Commissioning Plan, Meeting Minutes, Issues log/deficiency List

5 HW #5 Specifications
- Post on Discussion Board on Canvas and Quiz or Paper # 4 will be on Specifications
    - 50 Divisions refers to the 50 divisions of construction information, as defined by the Construction Specifications Institute (CSI)'s Master Format
    - Divisions 00-29
    - Training Plan (What goes into specs and why?)

6 HW #6 Field Observation Reports,
- Post on Discussion Board on Canvas and Quiz or Paper #5
    - Field Observation Reports
    - Meeting Minutes
    - Issues log/deficiency List

7 HW #7 Sequence of Operation, Equipment Submittals and Reviews

- Post on Discussion Board on Canvas and Quiz or Paper #6 will be on the Sequence of Operation, Equipment Submittals and Reviews

8 HW# 7 Commissioning Plan
- Post on Discussion Board on Canvas and Quiz or Paper #6 will be on the Commissioning Plan

In Class Discussion about Midterm Assignment:
- LEED Fundamental and Enhanced Commissioning (In class Discussion)
- IECC Code Minimum Commissioning

Midterm Assignment will be talked about and distributed.

10 Spring Break

11 Midterm Due in Class

12 HW# 8 BECx Building envelope components
a. Post on Discussion Board on Canvas and Quiz or Paper #7 will be on the BECx - Building envelope components
b. BECx is a quality assurance process that focuses on building envelope components, such as:
- Exterior Walls: Air and Vapor Barriers, Insulation, Through-Wall Flashings, Masonry Ties, Exterior Cladding and Finishes, Sealant Joints, Expansion Joints, and Exterior Attachments
- Fenestrations (Openings): Window Flashings, Storefront Windows, Operable Windows, Curtain Wall Window Systems, Doors, and Skylights
- Roofing: Roof Decking, Vapor Barriers, Insulation, Roofing Systems and Accessories, Drainage Systems, and Sheet Metal Flashings
- Waterproofing: Below-Grade, Plaza Decks, Balconies, Railings, and Planters
- Slab on Grade: Vapor Barrier, Penetrations, Reinforcements, and Pre-Pour Inspections.

13 HW# 9 Pre-Functional Checklists, Functional Checklists

a. Post on Discussion Board on Canvas and Quiz or Paper #8 will be on Pre-Functional Checklists, Functional Checklists

14 HW# 10 TAB Report Preliminary and Final (Water and Air)
a. Post on Discussion Board on Canvas and Quiz or Paper #9 will be on the

15 HW#11
- Post on Discussion Board on Canvas and Quiz or Paper #10 will be on the Issues Log, Systems Manual, Training Plan agenda/review/meeting, Trend Data, Final Commissioning Process Report

16 HW# 12
a. Review for final and Binder review (what is expected to be in the digital binder to turn in)

17 Final
a. In Class Final will be given