



BOC Level I

Project Workbook

FACILITATOR'S EDITION

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Edition 4.0

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BOC Level I Project - Introduction

Purpose. The purpose of the BOC Level I project is to enable participants to demonstrate their ability to apply skills developed in the BOC classes. The assignments require participants to gather information about their facility, provide documentation, and make recommendations for particular building systems. Taken as a whole, the project should provide the participant a useful overview of the facility’s operational characteristics, energy consumption, and maintenance status. Completion of the Level I Project Workbook is **REQUIRED** to earn a BOC Level I Training Certificate of Completion.

Organization and Instructions. The project workbook consists of five assignments given during the course series and should be completed and returned to the training coordinator for review or uploaded to the BOC Learning Management System (LMS) by the due date outlined in the course syllabus. Instructors and training coordinators can call the NEEC office at (206) 292-4793 for questions related to the project workbook.

Grading and Recording Scores. The BOC coordinator uses the assignment rubrics to check each item and calculate the score. If a participant scores below 70%, the coordinator will inform the student how to correct and resubmit the assignment. For in-person courses, the coordinator records the assignment scores in three places: 1) assignment rubric, 2) Project Score Card, and 3) BOC LMS. The reviewer should initial and date the rubric and score card in the ‘Office-Use’ sections and include comments, if needed. For remote courses, the coordinator will only record the assignments scores in the BOC LMS.

Project Assignment Description

Assignments by Class	Typically Due
BOC 1001: Draw a simple floor plan of the facility. Identify primary heating and cooling plants, distribution lines and control points.	the following class
BOC 1002: Create an energy benchmark for your building using Energy Star ® Portfolio Manager.	the following class
BOC 1003: Perform a simplified lighting survey including watt densities and lighting levels. Research available utility incentives.	the following class
BOC 1004: Review facility heating, cooling and ventilation operations and maintenance measures. Provide a control system overview identifying strategies by system and running time comparisons.	the following class
BOC 1005: Develop an Occupancy Schedule. Profile the occupancy of the facility by week, month and year	the following class

SAMPLE Project Score Card

Name: John Doe Company: Acme Building Services

***** OFFICE USE ONLY *****

Date	Assignment	Score	Comments (and Reviewer’s Initials)
9/5/22	Assignment 1: Building Floor Plan	91	Requested additional time to complete the project. G.H.
10/10/22	Assignment 2: Benchmark a Building	85	G.H.
11/10/22	Assignment 3: Lighting Survey	100	G.H.
1/10/23	Assignment 4: Control System Review	85	G.H.
2/10/23	Assignment 5: Occupancy Schedule	100	G.H.

Assignment 1: Building Floor Plan

Instructions

At the beginning of the BOC 1001B class, the instructor should refer participants to the Assignment 1 rubric and explain that it will be used to grade the assignment. Review each item and the project instructions. Discuss potential challenges and solutions such as access to systems & system identification. Suggest people in their organization that participants can talk to in order to gain access and/or get assistance in system identification. Fire escape floor-plans can be used as a starting point in lieu of as-built drawings. During class, demonstrate how to draw an air handler and other complex HVAC system components. Ask participants if they feel confident in their ability to complete the project. Answer questions.

Grading

Refer to the rubric, floor plan symbols, and project samples found in the Project Workbook Appendix to aid grading. Place a check marked beside each item that was completed. Eleven out of 11 check marks equal a score of 100%. 10 out of 11 correct = 91%, etc.

Grading FAQ

The FAQ below can be used as a general guide for commonly asked questions about scoring the assignments.

Q - What if it's not readily clear whether an assignment item was completed?

A - Offer to meet with the participant during a break or after class, or call/email the participant to discuss the project item in question. Depending on the total score, determine if the participant will need to correct the item.

Q - Does the project score affect course completion?

A - Assignments are scored on a pass/fail basis and require a score of 70% to pass. Participants must earn a passing score on all 5 assignments in order to complete the course.

Q - What if a participant says they are unemployed and do not have access to a commercial facility?

A - In order to receive the Training Certificate of Completion, the participant must complete and turn in all of the projects. Suggest that the participant network with another participant in the class to schedule a walk-through of their facility or use information from a previous employer. The use of a single-family residential building should NOT be suggested. The BOC LMS also includes sample building data that can be used for participants to complete the project assignments, if they do not have a facility of their own.

Assignment 2A: Benchmark a Building

Debriefing on the Previous Assignment

Typically, participants turn in Assignment 1 for grading prior to the 1002 class. The coordinator and instructor should review the assignment objectives, instructions, project examples, and answer keys ahead of time. At the start of class, the instructor should lead a 5-minute discussion about Assignment 1, starting with general questions such as: What went well? What didn't go well? How did you address challenges? Why did things happen? What will you do differently/better next time? How will you use this?

Suggested questions: How is your floor plan organized? How did you arrive at the square footage? How did you access information on your building?

Instructions

Participants will use Portfolio Manager to benchmark the building from Assignment 1. During the demo of Portfolio Manager, the instructor should reference the Portfolio Manager Quick Start Guide in Project Workbook Appendix B and note it will be helpful for completing Assignment 2. Discuss the importance of entering data correctly, e.g. use erroneous data sets to demonstrate how participants can spot data entry problems. Allow participants to practice EUI calculations during class.

Refer participants to the Assignment 2-A rubric and explain that it will be used to grade the assignment. Review each item and the project instructions. Discuss potential challenges, such as finding accurate data, and suggest solutions, such as making contact with a utility representative as a data resource and suggest ways to build a relationship with them. Ask participants if they feel confident in their ability to complete the project. Answer questions.

NOTE: Some participants may not be able to use Portfolio Manager if they lack access to needed data or are using a facility that is too small or not supported by the tool. If their building isn't supported by the tool, the participant should be referred to the alternative Assignment 2-B: Energy Accounting Report in Appendices B-2 and B-3 of their Project Workbook. If they lack needed data, they should be referred to the sample data in Appendix B-4 and the BOC LMS. They should then complete Assignment 2-A.

Grading Assignment 2-A

To receive full credit for the assignment, participants should complete and turn in the following documents:

1. Portfolio Manager Data Collection Worksheet
2. Statement of Energy Performance (SEP)
3. Benchmark Analysis Worksheet in the Project Workbook

To score the assignment, use the Project Workbook rubrics. For in-person courses, initial, date, and score the project in the office-use section. For in-person and remote courses, the project grade should also be recorded in the BOC LMS.

The Assignment 2-A rubric has 11 items to be graded. Count up the correct answers and round to the nearest whole number. Eleven out of 11 correct answers equal a score of 100% (10 out of 11 = 91%, etc.).

Grading Assignment 2-B

To receive full credit for the assignment, participants should complete and turn in the following documents:

1. Energy Accounting Report Parts 1-3.
2. Benchmark Analysis Worksheet

The Assignment 2-B rubric has 20 items to be graded.

Assignment 3: Lighting Survey

Debriefing on the Previous Assignment

Typically, participants turn in Assignment 2 for grading prior to the 1003 class. The coordinator and instructor should review the assignment objectives, instructions, project examples, and answer keys ahead of time. At the start of class, the instructor should lead a 5-minute discussion about Assignment 2 by asking general questions such as: What went well? What didn't go well? How did you address challenges? Why did things happen? What will you do differently/better next time? How will you use this?

Suggested discussion question: How can you use the Portfolio Manager data you collected?

Instructions

This is a 3-part project assignment. In Part I, participants conduct a lighting survey on the building from Assignments 1 & 2. In Part II, they research local lighting incentives. In Part III, they estimate the cost of a lighting retrofit using a typical utility incentive. Students will be required to demonstrate knowledge of lighting levels and re-commissioning methods to reduce energy use associated with lighting while maintaining recommended lighting levels needed for productivity and safety. The class exercises set students up to successfully complete Assignment 3, so instructors need to check whether students understand key concepts and topics throughout the class.

At the beginning of class, refer participants to the Assignment 3 rubric and explain that the rubric will be used to grade the assignment. Review each item and the project instructions. Ask participants to share details of lighting retrofits. Discuss potential challenges and solutions such as data gathering and terminology (i.e. luminaire). Ask participants if they feel confident in their ability to complete the assignment. Answer questions.

Grading

To receive full credit for the assignment, participants should complete and turn in the following documents:

1. Lighting Power Survey Worksheet
2. Lighting Energy Use Survey Worksheet
3. Utility Incentive Research
4. Lighting Retrofit Worksheet (answer key below on page 10)

To score Assignment 3, use the rubric provided in the Project Workbook. For in-person courses, initial, date, and score the project in the office-use section. For in-person and remote courses, the project grade should be recorded in the BOC LMS.

The rubric has 13 items to be graded for a total of 40 points. Count up the correct answers and round to the nearest whole number. Participants must show their work supporting how they arrived at the answer. Note the number of possible points associated with each item to be graded and calculate the percentage of correct points out of 40 accordingly.

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	Current	Proposed
Watts per fixture (A)	112 watts	75 watts
Operating hours (B)	3,000 hours	3,000 hours
Number of fixtures (C)	250	250
Annual consumption	84,000 kWh/yr	56,250 kWh/yr

(A)x(B)x(C) Note: Divided by 1000 to get kilowatt hours

Calculations

Energy Savings	$\frac{84,000 \text{ kWh}}{\text{Current annual consumption}}$	minus	$\frac{56,250 \text{ kWh}}{\text{Proposed annual consumption}}$	equals	$\frac{27,750 \text{ kWh}}{\text{Annual energy savings}}$
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Cost savings	$\frac{27,750 \text{ kWh}}{\text{Annual energy savings}}$	X	$\frac{\$12/\text{kWh}}{\text{Energy rate } \$/\text{kWh}}$	equals	$\frac{\$3,330}{\text{Annual cost savings}}$
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Fixture Cost	$\frac{250}{\text{\# of fixtures}}$	X	$\frac{\$40}{\text{Cost per fixture}}$	equals	$\frac{\$10,000}{\text{Total fixture cost}}$
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Utility Incentive	$\frac{250}{\text{\# of fixtures}}$	X	$\frac{\$4/\text{fixture}}{\text{Rebate per fixture}}$	equals	$\frac{\$1,000}{\text{Total utility incentive}}$
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Net project cost	$\frac{\$10,000}{\text{Fixtures plus labor cost}}$	minus	$\frac{\$1,000}{\text{Utility Incentive}}$	equals	$\frac{\$9,000}{\text{Net project cost}}$
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Payback period	$\frac{\$9,000}{\text{Net project cost}}$	divided by	$\frac{\$3,330}{\text{annual } \$ \text{ savings}}$	equals	$\frac{2.7 \text{ years}}{\text{Payback in years}}$
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Return on Investment (ROI)	$\frac{1}{\text{ROI}}$	divided by	$\frac{2.7}{\text{Payback in years}}$	equals	$\frac{37\%}{\text{ROI}}$
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Note: ROI is 1 divided by the payback period

Assignment 4: HVAC Controls Review

Debriefing on the Previous Assignment

Typically, participants turn in Assignment 3 for grading prior to the 1004 class. The coordinator and instructor should review the assignment objectives, instructions, project examples, and answer keys ahead of time. At the start of class, the instructor should lead a 5-minute discussion about Assignment 3 by asking general questions such as: What went well? What didn't go well? How did you address challenges? Why did things happen? What will you do differently/better next time? How will you use this?

Suggested discussion question: What's your existing lighting system? What rebates are available? Were you able to calculate power density and does it make sense?

Consider working through the Retrofit Worksheet calculations as a group.

Instructions

This is a 5-part project assignment. Participants complete:

- 1) Building and Mechanical HVAC Zone Information
- 2) Heating System Controls Operation Review
- 3) Ventilation Control Systems Review
- 4) Cooling Systems Controls and/or Heat Pump Controls Review
- 5) Control Systems Review

By successfully completing Assignment 4, participants demonstrate their knowledge of the proper operation of mechanical systems, mechanical controls, and the value of re-commissioning in order to reduce energy use without reducing comfort, indoor air quality or function needed for productivity and safety. During class, provide an example of a sequence of operation and demonstrate how you would do it. Suggested online resources:

- www.ctrlspecbuilder.com
- www.buildapedia.com
- www.engineeringtoolbox.com

At the beginning of class, refer participants to the project rubric and explain that the rubric will be used to grade the assignment. Review each item and the project instructions. Discuss potential challenges and solutions such as not being able to find equipment, time constraints. Ask participants if they feel confident in their ability to complete the project. Answer questions.

Grading

To receive full credit for the assignment, participants should complete and turn in the documents in the instructions section above.

To score Assignment 4, use the Project Workbook rubric. For in-person courses, initial, date, and score the project in the office-use section. For in-person and remote courses, record the assignment grade in the BOC LMS.

The rubric has 20 or 15 items to be graded depending on whether the building space studied has a boiler. Count up the correct answers and round to the nearest whole number. Participants must show their work supporting how they arrived at the answer. Twenty out of 20 correct answers equal a score of 100% (17 out of 20 = 85%, etc.).

Assignment 5: Occupancy Schedule

Debriefing on the Previous Assignment

Typically, participants turn in Assignment 4 for grading prior to the 1005 class. The coordinator and instructor should review the assignment objectives, instructions, project examples, and answer keys ahead of time. At the start of class, the instructor should lead a 5 minute discussion about Assignment 4 by asking general questions such as: What went well? What didn't go well? How did you address challenges? Why did things happen? What will you do differently/better next time? How will you use this?

Suggested discussion question: Did you discover anything needing attention when reviewing the heating/ventilation/cooling control systems? What did you find when you did the Control Systems Review? Is your system actually operating as programmed?

Instructions

In this 3-part assignment, participants document and analyze the effects of occupant density, hours of use and other occupant factors occurring within buildings. By successfully completing this assignment, participants should be able to discuss how building controls could increase occupant comfort, improve air quality, and reduce energy.

At the beginning of class, refer participants to the Assignment 5 rubric and explain that the rubric will be used to grade the assignment. Review each item and the instructions. Discuss potential challenges and solutions like communicating with occupants. Point out and discuss the relationship between occupancy and energy use. Ask participants if they feel confident in their ability to complete the assignment. Answer questions.

Grading

To receive full credit for the assignment, participants should complete and turn in the following documents:

1. Building Occupancy Schedule
2. An Occupancy Profile for each zone listed on the schedule
3. Occupancy Profile Analysis

To score the assignment, use the Assignment 5 rubric in the project workbook. For in-person courses, initial, date, and score the assignment in the office-use section. For in-person and remote courses, the assignment grade should be recorded in the BOC LMS.

The rubric has 17 items to be graded depending on whether the building space studied has a boiler. Count up the correct answers and round to the nearest whole number. Participants must

show their work supporting how they arrived at the answer. Seventeen out of 17 correct answers equal a score of 100% (15 out of 17 = 88%, etc.).

Debriefing on this Assignment

Typically, participants turn in Assignment 5 for grading prior to the 1006 class. The coordinator and instructor should review the assignment objectives, instructions, project examples, and answer keys ahead of time. At the start of class, the instructor should lead a 5 minute discussion about Assignment 5 by asking general questions such as: What went well? What didn't go well? How did you address challenges? Why did things happen? What will you do differently/better next time? How will you use this?

Suggested discussion question: Did the Occupancy Profile Analysis uncover any opportunities for rescheduling heating or cooling systems?