



# PLO No. 20 Report

## Assessment Measures and Results

At Cal Poly's Construction Management Department, PLO 20 (Understand the basic principles of mechanical, electrical and plumbing systems) is assessed using four different instruments, listed below.

### Assessment Measure 1: Embedded Questions in Exams

### Direct Measure

Questions are embedded in the midterm and/or final exams in the CM 411 – Specialty Contracting Construction Management course. All students must complete this course to graduate, so all students are assessed. The embedded questions were initiated in Fall 2018, and results from the embedded assignment are collected each quarter.

Our goal is that at least 80% of all students get at least 70% of the questions correct. Since the assessment measure was introduced in Fall 2018, students have achieved 90% or better on assessed questions.

### Assessment Measure 2: AIC Exam Results

### Direct Measure

Starting in academic year 2018-2019, as part of CM 461, all students must complete the AIC exam in order to graduate. Although a few students completed the AIC prior to Fall 2018, most of the results are from Fall 2018 onward.

Our goal is that our students perform either at or above the national average at each exam date. From Winter 2016 to Winter 2018, students performed above the national average; in Spring and Winter 2019, students scored under the national average by 11% and 8% respectively.

### Assessment Measure 3: Survey – Industry Employer

### Indirect Measure

At the end of each academic year, surveys are sent out to industry members who recruit and employ Cal Poly Construction Management graduates assessing graduates' abilities to understand the basic principles of mechanical, electrical, and plumbing systems. Surveys have been sent out in the spring of 2016 and each spring from 2108 through 2020.

Our goal is that at least 50% of employers assess students' ability as good or above. In all years, students scored greater than 50%, and employer perceptions have been trending upward each year since the survey was initiated, rising from 70% in 2016 to 83% in 2020.

### Assessment Measure 4: Survey – Graduating Senior/Recent Alumni

### Indirect Measure

At the end of each academic year, surveys are sent out to graduating seniors assessing personal abilities to understand the basic principles of mechanical, electrical, and plumbing systems. Surveys have been sent out in the spring of 2016 and each spring from 2108 through 2020.

Our goal is that at least 65% of students indicate their ability as good or above. In 2016 and 2018, only 46% and 56% of students, respectively, answered good and above. These results have been trending upward each year and in 2019 and 2020, 82% and 89% of students answered good and above.



# PLO No. 20 Report

## Evaluation of Assessment Data



This PLO is of medium concern to the department. Students are performing above expectations for three of the four measures, but below expectations on the AIC exam. Student and employer expectations have been trending upward over the last few years

The direct assessment instrument is considered valid for this evaluation. However, the instruments have not been consistently administered. As different instructors teach the course, there have been quarters where questions have not been asked, and the delivery of data has not been consistent each quarter. Additional work needs to be done to ensure each instructor understands their responsibilities for delivery of the assessment.

In some quarters, information has been collected for each individual question, to help identify areas where students are struggling. Overall, there is no consistent question or question type where students are underperforming.

Student results by question type are further explained later in this report.

## Quality Improvement Plan

Data for this PLO is collected quarterly by the PLO Champion and provided to the Outcomes Assessment Committee.

Industry and graduating senior surveys are collected each spring. Results from the AIC exam are collected after each exam is conducted (November and April). Results from surveys and the AIC exam are housed by the Outcomes Assessment Committee.

Every three years, the annually collected data will be analyzed by the faculty, with identification of strengths, weaknesses, and recommendations for curricular change, program change, or assessment instrument modifications. This analysis will happen in the following years:

2021/2022

2024/2025

2027/2028

2030/2031

## Actions Taken

As a result of the assessment data collected, the department has taken the following actions:

During Fall 2019 retreat, the assessment instrument and preliminary results from assessment of PLO No. 20 were reviewed by the faculty to identify areas of improvement to the assessment process that would affect the QIP. The results of the discussion are summarized as follows:

- The curriculum was evaluated and this material is sufficiently introduced and reinforced throughout the curriculum to scaffold this knowledge prior to assessment.
- During the Fall 2019 retreat, the assessment instrument and preliminary results were reviewed. Questions were analyzed to make sure they were at the correct Bloom's taxonomy level. Most questions were at a remember level and need to be revised to an understand level

## PLO No. 20 Report

- There was discussion to create and administer a standalone assessment (in lieu of assessment questions in midterms exams) as part of an overall MEP Project and Assessment which is still embedded in the course. Will consider as a future measure of assessment.
- The assessment is embedded in the correct class, and course instructors will continue looking for room for improvement and facilitate the continuous improvement processes in QIP to increase the quality of student learning experience.

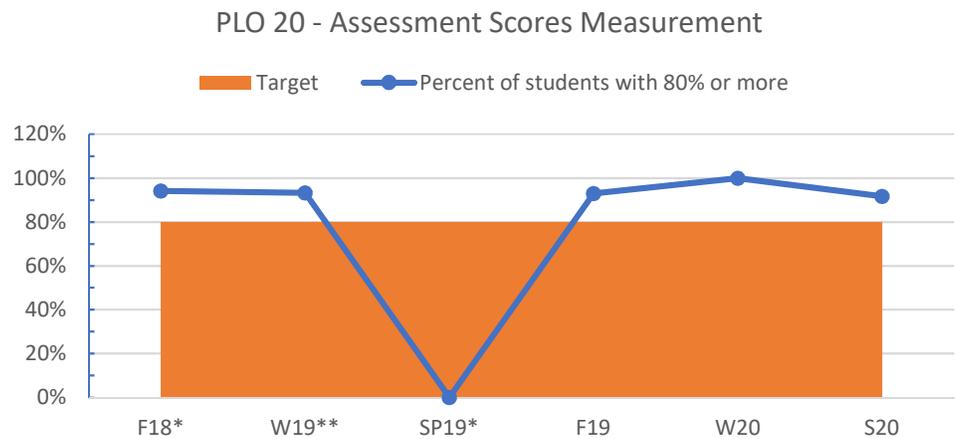
During the Fall 2020 retreat, the assessment instrument and results were reviewed by the faculty. The course and outcomes assessment champions were reminded to work with all instructors teaching the course to ensure consistent delivery and result collection.

# Assessment Summary

PLO No. 20 – Understand Mechanical, Electrical, Plumbing

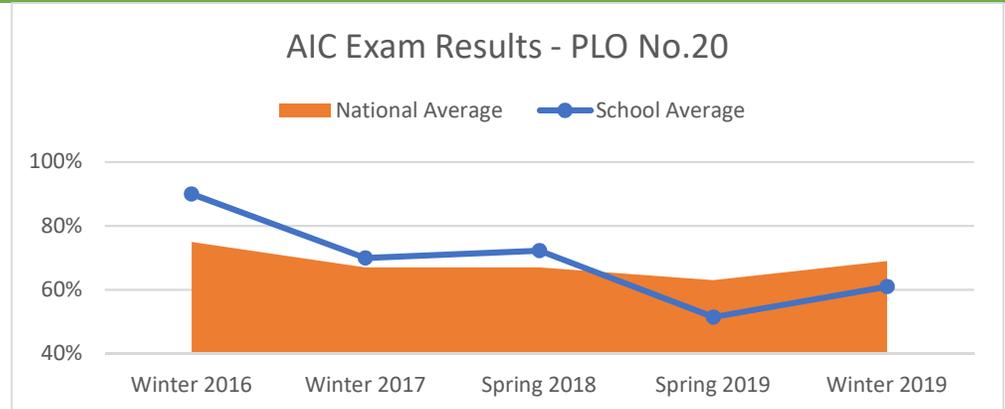
## Assessment Measure 1

**Assessment Method:** Essay question embedded in exams  
**Type of Measure:** Direct  
**Goal:** Students will answer 80% of questions correctly



## Assessment Measure 2

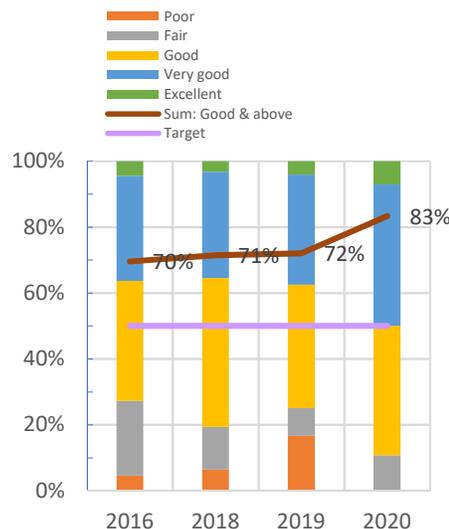
**Assessment Method:** AIC exam  
**Type of Measure:** Direct  
**Goal:** School average is higher than national average



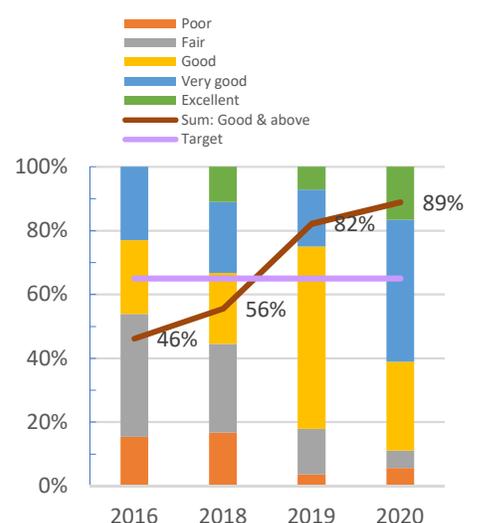
## Assessment Measures 3 & 4

**Assessment Method:** Surveys  
**Type of Measure:** Indirect  
**Goal:** 50% of employers answer good or above  
 65% of graduating students and recent alumni answer good and above

**Employer Survey Summary - PLO No.20**



**Graduating Seniors & Recent Alumni Results - PLO No.20**



# Resulting Actions and Follow-Up

PLO No. 20 – Understand Mechanical, Electrical, Plumbing

## Original Assessment Measure

**Fall 2017** First assessment measure implemented

## Modifications to Original Assessment Measure

**Fall 2019** Outcomes assessment measure and results from Fall 2017 to Spring 2018 were reviewed. It was recommended that the questions be updated to better align with the Bloom's taxonomy level 'Understand.'

**Winter 2020** Updated measures to align with the Bloom's taxonomy level 'understand' were embedded in the course.

# Assessment Measure 1: Background

PLO No. 20 – Understand Mechanical, Electrical, Plumbing

## PLO Number and Description

Understand the basic principles of mechanical, electrical and plumbing systems.

## Method of Assessment

The assessment is deployed in CM 411 – Specialty Construction Management. This course includes appropriate content and assessment questions derived through plan reading take-off assignments, quizzes, a mid-term, and a final exam.

Separate questions below will be embedded in two separate exams throughout the quarter, with answers collected and summarized at the end of each quarter and provided to the Outcomes Assessment Team.

## Assessment Reasoning

For MEP, the content was broken up into four separate categories, listed below, that are important for the understanding of the subject:

1. Understand the types of materials used in specialty contracting
2. Understand how to read mechanical, electrical, and plumbing plans and specifications
3. Know the different types of equipment and materials used in specialty contracting
4. Analyze a system design and estimate materials and components used in installation work packages

## Data Collection and Distribution

At the end of each quarter, results for each question will be extracted from each of the exams. Results will be collected for every student in the course and every question answered. These results will be summarized in an excel document listing the number of right/wrong responses for each question, and the overall percentage of questions answered correctly for each student.

## Result Expectations

The goal is that each question will be answered with 70% accuracy, and that 80% of the students will answer get at least 70% of the questions correct.

# Assessment Measure 1: Questions and Results

PLO No. 20 – Understand Mechanical, Electrical, Plumbing

## Questions

Questions vary slightly from quarter to quarter, but the question themes remain consistent. A database of questions is used to reduce the chance of asking the same question each quarter. Each question is asked in a multiple-choice format. The question themes are listed below:

### Electrical questions:

- Question 1: Cable versus wire
- Question 2: Lighting terminology
- Question 3: Ohms law calculations
- Question 4: Power equation
- Question 5: Wire sizing

### Mechanical and Plumbing:

- Question 1: Commercial AC
- Question 2: Psychometric
- Question 3: DWV
- Question 4: Valve type
- Question 5: Water pressure

## Assessment Results by Quarter:

	F18	W19*	SP19	F19**	W20	S20
Question 1	98%	0%	93%	63%	95%	100%
Question 2	78%	0%	67%	71%	84%	100%
Question 3	76%	0%	85%	100%	77%	#VALUE!
Question 4	51%	0%	48%	75%	84%	75%
Question 5	76%	0%	81%	96%	91%	71%
Question 6	93%	91%	85%	58%	95%	79%
Question 7	68%	98%	33%	96%	84%	96%
Question 8	98%	89%	96%	100%	56%	75%
Question 9	88%	93%	96%	38%	95%	100%
Question 10	90%	89%	100%	92%	98%	54%
Target for Passing	70%	70%	70%	70%	70%	70%
Number of Students In Class	41	45	27	24	43	24
Number of Students who took the exam	41	45	27	24	43	24

\*Electrical questions were not collected this quarter.

\*\*For one section of course, only overall score was provided, not individual scores for each question. Numbers only represent one of two sections for individual questions.

# Assessment Measure 2: Details

PLO No. 20 – Understand Mechanical, Electrical, Plumbing

## Method of Assessment

Students will take the American Institute of Constructors (AIC) Level 1 Certification Exam during their junior or senior year.

## Assessment Reasoning

The AIC exam has mapped ACCE student learning outcomes to questions in their exam; these results can be used to assess ACCE's 20 student learning outcomes.

## Data Collection and Distribution

Upon completion of the exam (held twice a year), results are sent from the AIC to a designated faculty member. These results include individual student performance by each ACCE SLO as well as national averages. The faculty member distributes the results to the data team for recording and results are shared at departmental meetings.

## Result Expectations

The goal is that the school average is higher than the national average for each test period.

## AIC Exam Results by Date

AIC Exam Results - PLO No.20						
	Winter 2016	Winter 2017	Spring 2018	Spring 2019	Winter 2019	Spring 2020**
School Average	90%	70%	72%	52%	61%	#N/A
National Average	75%	67%	67%	63%	69%	#N/A
Number of students who took the exam	1	9	10	4	97	0
Number of Students who Passed Exam	1	6	6*	0	79	0

\*one student left the exam early and this student's results are not included in the results

\*\*Exams cancelled due to COVID-19

# Assessment Measures 3 & 4: Details

PLO No. 20 – Understand Mechanical, Electrical, Plumbing

## Method of Assessment

Surveys are sent out each year to industry employers, graduating seniors, and recent alumni. Surveys ask respondents to rank each of the 25 PLOs against student performance with the scale of (1) unable to assess; (2) poor; (3) fair; (4) good; (5) very good; (6) excellent.

Industry employers are asked to rate their perception of Cal Poly student performance for each of the 25 PLOs.

Graduating seniors and recent alumni are asked to rank their individual performance in each PLO area based on their individual perception.

## Assessment Reasoning

The surveys are used to identify overall how the program is perceived by industry and how students perceive their attainment of each individual PLO.

## Data Collection and Distribution

Annually, each spring, a member of the outcomes assessment committee sends out a survey to (1) industry employers; (2) graduating seniors; and (3) recent alumni using Survey Monkey. Results are collected from each group, shared with the outcomes assessment committee, and shared with the department at the fall retreat.

## Result Expectations

The goal is that 50% of employers answer good or above and 65% of graduating students and recent alumni answer good and above.

## Employer Survey Results by Year

	<b>2016</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
Number of Responses	23	35	25	30
Unable to assess	4%	11%	4%	7%
Poor	4%	6%	16%	0%
Fair	22%	11%	8%	10%
Good	35%	40%	36%	37%
Very good	30%	29%	32%	40%
Excellent	4%	3%	4%	7%
Sum: Very good & Excellent	35%	31%	36%	47%
Sum: Good & above	70%	71%	72%	83%
Target	50%	50%	50%	50%

# Assessment Measures 3 & 4: Details

PLO No. 20 – Understand Mechanical, Electrical, Plumbing

## Graduating Seniors and Recent Alumni Results by Year

	<b>2016</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
Number of Responses	13	18	28	0
Unable to assess	0%	0%	0%	0%
Poor	15%	17%	4%	6%
Fair	38%	28%	14%	6%
Good	23%	22%	57%	28%
Very good	23%	22%	18%	44%
Excellent	0%	11%	7%	17%
Sum: Very good & Excellent	23%	33%	25%	61%
Sum: Good & above	46%	56%	82%	89%
Target	65%	65%	65%	65%