



THE SE3[≡] PROJECT

STRUCTURAL ENGINEERING ENGAGEMENT & EQUITY

RACIAL EQUITY
TASK GROUP

2020-2021



Racial Demographics of Civil Engineering Pathways in California: From Undergraduates to Industry Professionals

By the Structural Engineering, Engagement, and Equity Committee of the
Structural Engineers Association of Northern California (SEAONC)



- 1 **Motivation**
Page 1
- 2 **Introduction**
Page 2
- 3 **Data Processing**
Page 3
- 4 **Data Evaluation**
Page 4
- 5 **Pathway Comparison**
Pages 5 to 7
 - National General Engineering Pathways
 - National Civil and Structural Engineering Pathways
 - California Civil Engineering Pathways
- 6 **University Comparison**
Pages 8 to 11
 - Bachelor's Enrollment and Degrees Awarded
 - Master's Enrollment and Degrees Awarded
- 7 **Summary and Action Items**
Page 12
- 8 **Further Studies**
Page 13
- 9 **Appendix: Northern California University Data**
Page 14
- 10 **Data Sources**
Page 18
- 11 **Additional Resources**
Page 19

Motivation



In June 2020, the SEAONC Structural Engineering Engagement & Equity (SE3) Committee pledged to a series of actions as a commitment to stand in solidarity with the Black community and to combat racial injustice. One of these actions is to engage in research to educate ourselves and other Northern California structural engineers about the lack of Black representation in the structural engineering industry. In tandem with this research, SEAONC SE3 set out to compile resources to address the following questions:

- What are the specific barriers for Black engineers entering the industry? Where does the pipeline break down?
- How does the structural engineering industry compare to other science, technology, engineering, and math (STEM), and design-related disciplines when it comes to Black representation? How does representation in the Bay Area compare to that in the rest of the country?
- How can we improve the attraction and retention of Black talent in the structural engineering industry?

Though this report does not address each of these questions specifically, we hope readers will keep these questions in mind when considering the data presented in this report.

This report is only one of SEAONC SE3's efforts to fulfill our research pledge. More details on our future studies can be found at the end of this report. Although our pledge outlined above focuses on Black representation, this report provides data analysis on all racial and ethnic groups with an emphasis on the Black, Indigenous, People of Color (BIPOC) population. Overall, collecting and analyzing the data for this report presented a unique learning opportunity for us to understand the racial demographics of our profession and the pathways associated with it.



Introduction



This report looks to present data on the pathways into the civil and structural engineering professions, starting at the university level and continuing into the workforce. The progression of people from high school, through college, and into a profession is often called a “pipeline”. “Pipeline” implies that there is only one route to enter the profession and one successful outcome, without addressing that participants can enter the path at any stage.^a In this report, SEAONC SE3 refers to that progression as “pathways” because it is a more flexible definition of the ways that civil and structural engineers may take into our profession.

For this report, we collected and summarized publicly available racial and ethnic demographic data from California universities offering degrees in civil engineering. We have also included data on the racial and ethnic demographics of all civil and general engineering students across the country and the structural engineering, civil engineering, and general engineering professions. The racial and ethnic groups included in this report are Native American, Asian, Black, Hispanic/Latinx, Pacific Islander, and White people, as well as people who identify with two or more races. The source data for this report dictated which and how groups were included. By engaging in this research, SEAONC SE3 sought to understand the magnitude of underrepresentation and how that representation changes at different stages of the pathways studied, disaggregated by race/ethnicity, in civil engineering undergraduate and graduate programs and the structural engineering profession when compared to the general California population. Only California universities offering degrees in civil, structural, or architectural engineering were included in this research.

This report is meant to be a resource for leaders and human resource managers of structural engineering firms, particularly those in California, to understand the demographics of the civil, structural, and architectural engineering programs at California universities; identify universities with demographics that more closely reflect the California population; and broaden their recruitment efforts to include these programs. The enrollment and degrees awarded presented in this report is an approximate snapshot of the “current” state of racial and ethnic representation in the California civil engineering programs as the data collected

are for a single year. Therefore, the data from universities represent a single generation of students, while the data for the general population and the profession span many generations.

This report illustrates that underrepresentation of certain racial and ethnic groups, such as Black, Indigenous, and People of Color, exists at higher education institutions and that the gap is wider at the professional level. The loss of talent, particularly of folks from historically underrepresented groups, at progressive stages from education to profession, is often referred to as a “leaky pipeline”. It is not within the scope of this report or the expertise of the authors to comment on the historical barriers responsible for this gap. Where this report hypothesizes reasons for the underrepresentation of certain groups we will refer to and cite available research on the subject. While we expect attrition at all levels (for example, not everyone who graduates with a bachelor’s degree in civil engineering pursues a master’s degree in civil engineering), general attrition rates are not a focus point in this report.

There are certain universities and colleges that serve historically underrepresented groups by design. SEAONC SE3 notes the following:

- There are no Historically Black Colleges and Universities (HBCUs) in California offering civil engineering degrees. However, HBCUs have a significant influence on the prevalence of graduating Black professionals in engineering. The United Negro College Fund (UNCF) notes that 25% “of African American graduates with STEM degrees come from HBCUs.”^b
- Hispanic-Serving Institutions (HSIs), which are defined in federal law as an accredited, degree-granting, public or private nonprofit institution of higher education with 25% or more total undergraduate Hispanic full-time equivalent student enrollment, tend to have higher proportions of all racial/ethnic groups underrepresented in civil engineering compared to other California universities. These institutions have higher enrollment not exclusively of Hispanic/Latinx students, but also of Black, Native American, and/or Pacific Islander students.

Data Processing



The data sets for this report were compiled from various publicly available online sources, which are listed in the report’s Sources section. Most of the sources report data for a single year, e.g., enrollment or graduation data for a single academic year. The data comparing various populations in this report range from 2015 to 2019. For the American Society for Engineering Education (ASEE) data sets, which represent most of the universities presented in this report, the enrollment data represent the number of students enrolled in Fall 2017 and the graduation data represent the number of students graduating anytime from July 1, 2017 through June 30, 2018.

As the data for different populations come from a variety of sources, each set of data has differences in how racial or ethnic groups are defined and what terminology is used for different groups. In order to make the populations more easily comparable, SEAONC SE3 has processed the data in the following ways:

- Removed “Unknown” entries.
- Removed non-US citizen entries (“International” or “Foreign”), as no race or ethnicity for these entries was given in the data.
- Percentages of students were based on the remaining student population after removal of “Unknown,” “International,” and “Foreign” classifications.

The US Census treats Hispanic ethnicity identification separate from racial identification, while the data from universities and the workforce treat Hispanic/Latinx as a race. In order to make the US Census data more consistent with the remainder of the sources of data in the report, we present “white” as the percentage of the US population that is both white and does not identify as Hispanic or Latinx, while “Hispanic/Latinx” is the percent of the population that identifies as being of Hispanic/Latinx ethnicity, regardless of race.

While compiling enrollment and graduation data from California universities with civil engineering programs, any data sets with fewer than 30 entries were removed to protect the privacy of the individuals represented and provide more statistically compelling observations. The demographic proportions of these small programs can vary significantly between years due to the low population size, making comparisons of data from a single year less meaningful.

Values throughout this report have been shown with two digits for consistency and clarity.

The schools have been grouped by school type: California State Universities (CSUs), Universities of California (UCs), and private schools.

CSU	UC	Private Schools
Chico State*	UC Berkeley ✓	California Baptist* ✓
Fresno State* ✓	UC Davis ✓	Loyola Marymount ✓
Cal State Fullerton* ✓	UC Irvine* ✓	Santa Clara University ✓
Cal State Long Beach* ✓	UCLA ✓	Stanford ✓
Cal State LA* ✓	UC San Diego ✓	USC ✓
CSUN* ✓		University of the Pacific
Cal Poly Pomona* ✓		
Sacramento State* ✓		
San Diego State* ✓		
San Francisco State* ✓		
San José State* ✓		
Cal Poly SLO ✓		

* Indicates HSI (Hispanic Serving Institution).

✓ Indicates offering master’s programs.

Data Evaluation



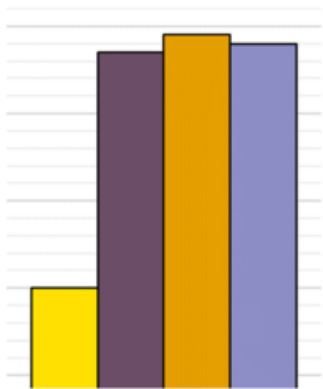
As SEAONC SE3 parsed through the available population data, we noticed four main trend shapes in the data. We will refer to these trend shapes throughout the discussion of the data, but we will not comment on every trend visible in the data. Our intent is that these general trend shapes can help readers understand the observed representation and retention characteristics of each demographic group.

Note that we are using the term “retention” broadly in this context. As stated above, the enrollment and degrees awarded data for bachelor’s and master’s degree programs are a snapshot in time, so we are not tracking individual students or classes’ retention through the pathway.

Sample Legend: ■ General Population ^[1] ■ BS Eng. Awarded ^[2] ■ MS Eng. Awarded ^[2] ■ Engineering Workforce ^[3]

The numbers in brackets after the legend entry indicate which source, listed in the Sources section of the report, the data set originates from.

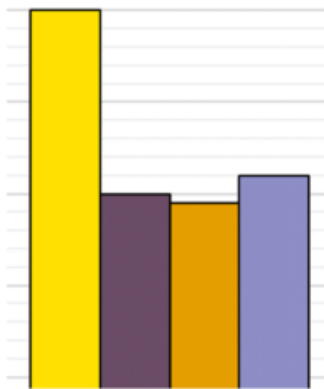
Consistent Overrepresentation



In this trend shape, the proportion of the population represented in the first stage—in the case of this report, at the undergraduate level—is greater than the proportion of that group in the general population. This overrepresentation is relatively consistent through the next phases (i.e., degrees awarded or the

engineering workforce). This trend indicates that the group has similar levels of retention as the total population at each stage of the pathway. Please note that “consistent” is not meant to imply that these proportions are unchanging over time.

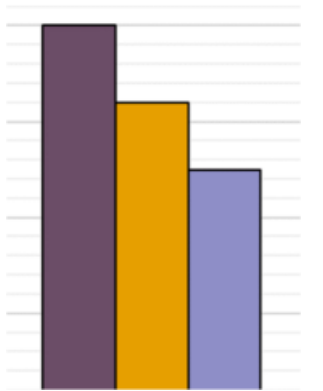
Consistent Underrepresentation



This trend shape is the opposite phenomenon from Consistent Overrepresentation. At the beginning of the pathway, the proportion of the population represented starts out as underrepresented compared to the proportion of that group in the general population. The proportion is relatively consistent

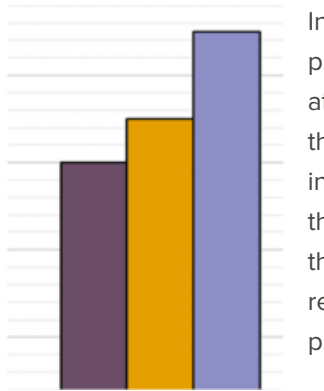
through the remaining stages.

Weak Retention



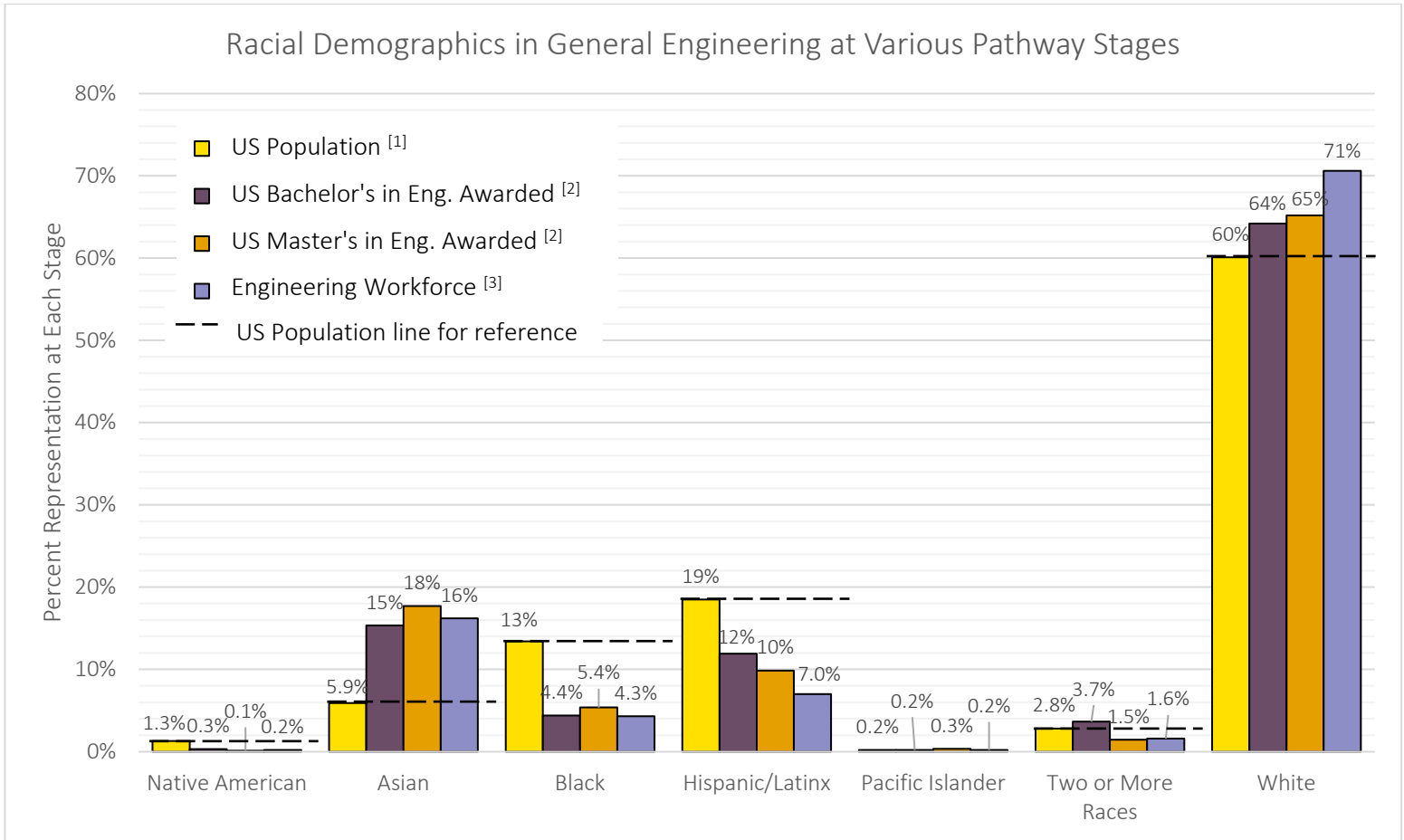
In this trend shape, the group’s proportion of the population decreases at each stage of the pathway. This is an example of what is commonly referred to as a “leaky pipeline.” This trend indicates that the group has below-average retention rates when compared to the total population at each phase of the pathway.

Strong Retention



In this trend shape, the group’s proportion of the population increases at each phase of the pathway. Note that this trend does not necessarily indicate that more people are entering the pathway at each phase but rather that the group has above-average retention when compared to the total population at each phase.

National General Engineering Pathways



This figure shows the pathway of engineers in the United States from bachelor’s degrees awarded, to master’s degrees awarded, to the US engineering workforce, with all stages compared to the US population as a baseline and grouped by race and ethnicity. Asian people are awarded engineering degrees and are present in the engineering workforce at more than triple their proportion of the US population (indicating consistent overrepresentation) while Black people are awarded engineering degrees and are present in the engineering workforce at around a third of their proportion of the US population (indicating consistent underrepresentation). Hispanic/Latinx people make up increasingly smaller fractions at each stage (indicating weak retention or a “leaky pipeline”) while white people make up increasingly larger proportions at each stage (indicating strong retention). Native Americans are consistently underrepresented at a quarter or less of their proportion of the US population. Pacific Islanders are the only group in this comparison that are consistently represented at approximately their proportion of the US population.

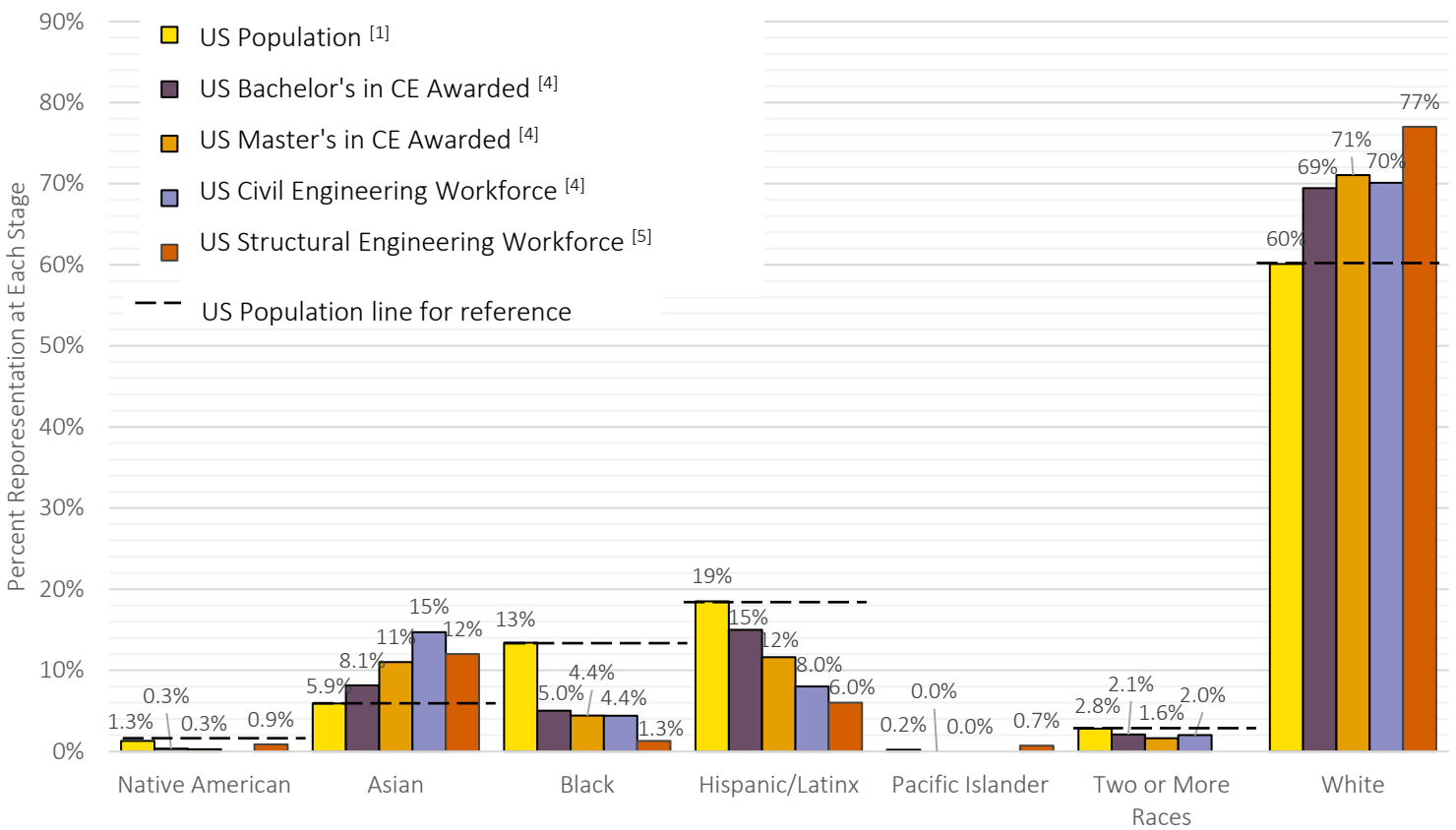
Note: There is an often-stated idea that the profession will automatically diversify overtime without intervention as a more diverse student population enters the workforce and as less diverse seasoned professionals retire. According to these data, the proportion of degrees awarded to Black engineering students (4.4% of BS and 5.4% of MS degrees) is very similar to the proportion of Black engineers in the workforce (4.3%). This suggests that if we continue the trend without intervention, Black engineers will continue to be underrepresented by the same factor.



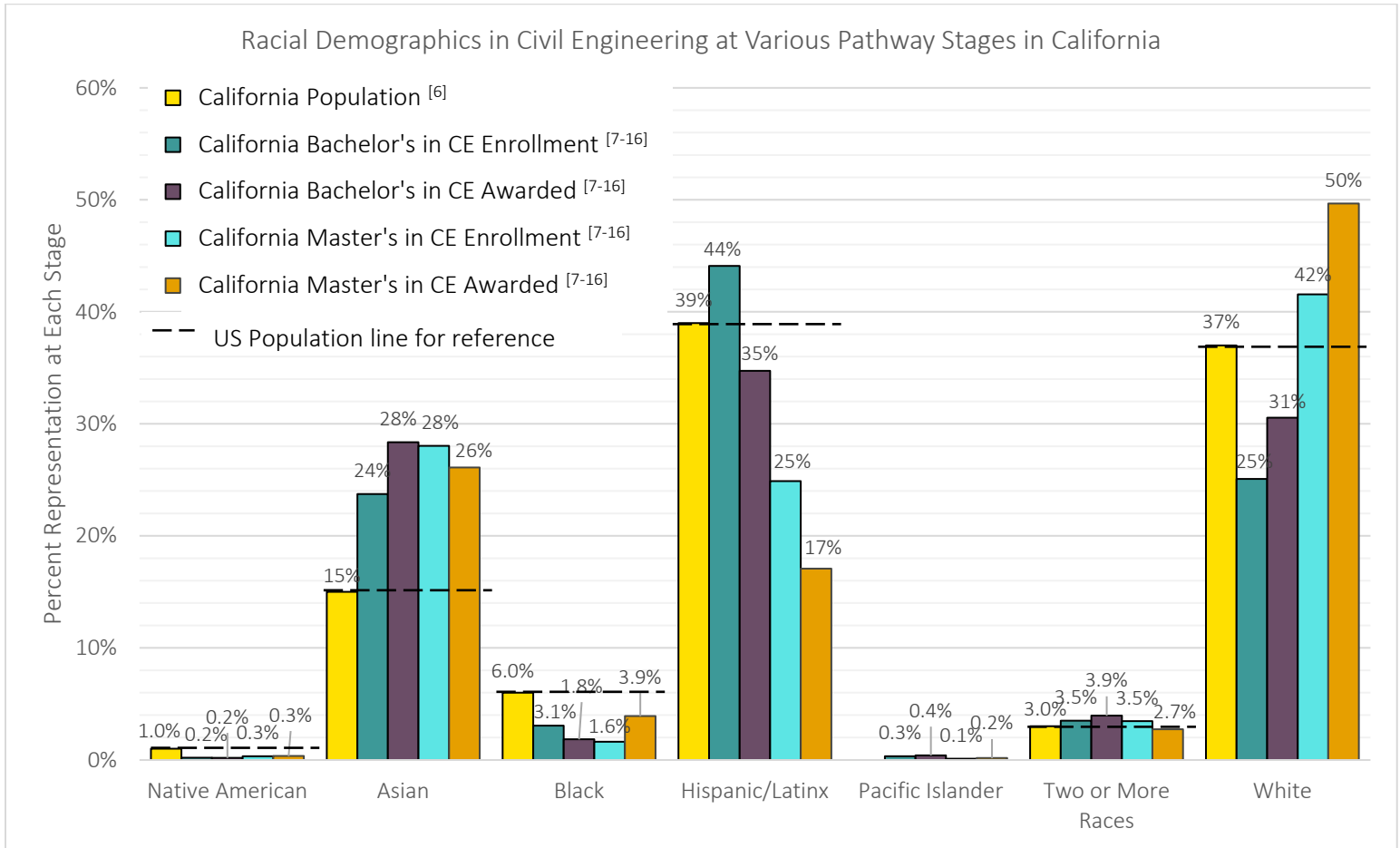
This figure shows a similar breakdown to the General Engineering Pathways, but with an emphasis on civil and structural engineering disciplines. Black civil engineers are consistently underrepresented by nearly a factor of three compared to the US population in both degrees awarded and in the workforce. However, the percentage of Black engineers drops from 4.4% of civil engineers to just 1.3% of structural engineers. Hispanic/Latinx engineers are increasingly underrepresented at each stage of the pathway, with less than half their relative proportion of the US population in the civil engineering workforce and less than a third in the structural engineering workforce. Data for both Native Americans and Pacific Islanders are not included in the civil engineering data set, but their proportions in the structural engineering workforce are high compared to their proportions of the US population.

Reminder: The numbers in the brackets after each legend entry indicate which source the data set originates from.

Racial Demographics in Civil Engineering at Various Pathway Stages



California Civil Engineering Pathways



This figure shows the pathway for civil engineering education at the state level in California. Black civil engineering students are underrepresented at both the undergraduate and graduate levels. Hispanic/Latinx students are poorly retained at all levels of civil engineering education—with less than half the proportion of civil engineering master’s degrees compared with their proportion of the California population. White students are initially underrepresented at the undergraduate level, but they have strong retention and are overrepresented in master’s program enrollment and degrees awards.

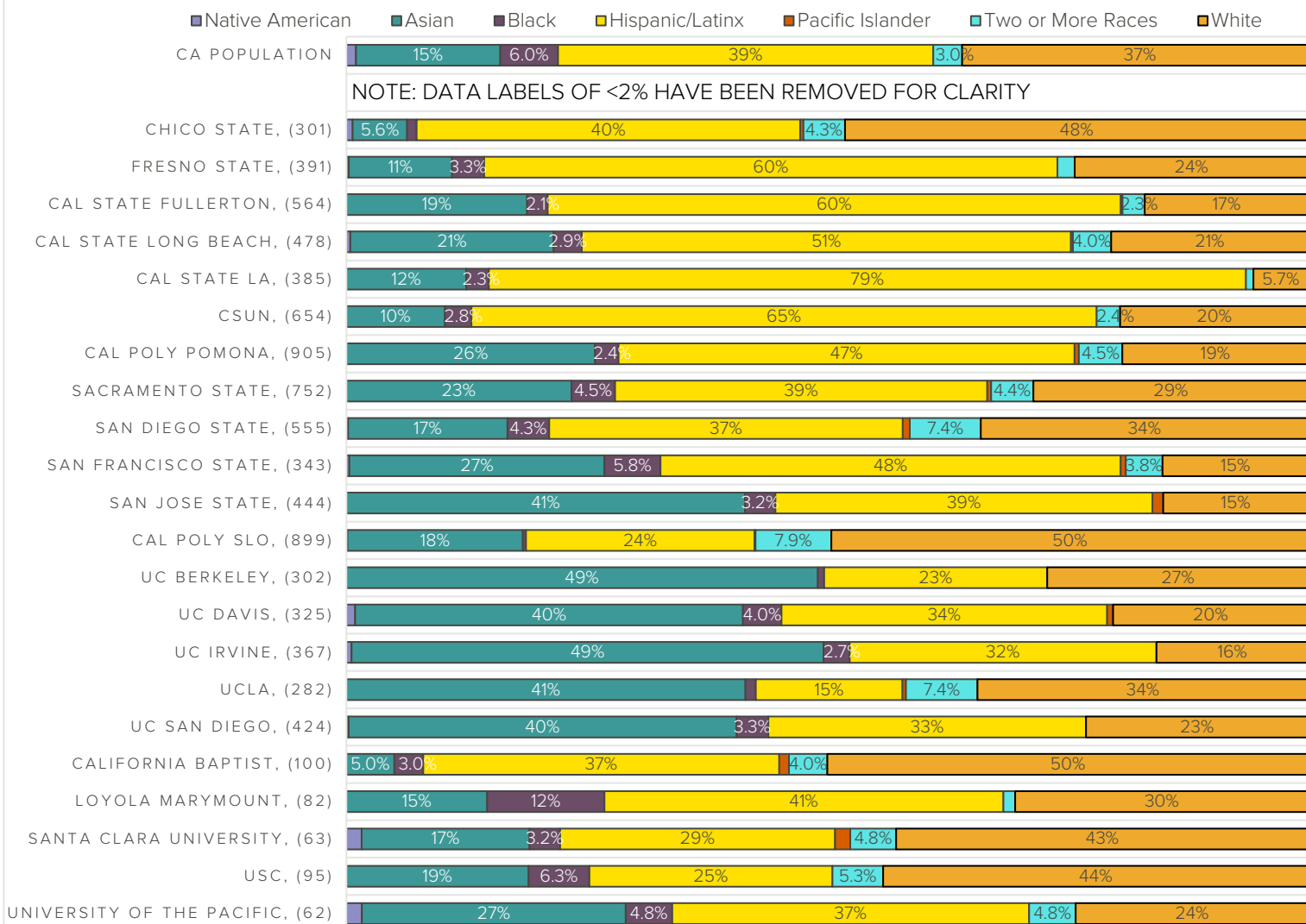
Civil Engineering Bachelor's Enrollment



The next four figures show the racial/ethnic distribution at California universities with civil, structural, and architectural engineering programs. For brevity, we will refer to all of these majors as civil engineering in these figures. As stated in the Data Processing section, universities with fewer than 30 students per stage were removed due to insufficient data. In each stage, the data set size (number of students) at each institution is shown in parentheses next to the school name.

Note: Pathways for several Northern California universities are shown in the Appendix of this report.

RACIAL DEMOGRAPHICS OF CIVIL ENGINEERING UNDERGRADUATE ENROLLMENT AT CALIFORNIA UNIVERSITIES



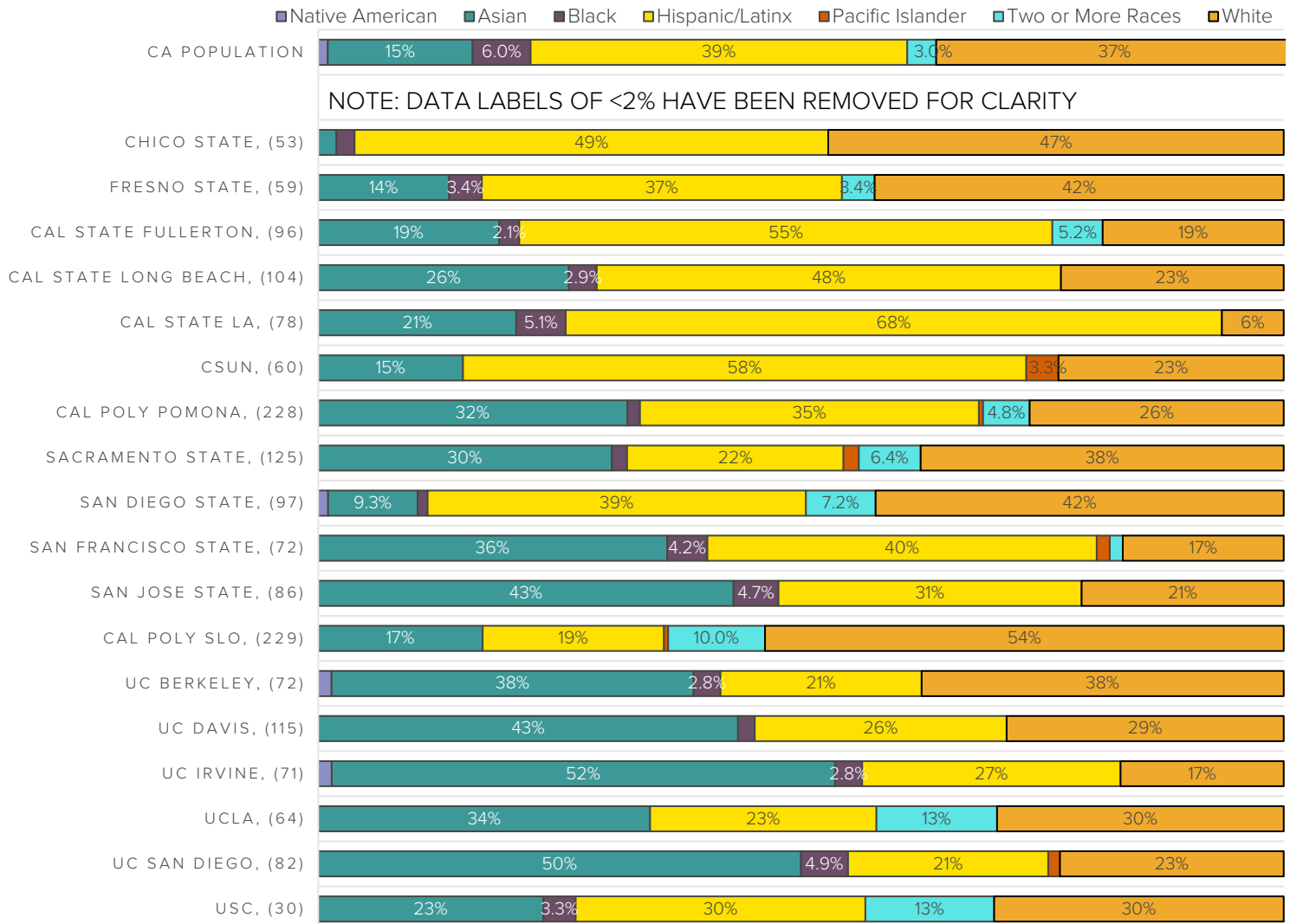
This figure shows the racial/ethnic distribution of undergraduate students enrolled in civil engineering at California universities for either 2018 or 2019 along with the overall California population shown in the top bar of the chart. Nearly all the CSUs have a higher proportion of Hispanic/Latinx students compared to the California population, except for San Diego State and Cal Poly SLO. Asian students are generally overrepresented at the UC schools relative to the California population.

Universities not included due to an undergraduate enrollment population size smaller than 30 students:

Civil Engineering Bachelor's Degrees Awarded



RACIAL DEMOGRAPHICS OF CIVIL ENGINEERING UNDERGRADUATE GRADUATION AT CALIFORNIA UNIVERSITIES



This figure shows the racial/ethnic distribution of civil engineering bachelor's degrees awarded at universities in California along with the overall California population shown in the top bar of the chart. Similar to the trend in undergraduate enrollment, many of the CSUs have a higher proportion of Hispanic/Latinx students who are awarded degrees relative to the California population. However, the proportions are lower compared to undergraduate enrollment.

Comparing degrees awarded to enrollment data gives an idea of retention in the civil engineering major (this pathway data can be found in the Appendix of this report). However, note that the enrollment data represent all students in a major, from first years to graduating seniors, so the population numbers are not directly comparable. We would recommend utilizing the percentages to understand which groups have higher or lower proportions of degrees than they do enrollment.

Universities not included due to an undergraduate graduation population size smaller than 30 students:

- California Baptist
- Loyola Marymount
- Santa Clara University
- Stanford University
- University of the Pacific

Civil Engineering Master's Enrollment

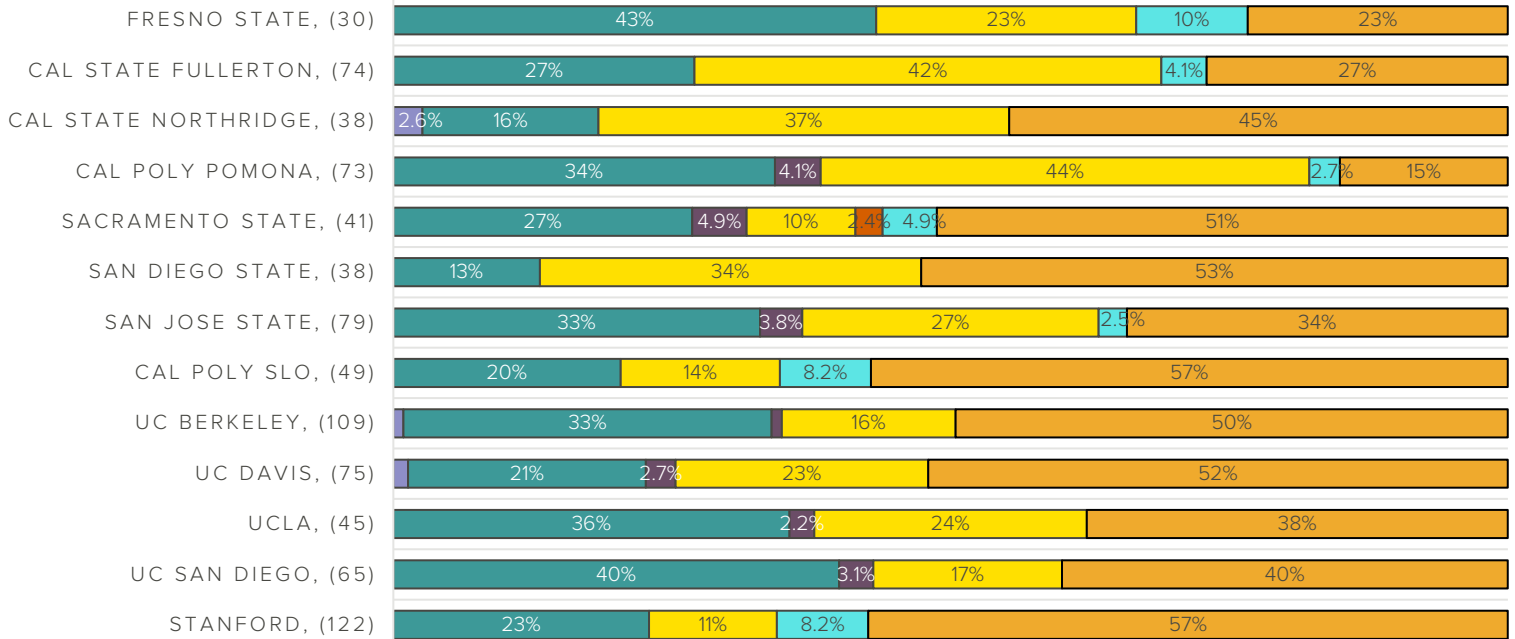


RACIAL DEMOGRAPHICS OF CIVIL ENGINEERING MASTER'S ENROLLMENT AT CALIFORNIA UNIVERSITIES

■ Native American ■ Asian ■ Black ■ Hispanic/Latinx ■ Pacific Islander ■ Two or More Races ■ White

CA POPULATION 15% 6.0% 39% 3.0% 37%

NOTE: DATA LABELS OF <2% HAVE BEEN REMOVED FOR CLARITY



This figure shows the racial/ethnic distribution of students enrolled in civil engineering master's programs at California universities along with the overall California population shown in the top bar of the chart. In general, the proportion of white students enrolling in master's programs increases at most schools compared to the undergraduate level, while the proportion of students of every other race/ethnicity decreases.

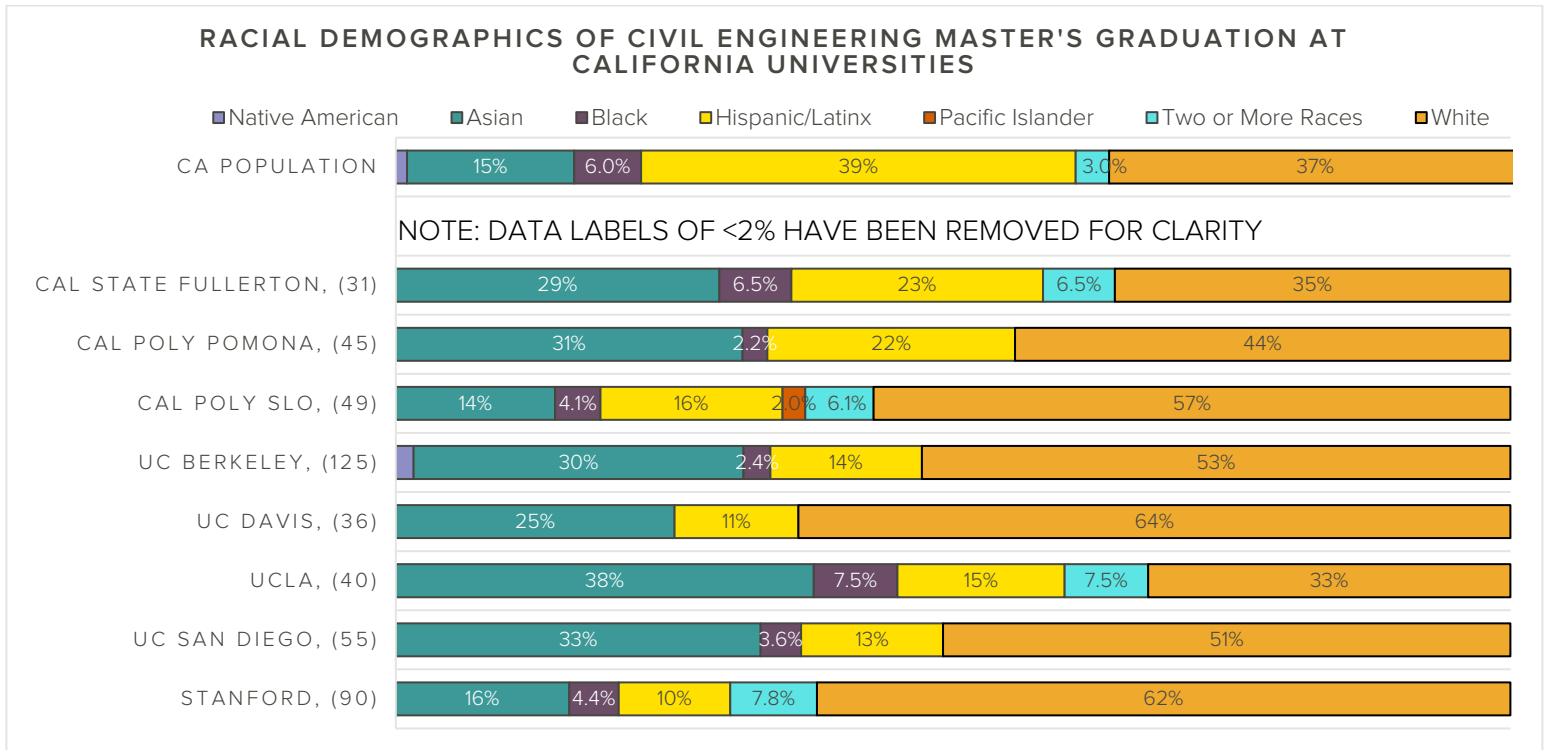
Universities not included due to a master's enrollment population size smaller than 30 students:

- Cal State Long Beach
- Cal State LA
- San Francisco State
- UC Irvine
- California Baptist
- Loyola Marymount
- Santa Clara University
- University of Southern California

Civil Engineering Master's Degrees Awarded



This figure shows the racial/ethnic distribution of master's degrees awarded in civil engineering at California universities along with the overall California population shown in the top bar of the chart. As with the master's degree enrollment, the proportion of white students is generally higher than at the undergraduate level. The proportion of Hispanic/Latinx students also decreases at each school compared to master's degree enrollment.



Universities not included due to a master's graduation population size smaller than 30 students:

- Fresno State
- Cal State Long Beach
- Cal State LA
- CSU Northridge
- Sacramento State
- San Diego State
- San Francisco State
- San Jose State
- UC Irvine
- California Baptist
- Loyola Marymount
- Santa Clara University
- University of Southern California

Summary and Action Items



As can be noted from the figures contained herein, Black, Indigenous, and Hispanic/Latinx people are underrepresented in the civil engineering pathway at various stages compared to the general population, including civil engineering undergraduate enrollment and degrees awarded, civil engineering master's program enrollment and degrees awarded, and the civil and structural engineering workforce. At the California state level, data on Black and Indigenous people exhibit the trend of "consistent underrepresentation" as defined in the Data Evaluation section. This may indicate increased barriers to entering civil engineering as undergraduates. Understanding what these barriers may be for civil engineering undergraduate students specifically is the goal of SEAONC SE3's Civil Engineering Education Experience Survey, which is described in the Further Studies section of this report. At the California state level, it is noted that Hispanic/Latinx people were overrepresented in undergraduate civil engineering enrollment but underrepresented in undergraduate degrees awarded and in both master's program enrollment and degrees awarded. This trend is an example of "weak retention". This trend may indicate that there are challenges for students in completing their bachelor's and/or master's programs and ultimately entering the profession. These challenges may include, among other things, lack of student engagement by the profession, financial burden, and lack of mentorship.^{c, d, e}

After viewing the figures above, the reader may be wondering how to make the profession more equitable, diverse, and accessible to everyone who may want to enter the structural engineering industry. SEAONC SE3 advocates for the following action items for individuals practicing in the profession, firm leaders, and/or professional associations to address underrepresentation of Black, Indigenous, People of Color in structural engineering:

Outreach Programs:

Outreach programs help increase interest in and awareness of the civil/structural engineering professions within underrepresented groups who may not otherwise be exposed to civil engineering as a career option for them.^f

- Participate in and/or donate to K-12 STEM outreach initiatives.
- Volunteer as a mentor to both K-12 and college students to ensure we keep students interested in our profession and show that there is a community of engineers investing in their success.

Financial:

Financial hardship is a major challenge for students of color (refer to the National Society of Black Engineers' Paving the Way report,^c the Nation Academies Press' Expanding Underrepresented Minority Participation,^d and Improving

Underrepresented Minority Student Persistence in STEM)^e. With a scholarship, students can shift from having a part-time job to having more time to study and excel in rigorous engineering courses. With a paid internship, students can obtain hands-on experience and make professional connections and maintain engagement.

- Provide scholarships and paid internships to students from underrepresented groups to encourage students to stay in their programs and complete their degrees.^g
- Consider contributing to the [SEAONC DEI Endowment](#), which provides financial support to DEI-based initiatives including scholarships and engagement programs.^h
- Establish a tuition reimbursement program to encourage promising engineers to obtain their master's degrees. Additionally, consider revising education requirements for entry-level positions to include bachelor's graduates who are interested in returning for their master's degrees in the future. Pursuing a graduate education may not be economically feasible to everyone, particularly to underrepresented students; refer to NSBE's Paving the Way report.
- Similarly, establish a student loan repayment (assistance) program for engineers who have already completed their graduate education. This will likely encourage entry-level engineers to pursue their passion without having to stress or chase the highest paying job—which may not be in structural engineering—to pay off student debt.

Recruitment:

- We encourage firms to expand their recruitment to at least one university that more closely reflects the demographics of California. While this may require additional logistical effort and planning, firms can consider this an active intervention and investment in the future of our profession and your firm in particular.
- Register your firm for the SEAONC virtual career fair for the opportunity to recruit students from various schools across California at one event.

Workplace Environment:

In addition to hiringⁱ, focus on creating inclusive and equitable workplaces^j for historically underrepresented groups.

- Offer continued education on DEI topics to firm employees.
- Survey your employees for ways to improve engagement^k and psychological safety.^l
- Ensure policies and practices are regularly examined and work towards making cultural awareness a competency for your firm leaders.
- SEAONC SE3 offers programming and publications on these topics.

Further Studies



In parallel to researching racial demographics of California universities, SEAONC SE3 launched the Civil Engineering Education Experience Survey, for current civil engineering students, to study other aspects of the student-to-professional pathways such as:

- Whether students intend to pursue a structural engineering career upon graduation and what challenges, if any, they have encountered or are encountering in their major.
- How students gain exposure to civil engineering as a potential career choice, e.g., mentor, teacher, parent, etc.
- Which students decide to stay in a civil engineering major and/or continue onto a civil engineering profession (race, gender, first-generation status, income).
- Which factors contribute to increased or decreased retention rates of different groups (race, gender, first-generation status, income).

This student survey closed in April 2021 and survey findings will be published in 2022. Although we released the survey in Fall 2020, we did not ask our respondents how they were personally and/or academically affected by the ongoing COVID-19 pandemic.^m Further study may include interviewing students who indicated interest in being contacted by the SEAONC SE3 Committee, at which point learning more about their remote student experience during the COVID-19 pandemic could be incorporated. In addition, the civil engineering student survey was restricted to undergraduate civil/structural engineering students, but a similar survey could be developed

specifically for civil/structural engineering graduate students pursuing a master's degree.

SEAONC SE3 is also interested in better understanding the representation of low-incomeⁿ and/or first-generation^o civil engineering students in California universities. A few California universities have this information publicly available for each major while other universities only make this information available for the school of engineering. With these data sets, we would like to understand whether these aspects of a student's background have an effect on the student persisting and/or graduating in civil engineering.

Investment in the next generation of structural engineers should be implemented in tandem with a focus on creating inclusive and equitable workplaces for historically underrepresented groups so that as civil and structural engineering students graduate and join the workforce, the structural engineering profession can retain a diverse group of engineers contributing to the built environment. SEAONC SE3 is developing job posting guidelines specifically for structural engineering firms to evaluate job postings for inclusive language and increase the pool of qualified and interested applicants.

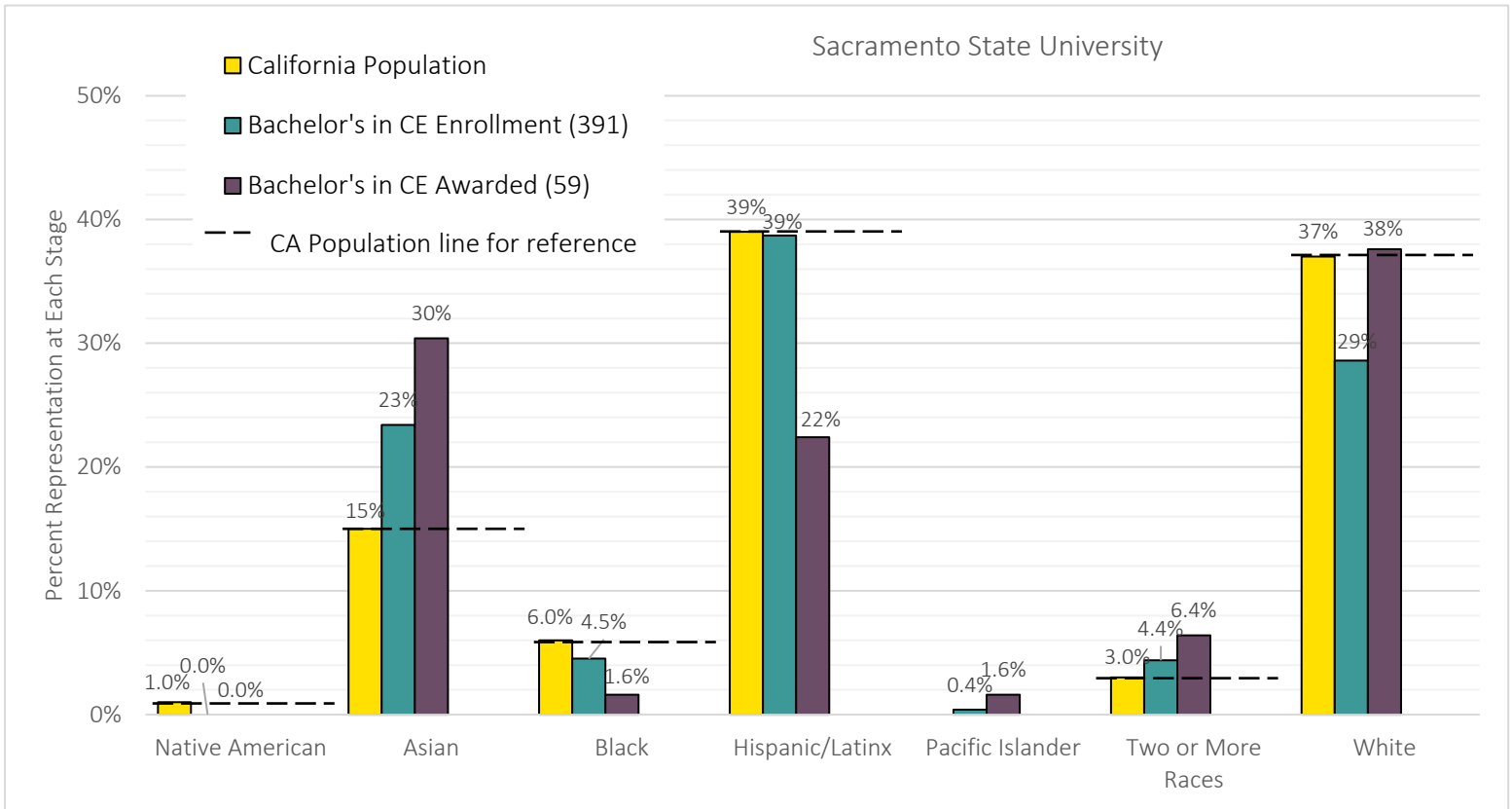
Many of these further studies could be performed in collaboration with the statewide Structural Engineers Association of California (SEAOC) and other local SE3 Committees located within the state of California. The SEAONC SE3 Committee looks forward to partnering with other organizations in further studies to help create a more diverse, equitable, and inclusive structural engineering profession.



Appendix : Northern California University Data

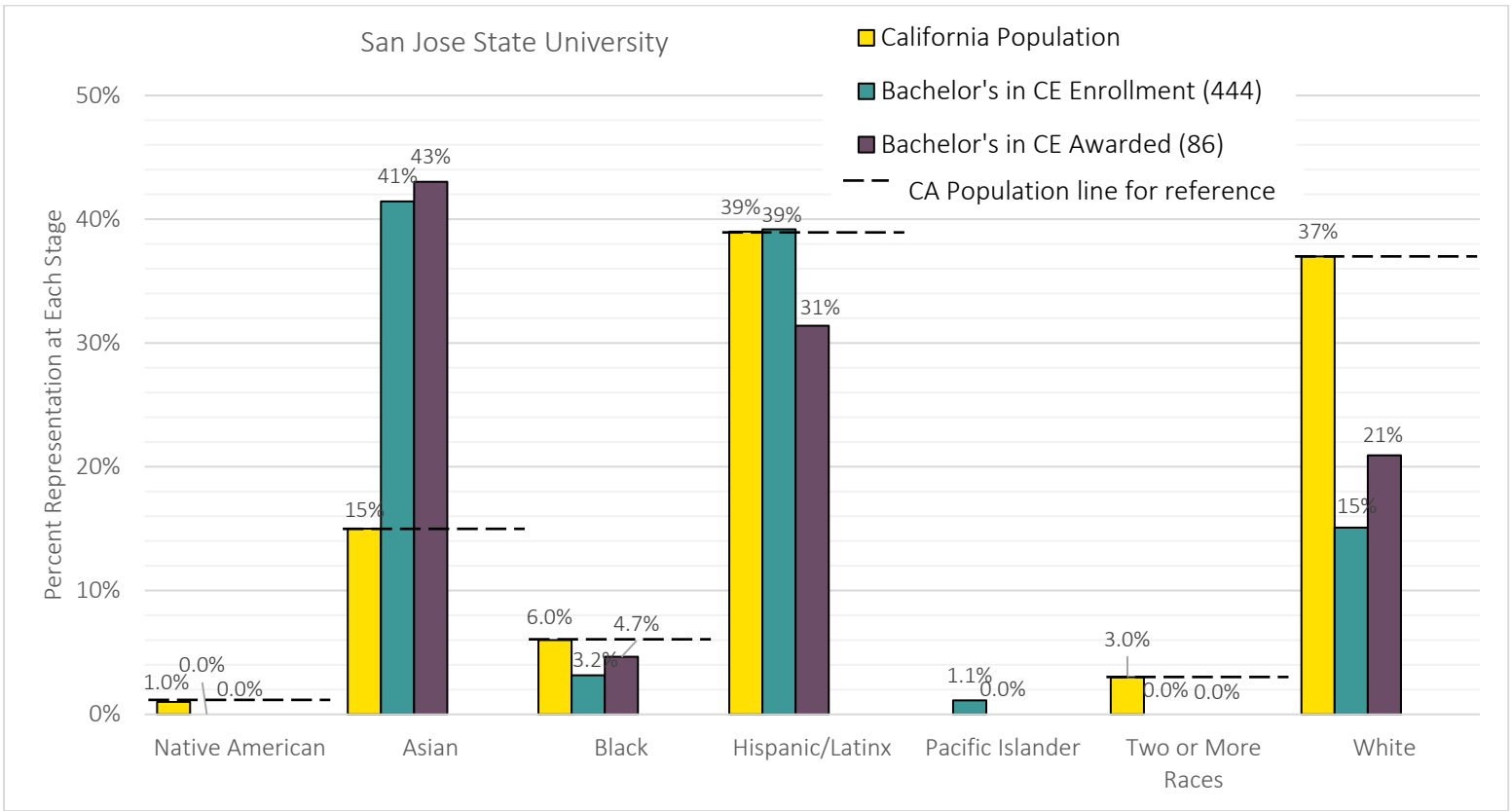
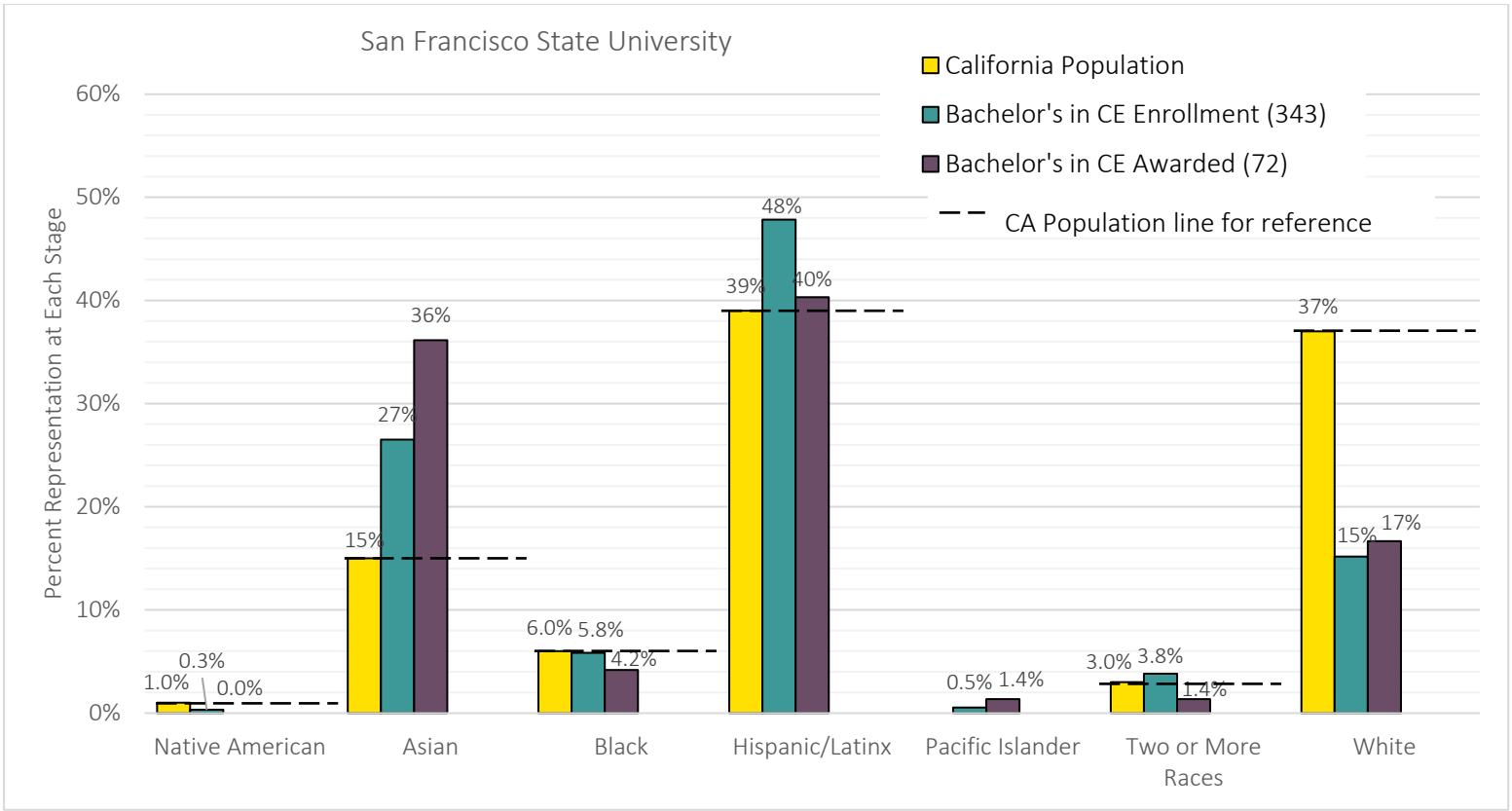


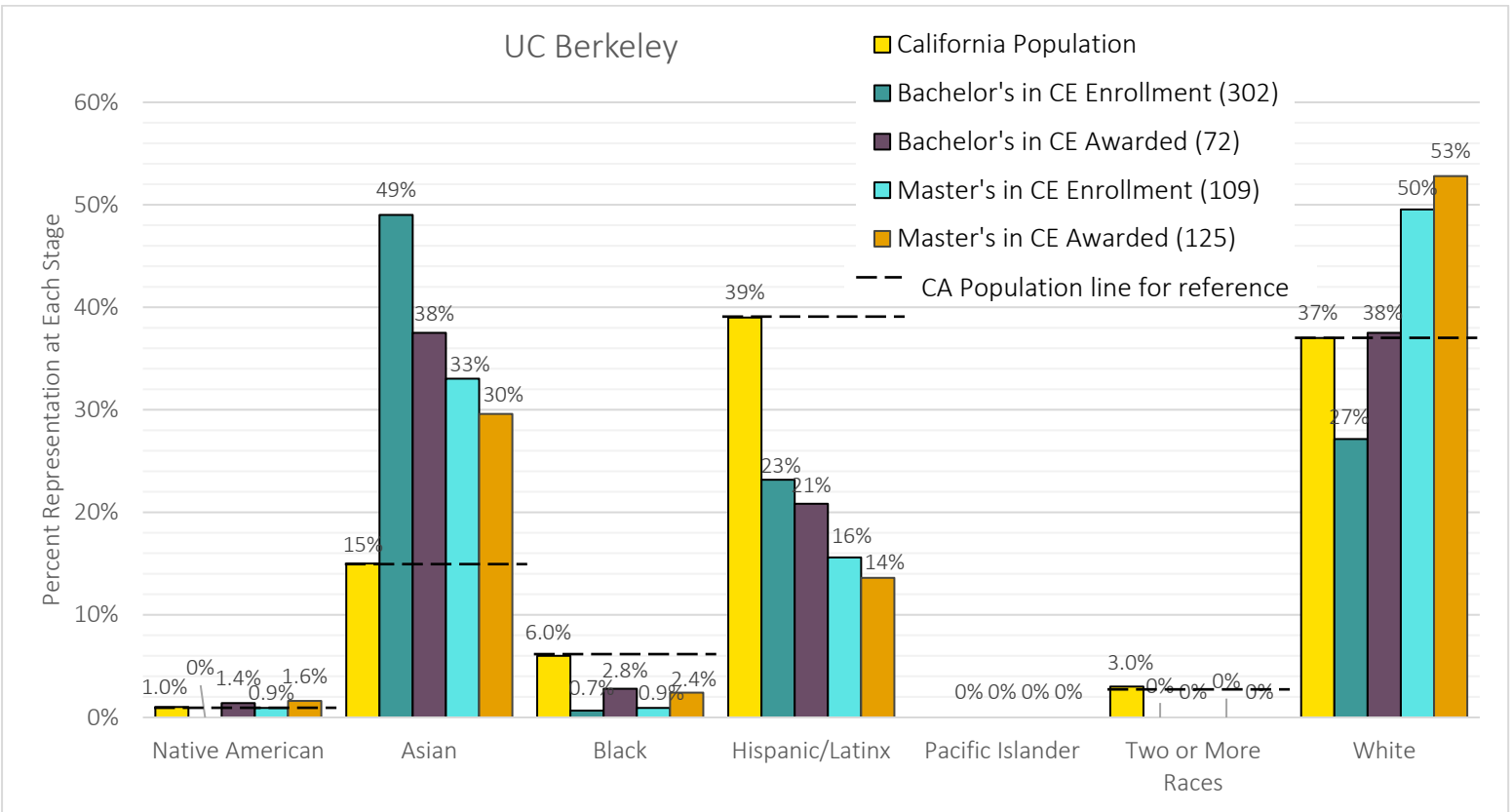
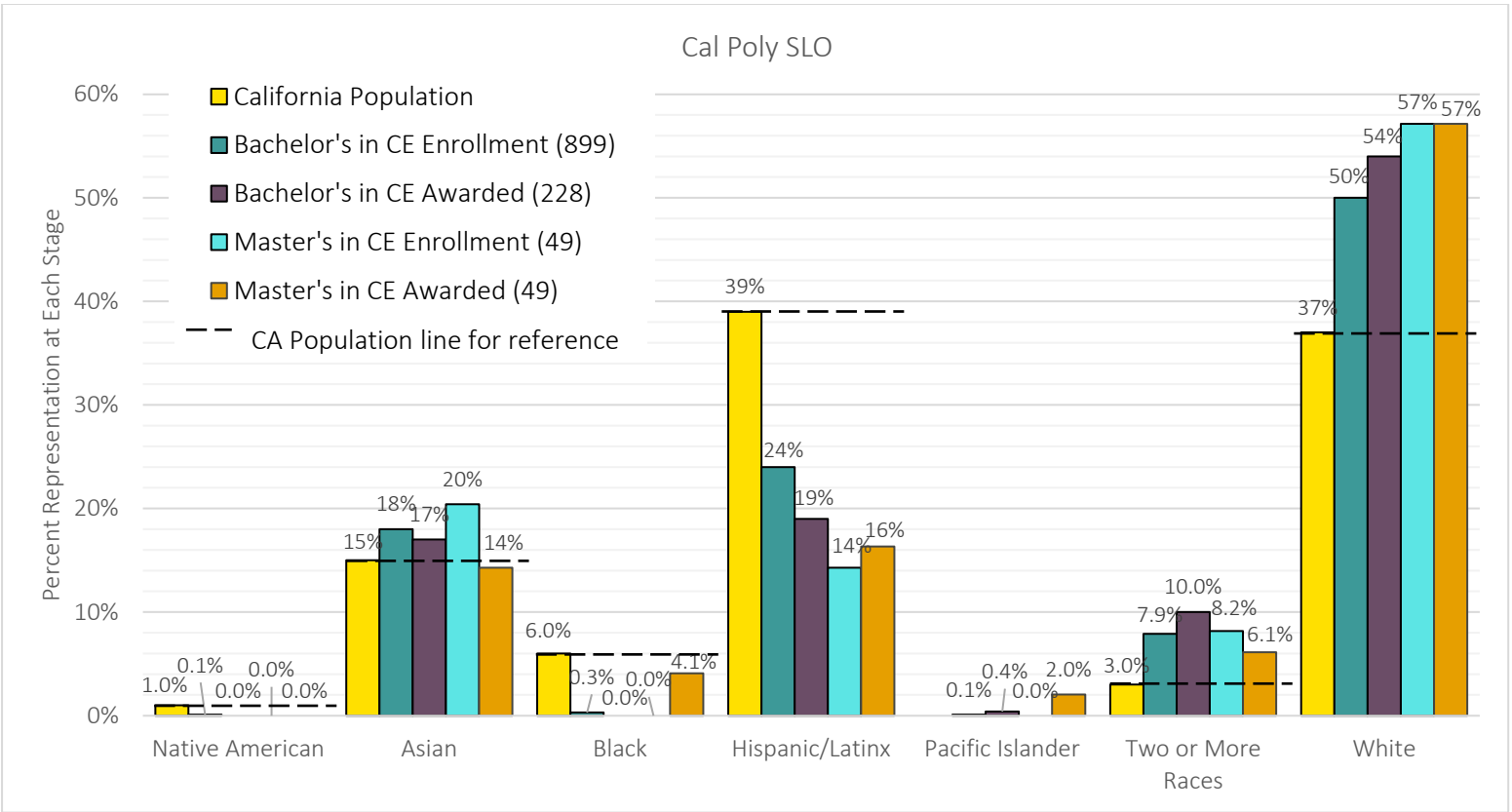
Included below are graphs similar to *California Civil Engineering Pathways* for the UC, CSU, and private schools in Northern California, presented in the order of the table in the Data Processing section. SEAONC SE3 encourages firms to use this data to inform their recruiting and outreach efforts.

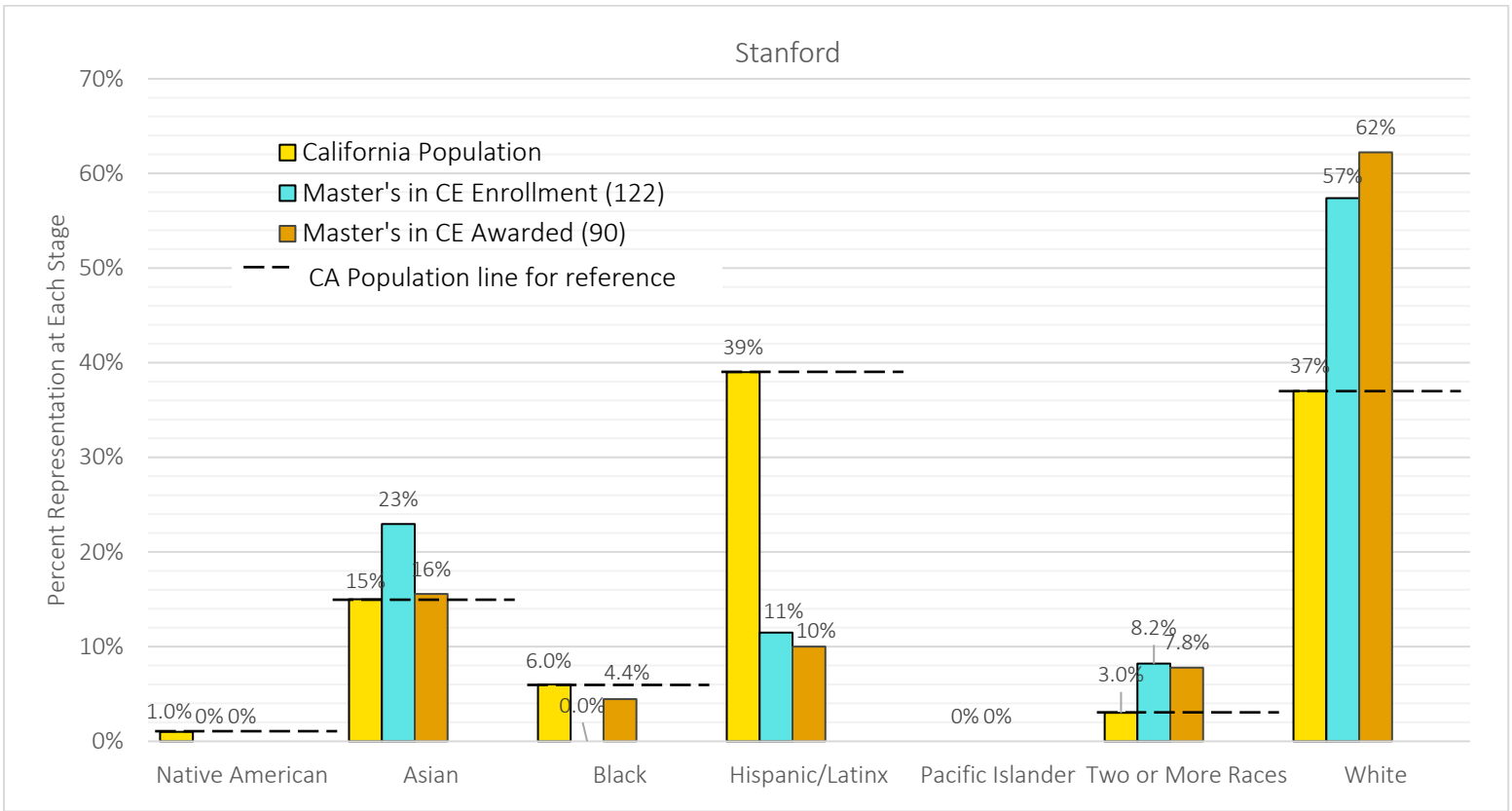
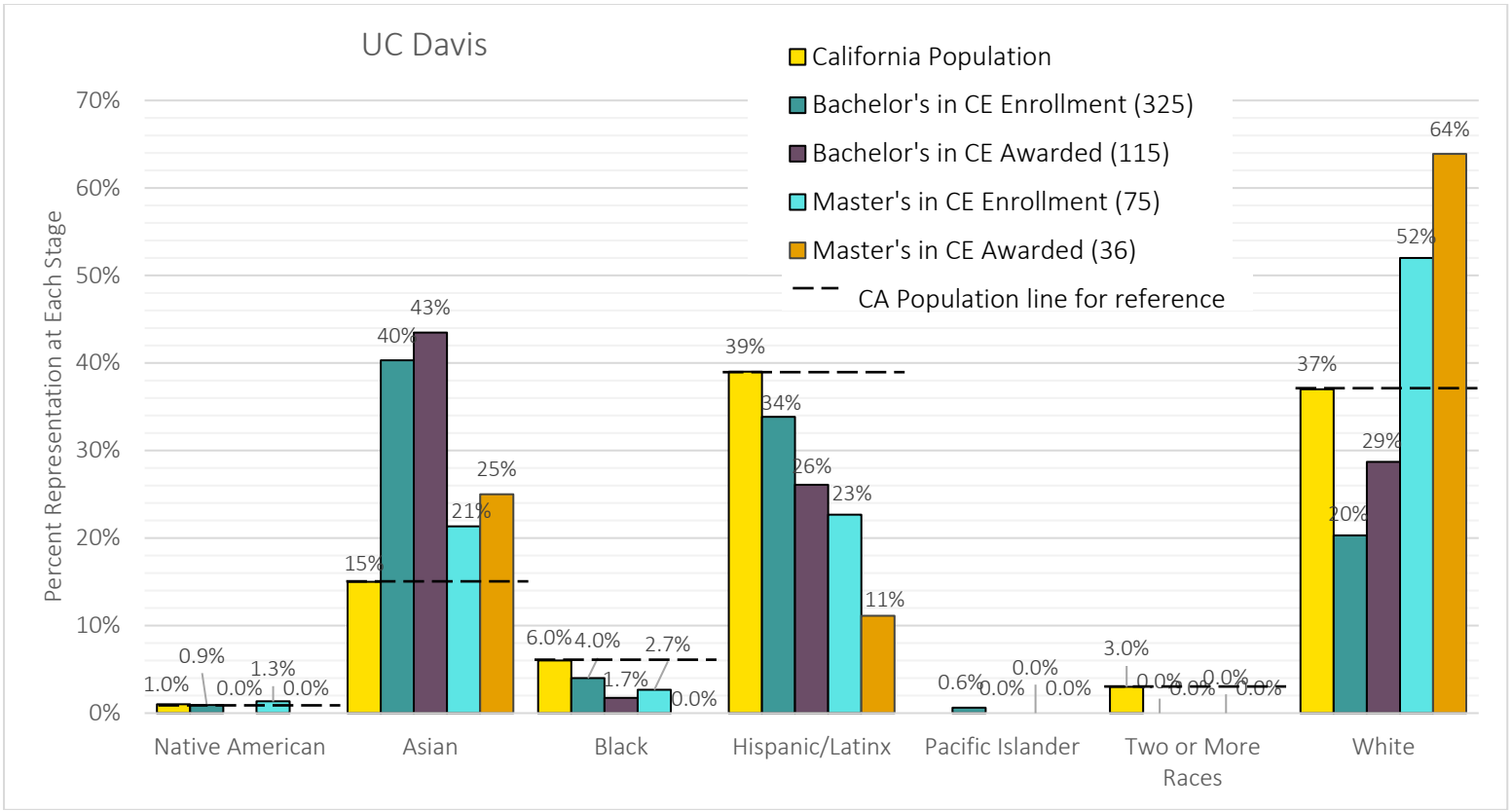


Reminder:

As stated above, data sets with fewer than 30 students have been excluded. For example, San José State, SFSU, and Sacramento State all offer master's in civil engineering programs, but total student enrollment and degrees awarded at the master's level were less than 30, so they are not included in the figures. Conversely, the master's program at Stanford has more than 30 students, so it is included but the undergraduate program has fewer than 30 students, so it has been excluded.









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Publication Team:

Primary Contributors: Kaat Ceder, Brenna Marcoux, Priscilla Nguyen, Hayley Proctor

Collaborators: Tiffany Hwang, Elide Pantoli, Danny Preut, Curtis Siegfried, Natalie Tse

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