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# LIDAR news

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# 3D MODEL INTEGRATION

## PRESERVATION
Mother Nature has not been kind to this national treasure

## RELIEF EFFORT
Insect-like drones rapidly provide data to technicians

## SENSE-SIBILITY?
The efficacy of new low-cost consumer-grade 3D scanner

# Laser Scanning Education in the Civil Engineering Program at Cal Poly Pomona

The California State University (CSU) system accommodates a wide range of undergraduate and master degrees programs. Within the system, two of its campus have been dedicated to a learn-by-doing education since their inception: Cal Poly San Luis Obispo and Cal Poly Pomona.

The Cal Poly Pomona University College of Engineering offers 11 undergraduate and 5 master degree programs housed in 7 departments. Serving over 5,000 students, the program is the 17th largest in the nation. The Civil Engineering (CE) program currently has approximately 1,000 undergraduate students, and 140 graduate students.

The Construction Engineering Technology (CET) program, which has been housed in the Engineering Technology Department, is currently being transitioned to the CE department, along with its 300 students and faculty. Starting Fall 2014, the CE department at Cal Poly Pomona will be serving approximately 1,300 undergraduate students and a growing graduate program, making it one of the largest undergraduate programs in the nation.

The CE program at Cal Poly Pomona is currently supported by 20 full time faculty plus temporary adjunct faculty.

> "Serving over 5,000 students, the program is the 17th largest in the nation."

All faculty are required to have industry experience. In addition to a doctorate degree, a professional license in the area of expertise is required before tenure is granted. The goal of this requirement is to ensure graduates receive an education that prepares them to pursue research opportunities with practical applications to social infrastructure, as well as the expectations of the industry.

## The Civil Engineering Program at Cal Poly Pomona

The bachelor's degree in civil engineering (BSCE) at Cal Poly Pomona currently requires completion of 198 quarter units (132 semester units) for graduation. Of these, 68 quarter units are general education (GE) courses mandated by the state's educational code, and set by the campus. The GE program enhances the students' education in communication and critical thinking, mathematics, physics, natural sciences, humanities, arts, literature, social sciences and awareness toward the importance of lifelong self-development.

As all engineering programs, CE has a large number of mathematics, physics and chemistry courses as support to the program, leaving 73 quarter units

BY DR. FRANCELINA A. NETO

**Figure 1:** College of Engineering Building 17 photo

**Figure 2:** College of Engineering Bldg. 17 – model 1

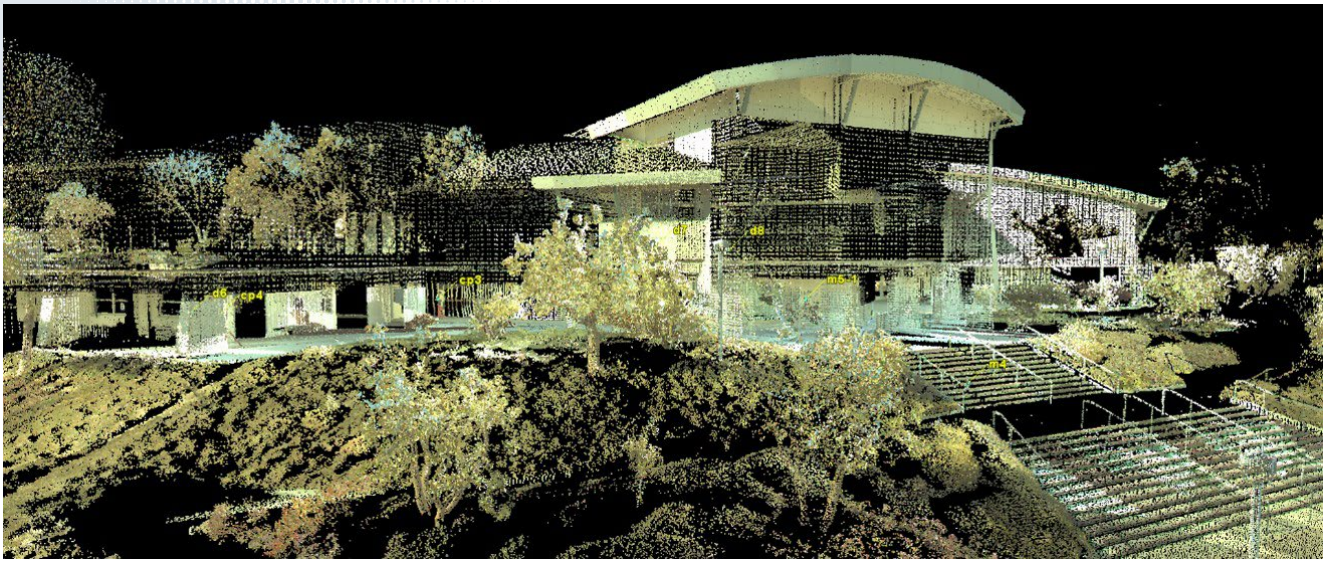

**Figure 3:** College of Engineering Bldg. 17 – model 2

of core, engineering specific CE department courses to prepare the students for a career in civil engineering. This requires good curricular strategies to keep up with the demands of an evolving world, and a good quality program that prepares engineers ready to tackle increasingly more difficult societal infrastructure problems.

A very important aspect of the engineering curriculum is to make the graduates aware of their role in society and the impact of their work in the world's infrastructure sustainability. The BSCE at Cal Poly Pomona combines a wide range of theoretical and practical engineering aspects, technology and its impact in society, resulting in a comprehensive, high quality education.

The BSCE at Cal Poly Pomona has three options: general, environmental and geospatial. All three options are ABET (Accreditation Bureau for Engineering and Technology) accredited under the civil engineering criteria. The Geospatial option is additionally accredited under the surveying engineering criteria. Graduates from the geospatial option in CE obtain credit toward both the Professional Engineers (PE) license for CE, as well as the Professional Land Surveyors (PLS) license.

The BSCE three options have about 80% of common course work. All undergraduate students in the program follow similar GE curriculum as prescribed by the campus, and have a set of common core classes. The common core and support course work includes mathematics, physics, chemistry, statics, and dynamics taught outside the CE department. All students in the BSCE program take additional common courses in drafting, surveying, transportation, materials, structural analysis, geotechnical engineering, and environmental and water resources.

The majority of the CE program students are enrolled in the general option. In this option, students are required to enroll in a few more advanced design courses in water resources, transportation, structural engineering, and upper division electives. Students in the environmental option have a fixed plan of studies that focus in environmental and water resources courses, with one technical elective.

Students in the third option, geospatial, complete the program with courses in transportation, photogrammetry, GIS, GPS, public lands, boundary and legal descriptions, and digital mapping. Students in the general option often take courses from the other two options as electives, besides other specific electives offered by the department each quarter. Laser scanning is taught in the Digital Mapping course, mandatory for geospatial option students, and an elective for the other two options. Laser scanning is also integrated in senior design projects.

## Digital Mapping Course and Application to Senior Design Projects

All students in the geospatial option in CE have to take the Digital Mapping course. As many as 24 students take this

course per year, and some students use this acquired knowledge in their final comprehensive design project.

The Digital Mapping course covers data collection systems for 3D surface modeling. Students learn to integrate robotic and laser scanning technology into visualization and animation for engineering projects. Over the years, students have been introduced to the theory of electronic data, data transfer and 3D modeling and interfacing in a variety of settings. Both Leica C10 Scanstation and Trimble GX scanning equipment, and Leica Cyclone software and Trimble Realworks have been used in data modeling. Applications identified by students during the courses and projects include topographic analysis, forensic crime scene investigation, public safety, homeland security, bridges and tunnels modeling, volumetric calculations, and pipeline recognition among others.

Cal Poly Pomona teams of students further explored the use of laser scanning modeling in several senior projects. In these projects, students used laser scanning technology to generate models of interiors, visualization of buildings, and data extraction for safety and security assessment. In these projects, students also learn to link different data collection systems such as GPS to laser scanning data.

One of the senior projects run under Dr. Turner's supervision in the CE department is a good representation of such student work. In that particular project, students collected data for one of the College of Engineering buildings, and generated fly through views of the model.

Students also scanned the interior of some areas in the same building, and generated 3D models of the building corridors and some rooms.

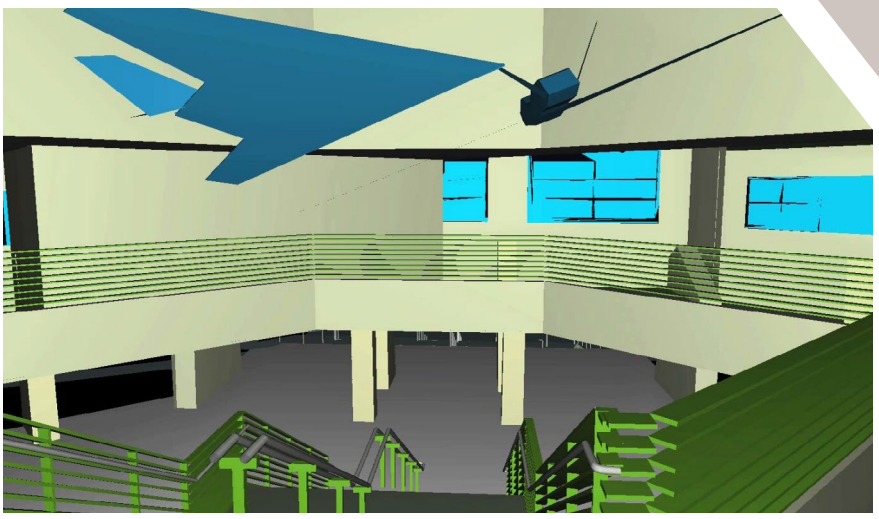

**Figure 4:** College of Engineering Bldg. 17 Main Entrance

Students also experiment with integration of laser scanned data with other data obtained from different sources. One such example is the integration of data collected in the same project, with CAD models shared by the campus facilities and management office.

## Future of Laser Scanning Technology Instruction at Cal Poly Pomona

In its most recent assessment of the curriculum and specifically the digital mapping course, the CE geospatial option program decided to incorporate more 3D modeling and visualization aspects into its curriculum. The CE department's Trimble GX unit which will be used for training of faculty in various technical areas, and extend the use of the technology to support a wider range of engineering and science applications.

The CE department has been awarded a small grant to expand faculty training on the use of laser scanning. Over a dozen engineering faculty has already shown interest in receiving training, to explore applicability for solutions in environmental, structural and transportation engineering. It is expected that more senior projects will adopt the use of laser scanning in their designs and engineering solutions, and that more Cal Poly Pomona graduates will be ready to use the technology in the work place in the future. One of the goals for the future is also to extend this technology to the Construction Engineering program, as well as to the CE master thesis and projects.


## Acknowledgements

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**Dr. Neto** received her Ph.D. in Photogrammetry from the University College London, UK in 1993. She has been a faculty in the Civil Engineering Department at Cal Poly Pomona for over 15 years, and department chair since 2009. She is a licensed Land Surveyor in California and her main interest are higher education issues, engineering curriculum development and 3D modeling.