



engineering news

School of Engineering

FALL 13

SANTA CLARA UNIVERSITY

DEAN'S MESSAGE

Here in Silicon Valley, we are situated among world leaders in industries such as information products and services, energy and green technologies, and biotech and medical device development, and we are steeped in this community's culture of diversity and collaboration that pays huge dividends in far-reaching innovations. So it follows that innovation, teamwork, and global engagement are intrinsic to an engineering education at Santa Clara University.

From creating No.1 best-selling mobile applications to determining the standard for the next generation of video coding, our students, faculty, and alumni are innovating for today's and tomorrow's consumers. They are also visiting new places, meeting new people, and working with NGOs, corporate research teams, and other academic institutions in an effort to build a more just, humane, and sustainable world for all.

And, oh, the places they go! Alaska, China, India, Singapore, Austria, and Haiti to mention just a few of the locations you will read about in this edition of *Engineering News*. Of course, Bronco engineers don't need to travel far to have universal influence as evidenced by our participation in the Solar Decathlon that was held right here in California earlier this month. But whether their work keeps them near or sends them to far-off locales, Santa Clara's Bronco engineers are grounded in the Jesuit, Catholic tradition of ethical decision making and practice.

Happy reading!

Godfrey Mungal
Dean
School of Engineering

Photo: Charles Barry



SCU's Radiant House drew more than 20,000 visitors during the 2013 Solar Decathlon.

THE EXPERIENCE OF A LIFETIME

At the close of the 2013 Solar Decathlon in mid-October, the solar-powered homes that had been designed, built, and operated for two weeks at the international competition sponsored by the U.S. Department of Energy were dismantled and readied for the trip home. Solar Village, a once-bustling enclave of energy and engineering innovation brought to life by an elite group of university teams was now a memory for the thousands of visitors who were delighted and inspired by the teams' creativity and ingenuity.

The ultimate in project-based, hands-on learning, the Solar Decathlon tested the engineering prowess, business acumen, and interpersonal skills of our Santa Clara undergraduate team. They designed Radiant House with the needs of a retired couple in mind, incorporating innovative bamboo construction techniques, low-maintenance building materials, and a user-friendly control system. Of the 10

contests held within the competition, half are objective measurements of how efficiently the systems of the home handle tasks such as producing hot water and maintaining comfortable temperature and humidity levels. Among these measured contests, Santa Clara was first in the scoring. Unfortunately, in the subjective contests such as Affordability and Architecture, Radiant House did not fare as well, and the team suffered a fall from 1st place to 11th by the end of the event.

Still, this was never just about the contest scores. "The experience the students have garnered over the past two years—the sense of pride and strength—is one they will carry for a lifetime, and we are so proud of them," said School of Engineering Dean Godfrey Mungal. Nicole Pal '14, assistant project leader, summed up the team's unflinching optimism for a brighter energy future when she said, "It's not about the project; it's about changing the world—we got this!"

A FAR-FLUNG SCU COMMUNITY BRINGS ELECTRICITY TO HAITIAN CLINIC



Newly installed solar panels serve the medical/dental clinic well.

Each fall, 15 or so engineering students enroll in ENGR 110, Engineering Projects for the Community, and spend the next 10 weeks focused on creating a solution for a neighboring school, science camp, or local organization's challenge. Because of the short timeframe, projects are generally limited in scope, but every now and again an opportunity arises, and some magic happens. Following is an example of just that kind of synergy and an explanation of how a medical and dental clinic in rural Haiti has benefited from the dogged determination of a disparate cast of characters brought together through Santa Clara engineering.

THE PLAYERS

Bob Downey '92: SCU economics alumnus, medical diagnostics and laboratory services specialist, resident of San Diego, secretary of the nonprofit organization Seattle-King County Disaster Team (SKCDT) that runs a medical and dental clinic in Haiti, and recipient of Santa Clara's 2012 Ignatian Award recognizing alumni for outstanding achievement in service to humanity.

Shoba Krishnan: associate professor of electrical engineering, proponent of community-based projects and community building, tireless student mentor.

Luanda Rotondano Marinho: visiting student from Brazil who spent a year studying engineering at SCU, tenacious problem solver.

Mike Strykowski: co-founder of The Solar Way Forward, extensive background in solar design for schools in Africa, consultant to solar energy practitioners, mentor and consultant on numerous SCU energy projects.

THE PROBLEM

The medical/dental clinic in the small village of Leon, Haiti, run by volunteers from Seattle-King County Disaster Team had no electricity. Power was generated by a large diesel generator at the nearby Catholic parish, which was problematic because of the cost and limited availability of diesel. The lack of consistent electricity caused problems for the dentist who has not been able to run the compressor to power dental tools such as drills. Additionally, treatment of nighttime emergencies such as difficult labor/deliveries or traumatic injuries was inhibited because of the lack of proper lighting.

THE SOLUTION

Design a solar photovoltaic system with the following criteria:

- Parts must be either available locally in Haiti or sized appropriately for transport from the U.S. with SKCDT volunteers
- System must be easily installed, rugged, and designed to deter theft
- Instructions for installation and maintenance must be detailed

THE STORY

When Bob Downey approached Shoba Krishnan about having a student take on this project, he could sense that she was leery. "It's best if the students have face-to-face contact with the customer," she said. "Bob was in San Diego, the installation was in Haiti. There was no way to go and assess the situation. It's important that students get that experience of meeting the community they are trying to serve and seeing firsthand their needs and challenges. Students don't get it if it's not in front of them physically." But Bob was determined. "I was familiar with the work the School of Engineering has done in other parts of the world and thought this would be a good opportunity," he said. Even though he was based in Southern California and his colleagues who would help with the installation were in the state of Washington, he had confidence in SCU's ability to come through. "I wouldn't have chosen another school because I know the reputation SCU has for quality education and sustainable, practical projects," he said. That explains

his eagerness to collaborate, but what made Shoba overcome her reluctance? "He was a Santa Clara grad so I just believed in him; they've never let me down," she said.

Enter Luanda. With a Brazilian education in controls and automation engineering that fell somewhere between SCU's electrical and mechanical engineering programs, Luanda was eager to take on a renewable energy project. "I've been doing volunteer work for a few years now," she said, "but being able to participate in this project and see the impact of the work we did was one of the most amazing experiences I had at Santa Clara University." Twice a week she and Bob met by phone to formulate a plan that made the most sense for Haiti; soon Luanda got to work designing the system. A project of this scope cannot be completed in 10 weeks, so she continued working on it after the quarter finished, through the Christmas break, and past the New Year holiday.

Along the way, Shoba introduced Mike Strykowski into the mix. Mike's enthusiasm for spreading the gospel of renewable energy is infectious. "I enjoy the mental gymnastics of putting systems in the middle of nowhere," Mike said. "This is not a cookie-cutter operation, and the idea of doing solar panels in Haiti and working with divergent groups was exciting. Also, SCU's policy of encouraging service-oriented projects was a guiding factor in my involvement. Many universities don't push that—with others it's all about the money. SCU prepares students to make money, but that's not the only focus. That appeals to me." With his boots-on-the-ground knowledge of what was

appropriate and was (or was not) available in Haiti, his input was important in determining the components that included PV panels, battery inverters, cabling mounting, and more—half of which were to be procured in Haiti and half to be purchased in the U.S.

After Bob confirmed the pieces that could be sourced in Haiti, Luanda, Mike, Shoba, and electrical engineering student Russell Weatherby addressed the challenge of training. Mike provided a sample mount solar panel and controller, and over the course of a weekend the team videotaped the process of building the system step-by-step. Next, Luanda wrote a project report, shipped some equipment to Seattle for the SKCDT volunteers to take with them in

February for the installation, and the team waited to hear news from Bob about how the installation went.

THE RESULT

A few weeks later, a happy email: “Everything is installed and working great. Thanks for your help!” Reflecting on the collaboration, Bob recently reported, “The videos and other documentation were invaluable to a successful project. Additionally, how Shoba, Mike, and Luanda arranged to have the system assembled and tested on campus prior to shipment was very helpful. We were under a very short time window to get everything in country, up and running. All those things together helped to make it happen successfully in this very remote area.”

And what has the effect been on the clinic? “Having electricity at the clinic has been so very helpful,” Bob relayed. “A man with a compound open leg fracture was brought in one evening this past June. Our physicians and paramedics were able to stabilize him working under regular light.”

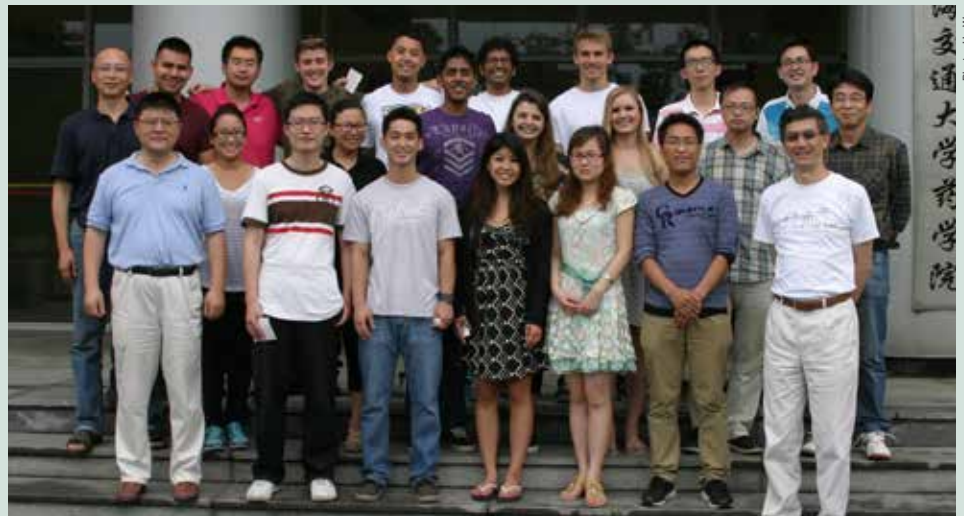
Oh, and that dentist? While we don’t have a report on how many more teeth he’s been able to drill, Bob did report: “The dentist is doing well and is able to run the air compressor for the drill off of the power generated from the solar.” A happy ending, indeed, and as Shoba says, “...that’s just one project!”

WEST MEETS EAST

In a classic case of “East meets West,” Shanghai Jiao Tong University (SJTU) and Santa Clara University have joined forces as creators and co-leaders of an annual summer program in which students can experience a new culture and educational system while visiting diverse industrial settings and expanding their vision of the global workplace.

Last summer, 11 SCU bioengineering students visited China, studying traditional Chinese medicine (TCM) with peers from the pharmacy program at SJTU and touring facilities in Shanghai and Nanjing. “The students experienced outstanding lectures from leaders in the field of pharmaceutical research,” said SCU bioengineering associate professor Zhiwen (Jonathan) Zhang, who helped create the program and accompanied the students on the trip. “At Santa Clara, we teach bioengineering with a clear goal toward its use in therapy or medical treatment. This direct exposure to a pharmacological point of research and therapy was invaluable to our students.”

Following their time at SJTU, the students were invited by Nanjing University to sit in on research seminars, hang out, and do some sightseeing. When the program wrapped up, six Bronco engineers stayed behind to perform research at the university. “The culture and protocols in the lab were a lot different than in the United States,” said Cade Ito ’14. “They did everything very precisely and quickly, but having to adapt to a different lab and a new language was a good experience.”



Faculty and students from Santa Clara and Shanghai Jiao Tong Universities

Jennifer Batará '13 shared a different perspective: “Engineers in America are not expected to get a lot of outside cultural experience,” she said. “We are expected to cultivate our technical skills. A program like this goes along with the Jesuit mission of trying to develop the whole person. Men and women are more than just engineers or businesspeople.”

Having had such a great experience in China, the Bronco engineers are eager to return the favor next summer when they host the program in Santa Clara for the International Summer Academy of

Bioengineering (ISAB). “Developing these ties so early in our careers is a great way to forge worldwide networks and enhances the reputation of both universities,” said Josegrio Zaragoza '13.

Read an expanded version of this story on our website: scu.edu/engineering/scu-sjtu.

TESTING THE WATERS 2.0



Jessica VanderGiessen '14 collects a water sample to test for pathogens in West Bengal, India.

For several years, bioengineering assistant professor Unyoung (Ashley) Kim has put students to work advancing research on a device to detect contaminants such as bacterial pathogens and arsenic in water samples collected in rural areas. A collaborative effort among students, SCU's Frugal Innovation Lab, and St. Xavier's College in Kolkata, India, the device—an electrochemical sensor, CheapStat analyzer, and laptop graphical user interface—was recently taken out into the field to test the validity of its results.

Jessica VanderGiessen '14 and St. Xavier's environmental studies professor Xavier Savarimuthu, S.J., gathered and tested 38 samples from the North 24 Parganas district in West Bengal, India. "We had a few objectives going in," said VanderGiessen. "We wanted to see if the current testing protocol was appropriate in a real-world setting, we needed to determine the most efficient method for water source application, and we wanted to learn how the design of the device could be improved."

Samples were collected and tested from shallow, midrange, and deep wells measuring from 30 to more than 120 feet. To validate the instrument, Fr. Xavier selected wells that were known to have the highest peak of arsenic contamination. Later, VanderGiessen analyzed the data and wrote a report.

In a Skype call with Kim, Fr. Xavier, and Radha Basu, director of the Frugal Innovation Lab, VanderGiessen reported her findings, and the group discussed how to improve the sensitivity of their electrochemical sensor, considered adding testing for a secondary contaminant to their platform, weighed options for safe and rugged packaging, and offered suggestions for simplifying experiments by modifying their sensors to include dried reagents, eliminating the need to mix the chemicals on site. "The project will continue over the next year with improvements being made to the sensor, signal conditioning, and integration with Android to create a 'lab-on-a-chip,'" said Basu.

Reflecting on their time together, Fr. Xavier said, "I have followed up with some of the villagers about the quantity of arsenic that they are exposed to. This interaction helps us build a good rapport with the community that will help pave the way for future research." VanderGiessen adds, "I'm so grateful to have had this experience. This field test provided invaluable data and feedback on our current design that will be used to guide our work through the coming year."

SETTING THE STANDARD FOR VIDEO CODING

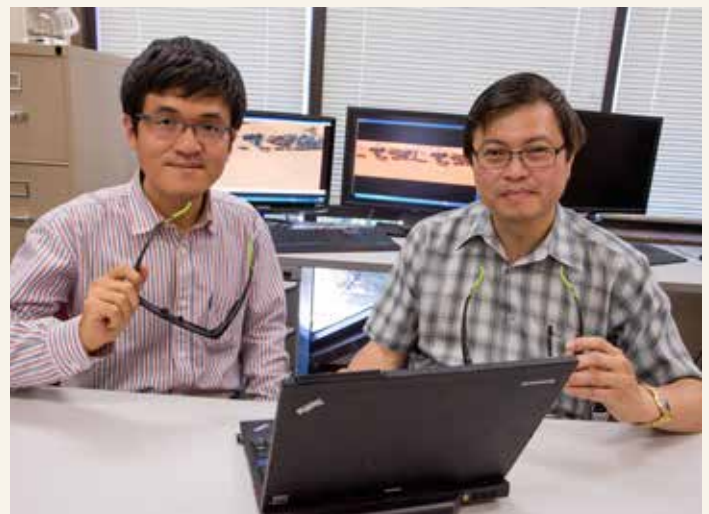
Radical advancements in video technologies such as "Free viewpoint video" (capturing an image of objects from all directions) and ultra-high definition (UHD) television that will one day afford 16 times the spatial resolution of current HDTV require computer engineers to innovate techniques to drastically save space and time in video coding.

Recently, one video compression method developed by SCU in conjunction with global information and communications technology leader Huawei Technologies, Inc./Hisilicon, was adopted as a normative (or required) method for 3D video coding, targeted to be released in January 2015. In addition, another video compression method developed by the team was adopted as informative (or optional).

When the International Standardization Organization (ISO) and International Telecommunication Union (ITU) put out a call for proposals a year ago to improve the efficiency of encoding 3D video data, SCU was well positioned to accept the challenge in competition against industry titans such as Samsung, Qualcomm, Intel, and leading research giants like Germany's Fraunhofer Heinrich Hertz Institute (HHI). Since 2005, Nam Ling, chair and professor of computer engineering at SCU, has led a team of Ph.D. students and research assistants working with Huawei/Hisilicon to advance industry standards for video coding. Zhouye Gu from Nanyang Technological University in Singapore had recently been recruited by Ling to join SCU's team as a research scholar; his first assignment: work with the SCU-Huawei team to devise a proposed solution for this 3D competition.

Working with the team, Gu devised a simplified process in depth coding that produces a 30 percent encoding time savings without performance loss, providing the same visual quality while using the same bitrate as current methods. His solution supports multiple views for free viewpoint coding and can accommodate even greater gains in coding depth and texture data as the field advances. Though SCU's proposal was not initially accepted, Gu was able to gain the support of a world-leading telecommunication research institution. "Our process improves upon techniques originated by them and, since they are a big player, their support holds a lot of weight," he said. After months of work, it was announced that SCU-Huawei's proposal had been adopted as a normative method for 3D-High-Efficiency Video Coding (HEVC). Between now and January 2015, SCU will continue to work with Huawei's researchers to further refine the coding process and to propose new methods for adoption. "The impact of the digital area is tremendous, and there is a lot more to be seen. As a university, it is important that SCU has a role in this," said Ling.

Read more: scu.edu/engineering/3Dvideo



Zhouye Gu (left) and Nam Ling

MOBILE APP ACQUISITION HAS ALUMNUS SHOUTING YAHOO!

Illustration: Courtesy of Jerry Shen



Jerry Shen and his avatar are happy with their move to Yahoo!

It's pretty cool when an alumnus who has just sold his Silicon Valley startup company to Yahoo! declares in his blog, "I took the mobile app development class for my master's degree, which completely changed my life."

That's Jerry Shen '10 (M.S. engineering management and leadership), founder of Bignoggins Productions, writing about the success of his wildly popular "Fantasy Monster," which reached the heights of No. 1 paid sports app on iPhone, iPad, and WP7, and No. 2 paid sports app on Android. In addition, Shen's "Draft Monster" climbed to No. 2 paid sports app on iPhone and iPad. Using these apps, fantasy sports league enthusiasts could easily edit lineups, make trades, take on free agents, and monitor scores on their mobile devices.

And it all started at Santa Clara University when Shen walked into adjunct professor Joshua Conner's Mobile Apps

Development class. Conner, an original member of the team that developed Apple's iPhone, also created the course that would change Shen's life. "It was the first time we offered the class," said Conner, "and the first assignment was to come up with a list of ideas that students would like to explore. By the end of the quarter, they were writing their own apps. Jerry took his application and built his company on that class project."

As Bignoggins began to take off, Shen quit his day job as a software engineer and "pushed the limits of how few hours I could work per week and still support my family." Three years later, Yahoo! acquired his

company and hired him as director of engineering for mobile and emerging products, incorporating his code and adding features to enhance the new Yahoo! Fantasy app.

While not every idea pays off so well, Conner (who currently works at NVIDIA as a compiler developer) says a number of students who have taken this course have started their own companies based on their classwork. "There is definitely a synergy here," he said. "Jerry comes to talk to our students each year and it's exciting to see their ambition grow as they take their ideas to the next level. It's great to be around that."

THE ETHICS OF BIOENGINEERING

At Santa Clara, we strive to educate the "whole person" to be of service in the world. Achieving this goal entails training students to think and act mindfully and ethically. This is particularly imperative in the field of bioengineering.

From the very beginning of the bioengineering program at SCU, department chair Yuling Yan has stressed the importance of an ethical perspective within its study. Each year, Margaret McLean, director of bioethics for SCU's Markkula Center for Applied Ethics, senior lecturer in the religious studies department, and affiliate faculty member in bioengineering, teaches one class within the Introduction to Bioengineering (BIOE 10) course. And each spring, she co-teaches Social and Ethical Dimensions of Biotechnology (BIOL 171) with Leilani Miller, associate professor of biology. McLean reports that "while examining technologies, including those related to genetic testing, gene therapy, and global health, students explore the basic ethics questions concerning

efficacy, safety, and impact on the end user. From there, we build a much more nuanced ethical infrastructure for them to draw upon as they approach their final project."

Last spring, bioengineering students Nick Wolfe '14, Tess Cauvel '14, and biochemistry major Emily Robinson '14 were intrigued by an article they read in *Nature* about a new gene therapy for reducing or eliminating mitochondrial disease in humans. They presented a consideration of the underlying science—addressing the medical problem, potential benefits, and ethical concerns—as fellow teams covered other cutting-edge issues at a Biotechnology Ethics Poster Session.

Prashanth Asuri, bioengineering assistant professor, brought his freshman students to a private viewing of the poster session for some peer-to-peer teaching. In small groups, the juniors and seniors shared their research with the younger students, most of whom hadn't taken an ethics course yet.

"Bioengineering is evolving at an incredibly rapid pace," said Asuri. "As the young engineers are preparing to contribute to the advancement of the field, they should also understand the ethical complexities involved. We want to develop technically competent and ethically responsible bioengineers." To keep pace with the changing landscape, department chair Yan is expanding SCU's bioengineering course offerings. "We are planning to offer BIOE 180, Clinical Trials—Design, Analysis, and Ethical Issues, next spring," she said. "This course fulfills both the bioethics requirement and counts as a technical elective, giving students more choice while also weaving ethics more tightly into the engineering curriculum."



Students share the ethics of bioengineering with their peers at a forum held each year.

For his part, Nick Wolfe said the ethics course will help him as he begins his career. "The future relies on technologies, and engineers need to thoroughly understand the concerns, consequences, and implications involved," he said. Classmate William Truong '13 added, "As engineers, we tend to think that any new technology must be good. This class made me think more deeply about the development of products and treatments and how they could help or hurt humanity."

BRNCOS HELP ALASKA COMMUNITY RECOVER FROM DISASTER

Photo: Robert Boscacci '14



Civil engineering student Ashley Husbands '14 and a local resident respond to the wreckage left by a flood in Galena, Alaska.

Last summer, five Santa Clara engineering students joined assistant professor Hohyun Lee and a group of their peers from various disciplines across campus on an immersion trip to Galena, Alaska, organized by business school lecturer Bill Mains. Their objective was to help the small community combat rising fuel prices by determining cost-effective ways of handling their energy needs.

Currently relying on diesel fuel to power their electricity, villagers typically pay an exorbitant 67 cents per kilowatt-hour to heat their homes, compared to 10 cents charged to Santa Clara residents. The community, which was formerly home to a U.S. Air Force base, was eager to work with SCU to learn about their energy options.

But upon their arrival, students were met with the news that Galena had just been declared a federal disaster site following a devastating flood. More than half the villagers had been evacuated; those who remained did not know what to ask in the way of federal support. The students immediately set to work helping the locals recover from disaster and providing input on how to rebuild for energy efficiency.

While some students began creating a questionnaire and contacting residents to identify their needs, others took waterline measurements or performed an energy audit. A pamphlet listing recommended

replacement appliances was created, and at a presentation to villagers, the students offered information on savings to be had by making small changes such as replacing incandescent lights with LEDs.

“We were fortunate to be there when the community really needed our help, said Lee. “Alaskans are very serious about energy; it’s not fiscally responsible to build a power plant just for the summer months when tourists visit, but they can install solar thermal water heaters for tourist cabins, they can replace their washing machines or freezers with models that are highly energy efficient.”

For her part, junior mechanical engineering student Kaci McCartan was proud to be a part of the group. “This trip to Alaska was a great way for different disciplines to learn to work together for a similar cause. It was cool to see business students, arts and science students, and engineering students all doing different jobs to help the community. Not only were we asked to use talents learned from our respective majors through surveying, energy auditing, and questionnaire creating, but we were also challenged to use our own personal talents to interact with the community to discover their wants and needs for rebuilding. I learned so much about myself and my passions during this trip, and I am so happy and blessed to have been a part of it.”

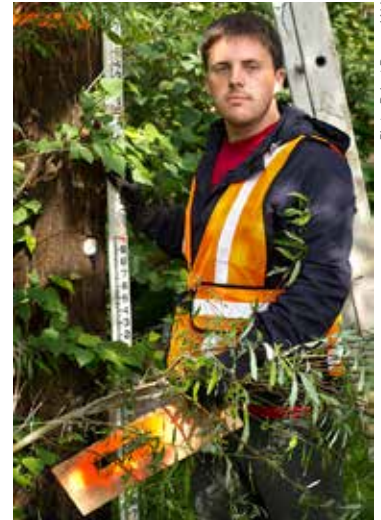


Photo: Robert Boscacci '14

Sam Heath '14, senior civil engineering student, measures water elevation marks.

CENTENNIAL BLESSINGS

Over the course of a century of operation, the School of Engineering has been the recipient of countless blessings. During the annual Senior Design Conference last spring, our community gathered for the unveiling of a Centennial Plaque which was blessed by James Reites, S.J., associate professor of religious studies and of engineering by courtesy (and, himself, a blessing to our community). Following is Fr. Reites' prayer:

“We are here to mark and celebrate the completion of 100 years of Engineering Excellence in the School of Engineering at Santa Clara University.

“Gracious God, we give thanks for your many blessings on the students and staff, faculty and administrators, our alumni, board members, and all who have promoted and continue to promote the great work of education in our School of Engineering.

“Bless this plaque commemorating this great event. May it be a reminder of our heritage, and a proud sign of future accomplishment. We ask your abundant blessings on our next 100 years. Amen.”



Photo: Charles Barry

Fr. Jim Reites (left) and Dean Godfrey Mungal unveil the School of Engineering's Centennial Plaque.



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School of Engineering

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