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Engineering Design that CARES

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by Gordy Slack

It began in 2008 with a phone call from David Edmund to Ryan Shelby. Shelby, a doctoral mechanical engineering student at UC Berkeley, was asked to assist in creating an energy-efficient and water-efficient housing design for the Mendocino-based Pinoleville Pomo Nation (PPN). Edmund, the environmental director for the PPN, had knocked on the right door, as Shelby is one of the founders of the Community Assessment of Renewable Energy and Sustainability (CARES) program and a strong believer in listening to the users to accurately assess their needs.

Ryan brought the idea to his advisor, Mechanical Engineering Professor Alice Agogino, who decided to make it a module in her E10 Human-Centered Sustainable Design class in Fall 2008. She worked with the PPN, Ryan and UC Berkeley architecture graduate student Yael Perez to drive the Berkeley students two hours north to spend a day meeting with members of the PPN on their sovereign Native American soil. They used an Innovation Workshop format based on Agogino's prior work in leading co-design workshops with under-served communities. This workshop was the first of many such meetings that resulted in an innovative and decidedly Pomo home prototype. The first three homes, funded with grants from HUD and DOE, will be completed in August 2011.

The Pinoleville Pomo people have been through much in the past century-and-a-half; displacement from their land, poverty, and the intentional disruption of their culture. But through it all, “they have sought to practice sustainability,” says Shelby. “But we can help them with their own ideas of sustainability by giving them some technological and design advice.”

The Pinoleville Pomo Nation has about 300 members, most of whom are spread around northern California. In recent years, the PPN government has tried to draw members back to tribally-owned lands just outside Ukiah in Mendocino County using, in part, the creation of housing that would be sustainable, both environmentally and from a culture and community point of view. Tribal leaders from the PPN did not want traditional ranch-style houses topped with solar panels and flow inhibitors

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on the water fixtures, says Shelby. “They were less interested in reducing their greenhouse gas contributions than in making self-sufficient homes, emphasizing their sovereignty and cultural heritage, preserving their privacy, and achieving harmony with the local environment,” says Shelby.

UC Berkeley graduate student Ryan Shelby and David Edmund, Pinoleville Pomo Nation environmental director, setting up an anemometer at the PPN.

“For example, curved walls are culturally important to the Pomo,” says Perez. “For spiritual reasons, they do not want right angles in their homes.” That longing for traditional rounded forms didn’t emerge in conversations right away, however. Those preferences were deeper down, and took time and trust to reveal. “The Pomo had their own way of framing ‘sustainability’ that came from a history we did not know much about,” says Perez.

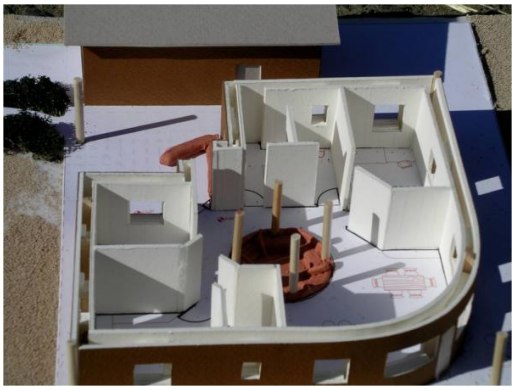
Like “sustainability,” the word “community” is also open to interpretation. Perez, considering the project at first, supposed that community values, energy efficiency, and economic needs would all be best accomplished by clustering the homes together, or making duplexes or triplexes. While she was right that the Pomo people treasure community, brainstorming sessions revealed a pressing need for privacy and independent family space. For such a small community to be sustainable, families need both space to gather and a large dose of privacy.

The 1,300-square-foot, three-bedroom prototype houses, viewed from above, are shaped “roughly like eyes,” says Perez. The “heart of the house” is round and the communal space around is curved on two sides says Perez. “Though there are corners, the house “works” in a circular way.

Food preparation is a communal activity, says Perez, and a large kitchen accommodates a number of cooks at once. Everyone gets involved, so there cannot be a wall between the kitchen and the main living space, which is round, too, and sunken a little into the earth, to stress connection with earth. A skylight floods the living space with natural light.

To save energy in hot summers, the design employs a geothermal cooling system: pipes containing refrigerant are run 12 feet underground, where temperatures remain nearly constant throughout the year. Refrigerant, warmed by the house, can be pumped through the pipes, where it will discharges the heat and resurfaces to cool off the house.

The main building material is renewable, cheap, and locally available straw bales, which provide great heat insulation and connect the building and its occupants to the earth—a primary value of the PPN. The houses also will be fitted with solar panels to generate electricity and warm water.



Final home design, image courtesy Yael Perez.

The program is remarkable not only because it produces excellent, culturally-tuned-in designs for groups that really need them, but also because it is such a powerful experience for students. “There is cross-pollination of knowledge from both sides, from Berkeley to PPN and from PPN to us,” says Shelby.

“Students want to use their engineering skills to help people,” says Shelby. “But there are not a lot of projects where they can go into the community, look the people they are working for in the eye, and then help develop designs that bring about big practical benefits in those peoples’ lives.”

“Most students don’t see their design projects built,” says Shelby. “You learn a lot very fast when you’re responsible for making something for people with serious needs. You can easily get caught up in the theory, but at the end of the day you have to be able to design it, to build it, and to get it implemented on the ground and get people to adopt and utilize it.”

Last year, CITRIS awarded CARES $74,000 in seed funding to help it expand. It is currently collaborating on six projects with Native American tribes across northern California. Like CITRIS, CARES is a multi-disciplinary undertaking. Architects, engineers, computer programmers, urban planners, and landscape architects work together on CARES projects, says Shelby. “At CITRIS we see everyone in these domains under one roof …we connect with a host of other grad students and professors.”

Professor Alice Agogino continues to serve as the principal advisor to CARES and is PI on the Native CARES project. She has developed collaborations with other UC Berkeley faculty: Greg Niemeyer from the Berkeley Center for New Media and Daniel Kammen from the Energy and Resources Group. Neimeyer is working with CARES on an indoor-air-quality-monitoring project and Kammen on feasibility studies for solar-power projects for Native American tribes in northern California. In addition Galen Cranz of the School of Architecture led a studio class with Yael Perez on clustered housing for the PPN, and Eric Brewer and his doctoral student Yahel Ben-David are working with the PPN on a wireless infrastructure as part of the Technology and Infrastructure for Emerging Regions (TIER) project.

“Without CITRIS we would not have made those personal connections,” says Shelby. “More than just funding, CITRIS provides an environment where you can collaborate with multiple stakeholders and harness the collective intelligence on campus toward real-world change.”