

Engineering

Engineering lies at the heart of the Solar Decathlon. This broad-based category employs a panel of jurors to rate the functionality, reliability, and innovation of the HVAC system and other technical features of each home.

Like many of the other contests, success in the Engineering category requires teams to decide how they will balance important but conflicting factors, such as cost, durability, uniqueness, and practicality. Also like the other contests, the Engineering score fails to incorporate ethical considerations. Of all of the categories, Engineering has the most to lose by neglecting the ethical issues present in every aspect of the design.

One reason is that engineering is so foundational to the competition. Behind every major component in the house is a technology made possible by engineering. In addition to obvious features, such as the HVAC system and photovoltaic panels, the steel frame was designed by an engineer, the bamboo construction method was developed by engineers, and the intuitive control system was made possible by the expertise of engineers. Anything man-made required an engineer to design and manufacture it. All of the construction materials required engineers to find the best method to extract and process them. Engineering is what makes the house possible.

Ethics are securely embedded within the Santa Clara engineering curriculum. Freshmen are introduced to the topic through a class period devoted to ethics in their Engineering I course. Senior design projects emphasize having an ethical mindset, and students are urged to ask questions like, “What is the benefit of this project? How has an attitude of environmental and social consciousness been incorporated into the design?” The Frugal Innovation Lab enables students to meet the needs of the developing world by developing low-cost technology rather than expensive and impractical solutions. Engineers continue to be well-represented in the on-

campus ethics arena, earning the Hackworth Fellowship and Environmental Ethics Fellowship. Santa Clara is dedicated to extending its goals of conscience, competence, and compassion to every student, especially its engineers.

This attitude is evident in the way the engineering team leads have approached the competition. The leader of the HVAC team spoke of how his group specifically sought out an insulation that was sustainable, since there are many ethical drawbacks to traditional insulation. For example, spray foam insulation is often made of petrochemicals and results in the release of hydrochlorofluorocarbons, a destructive greenhouse gas, during production. Fiberglass insulation is cheaper and more common, but it is also a strong irritant and great care must be taken during handling. Other environmentally friendly alternatives, such as mineral wool and straw bales, are not fire-resistant.

In the end, the team chose to use a combination of insulation materials. They will incorporate close-celled spray foam insulation called HeatLok-Soy 200, manufactured by Demilec. It is composed of recycled rigid urethane foam plastic treated with renewable soy oils, and no gases are emitted in the manufacturing process that will harm the ozone layer. The team will also use R-13 EcoTouch PINK FIBERGLAS insulation provided by Owens Corning, a local company. This insulation contains 99% natural mineral and plant-based materials, with guaranteed 58% recycled content. The team acknowledges that some of these innovations have been more expensive, but they are worth the benefits of safety and sustainability, since the natural materials pose less of a health risk as well.

The team has made other conscious ethical choices to increase efficiency and reduce environmental impact. The team will use eco-friendly refrigerants and extremely efficient HVAC components to minimize energy use, particularly in the heat pump. They have also sought out

innovations to maximize available solar power, including using the Tigo optimizing system, which allows real-time control of the photovoltaic array. When a single panel is underperforming, that panel can be automatically or manually bypassed so it does not affect the performance of the other panels. This information is visible on an intuitive dashboard that the owners can see and control. The Sunplanter racking system is an aesthetic way to elevate the solar panels at an optimal angle above the roof. They allow air to circulate freely below the panels. Some of this hot air is being redirected to other applications, such as the dryer and the hot water tank. Further examples of engineering innovation are discussed in the Comfort Zone, Hot Water, Appliances, and Energy Balance narratives.

Out of all of their engineering technologies, the team is most proud of the bamboo structural design. No other team in the competition is using bamboo in this way, and no other house requires as much student labor to make the structure possible. The extra work required to assemble the walls and joists, rather than using pre-made components, has lengthened the time needed to complete the house, but has also given the team members a sense of pride and ownership of their work. The bamboo has required an incredible amount of engineering to become a reality, from the designing and testing by the civil engineers to the construction in the structural lab, but nearly every key team member cites it as the number one distinguishing feature of Radiant House. The emphasis on bamboo has allowed sustainable construction methods to become a regular part of the team's ongoing conversation with students, sponsors, and the larger community. By highlighting the sustainable benefits of bamboo and proving to the judges that it can be a reliable construction material, the team is making a powerful case that ethics and efficiency are a winning combination in the engineering arena.