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Solar decathletes design 'inspiring' buildings with plastic pipe systems

CATHERINE KAVANAUGH

Plastics News Staff

Kansas State University

Students from Kansas State University competed in a single-family home division.

The next generation of green builders is looking to plastic piping systems to improve carbon footprints of buildings by reducing energy consumption, which achieves higher sustainability.

University student leaders in the green building movement incorporated solar energy, greenhouse gardens, pollinator pathways, and "inspiring" systems of plastic pipes into housing designs for the U.S. Department of Energy Solar Decathlon.

Seventy-two teams entered the 2021 collegiate contest to design highly efficient and innovative buildings powered by renewable energy. Nine teams also were part of a two-year program to build their projects.

Seven first-place winners emerged after judges considered the 10 factors of energy performance, engineering, affordability, resilience, architecture, operations, appeal to target market, comfort, innovation and the students' presentations.

Lance MacNevin, director of engineering for the Plastic Pipe Institute's building and construction division, was among the jurors. PPI has sponsored the design competition of the solar decathlon for seven years now -- since its inception in 2015.

This year, MacNevin was a juror in the "mixed multi-family" division, which had nine entries from U.S., Canada and South Korea. He liked what he saw and told me some of the highlights of the April 16-18 design challenge.

"The use of the plastic piping systems represented by PPI's building & construction division was inspiring," MacNevin said in an email.

He has been in the plastic pipe industry since 1993 and is an expert on plastic pressure pipes, such as chlorinated CPVC, high density polyethylene (HDPE), cross-linked PE (PEX), polyethylene of raised temperature (PE-RT), and polypropylene.

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Of the nine entries in the mixed multi-family division, four teams based their heating/cooling source on HDPE-based geothermal and three teams selected PEX-based hydronic radiant heating/cooling for space conditioning, MacNevin said.

The winning team for the division was Team Third Quadrant Design from University of British Columbia. They redesigned a laundromat in a historic building in a light industry zone in Mount Pleasant, Vancouver, into a mixed commercial/residential space. The new design incorporates rooftop gardens, solar arrays, a large buffering atrium and another energy-saving feature.

"The project utilized hydronic radiant heating/cooling with PEX tubing embedded in concrete floors," MacNevin said.

The students noted radiant heat is distributed more evenly compared to conventional forced-air systems, provides optimum temperatures for occupants comfort, uses little electricity, and operates without ducts, which reduces air losses and allows for higher ceiling heights.

The first-place students also designed radiant ceiling panels to heat and cool the commercial spaces.

The second-place team used similar products but embedded the hydronic radiant heating/cooling with PEX tubing into wooden/aluminum floor panels for a project called Sunblock Barrio Oeste by Team Barrio Oeste from University of Arizona.

And the third-place team for the mixed-use, multi-family division, from University of Missouri-Columbia, utilized ground-source geothermal piping loops for a project called CoMo Community Co-op. The design calls for HDPE pipes installed in 80 vertical boreholes on the property.

More than 70 percent of residential housing in the U.S. and Canada is now built using plastic pressure pipes such as CPVC and PEX for hot- and cold-water distribution, according to PPI. Plastics have been helping builders of all types solve problems and improve performance, MacNevin said, and there is increased awareness about plastic-pipe-based hydronic technologies to increase occupant comfort while reducing energy consumption.

"Although the growth of ground source geothermal systems has been stagnant for the past few years, we are anticipating a strong increase in 2021 and beyond, as a method to reduce carbon emissions for heating and cooling through reduced energy consumption," he said.

During a virtual award presentation, U.S. Secretary of Energy Jennifer Granholm congratulated the decathletes for trying to figure out how the nation can move toward a clean energy future for American families and communities.

Buildings currently account for about 74 percent of electricity use, 39 percent of total energy use, and 35 percent of carbon emissions in the United States, according to the DOE.

Granholm said more than 125 million buildings in the nation need retrofits to achieve a goal of net-zero emissions by 2050, which President Joe Biden's American Jobs Plan proposes to address.

The U.S. needs to rewrite the playbook for energy efficiency, renewables, modernizing the grid, decarbonizing buildings and transportation, Granholm said.

"It's not a silver bullet. It's silver buckshot," she added, encouraging the students to stay in the green building field.

"The competition doesn't end here. Now we need you need to bring those skills to the big decathlon, which is solving the climate crisis," Granholm said.

Since 2002, more than 20,000 students have participated in the Solar Decathlon. PPI is likely to sponsor the event for an eighth year.

"The popularity of the competition is growing, and the event is truly effective at educating the next generation of architects and engineers," MacNevin said. "Supporting these design

competitions is part of PPI's focus on sustainability, energy efficiency, and quality of life."

Inline Play

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