

Research + Application | Bus Shelter Prototypes for the Sonoran Desert

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The bus shelter prototype project is a design-build challenge undertaken by a fifth-year research studio in the School of Architecture at the XXXXXXXXX of XXXXXXX. The studio was charged with designing and constructing an adaptive modular system for bus shelters specific to the environmental and social conditions of decentralized urban areas in the Sonoran Desert. Pedagogically the project was conceived to provide students an educational experience that is analogous to professional practice; an opportunity to work with the actual en lieu of the hypothetical, the applied rather than the abstract and to engage communities through service learning. The studio engaged in original research that was applied in the constructed designs.

The region is subject to seasonally high temperatures and intense sunlight; extreme environmental conditions that inhibit broad utilization of the current bus shelter network. Existing bus shelter designs adopted by the local transportation authority are designed about economy or vanity and universally fail to consider the comfort of the occupants in regard to the extreme environmental conditions of the region. The transit-dependent ridership is perceived as tolerant; but when queried they express a strong desire for solar mitigation and expansive roofs to offer better protection from the rain. Many riders claim to miss their bus because they seek shade behind nearby utility poles, trees and buildings rather than sun-drenched bus shelters.

The project was comprehensive in scope; it opened with a pre-design phase comprised of first person experience, an analytical survey of all existing local bus shelter types, written surveys and interviews of riders. A performance-based program was developed, inclusive of all building, transit and accessibility regulations. Four sites were selected from the bus network's 2252 stops. The prototypical designs are comprised of three planes calibrated to maximize morning and afternoon shade, for four seated occupants, between the vernal and autumnal equinoxes. One plane is parametrically designed as a structural louver that enables visual contact between the occupants and the bus driver while maximizing shade. The shelters are strategically angled to further enhance visibility. Each shelter adheres to a two-foot ergonomic/material module and is equipped with integral bike racks, trash bin, and route maps. Four prototypical shelters were fabricated and installed. Students were responsible for all aspects of the project delivery including design, development, consultant coordination, construction documents, shop drawings, material acquisition, fabrication techniques, cost estimation, project scheduling and construction logistics.

Students learned about social responsibility, problem definition and evidence based design through working with the transit-dependent user group; recording their stories, insights and opinions. They demonstrated the potential value of architectural design through place-specific performance-based environmental design. The shelters are located in low-income/high-stress areas, which has raised two primary problems. The shelters function effectively in regard to environmental performance, but have become magnets for homeless people seeking reprieve from the intense heat and solar exposure; thereby displacing bus patrons. The shelters have fallen victim to the same vandalism that is endemic to their surrounding neighborhoods.

general description

The bus shelter prototype project is a design-build challenge undertaken by a fifth-year research studio in the School of Architecture at the University of Arizona. The studio was charged with designing and constructing an adaptive modular system for regionally specific bus shelters. The region is subject to seasonally high temperatures and intense sunlight, extreme environmental conditions that inhibit broad utilization of the current bus shelter network. The studio was conceived to be analogous to professional practice design directed by original research.

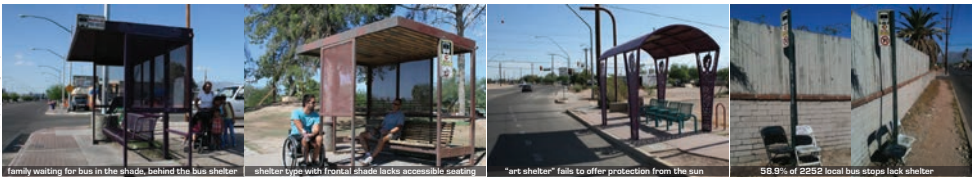


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experience observation

The first activity challenged students to assess the conditions of the local bus shelter network by first person experience; to define the problem in preparation for design. The ride-the-bus experience took place on an afternoon in late August; the sky was clear, the sun was intense and the high temperature was 106 degrees Fahrenheit, a typical summer day. The journey was scheduled to last approximately 3 hours, included 5 transfers and was coordinated to maximize the experience of diverse bus stop types. It lasted 4.5 hours.



surveys interviews

Studio participants conducted over 100 rider surveys and 30 video interviews. The transit-dependent riders presented unique insight into the culture, successes and failures of the public transportation system. They verified our speculation that solar exposure was most critical and that existing shelters almost universally failed in this regard. Riders also expressed unanticipated and passionate concern regarding the inadequate protection from direct and diverted rain water. The students found the riders to be engaging and tolerant.



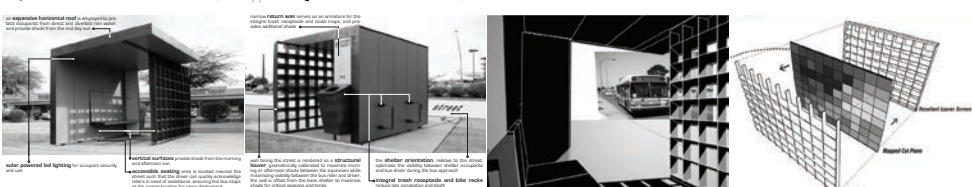
precedent analysis

Studio participants surveyed the eight common types of bus shelters adopted by the local transportation authority. Each type was surveyed, documented and digitally modeled, then evaluated in terms of location, orientation, program features, accessibility, driver/rider visibility, solar performance, water shed, materials and method of construction. Studio participants also considered global precedents with an emphasis on environmental specificity. Other municipalities consider their respective extreme conditions in bus shelter design.



design strategy

The prototypical designs are comprised of three planes calibrated to maximize morning and afternoon shade, for four seated occupants, between the vernal and autumnal equinoxes. One plane is parametrically designed as a structural louver that enables visual contact between the occupants and the bus driver while maximizing shade. The shelters are strategically angled to further enhance visibility. Each shelter adheres to a two foot ergonomic/material module and is equipped with integral bike racks, trash bin, and route maps.



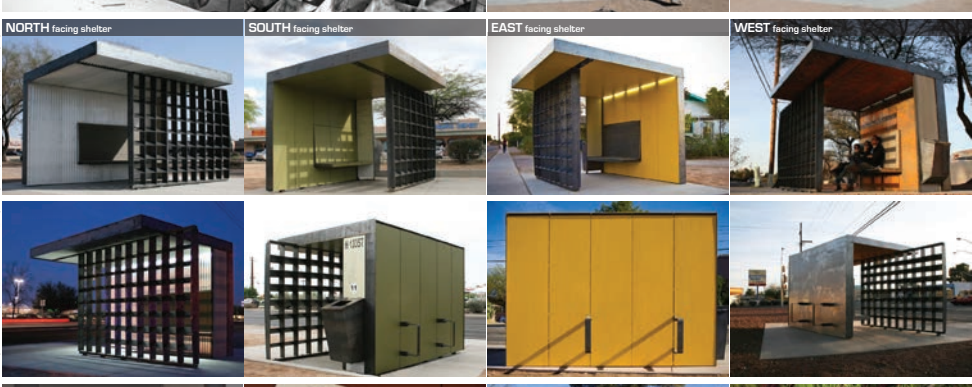
fabrication installation

Four prototypical shelters were fabricated and installed by the studio participants. All four shared a common structural system consisting of two panels, roof and wall, made of steel tubes; and a third louvered wall rendered as plasma-cut structural eggcrate. All material acquisition and fabrication was done by the students; welding was performed under the supervision of a professional certified welder. The structural panels were pre-fabricated in the school's material labs then transported and assembled on site.



prototype construction

The new prototypical system design was adapted to site conditions representing the four cardinal orientations and resulted in the construction of four shelters. Four sites were selected from the bus network's 2252 stops. Each of the four shelters utilizes a different cladding system; corrugated galvalume, graffiti resistant furs, demax, painted cement board and mild sheet steel. Some of the wall and ceiling cavities are insulated to minimize heat transfer, others function as porous rain screens. Credits: faculty Chris Trumble studio participants Emily Akaba, Dani Alvarez, Sean Bollinger, Paul Frederickson, Romar Karamooz, Erik Luhtala, Stephanie Mason, Virginia Munson, Reid Olson, Valerie Pellet, Steven Rosier, Evan Shalcross, Cathy Thompson, Kevin Turner, Sean Vandervell, drachman institute Kate Gannon, Peter McBride, tucson department of transportation Tom Fisher, Davita Mueller, structural James Galkin, TLCT Structural Inc. volunteers: Cruz Crawford, Stephen Elliot, David Koenig, Jason Kosmicki, Kevin Moore, Joe Miranda, Luis Guisada, Kelly Rehm, and Ben Thigles



conclusions performance

Students learned about social responsibility, problem definition and evidence based design through working with the transit-dependent user group, recording their stories, insights and opinions. They demonstrated the potential value of architectural design through place specific performance based environmental design. The shelters are located in low-income/high-stress areas that are prone to vandalism. Maintenance is underfunded and the expansive surfaces introduced for solar mitigation have become canvases attracting graffiti.

