Bus Shelter Prototypes

CHRISTOPHER D. TRUMBLE
University of Arizona
BUS SHELTER prototypes anthropology and environmental performance
The bus shelter prototype project is a design-build challenge undertaken by a fifth-year research studio in the School of Architecture at the XXXXXXXX xx XXXXXX. 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. Current 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 these unique environmental conditions. Through this project the studio is attempting to instill dignity in the use of local public transportation for the current ridership which is decidedly transit dependent. The new prototypical system design was adapted to site conditions representing the four cardinal orientations and resulted in the construction of four shelters.

The project was delivered as a collaborative comprised of fifteen students and instructor acting as architects and builders in partnership with urban planning representatives from the local transit authority, community facilitators, community members and the structural engineer. All partners were involved in the project from pre-design through occupancy.

Pedagogically the project was conceived to provide students an educational experience that is analagous to professional practice. Comprehensive in scope, the project opened with a pre-design phase comprised of 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 final prototypical system design was derived from fifteen initial schematic designs and refined to ensure its ability to effectively adapt to the four cardinal orientations. The design development utilized physical and digital modeling to generate environmental and experiential simulations. 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.

This project received $20,000 in funding from the Communities Putting Prevention to Work grant, sponsored by the US Department of Health and Human Services, mandated to implement evidence based strategies to reduce the risks for obesity, the use of public transportation has been proven to increase physical activity which counters the problem of obesity.

Students learned about social responsibility, problem definition and evidence based design through working with the transit-dependent bus rider user group; recording their stories, insights and opinions. They demonstrated the potential value of architectural design through place specific performance based environmental design.

Public transportation is an essential component of a healthy sustainable urban environment; fostering community through social interaction and using energy resources more efficiently. The bus shelter prototype project contributes to social and cultural sustainability by researching conditions, identifying and defining problems, and developing prototypical architectural solutions to enhance the performance and experience of using public transportation in the extreme environmental conditions specific to this region. It is our belief that through talking with and listening to the transit-dependent ridership, and using our architectural knowledge and skills we can challenge local design paradigms that inhibit the broad use of public transportation by choice-riders. The studio’s prototypical shelters employ passive strategies to mediate the extreme and specific environmental conditions of the region; intense sunlight, heat and seasonal downpours; and utilize solar powered LED lighting systems. The shelters each cost on average $5000 in materials excluding labor. The local transportation department is currently spending $10,000 per shelter installed, but pursuing designs that cost $3000. As a result of this project, the school is under contract to design and construct new prototypical shelters for the nearby Town of Marana.

credits: faculty XXXXX XXXXXX studio participants XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX department of transportation XXXXX XXXXXX, XXXXX XXXXXX structural XXXXX XXXXXX, XXXX Structural Inc volunteers XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX, XXXXX XXXXXX special thanks to the generous, spirited and tolerant bus riders of XXXXX
observation + rider interviews and survey  On a late August afternoon, with temperatures reaching 106 degrees farenheit, studio participants experienced the bus system and existing shelter network through a four hour excursion that involved five transfers. Studio participants then conducted over 100 rider surveys and 30 video interviews. The transit dependent riders presented unique insight into the culture, successes and failures of the system. They confirmed our conclusions regarding solar exposure and comfort but expressed unanticipated and passionate concern regarding the inadequate protection from direct and diverted rain water.

How effective are local bus shelters in providing the following?

1. Bus Route Information
   - 1
   - 2
   - 3
   - 4
   - 5

2. Adequate protection from the sun
   - 1
   - 2
   - 3
   - 4
   - 5

3. Adequate protection from the sun in summer
   - 1
   - 2
   - 3
   - 4
   - 5

4. Adequate protection from the sun in winter
   - 1
   - 2
   - 3
   - 4
   - 5

5. An environment that feels safe
   - 1
   - 2
   - 3
   - 4
   - 5

6. A clean and attractive environment
   - 1
   - 2
   - 3
   - 4
   - 5

7. Enough seating
   - 1
   - 2
   - 3
   - 4
   - 5

Please state what you like most about local bus stop shelters.

Please state what you like least about local bus stop shelters.

Bus Route Information

- 5 Tucson Bus Riders

Rain Protection

- 1
- 2
- 3
- 4
- 5

Summer Sun Protection

- 1
- 2
- 3
- 4
- 5

Winter Sun Protection

- 1
- 2
- 3
- 4
- 5

Safety

- 1
- 2
- 3
- 4
- 5

Environment

- 1
- 2
- 3
- 4
- 5

Seating

- 1
- 2
- 3
- 4
- 5

- 5 Tucson Bus Riders

Hard To Get On and Off
Stinky Bums and Weirdoes
Waiting at Them

No Information on Buses & Routes

“People Not Taking the Bus at the Bus Shelters”

Lack of TPD

Nothing

No Water Fountains

“Benchs out in the middle of nowhere Without Shade or Water”

Dirty Atmosphere

Hot Benches

Uncomfortable

The Benches

Harassment by TPD

“WE’re Drenched During the Monsoons”

Not Enough Seats

When it Rains/Sunny, They Sorta Protect You

Bus Shelter Analysis

- 5 Tucson Bus Riders

- 100 Participates were surveyed at multiple sites along the TDOT bus routes and transit centers.

A survey containing seven questions was passed out to Sun Tran patrons asking them to rank the quality of the current bus shelter designs.

A comment section located at the end of survey allowed participants to express specific complaints or praises for existing shelters.

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders

- 5 Tucson Bus Riders
regional precedents  Studio participants surveyed the eight common types of bus shelters adopted by the local transportation authority. Each type was documented, digitally modeled and 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.
selection of sites  Of the 2252 stops in the bus network, 925 were eliminated because they have shelters, another 1052 were eliminated due to low ridership, and another 75 were eliminated because they were outside of neighborhoods deemed to have a high/moderate risk for obesity. 200 sites were visited and 44 were selected for enhanced analysis due to desirable site conditions. Those 44 sites were evaluated about 14 criteria. 8 sites were determined to have optimal conditions and were selected for in-depth analysis. The final four sites were determined by studio votes.
Of the 2252 stops in the SunTran network 925 were eliminated because they have shelters, another 1052 were eliminated because they have low ridership, another 75 were eliminated because they were outside of neighborhoods deemed to have a high/moderate risk for obesity. 200 sites were visited and 44 were selected for enhanced analysis due to desirable site conditions. Those 44 sites were evaluated about 14 criteria. 8 sites were determined to have optimal conditions and were selected for in-depth analysis and presentation to the Transportation Authority.
**design strategies** The adopted system prototypes 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 seating, bike racks, trash receptacle, lighting and route maps.

- **an expansive horizontal roof** is employed to protect occupants from direct and diverted rain water, and provide shade from the mid day sun

- **integral trash receptacle and bike racks** reduce site congestion and blight

- **narrow return wall** serves as an armature for the integral trash receptacle and route maps, and provides additional shade

- **accessible seating** area is located nearest the street such that the driver can quickly acknowledge riders in need of assistance, ensuring the bus stops at the proper location for ramp deployment

- **vertical surfaces** provide shade from the morning and afternoon sun

- **solar powered led lighting** for occupant security and use

- **the shelter orientation**, relative to the street, optimizes the visibility between shelter occupants and bus driver during the bus approach

- **wall facing the street** is rendered as a **structural louver**, geometrically calibrated to maximize morning or afternoon shade between the equinoxes while maximizing visibility between the bus rider and driver; the wall is offset from the base shelter to maximize shade for critical seasons and times
EXISTING BUS STOP SIGN TO BE REMOVED AND REPLACED WITH SHELTER MOUNTED SIGNAGE

NEW SHELTER

DRIVE TO PARKING LOT 4'

NEW CONCRETE SLAB

11'-6'' 18'

UNPAVED AREA

EXISTING CONCRETE SLAB

NEW CONCRETE SLAB

100' VISIBILITY DISTANCE TO BUS DRIVER

UNPAVED AREA

EXISTING BUS SHELTER TO BE REMOVED

5'-0''

5'-0" W X 8'-0" D MIN.

ADA ACCESS LANE 3'-0" MIN.

SITE PLAN

Scale: 1/8" = 1'-0"

EXPLODED PERSPECTIVE

E

D

K

L

SCREEN WALL

A

B

C

D

ROOF/CEILING

H

I

J

BENCH

A   #10 Galvanized self drilling screws with gasket

B   8 mm Twin wall polycarbonate panel

C   3/8" Neoprene spacer

D   4" x  2" x 1/8" steel tube

E   1/4" Steel plate with 3/4" through bolt

F   1" x 1" x .065" Steel tube furring

G   10 ga. steel fascia

H   16 ga. steel cladding seat

I   2" x 2" x 1/8" steel tube

J   2" x 1" x .065" steel tube

K   1/4" Steel plate structural louver screen (vertical)

L   1/8" Steel plate structural louver screen (horizontal)

M   3/4" Expansion bolts

01 PLAN

02 LONGITUDINAL SECTION

03 TRANSVERSE SECTION

04 ELEVATION

SOUTH FACING
**EXPLODED PERSPECTIVE**

- **18' 10' 19'-6" 37'-4"**
- **DRACHMAN PARK AVE**
- **3'-11" 4'-0" MIN. 3'-0" MIN. 5'-0" MIN. ADA COMPLIANT**

**SITE PLAN**

- **Scale: 1/8" = 1'-0"**

**BENCHMARK**

- **A**  #10 Galvanized self drilling screws with gasket
- **B**  5/16" Fiber cement panel
- **C**  22 ga. Galvanized 7/8" hat channel furring
- **D**  3/4" CDX plywood with felt roofing membrane
- **E**  1/4" Steel plate with 3/4" through bolt
- **F**  4" x 2" x 1/8" steel tube
- **G**  10 ga. steel fascia
- **H**  1" x 1" x .065" sq. steel tube frame
- **I**  16 ga. steel cladding seat
- **J**  2" x 2" x 1/8" steel tube
- **K**  2" x 1" x .065" steel tube
- **L**  1/4" Steel plate structural louver screen (vertical)
- **M**  1/8" Steel plate structural louver screen (horizontal)
- **N**  3/4" Expansion bolts

**HSS 4" X 2" X 1/8" STEEL TUBE SILL PLATE**

**SEATING**

- **EQ.**

**SCREEN WALL**

- **A**
- **B**
- **C**
- **D**
- **E**
- **F**

**ROOF/CEILING**

- **A**
- **B**
- **C**
- **D**
- **E**
- **F**

**LONGITUDINAL SECTION**

- **Scale: 3/4" = 1'-0"**

**TRANSVERSE SECTION**

- **Scale: 3/4" = 1'-0"**

**ELEVATION**

- **Scale: 3/4" = 1'-0"**

**PLAN**

- **Scale: 1/2" = 1'-0"**

**01**

**02**

**03**

**04**
EXPLODED PERSPECTIVE

- Screen Wall
- Roof/Ceiling
- Return Wall
- Bench
- 1/4" steel plate with 3/4" through bolt
- 2" x 1" x .065" steel tube
- 16 ga. steel cladding seat
- 1" x 1" x .065" sq. steel tube frame
- 2" x 2" x 1/8" steel tube
- 1/8" steel plate structural louver screen (horizontal)
- 3/4" expansion bolts

PLAN

- Scale: 1/8" = 1'-0"

LONGITUDINAL SECTION

- Scale: 3/4" = 1'-0"

ELEVATION

- Scale: 3/4" = 1'-0"

SITE PLAN

- Scale: 1/8" = 1'-0"