Bus Shelter Prototypes

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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 Xxxxxxxxxx xx Xxxxxxx. 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.

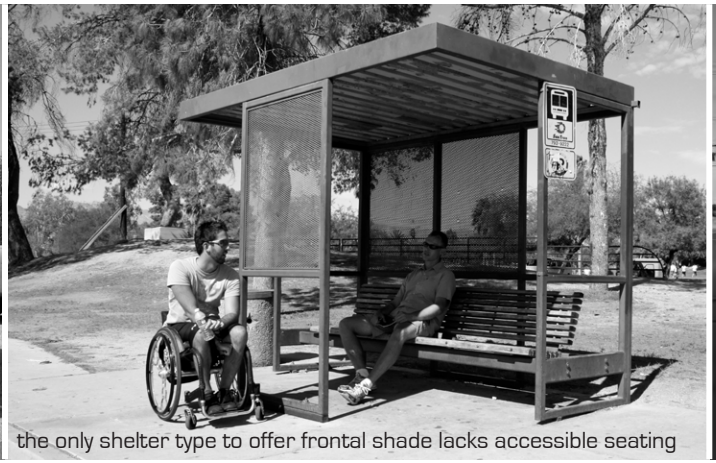
Public transportation is an essential component of a healthy sustainable urban environment; fostering community through social interaction and using energy resources more efficiently. The bus shelter prototype project **contributes to social and cultural sustainability** by researching conditions, identifying 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 Xxxxxxx **studio participants** Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx **xxxxxxxx xxxxxxxxx** Xxxxx Xxxxxxx, Xxxxx Xxxxxxx **Xxxxxx department of transportation** Xxxxx Xxxxxxx, Xxxxx Xxxxxxx **structural** Xxxxx Xxxxxxx, XXXX Structural Inc **volunteers** Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx, Xxxxx Xxxxxxx **special thanks** to the generous, spirited and tolerant bus riders of xxxxxx

observation + rider interviews and survey

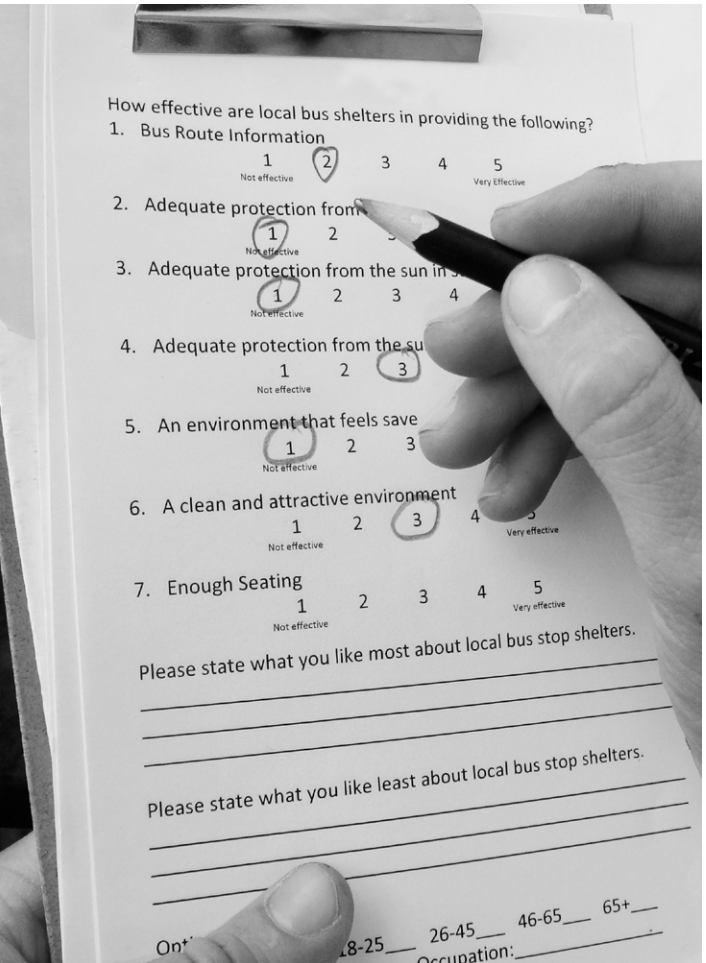
On a late August afternoon, with temperatures reaching 106 degrees farenheit, studio participants experienced the bus system and existing shelter network through a four hour excursion that involved five transfers. Studio participants then conducted over 100 rider surveys and 30 video interviews. The 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.

family seeking protection from the afternoon sun behind the shelter



the only shelter type to offer frontal shade lacks accessible seating

an "art shelter" fails to offer adequate protection from the sun



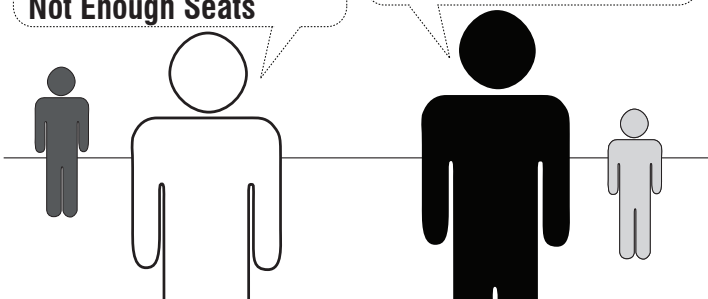
Hard To Get On and Off
Stinky Bums and Weirdoes
Waiting at Them
Bench Stoppers
Violence/Crime
No Lighting
Not Enough
"Nasty, Always Dirty, Always Bugs and Flies, just a NO"
No Information on Buses & Routes
"People Not Taking the Bus at the Bus Shelters"
Lack of TPD
Too Hot
Nothing
No Water Fountains
"Benches out in the middle of nowhere Without Shade or Water"
Doesn't Protect From Rain or Shine
"Some are Remote & Sketchy"
Everything
"No Shade Protection after 2:00PM"
Dirty Atmosphere
Hot Benches
Uncomfortable
The Benches
Harassment by TPD
"We're Drenched During the Monsoons"
Not Enough Seats

100 Participants 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.

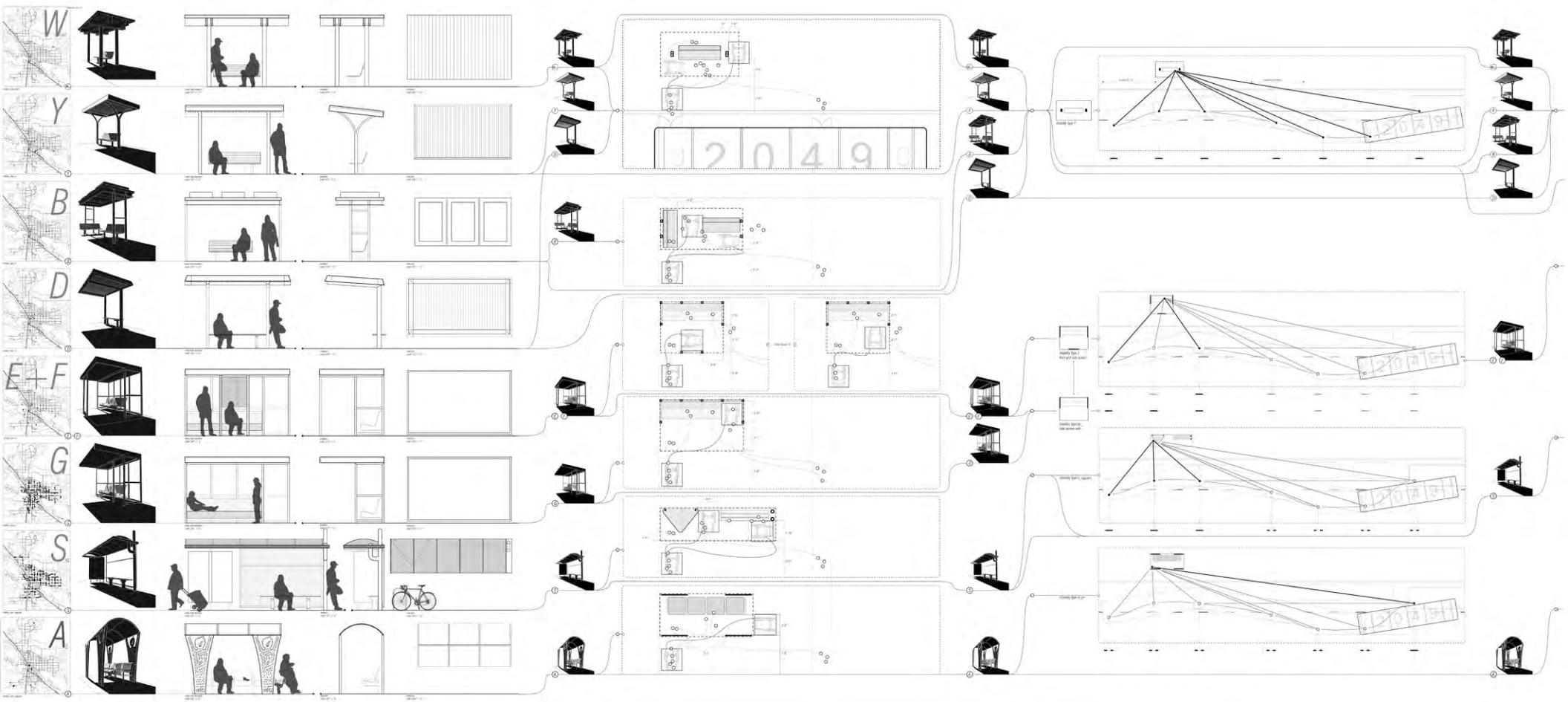
A comment section located at the end of survey allowed participants to express specific complaints or praise for existing shelters.

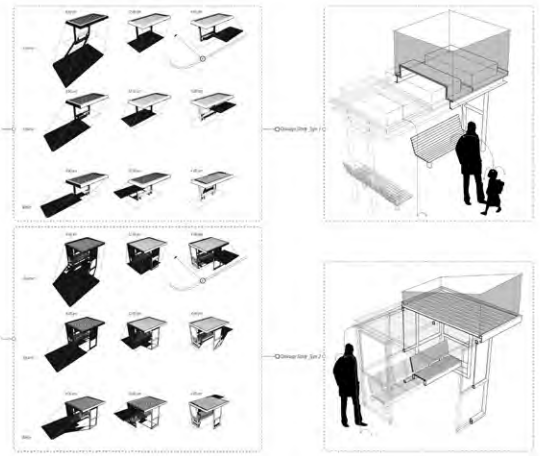
Doing Last Minute Homework
Clean
That There are a Lot of Them
People Watching
The Artistic Ones
They Look Nice
Easy to Find
The Security
"Meeting a Cute Guy, Which is Like 3 in a Million!"
Shade and a Spot to Sit
"It Is What It Is..."
Nothing
The Advertisements
The Bus Stopping
Nice Place to Sit and Wait
Desert Landscape
Air Vents
Information on the Bus Routes
Not Crowded Often
Shade From Trees
Interaction With Other People
"When it Rains/Sunny, They Sorta Protect You"

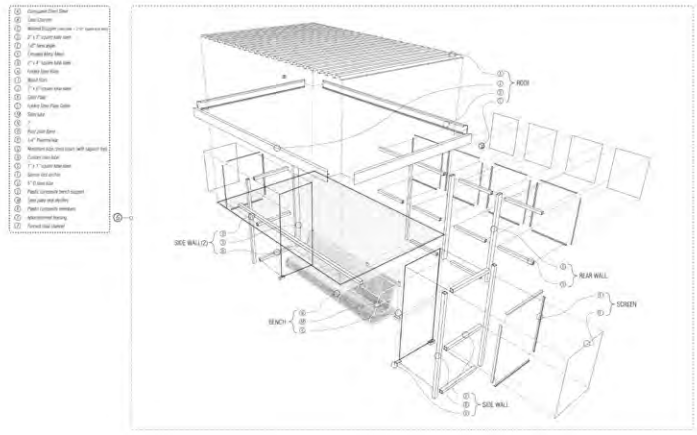


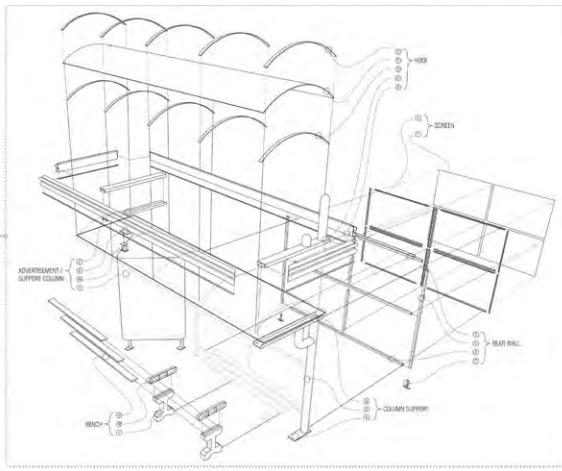
regional precedents

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.

Assessment Process

2252
bus stops system wide
our starting point is the total number of bus stops in the SunTran bus system

-925
bus stops that have shelters

1327
bus stops without shelters

-1052
bus stops without shelters that have low ridership (0-45)

275
sites have average ridership (46-568)

-75
bus stops outside of the high/moderate risk for obesity areas

200
possible sites that satisfy criteria
these sites are within the moderate to high risk obesity areas, have average ridership, and have no shelter

-156
eliminated through photo analysis of existing conditions
these sites were elimited due to poor site conditions, limited space, and adjacent properties

44
sites to visit
10 north facing, 6 south facing, 16 east facing, 9 west facing

Site Survey Process

Solar

Wind

Rain

Circulation

Area

Ridership

District

Visibility

Right-of-Way

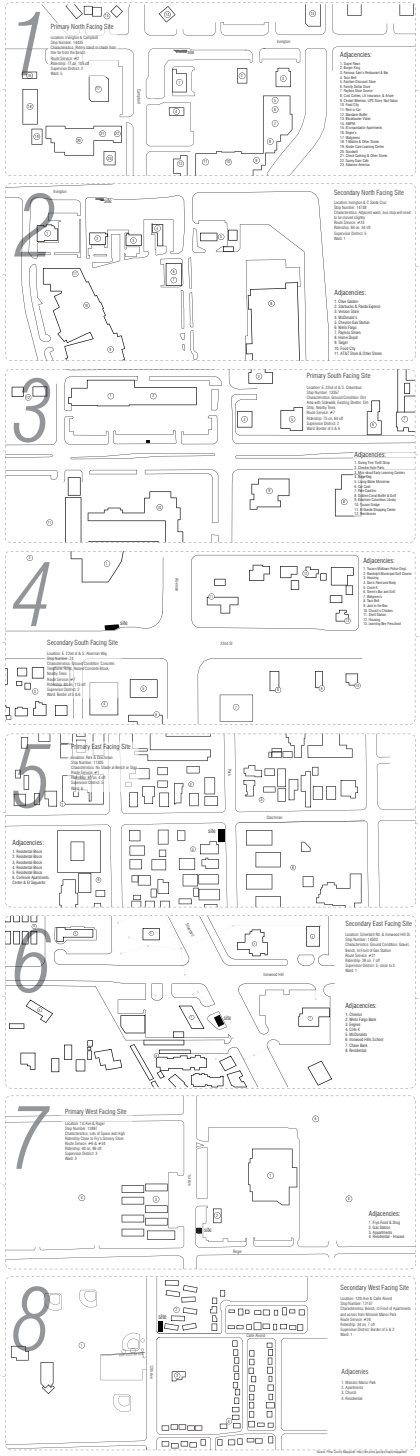
Obstructions

Adjacencies

Topography

Trash

Quality of Assembly



1

Pros
- satisfies all site selection criteria
- high ridership (182 total)
- pullout/turning lane can be used by bus
- ample depth to site, making it easy to make a large shelter if needed
- generous right-of-way
- many adjacent businesses, residences, and apartments
- shade trees nearby

Cons
- stop may need to be moved slighty east into pullout, which has less room for a bus shelter
- only one bus route services location
- two small trees are planted near the current bus stop location, possibly limiting space for bus shelter

2

Pros
- satisfies all site selection criteria
- many adjacent businesses and residences
- high ridership (118 total)
- shade trees nearby

Cons
- current bus stop location is not viable because of limited area for shelter
- site would need to be moved slightly east into a high traffic turning lane
- storm drain at current location
- adjacent wash that flows under the site
- close to the I-19, this is more of a car culture area
- only one bus route services location

3

Pros
- satisfies all site selection criteria
- many adjacent businesses and residences
- existing shelter that is in need of replacement
- high ridership (139 total)
- shade trees nearby

Cons
- sidewalk may need to be demolished in order to push it closer to the curb
- only one bus route services location
- gas line 8.5' back of current sidewalk location may limit depth of new slab

4

Pros
- satisfies all site selection criteria
- high ridership (196 total)
- shade trees nearby
- site has a decent amount of adjacent businesses, including highly trafficed Reid Park and Tucson Midtown Police Department

Cons
- there may be security concerns from the adjacent police department
- only one bus route services location
- telephone poles might obstruct visibility triangle of bus driver

5

Pros
- satisfies all site selection criteria
- high ridership (89 total)
- recently poured concrete pad (10'x18')
- a kind elderly gentleman neighbor adjacent to bus stop
- close to the University of Arizona
- enlarged setback in immediate area

Cons
- no trees
- only one bus route services location
- mostly residential area nearby
- poor protection from western light

6

Pros
- good protection from western light
- shade trees nearby

Cons
- limited space for a shelter
- low ridership (35 total)
- storm drain at current location
- site is located on the very edge of the risk for obesity area
- bus may block entry to gas station
- bus blocks view of oncoming traffic for cars pulling out of next drive
- does not satisfy all site selection criteria

7

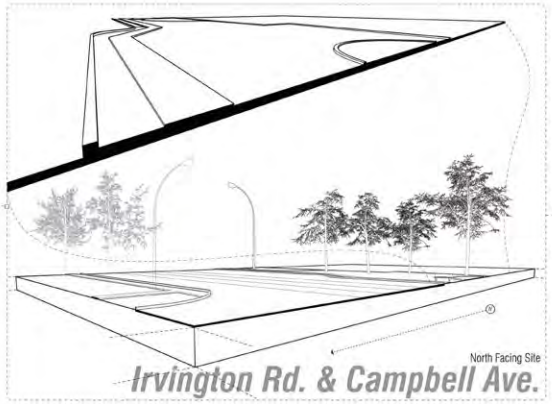
Pros
- satisfies all site selection criteria
- high ridership (136 total)
- many adjacent businesses and residences
- two bus routes service location
- shade trees nearby
- ample depth to site, excluding the immediate area around the large tree

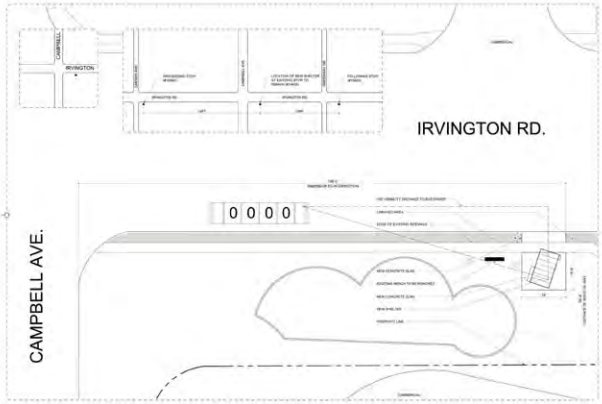
Cons
- large tree near where bus shelter would be placed (about 9' back from sidewalk)

8

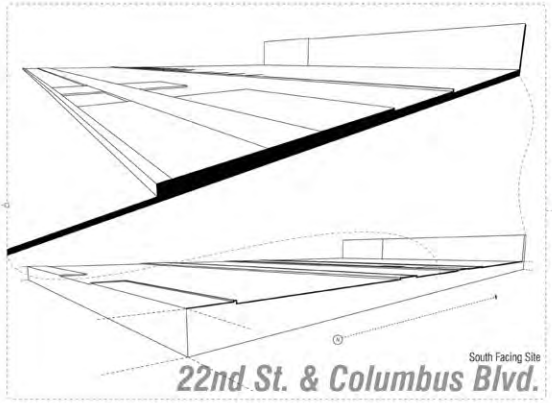
Pros
- satisfies almost all site selection criteria except ridership
- adjacent to Mission Manor Park and an apartment complex
- signal crosswalk nearby
- shade trees nearby

Cons
- low ridership (41 total)
- bus blocks view of oncoming traffic for next drive
- only one bus route services location
- limited space for a shelter
- does not satisfy all site selection criteria


North Facing Site
Irvington Rd. & Campbell Ave.

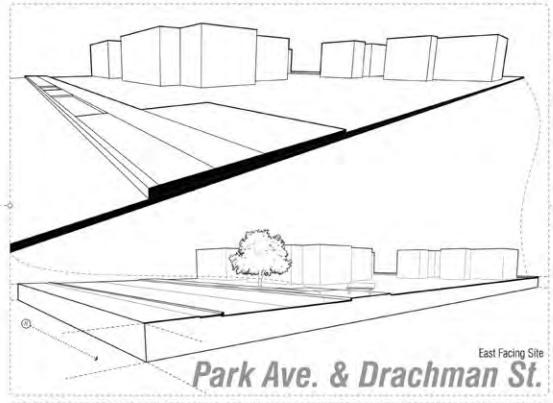

IRVINGTON RD.
CAMPBELL AVE.


NORTH FACING SITE


South Facing Site
22nd St. & Columbus Blvd.

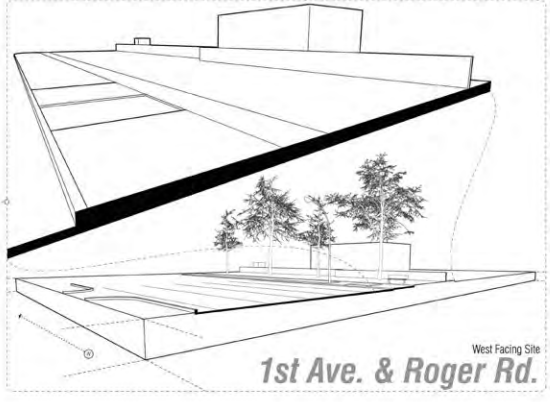

22ND ST.
DRIVE TO PARKING LOT

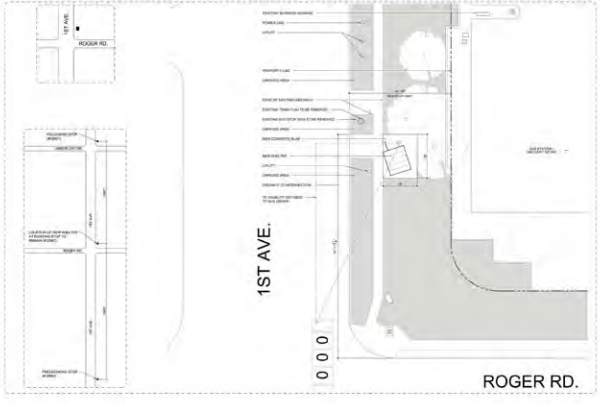

SOUTH FACING SITE


East Facing Site
Park Ave. & Drachman St.


DRACHMAN ST.
PARK AVE.


EAST FACING SITE


West Facing Site
1st Ave. & Roger Rd.


1ST AVE.
ROGER RD.


WEST FACING SITE

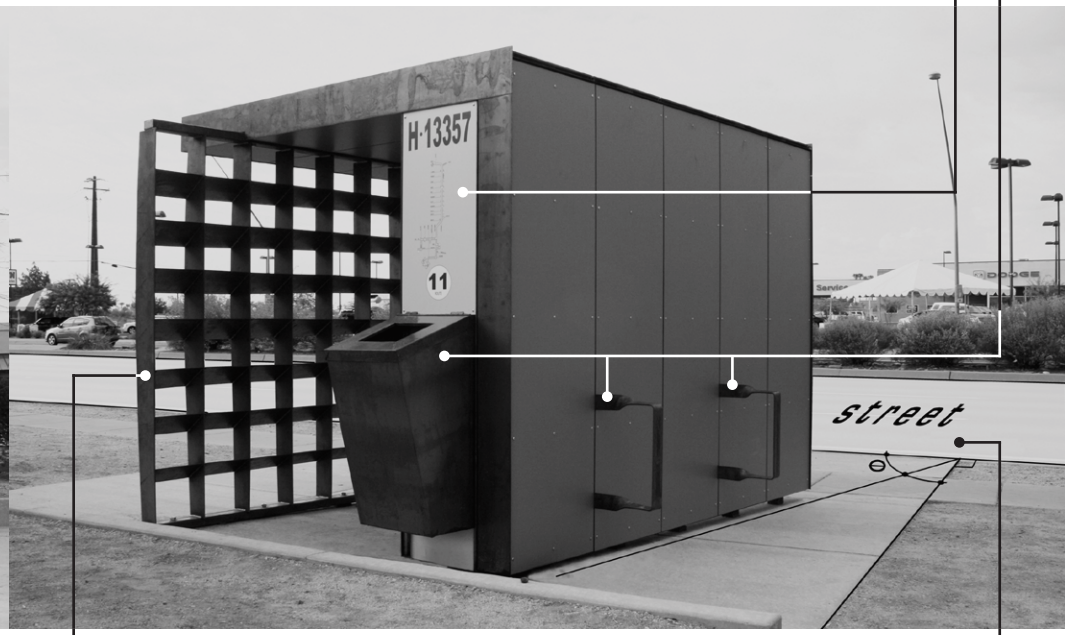
design strategies

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



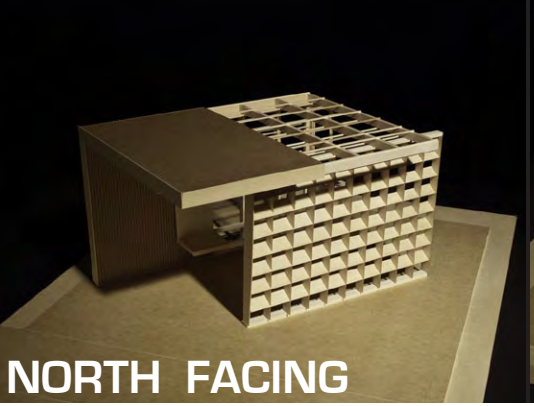
accessible seating area is located nearest the street such that the driver can quickly acknowledge riders in need of assistance, ensuring the bus stops at the proper location for ramp deployment

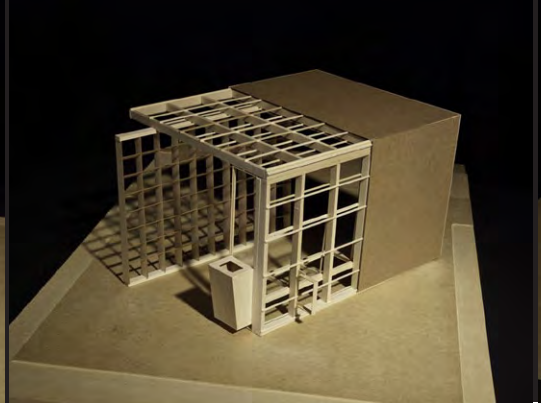
vertical surfaces provide shade from the morning and afternoon sun

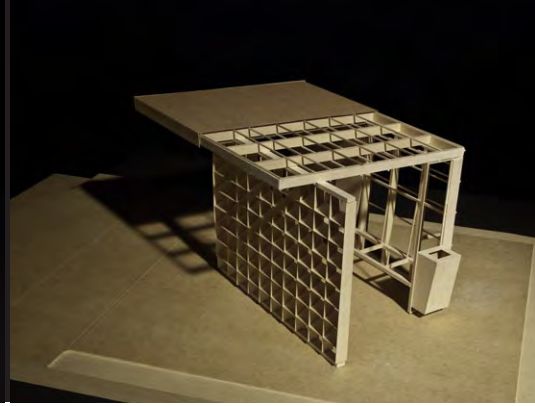
solar powered led lighting for occupant security and use

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

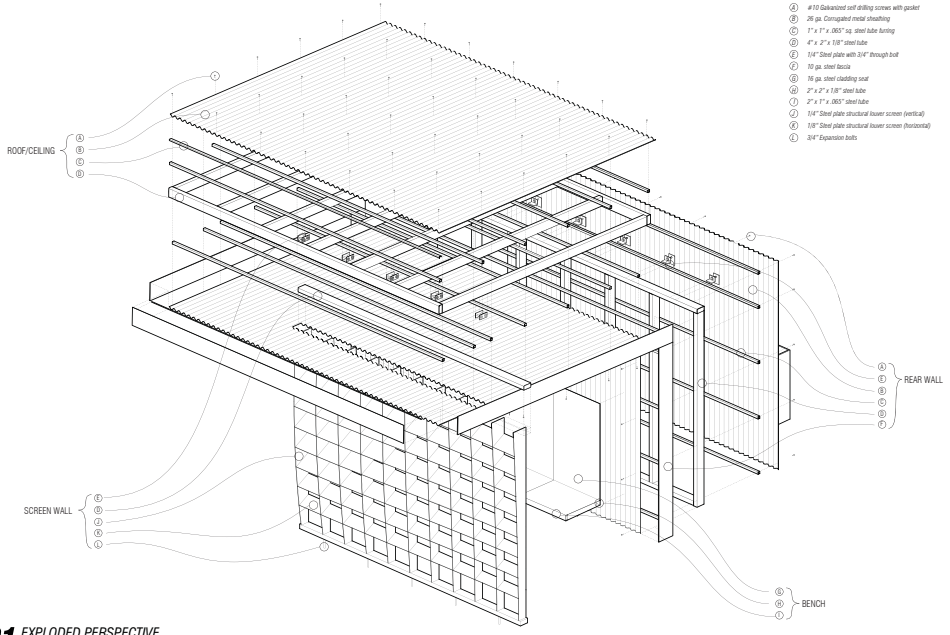
wall facing the street is rendered as a **structural louver**, geometrically calibrated to maximize morning or afternoon shade between the equinoxes while maximizing visibility between the bus rider and driver, the wall is offset from the base shelter to maximize shade for critical seasons and times



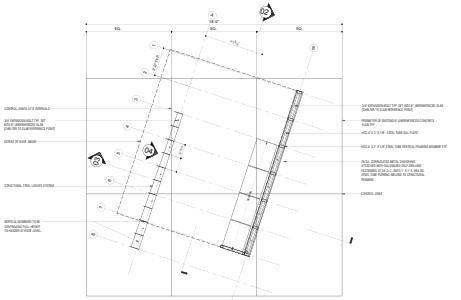




NORTH FACING

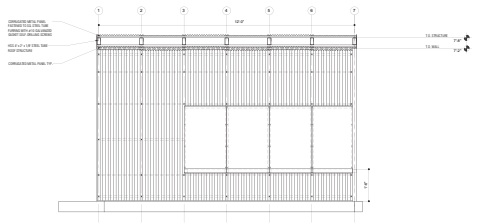


01 *EXPLODED PERSPECTIVE*



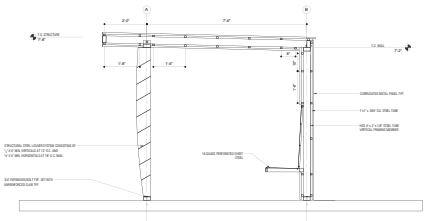
01 *PLAN*

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



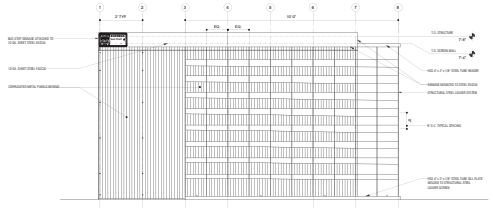
02 *LONGITUDINAL SECTION*

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



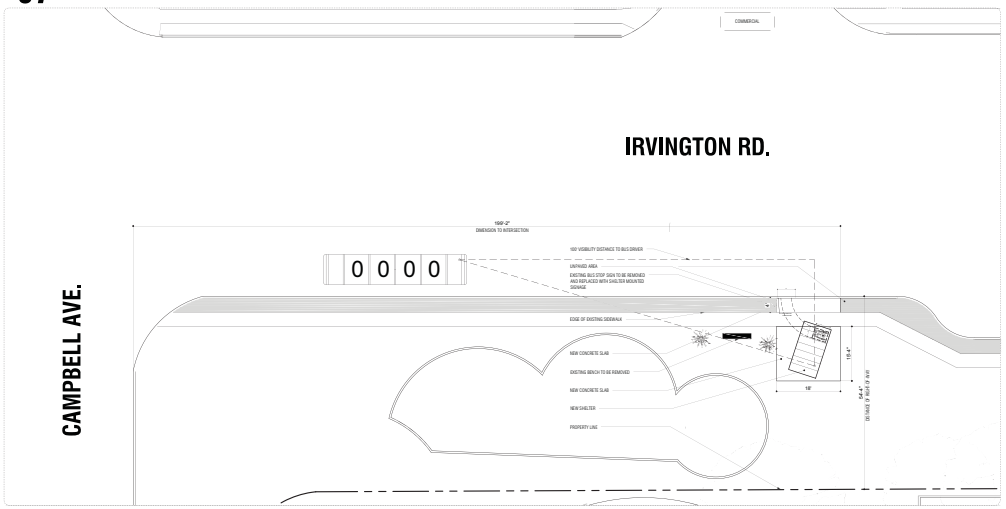
03 *TRANSVERSE SECTION*

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



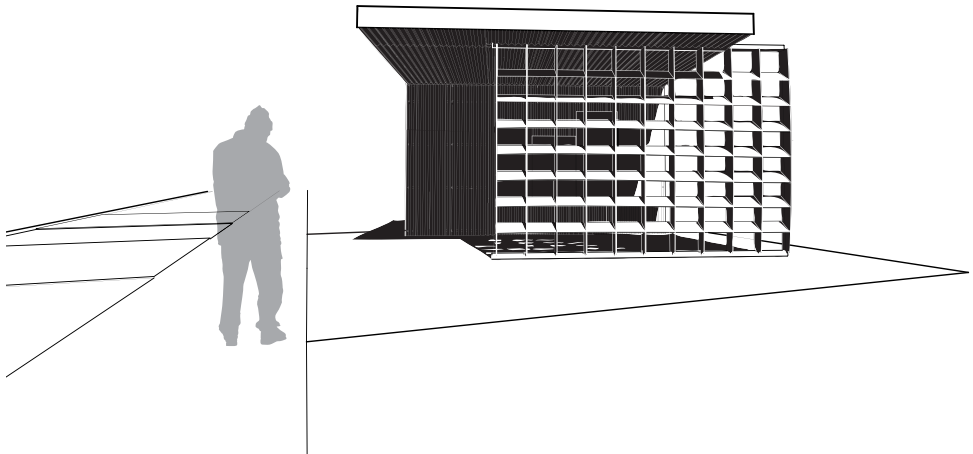
04 *ELEVATION*

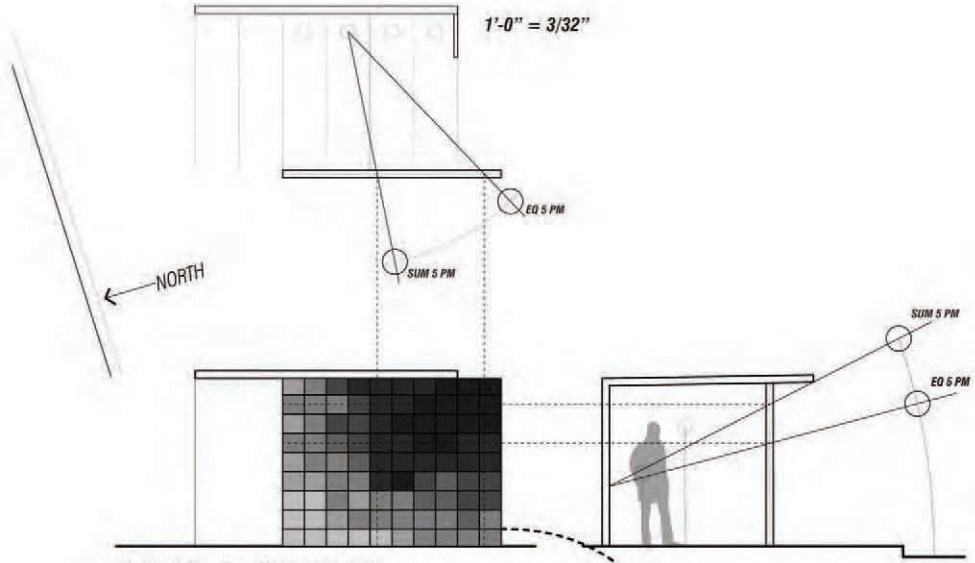
Scale: 3/4" = 1'-0"



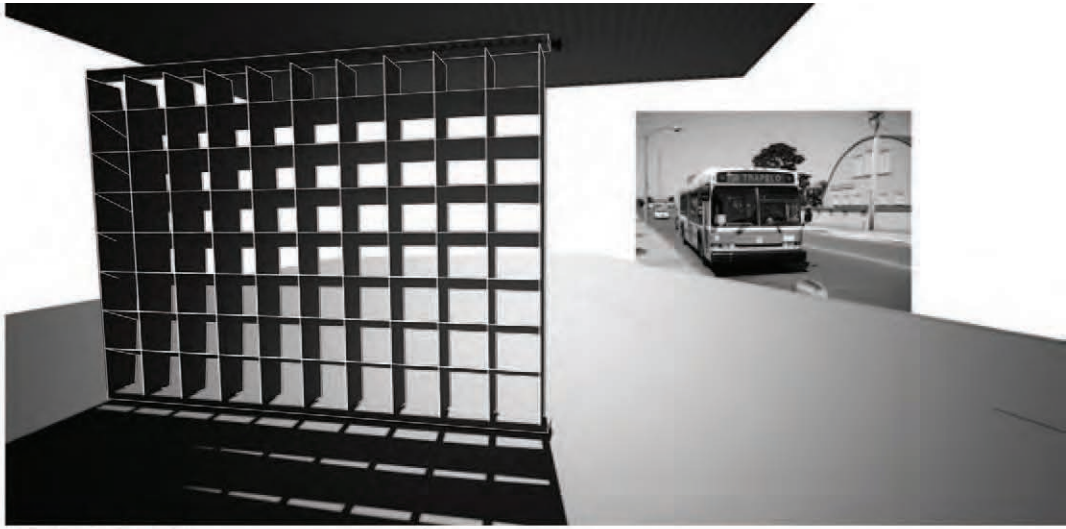
02 *SITE PLAN*

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





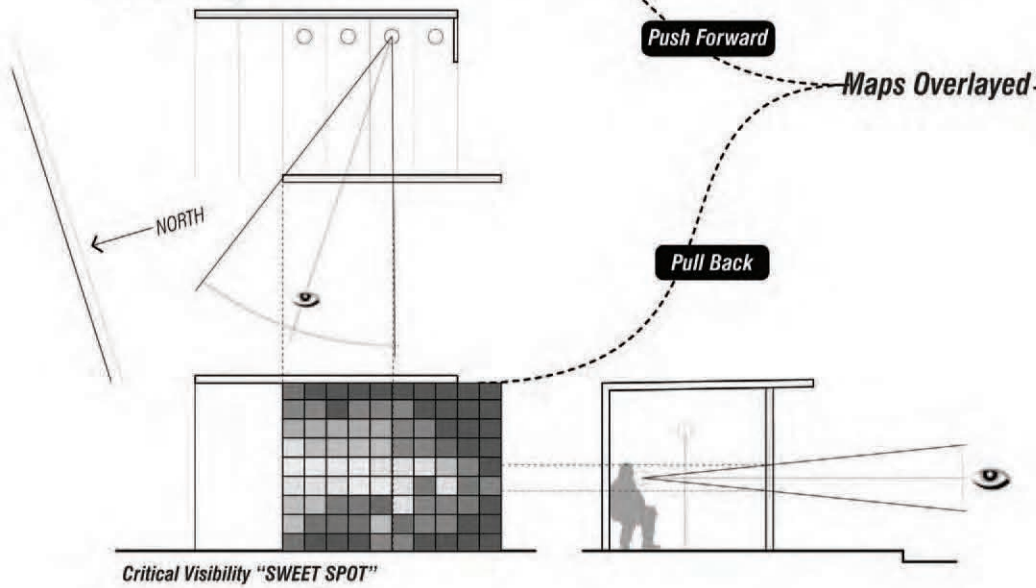
Critical Shading "SWEET SPOT"



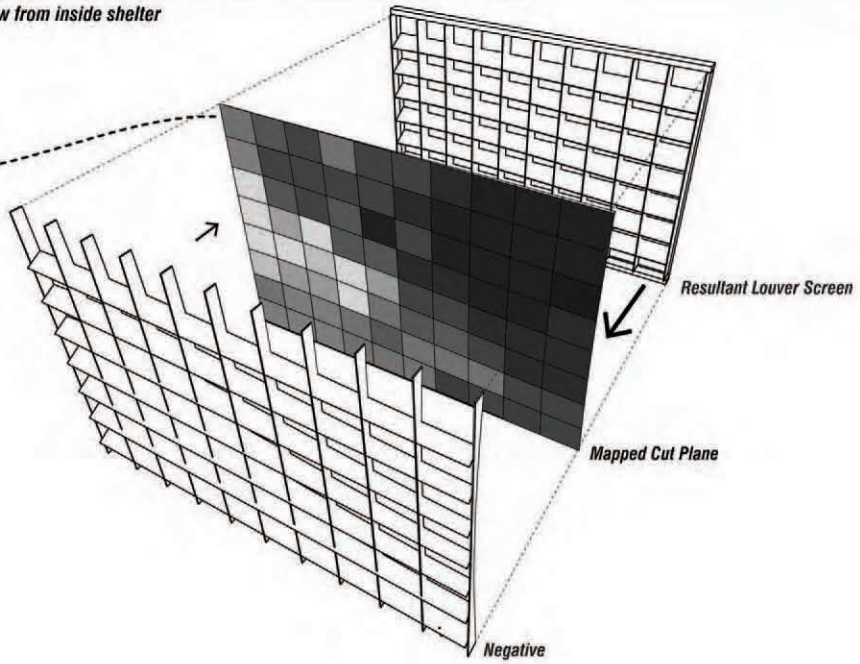
View from inside shelter

Push Forward

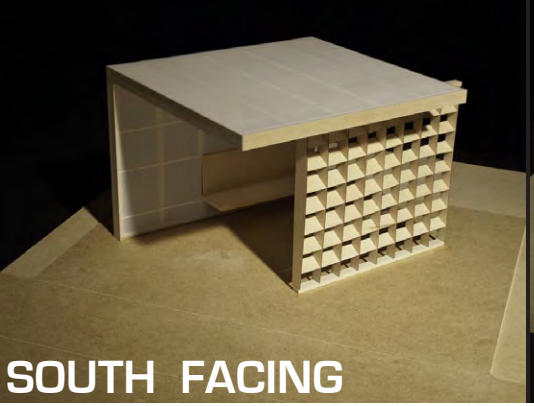
Maps Overlayed

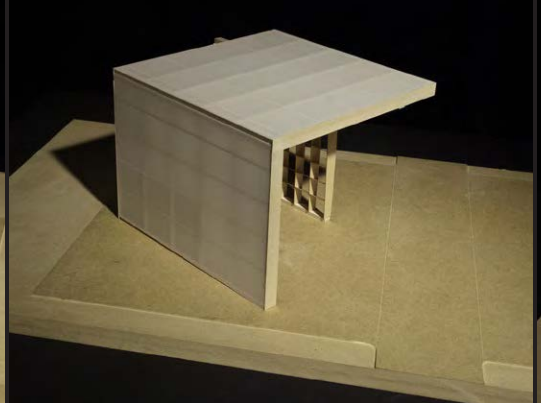


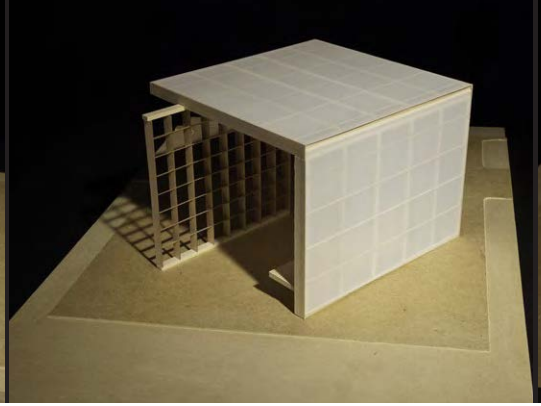
Pull Back

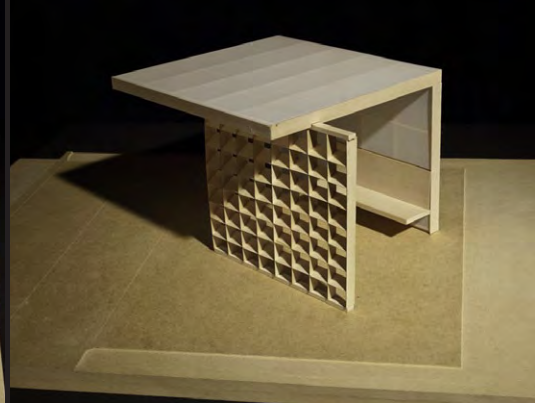


Critical Visibility "SWEET SPOT"

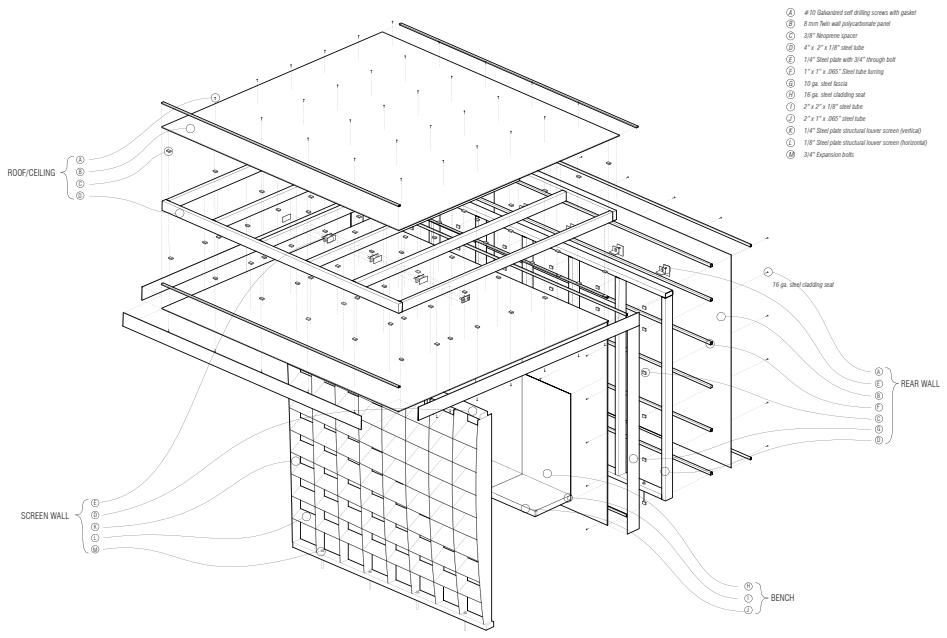






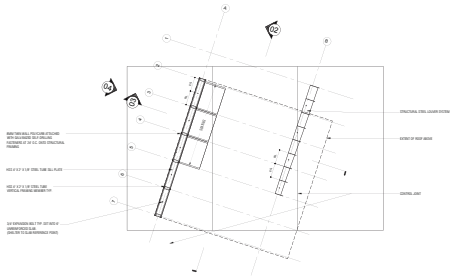


SOUTH FACING

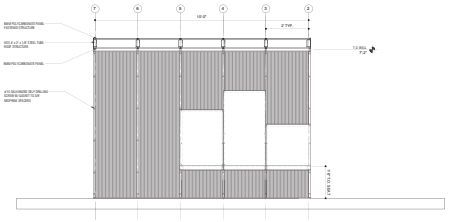


A # 10 Galvanized self drilling screws with gasket
B 8 mm Twin wall polycarbonate panel
C 3/8" Neoprene spacer
D 4" x 2" x 1/8" steel tube
E 1/4" Steel plate with 3/4" through bolt
F 1" x 1" x .065" Steel tube furring
G 10 ga. steel fascia
H 16 ga. steel cladding seat
I 2" x 2" x 1/8" steel tube
J 2" 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

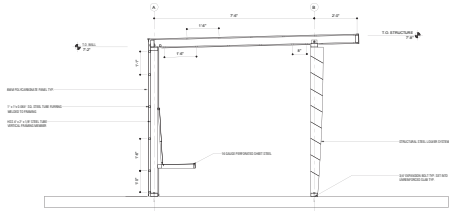
01 *EXPLODED PERSPECTIVE*



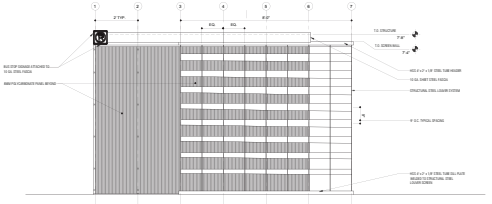
01 *PLAN*



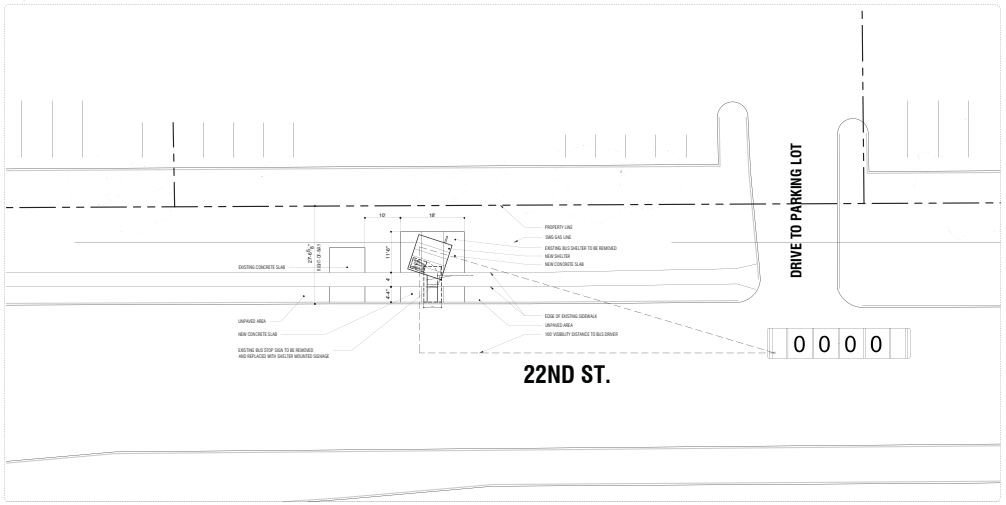
02 *LONGITUDINAL SECTION*



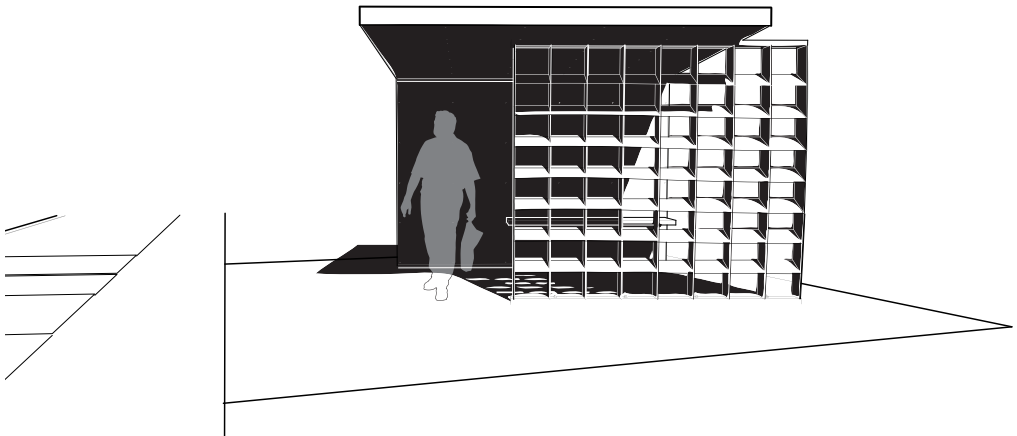
03 *TRANSVERSE SECTION*



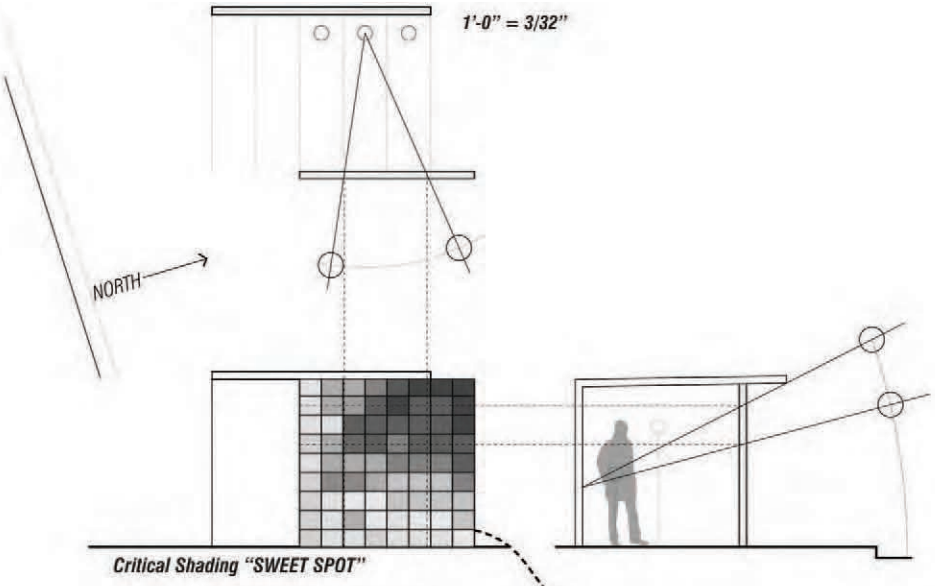
04 *ELEVATION*



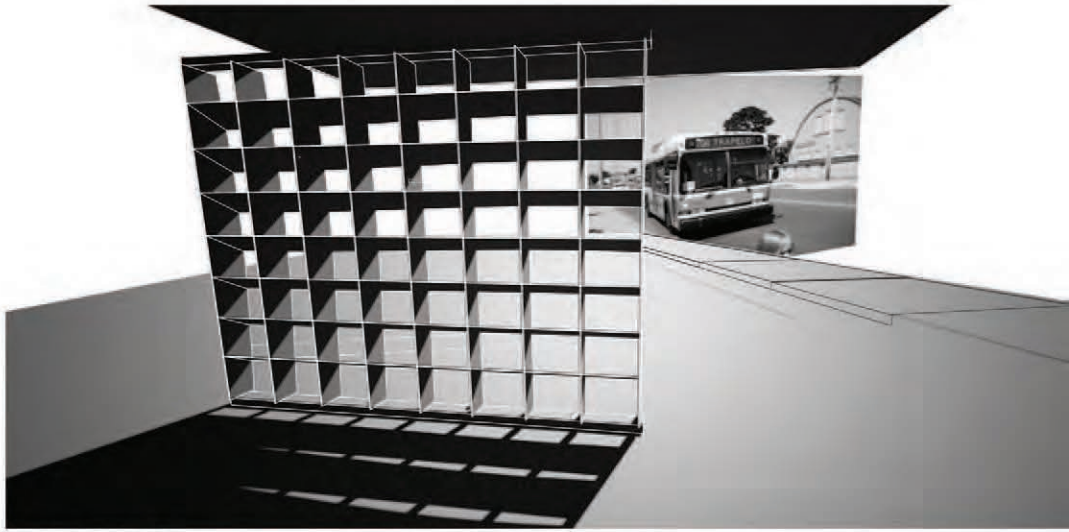
02 *SITE PLAN*



1'-0" = 3/32"



Critical Shading "SWEET SPOT"

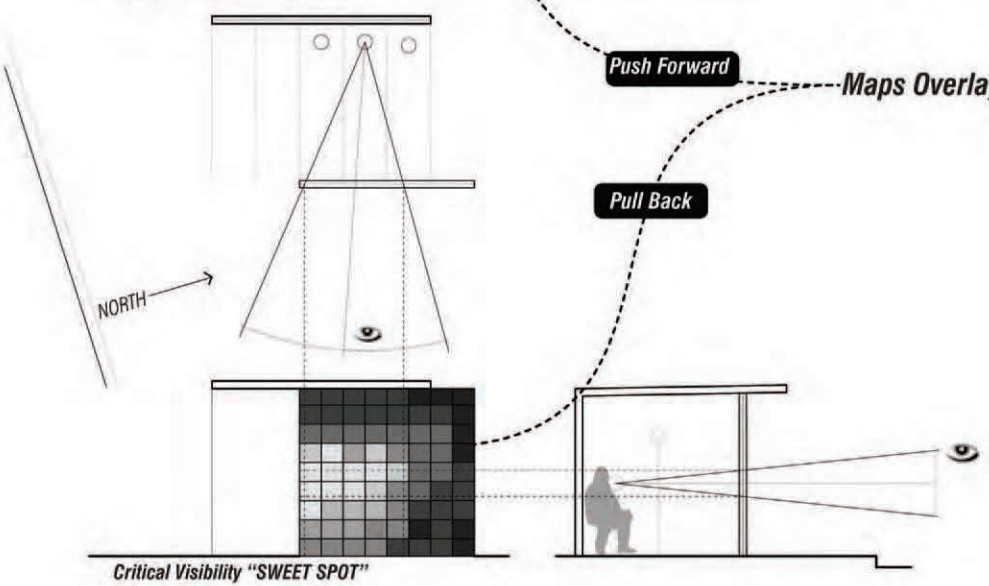


View from inside shelter

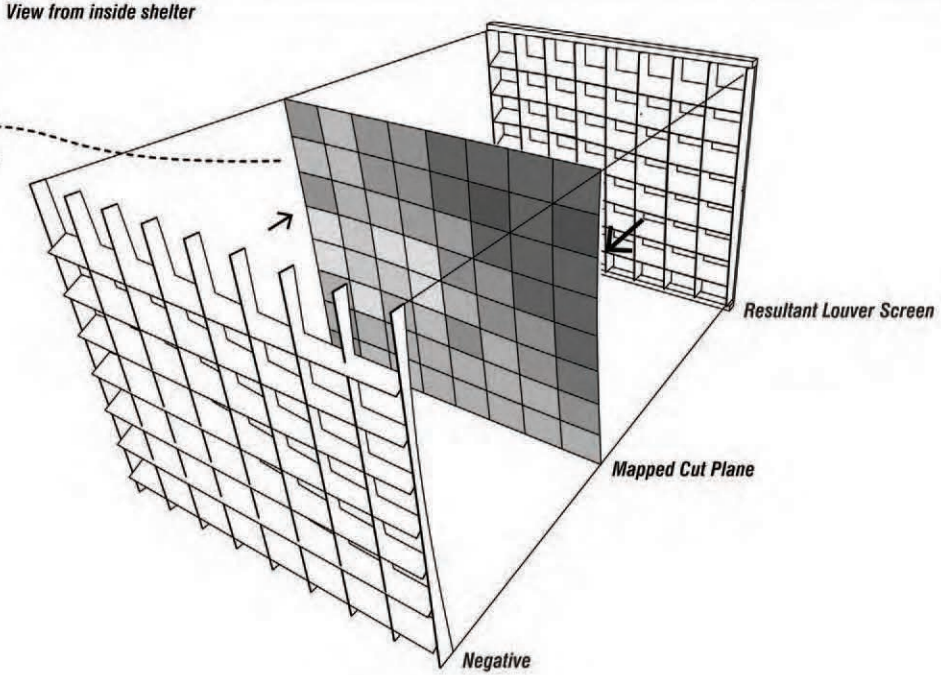
Push Forward

Maps Overlayed

Pull Back



Critical Visibility "SWEET SPOT"

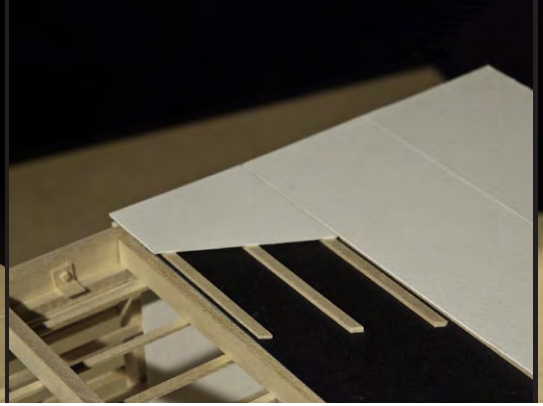


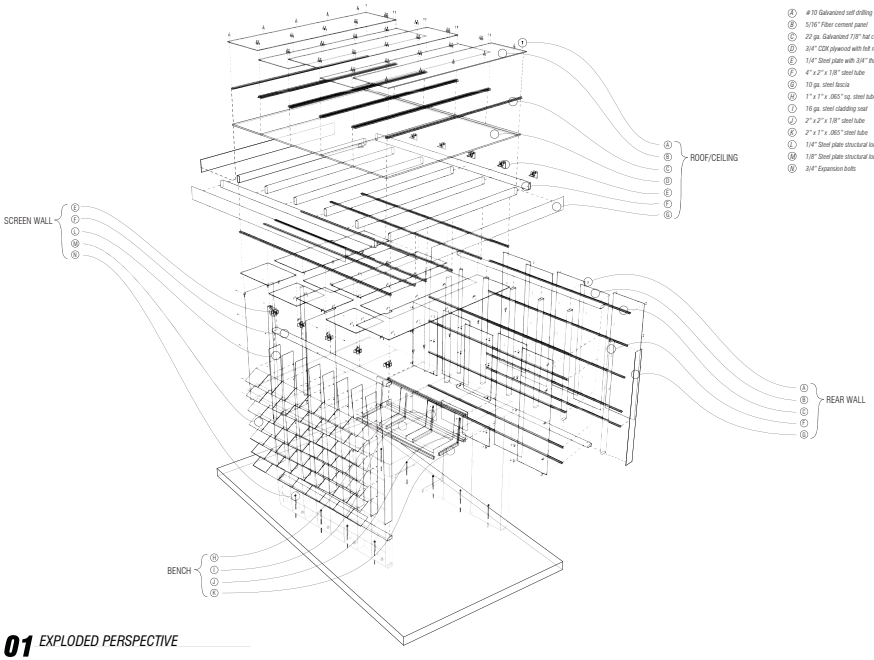



H·13357
11
ROUTE



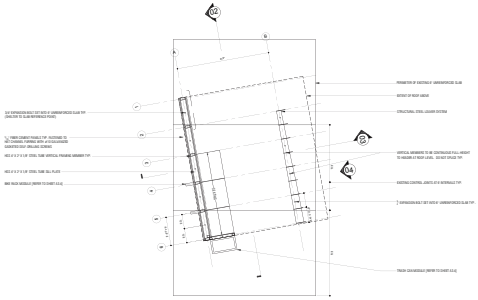


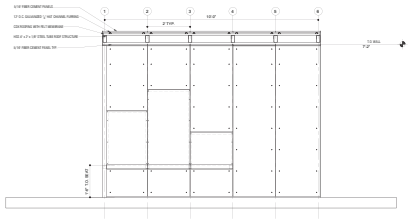


Ⓐ #10 Galvanized self drilling screws with gasket
Ⓑ 5/16" Fiber cement panel
Ⓒ 22 ga. Galvanized 7/8" hat channel furring
Ⓓ 3/4" CDX plywood with felt roofing membrane
Ⓔ 1/4" Steel plate with 3/4" through bolt
Ⓕ 4" x 2" x 1/8" steel tube
Ⓖ 10 ga. steel fascia
Ⓗ 1" x 1" x .065" sq. steel tube frame
Ⓘ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

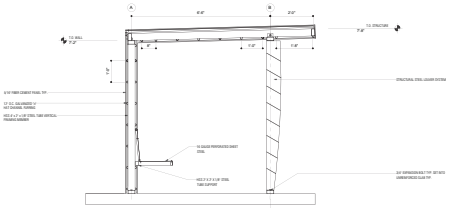
01 *EXPLODED PERSPECTIVE*



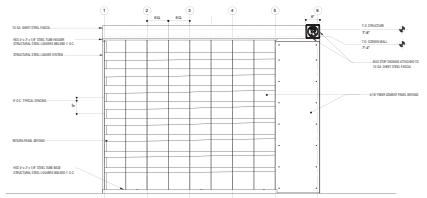
01 *PLAN*
Scale: 1/2" = 1'-0"



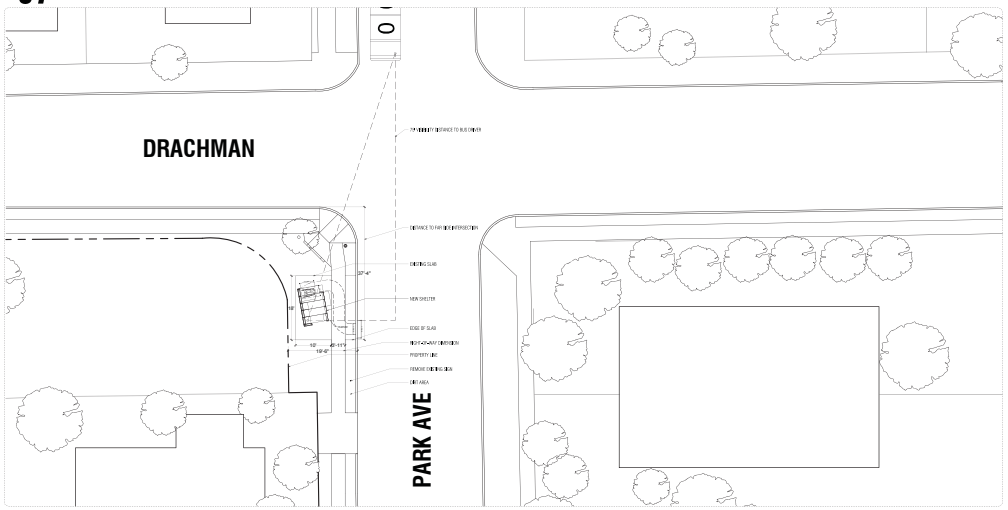
02 *LONGITUDINAL SECTION*
Scale: 3/4" = 1'-0"



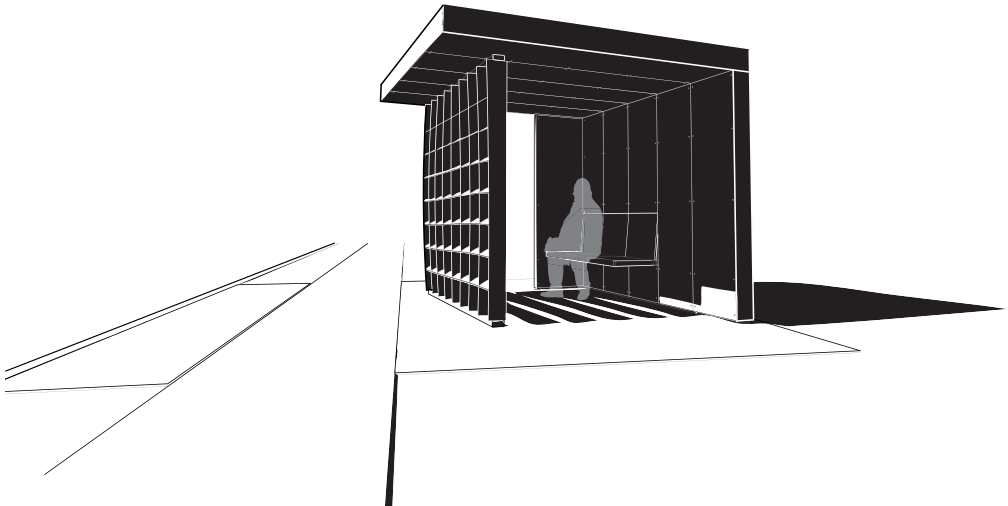
03 *TRANSVERSE SECTION*
Scale: 3/4" = 1'-0"

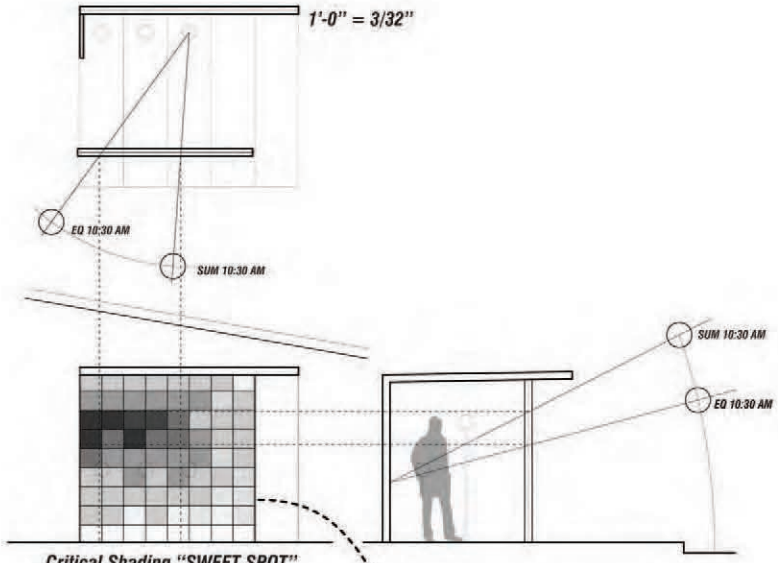


04 *ELEVATION*
Scale: 3/4" = 1'-0"



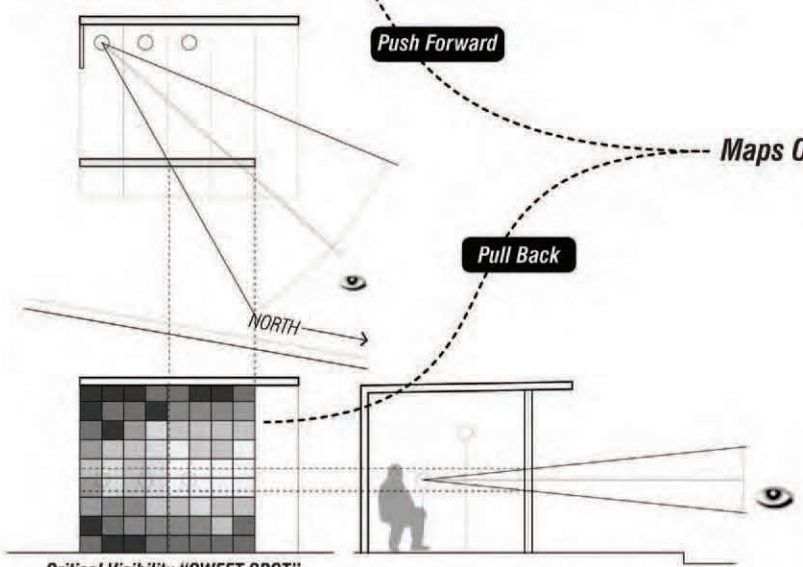
02 *SITE PLAN*
Scale: 1/8" = 1'-0"





Critical Shading "SWEET SPOT"

Push Forward

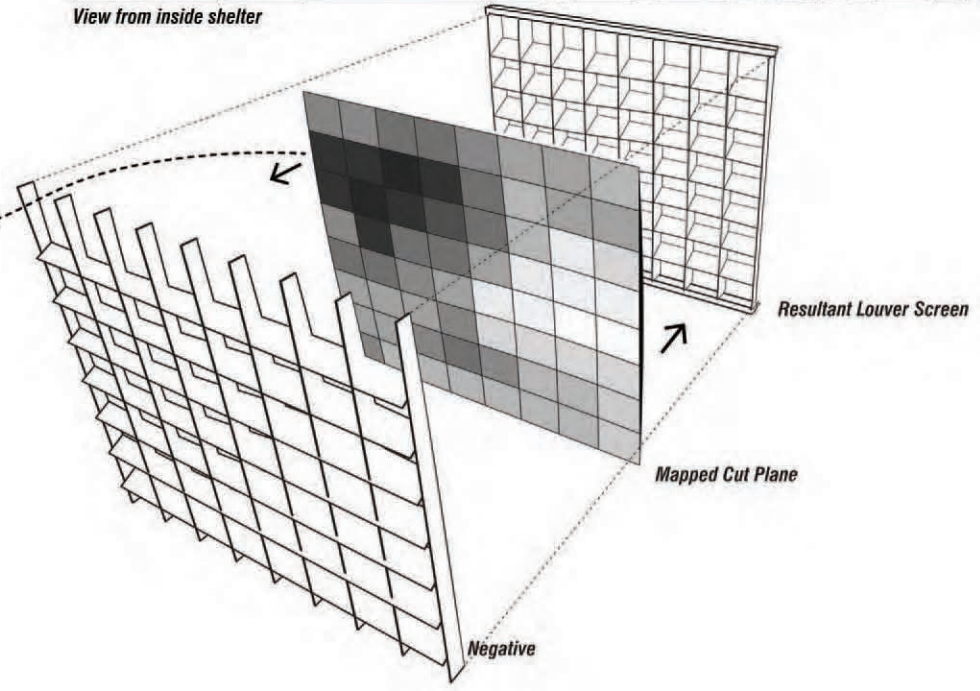


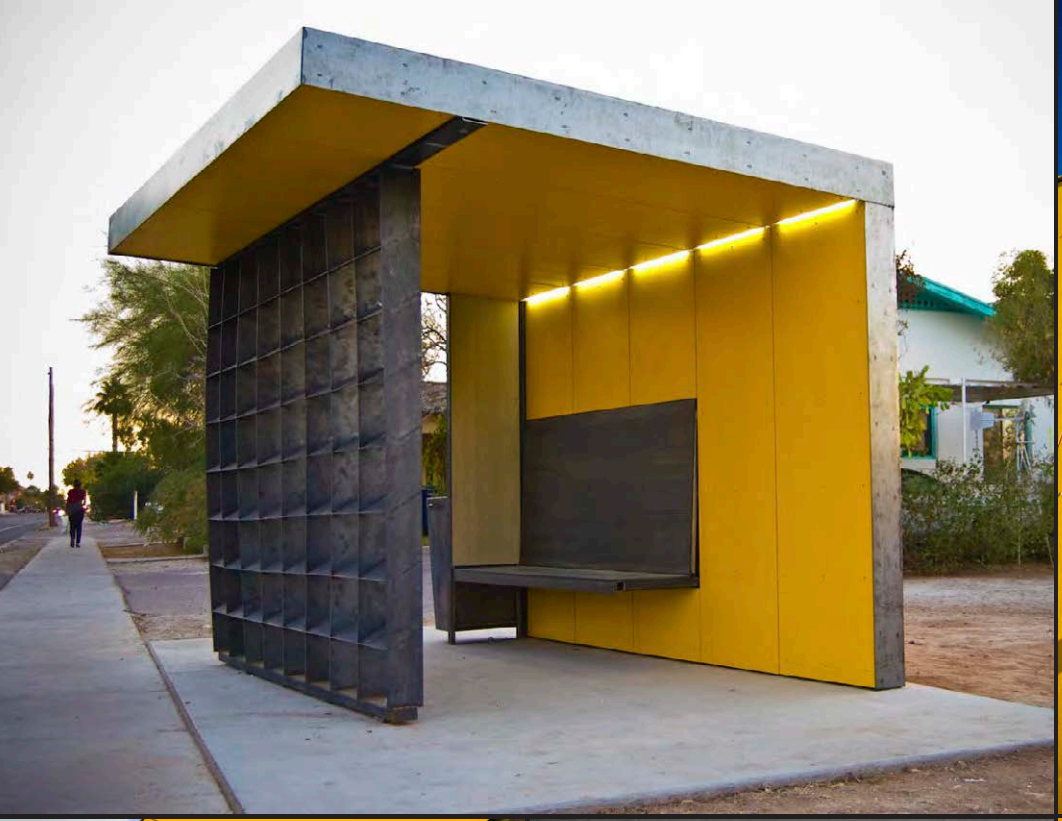
Pull Back

Critical Visibility "SWEET SPOT"

View from inside shelter

Maps Overlayed

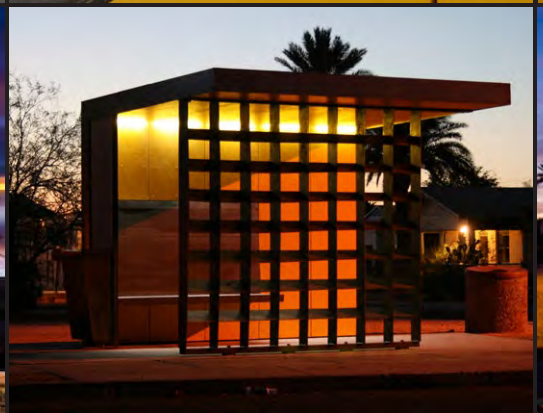


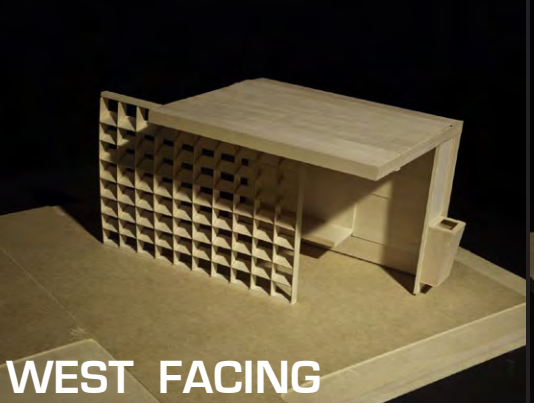




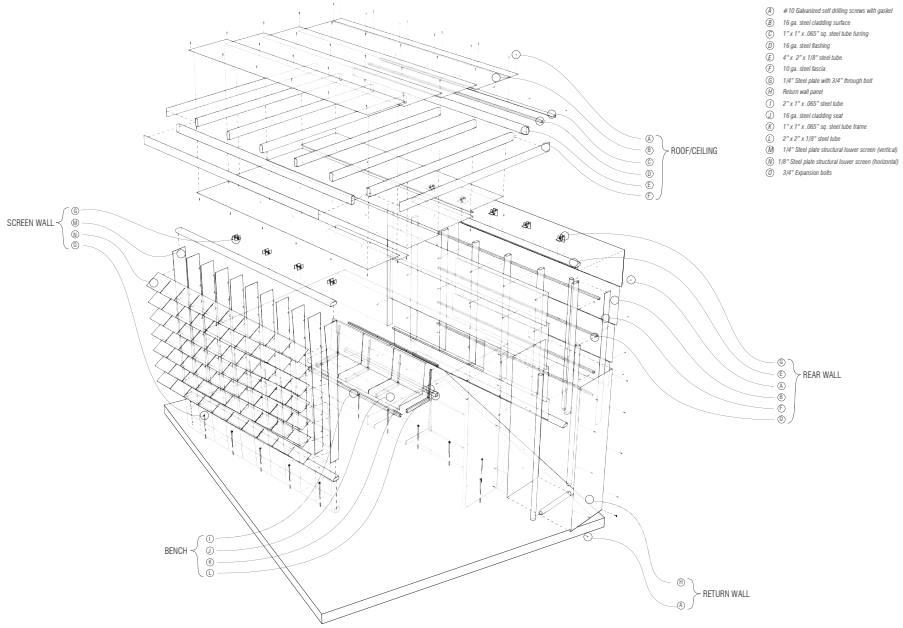




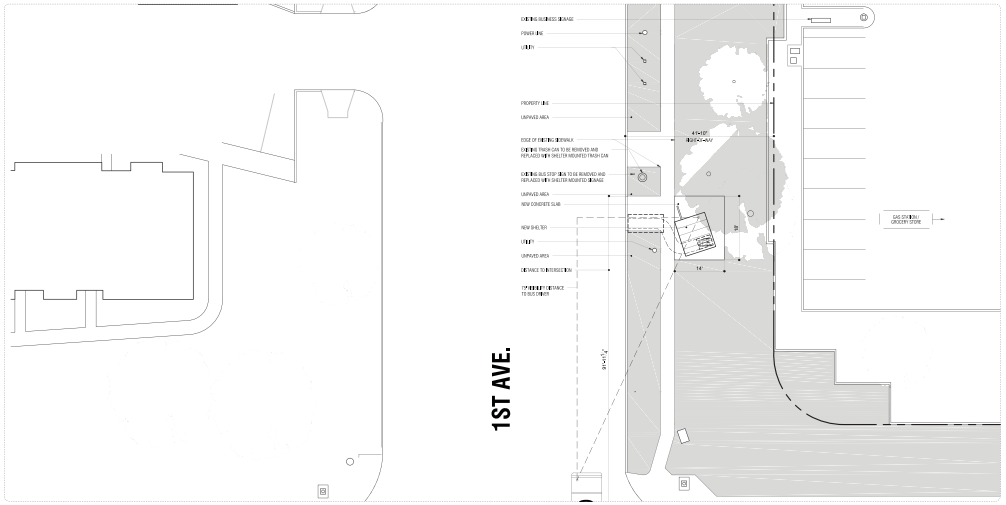



WEST FACING

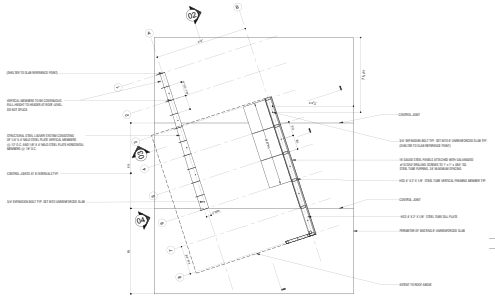


A. #10 Galvanized self drilling screws with gasket
B. 16 ga. steel cladding surface
C. 1" x 1" x .065" sq. steel tube furring
D. 16 ga. steel flashing
E. 4" x 2" x 1/8" steel tube
F. 10 ga. steel fascia
G. 1/4" Steel plate with 3/4" through bolt
H. Return wall panel
I. 2" x 1" x .065" steel tube
J. 16 ga. steel cladding seat
K. 1" x 1" x .065" sq. steel tube frame
L. 2" x 2" x 1/8" steel tube
M. 1/4" Steel plate structural louver screen (vertical)
N. 1/8" Steel plate structural louver screen (horizontal)
O. 3/4" Expansion bolts

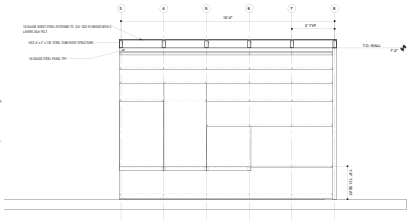
01 *EXPLODED PERSPECTIVE*



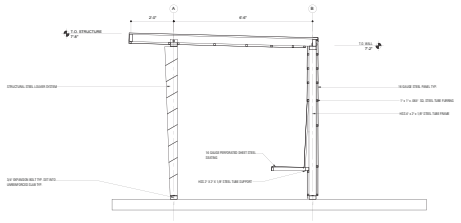
02 *SITE PLAN*



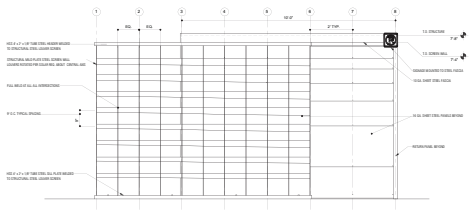
01 *PLAN*



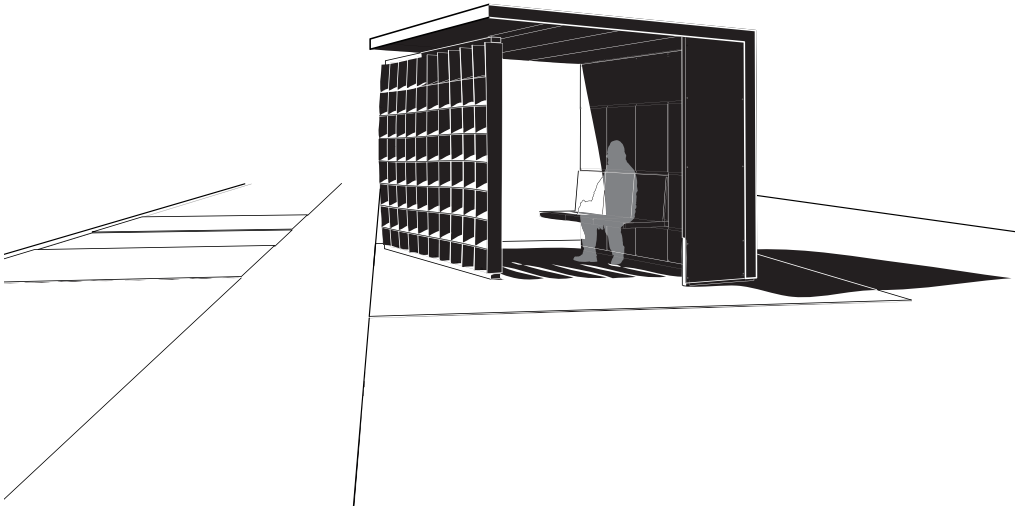
02 *LONGITUDINAL SECTION*

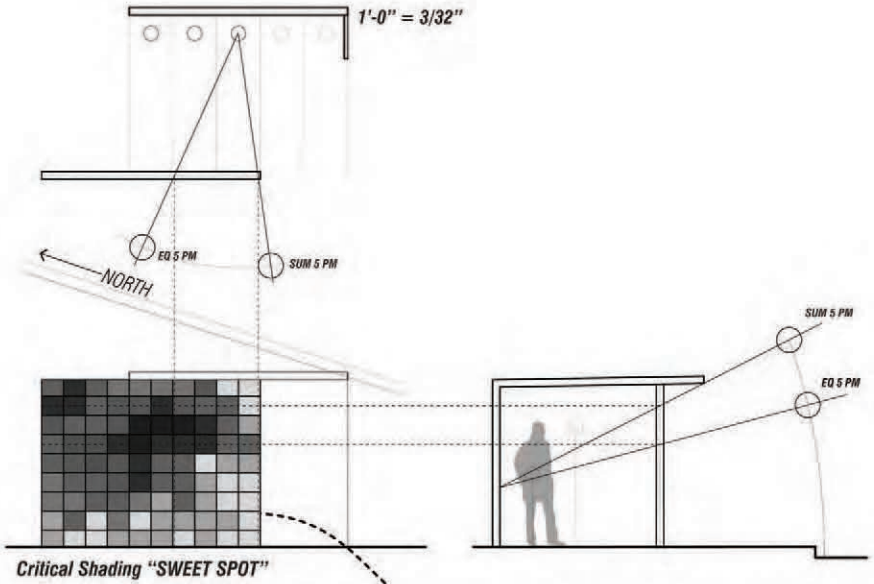


03 *TRANSVERSE SECTION*

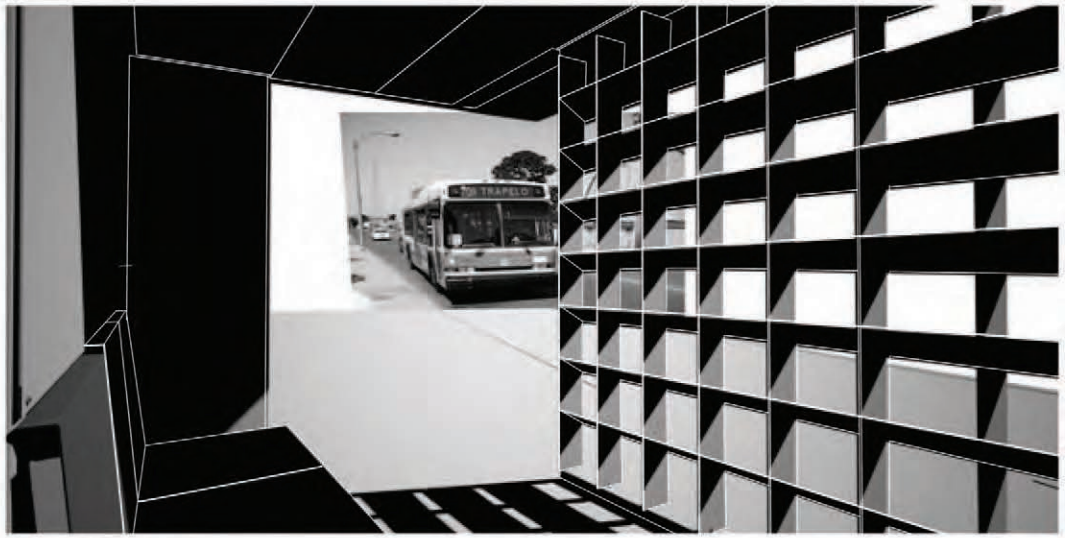


04 *ELEVATION*





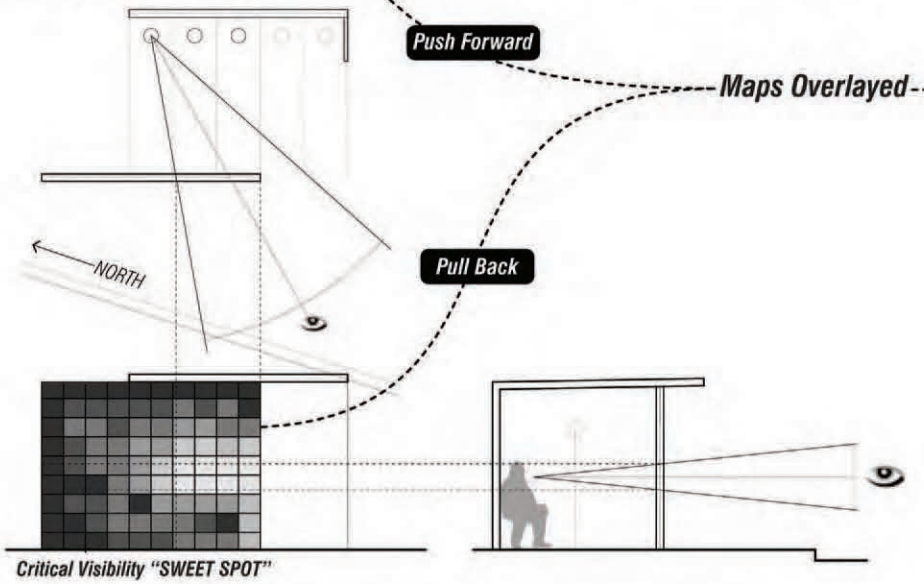
Critical Shading "SWEET SPOT"



View from inside shelter

Push Forward

Maps Overlayed



Pull Back

Critical Visibility "SWEET SPOT"