BUILDING A SHADE CANOPY
Building Ethical & Accessible Food Systems through Design

In 2011–12, a multidisciplinary team of Archeworks designers undertook an exciting research and design challenge with urban farm pioneer, Growing Power Chicago. Their work was guided by the principle that design can play a greater role in building ethical and accessible food systems.

The multi-purpose shade structure is one of several team-generated proposals that supports urban farm infrastructure and fosters a more participatory local food culture. Inspired by Growing Power’s approach to building projects and use of readily-accessible materials, this simple canopy creates its own habitat and activates space in a wide range of urban growing settings. It can provide shelter from the elements during the growing season, create a place to prep harvested produce, and serve as an anchor for community gatherings. In Summer 2012, the design team worked as volunteers with Growing Power staff to build and install its first prototype at the entrance of a new community-managed garden at Altgeld Gardens, a public housing community on Chicago’s far South Side. This illustrated manual was produced to guide subsequent installations and to help other urban growers build similar structures at their own farm sites.

When referring to this resource guide, builders are encouraged to adapt, modify, and improvise as necessary to best suit their specific needs, site conditions, tools, and materials. We welcome continued improvements on the structure, and invite builders to share their stories and photos at info@archeworks.org.

Archeworks • www.archeworks.org
Founded in 1994, Archeworks is a Chicago-based postgraduate design educator that advances design in the public interest and inspires collaborative action to shape more sustainable, healthy, and equitable communities. Our community design program has developed innovative design solutions to improve the physical, social, and environmental health of Chicago’s urban communities. We believe that design shapes the way we live, and want to make design accessible to communities and individuals least able to access it.

Growing Power • www.growingpower.org
Founded in Milwaukee, Growing Power is a national nonprofit organization and land trust supporting people from diverse backgrounds, and the environments in which they live, by helping to provide equal access to healthy, high-quality, safe and affordable food. Growing Power implements this mission by providing hands-on training, on-the-ground demonstration, outreach and technical assistance through the development of community food systems that help people grow, process, market and distribute food in a sustainable manner.

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This temporary structure provides a much needed shady spot on hot farm sites.

Getting out of the sun allows people to prepare harvested produce, gather and meet, or simply take a break. It’s also highly visible, making it an great place to welcome the community and sell goods.

It can be built with a small team (2-5 people preferred) over several days using readily available and inexpensive materials. Prior construction experience—particularly with hoop house building—is helpful, but not necessary. Multiple units can attach together, allowing the structure to expand in size as needed.
MATERIALS

1. 12” tube form
2. Welded wire mesh or 1/2” rebar
3. 8” x 1/2” anchor bolts with nuts and washers
4. Concrete (fast-setting not recommended)
5. 1 3/8” chain link “top rail” pipe
6. 1 5/8” chain link “line post” pipe
7. 4x4x10’ wood posts
8. Simpson Strongtie 4x4 EZ base
9. Simpson Strongtie Deck Joist Tie
10. Simpson Strongtie Rigid Tie
11. #8 x 1 1/4” wood screws and #14 x 3” wood screws
12. #9 x 3” lag bolts
13. Woodtite roofing screws
14. Suntop corrugated roofing panels
15. 1” IPS pipe strap
16. 2x4x10’ boards
17. 2x8x10’ boards
18. 1/2” galvanized chain
19. Rain barrel
20. Aluminum rain gutter
21. 1/2” galvanized chain link connector
22. Gutter bracket attachment
TOOLS

1 Utility blade
2 Ratchet with deep sockets or wrench
3 Growing Power pipe bending jig
4 Reciprocating saw
5 Twine
6 Level
7 Marker
8 Drill / Screwgun
9 Circular saw
10 Measuring bucket
11 1 1/2” spade bit
12 Flat-bladed shovel
13 Stakes
14 Shovel
15 Hammer
16 Tape measure
17 Screwgun bits
18 Wheelbarrow
19 Ladder

OPTIONAL
20 Spud bar
21 Paint
# Shade Structure Cost Estimate

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<th>Add-on Qty</th>
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**Total Costs:**

- **First 8' module:** $809.02
- **Add-on 8' module:** $583.63

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**Notes:**
- First 8' module:
  - 8' long modules, 10' high x 12.5' deep

**Add-on 8' module:**
- For roof support

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**Material Breakdown:**

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<tr>
<th>Material</th>
<th>Description</th>
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</thead>
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<tr>
<td>1 3/8&quot; x 21' chain link top rail</td>
<td>For bent rails in 1 3/8&quot; x 21'</td>
</tr>
<tr>
<td>1 5/8&quot; x 21' chain link line post</td>
<td>For bent rails in 5/8&quot; x 21'</td>
</tr>
<tr>
<td>Simpson Deck Joist Tie DJT14Z</td>
<td>Supports 2x8's around 4x4 posts in between modules</td>
</tr>
<tr>
<td>Simpson Rigid Tie RTF2Z</td>
<td>Supports 1/2&quot; x 8&quot; anchor bolts to roof support</td>
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<tr>
<td>Simpson Rigid Tie RTF-Z</td>
<td>Supports 1 3/4&quot; rigid conduit 2-hole pipe strap</td>
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<tr>
<td>1&quot; IPS / rigid conduit 2-hole pipe strap</td>
<td>For bent rails to roof support</td>
</tr>
<tr>
<td>48&quot;x96&quot;x1&quot; insulation board</td>
<td>For roof framing</td>
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<tr>
<td>12&quot; x 4' Quikrete tubes</td>
<td>For roof framing</td>
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<td>80lb Quikrete mix bags</td>
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<tr>
<td>Rain barrel</td>
<td>For roof framing</td>
</tr>
<tr>
<td>10' vinyl gutter</td>
<td>For roof framing</td>
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<tr>
<td>#9 x 2.5&quot; structural screws</td>
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<td>#8 x 1.25&quot; structural screws</td>
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<td>Woodtite 2&quot; roofing screws</td>
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<tr>
<td>#10 3/4&quot; hex-head self-tapping screws</td>
<td>For bent rails to roof support</td>
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</table>
Step-by-Step Guide

1. Plan and mark location

**TOOLS**  Stakes, Tape measure, Twine

SEE DIAGRAM A

The structure is designed in modular 8-foot segments that are roughly 10’ high and 12’ deep. Determine how large of a structure you need and where it should go by considering your site’s needs, space constraints, and budget. It’s easy to add on more 8’ sections in the future, so leave room if you might expand the structure.

In order to get the best shade year-round, plan for the backside of the structure to face south. The website www.suncalc.com can help you visualize shade on your site.

Use stakes for centerpoints of where footings will go, and remeasure across all dimensions to ensure correct placement. Check that corners are square by measuring diagonally.

2. Dig footings

**TOOLS**  Flat-bladed shovel, Shovel

SEE DIAGRAMS B AND C

With stakes as the center points, dig holes slightly larger than the recommended footing sizes.

Use a spud bar to remove rocks and break up tough spots. If ground conditions prevent digging to the required depth, expand the diameter of the footings considering minimum required footing depth.
STEP-BY-STEP GUIDE

3 Prepare back footings

MATERIALS  Tube form, Gravel, 1 5/8” pipe

TOOLS  Tape measure, Reciprocating saw, Marker, Level

SEE DIAGRAM C

Cut tube to required height with reciprocating saw.

Cut 1 5/8” line post to be 9” taller than form with reciprocating saw.

Infill dug hole with several inches of gravel to aid drainage.

Position tube in the hole with line post in the approximate middle of tube.

Infill with a couple inches of gravel to help hold line post in place.

TIP: Make sure tubes are level and in a straight line with a piece of string pulled tightly as a guide or a level.
Prepare front footings

**MATERIALS** Plywood or rigid insulation, Gravel, Wood scrap, Wire mesh or rebar, Anchor bolts, Thin wood strip, EZ Base, 1/2” nuts

**TOOLS** Twine, Tape measure

**SEE DIAGRAM D**

Build a mold for concrete out of plywood, rigid insulation, modified rain barrel or other form. Maintain recommended concrete weight and 4” minimum distance from edge of concrete to anchor bolts. Securely brace mold against outward pressure from concrete with twine and wood supports.

Infill dug hole with several inches of gravel to aid drainage.

Lay wire mesh or a grid of rebar sections about 3” off the ground. Use wire rebar support or drive anchor bolt upside down in the ground to hold mesh off the ground. Secure with twine or wire.

Attach anchor bolts to EZ Base with nuts on top and bottom of base and, using a thin piece of wood or metal, suspend over the middle of the form. (Failure to do this will make inserting anchor bolts at the correct position into the wet concrete very difficult.) Anchor bolts must be at least 4” from edge of form.
5 Pour concrete

**MATERIALS**  Concrete, Water

**TOOLS**  Wheelbarrow, Shovel, Measuring bucket, Trowel, Tape Measure

Remeasure all footings and make any adjustments before you pour concrete.

Mix concrete in wheelbarrow according to instructions on package.

Rear forms: Hold line post in center of tube form while filling with concrete.

Front forms: Ensure anchor bases are held in place and kept square as concrete fills around the anchor bolts.

As forms are filled, “mix” occasionally with a trowel or shovel to remove any air pockets.

Trowel top surface smooth.

Allow time for concrete to cure before putting stress on it. See instructions on package.

*Tip: Measure and add water slowly to concrete, a bit at a time, mixing thoroughly. Don’t add too much! Proper consistency should be like very dry oatmeal.*
6 Prepare pipes

**MATERIALS** 1 3/8” pipe

**TOOLS** Tape measure, Marker, Pipe bending jig, Reciprocating saw

**SEE DIAGRAM B**

Cut pipes with reciprocating saw to desired overall length.

Measure and mark area on pipe where bend will begin and end.

Bend pipe on jig per Growing Power instructions.

**TIP:** To keep all bends consistent, mark pipe every 18” within bend area, and start each bending “pass” from marks.
7 Prepare wood for framing

**MATERIALS** 2x4, 4x4, 2x8, EZ Base, Wood screws, Lag screws, Rigid tie, Deck joist tie

**TOOLS** Circular Saw, Drill, Spade bit, Phillips bit, Hammer

**SEE DIAGRAMS B AND E**

Cut 4x4 wood posts and 2x8s to required length.

From scrap section, cut a 7” section of 4x4. Attach to 2x8 where required to support the middle pipe using 3” wood screws.

Drill holes for pipe into 2x8 using 1 1/2” spade bit. The top of the hole should be 1 1/2” (the same thickness as a 2x4 purlin) from top edge of beam.

Drive 4x4 post into Simpson Strongtie EZ base with a hammer and scrap of wood. Secure with 3” lag bolts.

Attach deck joist tie or rigid tie to top of 4x4 post with 3” lag bolts. Use deck joist ties at the end of structure, and rigid ties in the middle to span sections.

**TIP:** Ensure that 4x4 wood post sits 1” above top of grade to help avoid rotting.

**TIP:** Cut materials as you need them. Reduce mistakes by holding materials in place to measure and mark them.
8 Assemble framing

**MATERIALS** 4x4, 2x8, EZ Base, Wood screws, Lag screws, Self-tapping screws, Nuts, Pipe strap

**TOOLS** Drill, Screwgun bits, Ratchet Reciprocating saw

**SEE DIAGRAM E AND H**

Raise 4x4 posts into position on anchor bolts within footings. Thread nuts, but do not fully tighten.

Place rear 2x8 beam into metal supports, aligning the drilled hole just to the side of the 4x4 post. The end of the 2x8 on the inner post should fall on center of the 4x4, using half of the rigid tie allowing for additions. Secure with wood screws to the metal supports and lag screws to the 4x4’s, if necessary.

Insert bent pipe into rear sleeves, then guide through front holes. Pipe may need to be trimmed further with reciprocating saw so that it doesn’t extend beyond edge of 4x4. Do not pull pipe through so much that once secured to 4x4, it causes the wood frame to lean backwards. Tighten nuts.

Secure pipe to 4x4 with pipe strap and wood screws, and to rear sleeve with self-tapping screws.

Raise front 2x8 into position and secure with wood screws to the metal supports and lag screws to the 4x4’s, if necessary.
9 Assemble roof support

**MATERIALS** 2x4, Wood screws, Self-tapping screws, Nuts, Pipe strap

**TOOLS** Tape measure, Drill, Screwgun bits

**SEE DIAGRAM B, G AND H**

Raise 2x4 purlin on top of pipes. Position flush against rear 2x8 and aligned with outer edge. From underneath, secure to pipes with pipe straps and wood screws.

Position subsequent purlins every 30” down the pipes, ensuring the outer edge aligns. The distance between the last two purlins will be significantly shorter, 24” at maximum.

When attaching the final purlin, which will hold the gutter, angle one end slightly towards the ground to direct collected rainwater, approximately at a 1/4” per foot slope. Ensure a rain barrel (with a platform) will fit underneath before attaching.

*TIP: When adding another 8’ section, position purlins to stagger above/below each other, not meet end to end.*

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10 Attach gutter

**MATERIALS** Gutter brackets, Gutter

**TOOLS** Drill, Screwgun bits

**SEE DIAGRAMS F AND G**

Screw on gutter brackets to bottom purlin. Center gutter on structure. Place gutter on brackets and clip in top gutter bracket piece. Clip on end pieces to gutter.

*TIP: Caulk seams where end pieces of gutter attach.*
STEP-BY-STEP GUIDE

11 Prepare roofing panels

**MATERIALS**  Roofing panels

**TOOLS**  Tape measure, Marker, Circular saw

**SEE DIAGRAM G**

Measure and cut roof panels for bottom section of roofline. Due to the slope of the last purlin, different length sections may be required. Roof panels should overlap gutter slightly, but if panels are too long, they might interfere with top of gutter bracket attachments.

12 Attach first roofing panel

**MATERIALS**  Roofing panels, Woodtite screws

**TOOLS**  Drill, Screwgun bits

Align first panel on right side to overhang front of structure by 12” and to align with end of purlins. Since this first panel sets the pitch for all remaining panels, ensure it is straight.

Using Woodtite screws, attach roof panel to frame, screwing through the top of every other raised ridge. Fasten so roof panel is secure but not tightly flattened to purlin.

Attach in this way at every purlin, stopping at second to last purlin, where next row of panels will overlap the first.
13 Complete roofing

**MATERIALS**  Roofing panels, Woodtite screws

**TOOLS**  Drill, Screwgun bits

Extend roofline to the gutter by connecting first full panel to its corresponding cut panel. Place the cut roof panel over the second to last purlin, but underneath the first panel so that rain doesn’t flow into the structure. Position the bottom edge to overlap the gutter and attach panels together and into the purlins with woodtite screws.

Continue to add panels to frame in this manner, starting with the full length panels at the top, which will overlap the previous section by one ridge, and adding a cut panel underneath it.

14 Modify gutter for rainwater

**MATERIALS**  Connecting link, Chain

**TOOLS**  Drill

Drill a 3/4” hole near low end of the gutter.

Unscrew connecting link and attach chain link. Feed through hole by inserting the tip of the link’s open end and passing the length of it through until entire connecting link sits in the gutter and chain hangs below. Close connecting link.

Place other end of the chain in a blue rain barrel for collection.

*Tip: Use only one small hole or point of exit for the rain water to pass through. Otherwise, chain will not effectively direct the water to desired location.*
Dimensions may vary based on site conditions.

Inner front footing (Diagram D)

Corner front footing (Diagram D)

Back footing (Diagram C)
Dimensions may vary based on site conditions.

**B SECTION**

- Full length roofing panel
- Wood and Pipe Connection (Diagram E)
- Purlins spaced 30” maximum
- Back roofing panel
- Gutter (Diagram F)
- Back Footing (Diagram C)
- Front footing (Diagram D)
- DIMENSION VARIES BASED ON SLOPE (DIAGRAM G)
1 3/8” Pipe
Self-tapping screws
1 5/8” Pipe
Quickrete tube
Concrete
Gravel

Measurements may vary, but total concrete weight should be approximately 300 pounds per back footing.

Maintain minimum 4” from edge of concrete to pipe if adjusting diameter.
Dimensions may vary based on site conditions.

Measurements may vary, but total concrete weight should be approximately 450 pounds per front corner footing and 700 pounds per front interior footing.

Maintain minimum 4” from edge of concrete to anchor bolts when adjusting footing length, width and height. Maintain minimum 3” distance from base to welded wire mesh or rebar if adjusting height.
Building a Shade Structure

DIAGRAMS

Woodtite screws
2X4 Wood purlin
1” Pipe strap
1 3/8” Pipe

11/4” Wood screws
1 1/2” hole in 2X8 Beam

Corrugated roofing

2X8 Wood beam
3” Wood screw
Simpson Strongtie Deck Tie Joist
(Corner posts only)
Simpson Strongtie Rigid Tie
Connector (joining 2x8)

4X4 Wood post
3” Wood screw
2X8 Wood beam

E

ROOF AND FRAMING CONNECTION

Dimensions may vary based on site conditions.
DIAGRAMS

Dimensions may vary based on site conditions.

F
GUTTER ATTACHMENT

Gutter bracket
Gutter
1 1/4" Wood screw

12' Roof panel
Cut to fit back roof panel

G
BACK PANEL LAYOUT

1 3/8" Top rail pipe
Corrugated roof panel
Pipe bracket
Woodtite screw
Metal screw
2 X 4 Purlin

14" 16" 18" 20" 22" 24"

Maintain adequate distance to top of rain barrel
DIAGRAMS

Dimensions may vary based on site conditions.

WOOD FRAMING LAYOUT

2x8 Wood beam
Inner front post

2x4 Wood beam
Pipe

Corner front post

Inner Front Post

2x8 Wood Beam
Corner Front Post

H