Building a Low-Cost Cooler & Packshed

Location: Farley Center **May 2011**

TOPICS

- Packshed Construction
- Cooler Construction

Overview

The Madison Area CSA Coalition partnered with the Farley Center for Peace, Justice and Sustainability to lead a two-day hands-on workshop to teach farmers how to construct a pack shed and walk-in cooler. The workshops took place at the Farley Center's farm incubator. The team of students and teachers designed and built a simple and complete pack shed and cooler in an existing pole barn approximately 60' x 30' in size. The packshed is 20' x 30', and the cooler is an additional 8' x 10' to the side.

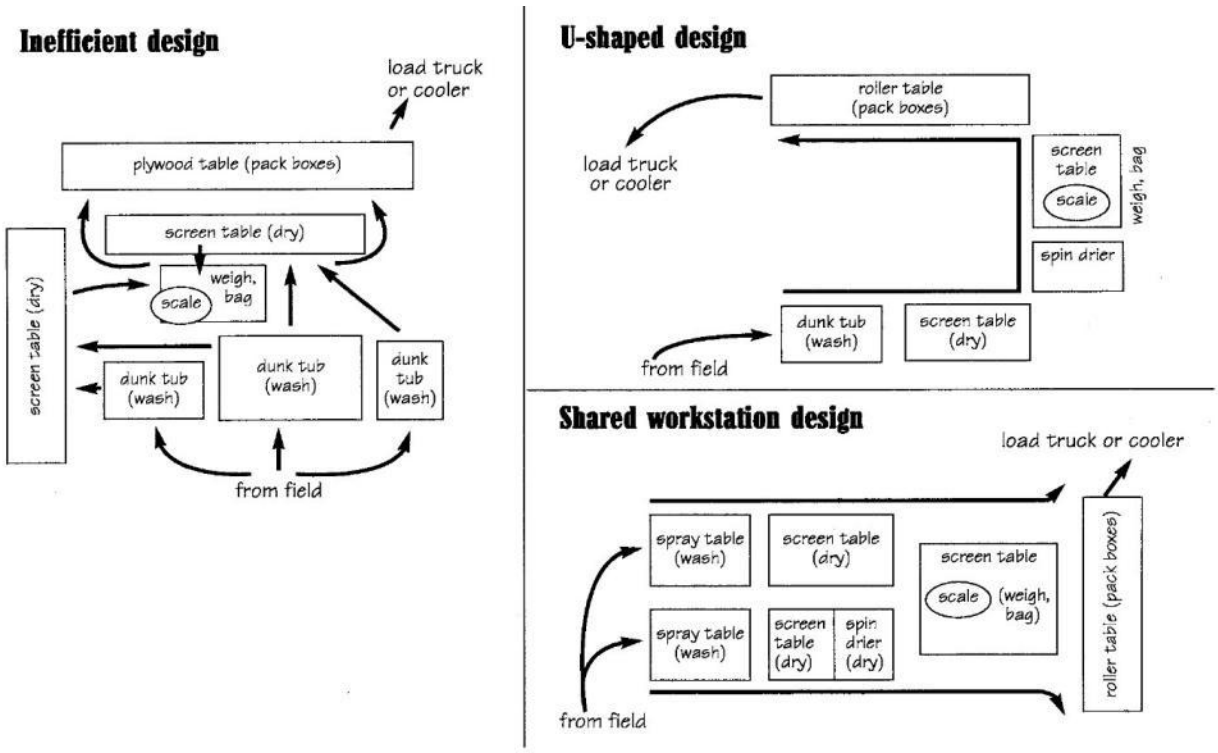
This handout provides an overview of how to build your own packshed and walk-in cooler for a diversified vegetable/fruit farm. It is entirely possible to construct a fully functional pack area with a cooler for under $5000 using new materials, and substantially less if you are able to procure used materials. Many of the decisions in designing this cooler were made with financial and skill-related accessibility in mind. The design itself takes a bare-bones approach, but for all practical purposes, the cooler is well-functioning and will probably afford many years of low-cost cooling.

The most important thing is that anyone with basic carpentry skills and tools can accomplish this in a few days, and that practically any space can be modified to house a cooler.

This project of the Farley Center and MACSAC was supported by the Beginning Farmer and Rancher Development Program of the National Institute of Food and Agriculture, USDA, Grant # 2010-03096.

The Packshed

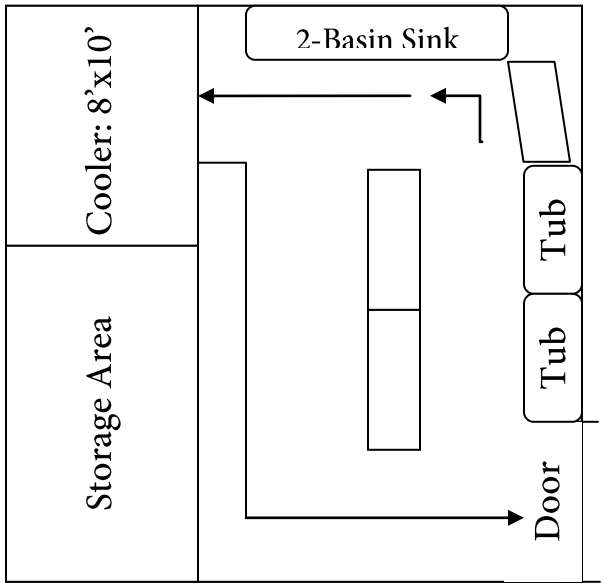
The first stage is to setup your packshed. Since nothing is in place and unmovable, now is the time to plan the overall layout and flow. You should make your flow as streamlined as possible. The follow are diagrams illustrating both inefficient and efficient designs:



Credit: University of Wisconsin Healthy Farmers, Healthy Profits Project, December 2000; 2nd Edition

The image above is from a large CSA farm, which grows a wide variety of fruits and vegetables for wholesale and CSA. On the left are two large stainless steel tubs (approximately 400 gallons) with a bottom drain that discharges into a drain channel in the concrete. On the left is a brush washer with a loading and discharge table on either end. Note how the hoses are suspended from the ceiling to minimize the risk of tripping and maximize the ease of access. In the background are the farm coolers, which are located at the end of the packshed flow. The two receiving lines are independent of each other; produce only travels along one line, depending on what is most appropriate.

The cooler and pack shed at the Farley Center will be used by four or more growers during the same season, possibly different growers from year to year, and therefore will undoubtedly go through many changes in internal layout. For this reason, there is no permanent setup to allow for any changes in use, but temporary metal shelving could be installed along the walls to allow for more efficient space use through vertical storage. We used a combination of the U-shaped and shared workstation design. The dunk tubs and wash table are against the wall in an L-shaped orientation, with additional tables in the middle of the area to allow multiple farms to utilize the space at the same time.



The layout to the left illustrates the current setup of the packshed area. The top (North), left, and right sides are the walls of the barn, while the lower edge extends another 30' for tractor and implement storage. The equipment is setup to accommodate incoming produce that requires hydrocooling or multiple washings (tubs), or is better suited for spraying (tables in the center). The tubs are stock tanks elevated on cinderblocks and drain via a pipe along the wall to the north of the barn. The tables are galvanized metal shelves with parallel round rods running across the width, also up on blocks. The stainless 2-basin sink is also plumbed to drain into a vegetative buffer.

The Floor

The floor is one of the most important elements of any packshed and can be anything from dirt to a concrete slab, depending on your needs. For a small operation, a 10' x 10' canopy with a small dunk tank and prep table can be plenty. For a large farm, a graded concrete slab with a drainage system is a must. The Farley Center packshed will be used by several farmers collectively growing on just over 4 acres, and uses ¼" crushed limestone gravel for the floor material, which is readily available in the Upper Midwest. A gravel base should be 4"-6" thick. 7.5-8 yards of gravel are required to cover the 600 sq. ft. of the packshed 4" deep. The limestone will appear rather sandy, but is far more suitable and solid than dirt.

In the photo, you can see the cooler space with concrete held in by forms and a drain pipe that is cut off after the concrete has set. The material to the outside of the forms is crushed limestone.

To apply the gravel, spread and rake out 2" at a time, and tamp it down either by hand[1] or with a gravel tamper, which can be rented from a hardware store for a small fee (in this case, $65/day). Properly compacted, this floor should easily accommodate pallet jacks and other wheeled transports.

The edges of the gravel pad by the door should be feathered out to allow a dolly or pallet jack to move in and out while minimizing the risk of tripping.

1 A hand tamper can be constructed any number of ways, but making sure the tamper has significant mass is important. Attaching handles to a 4x4 or log with a flat base will be sufficient. It is extremely hard work, however, and you should plan on taking frequent breaks to avoid muscle exhaustion.

Packshed Equipment

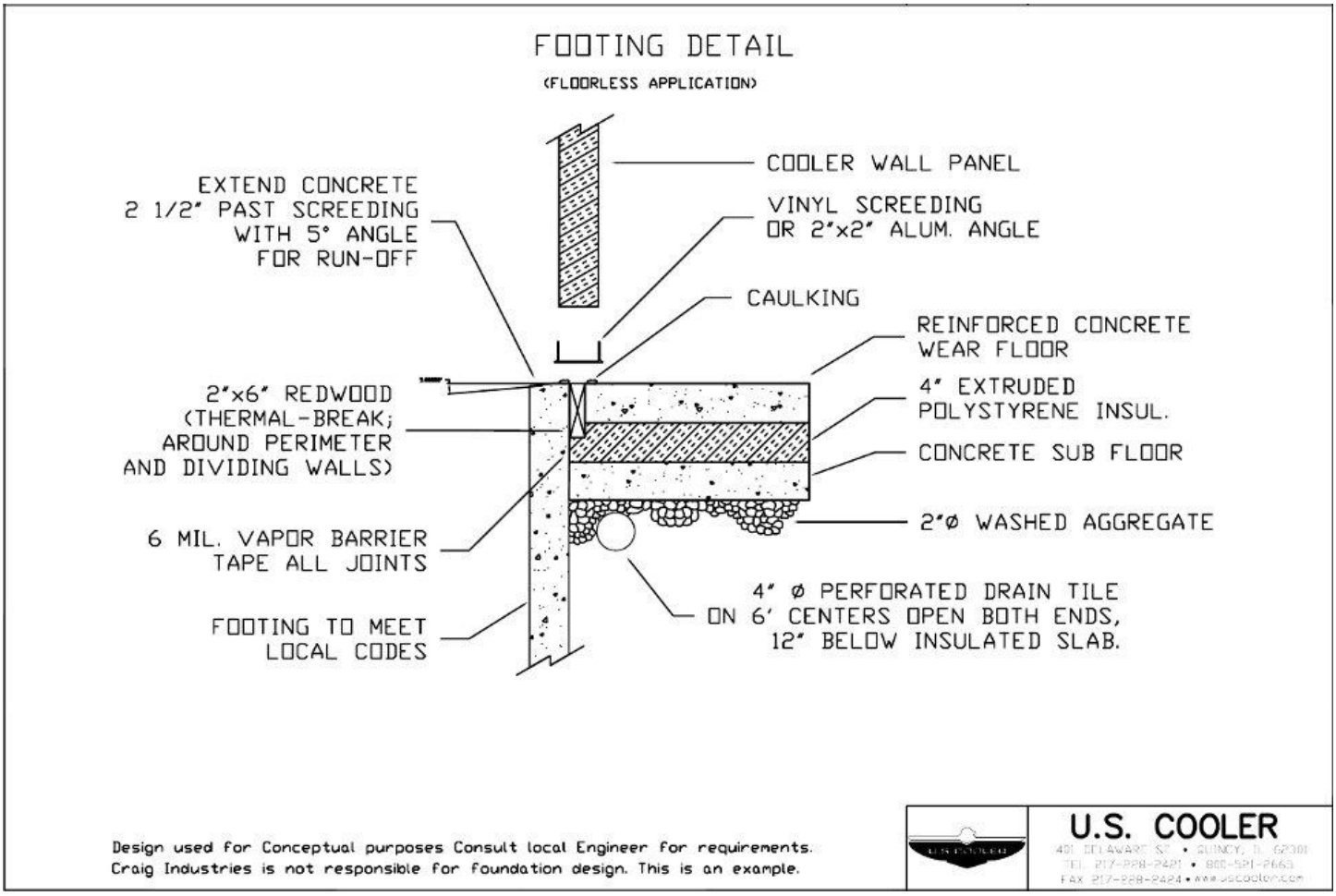
Packshed equipment does not have to be intricate, expensive, or difficult to acquire. Standard 6' plastic market tables work very well for handling a wide variety of wash situations. Stainless steel tables and basin sinks are ideal from a food safety standpoint, and are not too difficult to find – auctions and going out of business sales for restaurants and foodservice companies are excellent places to look. Smaller, 4' tables are ideal for mobile 1- or 2-person stations for work such as bagging and bunching.

A dunk tank where you can completely submerge produce is incredibly useful for quickly removing field heat from the crop, rehydrating any wilt that has occurred between harvest and packing. There are large stainless tanks designed for this purpose, but galvanized or fiberglass stock tanks work very well for small and medium sized producers. If you are growing salad/greens mixes, you will probably want three separate tanks for triple washing and a washing machine for drying them out with a spin cycle.

If you are looking to expand your packshed capabilities, a brush washer can greatly increase washing speed without compromising quality, but typically requires a couple of people to operate.

The Cooler

The cooler should be situated in a location that corresponds to the end of the packshed flow. In other words, produce at the final stage of packing or washing should be near the cooler door. The first element of the cooler to put in place is the floor. There are many ways to do this, including loose XPS (extruded polystyrene, or "pinkboard") insulation covered with a plywood floor, but a concrete pad is ideal. Many vegetable farmers do just fine with a non-insulated concrete slab, though adding insulation will create energy savings down the road at the cost of added materials and complexity up-front. The Farley Center used a simple concrete slab. A more complex, but more energy-efficient setup can be done as shown below in the sample diagram from U.S. Cooler.



Credit: U.S. Cooler Walk-in Cooler and Freezer Manual, available at http://www.uscooler.com/extras/pdf/uscooler_manual.pdf. 2011.

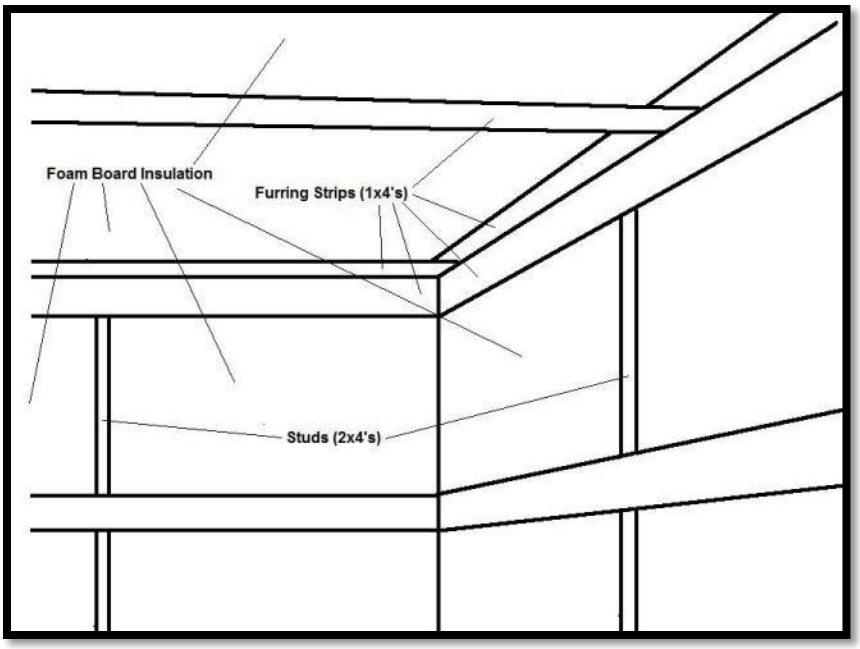
The Frame

The Farley Center installed a non-insulated slab and attached a 2x4 frame to the concrete with Tapcon screws every 12”. The ceiling, wall boards, and posts seen in the photo to the left are part of the original structure.

The concrete was graded to drain towards the center, and a PVC drain pipe was installed to discharge water off the side of the building into a buffer strip of plants to capture it.

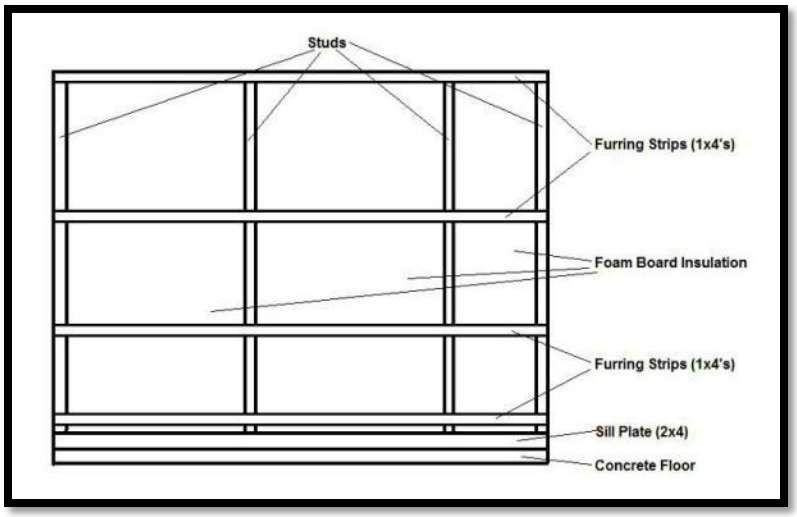
The next stage added 2x4 vertical studs as a basic frame for the door and insulation. The framing in the foreground is for the door, and the small frame in the rear is for the A/C unit. The studs are located to minimize the need for cutting insulation to size, but keeping in mind the need to attach plywood/OSB sheets on the exterior. One option is to run the plywood sheets lengthwise instead of vertically. The drain can be seen in the center of the floor. 2x4s fit the Farley Center space well for 4” of insulation, but in other spaces, 2x6s may work better if you want to add more insulation or are not able to extend insulation slightly past the edge of the boards.

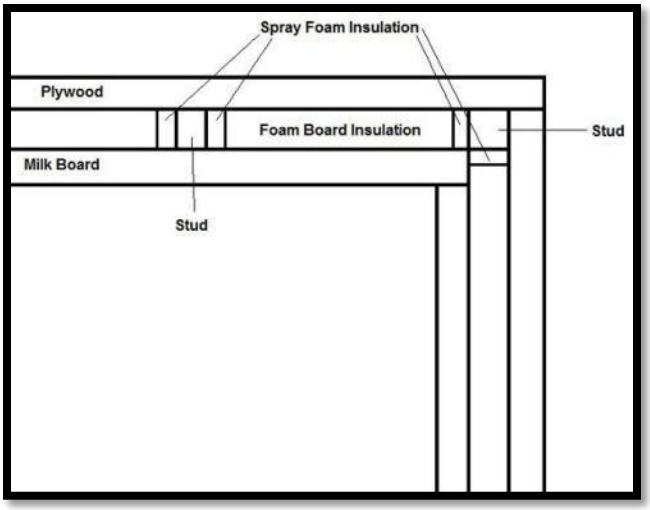
Since the site did not have electricity at the time of construction, most of the work was done using hand tools. Tin snips were used to cut open the A/C frame, and a handsaw cut the 2x4s, insulation, and plywood. A cordless impact driver was used for the Tapcon screws, and a cordless drill was used for attaching the plywood to the frame. Spray-in insulation should be applied to all the seams on the inside after the parts are in place.



The ceiling was already in place with studs as seen in the previous photos. To support insulation on the ceiling, 1x4 furring strips were installed on the top perimeter and over the insulation (into the studs). Additional furring strips were installed along the walls as a support structure for a washable paneling installed over the insulation to help minimize moisture problems as well as prevent accidental damage to the insulation (hitting it with pallets, hand trucks, crates, etc.)

The picture to the right shows a side profile for the cooler without the paneling installed. The sill plate is the 2x4 frame seen in the first construction photo. The precise spacing of the furring strips is not essential since they are merely a mounting and support structure for lightweight paneling. With too few strips, however, the panels would bulge and be prone to damage.





The image the left shows a diagram of the ceiling construction. Note the use of spray foam insulation where there is a seam of some kind – here, studs meeting the foamboard insulation. The “milk board” is a washable vinyl covering available at most major hardware stores.

The A/C Unit

Since Ron Khosla developed the Coolbot, building a cooler has become as simple as buying a regular window air conditioner and attaching a few wires from the Coolbot. On his website, he provides a chart to calculate the size of the A/C unit required to cool a given area. The Farley Center cooler is just under 8' x 10', and uses a 15,000 BTU A/C unit. A smaller, 12,000 BTU unit would probably have sufficed, but because multiple growers will be using the cooler, meaning that the door is opened more frequently, and because the floor is non-insulated, 15,000 BTU was chosen as the most appropriate size. For larger installations that require more than 15,000 BTU, you may need to check your electrical hookup as A/C units larger than 15,000 BTU require 240 volts. Multiple smaller units can also be used for one cooler.

Cooler Dimensions	Size of A/C Unit
6' x 8'	10,000 BTU
8' x 8'	12,000 BTU
8' x 10'	15,000 BTU
8' x 12'	18,000 BTU
10' x 12'	21,000 BTU
10' x 14'	25,000 BTU

When constructing the frame for the A/C, use the exact dimensions of the unit, without the window screens installed (most units have a recommended "minimum width" for the frame, but this includes the screens). The unit should fit snugly on all four sides, and spray-in insulation can seal any gaps.

Also be sure to include a support structure for the A/C unit on the outside of the cooler, such as a platform with two 45° beams underneath.

When completely installed, the A/C should rest snugly and securely in its frame. The Coolbot will need to be mounted very close to the A/C, so reserve a space for that. In this example, the stud adjacent to the A/C is a good location. To see how to connect a Coolbot to an A/C unit, visit http://www.storeitcold.com/install.php to see an instructional video and step-by-step direction.

All in all, the Coolbot installation should take no more than a few minutes.

The Coolbot

The Coolbot is a small, easy-to-use device that tricks regular A/C units into functioning as a cooler unit. The mechanics and design of a window air conditioner are substantially similar to commercial condensers. Air conditioners also don't need an annual Freon check since they don't use ozone-depleting coolants, and require significantly less electricity (as much as 60%), largely because they do not have multiple fans.

There are three main wires for the Coolbot – the short wire on the top of the unit is a temperature sensor. The wire next to that is inserted directly into the cooling fins of the A/C unit (you should be able to easily remove the front panel to access the fins) in order to detect the formation of frost, at which point it forces the A/C to run a defrost cycle. The top wire on the side is a power cord, and the bottom wire on the side is a small electrical heater which you wrap together with the A/C temperature sensor, using a small piece of aluminum foil, to trick it into thinking that it needs to be running. Notice that the top panel has been removed as well, since it limits airflow.

Workday Coordination

Coordinating a workday with friends, CSA members, and neighbors is particularly useful for building the cooler and some of the preliminary stages of construction such as pouring concrete or tamping gravel. We coordinated two work days with farmers who would be using the facility, farmers who would be interested in building their own cooler and interested members of the public. Certain stages of construction were more conducive to larger groups with a wide range of building skills, such as installing foam board insulation. Other stages, such as wood framing, worked better with a smaller group of people with at least some carpentry skills. One consideration in planning work days is that it's important to allow plenty of time for each stage of construction, as it can be a slower process than expected. In that vein, taking the time to be well prepared for workdays with larger groups makes the work run smoother and more efficiently.

Other Resources

For a more complicated design and a slightly higher cost, the University of Kentucky has an excellent publication for building your own walk-in cooler. Click for a pdf of the design and narrative as well as the parts/price list. Note that this design uses batt insulation, which is not recommended without a well-installed vapor barrier since it can harbor mold. However, XPS insulation is an easy substitute. It also has over-designed structural features since it is meant to be portable; a stationary equivalent would be more straightforward.

For general considerations for building a walk-in cooler, view Ron Khosla's notes on design, location, and construction at http://www.storeitcold.com/coolerconstruction.php.