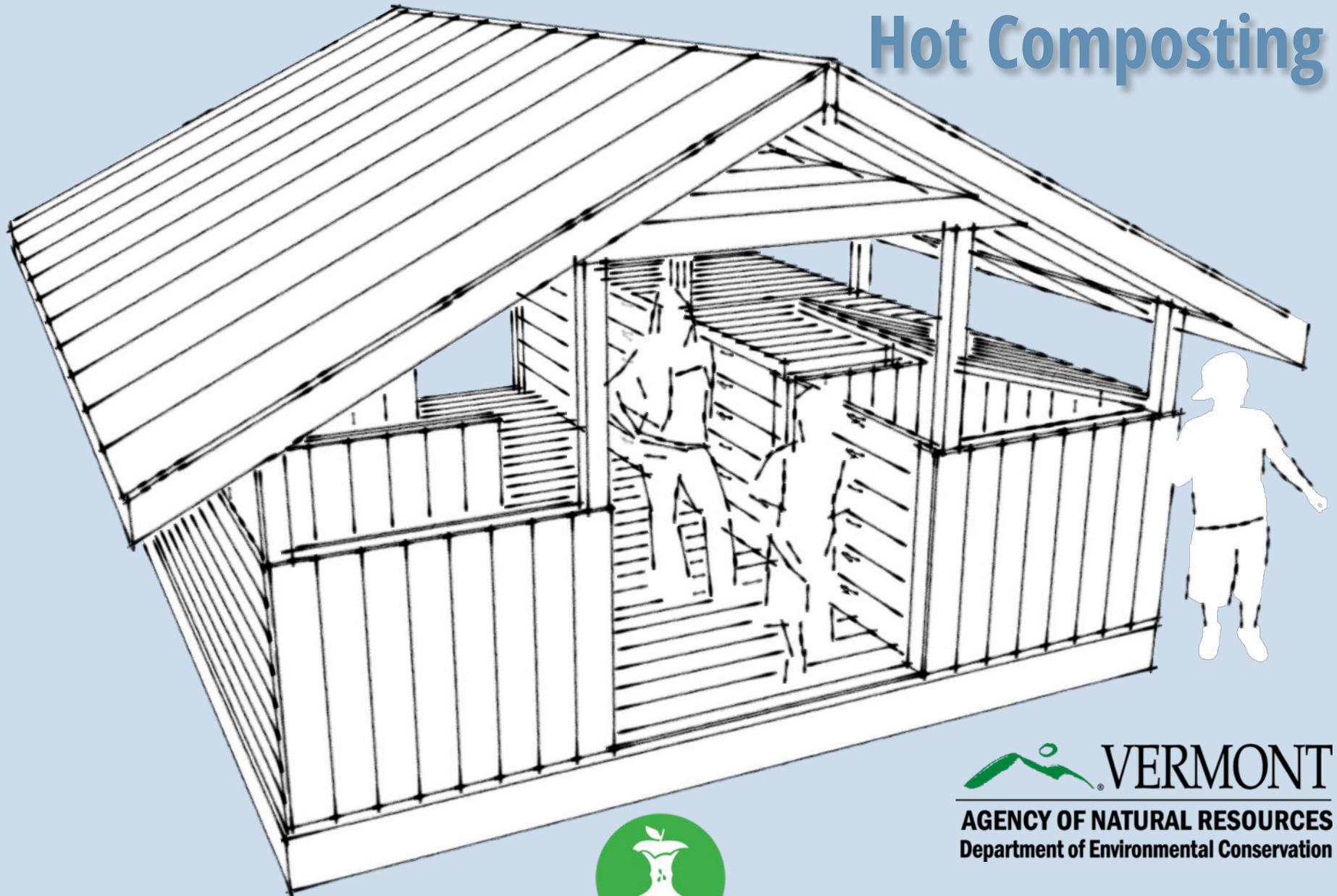


On-Site Composting **Designing a Bin System for Hot Composting**



 **VERMONT**
AGENCY OF NATURAL RESOURCES
Department of Environmental Conservation

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Companion Resources

- School Composting Options
- On-Site Composting For Schools: Planning and Implementation for Success
- Your On-Site School Composting Planning Checklist
- Managing you Bin Composting System
- Compost Recipes for Schools
- Compost Monitoring Log (Schools)



Designing a Bin System for Hot Composting

So you've decided to build a bin system for composting at your school, business, or farm. This tool has effective bin designs you can integrate into the design of your own building or system. We've seen numerous bin systems that simply don't meet people's needs. Some don't heat, some are too small for what is generated, some attract animals, some smell.... These problems can be resolved with simple and proven design and management solutions.

Here's what you need to know:

- The design strategies in this guide will help you make hot compost. We've seen compost as hot as 160° F in the dead of winter. The key is to insulate your bins if they are under 300 FT³ in volume (if you live in a cold climate).
- System size and materials flow are key. You will use the Bin Sizing Table to size your own system. From there, you

can use the conceptual designs to create plans for your own system.

- Animals are attracted by odors. Odors are caused by improper recipe & lack of oxygen. Use our recipe and bin management guide to avoid odors. Fortify your bins with hardware cloth and lids to mitigate unwanted entry by small animals.
- Bin systems are easiest to manage under cover. If you can't build a covered structure for your bins, do not build them in the drip zone of another building's roof.
- In addition to your compost bins, we recommend dedicating covered space for material and tool storage. This should be at least half and up to equal the area of the bins themselves, assuring plenty of storage capacity.

More storage space means you need to source materials less frequently.



- This system effectively composts meat, dairy, and bones.
- The larger the system, the more work it is to manage. At a certain scale, you'll really require a bucket loader to move and turn the material. This is highlighted in the Bin Sizing Table. Don't build a large bin system that requires a tractor unless you have a tractor!
- These systems are designed to hold compost for 8-9 months, at which time there should be no more visible food scraps. Finished or finishing compost does not need to be stored under cover or in a bin. Outdoors and in contact with the soil is as good or better than a bin.
- At schools, a good design and management plan are only half of the story. Our guide, "On-Site Composting for Schools Planning and Implementing a Program for Success," will help get all of the pieces in place before you start.



Spotlight: Ferrisburgh Central School On-Site Composting

The Bin System at the Ferrisburgh Central School processes approximately 200 lbs/week of food scraps throughout the school year. This system is turned by hand. Compost bins are on the left side of the building & materials storage is on the right. The system was built by a team of parents and is managed by students, teachers & parent volunteers. The on-site composting system, which has been active since 2010, feeds a robust & growing school gardening program. In 2012, the school constructed a greenhouse to extend their growing season. Materials for the system were almost entirely donated by local businesses. They leave a small trailer at a nearby horse farm & pick up the trailer filled with manure & bedding every couple of months, to keep their materials fresh. The compost regularly reaches 160° F!



Step 1. Size Your Bin System

Use Table 2 to estimate the cubic footage of your bins, based on the number of students in your school. As you can see in Table 1, Elementaries produce significantly more food scraps per student than do High Schools. The color of the cell in Table 2 indicates the bins' estimated fill time & the number of bins you'll require for an 8-9 month residence time in the bins. In addition, the

Table 1. Lbs/Week Food Scraps Generated By School Size

# of Students in the School	Elementary School	Middle School	High School
50	57	37	18
75	85	55	26
100	113	73	35
150	170	110	53
200	226	146	70
250	283	183	88
300	339	219	105
400	452	292	140
500	565	365	175
600	678	438	210
700	791	511	245
800	904	584	280
900	1017	657	315
1000	1130	730	350

Adapted From: Food Scrap Generator Database Calculations. VT ANR 2014.

largest schools would require a bucket loader for materials management.

Table 2. Compost Bin Size By School Size (FT³)

# of Students in the School	Elementary School	Middle School	High School
50	60	39	N/A
75	90	58	28
100	60	77	37
150	90	58	56
200	120	77	74
250	150	97	93
300	180	116	56
400	240	155	74
500	299	193	93
600	359	232	111
700	419	271	130
800	479	310	148
900	539	348	167
1000	599	387	186

-  3 Bins & 3 Month Fill Time/Bin
-  4 Bins & 2 Month Fill Time/Bin *
-  4 Bins & 2 Month Fill Time/Bin (Not recommended w/ out a bucket loader)

* Should consider using a bucket loader



Step 2. Decide on the Dimensions of the Bins

Based on the number of cubic feet capacity required (Table 2, now you can figure out the inner dimensions of your bins. If you are loading the bins by hand, don't make the pile higher than 4 ft, unless you have a plan to dump safely from above the bin down into it. A 4 ft tall compost pile in an insulated bin is enough to get really hot, so it's the perfect height for most small bins.

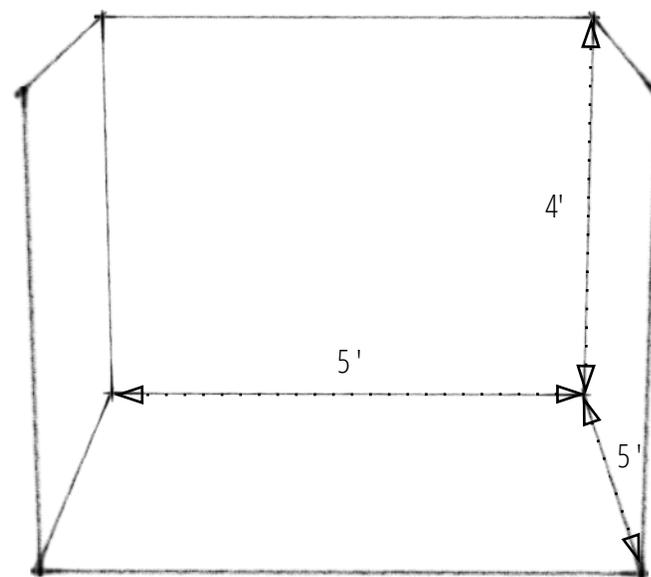
In our example drawings, we use 5' Wide x 5' Deep x 4' Tall bins. This would serve an Elementary with 150-160 students or a Middle or High School with 250 students.

We came to these dimensions by dividing the cubic footage of the bin, which would be 90 FT³ for an elementary, by the assumed 4' height of the bin, which gives us 22 1/2 FT². We'll want to use round numbers, so we rounded up to 25 square feet to give us a width and depth of 5' x 5'.

In larger systems, the bins will be designed to operate with a bucket loader. These bins could be piled 5 or even 6 feet in

height. The width of the bins and the height of the shed ceiling will need to accommodate loader bucket movements.

$$\frac{\text{Cubic Foot of Bins (Table 2)}}{\text{Height of the Bins}} = \text{Area of Bin Base (FT}^2\text{)}$$



Round up the target square footage in the bins to find a number that has round multiples. These will be the length and width of the bins. These multiples should provide an area that's within a few square feet of the bin sizing estimates in Table 2.



Step 3. Laying Out Your Bin System

Before you start designing your layout you should know the following:

1. The number of bins you need to build.
2. The dimensions of the bins.
3. If the system will be operated by human power and a pitchfork or with a bucket loader.

Now you can design the layout of your system.

Place your bins, storage, and work area so that everything is accessible. Give yourself plenty of working room, 5-6 ft wide if possible, for hand turned systems. Figure 1. is an example of a layout that we've used, which works very well for a small hand turned system that is managed under cover.

Figure 1.
Hand-Turned Bin System Layout

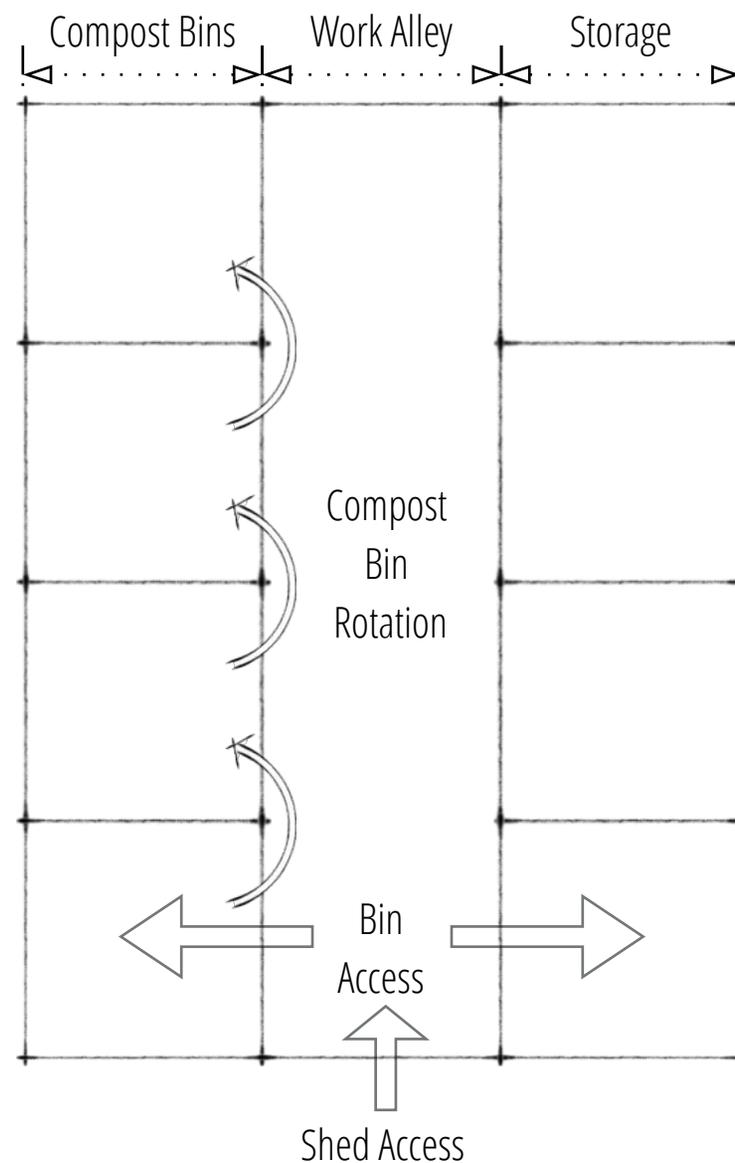
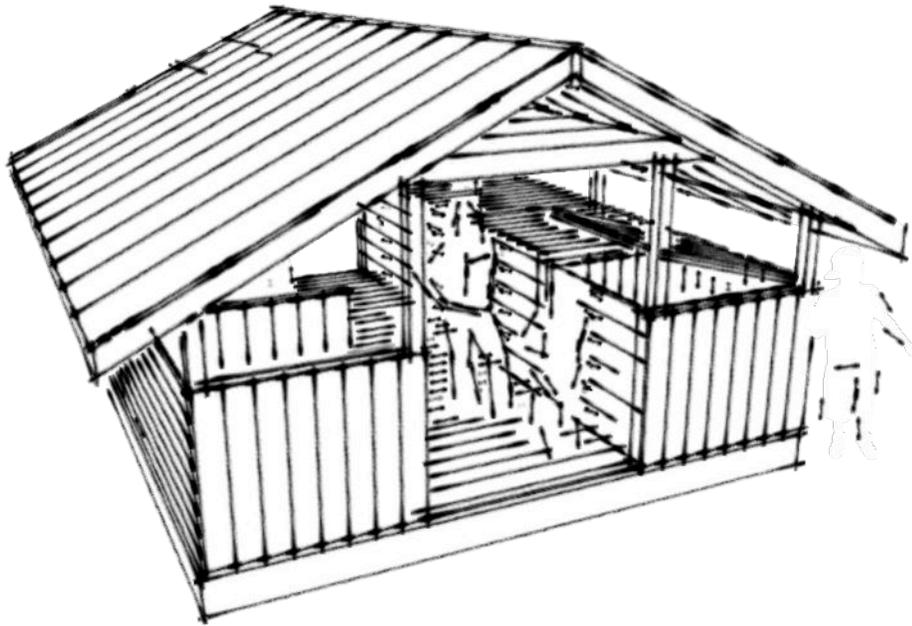
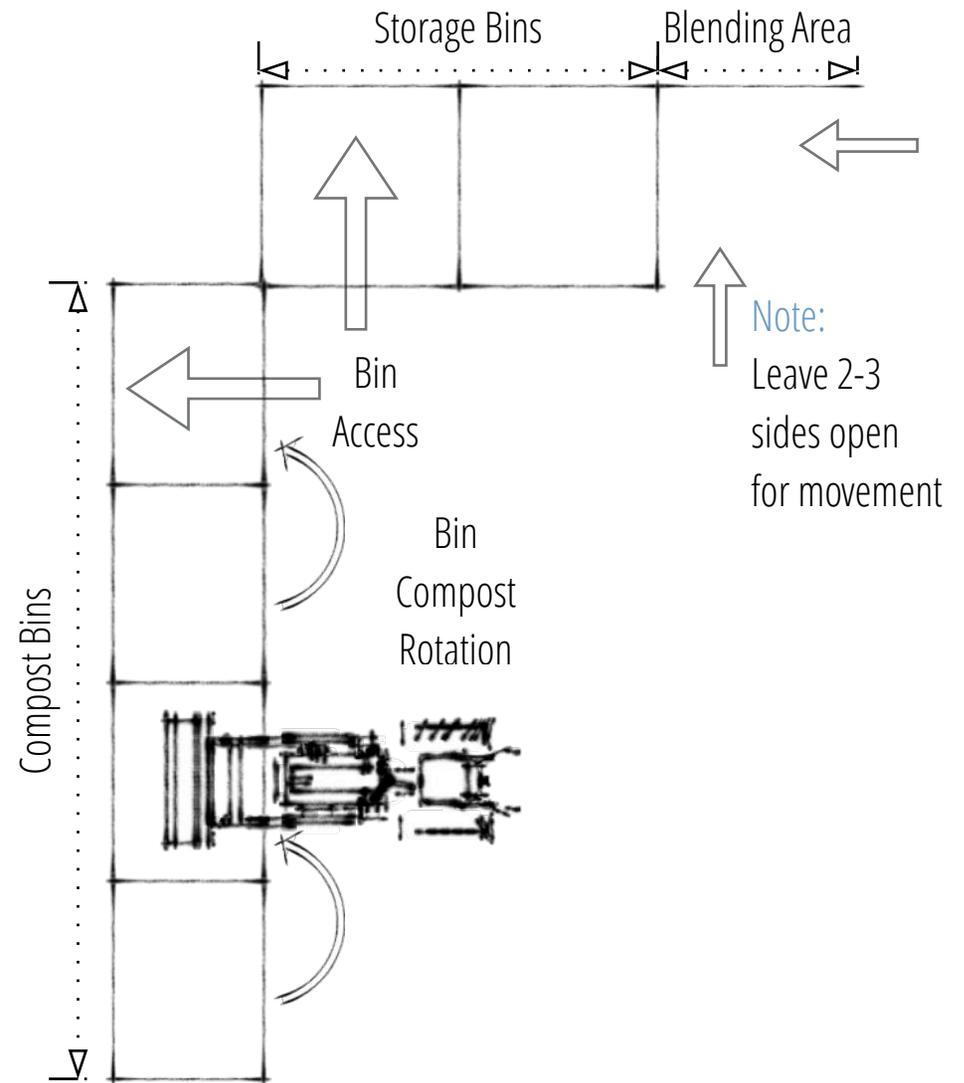


Figure 2.
Hand-Turned Bin System Once Constructed



If the system is to be managed with a loader, the layout will be different and might even warrant a small Materials Blending Area. An example layout is given in Figure 3.

Figure 3.
Loader-Turned Bin System Layout



Step 4. Create Building Plans for the Frame

The next step is to develop plans for building the structure's frame. We've given you some example drawings to start from, and adapt to your specific scale, needs, and innovations. If you are going to build a floor and a roof, designing the frame is an important first step, as the bins will be built around the frame. If you're building free standing bins, you can skip ahead to Step 5. for bin design concepts.

Most people are going to build relatively simple shed structures, but we do recommend finding an experienced builder or designer to draw up your building plans. Schools can usually find a parent volunteer or maybe an architecture student at a local college. These designers will be very helpful in building the structure too. A helpful process would be to:

- Draw the Floor Plan based on the Layout
- Draw the Building Footings
- Draw the Deck Frame
- Draw the Posts
- Plan the Overhang
- Draw the Beams and Roof Structure

Figures 3-6 are example building drawings based on the shed design used by the Ferrisburgh Central School, which were created by Nick Patch and other parent compost crusaders for the school.



Note: We assume the use of rough cut lumber in all our drawings, which is cheap and locally available throughout many rural regions. We use round dimensions such as 2" to describe a typical 2 x 4. Use dimensional lumber in place of rough cut with conversions as needed.



Figure 4.
Floor, Beams, and Joists

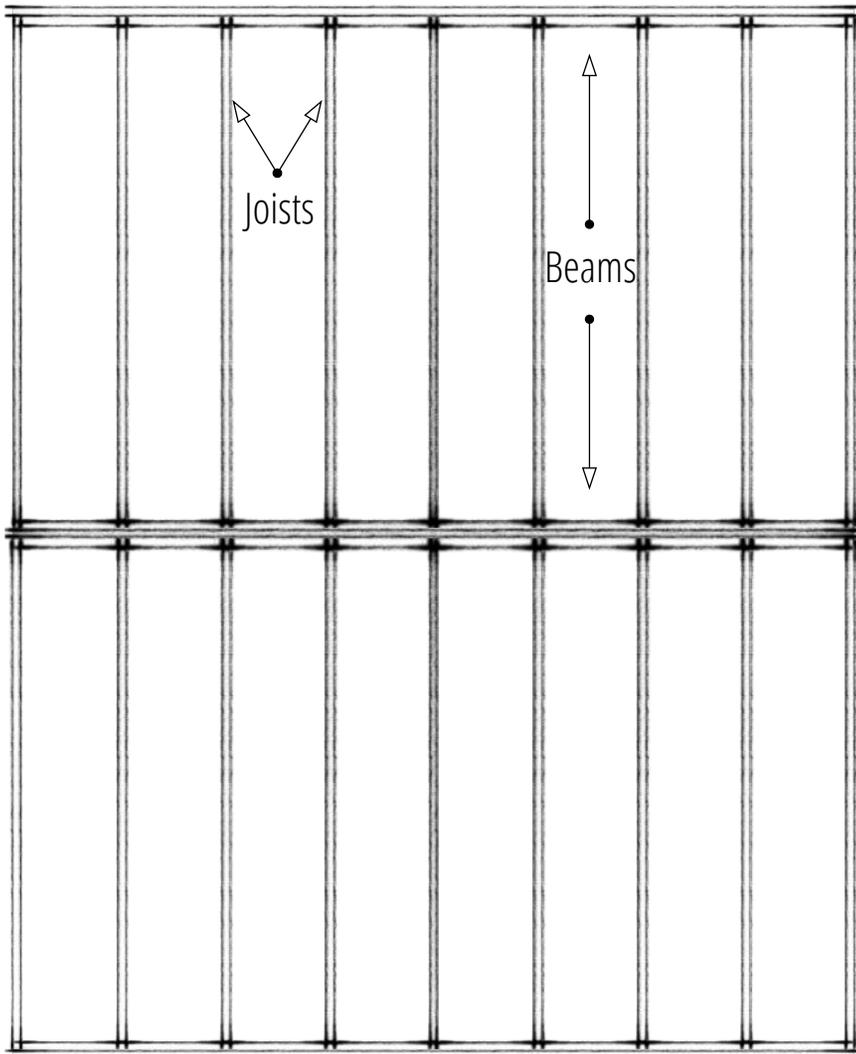


Figure 5.
Posts

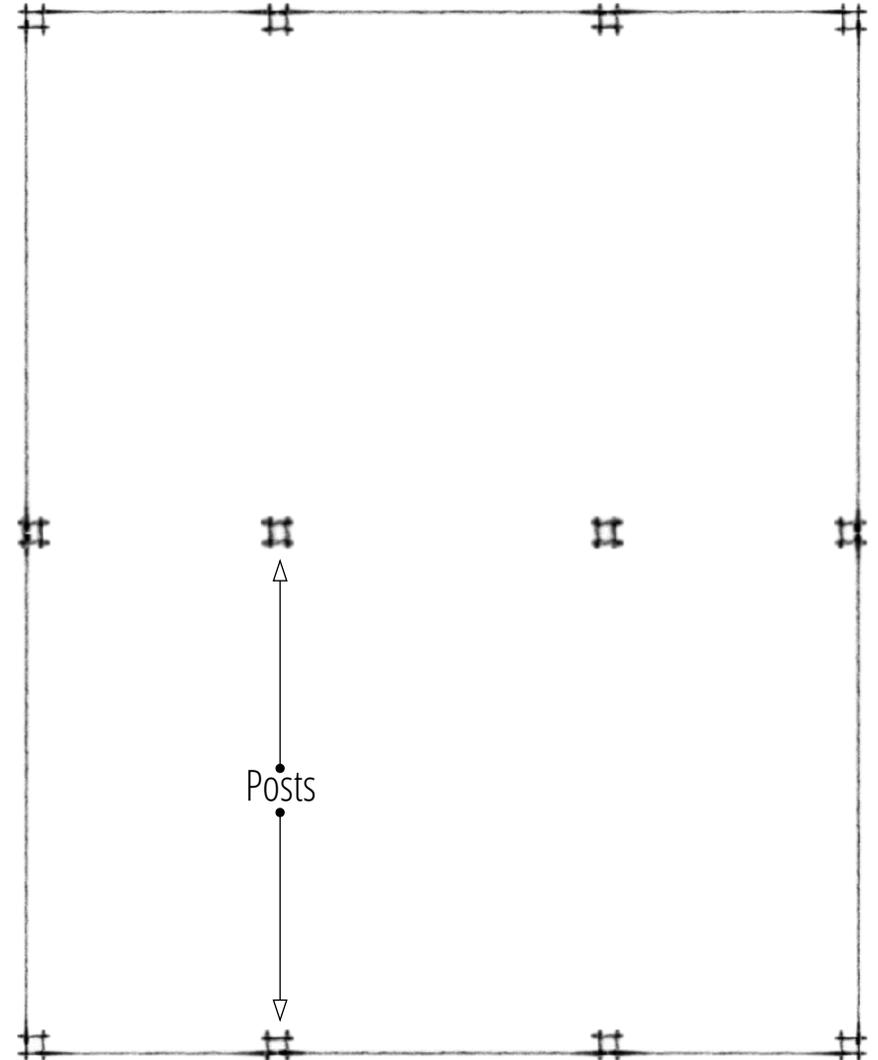
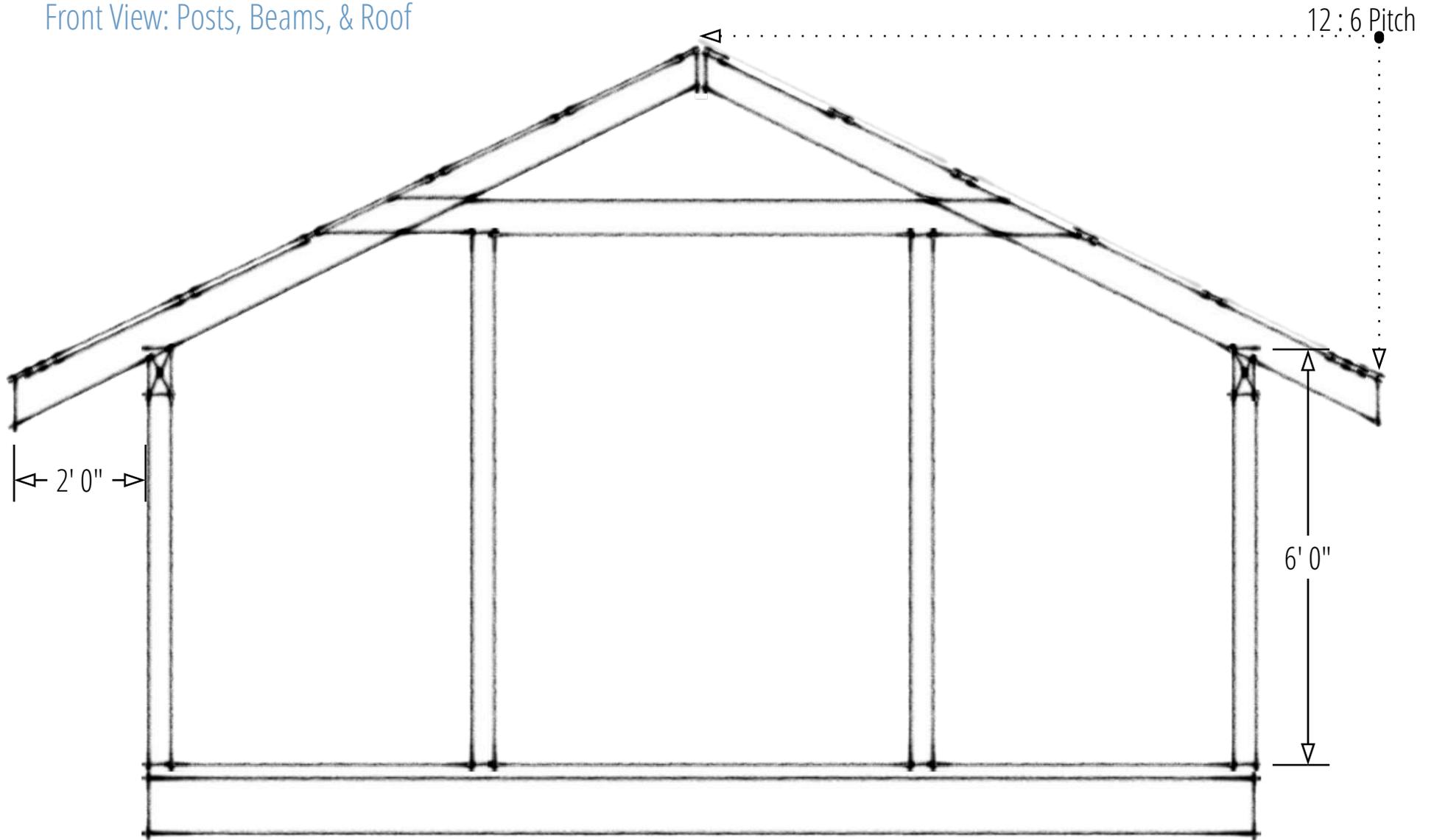


Figure 6.
Front View: Posts, Beams, & Roof



Step 5. Design Your Bins

Assuming your building plans are in place, including footings, structure, decking, and roofing, the next step is to design your bins. Figures 7-13 illustrate the basic concepts that we know work well. Your general system design may follow these exact layouts and designs or they may be very different. We would strongly encourage you to employ the following key design components (along with bin sizing).

The key components include:

- Insulation in the walls and lid
- Hardware cloth on the walls, floor, and cracks
- Holes in the floor to provide passive aeration
- Sliding slat door to enable easy loading
- Pulley or other leverage for lifting and securing bin lids safely
- Storage for raw materials and tools



Figure 7.
Blown Up Floor Plan

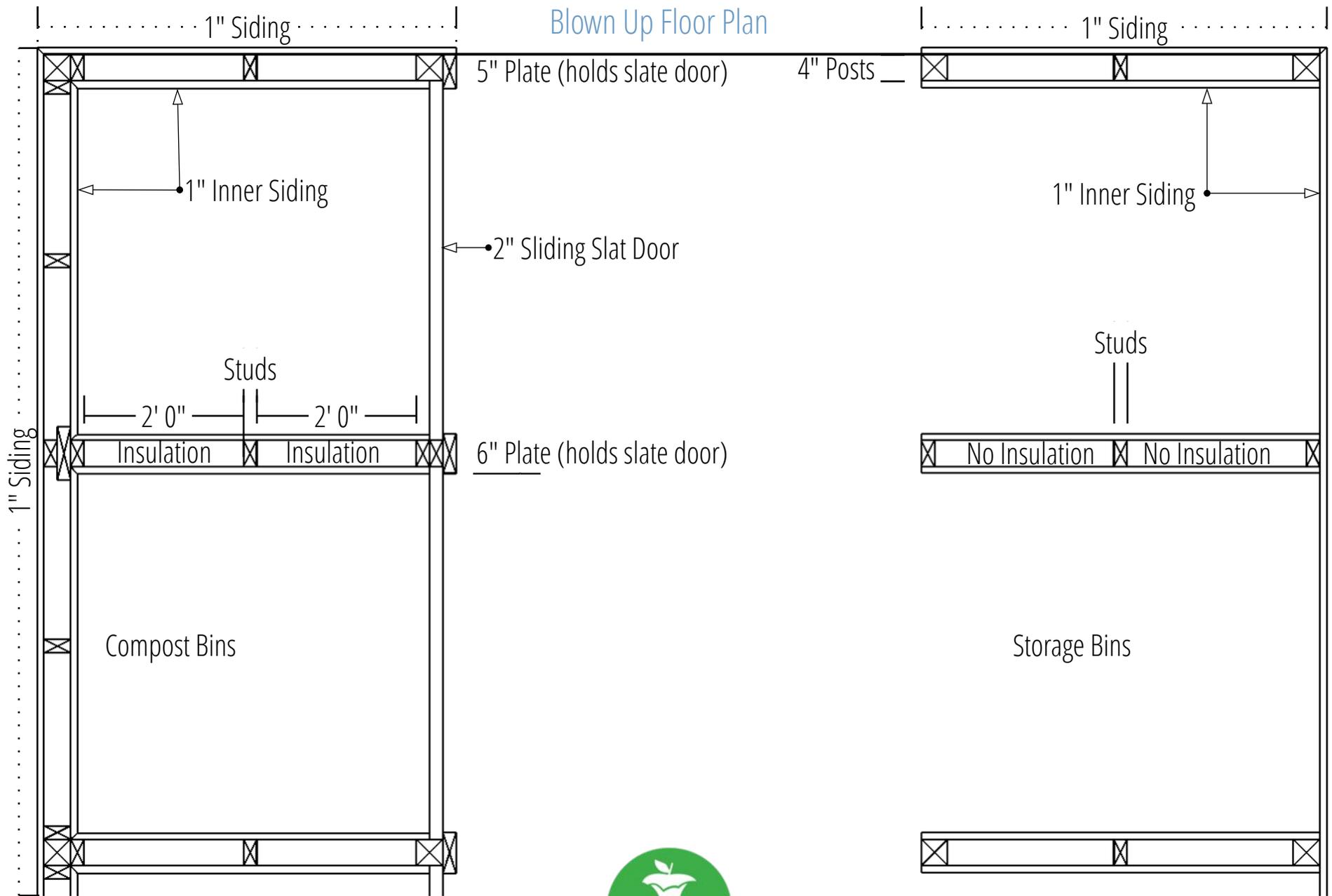


Figure 8.
Compost Bins Frame

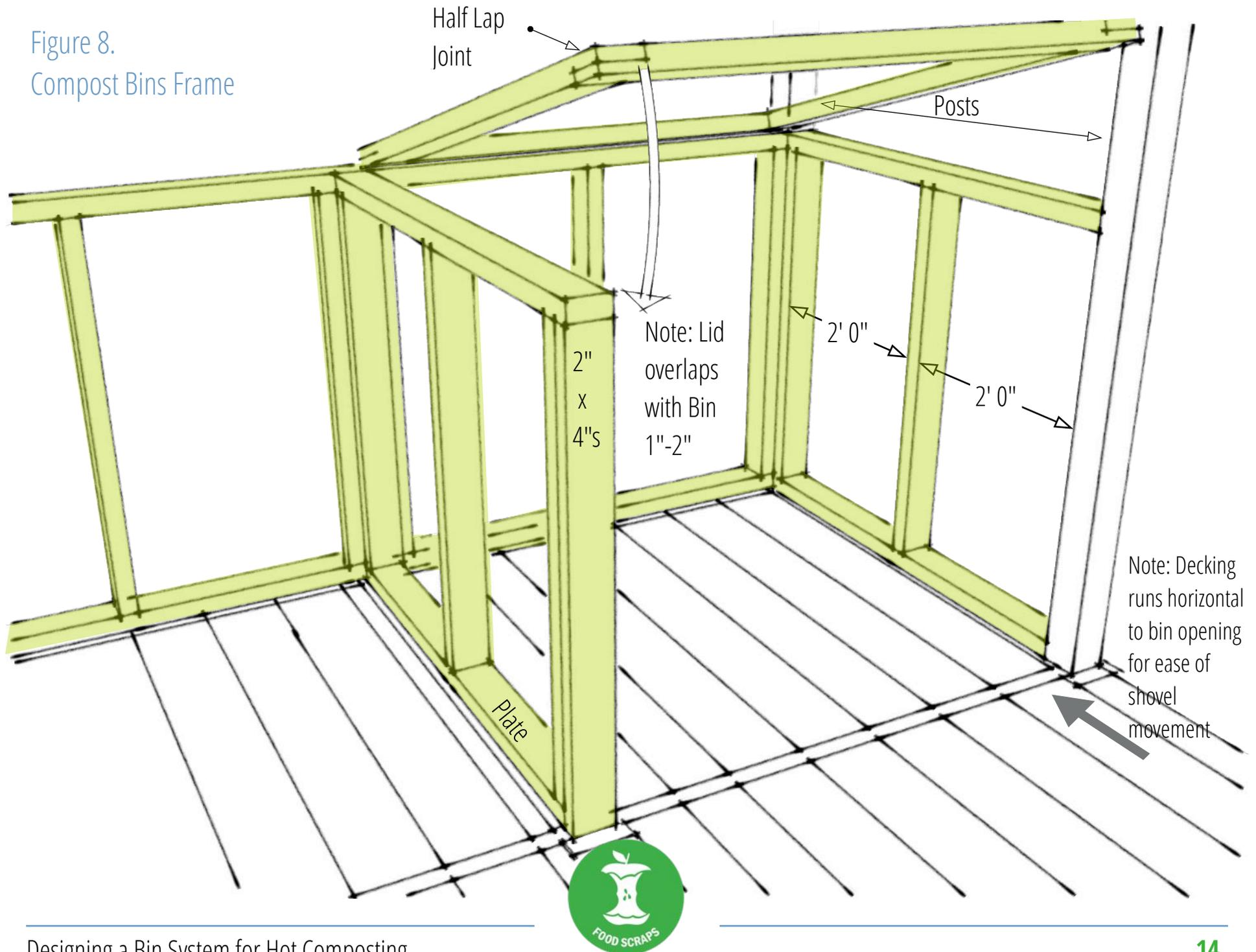


Figure 9.
2-4" Blue Board Rigid
Insulation to Lid, Sides,
and Back - Friction Fit

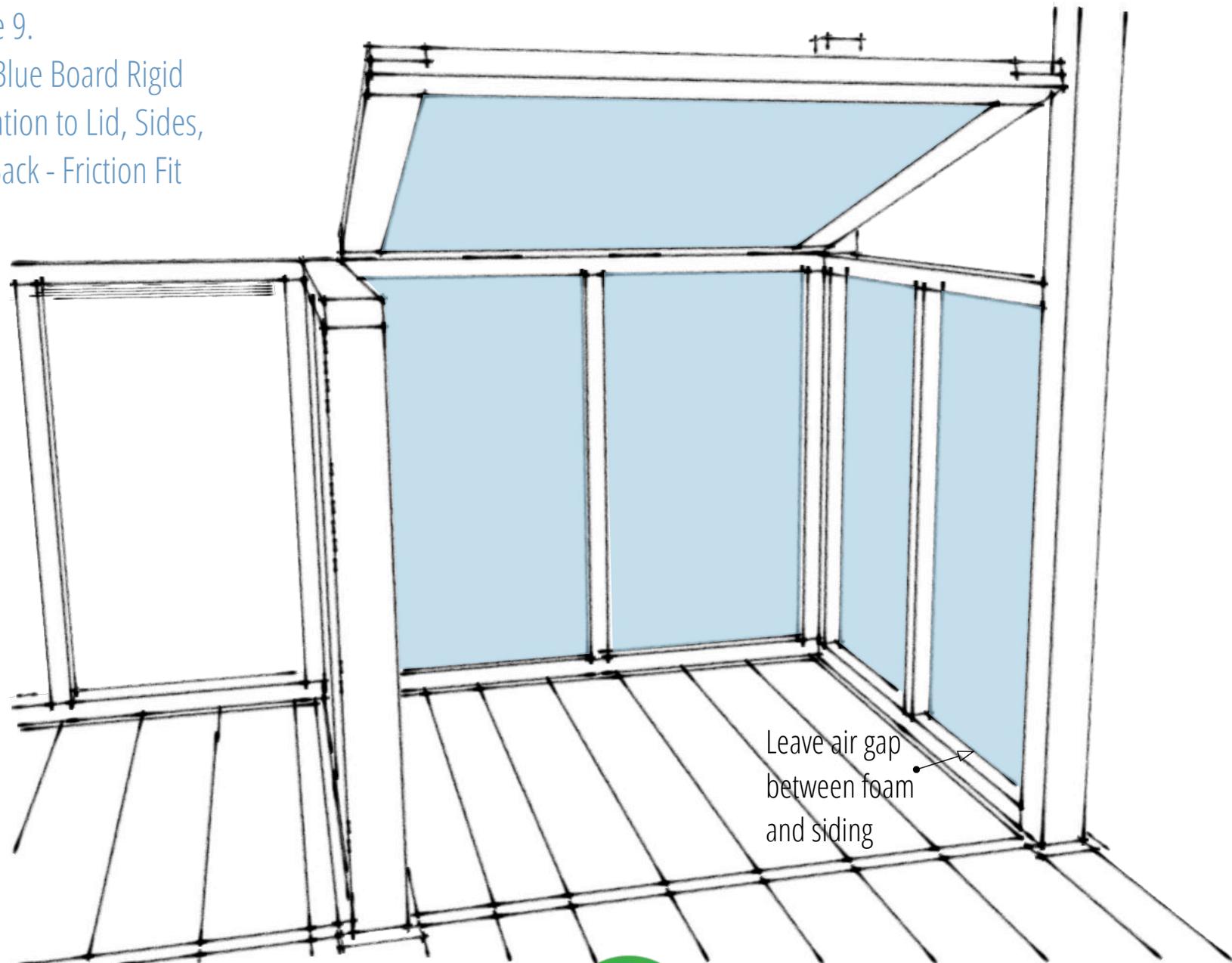


Figure 10.
Siding Over Insulation

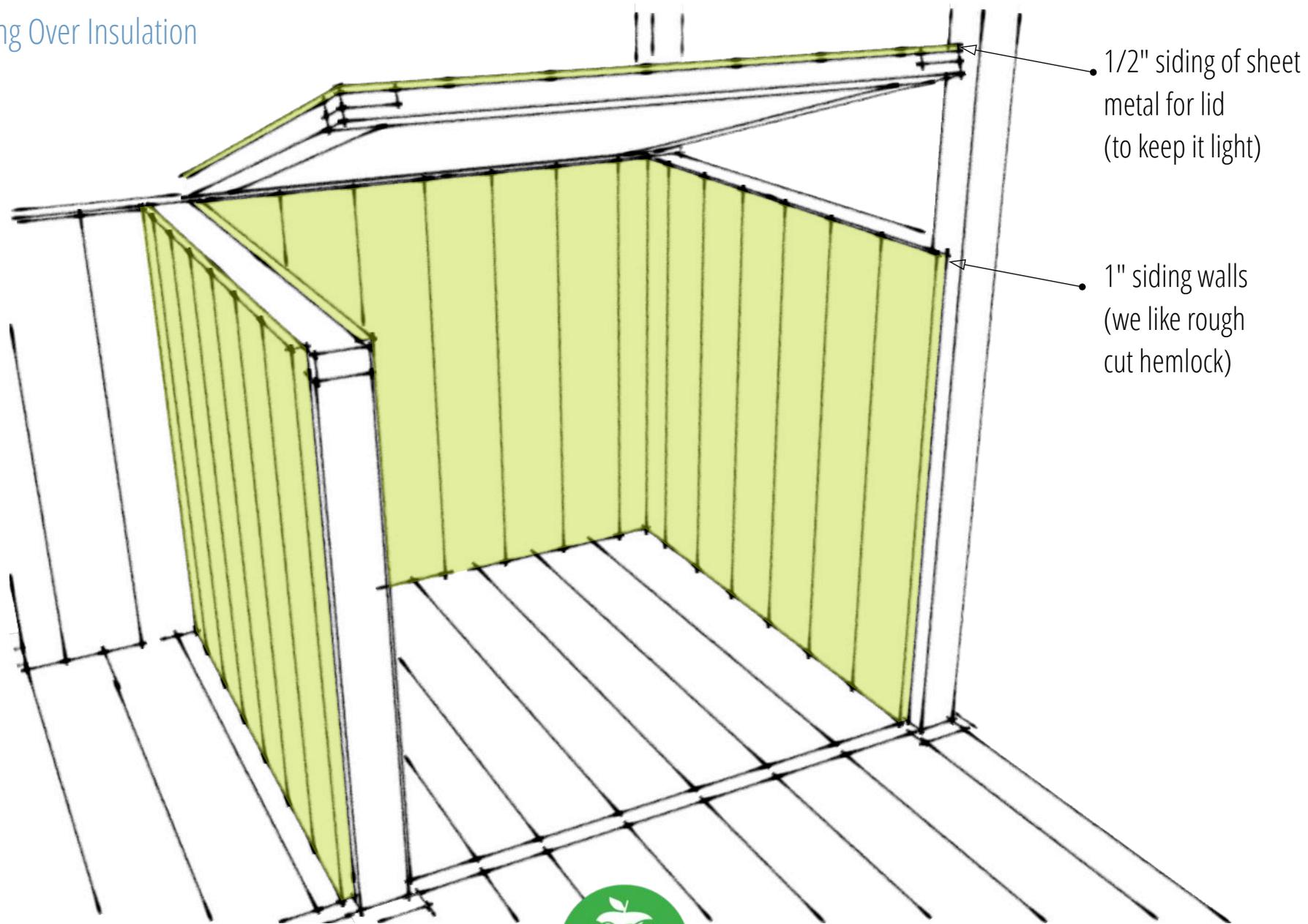


Figure 11.
Face Plates to Hold Sliding Slat Door In Place

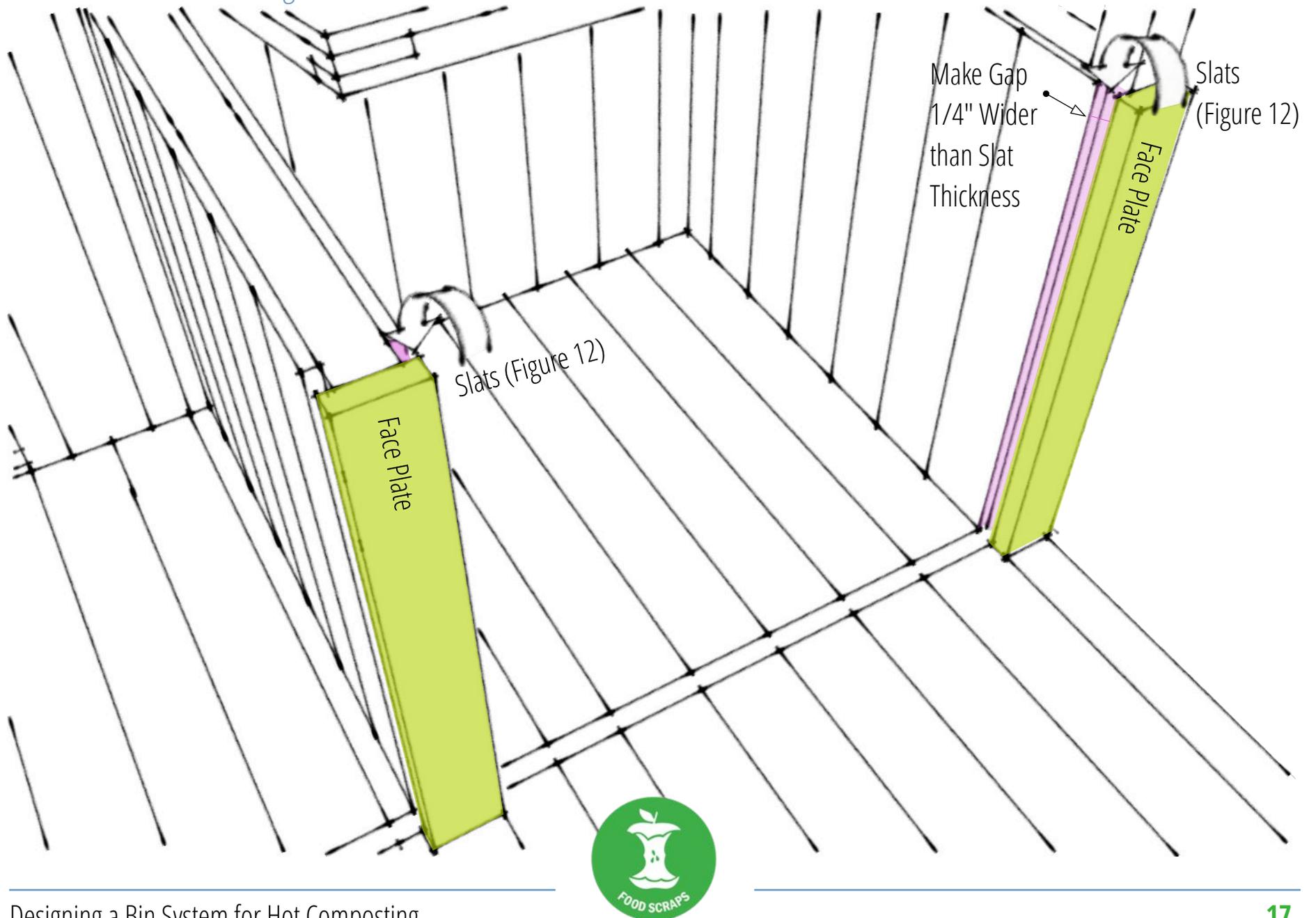
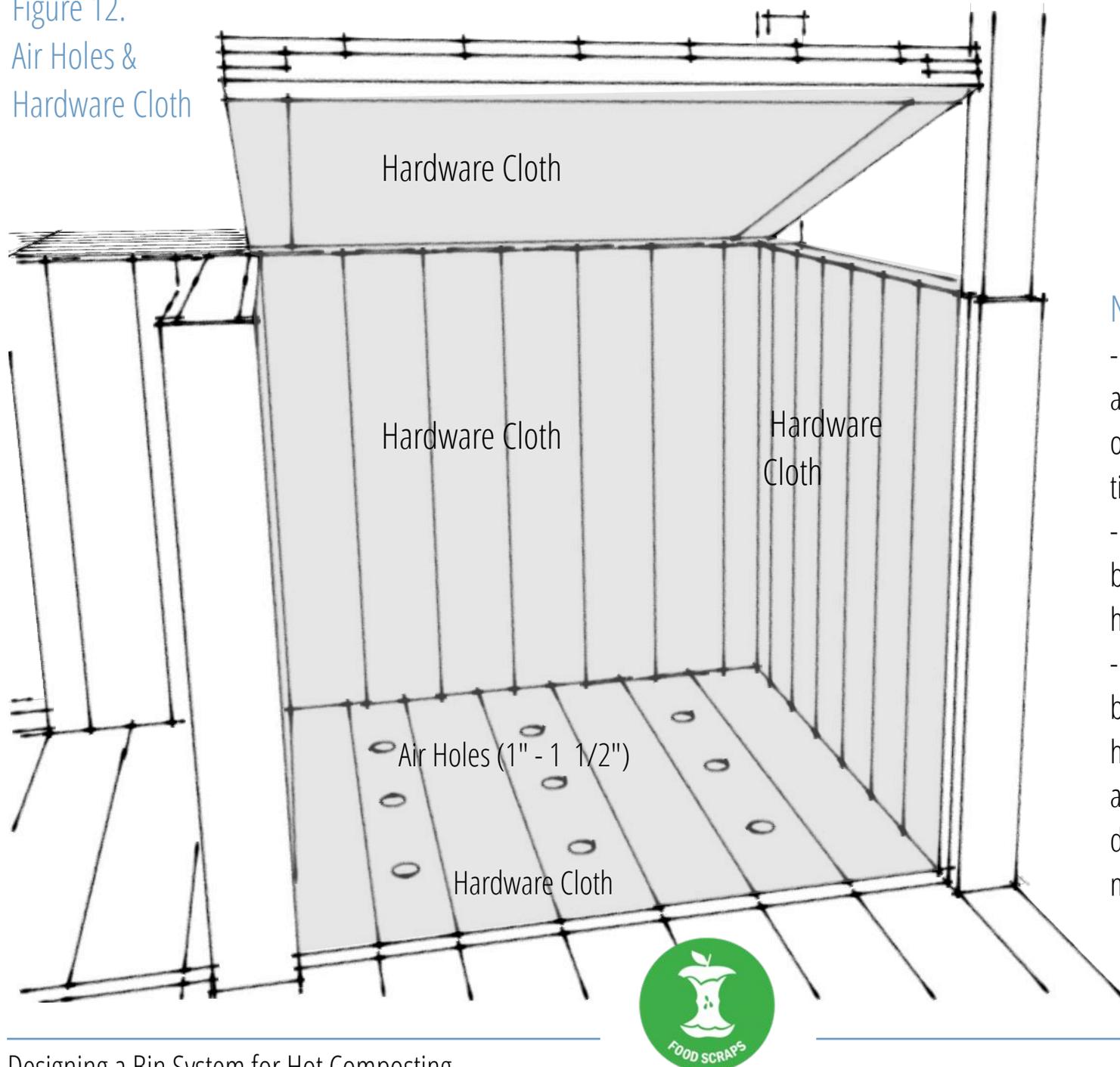


Figure 12.
Air Holes &
Hardware Cloth



Notes:

- Leave a hardware cloth flap around the rim and any other cracks for added tightness.
- Use a nail gun that shoots brads for easy attachment of hardware cloth
- Hardware cloth can be put beneath wood siding, however, this makes attaching siding more difficult (and it absolutely needs to cover air holes)

Figure 13.
Sliding Slat Door

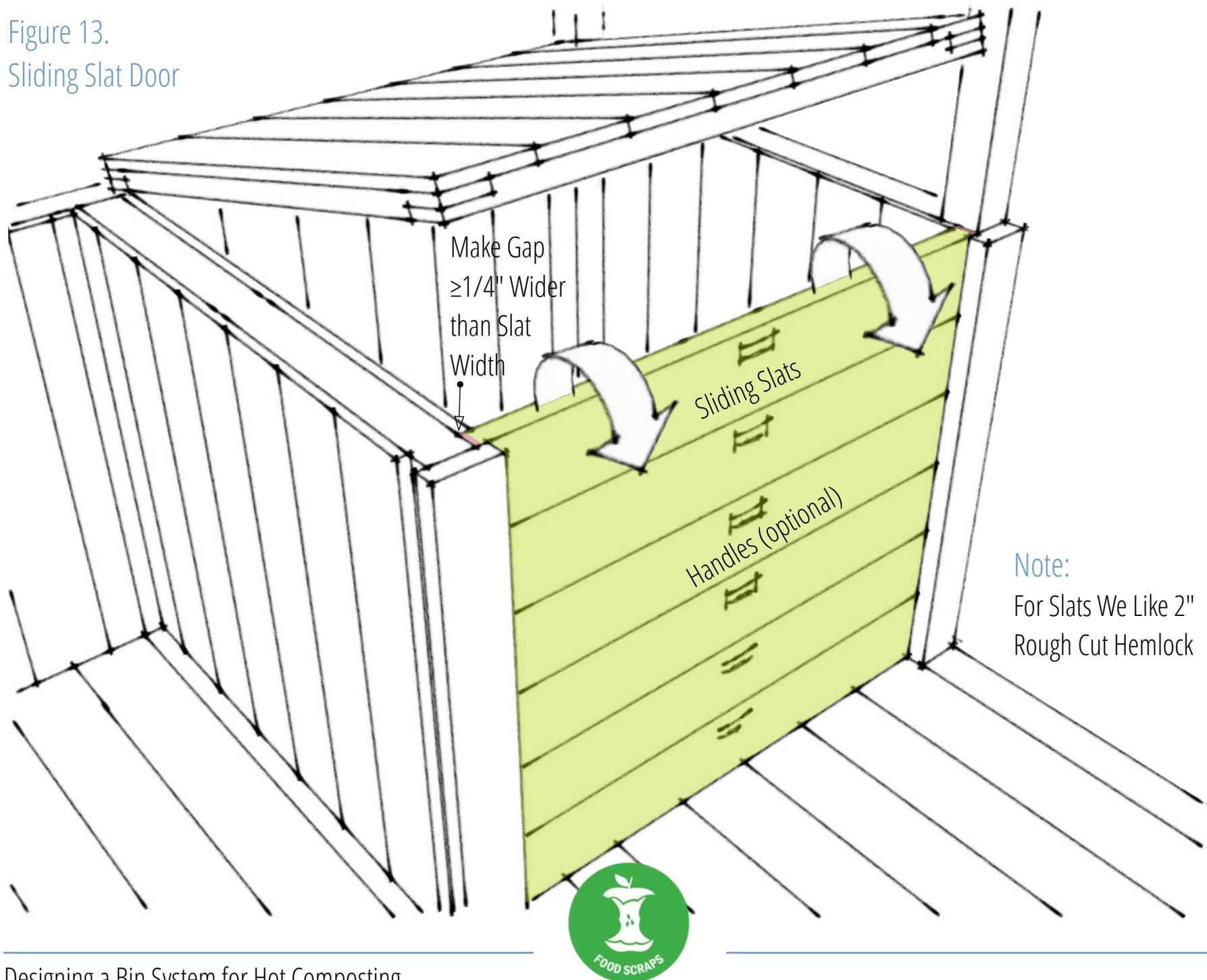
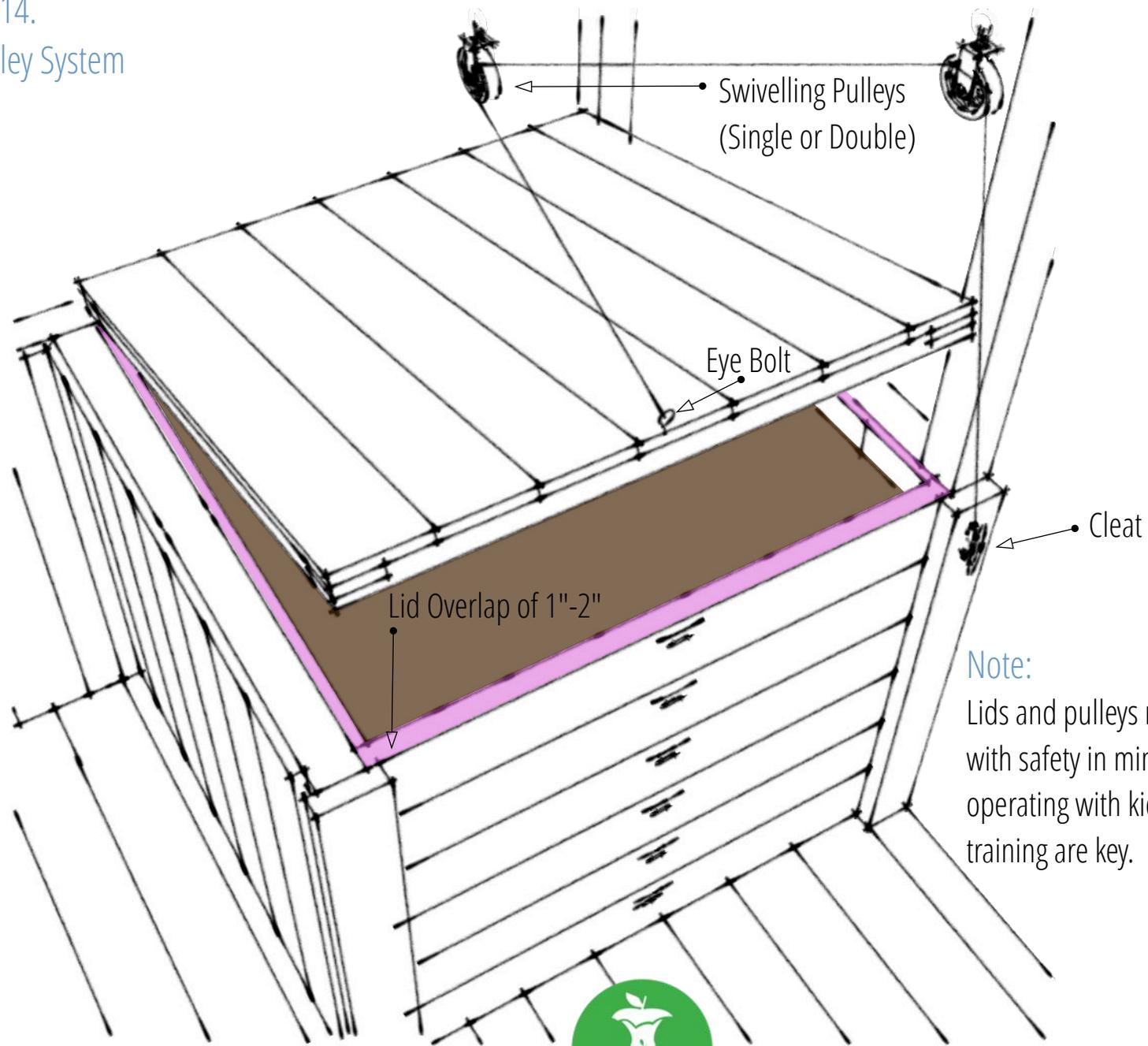


Figure 14.
Lid Pulley System



Note:

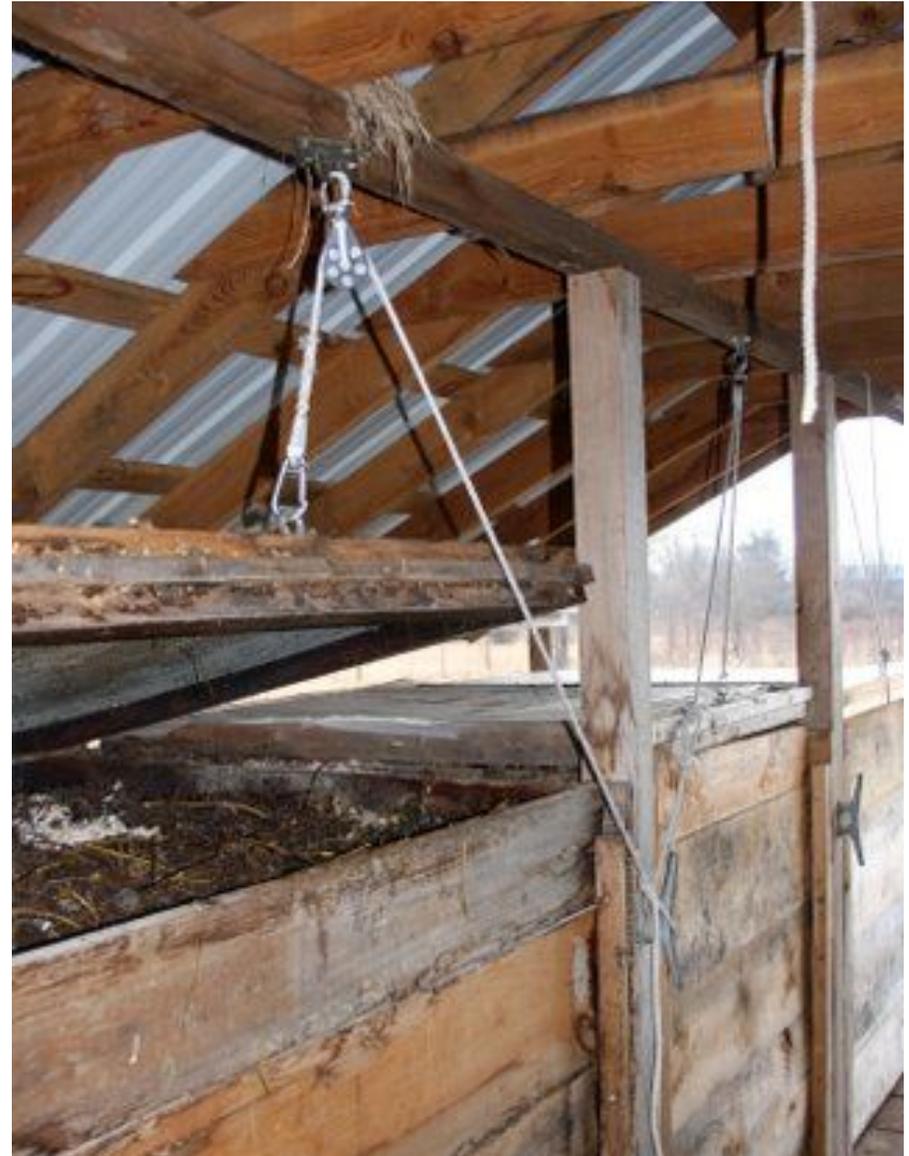
Lids and pulleys need to be designed with safety in mind, particularly when operating with kids. Supervision and training are key.





Lid Pulley Systems:

Pulley systems at Vergennes Union High School (Left) and at the Ferrisburgh Central School (Right), both designed by Nick Patch. The lids are opened for loading of raw materials and for unloading and turning. The Vergennes bins can be loaded from the top with a small tractor bucket. Nick's advice is to make the lids as light as possible by using a half lap joint in the corners and a thin light weight material to cover the insulation (sheet metal for example).



Estimating Building Materials

The table below has two materials estimates for a covered bin system like the one described in these designs. It works out to roughly \$12.00/FT².

On-Site Bin Materials Estimate		
Material	16' x 16' (256 FT ²)	20' x 24' (480 FT ²)
Lumber	\$1,200	\$2,400
Roofing	\$500	\$1,000
Hardware	\$300	\$500
Insulation	\$500	\$1,000
Footings	\$200	\$400
Hardware Cloth	\$300	\$500
Estimated Total	\$3,000	\$5,800

Having a rough estimate of materials will be helpful when fundraising. Potential sources of grants or materials donation include:

- Grassroots community foundations (e.g. New England Grassroots Environmental Fund)
- Local Solid Waste Management Entities (e.g. Local Solid Waste Districts in Vermont)
- Lumber & Hardware Outlets (e.g. Home Depot)

Photos

- Nick Patch
- Highfields Center for Composting

Original Content and Designs

By James McSweeney

(While at Highfields Center for Composting, with support from the Harris and Francis Block Foundation, The John Merck Fund, & the Ben & Jerry's Foundation)

References

Designing a Bin System for Hot Composting. Highfields Center for Composting. Hardwick, VT. Web Resource: No longer available.

Food Scrap Generator Database Calculations. Vermont Agency of Natural Resources, Department of Environmental Conservation, Solid Waste Program. May 2014. Web Resource: Retrieved July 24, 2015.



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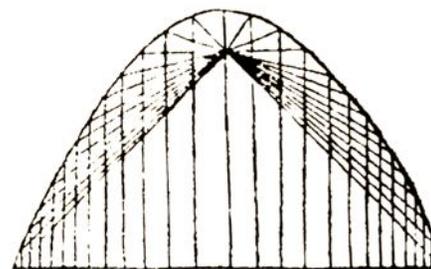
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