AN EXPERIMENTAL PASSIVE SOLAR BAT HOUSE

by Lon Drake 01/10

PURPOSE

Many of the traditional bat houses erected in the northern half of the US do not become occupied. After researching the subject over several years, I think that I understand how to do better. Therefore, in spring 2009 I put up a new design model, intended to better meet the needs of a maternity colony. It was promptly occupied for the summer. The purpose of this note is to encourage others to duplicate this experimental design in order to determine whether this success can be replicated. The emphasis here is on Iowa, and details may need to change for other parts of the country.

LOCATION

A good location is as important as the construction details. For this box-on-a-pole design the location requirements include:

- In a wetland, beside a wildland pond, or low in a wooded stream corridor.
- In full sun all day, May through September. In summer the sun rises in the NE and sets in NW.
- No overhanging or close tree branches from which a raccoon or squirrel could jump onto the box.
- Bats power dive downward when exiting a box and need open space below to regain altitude. The area below and around the box should be mowed, mulched or maintained in low vegetation.
- A box on a pole is a tempting target for adolescents with guns,---.
- Areas distant from the frenzy of human activity are preferred, and edges of wooded areas are preferred.

SPECIES

Our colonial species most likely to use the design which follows is the little brown bat, with good possibilities for northern myotis (Keen's myotis) and the evening bat. The big brown bat could probably be attracted by changing the width of the bat spaces between the partitions from 0.75 inches to 1.0 inches. It seems inadvisable to combine both bat spaces in the same box because the adults of the big brown might eat the immatures of the smaller species. The unknown here is the endangered Indiana bat. Southern Iowa is the northern limit of its summer maternity range. This might be a thermal limitation, so my passive solar bat box might be acceptable to them here, even though their preferred habitat is a cluster of loose bark flaps on a dead tree in a sunny location.

DESIGN CONCEPT

The general concept being pursued here is that a maternity colony needs a very warm and safe place to raise their young. This is why they favor an attic, because the mass of the building retains heat through the night, and their access through a knothole or a loose board under the eaves excludes predators like raccoons and snakes. My design resembles two traditional bat boxes on opposite sides of a tall pole, but the space between the boxes and above the boxes contains about 50 pounds of dry sand, which provides thermal mass, heating slowly by day and

staying warm overnight. To further smooth out temperature differences as the sun sweeps across the sky, heat transfer within the sand pack is facilitated with embedded rebar spanning top sand to side sand.

I have observed that by day, bats try to climb up as far as possible into a narrow confined space. I have also watched squirrels and raccoons spend a half hour trying to reach up into a tall space where a bat is hiding. Therefore in this design the bat spaces are 27 inches tall, providing at least a foot of safe space beyond the reach of the largest raccoon. Placing a 5 foot long stovepipe over the pole immediately below the bat box makes it less likely that a raccoon, snake or squirrel will even get into position to try.

Traditional bat boxes have interior partitions made of ¾ inch boards, which means that much of the box is full of lumber. My design uses thin ¼ inch plywood for partitions and allows a relatively compact tall prism to accommodate up to 100-200 bats in the upper safe zone, right under the warm sand pack. Very few Midwestern nursery colonies have been found to exceed this number, so there is no point in making the box larger.

If this design proves successful and becomes widely used, it may help create new colonies and prevent some attic bats from being whacked by the exterminator.

BLUEPRINTS

The recommended materials, dimensions and configurations are illustrated as four figures attached:

- Figure 1 is a plan view cross-section through the center, which shows most of the components of the box.
- Figure 2 is a vertical cross-section through the center to illustrate the backboards and the continuity of the sand pack and heat transfer rebar.
- Figure 3 is also a vertical cross-section through the center, at right angles to Figure 2, to illustrate the interior partitions
- Figure 4 is a side view sketch of the entire installation, to illustrate placement, pole bracing, predator shield, etc.

The three cross-sections are composites, illustrating multiple planes in the same view.

Ordinarily I would have built this mostly from recycled materials, but your boneyard supply is not interchangeable with mine, so I used mostly standard modern lumberyard components. One exception is the thin sheet aluminum which covers the roof. If you cannot find thin sheet metal in a large enough square to cover the roof in one piece without seams (look for wide flashing) I will give you an old aluminum lithograph printing sheet. Most of the components are assembled with torx deck screws, except for the interior partitions and their spacers, which are nailed in with long skinny brads. The post and braces are treated lumber, the box untreated. I assume that you know that ordinary lumber is identified as nominal sizes, not its actual dimensions, for example a "4x4" is actually 3.5 x 3.5 inches, a "2 x 4" is about 1.5 x 2.5 inches , etc.

FIGURE 1
PLAN VIEW CROSS-SECTION THROUGH CENTER

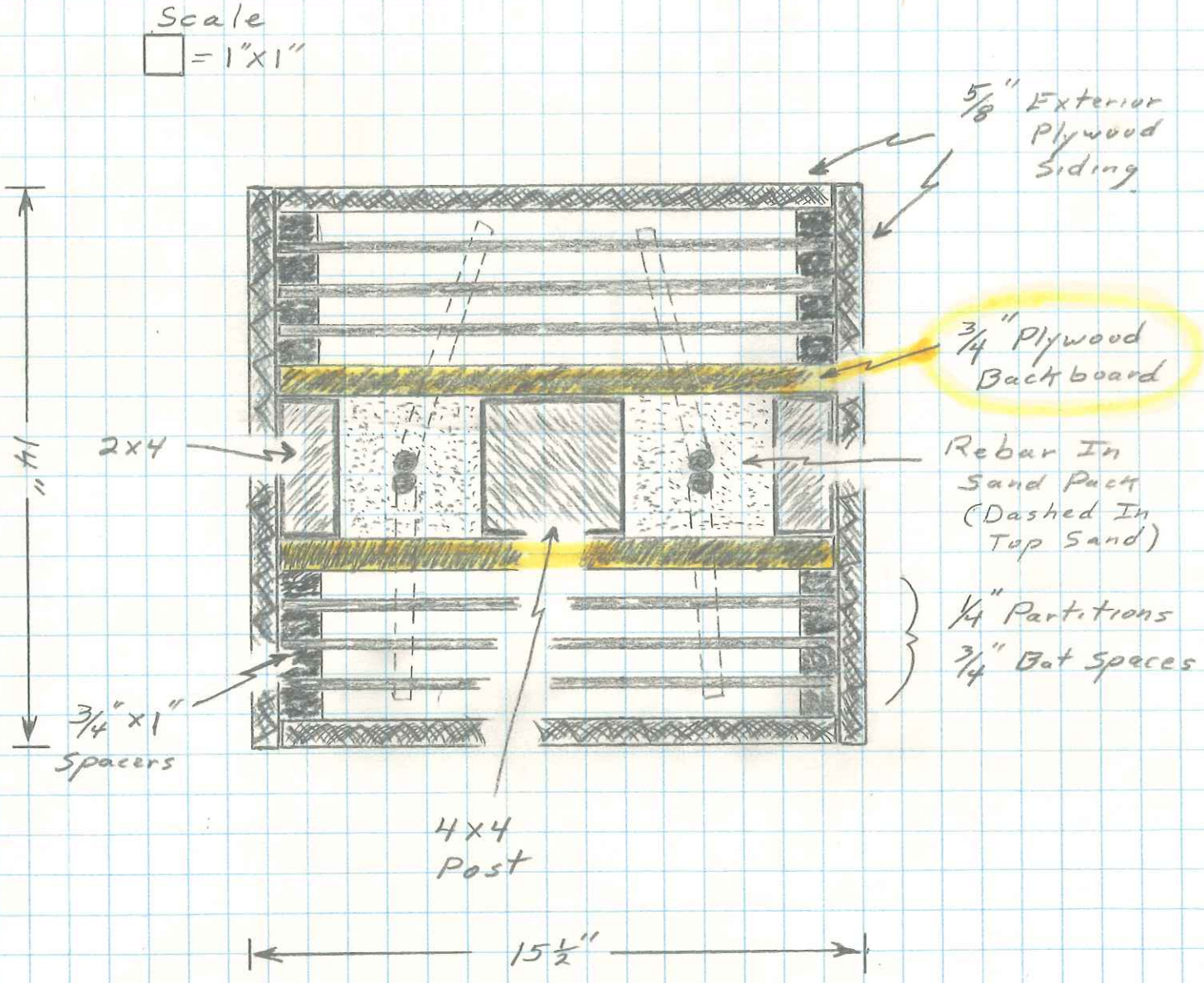

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FIGURE 2
COMPOSITE INTERNAL SIDE VIEW

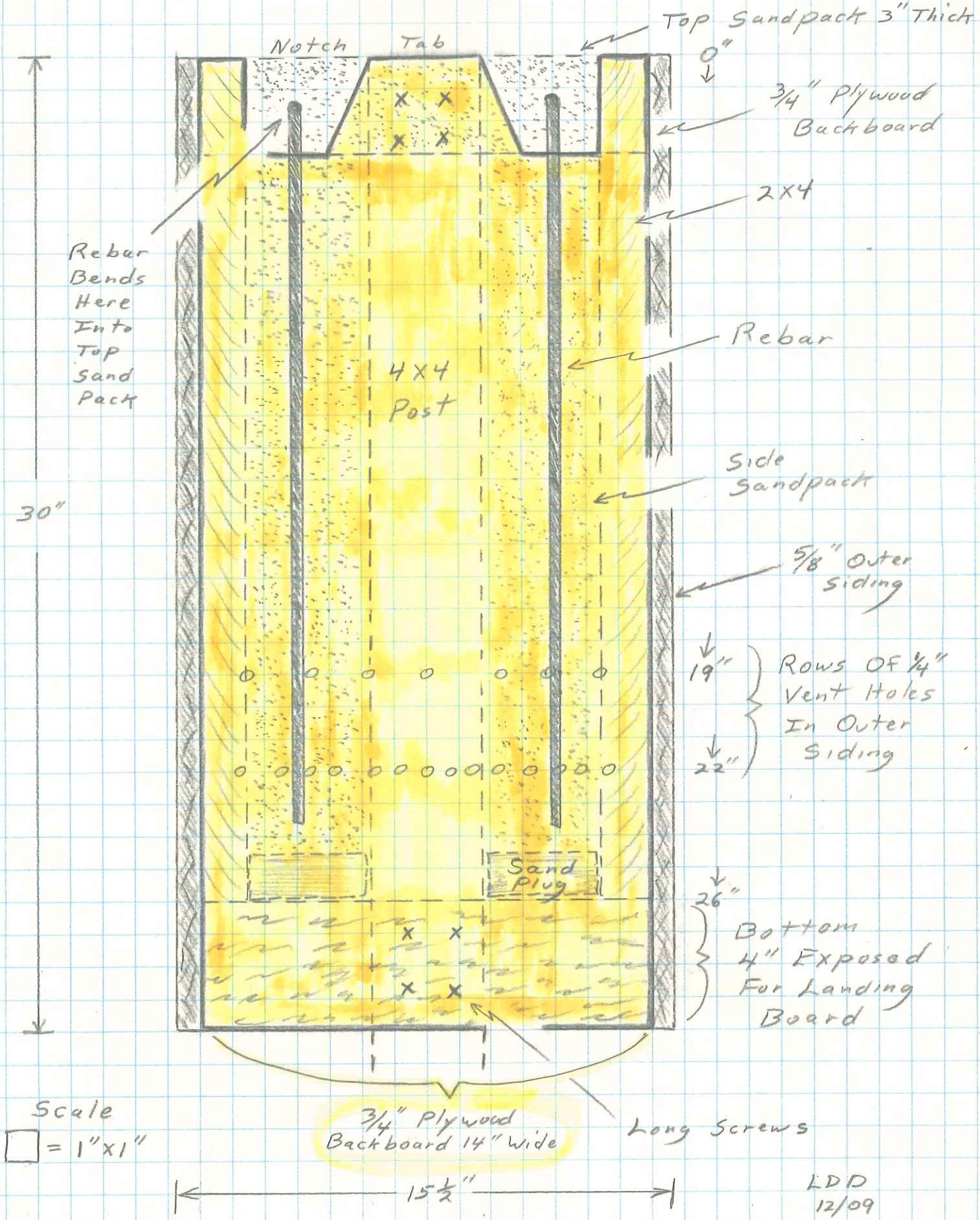


FIGURE 3
COMPOSITE INTERNAL SIDE VIEW

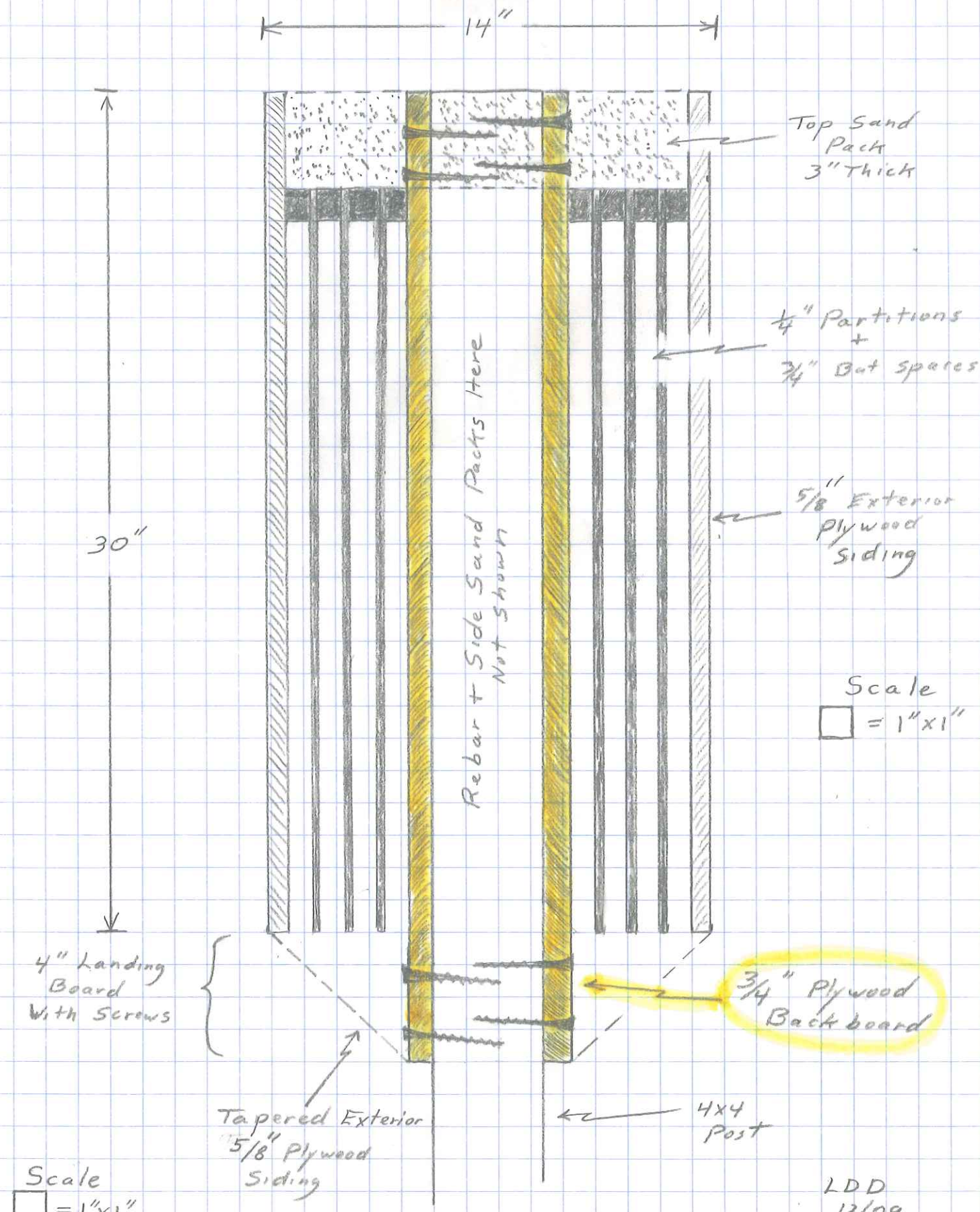
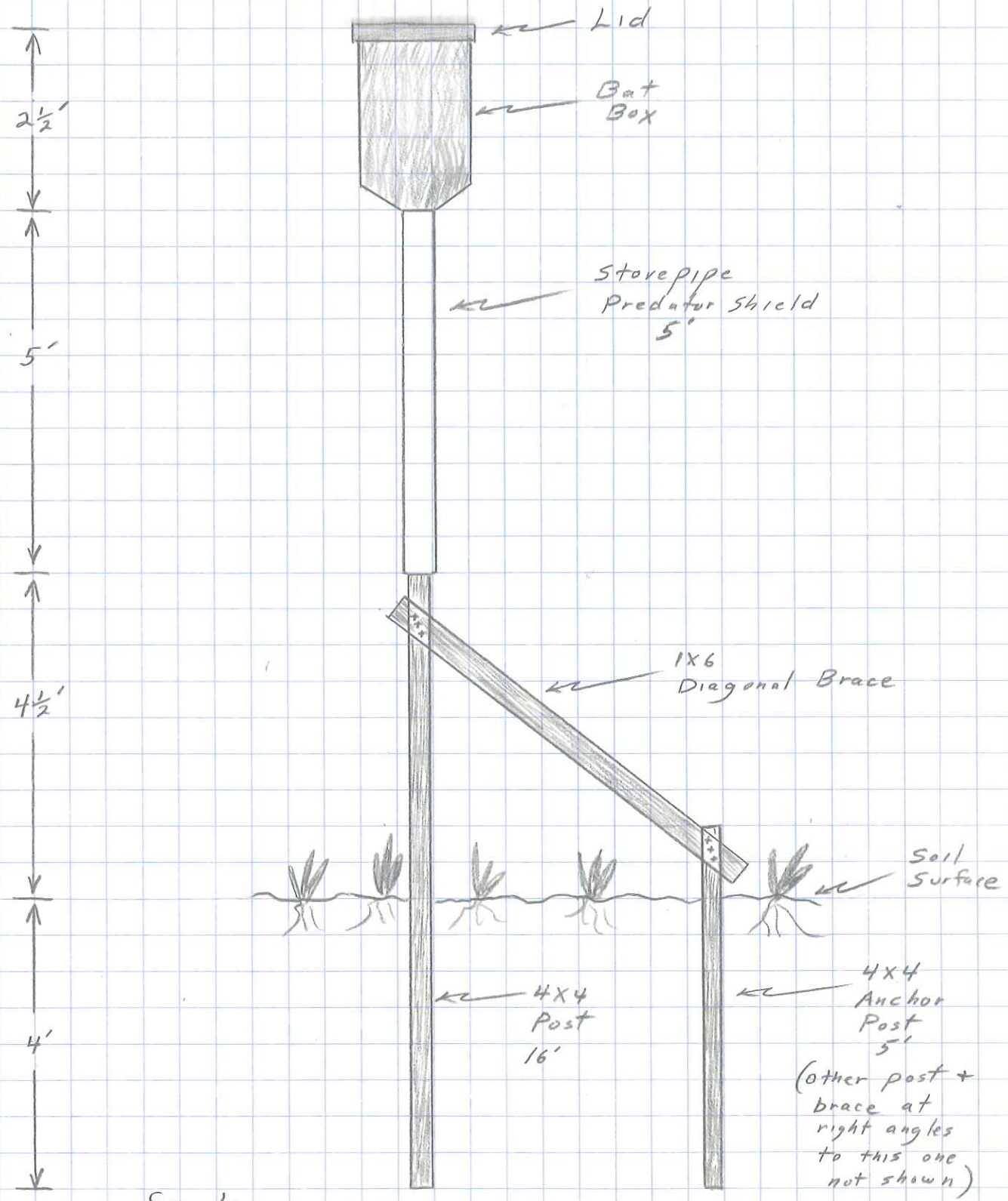


FIGURE 4
SIDE VIEW



Scale

= 1'x1'

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The figures assume that everything is perfectly square, straight and fits tight. Wood is rarely so perfect, but just build the box backboards first, fitting around the center post space, and then the outer dimensions of the box can be adjusted to fit. Use flexible caulking to fill in small gaps where necessary to keep it dry inside and prevent sand leaks, I used Big Stretch brand.

BOX DETAILS ← highlighted yellow on drawings

- The inner ¾ inch plywood backboards are the load-bearing walls, and all the weight of the box is transferred through these to the post. The raised top center tab on these is necessary as a place to screw them into the post. The notches on either side of the tab are necessary for the 3 inch sand pack all across the top of box to have continuity with the sand in the sides. Roughen the side of each backboard which will be inside box.
- Leave enough space between the two backboards to just slip over the 4x4 post later, when installing the box by sliding it over the erected post. Check to see that it actually fits before proceeding with the partitions and outer shell of the box.
- My ¼ inch partitions were veneer plywood, which was too smooth for the bats to grip. I roughened it by scrubbing vigorously with a small block of wood with a dozen deck screws protruding, which pretty much shredded the outermost veneer layers.
- Many sizes and configurations of rebar or scrap iron within the sand pack will work, as long as they are bent to transfer heat between the top and side sand packs. You will find multiple "L" shaped pieces of half inch rebar relatively easy to work with; cutting them with a carbide blade in a skil saw and bending them slowly in a vise while heating a small spot cherry red with a propane or MAPP gas torch. (grit)
- The outer sides of the box are made of grooved exterior plywood siding, with the grooves vertical. Later I stained it dark brown and then treated it with two coats of a 50/50 mix of boiled linseed oil and kerosene. This mix smells strong and takes a couple of months for the odor to dissipate, best done outdoors.
- In the case of extended very hot weather, the box might overheat in spite of the sand pack. The vent holes will allow the bats to move down into a cooler zone and still be sheltered.
- I borrowed a nail gun to shoot the long brads through the interior partitions and spacers, but a hammer would work ok, just slower.
- Only use completely dry sand. Wet sand will freeze and expand in winter, splitting the box. Small dry pebbles will probably work ok in place of sand.
- To prevent sand leaks, caulk any open seams, joints and cracks.
- Stain and linseed oil the sheet metal roof covering, the same as the plywood sides. If galvanized stovepipe is used as predator shield, stain it also, may take several coats.
- The Figures do not show all the details, just enough to get the basics in place, and beyond that it is just ordinary carpentry. The top lid is not illustrated, it is just a piece of plywood screwed onto a board frame that fits loosely down around the upper sides, and all is covered with a thin sheet of aluminum, folded around the edges and corners much like wrapping paper around a box.

INSTALLATION DETAILS

- Auger an 8 inch hole 4 feet deep for the 16 foot treated post. Use a plumb bob to set it perfectly vertical, remembering to face the 4 corners in the four cardinal compass directions so that all 4 sides of the box will see sun A.M. or P.M. Tamp all the removed

dirt back into the hole around the post, yes it will fit if you add it in small "lifts" of 4 or 6 inches, tamping as you go with a skinny pole.

- Set the two 4x4 brace anchor posts also 4 feet deep with one foot exposed, again tamping all dirt back in holes. Attach the 1x6 diagonal braces. When completed, the two diagonal braces should be at right angles to each other and the main post should be nearly immobile even if shaken somewhat vigorously.
- The predator guard, a five foot length of 5 inch stovepipe, should just slide down over the 4x4 post. Crimp it in against the post on all 4 sides on top and secure with small screws. This will keep snakes from climbing up the space between the pipe and post.
- Plan to mount the box on the pole with one landing board facing northeast and the opposing one facing southwest. This puts one of the side sand packs facing northwest to catch the sun at the hottest part of the day.
- The most difficult part of this project was hoisting the completed box up and over the top of the post. Two of us did it standing on stepladders balanced on the tailgate of a pickup truck. This is not recommended, get more people and better equipment. A couple of temporary screws into the post, above the stovepipe, will keep the box from sliding down too far, and the sand plugs at the bottom of the box will keep the bottom of the box centered on the post. Put four long deck screws through each of the two upper backboard tabs above, and each of the two lower backboard landing areas below, for a total of 16 screws attaching the box to the 4 x 4 post.
- Caulk any gaps between post and sand plugs to prevent sand leaks.
- Put the rebar heat transfer iron into the box and suspend temporarily in place with strips of wood or wire. Pour in sand, tap box to settle, and level it flush with top of box.
- Attach lid with two short screws through it's sides.

MONITORING

On a quiet clear evening, as twilight descends, park your chair about 30 feet from box, positioned so that exiting bats will be silhouetted against the sky. They often exit fast and are sometimes just a dark blur and are gone in a moment. If your count increases as summer progresses, it may be the young learning to fly, this is more likely to be true if some observed during later monitoring seem to be smaller (our only smaller adult bat is the pipestrelle, which normally doesn't live in bat houses.) My niece, with better hearing than me, can hear their claws scratching their way down the partitions before exiting. Some individuals may wait to exit until it is too dark to see them, especially if they think you are lurking too close.

Please keep me informed of your progress and problems.

DISCUSSION

- For southeastern Iowa, three inches of sand in the top of a dark brown box represents my best guess at the minimum solar thermal storage/moderation requirements. For cooler central Minnesota, or more cloudy Buffalo, NY, a black box may be more desirable, with perhaps an inch or two more sand for extra thermal storage on bright hot days to prevent overheating.
- A different approach to obtain more serious thermal mass would be to attach small lightweight bat shelters to concrete bridge piers which face the early afternoon sun. I'm just starting to work on this, get back to me for more details.

- For best access to wet soil areas for installing the post and box, late September to mid-October is often the driest time of the year. Another access option is to wait for a crust of soil to freeze but before snow gets too deep. To prevent the soil from freezing right where you want a post to go, weight down a piece of 3 x 3 foot foamboard two inches thick or place a couple of straw bales tight together, or build a mound of leaves or other vegetation sorta like a little muskrat house, and the soil will stay unfrozen all winter.
- In my 2008 version of this model, I used ¼ inch mesh hardware cloth for partitions. This appeared briefly successful, saw a few bats, until house wrens moved in and filled the bat spaces full of sticks by jamming them into the mesh and chased out the bats. After replacement of the hardware cloth with thin plywood partitions the next winter, the wrens were foiled and bats colonized for the summer of 2009.
- Modern treated lumber is very corrosive to ordinary steel. You need to use screws specifically made for this wood product.

TAXONOMY DETAILS

For many decades, Keen's bat was identified as having a nearly coast to coast distribution across the northern latitudes of North America, and was labeled as Myotis keenii septentrionalis. However in 1979, van Zyll de Jong reported some differences in morphology between those living in British Columbia and their more eastern counterparts, so he considered them to be separate species. Some researchers, for example Jones et al, 1992, and Whitaker and Hamilton, 1998, accepted this split, while others disagreed, for example Wilson and Reeder 1992. More modern publications generally accept this split and the eastern population has been renamed the Northern Myotis (Myotis septentrionalis) while the British Columbia population remains Keen's Myotis (Myotis keenii)

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