Updated and Revised - 2013

The Bat House Builder's Handbook

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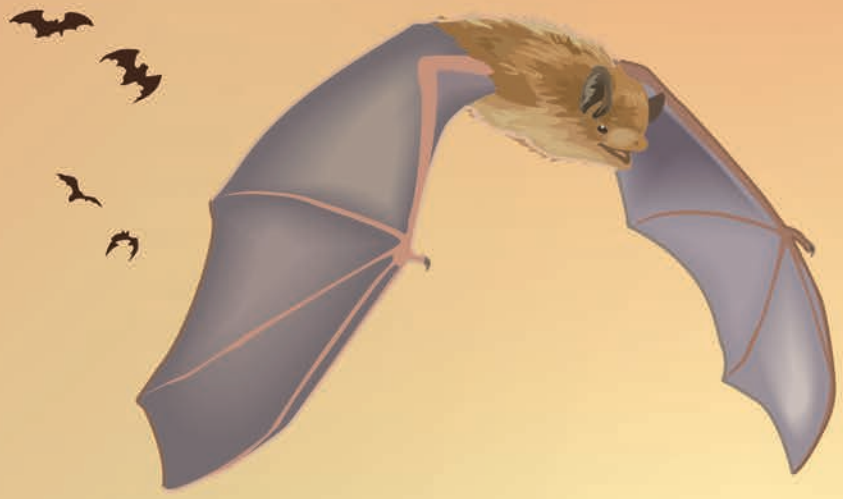

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P.O. Box 162603, Austin, Texas 78716

Dear Friend:

Thank you for your interest in helping bats. Building and installing a bat house can make a difference for bats and help promote a healthy environment. And you can accomplish even more by joining Bat Conservation International.

In addition to funding critical conservation efforts around the world, BCI members receive:

- *BATS* magazine, our quarterly publication filled with full-color photos and the latest discoveries about bats
- Invitations to join workshops, field projects and ecotours, as well as opportunities to see the world's largest bat colony emerge from Bracken Cave in central Texas.

You'll find additional details in this handbook. We hope to hear from you soon.

Sincerely,

Merlin D. Tuttle
Founder and President
Bat Conservation International
-1993-

Cover illustration by David Chapman from artwork by Andrea Peyton

Back cover:
The spectacular sight of large numbers of bats in flight across the evening skies used to be far more common. Many North American bats have lost key roosting habitat, from caves to old-growth forests. Erecting bat houses and carefully observing the results give us a unique opportunity to help these magnificent animals.

PHOTO ' MERLIN D. TUTTLE, BCI / 8406409

This edition was revised and updated in 2013
by Jim Kennedy, Robert Locke and Dianne Odegard of Bat Conservation International
and Laura Seckbach Finn of Fly By Night, Inc.

ISBN 0-9742379-1-4

The Bat House Builder's Handbook

Contents

Why Build a Bat House?

AMERICA'S BATS ARE AN ESSENTIAL PART of a healthy environment. Nevertheless, many bat species are in alarming decline, largely because of unwarranted human fear and persecution and the loss of natural roosts. You can help by putting up a bat house. You'll benefit directly from having fewer yard pests and will enjoy learning about bats and sharing your knowledge with friends and neighbors. Few efforts on behalf of wildlife are more fun or rewarding than helping bats.

As primary predators of night-flying insects, bats play a vital role in maintaining the balance of nature. By consuming vast numbers of pests, they rank among humanity's most valuable allies. Just one little brown myotis can catch a thousand or more mosquito-sized insects in an hour, and a colony of 150 big brown bats can catch enough cucumber beetles each summer to prevent egg laying that otherwise could infest local gardens with 33 million rootworms. Cucumber and June beetles, stinkbugs, leafhoppers, and cutworm and corn earworm moths – all well-known pests – are just a few of the many insects consumed by these frequent users of bat houses. In addition, many pests flee areas where they hear bat echolocation sounds.

Our immediate goal is to preserve America's most widespread species in sufficient numbers to maintain nature's balance and reduce demands for chemical pesticides. Thanks to a decade of BCI-sponsored bat house research we are now able to accommodate 14 species of North American bats in the bat houses described in this handbook, including threatened and endangered species such as the Indiana myotis and Wagner's bonneted bat. Bat houses are being used from Mexico and the Caribbean to British Columbia and Newfoundland.

Best of all, if you carefully follow instructions, your odds of success exceed 80 percent. Isn't it about time to extend a helping hand in exchange for a healthier neighborhood?

Bat house designs continue to evolve. Rocket boxes, invented by former U.S. Forest Service biologists Dan Dourson and John MacGregor, are being used by at least eight species of crevice-dwelling bats across North America (*Figures 6 and 7, pages 14-15*). This design allows bats to choose sunny or shaded sides, depending on their temperature preference.

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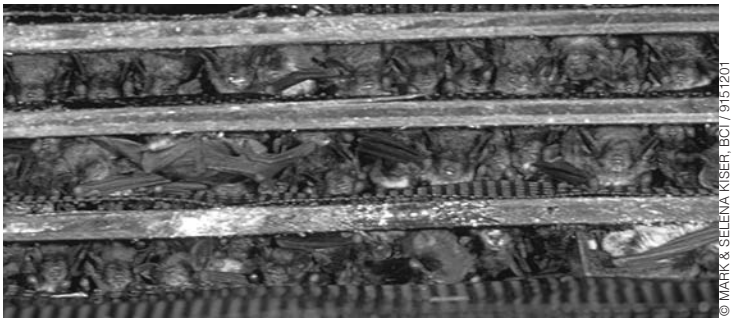

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Putting up a bat house is one of the more rewarding ways to help wildlife. A maternity colony of several hundred little brown myotis raised young in this back-to-back pair (only one side shown) of nursery houses in British Columbia, Canada. Bat houses like these are now providing shelter for thousands of North American bats each year.

Building a Community Bat House

SOMETIMES YOU NEED A REALLY BIG BAT HOUSE – one that can handle thousands of bats. BCI can help with that.

As communities become more aware of the importance of bats, humane exclusions are becoming the rule when bat colonies are discovered in buildings. But the displaced bats still need a place to live, and there often are many more bats than traditional bat houses can handle.

BCI worked with architects and engineers to design a "community bat house" that's 10 feet square and mounted on utility poles. With hundreds of removable chambers, the structure can house up to about 30,000 bats.

Initial construction plans have been amended to give the community bat house broader utility and to ensure it meets typical state and local building codes. Several of these structures have been built recently by conservation-minded communities in Florida and Canada.

Construction plans for BCI's community bat house are available free by contacting BCI's Artificial Roosts Coordinator at *bathouses@batcon.org*

COURTESY OF CORI LAUSEN

This "bat condo," based on BCI's plans, can house up to 30,000 bats. It was built at the Creston Valley Wildlife Management Area in British Columbia, Canada.

Building Your Bat House

New discoveries greatly enhance our ability to attract bats ...

VOLUNTEERS WITH BCI's Bat House Project conducted research on hundreds of bat houses and other artificial roosts. The designs illustrated on the following pages incorporate the most successful features identified in those tests. The correct bat house for you depends on available tools and lumber, your skill as a carpenter, your budget and your expectations. You can, of course, modify your bat house to adjust for location-specific factors, such as climate and the preferences of local species.

Key Criteria for Successful Bat Houses

Design

The most successful bat houses have roost chambers at least 20 inches tall and at least 14 inches wide. Taller and wider houses are even better. Rocket boxes, a newer pole-mounted design with continuous, 360° chambers, should be at least 3 feet tall (*Figure 6 on page 14*). All houses should have 3- to 6-inch landing areas extending below the entrances or recessed partitions with landing space inside.

The number of roosting chambers is not critical, but in general, the more chambers the better. Single-chambered houses (*Figure 3 on page 10*) should be mounted on wooden or masonry buildings, which helps to buffer temperature fluctuations. Houses with at least three chambers are more likely to provide appropriate ranges of temperature and better accommodate the larger numbers of bats typical of nursery colonies. Two single-chamber houses can be mounted back-to-back on two poles to create a three-chamber bat house.

Our nursery house plans on pages 11-13 (*Figures 4 and 5*) represent the best compromise between bat needs and builder convenience. The 17½-inch width enables builders to make two houses from a half-sheet each of ⅜-inch and ½-inch plywood and sharply reduces waste materials. Widths of 24 inches or more and heights of 36 inches or more are preferred by many bats. Greater heights are not often necessary but might be appreciated for their greater thermal gradients.

Roost partitions should be carefully spaced ¾ inch to 1 inch apart. Three-quarter inch is generally preferable, although some small myotis bats and tri-colored bats may prefer roosting crevices between ½ inch and ¾ inch, while larger bats may prefer 1 inch to 1½ inches. Chambers greater than ¾ inch, however, are more likely to attract non-target animals, such as wasps, rodents and birds.

Partitions and landing areas must be modified to provide footholds for bats. These can be created in various ways. The best method for wooden bat houses is scoring or grooving surfaces horizontally every ¼ to ½ inch. Scoring tools can be made from blocks of wood with screws protruding through one side, or you can use shallow saw cuts ½₂- to ⅛-inch deep. Do not cut deeper into plywood or it will quickly deteriorate. After roughening, interior plywood surfaces should be protected with dark, water-based stain. Stucco coatings applied to plastic roosting surfaces (after first sanding the plastic) have proven successful for years.

UV-resistant plastic mesh can also be used. We recommend the ⅛-inch- or ¼-inch-square, heavy-duty plastic mesh. The mesh must be securely stapled every two inches across the entire surface and along all edges (do not cover ventilation slots). Mesh is attached to one side of each roost partition and to the backboard and the landing area.

We do not recommend any metal mesh or metal hardware cloth, as these are abrasive and can injure bats. Nylon or fiberglass window screening typically wears out quickly and can trap and kill bats. It is not recommended.

Ventilation slots are critical in houses that will be used where average high temperatures in July are 85°F or above. Half-inch slots should be used to reduce the entry of light and unwanted guests, such as birds. The front vent should extend from side to side about six inches above the bottom (for houses three feet or taller, approximately one-third the distance from the bottom). A vertical vent, ½ inch wide by six inches long, should be included at each end of the rear chamber of multiple-chamber houses.

The vents greatly reduce the odds of overheating on extra hot days and especially contribute to success in moderate or hot climates. They may be unnecessary in exceptionally cool areas.

When nursery houses are mounted in back-to-back pairs on poles (*Figure 2 on page 8*), an additional horizontal vent slot – like the one in front, but ¾ inch tall – should be added in the rear. This slot allows bats to move from one house to the other without going outside. Such an arrangement also provides ideal temperature ranges for nursery colonies.

Construction

For single-chamber and nursery houses (*Figures 3 to 5*), ½-inch (or thicker) exterior plywood is ideal for fronts, backs and roofs, while 1- or 2-inch-thick boards are best for

the sides. One-inch (¾-inch nominal size) cedar or poplar lumber is recommended for rocket boxes. Roofs for any house type can be built of ¾-inch exterior plywood to increase longevity. Cover roofs with shingles or metal for extra protection. Plywood should have a minimum of four plies for durability. Use of ⅜-inch plywood for roosting partitions reduces weight and allows more roosting space for a given house size.

Pressure-treated wood contains chemicals that may be toxic to bats and should be used only if sealed by painting. Alternative materials, such as plastic or fiber-cement board, may last longer than wood and require less maintenance.

Coated deck screws or other exterior-grade screws should be used instead of nails to assemble houses. Staples used to attach plastic mesh should not protrude from the backs of panels and must be exterior grade or galvanized to prevent corrosion. All seams must be caulked, especially around the roof, prior to painting. Latex caulk is paintable and is the easiest to use.

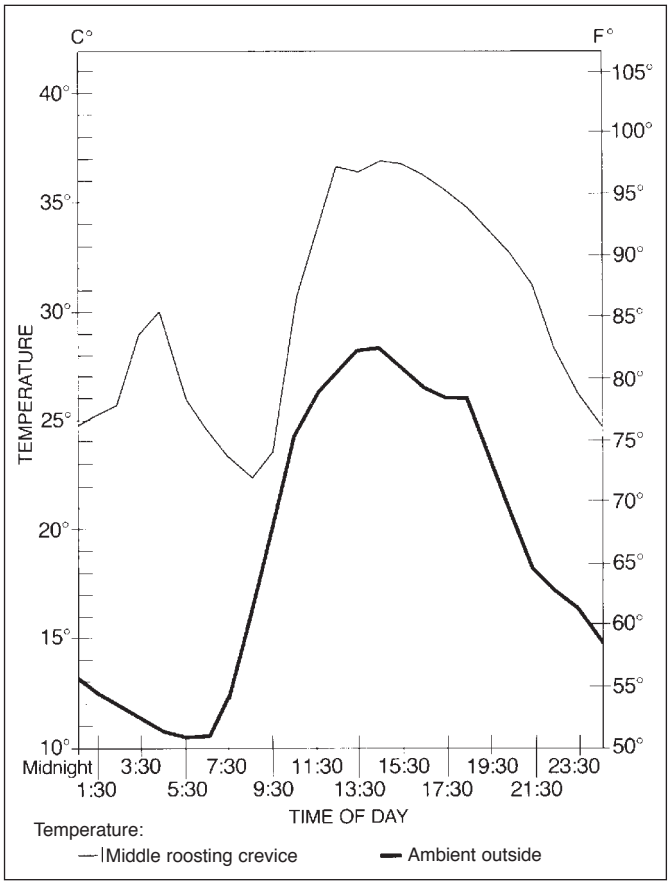
Wood treatment

Bats apparently like dry, non-drafty homes as much as we do, so bat houses need to be carefully caulked and painted. Providing sufficient warmth without overheating is a key element in attracting bats. To protect against moisture, air leaks and wood deterioration, apply one coat of primer to all outer surfaces, including vent openings and landings and entry areas. Follow that with two coats of flat exterior, water-based paint or stain. Do not use oil-based products. Application of two coats of dark paint or stain to inside plywood surfaces prior to assembly greatly extends the life span of the bat house and provides a darker interior.

Research shows that bat houses in cool climates need to absorb much more solar heat than those in hot climates. Houses should be stained or painted black or dark where average high temperatures in July are 85° F or less; dark or medium colors (such as brown, gray or green) at 85-95° F; medium or light colors at 95-100° F; and light or white where July averages exceed 100° F. (*See Figure 8 on page 17 for recommended paint colors.*) Much depends upon the amount of sun exposure. Darker colors help absorb more heat from less sun.

Sun exposure

When choosing a location for your bat house, both sun exposure and heat absorption (based on house color) must be carefully considered. Too little sun exposure is the most important known cause of bat house failure, even in relatively hot climates as far south as Florida and Texas. Overheating, though a possibility, can be greatly reduced by using ventilation slots (*see Design section on page 6*). Ventilated houses with tall chambers allow bats to move vertically to find their preferred temperatures through daily and seasonal cycles, which provides a wider margin for error in selecting appropriate sun exposure and color.



(Courtesy of Lisa Williams, Pennsylvania Game Commission)

FIGURE 1: This graph compares internal and external temperatures over a 24-hour cycle at a bat house occupied by a nursery colony of little brown myotis in Pennsylvania. Temperatures in roosting crevices remained in the 80-100°F range for 16 hours a day, falling below 80° only for eight hours in the morning. The house is similar to our nursery design and is vented, covered with black tar paper and exposed to approximately seven hours of full sun each day.

Bats in nursery colonies prefer warm houses, ideally where temperature gradients cover at least a 10° to 15° F range, predominantly between 80° and 100° F, meaning that their roosts require solar heating in all but the hottest climates. The graph in Figure 1 (*above*) illustrates the impact of solar heating on a black bat house by comparing internal and external temperatures over a 24-hour cycle. This house was occupied by a nursery colony of little brown myotis.

In areas where high temperatures in July average 80° F or less, houses should be black and receive at least 10 hours of daily sun; more may be better. Even in areas where high temperatures in July average less than 100° F, houses of appropriate color should receive at least six hours of direct sun daily.

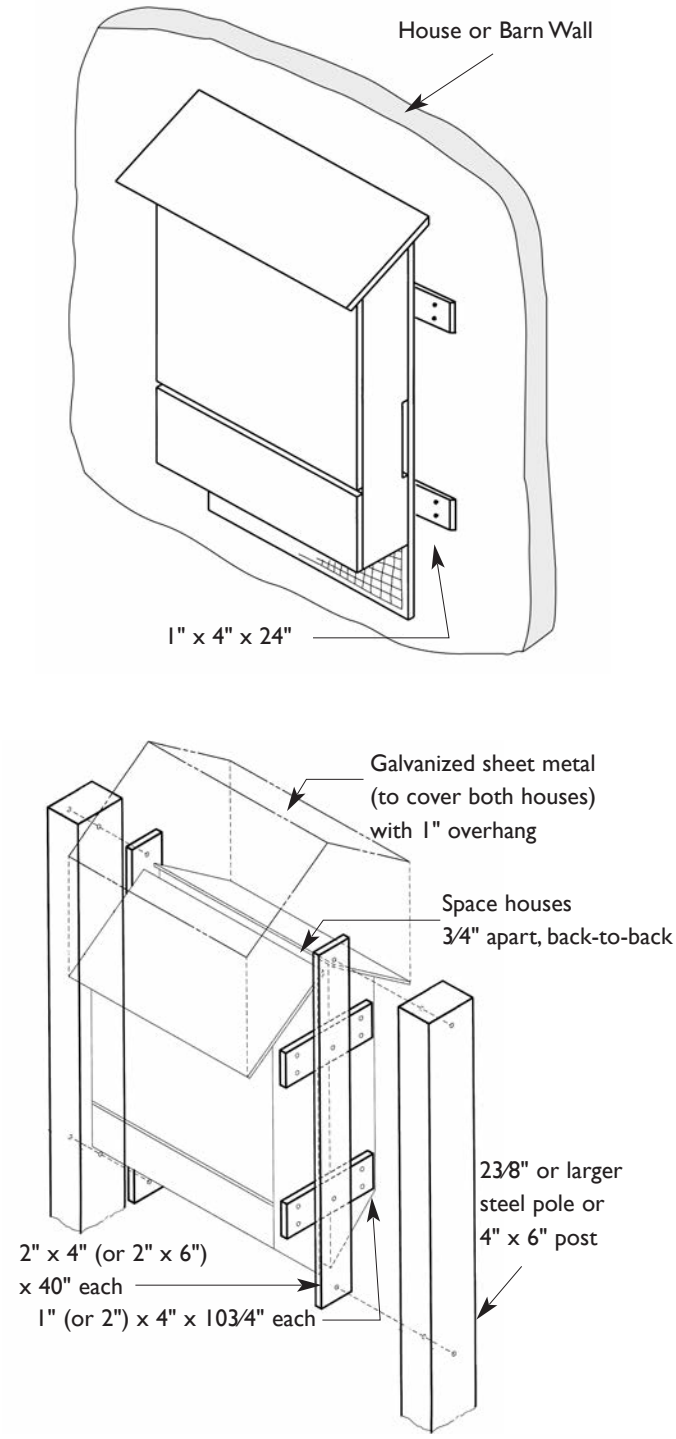


FIGURE 2: Nursery houses can be mounted independently on the side of a building or on a pole. However, when houses are mounted back-to-back in pairs, the space between can accommodate more bats and provide an especially well-ventilated area for use on hot days. The tin roof is optional, but aids greatly in protecting the houses from midday sun and creates extra roosting space.

Some sheltered locations, such as barn lofts (*photo on page 25*) or underneath pole barns or porches, can be used successfully, as long as enough of the heat absorbed by the building's roof reaches the bat house. Under these conditions, bat houses typically must be close to the roof to receive adequate warmth.

When two houses are mounted back-to-back on poles, attached at the sides and covered by a tin roof (*Figure 2*), solar heat gain is reduced at midday, when the risk of overheating is greatest. This provides a wide range of temperatures between the house that's exposed to full sun and the one that is largely shaded by the other, partly because heat transfer is minimized by the ventilated area between them.

By roughening the backs of both houses and providing a ¾-inch horizontal ventilation slot in the rear of each, another roosting chamber is created with access from either house or the sides. An exceptional temperature range is provided for bats to choose from, with a much-reduced risk of overheating.

In climates where high temperatures in July average 100° F or more, extra protection can be provided by extending the overhang of the metal roof to lengthen the period of midday shade.

Habitat

Most nursery colonies choose roosts within a quarter-mile of permanent fresh water, preferably a stream, pond, river or lake. Greatest bat house success has been achieved in areas of diverse habitat, especially where there is a mixture of agricultural use and natural vegetation (as is often the case around orchards) .

Some myotis are most likely to use bat houses located near caves or abandoned mines, where they can hibernate in winter. Big brown bats can hibernate in buildings, cliff-face crevices and other non-cave locations. Many Mexican free-tailed bats migrate south for the winter, although others remain near their summer roosts. Bat houses are also more likely to succeed in areas where bats are frequently found in buildings, particularly where they have been excluded from buildings.

Mounting

Bats find houses mounted on poles or buildings in less than half the time they typically need to find houses mounted on trees. Tree-mounted houses also appear to be less attractive, as they tend to receive less sun and are more vulnerable to predators. Houses mounted under the eaves on wood or stone buildings, but still exposed to the sun, tend to be better protected from rain and predators and have been especially successful.

Nursery colonies of up to 1,100 bats have been attract-

ed to pairs of nursery houses mounted on poles back-to-back, ¾ inch apart and covered by a tin roof (*Figure 2*). Buildings offer good mounting sites almost everywhere, but they are essential in very cool or dry climates. In dry areas, where day-to-night temperatures may vary by more than 28° F, buffering from nighttime extremes is needed.

Where climates are moderate to hot with average to high humidity, it is best to test pairs of houses mounted back-to-back on poles – a light one facing north and a moderate to dark one facing south. Houses of different colors can also be tested side by side on buildings, with both houses facing the same direction, in any climate. By observing roost choices of the first occupants, bat preferences can be determined and met by varying the color or sun exposure for subsequent houses.

In intermediate to hot climates, bats typically prefer vented houses, with open bottoms, that provide a wider range of temperatures in a single house. This permits the bats to move vertically to find preferred roosting temperatures as exterior temperatures change.

In the coolest climates, houses can be tested without vents and with all but ¾ inch of the sloping bottom covered; this combination increases inside temperature by reducing air circulation.

All bat houses should be caulked and painted or stained to prevent deterioration and leaks. Any leaks that develop must be repaired. Except in extreme southern Florida and the western United States, where larger species may prefer 1- to 1½-inch crevices, ¾-inch crevices seem best.

To the extent possible, locate all houses 20 to 30 feet from tree branches or other obstacles and 12 to 20 feet above ground (or above the tallest vegetation beneath the bat house). Those located nearest an area's largest water source are typically the most successful, as are those in or adjacent to the most diverse or natural vegetation (*Table 1*). The best locations are along streams, rivers, lakes or forests because these are natural bat flyways.

Protection from predators

Safety from predators appears to be a key factor in bats' choice of bat houses. Those mounted on the sides of buildings or high up on poles provide the best protection. The largest colonies attract the most predators and require the greatest height. Locations at least 20 feet from the nearest tree branches or utility wires reduce obstructions and predation and often receive more sunlight.

Where climbing snakes or raccoons occur, you may need to purchase predator guards from a supplier of purple martin birdhouse products. Or you can make your own guards by tightly covering the upper end of a 3-foot section of 10-inch-diameter galvanized stove pipe with ¼-inch hardware cloth and cutting a hole in the middle for a bat house pole. Place one predator guard around each pole about four feet above the ground. Snakes typically try to climb the inner pole to the screen and give up.

You may further thwart climbing invaders by occasionally oiling the exterior metal. If bats suddenly disappear at a time when they traditionally have been present, the most likely culprits are rat snakes, although other predators can have the same effect.

Avoiding uninvited guests

Houses with open bottoms are far less likely to be occupied by birds, mice, squirrels or parasites, and they do not require removal of accumulated droppings. Wasps do not normally cause problems once bat colonies move into bat houses. Paper wasps, the ones with painful stings, rarely build nests in ¾-inch spaces. If they begin to build a nest at a house entrance, they can be discouraged with blasts of water from a garden hose before their workers emerge. Mud daubers are seldom aggressive and have weak stings. If their nests accumulate inside, just scrape or hose them out when bats are not present.

Cleaning and maintenance

Cleaning open-bottomed houses is unnecessary unless mud dauber or wasp nests accumulate.

Maintenance should not be needed for the first several years for houses that have been carefully caulked and painted before being put up. Recaulking and painting may be necessary eventually, however, and should be done when bats are not present. Drafty houses may be abandoned by bats if not repaired.

Importance of local experiments

We have much to learn about the needs of individual bat species in some areas. Before putting up more than a few houses, you should test for local needs, especially by comparing the occupancy rates of houses with different sun exposures and shades of a color for heat absorption.

To determine the temperature needs of local bats, first try the colors and sun exposures that we recommend. Then try mounting two houses side-by-side on a building where they receive similar sun; paint one darker than the other to see which one the bats prefer. Alternatively, paint one pair of pole-mounted houses darker than another pair, or extend the roof to provide more shade.

When bats move in, observe their behavior to see which house or pair of houses they prefer during temperature extremes through a daily or seasonal cycle. Their choices will provide important clues to their needs, enabling you to enjoy improved success with future houses.

Four-chamber Nursery House

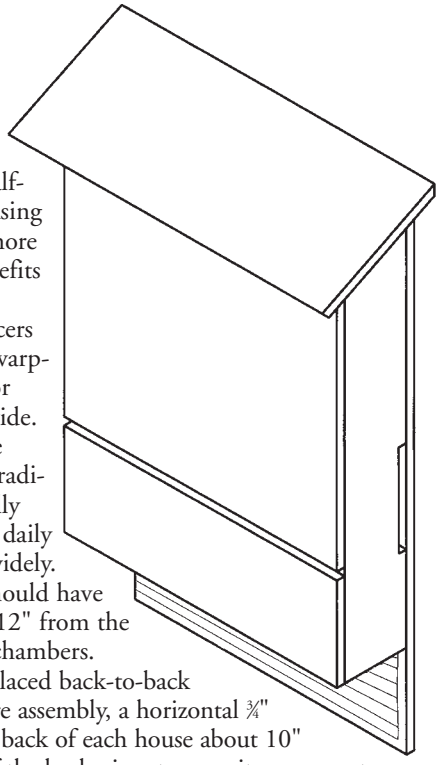
Materials (makes two houses) • *Diagrams on pages 12 & 13*
½ sheet (4' x 4') ½" AC, BC or T1-11 (outdoor grade) plywood
½ sheet (4' x 4') ⅜" AC or BC (outdoor grade) plywood
Two pieces 1" x 6" (¾" x 5½" finished) x 8' pine or cedar
One lb. coated deck or exterior-grade screws, 1⅝"
20 to 25 coated deck or exterior-grade screws, 1¼"
20 to 25 exterior-grade screws, 1"
One quart dark, water-based stain, exterior grade
One quart water-based primer, exterior grade
Two quarts flat water-based paint or stain, exterior grade
One tube paintable latex caulk
Black asphalt shingles or galvanized metal
12 to 20 roofing nails, ⅞"

Recommended tools

Table saw or circular saw	Paintbrushes
Variable-speed reversing drill	Hammer (optional)
Screwdriver bit for drill	Tin snips (optional)
Tape measure or yardstick	Bar clamp (optional)
Caulking gun	Sander (optional)

Construction

1. Measure, mark and cut out all wood according to the sawing diagrams on pages 12 and 13.
2. Roughen interior and landing surfaces by cutting horizontal grooves with sharp object or saw. Space grooves ¼" to ½" apart, cutting 1/32" to 1/16" deep.
3. Apply two coats of dark, water-based stain to interior surfaces. Do not use paint unless the grooves are quite deep.
4. Attach side pieces to back, caulking first. Use 1⅝" screws. Make sure top angles match.
5. Attach 5" and 10" spacers to inside corners per drawings on page 12. Use 1" screws. Roost-chamber spacing will be ¾" (front to back). Do not block side vents.
6. Place first roosting partition on spacers even with bottom edge of roof. Place 20" spacers on partition and screw to first spacers (through partition), using 1⅝" screws.
7. Repeat step 6 for remaining spacers and partitions.
8. Attach front to sides, top piece first (caulk seams). Be sure top angles match (sand if necessary). Leave ½" vent space between top and bottom front pieces. A bar clamp may be useful if sides have flared out during construction.
9. Attach roof supports to the top inside of front and back pieces with 1" screws. Don't let screws protrude into roosting chambers.
10. Caulk around all top surfaces, sanding first if necessary to ensure good fit with roof.
11. Attach roof to sides and roof supports with 1¼" screws. Caulk around roof and side joints to further guard against leaks and drafts. Don't let screws protrude into roosting chambers.
12. Paint or stain exterior three times (use primer for first coat).
13. Cover roof with shingles or galvanized metal.

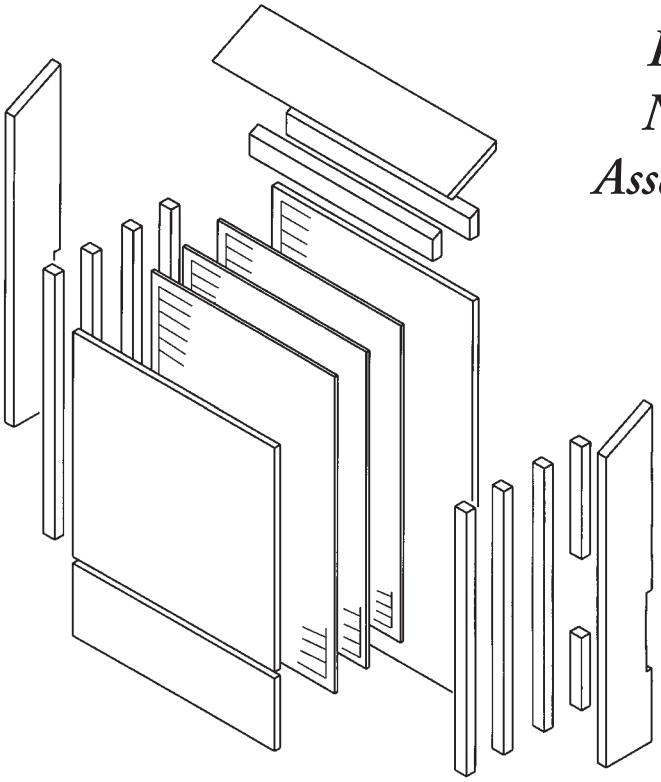


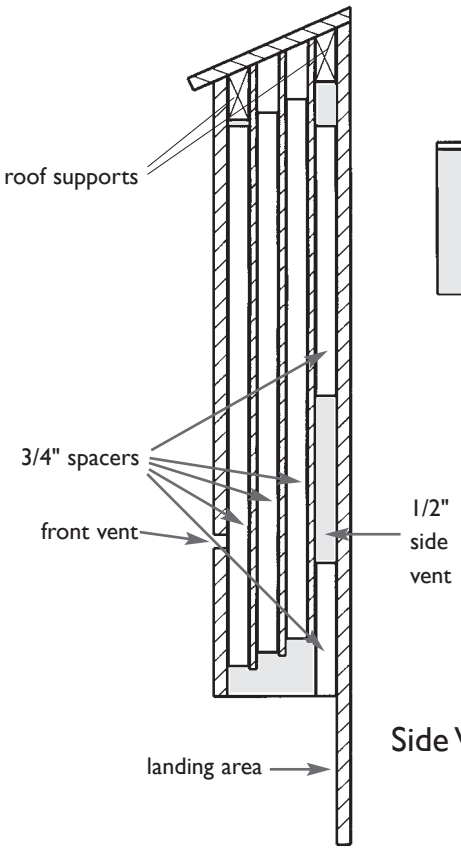
Optional modifications

1. These nursery-house dimensions were chosen to permit construction of two bat houses per half-sheet of plywood. Increasing house width to 24" or more or adding partitions benefits bats and attracts larger colonies. Additional spacers are required to prevent warping of roost partitions for houses more than 24" wide.
2. Taller bat houses provide improved temperature gradients and may be especially useful in climates where daily temperatures fluctuate widely. Bat houses 3' or taller should have the horizontal vent slot 12" from the bottom of the roosting chambers.
3. Two bat houses can be placed back-to-back mounted on poles. Before assembly, a horizontal ¾" slot should be cut in the back of each house about 10" from the bottom edge of the back piece to permit movement of bats between houses. Two pieces of wood, 1" x 4" x 10¾", screwed horizontally to each side, will join the two boxes. Leave a ¾" space between the two houses, and roughen the wood surfaces or cover the back of each with plastic mesh. One 2" x 4" x 40" vertical piece, attached to each side, over the horizontal pieces, blocks light but allows bats and air to enter. Use a 2" x 6" vertical piece if securing houses with U-bolts to metal poles. A galvanized metal roof that covers both houses protects them and helps prevent overheating. Eaves should extend about 3" in front in southern areas and about 1½" in the north.
4. Ventilation may not be necessary in cold climates. In that case, the front of the bat house should be a single, 23"-long piece. Far-northern bat houses may also benefit from a partial bottom to help retain heat. Slope the sides and bottom at an angle of 45° or greater to reduce guano build-up. Leave a ¾" entry gap at the back and be sure the bottom does not interfere with access to the front crevices. A hinged bottom is required to permit annual cleaning.
5. Durable plastic mesh can be substituted for roughening. Attach mesh to backboard, landing area and one side of each partition after staining interior, but prior to assembly. Use only ⅛-inch HDPE plastic mesh (such as "bat house netting XV1672" from www.industrialnetting.com/bat_houses.html) and attach every two inches with 3/16" stainless steel staples.
6. Make partitions removable by attaching small cleats with thumbscrews to the bottom of side pieces for support. Spacer strips are unnecessary if grooves for partitions are cut in the side pieces with a router or dado saw blade.

FIGURE 4

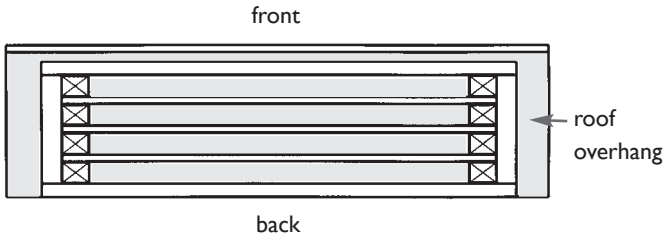
Four-chamber Nursery House Assembly Diagrams

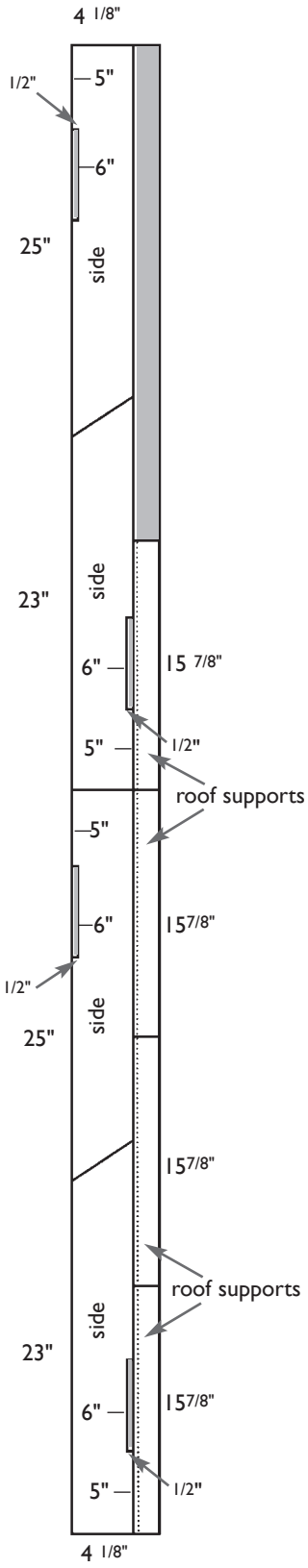




Side View

Bottom View

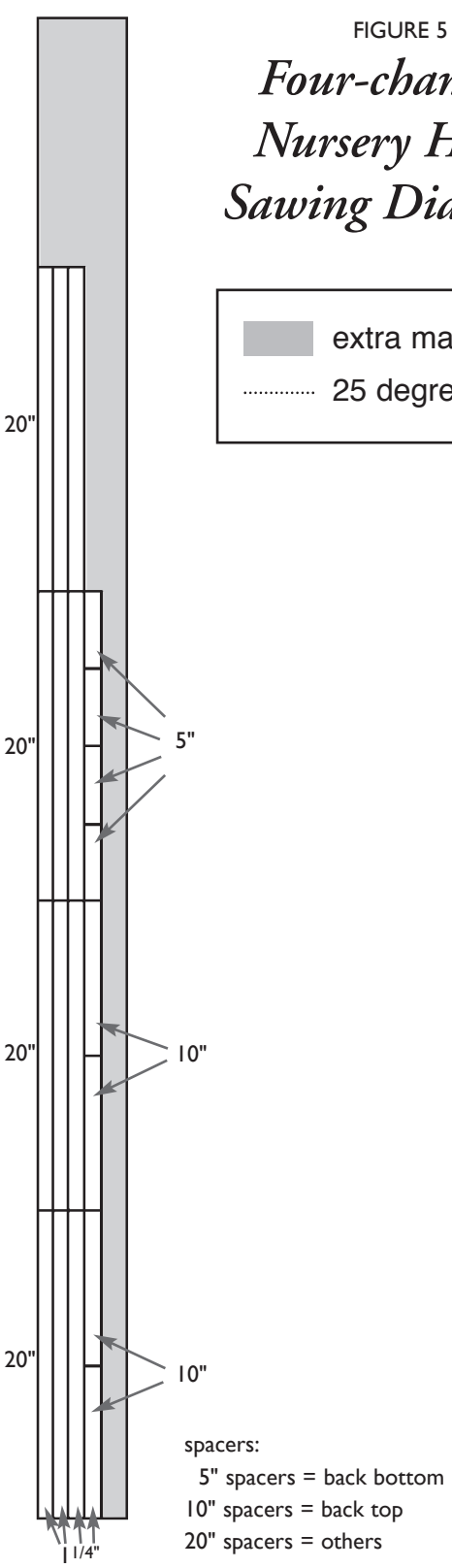




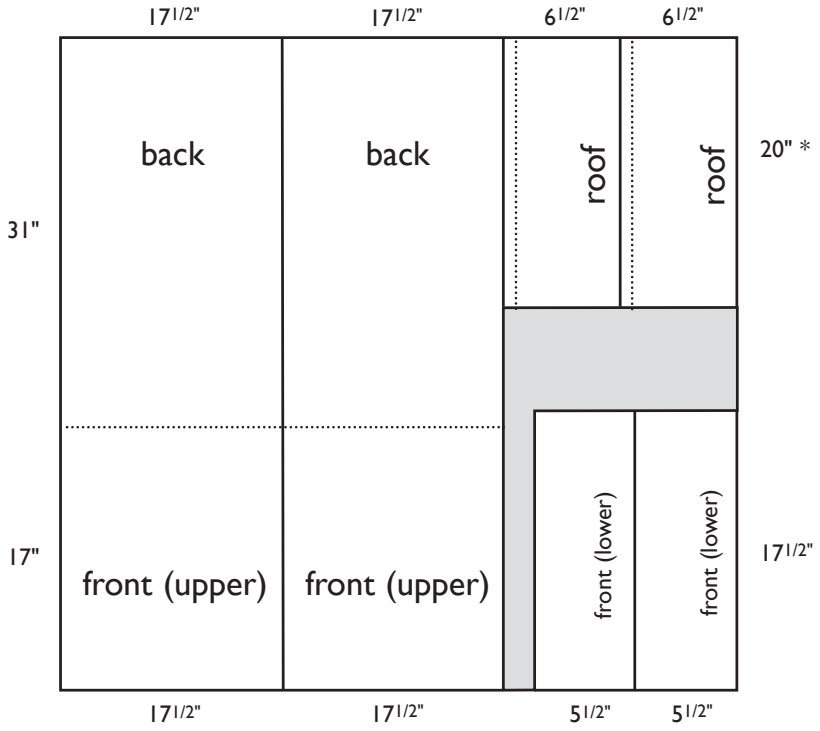
1" x 6" x 8' board

FIGURE 5

Four-chamber Nursery House Sawing Diagrams

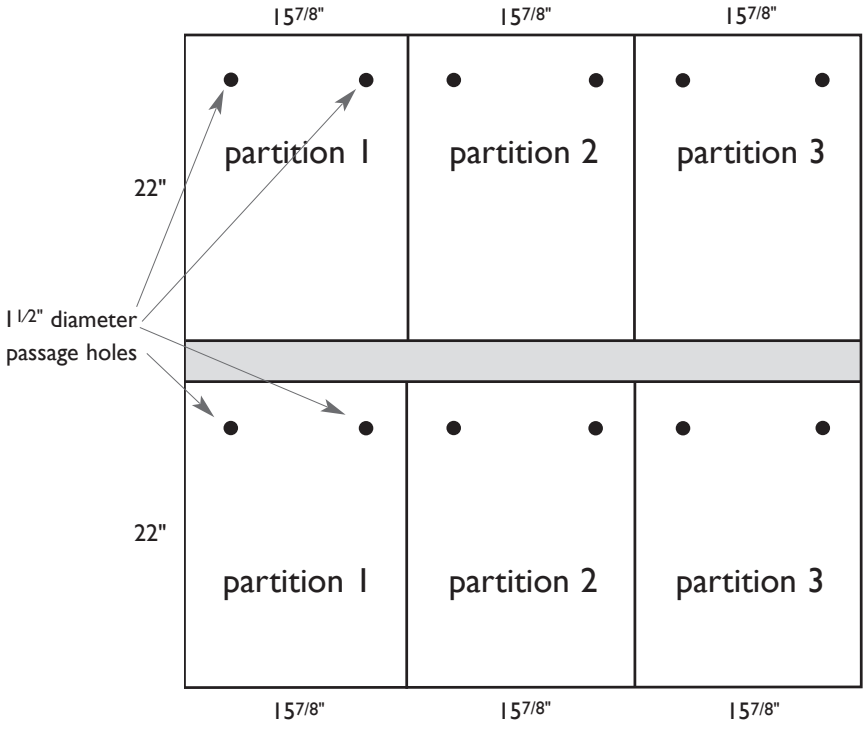


1" x 6" x 8' board



4' x 4' x 1/2" plywood

* 19" if mounted between two poles



4' x 4' x 3/8" plywood

Two-chamber Rocket Box

Materials (makes one house)

2" diameter (2⅜" outside diameter) steel pole, 20' long
Two 1" x 4" (¾" x 3½" finished) x 8' boards*
Two 1" x 8" (¾" x 7¼" finished) x 8' boards*
Two 1" x 10" (¾" x 9¼" finished) x 6' boards*
24" x 24" x ¾" piece of AC exterior plywood
Box of 100 exterior-grade screws, 1⅝"
Box of 100 exterior-grade screws, 1¼"
16 to 32 exterior-grade screws, 2"
20 to 30 roofing nails, ⅞"
One quart water-based primer, exterior grade
Two quarts flat, water-based stain or paint, exterior grade
Asphalt shingles or dark galvanized metal
One tube paintable latex caulk
Two ¼" x 4½" carriage bolts, washers and nuts

** Western red cedar or poplar preferred*

Recommended tools

Table saw or circular saw
Caulk gun
Hammer
Tape measure
Square
Jigsaw, keyhole saw or router
Sandpaper or sander
Rasp or wood file
Variable-speed reversing drill
1½" hole saw or spade bit
⅛" and ¼" drill bits
Screwdriver bit for drill

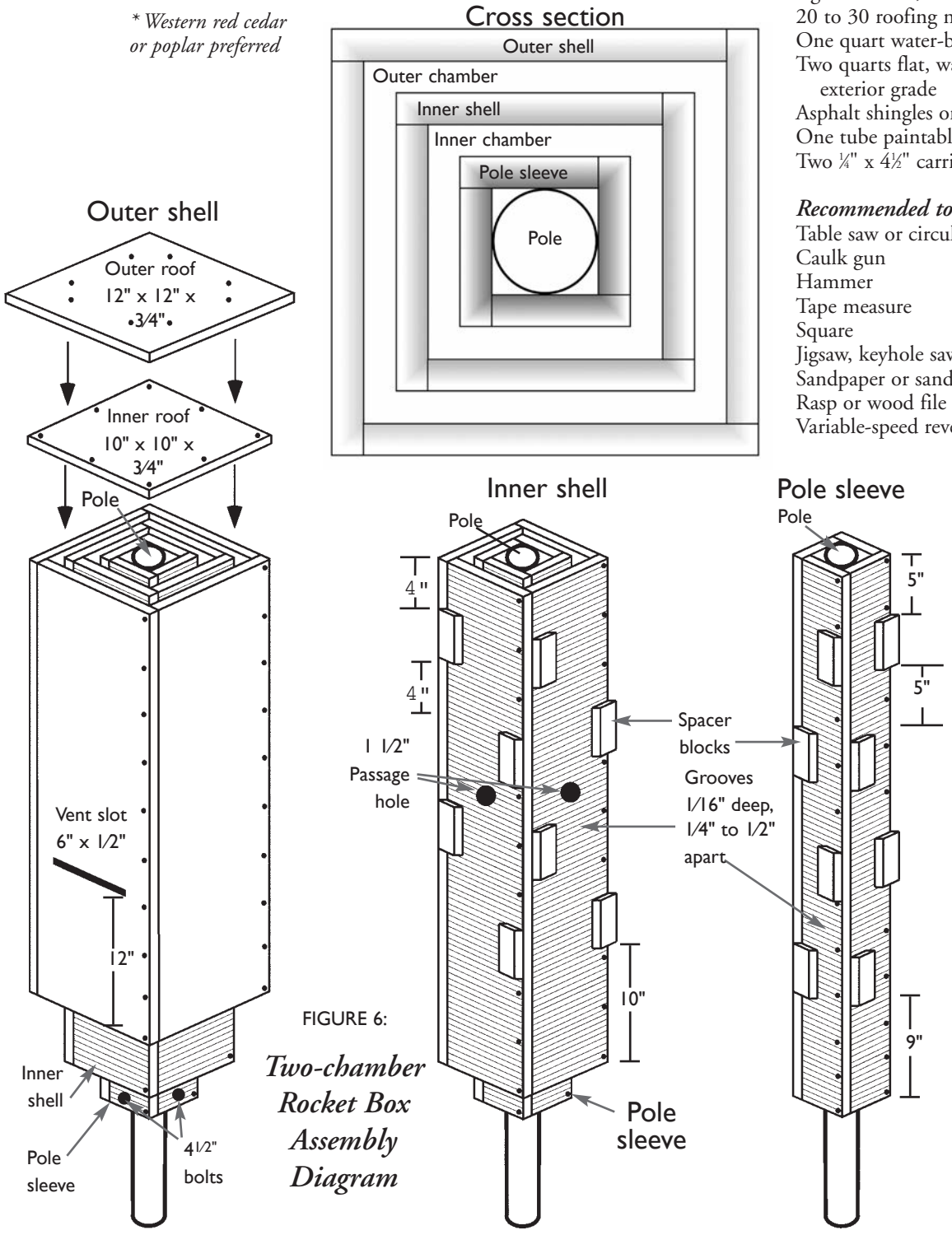


FIGURE 6:
Two-chamber Rocket Box Assembly Diagram

Construction

1. Measure, mark and cut out parts according to Figure 7. Dimensions must be exact for correct fit. Cut out two vent slots and four passage holes as shown.
2. Cut 1/16"-deep horizontal grooves ¼" to ½" apart on one side of all 36" and 45" boards and on both sides of all 42" boards. Sand to remove splinters.
3. Drill two ⅛" holes through each ¾" x 1½" x 4" spacer block to prevent splitting.
4. Assemble four pole sleeve boards into a hollow, square box as shown using 1⅝" screws and caulk. Pre-drill holes to prevent splitting. Countersinking holes may also help.

5. Attach spacer blocks to pole sleeve as shown (four per side) using two 1¼" screws per block. Bottom spacer blocks are 9" up from bottom of pole sleeve. Top spacer blocks are 5" from top. Alternate spacer blocks on left and right sides, 5" apart.
6. Assemble four inner shell boards into a hollow, square box as in step 4.
7. Slide pole sleeve into inner shell until top edges are flush. Bat passage holes will be towards the top. Mark location of spacer blocks. Secure inner shell to pole sleeve with 2" screws through the spacer blocks to ensure no screws protrude into roosting chambers. Pre-drill holes first to avoid splitting spacer blocks (countersinking holes may also help).
8. Attach spacer blocks (4 per side) to inner shell as shown, using two 1¼" screws per block. Bottom spacer blocks are 10" up from the bottom edge of the inner shell. Top spacers are 4" from top. Alternate spacers left and right sides, 4" apart.
9. Assemble four outer-shell boards into a hollow, square box as in step 4. Vent slots are on opposing sides and oriented towards the bottom.
10. Slide finished outer shell over inner shell, so that 6" of inner shell protrudes below outer shell. Mark locations of spacer blocks. Secure outer shell to inner shell as in step 7 (pre-drill holes first). Ensure that no screws protrude into the roosting chambers.
11. Caulking first, attach inner roof to box with 1¼" screws. Carefully drive screws into top edges of shells to prevent screws from entering roosting chambers.
12. Center and attach outer roof to inner roof with 1¼" screws, caulking first.
13. Paint or stain exterior three times (use primer for first coat). Cover roof with shingles or dark galvanized metal.
14. Slide completed rocket box over pole. One inch up from the bottom edge of pole sleeve, drill a ¼" hole all the way through pole and sleeve. Rotate box and pole 90° and drill another ¼" hole, 2 inches from the bottom, through pole and sleeve. Secure box to pole with two 4½" bolts, washers and nuts. Orient vent slots north and south during installation.

Optional modifications to the rocket box

1. For extra mounting height, insert a 4½" bolt and nut about halfway up through pole sleeve after completing step 5.
2. For extra heat-holding capacity, create a compartment in upper half of pole sleeve with a 2½"-square piece of leftover plywood. Fill upper half of sleeve with sand, gravel or dirt, and seal with another piece of plywood flush with top.
3. In warmer climates, a larger outer roof with more overhang can be used for additional shading.

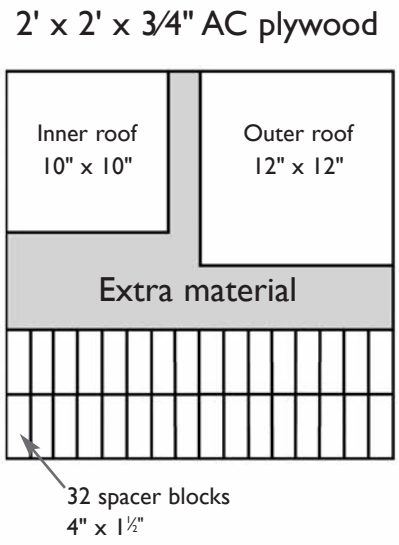
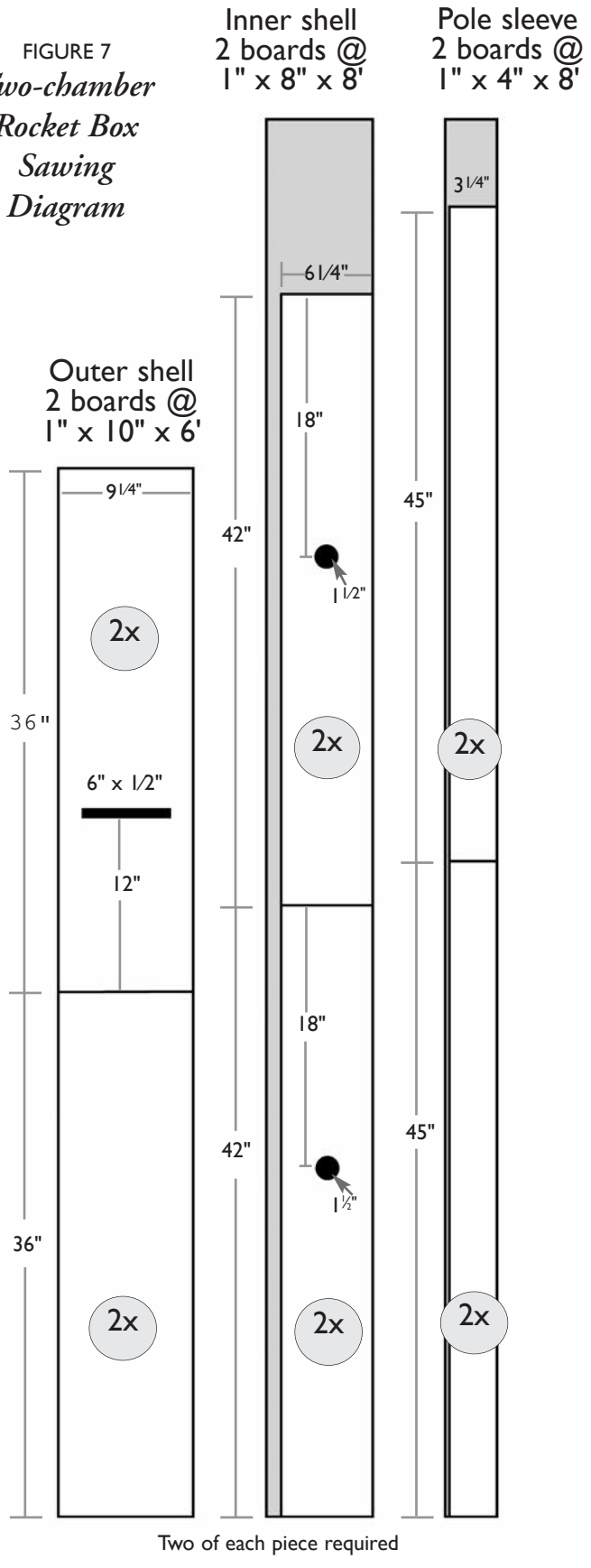


FIGURE 7
Two-chamber Rocket Box Sawing Diagram



Troubleshooting
Your Bat House

If bats aren't moving into your bat houses, an effective strategy to learn what works best for bats in your area is to install more than one house so bats can choose from a range of colors, locations and mounts (*right*). Everything worked just right at a pecan orchard in Georgia, where this pair of triple-wide nursery houses (*left*) attracted 1,000 to 1,200 free-tailed bats.

SINCE BCI FIRST PROMOTED BAT HOUSES in the early 1980s, many other vendors have followed suit. While some have done a lot to expand public interest in bat conservation, others pay far more attention to competitive pricing than to the needs of bats. Such vendors rarely provide mounting instructions or other accurate information and often market poorly built houses that bats aren't likely to use even under the best of circumstances. When that happens, bat conservation suffers.

By experimenting with different bat house placement, crevice widths and amounts of available solar energy, you can not only have fun helping bats, but we can learn more about their needs. So if your bat house is unoccupied, experiment!

Unoccupied houses often become successful if they are moved to receive more or less sun, stained or painted to absorb more or less heat or raised higher off the ground. When previously unsuccessful houses begin attracting bats after they are modified, we often gain especially valuable insights into the needs of bats.

If, despite providing ideal conditions, a bat house remains unoccupied, other factors must be involved. Most properly built and placed houses in our survey were occupied. But some apparently failed because local bats already had all the roosts they needed. Distances to undisturbed hibernating sites, pollution levels and the availability of food are also important factors. With the possible exception of arid areas with unusually large day-to-night temperature fluctuations, we find no evidence that any geographic region is unsuitable for successful bat houses.

By experimenting with different bat house placement, crevice widths and amounts of available solar energy, you can not only have fun helping bats, but we can learn more about their needs ...

Frequently Asked Bat House Questions

Will attracting bats to bat houses in my yard increase the likelihood that they will move into my attic or wall spaces?

No. If bats were attracted to your attic or wall spaces and could get into them, they probably would already be living there. The best way to ensure that bats won't inhabit your home is to keep it in good repair. Bats can enter spaces as small as one-half inch in diameter.

If I have bats living in my attic but would prefer that they occupy a bat house instead, what should I do?

Attics and other parts of buildings often provide ideal bat-roosting sites. In most cases, bats will not voluntarily move from an attic. In such cases, alternative roosts ideally should be provided several months or one season before the desired move.

The bats should be excluded from the attic at a time in the early spring or late fall when flightless young are not present.

Permanently and humanely evicting bats from buildings is usually not particularly difficult, but it requires patience and attention to detail. Exclusions can sometimes be performed by homeowners following guidelines available on our website. You can watch to see where the bats emerge at dusk and use exclusion tubes to create one-way exits.

For detailed information on excluding bats and bats and buildings issues, visit *www.batcon.org/buildings*.

How many bats can potentially occupy my bat house?

Depending on the size and the number of chambers, your bat house might shelter fewer than 50 to as many as several hundred bats. A very large "community bat house" might attract thousands.

Can bats be introduced into areas where they do not already live?

If appropriate bat species pass through your general area, putting up a bat house may attract a colony, but there is nothing you can do to introduce them artificially. Bats have strong homing instincts and would probably return to their original roost.

Catching or purchasing bats (which is often illegal) for introduction into a new bat house should not be attempted. At the current time, there are no proven lures or attractants that will entice bats into occupying a bat house.

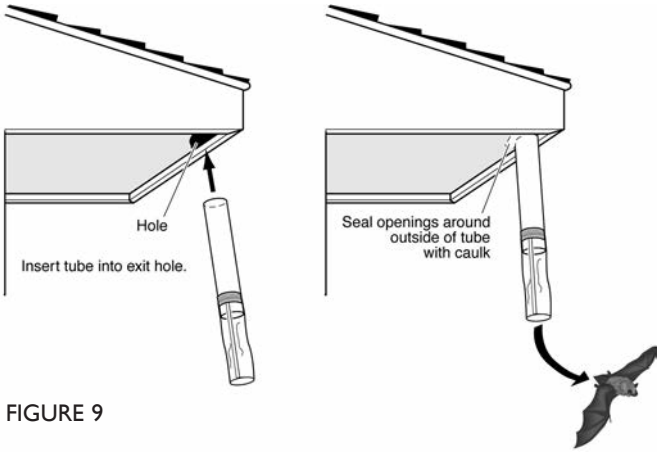


FIGURE 9

Bat houses are often installed as alternative homes for bats roosting in walls or attics. Excluding bats from buildings requires establishing one-way exits through which the bats can leave but cannot return, while also sealing all other potential entry points. Exclusions should not be conducted between April and late August, when pups might be trapped inside. In most cases, tubes make the best bat-exclusion devices. The tubes should be about two inches in diameter and 10 inches long. They can be purchased commercially or made from PVC pipe or other materials. Exclusion techniques are described in detail on BCI's website: *www.batcon.org/buildings*.

How can I determine the likelihood of attracting bats?

Most North American bats prefer to live within a few hundred yards of fresh water, especially streams, rivers or lakes. In some western areas, even swimming pools or small cattle tanks that provide open water may be sufficient. All bats, especially nursery colonies, require good feeding habitat; riparian areas (along rivers or lakes) are typically best. Exceptionally high bat house success has been achieved in areas that support varied agriculture, especially orchards and natural woodlots or other vegetation near water.

Areas where bats already have attempted to live in buildings are a good bet, and in northern areas, the nearer they are to potential hibernating sites in caves or abandoned mines, the better.

Why might bats not be attracted to my bat house?

It may not be well built, which usually means a failure to: 1) provide ¾-inch roosting crevices that are at least 20 inches tall and 14 inches wide; 2) carefully caulk and paint; or 3) include ventilation slots. Also, even well-built houses must be positioned and painted an appropriate color for