

Building Hives and Observation Nest Blocks for Solitary Bees and Wasps

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Dimensions and construction details are given as a supplement to the February article on the method.

1 Introduction Recent articles¹⁻³ have introduced a method for observation, selection, and field experiments on solitary bees and wasps. The method is not intended for mass rearing. Some articles may be useful to educators interested in popularizing gentle beneficial insects, agricultural scientists seeking equipment for a census of woodnesting bees and wasps, biologists concerned with development and parasitism, or fruit growers and beekeepers

interested in pioneering innovative approaches to pollination and pest management. All four articles might possibly provide the basis for a continuing year-long high school project involving the woodworking, biology and mathematics departments. The first article described a convenient new method for observing pollen bees and hunting wasps, and it will be useful to have it close at hand for the photographs. These showed views of observation nest blocks with transparent lids stacked within elevated hive bodies for protection, easy access and inspection. The second article included photographs of bee and wasp nests. The present article supplements the first by giving equipment dimensions and construction hints.

2 Observation nest blocks The upper part of Table 1 is a bill of materials giving the finished dimensions of the wooden nest block and its transparent acrylic lid. Figure 1 illustrates one of the 5 types of block that differ in bore width and number of bores. The 'bores' are actually blind-ended U-section grooves routed by 'core box' or 'round nose' cutters⁴ and closed by the lid. How the lid is best attached to the block depends on priorities (2.4 below).

<i>Bill of Materials</i>					
PART	FINISHED SIZE			MATERIAL	QUANTITY
	Thickness	Width	Length		
<i>50 Nest blocks</i>					
Nest block lids	1/8"	3 1/2"	6 1/4"	Acrylic	50 pieces
1/8", 3/16" & 1/4" blocks	1/2"	3 1/2"	6 1/4"	Select pine	10 each
5/16", 3/8" nest blocks	3/4"	3 1/2"	6 1/4"	Select pine	10 each
<i>1 Hive</i>					
A. Back wall	3/4" (19 mm)	8 3/4"	19"	Fir ply	1 piece
B. Left wall	3/4" (19 mm)	8 3/4"	16 1/4"	Fir ply	1
C. Right wall	3/4" (19 mm)	8 3/4"	16 1/4"	Fir ply	1
D. Nest roof	1/2" (8-9 mm)	7 1/4"	19"	Fir ply	1
E. Nest floor	3/4" (19 mm)	7 1/4"	19"	Fir ply	1
F. Louver	1/2" (8-9 mm)	7 1/4"	19"	Fir ply	1

Table 1

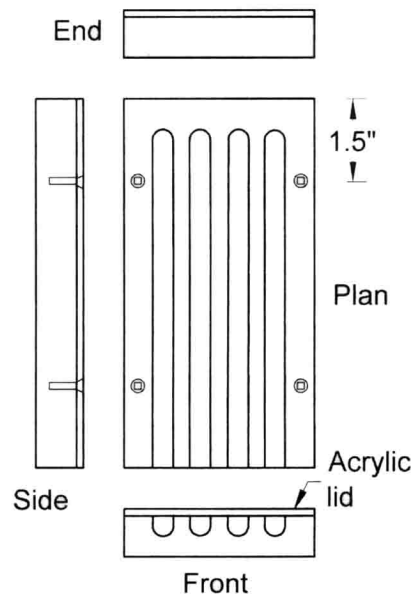


Figure 1. Plan and elevations of 4-hole 3/8" bore width observation nest block.

OBSERVATION NEST BLOCKS assuming 3.5" wide plank							
'Bore width' or groove width	Groove set up			Groove checks		Plank thickness	
	# per block	Depth reduction in 128 ^{ths}	Edge offset in 16 ^{ths}	Centre spacings in 16 ^{ths}	Final edge in 16 ^{ths}		Final interspace in 16 ^{ths}
1/8"	8	-2	10.5	5	9.5	3	1/2"
3/16"	7	-3	10	6	8.5	3	1/2"
1/4"	6	-4	10.5	7	8.5	3	1/2"
5/16"	5	-5	10	9	7.5	4	3/4"
3/8"	4	-6	11.5	11	8.5	5	3/4"
1/2"	4	-8	11.5	11	7.5	3	3/4"

Table 2. Measurements for observation nest blocks.

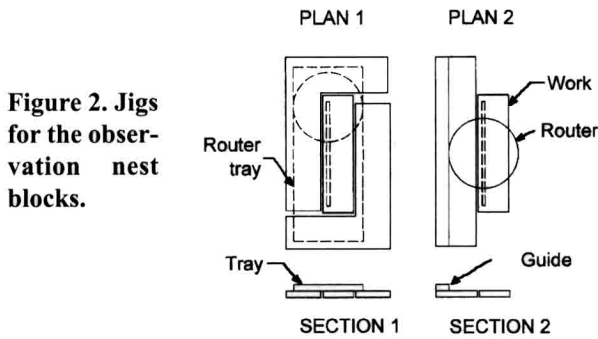


Figure 2. Jigs for the observation nest blocks.

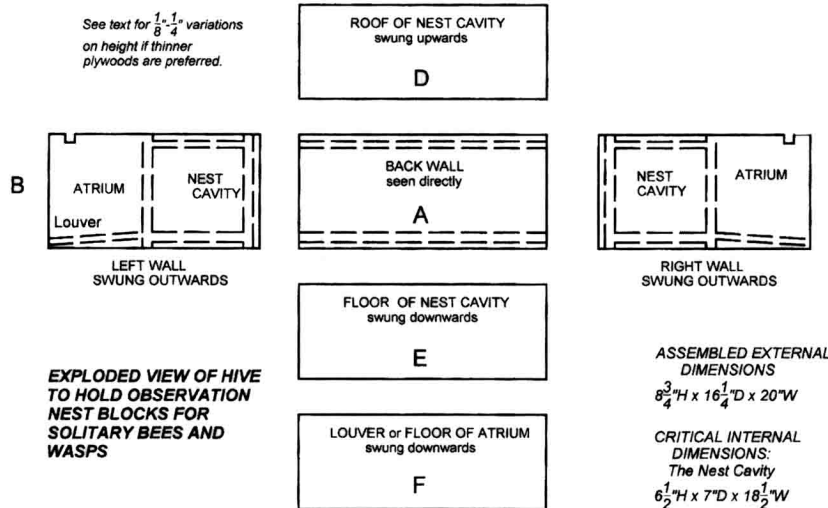


Figure 3. Exploded view of hive body.

2.1 A small router jig Figure 2, left, shows a jig suited to small or moderate numbers (150) of nest blocks and a small workbench. It consists of homemade clamping baseboards and a router guide tray.

A double length 3/4" thick work piece is clamped between two large 3/4" thick plywood L boards by lateral pressure between, e.g., plywood bench stops and clamps consisting of eccentrically pivoted plywood disks screwed to the bench top. The same arrangement is used for 1/2" thick lumber, except that the workpiece is

LUMBER AND SUPPLIES	
Quantity	Item
300 NEST BLOCKS:	
12	10' lengths of 3/4 x 4 select pine (i.e., 1/2" x 3 1/2")
9	10' lengths of 1 x 4 select pine (i.e., 3/4" x 3 1/2")
1 each	1/8", 3/16", 1/4", 5/16" and 3/8" core box router cutters for grooves
2	4' x 8' sheets of 1/8" acrylic
1 each	Paints, 472 ml (16 oz) flat black, 237 (8 oz) ml flat white
13	Boxes of 100, # 6 wood/metal flat socket countersink screws, 1/2" long, fully threaded
1	1/8" drill bit and 3/8" countersink for holes in acrylic covers
1	3/32" drill bit for corresponding screw holes in pine
6 HIVES:	
2	2' x 8' sheets of 3/4" fir plywood
1	2' x 8' sheet of 1/2" fir plywood
1 each	1/2" and 3/4" diameter, 1" long, straight router cutters for dados
1	1/2" piloted router bit for edge trimming
1	16 oz weatherproof glue
1 each	Paints, 946 (32 oz) ml, wildflower yellow, blue, and rose

Table 3

brought flush with the L-board surface by a slightly smaller 1/4" thick shim. The router tray of hardboard and plywood has a longitudinal slot in its floor cut by running the router up the tray, end walls or stops set to limit the travel of the router to just over 12", and open corners for brushing out wood dust. The tray is placed on the L pieces, its edges registered against preset marks, and clamped down on the work piece by press-down bench clamps. A 2 h.p. plunge router is run up the left edge of the tray, cutting one groove, and the jig unclamped, reregistered, etc. to cut the next groove. The work piece is finally divided into two nest blocks with 6" long bores.

The making of a registration mark begins by marking a master work piece with lines of proper spacing and length that correspond to the desired groove centers. The slot of the router tray is then carefully centered on one line on the work piece, and the corresponding registration line drawn with a colored ballpoint pen on the L-board using the left edge of the router tray as a ruler. Columns 4 and 5 in Table 2 give the offset and spacings of the lines for the master in 16^{ths} of an inch. Columns 6 and 7 provide checks on the execution, giving the edge spaces and interspaces that should remain in the nest block after the grooves are cut.

2.2 A larger jig Frequent registration and clamping while standing at one spot can be fatiguing in long production runs. In that case I screw down as many as 4 copies of the simple jig shown in Fig. 2, right, side by side onto a large work bench. The jig is a 3/4" thick plywood baseboard bearing a straight 1 x 2 strip as a guide for the edge of the router base.

Each guide strip is securely positioned to cut one groove. The work-piece is clamped flush against the baseboard with lateral pressure and end stops. After cutting one groove the work is moved to the next jig, and so on from jig to jig, and then all the way back again through the jigs after a reversal, to cut upto 8 different grooves. With 4 jigs and 4 double length work pieces on the go at once, one can cut upto 4 grooves for each firing up of the router, and the exercise of walking up and down the bench from jig to jig is not unpleasant.

2.3 Groove depth The depth of the router cut should be $\frac{7}{8}$ of the cutting diameter. The U section of the wood groove then has almost the same cross sectional area as a drilled circular bore of that diameter. As plunge routers flex a little under pressure, one cannot adhere precisely to the depth reductions in 128ths of an inch relative to column 1, set out in column 3 of Table 2, but approximating is worthwhile. Router the convex side of any curved lumber.

2.4 Securing the lids There are three options, depending on priorities. (A) *Convenient detailed viewing* Four snug countersunk woodscrews (Fig. 1, Table 3) will hold the lids securely so that the blocks can be tipped on edge or upside down, as will happen when loose blocks are transported, dropped, or passed around an audience. Such blocks can be rapidly removed from the hive and quickly replaced after thorough inspection. Possible problems are lateral penetration of some nests (e.g., of bees of subgenus *Megachile* and wasps of the subfamily Eumeninae) by tiny parasitoid wasps when nest densities are high, and the labor of removing and replacing upto 200 screws per hive in the annual block cleaning¹. (B) *Detailed viewing* If the nest cavity is fitted with Allen compression screws (see 3 below), and blocks will be handled with care, replace the woodscrews with 2-4 loose short tacks. Lids can then be lifted off and speedily replaced. This option largely meets the problems of infiltration and cleaning in (A) above, at the modest cost of having to unscrew and retighten 5 compression screws on each hive inspection. The woodscrews can always be replaced for loose transport. (C) *No lateral infiltration* As described earlier¹, limp polyethylene lids and pads meet the problems in (A), but visibility is poor and blocks must be transported clamped within the hive. However, less clamping force is required than in (B).

3 Hive body The February article should be consulted for oblique views¹. The lower part of Table 1 sets out the dimensions of the 5 boards, labelled A to F, that make up the hive body illustrated in the exploded view of Fig. 3. Figure 4 gives some simple views and cross sections. Figure 5 shows details of the $\frac{1}{4}$ " deep dados on the insides of the back wall A and sidewalls B and C. If necessary the height of the hive body can be altered by $\frac{1}{8}$ "- $\frac{1}{4}$ " according to preferences for plywoods and the intended use of the 'attic'. Attics are

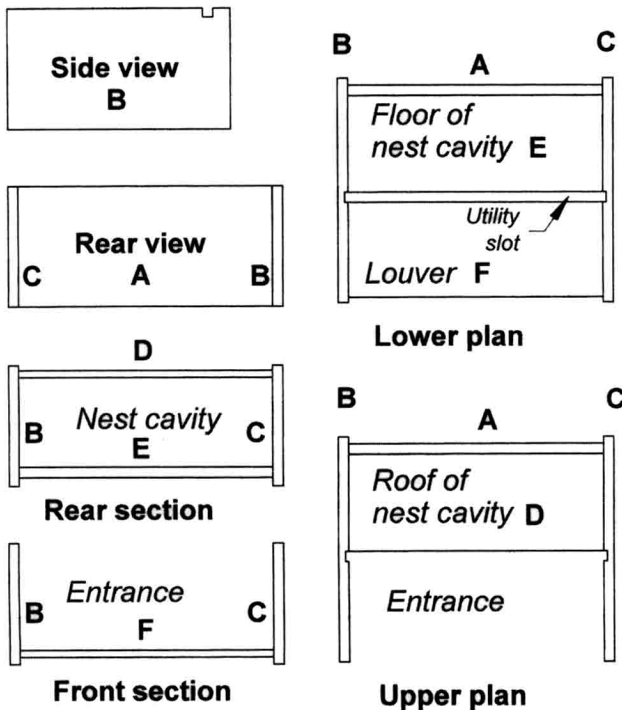


Figure 4. Views and cross sections of hive body.

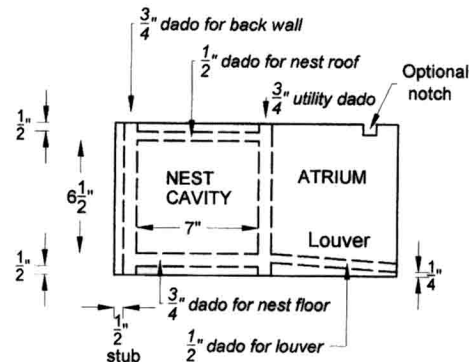
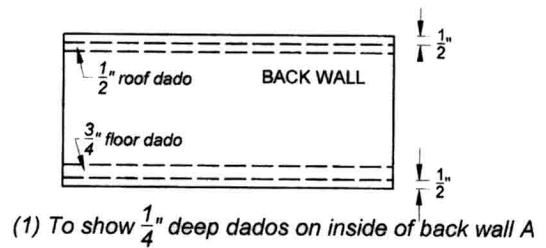
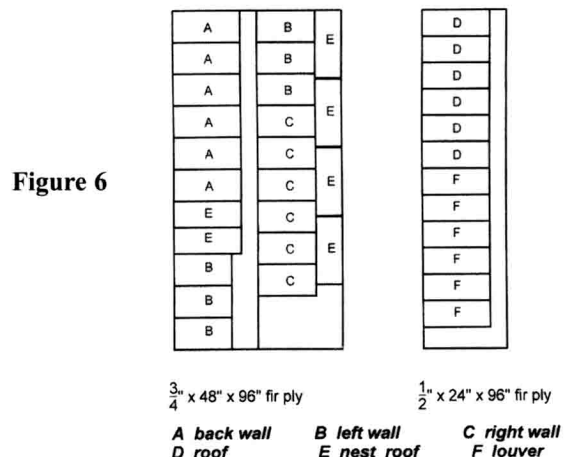


Figure 5. Details of dados on back wall and right side-wall.

utility, floor or roof, spaces of about 1" between nest cavity roofs and floors, that exist only when hive bodies are stacked and roofed. They are created by the $\frac{1}{2}$ " inset of the nest roof D and floor E from the edges of the back A and side walls BC (see Fig. 3 A, B & C and Fig. 4, rear section). I use the attic to accommodate tools, nest blocks, and any protruding Allen set screws (see next). $\frac{3}{4}$ " plywood for the nest floor has proved very satisfactory. Most of my hives have used "d" instead of the recommended $\frac{1}{2}$ " ply for the nest cavity roof D and louver F. $\frac{1}{2}$ " ply is better if the convenience decision (see 2.4 (B) above) is to fit hives with Allen screws to compress stacks of observation nest blocks. If so 5 holes should be drilled in the nest cavity roof D to take $\frac{1}{4}$ " - 20 T-nut and $\frac{1}{4}$ " - 20 Allen set screws, one pair for each stack of nest blocks. Use hardboard or brass shims to spread the screw pressure, and place a thin sponge under the stack to take up swelling or shrinkage due to the weather¹.

When starting a production run I shape 4 boards as templates (only one is needed for the sidewalls) and rough cut the work pieces with a jigsaw, trimming to final size with the templates and

Layout for 6 hives



a piloted edge trimming bit⁴. The dados of Fig. 5 are cut by wedging the trimmed boards within rough trays with 3/4" deep sides (same thickness as the work) across which are nailed straight edge guide strips. Remember that the left and right sidewalls B and C are mirror images! Plywoods vary slightly in thickness and occasionally a little rapid widening with a straight bastard file is needed so that the boards fit easily into the dados. Gluing takes care of any looseness. Table 3 lists lumber and supplies for 6 hives and the corresponding nest blocks, while Fig. 6 shows a cutting plan. I rely on Titebond II® waterproof glue when making up, avoiding nails and screws. For cheap gluing clamps use elastic rope, or a pair of scrap boards held by two long metal studs with nuts and washers.

4 Painting Paint simply, as a pilot field trial gave no evidence for any very strong preference of the bees and wasps for particular colors³. Paint all parts of a given hivebody in a single wildflower color, sparing the inside of the nest cavity and the attics in case of toxicity. For a cue as to 'home', stack hives of contrasting colors. When packing hives quickly in the Spring the fewer the nest block colors the better. Cues as to nest position within the hive are given by painting upto 40% of the fronts of blocks white and the remainder black, and stacking blocks to make a color pattern.

5 Other issues The utility slot or gap (Fig. 4) left between boards E and F is important for spilling rain. For a heavy hive roof, take a piece of unpainted 24" x 20" fir plywood raised on 3/4" x 2 strips to give a full attic space, tile it by nailing on 2 pieces of tarpaper roofing tile with overlap all round the edges, and cover the exposed nail heads in turn with a piece of tile held by a dab of tar. Aluminium would be lighter than tile. Or a standard Langstroth beehive roof may do.



For the hive platform¹ I make a coarse lattice, like a farm gate, of 3/4" x 3 wooden spruce strips supported near its corners on 1/4" diameter 5 ft or longer metal poles (fence rail). These are driven at least 1 ft into the earth using a 2 ft long 1 1/2" internal diameter iron pipe, with a welded end, as a hammer. In the past I have anchored the heads of the poles to the platform with wooden sockets, but loose pegging is easier and should be good enough for hives within a secure property or beeyard. So this year I'll try drilling a vertical clearance hole through the wood above a pole end and hanging a long bolt down into the pole to stop the platform wandering too far. A platform loaded with 2-3 hive bodies and roof is top heavy, but stable and safe for ordinary *adult* use. Vaseline applied to the upper parts of the poles, to the pole-platform junctions, and to the inside ends of poles will exclude all ants except those falling from overhanging branches.

Answers to a number of questions about the method may be found in the earlier issues.

ACKNOWLEDGEMENTS

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