

# The Four Dimensions of Honeybee Comb Construction

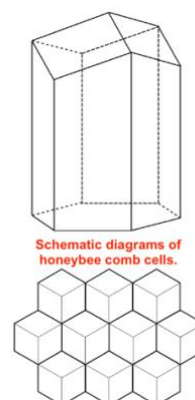
A honeybee colony must process nectar into honey, store pollen for its protein and lipid source, and provide a nesting structure for egg laying and raising of young. To do this, *Apis mellifera* creates a wax comb (see [\\*comb\\*](#)). Genetic memory guides the coordination of thousands of individual honeybees who begin this process as soon as a swarm enters the confines of a hollow space chosen to begin a new nest.

Working in darkness, orienting the comb planes in alignment with earth's magnetic field (see [\\*direction\\*](#)), construction lines are set and they begin. Using scales of lipid that solidify as they are secreted from abdominal organs (see [\\*wax\\*](#)), workers chew the wax and fix the upper attachments for each comb, then proceed downward, using gravity as a guide. Many articles have been written which marvel at the *two-dimensional* hexagonal structure of the honeycomb, but there is, of course a *third dimension* to space. A recent article in *Apidologie* (see [here](#)) describes the honeycomb as follows:

*The hexagonal prism comb cells that they build are composed of three congruent rhombuses at the bottom with the following angular features: obtuse angle of the rhombus at the bottom of the cell,  $109^{\circ}28'$ ; acute angle of the rhombus at the bottom of the cell,  $70^{\circ}32'$ ; dihedral angle formed by each rhombus face and the cell wall,  $120^{\circ}$ ; and dihedral angle formed between the rhombus faces,  $120^{\circ}$ . Hexagonal comb cells with these features have the smallest possible surface area, largest volume, and thus highest storage capacity compared with alternative cell structures.*

*Combs are composed of thousands of hexagonal cells. Adjacent hexagonal cells on the same comb surface share a cell wall, and hexagonal cells on different comb surfaces share a cell bottom. The cell walls and bottoms are relatively thin. The thickness of the cell wall is  $0.073\text{ mm}$  and the thickness of the cell bottom is  $0.176\text{ mm}$ .*

The article provides these images and illustrations:





The fourth dimension of the comb is *time* (see [\\*time\\*](#)), since construction is a process that occurs over time, as the comb is expanded and remodeled according to the needs of the honeybee colony.

Here are a few images of comb being built in the hives of [Apiopolis](#):

