2022-23 Ventilation Observational Study

The Question We Investigated

How does colony temp and humidity differ between colonies with:
a single vent at the lower entrance and a top and bottom vent?

Airflow with Single Bottom Vent vs Top/Bottom Vents

Goal: determine vents sizes that would product the same airflow rates with in the colony

Method: Complex fluid dynamics calculations are beyond the scope of this study. Instead, we use simplifying assumption that the inside of the colony is always at 60F, use equations for buoyancy-driven flow (see "Single-sided Natural ventilation: Design Analysis and General Guidelines https://dspace.mit.edu/handle/1721.1/37561)

Equations used:

Area single vent opening = $3 * \text{Sqrt}(2) * At * Ab / (\text{Sqrt}(At^2 * Ab^2))$

where At = area of the top opening

Ab = area of bottom opening

	TOP & BOTTOM ENTRANCE SIZES		SINGLE BOTTOM ENTRANCE for EQUIVALENT AIRFLOW		
2021 Wrap Study Top/Bottom Entrance Sizes	Lower Entrance Size	Upper Entrance Size	Single Entrance Area (in^2)	Height	Width (inches)
Hive3	5/8"x3/8"	1/2"x3/8"	0.6212	0.375	1.66
Merr1	2" x 5/16"	1/2" x1/2"	0.9848	0.3125	3.15
Sask1	1/2 oval	1/4" x 3/8"	0.3928	0.375	1.05
	7/8"x3/4"	7/8"x3/8"	1.2451	0.75	1.66
	1/2" x 3/4"	1/2" circle	0.7377	0.75	0.98
	1/2 oval	1/2"x3/8"	0.6710	0.375	1.79

2022 Study will use these dimensions

Colony setup

Empty super with 3” of polystyrene/foam insulation

Inner cover - entrance : blocked OR ½” x 3/8” with wind block (see below)

1 ½” shim with weather Stripping

4 mediums

2 with slatted Rack – 3 with no slatted Rack

Lower Entrance – either 1.8”x 3/8” or ½ oval (1/2”x3/8”)

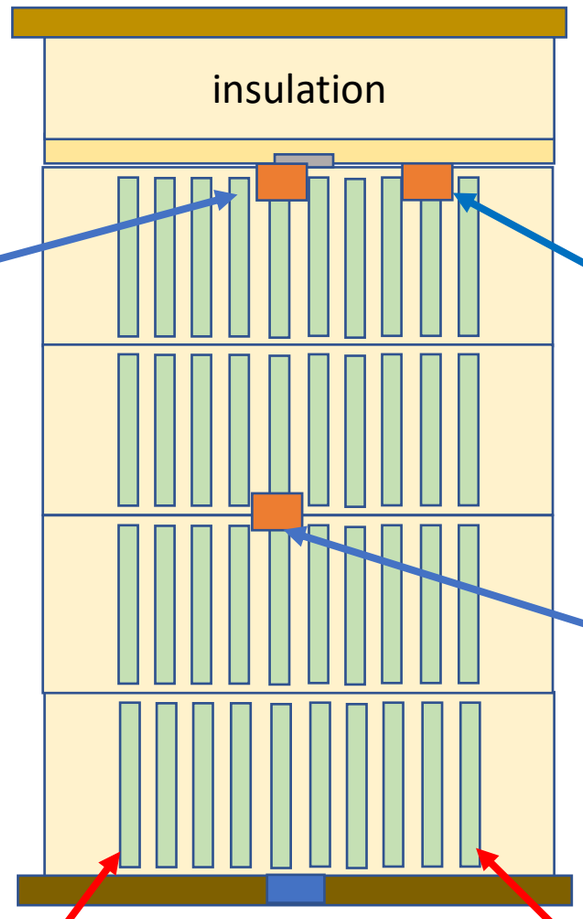
Cinder blocks wrapped with Reflectix

Screened Bottom board closed with ½ Polystyrene

Wind block on inner cover opening

Broodminder Sensor Setup

- Five Broodminder Sensors installed in the colony
  - 3 colonies have 5 Temp/Humidity sensors
  - 2 colonies have 4 Temp/Humidity sensor & 1 Temp only Sensor
- Apiary Temperature from Broodminder subhub installed on apiary fence pole



2 Temp/Humidity sensors: (box4, frame5)
#1- 2“ from south side of colony
#2 - 2” from north side of colony

1 Temp-only OR temp/Humidity Sensor – Box4, frame9
2“ from east side of colony, 9” from south side

2 Temp/Humidity sensors: (box2, frame5)
#1- 2“ from south side of colony
#2 - 2” from north side of colony

Frame1, box 1

Frame10, box 1

Colony setup

Colony	Entrance faces	Wrap	Slatted Rack?	Upper Entrance With wind block	Lower Entrance
Sask1	South	Cozy (R8)	Yes	No	1.8”x3/8”
Sask2	South	Cozy (R8)	Yes	1/2” x 3/8”	½ oval – 1/2” x 3/8”
Ital1	South	Cozy (R8)	No	No	1.8”x3/8”
Sask3	South	Cozy (R8)	No	1/2” x 3/8”	½ oval – 1/2” x 3/8”
Stalker	North	3 layers of R3.7 Colony quilt (R11.1)	No	1/2” x 3/8”	½ oval – 1/2” x 3/8”