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Poultry Housing Tips

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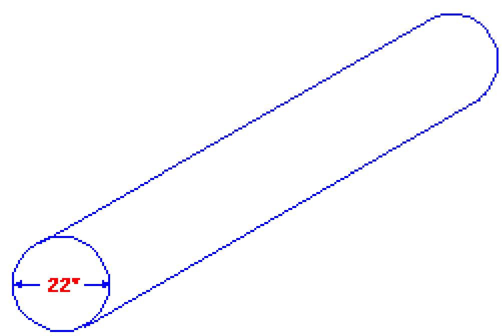
Wind Speed in Tunnel-Ventilated Poultry Houses

Imagine you have a pipe 22' across and 500' long. Connected to the end of the pipe is a large pump capable of moving 1,140,000 gallons of water every minute (152,000 cubic feet of water per minute). How can you determine how fast the water will flow in the pipe? Actually, it is very easy to calculate. All you have to do is divide the pump capacity by the cross-sectional area of the pipe. For example:



Velocity= pump capacity / cross-sectional area of the pipe

cross-sectional pipe area = 3.14 x (diameter / 2)2

= 3.14 x (22 ft. / 2)2
= 3.14 x (11 ft.)2
= 3.14 x 121 ft.2
= 380 ft2

Velocity = 152,000 ft.3/min. / 380 ft.2

= 400 ft./min. (4.5 mph)

If the pipe was larger in diameter, the velocity of the water in the pipe would be lower. For example, let's say instead of a 22' diameter pipe, we had a pipe 24' in diameter.

Velocity = pump capacity / cross-sectional area of the pipe

= 152,000 ft.3/min. / 452 ft.2
= 336 ft./min. (3.8 mph)

Conversely, if we used a smaller diameter pipe, for instance 19' in diameter, the velocity of the water in the pipe would be higher.

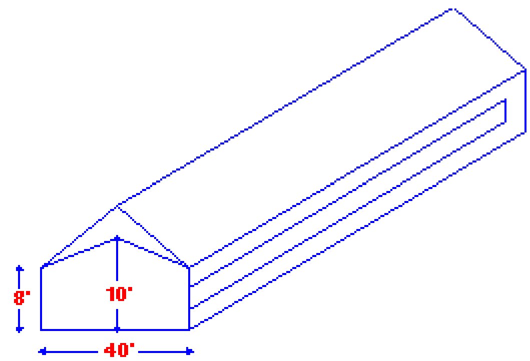
Velocity = pump capacity / cross-sectional area of the pipe
= 152,000 ft.3/min. / 289 ft.2
= 526 ft./min. (6 mph)

In all cases the pump would be moving the same amount of water. The only difference is that the smaller the pipe, the faster the water will move in the pipe; the larger the pipe, the slower the water will move in the pipe.

It is important to understand that the length of the pipe has very little to do with how fast the water flows. This is easy to visualize. If you connected a 2' length of hose to a spigot and then connected a 20' length of hose to the same spigot, the water could come out of the two different length hoses at the same speed.

The pipe flow examples above are actually illustrations of the average air speed expected in a tunnel-ventilated house with eight 48" fans in a 40' wide, drop ceiling house; a 40' wide, open ceiling house and a 34' wide, drop ceiling house, respectively. The only differences are that in tunnel-ventilated houses we are dealing with air, not water, and our houses are rectangular, not cylindrical.

The average air speed in a tunnel-ventilated house can be calculated by dividing the total fan air moving capacity by the cross-sectional area of the house. The cross-sectional area of the house can be determined by multiplying the average ceiling height by the width of the house. For instance, if a 40' X 500' house with eight 48" fans (19,000 ft3/min) had a side-wall height of eight feet and a ceiling height of ten feet at the peak, the average ceiling height would be nine feet. The cross-sectional area of the house would be determined by multiplying nine feet by forty feet (360 ft.2).



Velocity = fan capacity / house cross-sectional area

= 8 x 19,000 ft.3/min. / 360 ft.2
= 422 ft./min. (4.8 mph)

Generally, the lower the ceiling and the narrower the house, the higher the air velocity will be in the house.

	House Width**		
	36 ft.	40 ft.	42 ft.
six fans*	281	244	228
seven fans	328	285	267
eight fans	375	326	305
nine fans	422	366	343

Table 1. Average Air Velocity (ft./min.)
(open ceiling)

	House Width**		
	36 ft.	40 ft.	42 ft.
six fans*	352	310	293
seven fans	410	362	342
eight fans	469	414	390
nine fans	528	465	439

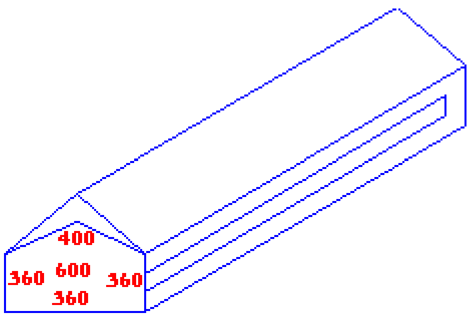
Table 2. Average Air Velocity (ft./min.)
(drop ceiling)

* (19,000 ft3/min. per fan) ** (7 1/2' side wall)

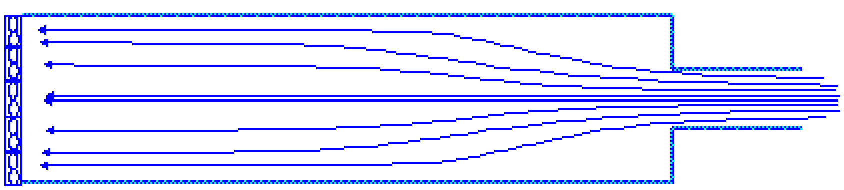
	Side Wall Height			
	6 ft.	7 ft.	8 ft.	9 ft.
six fans*	371	328	294	266
seven fans	433	383	343	311
eight fans	495	438	392	355
nine fans	557	492	442	400

Table 3. Average Air Velocity in a Drop Ceiling House (ft./min.)

The above equation and tables provide the average air velocity expected in any tunnel-ventilated house. The actual air speed will vary from the center of the house to the side walls and floor. In any tunnel-ventilated house the air will always move faster in the middle of the house than on the side walls or near the floor. Just like water in a river, the air in a poultry house will always flow faster in the middle than near the sides.



A common question about tunnel-ventilated houses is how much opening is needed and how does inlet opening size affect the speed of the air in thehouse? This question can best be answered by looking at the following example. Let's say instead of a door at the end of the house there were a 100' long tunnel that measured 10' X 12' and this tunnel was the only place air could enter the house. The speed of the air in this 100' tunnel could be determined by dividing the total fan air moving capacity by the cross-sectional area of the smaller tunnel (152,000 ft.3/min. divided by 120 ft.2 (10' X 12') is equal to 1,267 feet per minute). Though the air would travel in this short tunnel section at nearly 1,300 feet per minute, would it move down the rest of the house at this speed? The answer, of course, is no. After exiting the tunnel and entering the house the air would expand after traveling 50 to 100 ft to fill the larger cross-sectional area of the house. Whether there was actually a 100' tunnel section or just an opening in the end wall, the air would still enter the house at the same speed and the end result would be the same. It is important to keep in mind that though using too small of an opening will increase the amount of air movement in the inlet end of the house, it will actually decrease the speed of the air in the rest of the house.



A fan's ability to draw air into a house can be affected by how much opening is available to it. If a 48" fan is provided a minimum of 30 square feet of opening, its performance will not be significantly affected (40 square feet of opening is ideal). But, if less than 30 square feet of opening per 48" fan is provided, fan performance will begin to drop off. In the above example where only the end wall door was used for an opening (15 square feet per fan), the amount of air the fans move would decrease 15 to 30 percent, depending on the condition of the fans.

Fan capacity = 19,000 ft3/min x 70%

= 13,300 ft3/min

Velocity = fan capacity / house cross-sectional area

= 8 x 13,300 ft3/min / (40 ft. x 9 ft.)
= 295 ft./min. (3.4 mph)

The air speed would of course still be high within 100 feet or so of the door, but air movement in the remainder of the house would be decreased to less than 300 ft./min. The decreased air speed would result in a decreased wind chill effect as well as a larger front-to-rear temperature increase.

Too large of a tunnel opening can also cause problems, though not nearly as severe. If more than enough opening is provided, the air will enter the house slower than it moves down the house past the inlet opening. This would result in a reduced wind chill effect for those birds in the immediate tunnel curtain area. The rest of the birds in the house would not be affected. The decreased air speed in the front of the house may not encourage fog to mix as well in the front of the house as it should.

As a general rule, the amount of opening required for a tunnel-ventilated house should be roughly equal to the cross- sectional area of the house. This should insure that the air will enter the house at the same speed at which it moves down the house. When in doubt, install a little more opening than the cross-sectional area; you can always close it down a little if necessary.

A static pressure gauge can be used to check whether you have the proper amount of opening. The pressure should be between a 0.03" and 0.06" with all exhaust fans operating. Within this range, fan performance will be maximized.

Some producers have installed static pressure controlled curtain machines on their tunnel openings. The installation of these machines typically will not hurt anything, but they will provide very limited benefits in most cases. By adjusting the tunnel curtain as the number of fans operating changes, the speed of the air entering the house can be kept more constant. But this will have no effect on how fast the air travels down the house. Again, the cross- sectional area of the house determines that.

It is important to note that a static pressure machine should not be used in an attempt to minimize the chilling of birds when tunnel ventilating. If you are worried about chilling the birds, it is probably too cold outside to be tunnel ventilating.

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