

Example 1

How to determine the number of fans needed for a cross-ventilated barn with cooling pads

Assumptions:

- ✓ 8-row, 800-head freestall
 - ✓ Dimensions of 210' by 420'
 - ✓ Baffle height of 8' and one baffle per two rows of stalls
 - ✓ Design velocity under the baffle of 528 fpm
 - ✓ Cooling pads result in 0.05 inches of static pressure at air velocity of 400 fpm
 - ✓ Performance test results show exhaust fan moving 31,000 cfm at 0.12 inches of static pressure
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Calculate cross-sectional area under baffle:

✓ $A_{cs} = 8' * 420' = 3,360$ sq. ft.

Calculate volumetric flow rate to meet design velocity and air exchange per cow:

- ✓ Calculate airflow based on velocity:
 $Q = 3,360$ sq. ft. * 528 fpm = 1,774,080 CFM
 - ✓ Calculate airflow based on number of cows:
 $Q = 800$ cows * 1,000 CFM/cow = 800,000 CFM
 - ✓ Choose larger: 1,774,080 CFM
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Size inlets:

- ✓ $1,774,080$ CFM/400 FPM = 4,435 sq. ft.
- ✓ Find inlet height: 4,435 sq. ft./420 ft. = 10.56 ft. high

Estimate static pressure:

- ✓ Calculate static pressure per baffle (equation 5 in Dairy Cooling: The Benefits and Strategies): S.P.baffle = $(528 \text{ fpm}/4,000)^2 = 0.0174$ inches of water/baffle
 - ✓ Sum static pressures: 0.05 in. at inlet + $0.0174 \text{ in./baffle} * 4 \text{ baffles} = 0.12$ inches of water
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Consider fans needed: