

Example 1

Tunnel-ventilated barn

Assumptions:

6-row, 800-cow freestall

Dimensions of 120 ft. wide by 500 ft. long

Eave height of 12 ft. and ridge height of 22 ft.

Design velocity of 704 fpm

Assume 0.1 inches of static pressure for barn

Performance test results show exhaust fan moving 31,000 CFM at 0.1 inches of static pressure

Calculate cross-sectional area:

$$A_{cs} = 12 \text{ ft.} * 120 \text{ ft.} + ((22 - 12) \text{ ft.} * 120 \text{ ft.})/2 = 2,040 \text{ sq. ft.}$$

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

Calculate airflow based on velocity: $Q = 2,040 \text{ sq. ft.} * 704 \text{ fpm} = 1,436,160 \text{ CFM}$

Calculate airflow based on number of cows: $Q = 800 \text{ cows} * 1,000 \text{ CFM/cow} = 800,000 \text{ CFM}$

Choose larger: 1,436,160 CFM

Consider fans needed:

Number of fans = $1,436,160 \text{ CFM} / 31,000 \text{ CFM/fan} = 46 \text{ fans}$