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SIZING INLETS FOR MECHANICAL VENTILATION PART 3 of 3

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Inlets require thoughtful sizing, placement, and control.

The air inlets are the most important part of a ventilation system since they are responsible for providing good air distribution and movement. To the credit of agricultural fan manufacturers, there are many good fans that will provide the desired air exchange. But, to many people, ventilation is still "a fan" and solutions to ventilation problems are often solved by the addition of more fans. Additional fan capacity is justified in some situations but more often the cause of poor air quality in poultry structures is improper inlet function.

Mechanical ventilation components include fans, inlets, and controls, each of which is necessary. They need to function together as a system. In mechanical ventilation, fans are responsible for the amount of air exchange while inlets control the air distribution within the ventilated space. Air exchange is simply fresh air delivery to all birds and mixing of fresh air with stale air prior to removal from the building.

Inlets come in many shapes and sizes with varying levels of usefulness. The three functions of an air inlet are to provide fresh air throughout the building, control direction of air flow, and maintain fast inlet air velocity. If these three functions are not achieved, then poor air distribution, uneven temperatures, and drafts are the result. Fast inlet velocity is essential for providing air mixing and desirable circulation patterns.

Inlet design and operation demand that some technical aspects of air flow be understood. In addition, there is an "art" to inlet operation that comes with experience. The art and experience aspects are what make inlet function unique to each application and often provides hurdles in diagnosing and solving ventilation problems.

How Big Should Inlets Be?

Air moves into a poultry building in response to a static pressure difference created by the fan(s). Air moves from a region of higher pressure to lower pressure and will enter an exhaust-ventilated house through any inlets (or holes) in the structure. The static pressure difference required to ventilate a building is very small, on the order of 0.05-inch water. When maintaining a relatively constant static pressure of this magnitude, one can calculate how much inlet area will provide the required inlet air speed required for proper air jet mixing and control. Provide 1.7 square feet of inlet area per 1,000 cubic feet per minute (cfm) of fan capacity. Another way to measure this is as 1 square-inch of inlet area per 4 cfm fan capacity. For continuous slot inlets, providing 2 square feet per 1,000 cfm is even better. (Note that tunnel ventilation inlet sizing is based on a different criteria than outlined above.) Stay within this range of inlet size. A smaller inlet will create faster inlet jet velocity but increases resistance to air flow that can overload fans. Larger inlets cause more problems by creating drafts, not distributing air properly, and allowing dead air zones in the building. The inlet opening size is adjusted each time the fan exhaust rate changes. We want to maintain a reasonably constant static pressure around 0.05 inches in the building to provide fast inlet jet velocities. Controllers are used to adjust inlet-opening size while maintaining correct static pressure.

Restrictions or obstructions to air flow before or after the inlet must be avoided. Obstructions after the inlet deflect air into undesirable drafts and can destroy good air circulation. Obstructions include waterlines and 2x4s in the air jet path. Restrictions before an inlet baffle will increase resistance to air flow. This lowers air speed. The minimum upstream restriction should be no less than twice the maximum baffle inlet width (see figure).

For example, consider the typical four-foot long by 10-inch wide box inlets spaced every eight feet in a broiler house. If the maximum baffle inlet opening is 8 inches, then at least a 16-inch clearance is recommended for air coming in the eave soffit and over the sidewall construction at the eave. Not many house constructions can provide this space. In fact, field observations suggest that some houses do not even provide eight inches of clearance. One solution would be to provide more box inlets so that with a narrower baffle opening the upstream clearance criteria is met. Another solution is to switch to tunnel ventilation for high volume air circulation during hot weather.

Inlet Design Checklist

• Building Width. MidWest Plan Service agricultural engineers recommend that for buildings up to 38 feet wide, place continuous slots at the ceiling along both sidewalls. For wider buildings, add one or more interior ceiling slot or box inlets. This is based on how far a ceiling air jet can travel across a building with an objective to provide air distribution to the center of the building.

• Maximum Distance. The maximum distance between fan and inlet is 75 feet. Air moving this far in confinement animal housing has picked up enough moisture, odor, dust, and/or heat to be considered stale air and should be discharged from the building.

• Near Fans. Close inlets within 6 to 8 feet of each side of a fan during cold weather to prevent air short-circuiting out the fan before distributing throughout the building.

• Sectional Inlets. Inlets should be installed in sections so that optimal slot opening and air distribution can be effectively controlled. Some buildings have sections that are not used for part of a production cycle, such as during partial-house brooding of broilers, so only the populated half of the house has functional inlets. Box inlets, which are spaced rather than continuous, can provide control over air distribution as building bird population and weather change.

• Cold Weather Inlets. Controlled inlets are essential to direct incoming cold air and to provide mixing. Inlets are placed high on the sidewalls so that air can be tempered with room air before it reaches the birds. The attic can be a wind-protected air inlet. This prevents wind and driven precipitation from entering through sidewall inlets. Often only a portion of the building inlets are used in the winter. For example, every other section of a continuous baffle inlet may be closed for the winter while the remaining sections are controlled to provide ventilation inlet area. This allows half the inlets to be open one-half inch rather than trying to keep all the inlets open one-quarter inch. Generally, construction irregularities will prevent uniform openings less than one-half inch wide on long buildings.

• Hot Weather Inlets. It is best to bring fresh air directly from outdoors. Roof insulation reduces sun warming of the building and is required if using attic ventilation in hot weather. Outdoor air can be blown directly onto older or adult birds (not recommended for the very young) to create a wind-chill effect for enhanced cooling. Hot weather inlets need to be sized to provide a large amount of air.

• Inlet Screens. Screen the intake with three-quarter-inch hardware cloth or bird netting. More restrictive screening or residential-type soffit vents with pinholes will drastically reduce air flow and will clog with dust for further resistance to air flow.

• Inlet Size. Provide 1.7 to 2.0 square feet of inlet area per 1,000 cfm fan capacity. Provide at least double this area upstream of control point of inlet.

More information is available in "Inlets for Mechanical Ventilation Systems in Animal Housing," G-91, an eight-page fact sheet. This and other agricultural engineering publications on ventilation of agricultural buildings are available free from Agricultural and Biological Engineering Extension, 246 Agricultural Engineering Building, University Park, PA 16802, (814) 865-7685.