THE IMPORTANCE OF FANS IN THE LUMBER KILN DRYING PROCESS

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The purpose of the air circulation in lumber drying kilns is two fold:

1. To carry heat to the lumber to bring it to the desired temperature, and to evaporate the moisture removed in drying.
2. To carry the evaporated moisture away from the load.

In the majority of kilns used for softwood drying in Western North America, this air circulation is created by propeller (or axial) type fans located inside the kiln, in a fan deck located above the lumber charge. This type of fan is not arbitrary, it is the most energy efficient design for this application.

Fan selection is governed by the combination of airflow (cubic feet/minute of high relative humidity air) and the pressure rise (Fig. 1) (inch H_2O) required across the fan. The combined airflow through the fans is equal to the airflow through the kiln load, plus the fraction of the flow vented to carry away the moisture released from the load.

The pressure rise across the fans equals the pressure lost as the airflow circulates through the load, and around other obstructions in its path, such as the steam heating coils. This pressure loss is primarily determined by the velocity or speed with which the airflows through the load (ft/min), actually the square of the velocity (ft^2/min^2) and secondarily by the size and shape of the spaces formed by the stickers.

So, both the fan flow and pressure rise, and thus their design, are determined by the load for which the kiln was designed (its height, width and the thickness of the lumber and stickers) and the air velocity through it.

What determines the air velocity through the load? It is a trade off: between the horsepower of the motor(s) needed to drive the fans, and the uniformity of the final moisture content distribution through the load, given a particular drying schedule.

The higher the air velocity through a load of given dimensions, the higher the airflow and the pressure drop. The horse power required to drive the fans at their design point is proportional to the product of the flow and pressure rise at that point - or the cube of the airflow velocity through a given load!

But if the airflow velocity through the level is kept low to save capital and operating cost, it has to pick up proportionately more moisture in each pass through the load for a given drying rate. Under these conditions, the difference in humidity level, between air going into and the air leaving the load, will be large and even with frequent flow reversals the wood in the center of the load will be too wet.

Decades of practical experience have led us to 400 to 600 feet/min. as the optimum air velocity level for softwood drying - and thus the modern reversible propeller fan in the kiln layout you know so well. This layout also determines the number of fans used for a given length of kiln -again an empirical trade off between air flow uniformity into the load (and thus final moisture content variation) versus capital cost (more, smaller fans with the same total air flow will cost more).

The kiln fan arrangement used (Figure 2) (cross-shaft versus line-shaft) is yet another empirical trade off, between air pressure (and horsepower) losses and capital

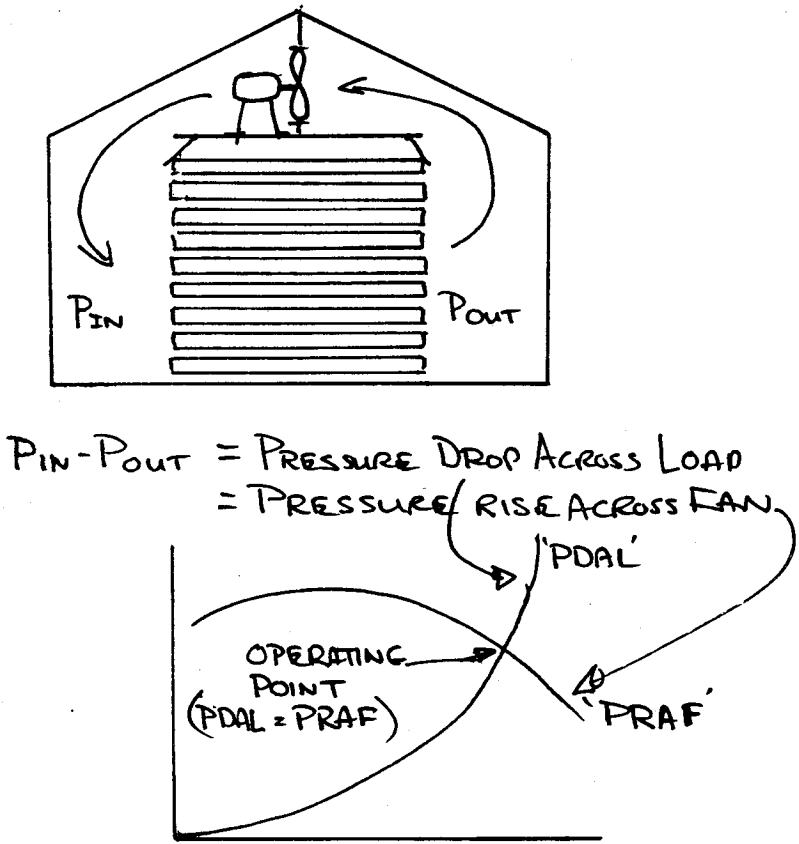

Figure 1. Airflow and pressure changes govern fan selection.

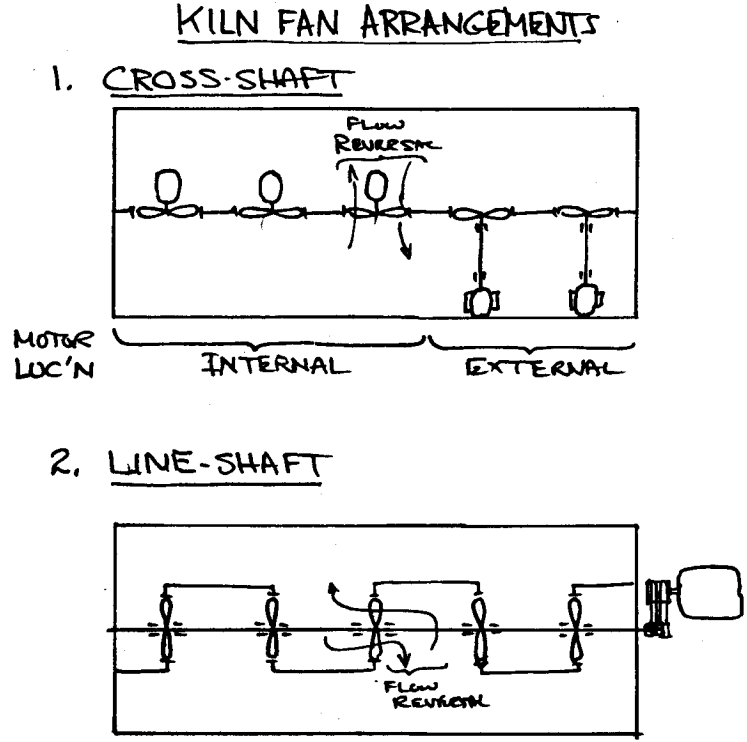

Figure 2. Kiln fan arrangements.

cost. A cross-shaft arrangement has a straight and efficient air flow path, but requires either one drive motor per fan or complex belt or gear drives. A line-shaft arrangement gives a simple robust drive train from a single motor, which is more economical to buy and maintain.

Finally, you may have the choice of motors mounted outside the kiln, or inside. A totally enclosed, sealed motor designed to operate at kiln temperatures is expensive, but does automatically recycle any losses as heat to the kiln atmosphere. This is a poor exchange at today's low energy prices, especially considering the easy access to external motors if they need service during a kiln run.

How does all this help you if you already have a kiln? It tells you that your kiln and its fans are designed for a load of specific characteristics, height, width, lumber and sticker thickness (Figure 3). If you are drying a different lumber thickness you need to adjust sticker thickness to maintain about the same flow area through your stacks - or consult with the manufacturer to change the fan pitch (and possibly motor size) if practical.

If you don't baffle your load well, and use square packages, not only will you lose the uniform airflow the kiln was designed to give you, but also much of the fans' airflow will bypass the load (at a velocity more than double that through the load), increasing drying time and moisture variation despite a higher total fan airflow and electrical power consumption.

If you don't inspect and maintain your fans regularly, they won't give the airflow the kiln was designed for and you won't get reliable drying performance. I've even seen kilns where one or more fans were free wheeling in reverse on the driveshaft, short circuiting the kilns air circulation!

Your kilns' fans are the key to quality product from a reliable process, so don't forget their importance to your operation.

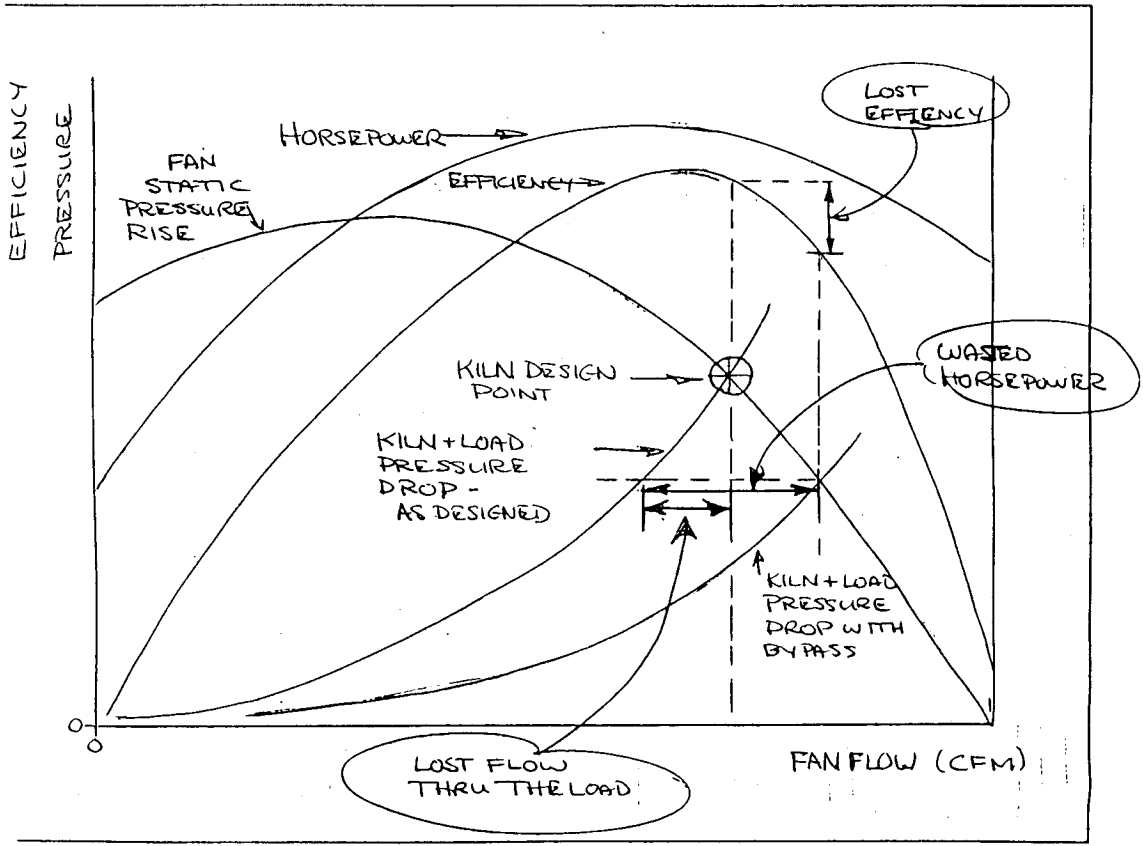

Figure 3. Kiln fans are designed based on the characteristics of the load and chamber.