Introduction to Fan Affinity Laws

The fan affinity laws offer a quick way to evaluate fan performance when wheel speed or diameter is changed. This capability is especially useful when a VFD or other speed control is employed. Simplified versions of the three main fan laws are as follows:

Fan Law 1: The change in flow rate (CFM) is directly proportional to changes in speed.
Therefore:

$$CFM_{New} = \frac{RPM_{New}}{RPM_{Old}} * CFM_{Old}$$

*Note that Hertz can replace RPM in these equations

Fan Law 2: Static pressure (SP) is proportional to the square of the change in speed.
Therefore:

$$SP_{New} = \left(\frac{RPM_{New}}{RPM_{Old}}\right)^2 * SP_{Old}$$

Fan Law 3: Fan brake horsepower changes are proportional to the cube of changes in speed.
Therefore:

$$BrakeHorsepower_{New} = \left(\frac{RPM_{New}}{RPM_{Old}}\right)^3 * BrakeHorsepower_{Old}$$

Example Problem:
A 12,000 CFM fan operates at 500 RPM using a 4.8 brake horsepower motor. This fan generates 1” of static pressure. The unit is installed and the actual static pressure at the job site is found to be 1.5”. What is the new brake horsepower?

Rule 3 solves for horsepower: $BHP = \left(\frac{RPM_{New}}{500}\right)^3 * 4.8$

RPM_{new} found via rearranging rule 2: $RPM_{New} = 500 * \sqrt{\frac{1.5}{1}}$

Answer: **8.8 brake horsepower**