VariTrane™ Duct Designer

An in depth look...

Introduction

The VariTrane Duct Designer duct design program was written to help optimize design while obtaining a minimum pressure system. The program is based on engineering data and procedures outlined in the ASHRAE Fundamentals Handbook. It includes tested data from the ASHRAE Fitting Database and from United McGill to provide the most accurate modeling possible.

The program consists of three subprograms or applets: Duct Configurator, Ductulator and Fitting Loss Calculator. Each of these applets can be used individually or combined to provide a complete duct analysis.

Duct Configurator

Duct Configurator sizes and analyzes supply duct systems. Quickly model the conditions for any duct system and specifications for each section, terminal unit, and diffuser. The section-by-section approach easily incorporates existing ductwork and fittings.

Design Methodologies

Equal Friction

This design methodology sizes the supply duct system for a constant pressure loss per unit length. This is the most widely used method of sizing lower pressure, lower velocity duct systems. The main disadvantage of this method is that there is no equalization of pressure drops in duct branches unless the system has a symmetrical layout.

Note: Set the optimal design friction rate per length of duct for the entire duct system in Duct Configurator by calculating the friction rate in the first trunk section of the system (the section connected directly to the fan). If the friction rate calculated for the trunk section is undesirable for the entire system, override the friction rate by selecting "No" to "Use calculated friction rate?" Set it directly in the field that appears.

Static Regain *Improved*

This design methodology sizes the supply duct system to obtain uniform static pressure at all branches and outlets. Much more complex than equal friction, static regain can be used to design systems of any pressure or velocity. Duct velocities are systematically reduced, which allows the velocity pressure to convert to static pressure, offseting friction losses in the succeeding section of duct. Systems designed using static regain require little or no balancing. One disadvantage of this methodology is that oversized ducts that can occur at the ends of long branches. However, VariTrane™ Duct Designer lets you limit this problem by specifying a minimum velocity constraint.

Note: Set the minimum velocity constraint directly on the main tab. Choose from one of the three values listed or specify your own velocity constraint.

Fitting Entry Methodologies *New*
Two new fitting entry methods in Duct Configurator add increased flexibility to the data entry process. They include:

The **Lowest Friction** method reduces entry time by limiting the amount of operations required for fitting selections. When checked, the fitting chosen is based on the fitting type and shape. Fitting types include transition, 45-degree wye, 90-degree tee, bullhead tee, and cross; along with fan connection, entry, and exit, which are available under certain circumstances. When a fitting type is selected, a fitting is automatically chosen based on lowest frictional loss, which eliminates a lengthy search through the available fittings.

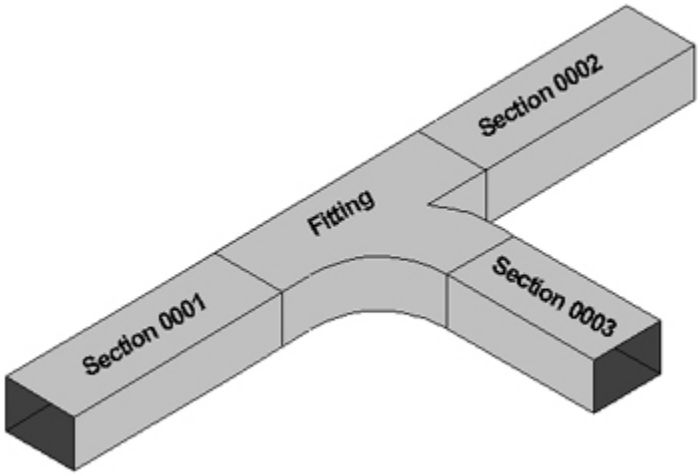
The **Quick Pick Fitting** method allows a user to customize the fitting types and available fittings within those types. When this method is selected the user selects a fitting type and shape. From these choices a customized list of fittings is presented based on the user's preference of fittings. The selections for a given fitting type must be set prior to using this method, but after the initial setup, the list of customized fittings will be available for any duct systems modeled in the future.

The **ASHRAE** method is the traditional method of inputting fittings and it provides the full assortment of ASHRAE fittings. When checked, every ASHRAE database fitting from a given fitting type is available for selection. This method offers the most accurate, but also the most tedious entry method.

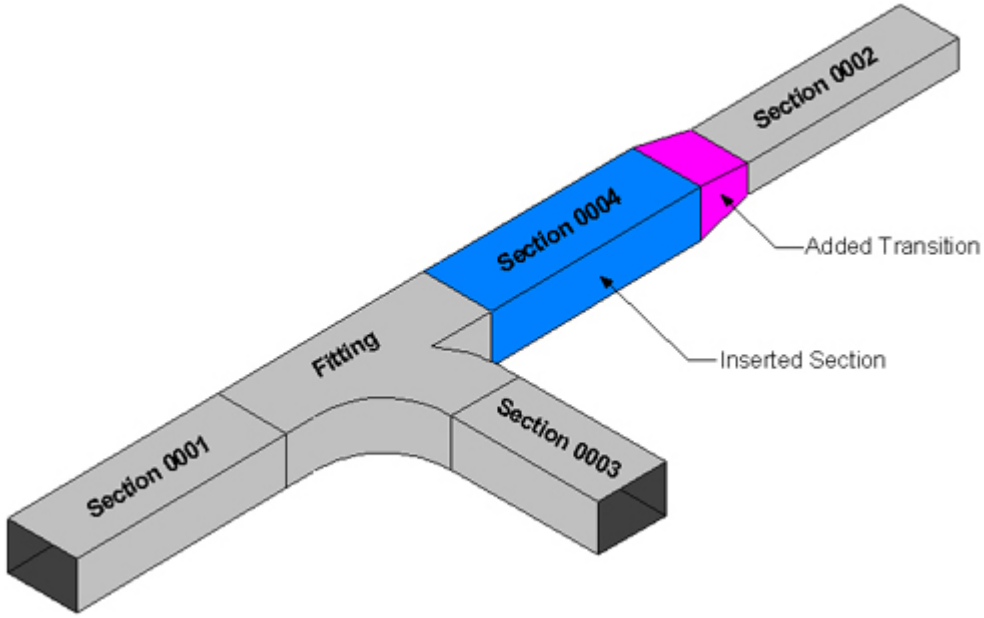
These methodologies may be used in conjunction with one another at any time in the entry process. For example, halfway through entering a duct system with the **Lowest Friction** method the user discovers a fitting that is not a close enough match to any of the fitting types. At this point the user can switch to the **ASHRAE** or the **Quick Pick Fittings** method of fitting selection and then back again if necessary.

Trane VAV Box Selections *New*
VariTrane™ Duct Designer now offers the ability to make Trane VAV box selections directly from the program through a seamless integration with the TOPSS program (Trane Official Product Selection Software). This eliminates the tedious and time-consuming process of transferring product selection data into Duct Configurator. It also provides additional sizing criteria and increased accuracy in the duct design procedure. The ability to export the VAV box selections to the TOPSS software gives the user the ability to further analyze the box selections.

Insert Feature *New*
Modifying an existing duct system layout is easier with the new insert feature. When a selection is inserted between two sections, it is connected to the downstream section by a transition of the same shape and is connected to the upstream section by the fitting that existed prior to the insertion. The transition can then be changed to a junction to create additional takeoffs in the system. (see below)



Modified Duct System (inserted section between 0002 and 0001)



Features

Auto-Correct for Leakage

When this feature is checked, Duct Configurator automatically recalculates the airflow required at the supply fan to overcome leakage losses in the system. The amount of leakage is based on the leakage class you select. Leakage class is an ASHRAE term that denotes the leakage airflow per unit of duct surface area at a specific static pressure. For more information on leakage, see Chapter 32 in the 1997 *ASHRAE Fundamentals Handbook*

Auto-Correct for Thermal Losses/Gains

During the journey from the supply fan to the conditioned spaces, the air stream may undergo various thermal changes. When this feature is checked, Duct

Configurator automatically recalculates the airflow required at the supply fan to adjust for heat loss or gain based on the thermal insulation specified for each section and the temperatures specified inside and outside of the duct sections.

Auto-Balance the System *Improved*
By checking this advanced feature, Duct Configurator will automatically add dampers in non-critical paths, where required, to balance the pressures in the system. Whenever the static overpressurization exceeds 1.0 in. wg in a given section, the application inserts an orifice rather than a damper to balance that section. This is done for acoustic optimization because orifices are less noisy than dampers when high-pressure drops are required to balance the system.

When this feature is not checked, Duct Configurator identifies the critical path and determines the required duct sizes and supply fan airflow accordingly, but it does not correct the oversized ductwork or reduce over pressurization with dampers in the non-critical paths.

Resizing Non-Critical Paths *Improved*
Would you like to reduce your duct material and installation costs up to 40 percent or more without affecting your annual energy costs? You can by using the new improved Resize Non-Critical Paths feature in Duct Configurator. Duct Configurator can optimize the non-critical path sizes prior to adding any dampers or orifices. All non-critical paths sized using either Equal Friction or Static Regain have excess static pressure. By reducing the sizes of the duct sections in the non-critical paths, the majority of the excess static pressure is converted to velocity pressure. The remaining excess static pressure can then be reduced using dampers as described above.

Note: By enabling auto balancing with resizing non-critical paths, the calculation time increases dramatically. This is due to the tremendous amount of iterations that can accumulate for each path. For this reason it is suggested to run this feature after the initial design has been optimized.

Adjust for Elevation Differences
Duct Configurator does system calculations both at the elevation you specify and at sea level. You can specify elevation changes for individual sections of duct if there are large elevation differences from the inlet to the outlet of a given section.

Constant/Variable Volume Systems
Duct Configurator can model both constant and variable volume systems. Constant volume systems are systems in which the *block airflow* equals that of the *peak airflow*. If these values are not the same, it is said that there is *diversity* in the system. Diversity is the decimal value that describes the ratio of block airflow and peak airflow.

$$\text{Diversity} = \frac{\text{Block Airflow}}{\text{Peak Airflow}}$$

If the diversity is something other than 1, the system is a variable volume system. This can be input in one of two ways. Diversity factor or block airflow can be input on the fan tab, but not both. The program then calculates the remaining variable. Peak airflow is always known since it is input on the VAV or diffuser tab for each terminal

device. The diversity is then equally distributed throughout the system. For example, if the diversity factor is 0.8 at the fan and 1.0 at each VAV box, the root section diversity factor would be slightly more than 0.8 and the section immediately preceding the VAV box would have a diversity factor slightly less than 1.0.

Note: Modeling downstream of VAV boxes can not currently be done, therefore VAV boxes and diffusers can not be used in the same modeled duct system. To account for the losses downstream of a VAV box use the Ductulator in conjunction with the Fitting Loss Calculator to determine pressure loss in each section of the longest run. Then add all of the losses together and enter that value in Duct Configurator.

Existing Building or Design Constraints
Another feature of the Duct Configurator applet is the ability to easily meet design constraints or model existing ductwork. To do this, set maximum or fixed section size constraints.

Note: An unlimited amount of take-offs can be connected to a section defined as a plenum.

Spreadsheet *Improved*
Make design changes and check for entry errors with ease through the spreadsheet view in Duct Configurator. Once in the spreadsheet view, double-click on a field category to get further information. Use copy/paste functionality to make global changes!

Ductulator®
This applet transforms Trane's popular manual duct sizing and layout calculator into a convenient PC-based tool. Use this applet to quickly size system components and determine the appropriate nominal duct size for equal friction applications.

Fitting Loss Calculator
This applet lets you quickly identify the optimal fittings and sizes for each duct section by comparing their efficiency and cost.

Note: Return and exhaust systems cannot yet be modeled using Duct Configurator. To account for these losses, use the Ductulator in conjunction with the Fitting Loss Calculator to obtain the static pressure losses through the return and exhaust ductwork.

These applets, combined with an integral database of accurate performance data for hundreds of ASHRAE and United McGill fittings, allow you to confidently model new or existing supply duct systems, whether round, rectangular or flat oval. Once you complete your design, print reports with detailed information about all aspects of the duct system, including bills of material.