Introduction

Rheia is the first fully engineered air distribution system for the homebuilding industry, from design intent through installed performance. Rheia offers balanced, controlled comfort for a better home using custom design software, engineered components, simplified installation, and technology-based commissioning. Rheia is leading the industry to expect and deliver higher quality HVAC systems.

This Rheia Zoning Design Manual provides information to properly design a zone system with Rheia. It is intended for experienced HVAC designers who are familiar with Rheia Design plugin for Right-Suite® Universal (RSU) and the Rheia Engineering Design Manual available at www.rheiacomfort.com/resources/designers. This manual contains advice on when to use zoning, an overview of zone equipment options with advantages/disadvantages, Rheia fundamentals regarding zoning, and the alternate steps for creating a zone design with Rheia.

Tip: This manual is a subset of the Rheia Engineering Design Manual, which provides necessary, foundational information for designing every Rheia system. All users must be familiar with that manual before considering the information contained herein.

Designing with Rheia: when to use zoning

With conventional systems, zoning is used for a number of reasons, most commonly: to maintain uniform temperatures throughout the home; to meet code requirements; to handle extreme seasonal load differences; and to provide the homeowner with multiple thermostat set points.

For each floor plan, the designer should understand the reason for specifying a zone system and determine if it is necessary with a Rheia system. The designer also will recommend how many zones to specify based on builder preference, number of floors, floor plan, window locations, market, climate, price point, and other factors. For best performance, Rheia advises a maximum of three zones with this system.

Temperature uniformity

Every Rheia system is balanced to meet design airflows. With Rheia, temperature uniformity can be maintained across a wide variety of floor plans without zoning. As a designer, if you've chosen zone systems in the past simply to combat uneven temperatures, using Rheia may eliminate the need for a zone approach.

For example, case studies from Rheia pilot homes in Pittsburgh, PA (heating climate, heating/cooling extremes), and Orlando, FL (cooling climate, high humidity), show a Rheia system outperforms a conventional duct system for temperature uniformity throughout the home. In both case studies, the pilot homes were 2200-2500 square feet, two-story floor plans. While the conventional duct system varied ~7°F from room to room, the Rheia system kept the homes much more consistent—only 3-4°F from room to room. Rheia's better performance statistics are the cumulative result of our propriety software design calculations, engineered component parts, tighter controlled installations, accurate balancing dampers, and commissioning for each home based on design intent data.

Some larger homes have two units rather than a zone system. There will be no change to this current practice with Rheia.

Code requirements

Some juridictions require zone systems based on square footage, number of floors, or other factors. If the local code requies a zone system, zoning will still be required with Rheia. If a zone system is required by code, follow this guide to create a proper zone design with Rheia.

Extreme seasonal loads

In markets with extreme seasonal loads and on certain floor plans within those markets, designers may need to provide a zone system to keep the home balanced in all seasons. In these cases, follow this guide to create a proper zone design with Rheia.

Multiple setpoints

Builders may want to offer multiple setpoints as an upgraded option that gives homeowners more flexibility, for example, to set bedroom temperatures cooler than common areas or to turn off air to a guest suite when it's unoccupied. In these instances, it's important that builders and homeowners understand how the zone system operates and its limitations. There is additional information on zone system operations and limitations later in this guide.

Overview of zoning equipment options

Rheia does not currently manufacture any zoning components. The three design solutions listed below use market-available components including the zone dampers and controls:

- Bypass-free system, single speed
- Bypass-free system, two speed
- Bypass system

This section describes the functionality for each of the three options. The section ends with a comparison table of the advantages and disadvantages of each system. It's the role of the designer to understand the zoning equipment options approved for use with Rheia and to work with the builder to specify a system that best meets the needs per floor plan.

Bypass-free system, single speed

Jackson Systems' ESP product line is the basis for this option, although equivalent systems by other manufacturers are approved.

Components

The bypass-free system consists of motorized zone dampers, a static pressure sensor in the supply plenum upstream of the dampers, and a zone control panel (Jackson Systems' MD dampers and ESP control panel with static pressure sensor). Each zone also has its own thermostat wired to the zone control panel. These components integrate with most residential AHUs. Designers must specify the correct panel model to match the AHU type (gas/heat pump, single stage/two stage, etc.).

How it works

Each thermostat communicates with the zone panel. When any zone calls for air, the AHU turns on. The motorized dampers of the zones calling for air open, and the dampers of the zones not calling for air remain closed. The static pressure sensor in the supply plenum monitors the supply static pressure and communicates with the zone panel. If one or more dampers remain closed while the AHU is running, the system static pressure will increase. When the system static pressure reaches a preset maximum (usually ~0.35-0.40 IWC), it triggers the zone panel to open the closed dampers just enough to relieve the excess pressure. Tests indicate that bleeding a small amount of conditioned air for a short time into non-calling zones has little to no impact on the zone temperature. This allows the system to operate below the preset maximum static pressure without using a bypass.

When specifying a bypass-free, single speed system, the designer will calculate the preset maximum for static pressure within the Rheia Design plugin for RSU. During installation, the contractor will set the equipment per the designer's calculation. To accommodate increased airflow, the designer will also need to add a few supply ducts downstream of each manifold.

Bypass-free system, two speed

Jackson Systems' ESP product line is the basis of design for this option, although equivalent systems by other manufacturers are approved.

Components

The bypass-free system, two speed uses the same types of components as the bypass-free system, single speed: motorized zone dampers, a static pressure sensor in the supply plenum upstream of the dampers, and a zone control panel (Jackson Systems' MD dampers and ESP control panel with static pressure sensor). Each zone also has its own thermostat wired to the zone control panel. These components integrate with most residential AHUs. Designers must specify the correct panel model to match the AHU type (gas/heat pump, single stage/two stage, etc.).

How it works

Each thermostat communicates with the zone panel. When all zones are calling for air, the AHU turns on at high speed and the motorized dampers open for all zones. When one or more but not all zones are calling for air, the AHU turns on at low speed, the dampers of the zones calling for air will open, and the dampers of the zones not calling for air remain closed.

The static pressure sensor in the supply plenum monitors the supply static pressure and communicates with the zone panel. The zone panel has internal logic to tell the AHU when to run at high speed or low speed, and also to monitor but not exceed the maximum static pressure. If the static pressure reaches the maximum, it triggers the zone panel to open all closed dampers just enough to relieve the pressure. Tests indicate that bleeding a small amount of conditioned air for a short time into non-calling zones has little to no impact on the zone temperature. This allows the system to operate below the maximum static pressure without using a bypass.

When specifying a bypass-free system, two speed, the designer will size the Rheia duct system per normal (no need to increase the number of supply ducts).

Bypass system

Honeywell TrueZONE product line is the basis of design for this option, although equivalent systems by other manufacturers are approved.

Components

The bypass system uses motorized zone dampers, a barometric bypass damper, and a zone control panel (Honeywell ZD zone damper, CPRD bypass damper, and HZ control panel). Each zone also has its own thermostat wired to the zone control panel. These components integrate with most residential AHUs. Designers must specify the correct zone panel model to match the AHU type (gas/heat pump, single stage/two stage, etc.).

How it works

Each thermostat communicates with the zone panel. When any zone calls for air, the AHU turns on. The motorized dampers of the zones calling for air will open, and the dampers of the zones not calling for air remain closed. When one or more zone dampers remain closed, the supply air that is intended to flow through the closed dampers circulates from the supply plenum, through the bypass duct/bypass damper, and directly to the central return. The bypass duct and damper help to keep static pressure below the maximum when one or more zone dampers remain closed.

When specifying a bypass system, the designer must size the bypass duct using conventional sizing methods to relieve all but the smallest zone's airflow at the supply static pressure. During installation, the bypass damper is set to a specific static pressure. Also, the designer will size the Rheia duct system per normal (no need to increase the number of supply ducts).

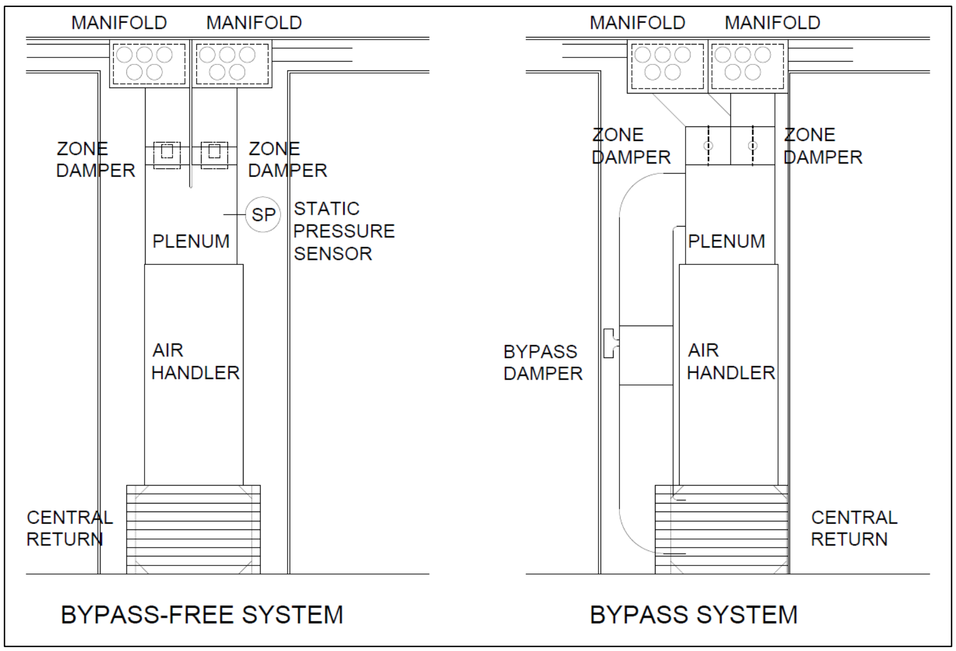

Figure 1. Bypass-free systems (single and two speeds) maintain static pressure by slightly opening non-calling zone dampers to bleed off air. A bypass system maintains static pressure by directing air through the bypass duct/damper and into the central return when one or more zone dampers remain closed.

Advantages and disadvantages

Each zone system has advantages and disadvantages in cost, equipment size, energy efficiency, and maintaining temperature across multiple setpoints. All three zone systems are good for maintaining uniform temperature throughout every zone; however, as we mentioned earlier, if this is the main reason for choosing a zone system, it is likely that with Rheia you can specify a non-zone option that will achieve the uniform temperature goals and save the builder the additional costs of a zone system.

Remember, it's the role of the designer to understand the zoning options approved for use with Rheia and to work with the builder to specify a system that best meets their goals per floor plan. Use the following matrix to help choose which solution is best for the home being designed.

Table 1. Advantages and disadvantages of zone system equipment options

	Bypass-free system, single speed	Bypass-free system, two speed	Bypass system
Advantages			
Low equipment cost	X		X
No increase in number of supply ducts to maintain static pressure		X	X
Compact, fits in 3'x3' mechanical closet	X	X	
Higher energy efficiency (because bypass is eliminated)	X	X	
Maintains separate setpoints from zone to zone (3-5° maximum)		X	X
Disadvantages			
High equipment cost		X	
Must increase number of supply ducts to maintain static pressure, which increases costs	X		
Not compact; requires ~3'x5' mechanical closet			X
Lower energy efficiency			X
Difficult to maintain separate setpoints from zone to zone	X		
Higher risk of expansion coil freezing			X
Not allowed by code in some jurisdictions			X

Rheia fundamentals: additional information for zone systems

Once the zone equipment has been selected, the designer must take some additional steps before beginning duct layout within the Rheia Design plugin for RSU. Specifically, the designer must locate the zone dampers and manifold in relation to the AHU as well as size the zone dampers and supply plenum.

Tip: All Rheia systems, including zone systems, must be configured to allow equal static pressure for every manifold and for all duct take-offs from the manifold(s). The Rheia Design plugin for RSU makes calculations based on this assumption. No zone can have extra components or other causes for pressure drop upstream of the damper or the system will not balance properly.

Rheia provides two options for configuring the AHU, zone dampers, and manifolds to ensure equal static pressure to all zones. Both options work with upflow and downflow AHUs and with two-zone and three-zone systems. The two options, Tall Closet configuration and Short Closet configuration, are driven by the ceiling height of the mechanical closet.

- Tall Closet configuration: vertical alignment of AHU, supply plenum, zone dampers, and manifolds. Use this configuration whenever possible because the vertical alignment results in a lower pressure drop and is thus more efficient.

- Short Closet configuration: AHU, "T" supply plenum, zone dampers, and manifold. Use this as an alternative solution, when the mechanical closet cannot accommodate the Tall Closet configuration.

It is the designer's role to evaluate the floor plan and develop a design strategy with the builder, architect, and structural engineer for the location of the mechanical closet and duct routing. In Rheia systems, all equipment and ducts are located within the thermal envelope.

Tall Closet configuration

When the ceiling height in the mechanical closet is sufficient, align the supply plenum, zone dampers, and manifolds vertically.

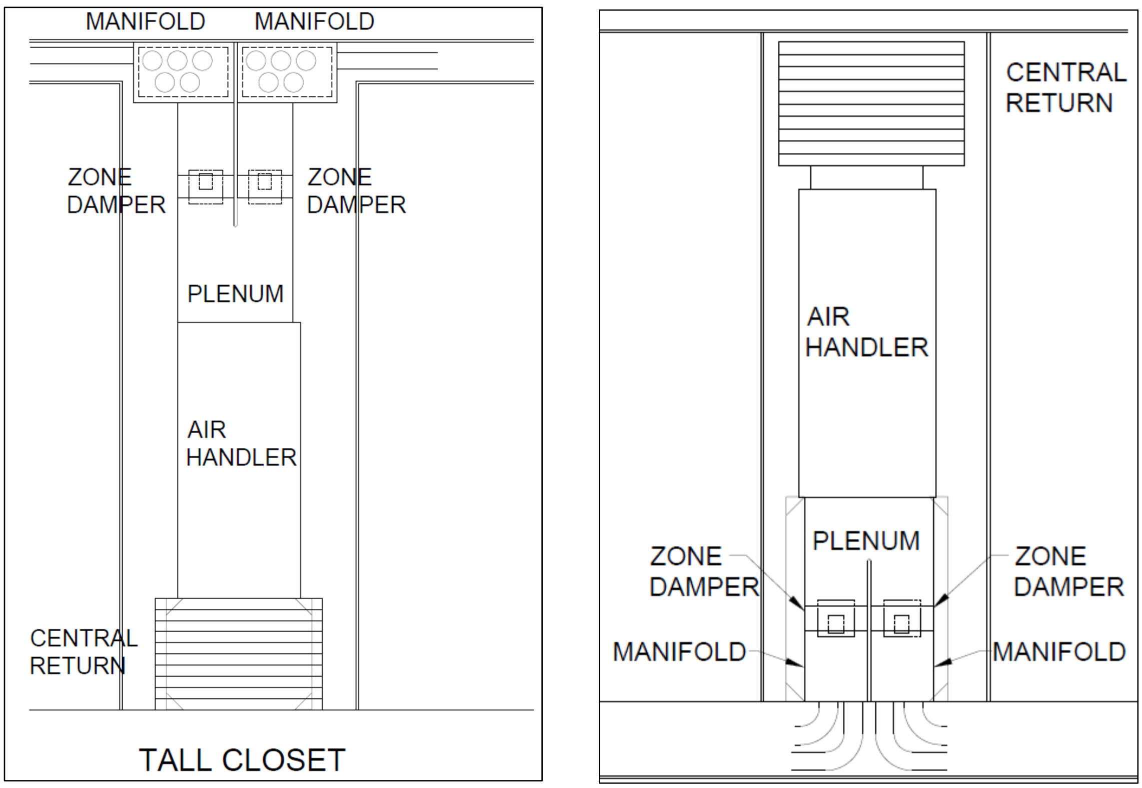

Figure 2. Use the Tall Closet configuration for lower pressure drop and better efficiency with both upflow and downflow AHUs.

In a Tall Closet configuration, it is important to note the location of the supply air outlet from the AHU. If the AHU has a supply air outlet that is not centrally located, you must orient the dampers perpendicular to the outlet opening. Orienting them parallel with the opening will favor one manifold, resulting in unequal static pressure.

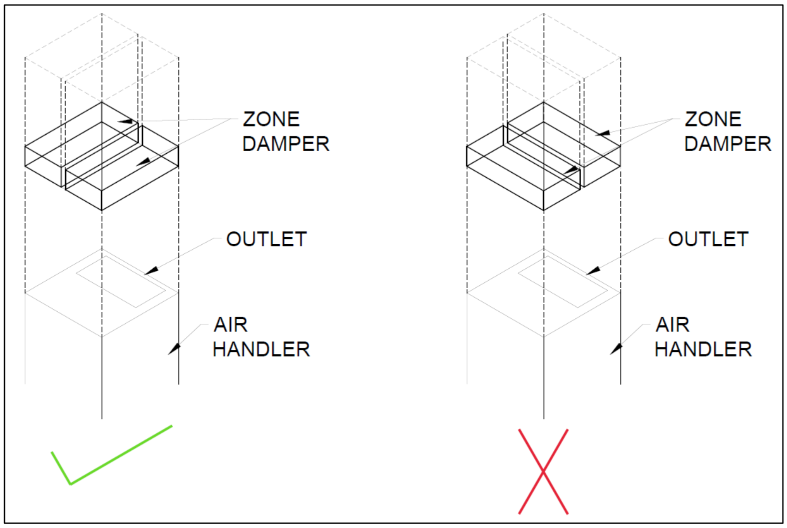

Figure 3. For an AHU with supply air outlet that's not centered, be sure to orient the zone dampers perpendicular to the AHU outlet as shown on the left. Avoid the positioning shown on the right, so as not to favor one manifold over the other.

Short Closet configuration

When the mechanical closet height cannot accommodate the Tall Closet orientation, specify a "T" supply plenum and locate the zone dampers and manifolds horizontally from the AHU. This configuration requires a wider mechanical closet and additional dropped ceilings, or it can be located in a large closet or basement.

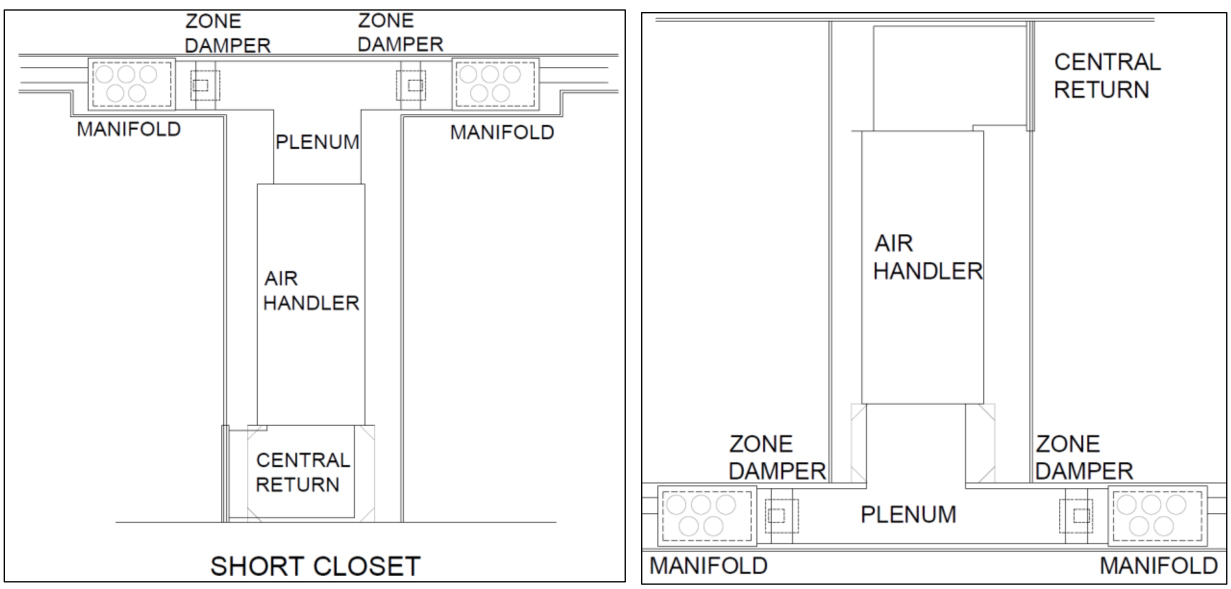

Figure 4. Use the Short Closet configuration as an alternate solution with both upflow and downflow AHUs.

Supply plenum and zone damper sizing

Rheia has developed the following best practices for sizing the supply plenum and selecting and sizing the zone dampers. Use these best practices with all zoning equipment options (bypass free, single-speed; bypass-free, two speed; and bypass) as well as both confugurations (Tall Closet and Short Closet).

1. Size the supply plenum to match the size of the AHU outlet. This will minimize pressure drop and will be easier to install.
2. Specify rectangular zone dampers (not round) for better flexibility and fit. Rectangular dampers can be made shorter and wider to fit the configuration you've specified. Rectangular dampers also have a shallower airflow dimension compared to round dampers, so they take up less space.
3. Using conventional methology, size the zone dampers primarily to minimize static pressure drop at full airflow and secondarily to fit the physical space available. Rheia recommends sizing the zone dampers for a maximum friction loss of 0.05" per 100 ft. of duct. Testing shows that dampers sized this way result in a negligible pressure drop for the system static pressure and do not affect system performance.
    - In a Tall Closet configuration, the ideal zone damper size will match the dimensions of the supply plenum; however, if this requires the dampers to be undersized per the 0.05" per 100 ft. of duct sizing criteria, do not match the plenum size.

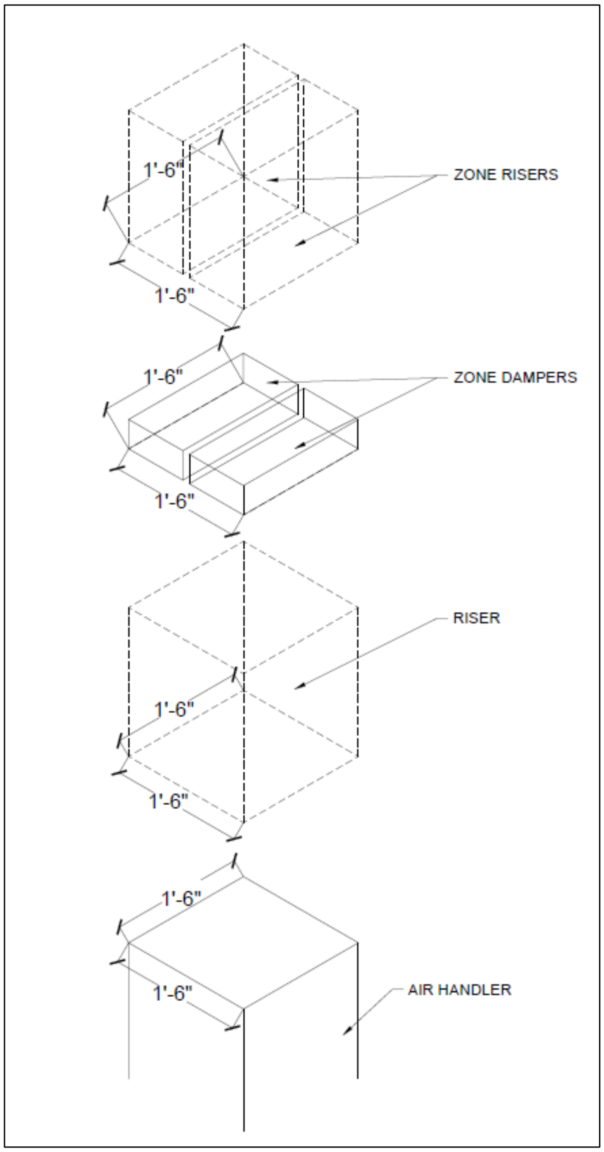

Figure 5. In a Tall Closet configuration, all components should match up dimensionally for ease of installation and reduced pressure drop.

- In a Short Closet configuration, the mechanical closet dimensions and/or dropped ceiling dimensions will affect the zone damper size. When dampers and manifolds will be in a dropped ceiling, first consider the framing of the drop. Specify the height of the damper to be short enough to fit within the drop and then wide enough to handle the airflow per the 0.05" per 100 ft. of duct sizing criteria.

Tip: Based on research and testing to evaluate the effects of oversized zone dampers, Rheia's results show that oversized dampers WILL NOT have a negative effect on system performance or balancing in either a Tall Closet or Short Closet configuration. Therefore, it is safe to increase zone damper sizes as necessary to make the connections to the supply plenum as easy as possible. Undersized dampers, however, WILL have a negative impact on the system performance. Undersizing one or more zone dampers can cause unequal static pressures in the manifolds and/or additional system static pressure that has not been accounted for in the calculation. Never undersize any zone damper.

Supply system design

When you specify a bypass-free system, single speed, you will need to add supply ducts downstream of each manifold to accommodate some increased airflow and maintain a balanced system. Follow the best practices in this section to help determine: zone sizes, static pressure preset maximum, design static pressure, and percentage increase of supply ducts to accommodate increased static pressure.

Tip: When you specify either a bypass system or a bypass-free system, two speed, you will not need to include additional supply ducts. In those designs, determining the number of supply ducts downsteam of the manifolds will follow the the same design process as a Rheia non-zone system. See the Rheia Engineering Design Manual available at www.rheiacomfort.com/resources/designers.

Zone sizes

Often-used zoning practices group rooms together in zones such as: first floor/second floor, east/west, and large thumb rooms. Follow these same practices in designing a zone system with Rheia. For a bypass-free system, single speed, strive to keep the zone sizes as similar as possible (per design CFM), as shown in the 60/40 split in Figure 6. Similarly sized zones allow dampers to close more without increasing the static pressure beyond the limit.

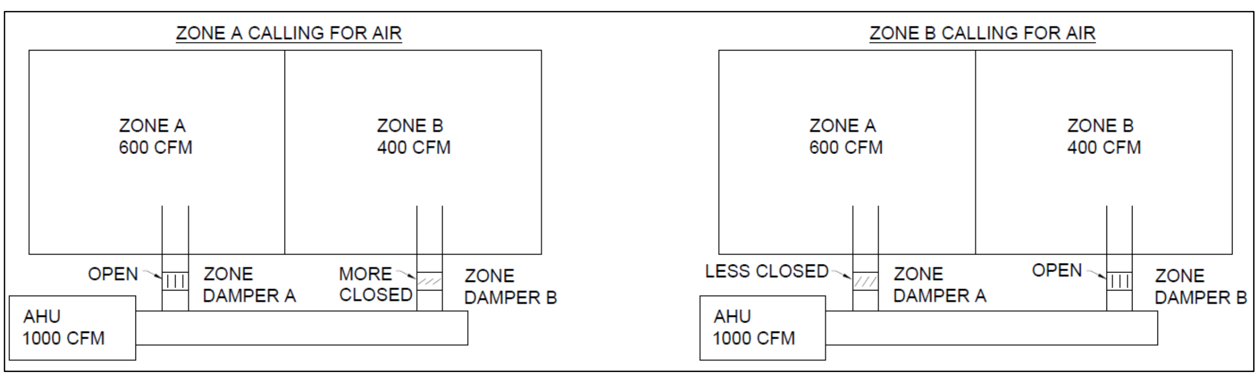

Figure 6. Example of a two-zone system showing how much each damper is able to remain closed in the non-calling zone.

In this example, when Zone A is calling for air and the static pressure limit is reached, Zone B damper will only need to open slightly to bleed off excess air and maintain system pressure. However, when Zone B is calling for air and the static pressure limit is reached, Zone A damper will need to open more to bleed off excess air.

Avoid designing any zone < 30% of total airflow because a bypass-free, single speed system will not be able to accommodate the static pressure increase. If a < 30% zone must be included in your design, consider using one of the other approved zone equipment types.

Static pressure preset maximum

Recall that a bypass-free system, single speed works like this:

> Each thermostat communicates with the zone panel. When any zone calls for air, the AHU turns on, the motorized dampers of the zones calling for air open, and the dampers of the zones not calling for air remain closed. The static pressure sensor in the supply plenum monitors the supply static pressure and communicates with the zone panel. If one or more dampers remains closed while the AHU is running, the system static pressure increases. When the system static pressure reaches a preset maximum (usually ~0.35-0.40 IWC), it triggers the zone panel to open any closed dampers just enough to bleed off some air and reduce the static pressure.

To determine the static pressure preset maximum, take the total external static pressure from the Manual S calculation and subtract the return static, coil static, and filter static. This will leave you with the maximum static available for the supply which will be the preset maximum.

For example, assume the total external static pressure (ESP) for a unit is 0.80 IWC. The figure below is from the Duct Preferences page within Rheia Design plugin for RSU®. Take your total ESP of 0.80, subtract 0.248 for the coil and 0.161 for the return and filter to get 0.391 IWC. This will be your supply system preset maximum.

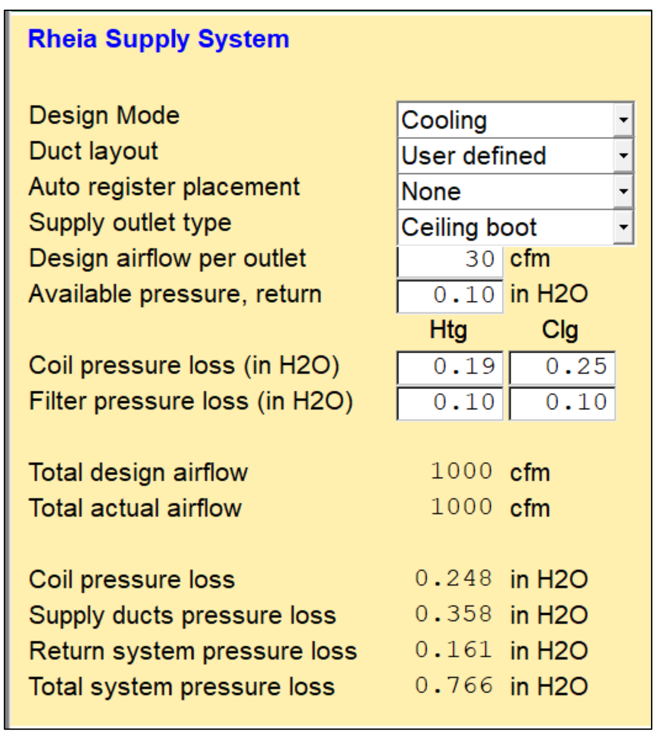

Figure 7. Use the Duct Preferences page to help determine the supply system preset maximum static pressure.

Tip: The Supply ducts pressure loss and Total system pressure loss shown in the Duct Preferences page will be the calculated values based on the current design shown. Add or remove ducts as described in this section and the Rheia Engineering Design Manual until those values match the intended design.

Design static pressure

You also will need to calculate the design static pressure, which you find by taking the static pressure preset maximum and subtracting the correct static pressure increase from Table 2 below. The increases shown in the table occur when one or more zone dampers is closed.

Keep in mind the following when determining design static pressure:

- The goal of a bypass-free single speed zone system is to achieve temperature uniformity throughout the home, NOT to provide the homeowner with separate setpoints in the home. Because of this, the designer does not need to size the duct system so any of the zone dampers can close 100%. There will always be some bleed off into the zones not calling for air.
- Every home will have unique needs based on number of floors, glazing, thumb rooms, and other factors. Designers will evaluate every home to determine what percentage of airflow between zones is necessary to keep the home at a uniform temperature.
- When all dampers are wide open, there will be an even airflow distribution across all zones. With one or more dampers closed, however, the airflow distribution across the zones will change, and the static pressure will increase.

Table 2 shows the static pressure increase at the supply plenum and the percentage of total airflow distributions between the zone calling for air and the non-calling zone. Reading from left to right, the table provides data for these zone sizes: Equal Size Zones (50/50 CFM split when all dampers are open) and Unequal Size Zones (33/67 CFM split with 33-side damper closed and also with 67-side damper closed.) In the table, “Zone Size” refers to the CFM delivered when all dampers are open and “Percentage of Total Airflow” refers to the airflow change vs. when all dampers are open.

Table 2. Airflow percentages per zone and static pressure increases with one or more dampers closed

	Equal Zone Sizes (CFM is split 50/50 when all dampers are open)			**Unequal Zone Sizes** (CFM is split 33/67 when all dampers are open)					
				33-side damper closed			67-side damper closed		
Static pressure increase (at supply plenum)	0.05	0.1	0.15	0.05	0.1	0.15	0.05	0.1	0.15
Zone calling for air (percentage of total airflow)	54%	60%	68%	58%	83%	90%	52%	58%	62%
Non-calling zone (percentage of total airflow)	46%	40%	32%	42%	17%	10%	48%	42%	38%

Following are scenarios for three homes. Each explains how to take the static pressure preset maximum, use Table 2 to interpolate the static pressure increase, and then subtract to find the design static pressure.

Home 1: Two-zone system with equal size zones 50/50

The static pressure maximum set by the static pressure probe is 0.35 IWC. The designer determines that the home requires a 65%/35% airflow split at the most extreme load condition to maintain a uniform temperature. By interpolating from the table above, the designer determines the static pressure increase must be 0.13 IWC. Therefore, the design static pressure must be 0.22 IWC.

0.35 IWC preset max — 0.13 IWC static pressure increase = 0.22 IWC design static pressure

Home 2: Three-zone system with equal size zones 33/33/33

The static pressure maximum set by the static pressure probe is 0.40 IWC. The designer determines that the home requires a 60%/40% split in airflow between zones calling for air and non-calling zones to maintain a uniform temperature. Since the worst-case scenario occurs when only one zone is calling for air, the columns on the far right are used and the interpolated static pressure increase must be 0.13 IWC. Therefore, the design static pressure must be 0.27 IWC.

0.40 IWC preset max — 0.13 IWC static pressure increase = 0.27 IWC design static pressure

Home 3: Two-zone system with unequal size zones 60/40

The static pressure maximum set by the static pressure probe is 0.35 IWC. The designer determines that the home requires a 60%/40% split in airflow between the zone calling for air and the non-calling zone to maintain a uniform temperature. By interpolating from the table above, the designer determines the static pressure increase must be 0.12 IWC. Therefore, the design static pressure must be 0.23 IWC.

0.35 IWC preset max — 0.12 IWC static pressure increase = 0.23 IWC design static pressure

Once you have determined the design static pressure, add ducts or edit the duct design until the Supply ducts pressure loss value matches your design static pressure. The Supply ducts pressure loss value can be seen on the Duct Preferences page within Rheia Design plugin for RSU®. An example is also shown in Figure 7, page 11 of this manual.

Supply ducts increase

It is important to keep the return, coil, and filter static pressure drops to a minimum when using this zoning option. When the design static pressure is high, the designer will not have to add many ducts to provide the static pressure increase. When the design static pressure is low, however, it will require more ducts to fulfill the static pressure increase. See Table 3 for estimates of the duct count increases (by percentage) as the design static pressure changes.

Table 3. Estimates for duct count increases when design static pressure changes

Change in design static pressure	Resulting duct count increase
0.40 IWC to 0.35 IWC	4% more ducts
0.35 IWC to 0.30 IWC	7% more ducts
0.30 IWC to 0.25 IWC	8% more ducts
0.25 IWC to 0.20 IWC	9% more ducts
0.20 IWC to 0.15 IWC	13% more ducts

Rheia design process: alternate steps for zone system

All Rheia systems must be designed using Rheia Design plugin for RSU. When designing a zone system, the step-by-step instructions are the same as with a non-zone system, with a few exceptions. Follow the Rheia Design Process found in the Rheia Engineering Design Manual for steps 1, 2, and 5 through 19. The alternate steps 3 and 4 are in this section.

Steps 1 and 2

See Rheia Engineering Design Manual, found at www.rheiacomfort.com/resources/designers.

Step 3: Create multiple zones and select Rheia Duct System

1. Open the Multitzone Tree window to create multiple zones. Click the Add Zone button to add as many zones as needed and name them accordingly. Drag and drop each room into the appropriate zone.

   Tip: Rheia recommends a maximum of three zones per AHU.

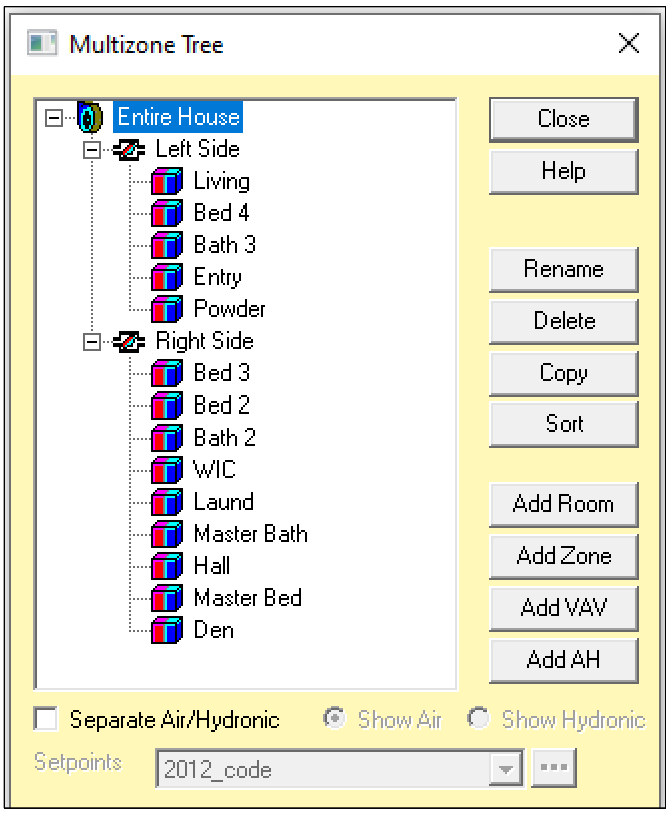

Figure 8. Use the Multizone Tree window to create zones and organize rooms within each zone.

2. Turn on the Ducts layer by checking the box in the far right of the screen. The AHU and diffusers automatically appear on the drawing sheet.

3. To select the Rheia Duct System, right click on the AHU. In the Property Sheet, find the Rheia Duct System field and set the pull-down option to Yes. This automatically generates manifolds for each zone on the drawing sheet and changes the square diffusers to round, Rheia Ceiling Diffusers.

   Property Sheet › General › Rheia Duct Design System › Yes

   Tip: Ceiling diffusers appear as the default in the Rheia Duct System. You'll locate the diffusers and specify types later in the design.

Step 4: Relocate AHU and manifolds; draw supply plenum connections

1. Relocate the AHU by clicking and dragging it into the mechanical closet on the floor plan.
2. Relocate the manifolds by clicking and dragging them into the mechanical closet. To see the zone name for a manifold, right click the manifold and the zone name will appear in the Property Sheet. Make sure each manifold is positioned correctly per its zone.
   - For an upflow AHU, position the manifolds next to the unit. In reality, the manifolds will be connected directly above the AHU, but that cannot be displayed within this interface.
   - For a downflow AHU, position the manifolds on the floor below the unit.
3. Draw the supply plenum from the AHU to the manifolds. Be sure to size the short supply plenum correctly because it will be accounted for in the pressure loss calculation. You can change the plenum sizes by right-clicking on the duct and adjusting the dimensions in the propery sheet. It will appear as a full connection when the first diffuser-to-manifold connection is made.
   - For a Tall Closet configuration, draw the plenum directly from the AHU to each manifold to indicate the vertical connection.

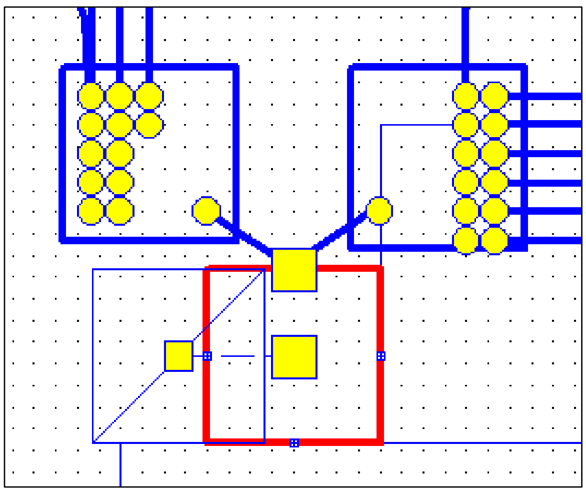

Figure 9. Tall Closet configuration. Draw a short supply plenum directly from the AHU to each manifold. Size this correctly for accurate pressure loss calculation.

   - For a Short Closet configuration, draw the plenum as a “T” to indicate the horizontal connection. For a three-zone system, repeat this process to add a third zone.

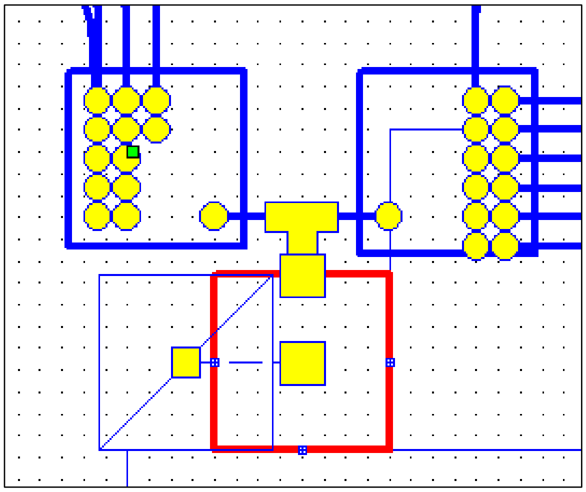

Figure 10. Short Closet configuration. Draw a "T" supply plenum from the AHU to the manifolds. Size the plenum correctly for accurate pressure loss calculation.

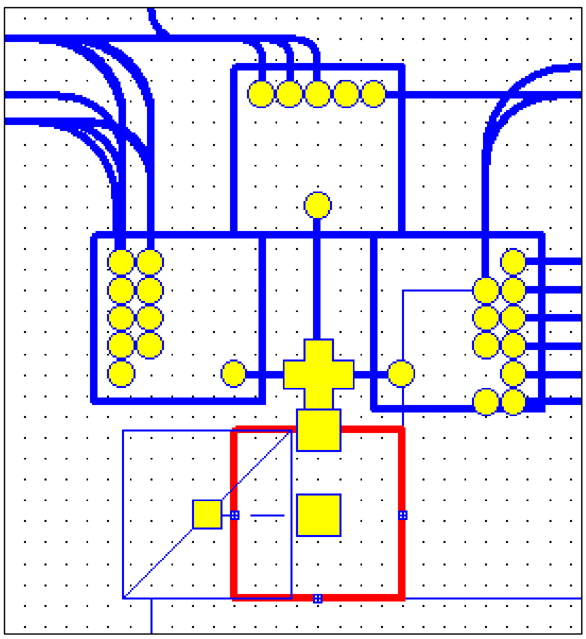

Figure 11. Example of a three-zone system in a Short Closet configuration.

The Rheia calculation engine will automatically calculate the airflow split between the manifolds and pressure drop through the connector components. The supply static pressure represents the static pressure at the airflow split.

Tip: Later in the design process, you'll be able to increase the size of the manifold as needed to accommodate all duct connections.

Steps 5 through 19

See Rheia Engineering Design Manual, found at www.rheiacomfort.com/resources/designers.