The cost advantages of systems thinking

Overview

A question we heard a lot from a builder or contractor when introducing Rheia is; "Rheia uses a lot of ductwork, won't that cost more?"

The initial reaction to a home run system is that there is significantly more material used and therefore significantly more cost. It is true that conventional trunk-and-branch duct systems have fewer total linear feet of duct and total number of parts compared to a RHEIA home run system, but the cost of a system is calculated on the following combination of factors beyond simple part counts:

The number of SKUs (Stock Keeping Units) utilized by a typical RHEIA design is very low at only 12 components and assemblies (including the duct and brackets) compared to a conventional system with about 75 SKUs. The reason this is possible is because RHEIA uses a single diameter, 3" flexible duct for all supply runs. This one-size approach requires that only one size of each component is needed. There is no longer a need for a 6", 8" and 10" 90-degree elbow as is the case with a conventional system, for example.

With only one size of each component and high part counts, production volumes per part are high (in the millions). RHEIA can therefore use mass-manufacturing methods to keep part costs extremely low. Injection molding produces very low-cost parts at high volumes while also creating components high levels of functionality, which in turn enables installation efficiencies and improved system performance. Injection molding is very scalable. Multi-cavity tooling further increases productivity and reduces part costs.

Even though there are many more duct runs than a conventional trunk and branch design (three times more typically) the material costs of the system does not increase proportional since from a manufacturer's perspective higher volumes of the same size duct can realize lower per foot costs.

RHEIA achieves a compact and efficient duct layout which reduces overall duct length. This is due to its design approach to locate diffusers on interior walls. A typical rule of thumb in many climates is to locate diffusers at the perimeter of the room, especially below windows, to offset the source of cold or heat. This logic is based on how homes used to be built—drafty and without high levels of insulation—rather than how they are built today—with well insulated and air-sealed enclosures. There simply is no need to distribute air to the perimeter of the home under today's code environment. Another feature of RHEIA is its approach to the return system. Efficiencies in material use are gained through a simplified design method and approach to return design. For example, HVAC contractors today often specify a complex return system consisting of one central return per floor and a dedicated return from the master suite. RHEIA is instilling a simplified return design that leads to more compact return systems that cost less, and work better. This approach is based on extensive research into simplifying air distribution. At the Pittsburgh pilot home, for example, a simple two-point return system was installed and shown to produce satisfactory airflows.

HVAC design is an important factor to save cost with RHEIA. On a per-lot basis there is a lot left on the table by HVAC systems because they are not tailored to the specifics of a home's site. For example, by producing designs for an entire community using worst case assumptions an excessof

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system capacity is often installed. Right-sizing a RHEIA system to a home (enabled by RHEIA's proprietary software) ensures RHEIA is not designed to the 'worst-case' scenario.

RHEIA's commissioning process reduces overhead costs for builders and contractors. By confirming that each system is performing as designed through a commissioning process, there will be fewer call backs. This is possible due to the ability of RHEIA's software to produce a predicted airflow measurement for each duct run that can be confirmed during commissioning.

The inventory equation is simpler for the contractor—RHEIA takes up less space in their warehouse. The low SKU count and smaller components requires less warehousing and is simpler to inventory. The volume of material that must be shipped to each job site is also reduced. A typical RHEIA system pallet is roughly 1/3 the size of pallets used in conventional systems.

Contractors incur labor costs when pre-assembling the manifold, but it is lower cost than conventional systems requiring multiple splitter boxes, trunks or plenums.

RHEIA designs require the purchasing of 3" duct which costs less than a 12" or 14" duct per linear foot with a. big difference in material volume. We also are using non-insulated versus insulated duct which also reduces system cost.

RHEIA's single diameter duct is central to its simplification. The 3" duct is ideal for routing through interior walls. Conventional ductwork requires large chases and bulkheads which have to be framed and drywalled. As the building codes push the industry to move all ductwork into to be brought into conditioned space, it significantly increases the framing costs. While chases and drop ceilings are, in some cases, required in a RHEIA design, the cost is less because they are smaller and lass intrusive.

The reduction in on-site labor realized by RHEIA is a key value for the builder and contractor, and a central benefit to RHEIA. The volume and amount of custom fabricated components is virtually eliminated. Manifolds and return plenums are standardized to a limited number of configurations which simplify the off-site manufacturing operation for the contractor.

Finally, and perhaps most importantly, labor savings are a major factor in HVAC system cost. Simply put, RHEIA takes less time to install. A conventional system is laborious and on a per-connection basis takes significantly more time. Even though there are hundreds of connections in a RHEIA system in total the system is more efficient to install due to each connection only requiring a few seconds to make. There is also no additional air sealing required after installing a RHEIA system. The component duct and manifold assemblies are engineered to be virtually leak-free.