

Luther Home of Mercy Case Study

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Study Compares the Kingspan KoolDuct System to Metal Duct System

Results show lower leakage rates and reduced operating costs with KoolDuct system

By

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Luther Home of Mercy is a not-for-profit organization founded in 1928 for the purpose of caring for people with developmental disabilities. Located in Williston, Ohio, it serves approximately 250 people in 10 residential cottages on a purpose-built campus, and throughout the community in private homes and in family care facilities built and staffed by the organization.

The residential cottages, normally the subject of research conducted by families in search of quality care and high standards of accommodation for their loved ones, recently became the focus of a different kind of study – one that compared the energy use, associated CO₂ emissions and the installed, operational and whole life costs of two different heating, ventilation and air-conditioning (HVAC) air-distribution ductwork installations.

One installation was a conventional sheet metal duct system wrapped with glass fiber insulation and the other; the Kingspan KoolDuct System - a pre-insulated UL Listed ductwork system constructed from premium performance non-fibrous rigid thermoset insulation panels. Luther Home of Mercy first became acquainted with the KoolDuct System during the construction of their family care homes.

“We’ve been quite pleased with the product, because it’s quiet, it offers a superior insulation value and it’s finished inside and out with foil, preventing the passage of fiberglass through the air stream,” explained Don Wukotich, executive director of Luther Home of Mercy. “So, when it came time to build two new residential cottages on our campus, we were prepared to use it again in both cottages.”

Those plans changed, however, with a suggestion from the ductwork contractor, Commercial Comfort Systems, Inc. (CCS), Maumee, Ohio. According to CCS owner Fran Lanciaux, because the two 7,000 square foot buildings were identical and being constructed side-by-side, they presented an unusual opportunity to compare two different duct systems.

The T-shaped single-story structures house 12 residents in total, four in each of three wings. Where the wings meet, residents share a dining room, activity area and kitchen. Lanciaux's proposal to install different duct systems in each of the two cottages was fueled by an interest in the air-leakage rates of both systems. "Because the buildings were so similar, we felt we could conduct a fair comparison of the duct systems and gain valuable empirical information regarding their respective leakage rates, a topic that today, more than R-values, is the focus of the Department of Energy," noted Lanciaux.

After having consulted Kingspan Insulation Ltd, the insulation manufacturer and owner of the KoolDuct system in the US, both Lanciaux and Kingspan approached MDA Engineering, Inc., Maumee, to perform the comparison study. MDA was the ideal choice because it had designed the HVAC systems and was familiar with both buildings. The HVAC systems consisted of four high-efficiency furnaces, cooling system condensing units and duct work in the vented attic.

The installation and test

The KoolDuct system (with a published R-value of 6.0 sf-hr-°F/BTU for the 7/8" panel thickness) was constructed using miter cuts and folds on the longitudinal corners, with a bead of room-temperature-vulcanizing (RTV) silicone adhesive at each corner. Transverse joints between ductwork sections were joined using Tiger connectors and also sealed with RTV adhesive. All joints were additionally sealed with a UL-181-A aluminum foil vapor barrier tape.

Although CCS typically makes the sheet metal duct it installs, in the interest of an impartial comparison, it competitively bid the metal duct contract. Constructed to Sheet Metal and Air Conditioning Contractors' National Association [SMACNA] seal Class B

standards, sections were assembled in the winning bidder's shop to assure good seals on the longitudinal joints. Longitudinal Pittsburgh seams were sealed with RTV silicone adhesive before the lap was folded over in the shop. Transverse joints were assembled and sealed in the field with Hardcast 321 Duct-Seal. The metal duct system was insulated to match the KoolDuct insulation performance characteristics, with both systems designed to meet ASHRAE 90.1-2004 and 2006 IECC duct insulation requirements.

An independent testing, adjusting and balancing (TAB) contractor certified by the Associated Air Balance Council (AABC), performed the leakage tests on the entire run for both systems, from furnace discharge to registers, using new, certified Oriflow brand testing equipment. Measured leakages at 2" w.c. static pressure (469 CFM for KoolDuct and 2306 CFM for metal duct) represented 6.7 percent of the operating supply CFM for the KoolDuct system and 33 percent for the metal duct system. When these rates were corrected to the actual average duct operating pressure of 0.1325" w.c., they represent 1.73 percent of the supply CFM for the KoolDuct system and 8.5 percent for the metal duct system.

The analysis

To conduct the analysis, three building models with the same physical characteristics were created in Trane Trace 700, a commonly used energy analysis program. Model 1 was a building with perfect ducts and no leakage. Models 2 and 3 represented the KoolDuct and metal duct buildings, each with their respective operating leakages. Actual energy bills provided utility rates – a blended 9.53¢/kwh and 99¢/Therm. The Toledo, Ohio, weather file was used, and simulations were run for 8,760 hours or one year. In addition, each model ran in four equal orientations 90 degrees apart, with findings averaged to create energy uses that are not orientation dependent.

HVAC costs in each building were determined by subtracting lighting costs from the total building energy and electric costs, while the life cycle cost analysis of each building included material and labor costs, finance costs, a five percent interest rate, a three percent inflation rate (applied to energy) and a 10 percent discount rate. Finally, because

the buildings and the ductwork installations are a long-term investment for Luther Home of Mercy, financing and project life were set at 30 years.

Summary and conclusions

The results showed that the KoolDuct system leaked less and cost less. This was despite the fact that the metal duct system had been constructed with great attention to sealing and installed at the lowest price from competitive bids to minimize any inherent KoolDuct leak advantages, as well as any material and labor cost advantages.

The key findings were as follows:

- The lifecycle-cost payback of the KoolDuct system was immediate because all costs were less than those for the metal duct system.
- The capital cost (materials and labor) was nearly 17 percent less for KoolDuct.
- KoolDuct was faster and easier to install, because lightweight duct sections are easier to handle, require fewer hangers and require no additional insulation. In addition, longer sections – as long as 13 feet for KoolDuct compared to five-foot sections for metal duct – translate to fewer joints, less time making and sealing joints, and reduced opportunities for leakage.
- Operating leakage cost for the KoolDuct system was nearly 80 percent less than the metal duct system.
- First-year operating costs, as a result of leakage for the KoolDuct system, were 70 percent less than the metal duct system, with overall HVAC operating costs 7 percent less.
- Using state average energy mix CO₂ generation data, provided by the Trane Trace program, the KoolDuct system saved an estimated 12,528 pounds of CO₂ annually when compared to the metal duct system. This is equivalent to reducing gasoline consumption by 639 gallons, according to the carbon equivalence calculator on the EPA's web site.

Lanciaux was not surprised by these findings. "Our company has found that after hundreds of installations and independent testing, KoolDuct consistently exceeds the performance of any other ductwork product on the market by demonstrating higher R-

values and lower installed air-leakage rates,” he said. “It is, quite simply, a high-efficiency, better indoor air quality (IAQ) solution for air distribution.

“In addition, it offers benefits in the area of labor. It’s neat, clean and because it’s pre-insulated, I don’t have to worry about leaving room for insulation as I install the duct work, and I don’t have to hire an insulator to wrap the duct work after it has been installed. So, we’ve become a one-stop shop, reducing time on the job. “

According to architect Walter Nelson, Normand Associates Inc., Perrysburg, Ohio, the KoolDuct product worked especially well in the projects he designed for Luther Home of Mercy. “What you see is what you get with the KoolDuct system,” he said. “Installation goes quite a bit faster, you don’t have to worry about an insulator missing something, and all the air test results I’ve seen indicate the product is a lot tighter than a sheet metal duct system.”

Final word

In the face of environmental and legislative pressures, there is no question that saving energy is high on everybody’s agenda right now. As a result, the role played by HVAC ductwork systems on energy consumption has become just as important as cost saving and speed of construction in both new construction and renovation works.

The KoolDuct system was introduced in the United States approximately six years ago and has since been increasingly used on many high specification projects requiring a ductwork system that delivers design performance in practice. Studies like this should go a long way toward further demonstrating the ability of KoolDuct to meet and exceed insulating and leakage requirements while providing a cost-effective, energy saving and carbon reducing solution for air distribution.

As a result of the findings from this study, Kingspan Insulation has produced a white paper: The Kingspan KoolDuct System, Rethinking Ductwork – Luther Home of Mercy. To download a copy, please visit www.insulation.kingspan.com/luther.

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