

# CONSTRUCTION

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## 28 Fabric Ducts: An Easy Ventilation Choice

*Brian Refsgaard and Simon Khaled, P.Eng.*

There is no doubt inflation, supply chain disruptions, and other residual effects of the pandemic continue to affect Canadian construction projects and delay their completion. However, there might be a silver lining to this dark cloud. Once projects are ready for HVAC completion, choosing fast-installing ventilation materials, such as fabric duct, can help speed up projects.



## 36 Unearthing Remediation Specifications: The Three Ps for Specifying Work at Contaminated Sites

*Joanna Wcislo*

When a specifier must develop specifications for a remedial design project, there are certain things that should come to mind for successful completion of the project. This article will guide an architect, engineer, contractor, or specifier on what a proper remediation specification should include. It will focus on specifying remedial design projects and how best practices, defined by three Ps (planning, parameters, practicality) can be most effectively applied.



## 42 Enhancing Safety and Productivity on Design-Build Construction Projects

*Jason Chiu*

There are several phases to the lifecycle of building projects that should be overseen, not only in the design but also for on-site delivery. For a project work site, three aspects which must be considered are intrusion, interruption, and injury; as these are also the three most common threats to productivity, profitability, and employee welfare.

## Departments

Message from the President . . . . 50

*Kazim (Kaz) Kanani*

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**Construction Specifications Canada**

120 Carlton St., Suite 312

Toronto, ON M5A 4K2

Tel: (416) 777-2198 • Fax: (416) 777-2197

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# FABRIC DUCTS

## An Easy Ventilation Choice

By Brian Refsgaard and Simon Khaled, P.Eng.

It is difficult to find a construction project that is not delayed in some way due to the current supply chain crisis. Portions of global trade have slowed down post-pandemic. In the Canadian construction industry, residual effects of the pandemic have caused supply chain issues. Some projects have been held up for months. However, there is good news for fast-tracking some trades, such as ventilation.

Mechanical equipment availability within the HVAC trade is one of several building trade sectors currently stalling new construction projects due to

supply chain issues. The current pandemic-induced supply, demand crunch, and logistics bottlenecks did not give a pass to the HVAC industry, as it depends all points to get its products to the market. Mechanical equipment is taking up to 10 times longer to get to jobsites compared to pre-pandemic time schedules. Further, labour shortages in the skilled trades and inflationary labour costs are also contributing to project slowdowns, as labour cost have risen, putting projects on hold for re-evaluation and ensuring they do not end up over budget.





*Fabric duct is ideal for sports facilities because flying objects cannot damage or dent it.*

While many of the aforementioned factors affect project completion deadlines, ventilation selection is a hedge architects, consulting engineers, and HVAC contractors are using to expedite projects toward completion once mechanical equipment finally arrives on-site and is installed.

#### **Fabric duct versus metal duct**

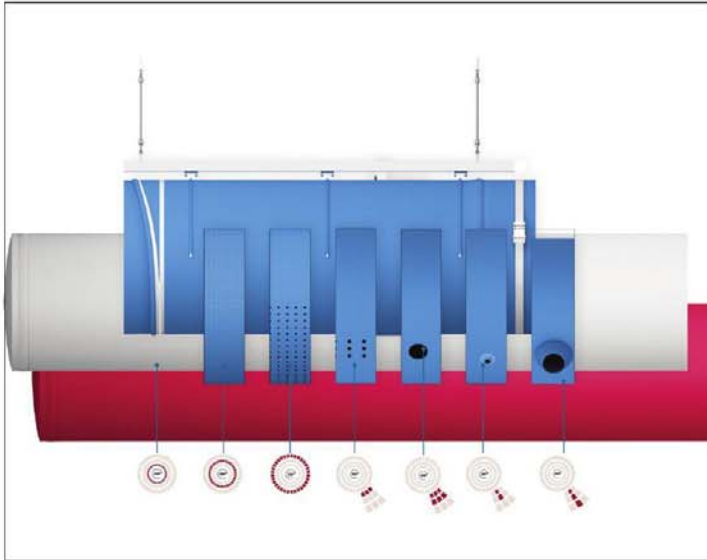
Fabric duct has been a construction standard for decades, and is now gaining popularity exponentially due to its significantly shorter installation times, in comparison to metal duct. Fabric duct can be installed up to 60 per cent faster than metal duct, depending on the application and project size. Metal duct comes in many jobsite-friendly assembled parts, such as air distribution boots and takeoffs. Metal also comes in multiple lengths and must be jobsite connected for long runs. In contrast, fabric duct air distribution vents are factory designed into the product, and long runs are typically shipped in one piece—all the sections are simply zipped together. Fabric duct's lighter weight also expedites installation, because it requires less installers, has lighter lift equipment, and the product is generally easier to handle. Instead of two or more weeks to install metal ductwork, fabric duct can fast-track installation to just one week. Depending on the ventilation design's complexity, lead times from some fabric duct manufacturers are 14 days or less, which is half the time of metal ductwork lead times.

Aside from lower installation costs, fabric duct's lighter weight reduces lift equipment rental costs.

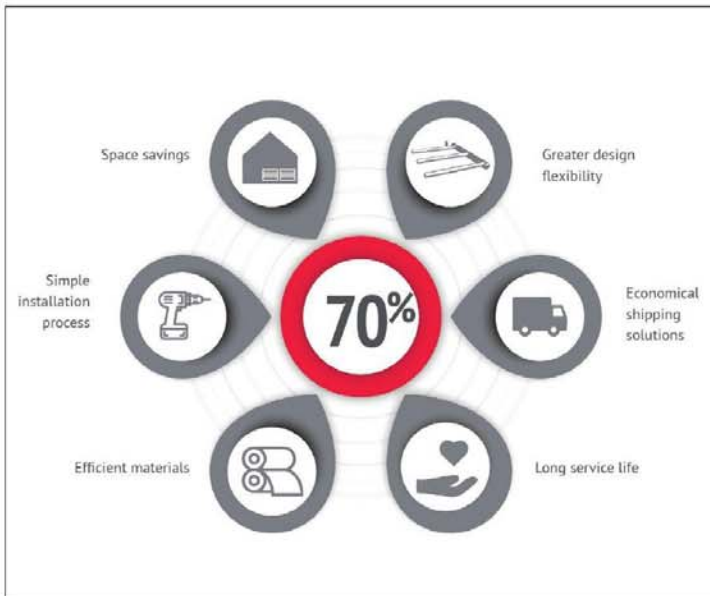


*Fabric duct was chosen for this sports pool complex because natatoriums are harsh environments and have high humidity and airborne pool chemicals.*

Lighter ductwork also reduces the number of workers required to install it, which is an advantage since staffing is still stretched thin. For example, a 1219.2-mm (48-in.) steel trunk line hung from a 7.62-m (25-ft)-high ceiling may need several heavy-duty lifts and three to four workers to rig it into position. However, the same-sized fabric duct trunk line might require a lighter duty, less expensive lift rental and only two installers to hang it.



*Fabric duct vents are factory engineered to consulting engineer specifications and can range from flow through fabrics on the left to highly directional jet streams on the right.*



*Six ways fabric duct is superior to metal duct in many applications.*

Contractors often perceive steel duct as the cheaper alternative to fabric duct, but it is a misconception when considering all factors in a complete ventilation installation. It is true spiral round metal duct is less expensive per linear metre (linear foot). However, it is sold a la carte from distributors. Boots, takeoffs, registers, hangers, coatings, insulation, and other accessories that increase the initial cost are sold separately. When a complete system is estimated,

steel duct's cost is similar to a fabric system, which is engineered and priced as a complete system of airflow, diffusion, and hanging hardware. Further, fabric costs are more predictable, because its price and availability are more stable and less influenced by commodity price fluctuations. When the labour reduction of up to 75 per cent is considered, fabric duct is significantly less expensive.

The trend toward open architectural ceiling design, versus T-bar-style ceilings, is also boosting fabric duct as a ventilation choice. Recessed ventilation duct must be metal, according to most codes. However, open ceiling designs are the perfect application for fabric duct. While fabric duct is suitable for any application with an open architectural ceiling, its specification is particularly well-suited in Canada for sports facilities, natatoriums, food processing, warehousing, and industrial uses—especially those that handle corrosive materials.

Food processing plants are at times very corrosive environments of process chemicals, biological contaminants, and cleaning chemicals to sanitize the space periodically. However, the large amount of antimicrobial cleaning chemicals involved in daily surface, floor, and wall cleaning gradually corrodes metal duct into premature failure. Fabric duct is resistant to corrosion caused by cleaning chemical agents. Metal duct can also be prepared for corrosion resistance, but it requires interior and exterior epoxy or galvanized coatings, which raise the initial cost.

Permanently installed metal duct is labour intensive to clean in place. However, the interior and exterior surfaces of fabric duct are faster and less expensive to clean because of their quick disassembly, transportation to a commercial launderer, and ease of reassembly on-site by one or two maintenance staff members.

### **Battling condensation**

Insulation is critical for condensation prevention in high-humidity environments such as indoor pools and cannabis grow operations (CGOs). Fabric does not attract condensation, but cold metal does and, therefore, requires the added expense of interior or exterior insulation or double-wall insulated spiral metal duct.

A case in point is the Granite Curling Club of West Ottawa. Ice rinks, in general, can be subject to fogging and uneven ice surfaces when humidity is not controlled through dehumidification and uniform airflow distribution. Designed by Goodkey,



Weedmark Consulting Engineers, and installed by Burchill Mechanical Contractors, the rink construction strategy used two fabric ducts along the alleys: an 18-m (62-ft) of 406-mm (16-in.) diameter, and a 23-m (76-ft) of 406-mm (16-in.) diameter to prevent condensation. Double-wall insulated round metal duct was an option, but it is more expensive and is not always a fail-safe method in extreme occupied environments, such as ice rinks.

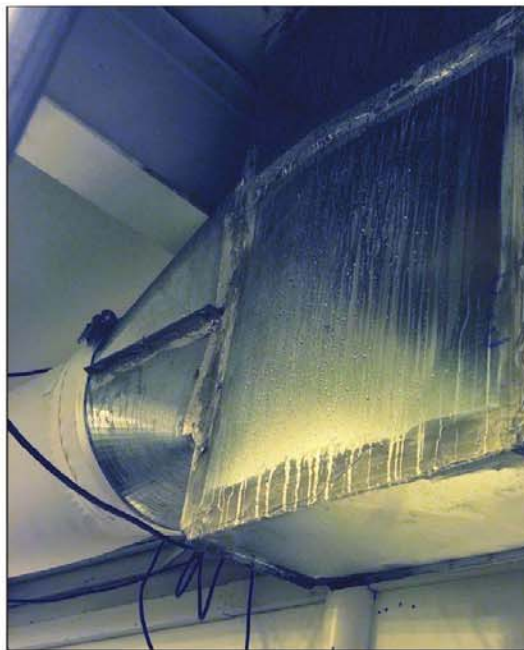
Condensation control is critical in the fledging CGOs industry. Condensation prevention, combined with antimicrobial fabrics, is one reason designers of potentially high-humidity environments, such as cannabis facilities and indoor pools, prefer fabric versus metal duct. This is especially critical in Canada, which passed cannabis legislation in 2018, leading to a proliferation of CGOs.

In the U.S., Real Leaf Solutions (RLS) in Kalkaska, Michigan, has proven the performance value of fabric duct in cannabis growing. The grow-op retrofitted two 139-m<sup>2</sup> (1500-sf) flowering rooms using fabric duct with 5.4-tonne (6-ton) and 7.2-tonne (8-ton) variable refrigerant flow (VRF) systems. Tom Beller, the company's chief operations officer, believes this combination helped produce a harvest with a 20 per cent yield improvement, compared to older rooms with metal duct and conventional air conditioning equipment.<sup>1</sup>

RLS's fabric duct solution incorporates a linear orifice array at the four and eight o'clock positions on each 508-mm (20-in.) diameter length. The fabric also disperses approximately 12 per cent of the airflow through the duct's permeable surface to prevent condensation. The factory-engineered permeability and linear dispersion result in a uniform 70.8 m<sup>3</sup>/minute (2500-cfm) air distribution per duct run, which helps plants thrive.



*Ras L' Bock Microbrasserie in Quebec chose a green fabric with their logo applied to the surface to impress visitors in their microbrewery.*



*Metal ductwork requires the added expense of interior or exterior insulation or double-wall insulated spiral metal duct to control condensation.*



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*Condensation prevention, combined with antimicrobial fabrics, is one reason designers of potentially high-humidity environments, such as cannabis facilities, prefer fabric versus metal duct.*

In natatoriums, the use of fabric duct helps prevent condensation and eliminates the need for metal duct coatings and periodic maintenance. For example, at the new \$48 million Aquatic Center at Mylan Park (ACMP) in Morgantown, West Virginia, the contractor substituted fabric duct for the original design of polyvinyl chloride (PVC)-coated, single-wall spiral metal duct. The switch reduced ductwork material costs by \$55,000, according to Chris Myers, the general manager for design/build mechanical contractor at A. Durer Inc. (ADI).<sup>2,3</sup>

Fabric duct also decreased labour costs for the 8361-m<sup>2</sup> (90,000-sf) facility and reduced trade stacking, because it installs up to 60 per cent faster than metal duct. According to Myers, the expedited installation cut six to eight weeks from the ductwork installation time. Further, the fast-tracking allowed other trades to complete their work sooner than if conventional metal ductwork had been used. The fabric duct's single-point aluminum suspension system, which serves the Olympic-sized competition pool and six-lane diving well, was installed in just 10 days. Afterward, only five days were needed to hang the 299-m (980-ft) of fabric ductwork, consisting of 2438-mm (96-in.) diameter

headers and branches ranging from 1219- to 1422-mm (48- to 56-in.) in diameter.

### **Fabric esthetics**

While fabric duct can be more esthetic than the external ribbing and protruding registers common with spiral metal duct, it can sag and deflate when the air handler is off or operating at partial capacity. As a result, the fabric duct industry has taken great strides to reverse this disadvantage by using internal and external support systems which give it a near or 100 per cent inflated appearance.

Shape retention innovations include metal or fibreglass internal or external support hoops. Depending on the manufacturer, these supports are factory installed and do not require assembly on-site. However, some types may require additional labour. Visible external hoops affect the streamlining of the duct surface, but do not add friction loss. While internal hoops are not visible from the outside, if left exposed inside the duct, they can add significant friction loss. However, if the internal hoops are enclosed in fabric sleeves, the friction loss decreases significantly.



Another esthetic advantage of fabric systems is the diversity of colours and patterns available. One must paint exposed metal duct, typically in the field, when colours are important to the interior design. For instance, owners regularly specify corporate and school colours, logos, and even patterns on fabric duct systems. Architects can select essentially any repetitive pattern, such as coffee beans for a coffee shop, fruits and vegetables for a grocery store, or camouflage for an outfitter store to supplement or enhance the interior design theme. These same patterns and logos may be cost-prohibitive for metal duct.

The Ras L' Bock Microbrasserie, La Pocatière, in Quebec, is a pub with a microbrewing production room intended for public tours where esthetics were critical. High above the towering beer brewing equipment is a green, 30-m (100-ft)-long, 609.6-mm (24-in.)-diameter food-processing-grade fabric duct. The duct's nozzle vents help generate an air velocity that reaches the occupied area 7.26 m (25 ft) below, but is very evenly distributed, unlike drafts common with metal duct/register systems. The pub chose to have its pink logo silk-screened onto the green fabric for brand recognition. Consequently, the ductwork creates a colourful contrast to the monochromatic room with white walls and stainless steel equipment. Silk-screened logos, mottos, and custom corporate or school colours are common in the fabric duct industry.

Aerosolized cleaning chemicals as part of the brew process sanitization regimen was also a potential for corroding metal duct. Further, yeast used in the brew process can harbour colonies of biological contaminants that require regular duct cleaning. Biological contaminants are less likely to grow because fabric duct does not attract condensation, which can nourish microbes.

### Energy efficiency

Studies have shown fabric duct uses less energy than metal because its air dispersion methodology provides uniform distribution throughout a space with fewer dead or static spots. As a result, the designer can achieve a consistent temperature, and the mechanical equipment runs less.

One study, "Thermal Comparison Between Ceiling Diffusers and Fabric Ductwork Diffusers for Green Buildings," compared the heating performance of metal versus fabric duct at various flow rates. Conducted by the Department of Mechanical Engineering at Iowa State University, the study showed fabric duct heats rooms faster, more uniformly and, as a result, more efficiently. The fabric system was 24.5 per cent more efficient than the ceiling metal diffuser system. The latter fell short because a significant fraction of distributed air stayed along the ceiling. The fabric system's higher velocities and multiple outlets resulted in more energy absorption by the room.



*The D-shaped fabric duct distribution system is an ideal application for low clearance ceilings that cannot accommodate low hanging metal or a round fabric duct.*

Systems reach set points more quickly, which decreases the mechanical system's runtime.<sup>4,5</sup>

Fabric can also provide an unlimited number of linear air dispersion vents ranging anywhere from micro-perforations to orifices of several millimetres (inches) in diameter. Unlike



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*When esthetics are critical, the streamlined appearance of fabric duct can enhance any environments.*

spiral metal duct, with registers every 1.5 to 3 m (5 to 10 ft), distributing large volumes of air and requiring reducers, fabric duct's linear vents distribute air along the entire length.

Consequently, fabric duct also has less friction loss than metal due to fewer reducers. This also creates a more uniform static pressure without requiring reducers. This and other factors also make fabric duct a quieter product.

In addition to linear vents, engineers may often design fabric duct with precise surface permeability via a standalone distribution method or in combination with any vent combinations. This also promotes more uniform airflow, temperatures, and efficiency.

### Conclusion

There is no doubt inflation, supply chain disruptions, and other residual effects of the pandemic continue to affect Canadian construction projects and delay their completion. However, there might be a silver lining to this dark cloud. Once projects are ready for HVAC completion, choosing fast-installing ventilation materials can help speed up projects. Further, the effects of the pandemic might also prompt the construction industry to look elsewhere for more suitable, alternative building materials, which will also offer energy efficiency, durable esthetics, and high performance for building owners now and in

the future. Both metal and fabric duct have a place in the construction industry. Architects, specifiers and design/build contractors should examine every project scope for the best choice. 📌

### Notes

<sup>1</sup> See "Michigan Cannabis Grow-Op Increases Yields with HVAC System Retrofit," HVAC Insider, hvacinsider.com/michigan-cannabis-grow-op-increases-yields-with-hvac-system-retrofit.

<sup>2</sup> Learn more about "Project Files: Episode 29—Aquatic Center at Mylan Park," ACHR News, achrnews.com/articles/143470-project-files-episode-29-aquatic-center-at-mylan-park.

<sup>3</sup> Read this article on fabric ducts, constructionspecifier.com/fabric-duct-solves-hvac-engineering-challenges-for-48-m-aquatics-center.

<sup>4</sup> Consult "Thermal Comparison Between Ceiling Diffusers and Fabric Ductwork Diffusers for Green Buildings," ScienceDirect, sciencedirect.com/science/article/abs/pii/S0378778811002970.

<sup>5</sup> Access this report, "Mechanical engineering student makes discovery in ductwork" by Jesa Wolthuizen, Iowa State University College of Engineering News, news.engineering.iastate.edu/2012/05/25/mechanical-engineering-student-makes-discovery-in-ductwork.



*Brian Refsgaard is president of FabricAir in Suwanee, Georgia, a manufacturer of fabric air dispersion duct. Refsgaard joined FabricAir's sales staff in 1990 and became the firm's CEO in 1999.*

*Today, the FabricAir Group operates 13 sales companies globally and offers a full line of fabric duct and accessories. Refsgaard can be reached at br@fabricair.com.*



*Simon Khaled, P.Eng., is the Master Group's air distribution product director for eastern and central Canada, as well as business development director for ventilation and engineering business solutions.*

*Khaled has an engineering degree from Polytechnique de Montreal and is a member of American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) and Building Owners and Managers Association (BOMA) Quebec. Khaled can be reached at skhaled@master.ca.*