STEEL DESIGN

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SPRING 2021

DEFINED DESIGN

Structube makes its mark on Laval with brilliant, custom coloured steel

by GKC Architects and Norbec

IN THIS ISSUE

STEEL DESIGN

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About ArcelorMittal

ArcelorMittal is the world's leading steel and mining company. Guided by a philosophy to produce safe, sustainable steel, it is the leading supplier of quality steel products in all major markets including automotive, construction, energy, household appliances and packaging. ArcelorMittal is present in more than 60 countries and has an industrial footprint in more than 20 countries.

With a strong presence in North America, Europe, South America and South Africa, and an emerging presence in China, ArcelorMittal delivers a large scale of products, solutions and services to customers with the same quality focus in all regions. ArcelorMittal is the leader in steel technology, both in the breadth and depth of our product portfolio, and in our ability to supply a range of grades throughout the world. ArcelorMittal is a supplier of choice for all markets, a testament of our commitment to working collaboratively with our customers to engineer advanced steel grades to meet their needs.

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COVER PHOTOGRAPH
Structube Headquarters, Laval, QC
by Stéphane Brugger

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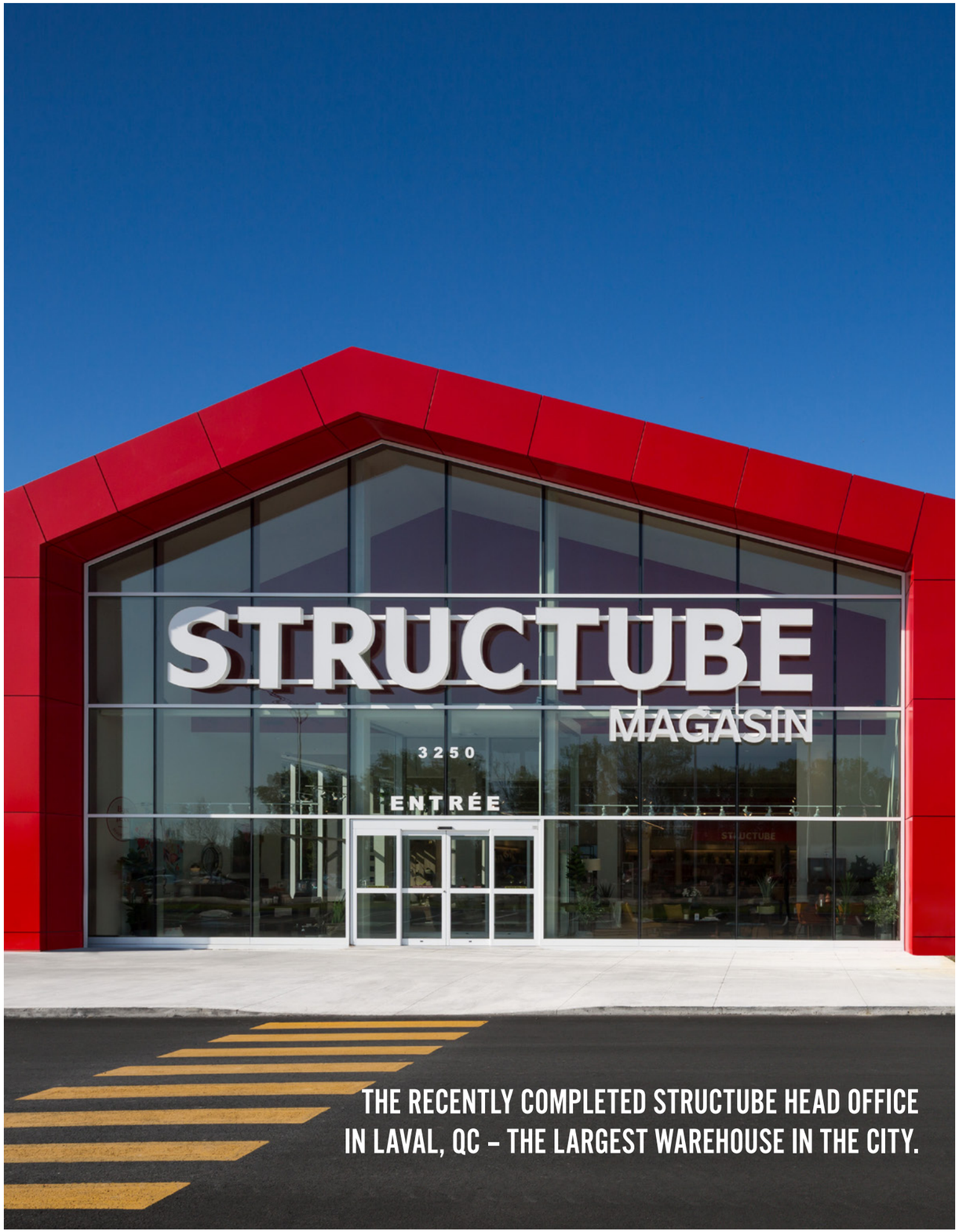
Grant Stevens, vice-president of corporate services for KF Aerospace on the construction of their new hangar. See full article on page 8.



THE RECENTLY COMPLETED STRUCTUBE HEAD OFFICE IN LAVAL, QC – THE LARGEST WAREHOUSE IN THE CITY.

FORM + FUNCTION

Expanding the palette of coloured steel surfaces

Story: Julia Preston Photo: Stéphane Brugger

Picture a child with a red crayon.

Ask them to draw a house, and you'll likely see a rectangle topped with a triangle. This distinctive shape has come to symbolize home.

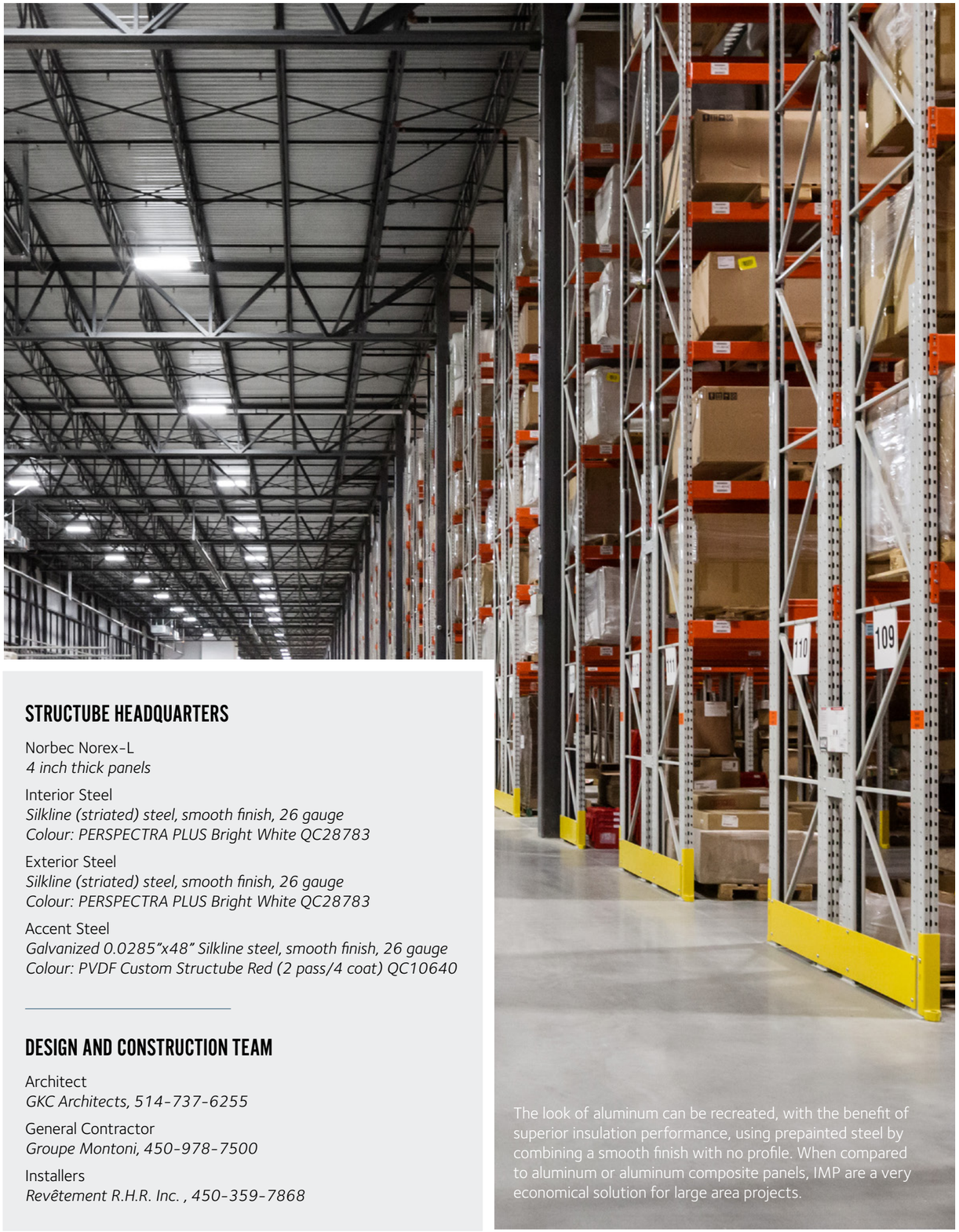
When Structube was looking to construct a new head office, store and warehouse, this iconic house image was integral to the design of the building's façade.

Structube is known for its furnishings, décor and home accessories. To emphasize the company's focus on home, GKC Architects added the outline of a house to the front entry of the new Structube head office. The distinctive house shape, in Structube's signature red, highlights the Montreal-based company's raison d'etre.

The $80-million, 60,000-square-metre facility opened in Laval in 2018. The new building is the largest warehouse in the city. It enabled Structube to discontinue rented warehouses and centralize administrative offices as well as distribution under one roof. A 3,700 square metre store included in the complex also allows the company to showcase a wide range of products.

The building is constructed with insulated metal panels (IMP) by Norbec. Installation of the IMP was completed by Revêtement RHR in record time explains Laurence Roy, marketing manager for Norbec.

"The speed of installation is one of many benefits of insulated metal panels," she says. "The envelope can be closed very quickly using



STRUCTUBE HEADQUARTERS

Norbec Norex-L
4 inch thick panels

Interior Steel
Silkline (striated) steel, smooth finish, 26 gauge
Colour: PERSPECTRA PLUS Bright White QC28783

Exterior Steel
Silkline (striated) steel, smooth finish, 26 gauge
Colour: PERSPECTRA PLUS Bright White QC28783

Accent Steel
Galvanized 0.0285"x48" Silkline steel, smooth finish, 26 gauge
Colour: PVDF Custom Structube Red (2 pass/4 coat) QC10640

DESIGN AND CONSTRUCTION TEAM

Architect
GKC Architects, 514-737-6255

General Contractor
Groupe Montoni, 450-978-7500

Installers
Revêtement R.H.R. Inc. , 450-359-7868

The look of aluminum can be recreated, with the benefit of superior insulation performance, using prepainted steel by combining a smooth finish with no profile. When compared to aluminum or aluminum composite panels, IMP are a very economical solution for large area projects.

IMP, making it ideal to start the work in the interior as fast as possible and have the store running as soon as possible."

When it came to the vibrant entry feature, Norbec created a custom paint colour that is an exact match Structube's official red.

Three layers of PVDF paint were applied to the panels to achieve the desired colour. PVDF, a resin-based coating system, is extremely durable. At the same time, it is a cost-effective alternative to metallic systems, which require a clear coat. Norbec's PVDF coatings meet rigorous requirements for aesthetic quality, flexibility, surface strength, chemical and UV resistance.

This new hue is now part of Norbec's colour palette. The company offers 25 colours in SMP and PVDF finishes and they continue to expand. At the beginning of this year, they added electric yellow and vibrant red, and horizon white is coming soon.

"Over the years, architects have loved creating a contrast with light and dark colours, as well as patterns along certain walls of the construction. [Or] sometimes they are looking for a pop of colour on a building," says Roy. The wide range of colours available--from whites and greys to reds, blues and greens--help clients like Structube achieve any vision.

Clients can order a mini fan of steel samples to get the real visual of the colours and be able to make the best choices for their projects.

In addition to colour, Norbec offers several types of profiles and finishes to give a different texture and style to the panel. There are three profile options: silkline (striated), micro ribbed or fluted. The finishes can be smooth or embossed depending on the project.

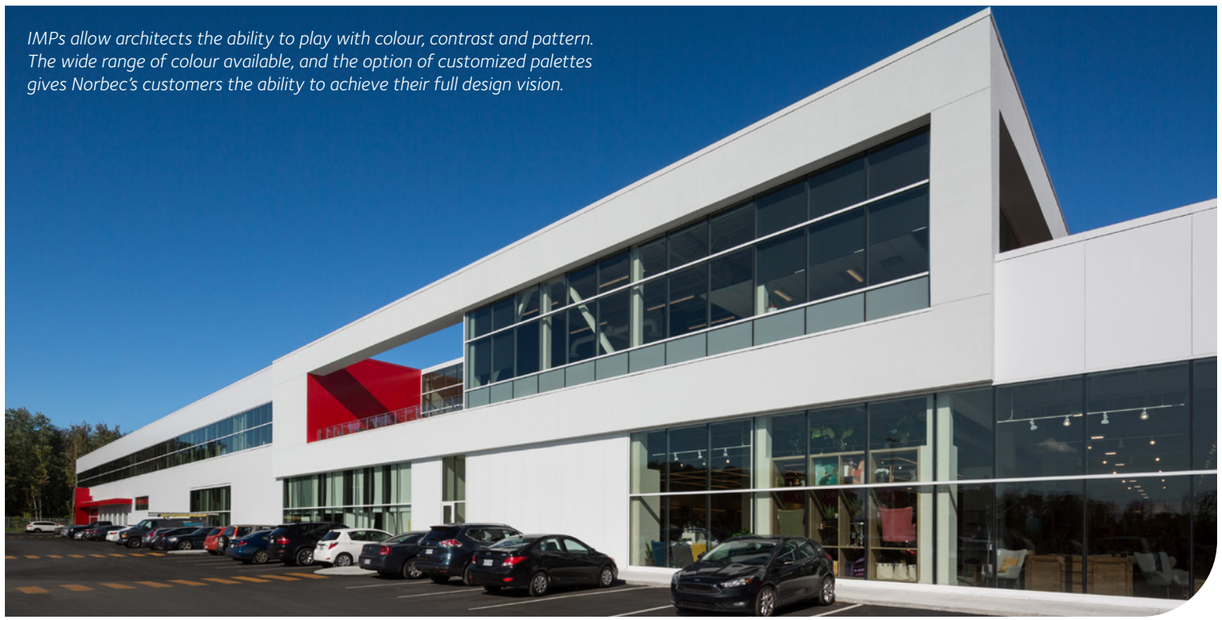
For Structube, GKC chose the silkline profile with a smooth finish. Silkline uses striations to create better rigidity in the steel. This rigidity makes it possible to manufacture longer panels, especially in dark colours.

IF MORE VERSATILITY IS DESIRED, INTEGRATED ELEMENTS CAN BE ADDED TO THE METAL PANELS TO ALLOW FOR EVEN MORE CREATIVE EXPRESSION

"If more versatility is desired, integrated elements can be added to the metal panels to allow for even more creative expression. Films can be printed on and then installed on the panels, causing no damage to them. Aluminum accents are popular additions, whether it be sections, overlay designs or even wooden accents in order to create a meaningful concept for the building," explains Roy.

Clients can recreate the look of aluminum with prepainted steel by combining a smooth finish with no profile. This achieves the aluminum look, but with the benefit of superior insulation at a lower cost. When compared to aluminum or aluminum composite panels, IMP are a very economical solution for large area projects.

All of Norbec's applications are installed using Z-shaped brackets, ensuring the panels are not damaged during the process, but enabling architects like GKC to be as creative as they would like. Whatever finish clients choose, the panels are easily washable and weather and corrosion resistant, which means Structube's red entry will remain a vibrant feature for years. ■



IMPs allow architects the ability to play with colour, contrast and pattern. The wide range of colour available, and the option of customized palettes gives Norbec's customers the ability to achieve their full design vision.

A CLEAR SPAN FOR SUCCESS

The new KF Aerospace maintenance hangar located at John C. Munro, Hamilton International Airport.

KF Aerospace's growth plans take off with steel support

Story: Julia Preston *Photos: Daniel Banko and Pat Versavel*

A Boeing 777 airplane is 74m long, 65m wide and 18.5m tall. If you want to park it in the garage, you're going to need a big one.

Such a garage—or hangar, more accurately—exists at the YHM Hamilton International Airport. Opened in November 2019, the hangar is 87m wide by 80m deep with 20m high ceilings and easily accommodates wide-body aircraft, like the Boeing Triple Seven. Easily because the whole 23,000 square metre hangar is a clear span design.

The hangar is owned by Canada's KF Aerospace. KF specializes in aircraft maintenance, repair and overhauls. In mid-2018, owner Barry Lapointe decided that a wide-body hangar was necessary to maintain and expand the company's customer base. Just over a year later, KF opened the doors on the new facility in Hamilton.

Pat Versavel , vice-president of engineering and innovation for Behlen Industries LP, reviews the timeline. "We had started quoting the project back in September and it kept going back and forth over various combinations... On December 31 it was actually awarded, and we started working on it right away at the beginning of January. All the steel was basically assembled by the end of August, and we handed over the keys in November. For that size of building and everything that went on it's a pretty tight schedule."

Behlen is known for its steel building systems. The company fabricated the hangar at its plant in Brandon and shipped the components to Hamilton.

"Everything is built or fabricated so that when it arrives on site the parts get organized and then following the instructions you just bolt everything together, stand it all up in a sequence that will make sure that it's stable as it goes up," explains Versavel. "It allows the whole product to go together very quickly because there is no site work that is required... You get a very rapid enclosure of a structure."

Wide-body aircraft typically have a fuselage that is more than 5m in diameter, multiple aisles and several cabin classes. A narrow-body aircraft, by contrast, has a single aisle and is usually less than 4m across.

KF focuses on heavy maintenance, meaning that a plane receives thousands of hours of work over multiple weeks. "We remove the entire interior of the airplane and we inspect it and we do all kinds of work," explains Grant Stevens, vice-president of corporate services for KF.

The new hangar enables KF to break into the wide-body market, while also continuing its narrow body services.

"A wide body hangar is quite a bit more of an investment because of course you've got that much more structure free span," says Stevens. "It's not like doing a warehouse where you can put a supporting pillar every 20m... You've got to have free span clearance in your building [which]... can start to astronomically increase in price and the challenges involved."

BECAUSE OF THE CLEAR SPAN DESIGN, THE BUILDING WILL HOLD ONE WIDE-BODY AIRCRAFT ALONGSIDE TWO NARROW-BODY AIRCRAFT OR UP TO FIVE NARROW-BODIES AT ONE TIME.

Because of the clear span design, the building will hold one wide-body aircraft alongside two narrow-body aircraft or up to five narrow-bodies at one time.

"In order to improve efficiencies in the operation, we wanted to ensure that we had enough space," says Stevens. "The width really allowed us to do multiple different projects... So it gives us a lot of flexibility from the operational perspective."

In addition to the accelerated timeline, the scale of the building presented challenges for manufacturing, transporting and construction.

"We've got the capacity to weld members that are about 3m deep, and in this case our deepest member was about 2,700mm, so we're getting very close to the upper end of our maximum depth capacity," says Versavel.

Flange sizes, connection plates, bolts, the weight and length of individual members, transporting the assemblies—every step of the hangar project was bigger and more complex.

Some members came in around 7,700kg. "You stack three of those on a truck and that's a full semi load," says Versavel.

On-site in Hamilton, there was limited storage space, so pieces had to be delivered in the right order to keep construction moving.

To achieve the 85m span, KDM Erectors did a bay lift using three cranes. Rafters were assembled on the ground then lifted up and set into place.

Quality control was essential to ensure everything fit together as intended.

"When you think of the cost of those cranes and the people and everybody that's involved if things don't line up... it's a huge cost," says Versavel.

Flexibility was also critical. "When you're doing projects like this, everybody's working on a fast track, but you have to still be somewhat adaptable," says Versavel. As changes arose or designs were finalized, Behlen had to make adjustments.

"You need to support the product you've built. You can't just walk away and say I did my part," says Versavel.

Beyond the structural steel, the cladding and roofing also received special consideration.

TO ACHIEVE THE 85M SPAN, KDM ERECTORS DID A BAY LIFT USING THREE CRANES. RAFTERS WERE ASSEMBLED ON THE GROUND THEN LIFTED UP AND SET INTO PLACE.

On the siding, KF chose a three colour scheme with grey and red vertical stripes at the corners to highlight the company's corporate colours. Paired with the company's logo, the cladding makes the hangar a striking billboard for KF.

On the roof, the company selected a lighter colour to improve reflectivity and reduce heat transfer in the summer. Given the scale of the roof, expansion, contraction, splices and wind loading were also concerns. Versavel says, "The door could be open under a big wind, and so you've got lots of interior pressure as well as exterior pressure to deal with."

On a Saturday in November 2019, KF opened the giant hangar doors and planes started rolling in.

The new space and new capabilities open up new opportunities for KF. Stevens says, "It gives us that additional space and allows us to grow our staffing out there significantly over the next 5 years... It allows us to break into the wide body marketplace. It also allows us to support some of the existing customers that may not have been able to stay in Canada in the past because there wasn't enough capacity." ■

Behlen is known for its steel building systems. The company fabricated the hangar at its plant in Brandon and shipped the components to Hamilton.

KF AEROSPACE HAMILTON

Main hangar
280'x265'x68' eave 0.8:12 slope
265'x58'=8 1/2 door opening

Door pockets
18.5'x45'

Annex
50'x246.5'

Total area
88,192 sq ft

Cold formed steel: Z275 (G90) galvanized; 175 ton

Roof Behlen Thermal Guard system with 10" insulation cavity

Liner panel Behlen AWR profile 26 gauge Perspectra Plus QC28317 White/White AZM150 Galvalume™ coating

Roof Behlen SSR24 standing seam roof 24 gauge Perspectra Plus QC28730 Regent Grey AZM150 Galvalume™ coating

Wall sheeting Behlen Widespan profile 26 gauge Perspectra Plus QC28273 Bone White, QC28306 Charcoal, QC28250 Dark Red AZM150 Galvalume™ coating

Door sheeting Behlen Ultra Span profile 26 gauge Perspectra Plus QC28273 Bone White AZM150 Galvalume™ coating

DESIGN AND CONSTRUCTION TEAM

Builder
Grassmere Construction, grassmere.com

Erector
KDM Erectors, kdmerectors.com

Fabricator
Behlen Industries LP

LEFT:
Given the scale of the roof, expansion, contraction, and wind load were concerns in the final design. Steel was chosen to maintain structural integriity, and balance interior pressure and exterior pressure during high winds.

DELIVERING THE GOODS

Managing costs and efficiency by building for the environment you are in

By Julia Preston
Photography by Pretium Projects Ltd.

"In Winnipeg it's much easier for us to design buildings because we don't have any seismic load. It's only wind loads... The deck was used to support the weight of the roofing system and the snow during the winter"

A new FedEx distribution facility in Manitoba can sort up to 30,000 packages an hour. All of them will pass under a roof of where the raw material originates from ArcelorMittal Dofasco steel.

A new FedEx distribution facility in Manitoba can sort up to 30,000 packages an hour. And all of them will pass under a roof of where the raw material originates from ArcelorMittal Dofasco steel.

Opened last October, the Ground Sorting and Distribution Facility increases FedEx's capacity in Canada and marks the company's commitment to improve service and delivery time.

"The facility opened with approximately 75 employees and [we] will add to the workforce as necessary to meet growing customer demand for our services. It also contracts with 10 local service provider businesses that separately employ about 150 drivers and staff," says Dana Hardek with FedEx Ground.

Located in Winnipeg's St. Boniface Industrial Park, the 23,225 square metre distribution facility sits on 40 acres and includes loading bays and office space.

Canam Group Inc. designed the steel structure and supplied components, including joists, girders and steel deck. Abesco Ltd. supplied the steel structure. The walls are constructed from pre-cast concrete panels by Lafarge.

Chief engineer Martin Couture from Canam explains, "In Winnipeg it's much easier for us to design buildings because we don't have any seismic load. It's only wind loads... The deck was used to support the weight of the roofing system and the snow during the winter."

He also used the deck in compression for a special connection and diaphragm action.

"Using the deck in compression [is something I don't do] very often, maybe one project in 100," says Martin Couture. There were some unique calculations required because of superimposed bending moments and compression. So we have to include those two kinds of loads. Structural support was required for snow loads and the wind loads created tension or compression loads at the perimeter. Also the diaphragm loading condition have has to be transferred into the vertical bracing."

The deck used is P3606, with a mechanically fastened side lap.

Canam has developed its deck to maximize the strength-to-weight ratio. This results in lower material handling and erection costs while maintaining

durability. While the deck is a structural component, it can also enhance a building's appearance with applied coatings.

Winnipeg-based Pretium Projects Ltd. was the general contractor and project manager for the build. Pretium President Justin Bova says that the company's lean construction approach allowed them to complete the build in 11 months, despite facing several challenges.

> "It was the fastest installation of structural steel and metal deck that I've ever seen in my career."

"One of the most challenging things... was the site itself," explains Bova. "The substrate wasn't of the best quality. We actually required 23 metre deep pre-cast piles, over 700 of them, as part of our foundation."

The foundation is an eight-inch structural slab on cardboard void forms with two mats of reinforcing steel and macro fibres added to the concrete mix.

The crew also faced weather challenges, which exacerbated the site challenges. Construction began in October 2019, and the city received the second highest amount of precipitation for October in Winnipeg's history.

"It was already bad enough, you're building on a swamp and now you add this huge volume of water to said swamp. We had to switch gears really quickly in order to salvage any kind of work environment," says Bova.

To protect the cardboard void form, the team had to quickly erect and enclose the building to achieve a watertight work environment.

Canam took nine weeks to install all the columns, joists and beams. Then they laid the entire 23,225 square metre deck in just eight days. Bova says, "It was the fastest installation of structural steel and metal deck that I've ever seen in my career."

The mechanically fastened side lap, coupled with organized deliveries and installation, helped the crew to achieve the rapid enclosure.

But the team also had to make adjustments for the winter temperatures. Elio Perrazzino, project management manager, Eastern Canada for Canam explains, "While erecting the building we needed to be fully decked and fastened to have the precast panels installed... We had to account for the temperature, so we could have the structure plumb."

Because the team erected the building without any heat inside, they built it with tapered walls initially. The top of the column was slightly inside, by roughly one and a half inches. Once the pre-cast wall panels were installed and the building was heated, the walls became plumb.

For FedEx, the finished facility is all about efficiency and speed. Five massive conveyor systems run almost 240 metres—nearly the entire length of the building. Trucks bring loads of parcels, which are sorted and transferred to the correct truck for distribution as quickly as possible.

The design and construction process set the stage for that speed.

Bova concludes, "If you're proactive and if you're organized, and if you have the right team in place, even the most aggressive schedules and budget can be met whilst maintaining the highest degree of quality and safety." ■

Rendering by: Verne Reimer Architecture inc.

SCANNELL PROPERTIES

Steel deck
P3606 22 gauge & 18 gauge, P-3606 deck: 40 ksi galvanized G-90

DESIGN AND CONSTRUCTION TEAM

Building Owner and Developer
Scannell Properties, 317-843-5959

Architects
Verne Reimer Architecture Inc., 204-944-9272

Engineers
Canam Group Inc. / Wolfrom Engineering Ltd. , 418-228-8031

Construction Project Manager
Pretium Project Ltd., 204-594-1429

Steel Structure
Abesco Ltd., 204-667-3981

Steel Components
Canam Group Inc., 418-228-8031

Panels
Lafarge Canada Inc., 403-225-5400

ACHIEVING NET ZERO ENERGY READY WITH STEEL

Weighing in on the benefits and performance of steel construction

Awareness is growing of sustainable building technologies and the need to reduce energy consumption. For architects, designers, engineers, contractors and developers, this increasing environmental consciousness translates to an openness to explore new construction techniques and evaluate how to minimize our long-term impact on the planet.

ArcelorMittal Dofasco is contributing to this conversation with a Passive House/Net Zero Energy Ready case study. The study examined how steel, concrete and timber compare environmentally and financially in a mid-rise residential building.

Both Passive House and net zero focus on energy efficiency to decrease carbon and greenhouse gas emissions. Buildings constructed using conventional methods consume significant quantities of energy. Heating, cooling, hot water, appliances, lighting, windows and doors all contribute to a building's carbon footprint.

Passive House standards address energy consumption, air tightness and interior comfort. The "passive" label arose because of the extreme low energy required to operate these types of buildings. The International Passive House Association explains that buildings require "hardly any active heating or cooling to stay comfortable year-round."

Minimizing energy consumption is key to a net zero energy ready building, as part of the aim to achieving the full net zero standard requiring that a building use only as much energy as is produced on-site from renewable sources.

These modern building standards can be implemented in a variety of ways depending on climactic conditions, local building traditions and individual preferences. As such, they are ideal subjects for a comparative study.

In this Passive House study, ArcelorMittal Dofasco analysed a hypothetical six-storey mixed-use commercial and residential building located in the Greater Toronto and Hamilton area. The building was 6,916 square metres and featured a split ground level podium for commercial space separated by a pedestrian walkway and 75 residential units on the upper levels.

The study was completed under ArcelorMittal's Steligence® initiative. This program uses technology and practical knowledge from independent industry experts to evaluate different construction methods.

Three different design scenarios were analyzed covering steel, concrete and timber construction. Each scenario incorporated a unique structural and exterior wall system to achieve the Passive House energy standard.

David Riley, senior mechanical engineer with mcCallumSather, oversaw the energy modelling process and developed the mechanical system concept for the project. He explains that the building envelope was the main focus of the study, regardless of whether the building was wood, concrete or steel. "At the end of the day, the energy targets that we need to meet are the same," he says. "It really comes down to how the building is built... and the thermal performance."

All designs featured the same structural design for the first level with additional upgrades:

- Insulated slab and footings
- Triple-glazed curtainwall, windows
- Increased roof insulation
- Centralized energy recovery system
- Thermally broken floor assemblies and balcony connections

PASSIVE HOUSE STANDARDS	
Space Heating Demand	not to exceed 15 kWh annually OR 10W (peak demand) per square metre of usable living space.
Space Cooling Demand	roughly matches the heat demand with an additional, climate-dependent allowance for dehumidification.
Primary Energy Demand	not to exceed 120 kWh annually for all domestic applications (heating, cooling, hot water, and domestic electricity) per square metre of usable living space.
Airtightness	maximum of 0.6 air changes per hour at 50 Pascals pressure (as verified with an onsite pressure test in both pressurized and depressurized states).
Thermal Comfort	must be met for all living areas year-round with not more than 10% of the hours in any given year over 25°C.

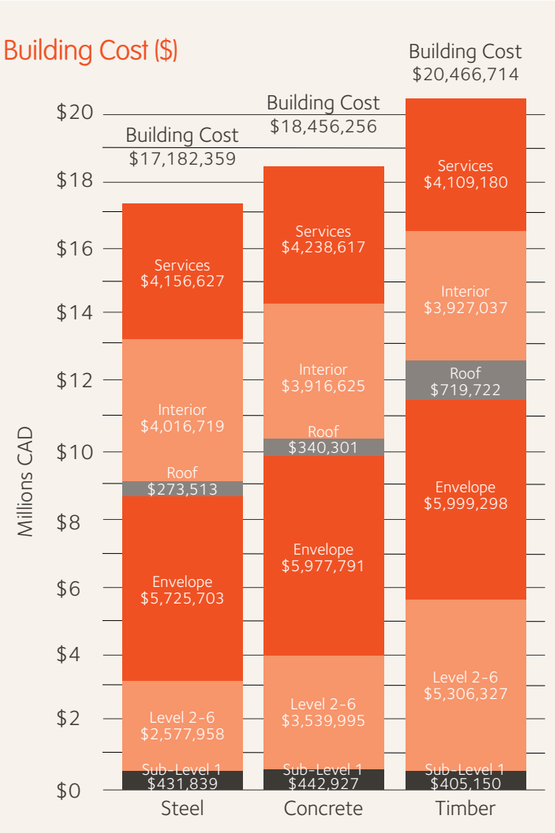
The most important technique to achieve net zero energy is to construct thermally efficient, air tight enclosures. Each material presents its own challenges in achieving this standard.
For steel, its higher conductivity levels require it to be fully protected from exterior conditions.

One technique is structural thermal breaks for components that extend through the insulation layer.

Another is to use large-format wall panels with steel-framed back-up assemblies. These assemblies are fully insulated on the exterior with lightweight cladding assemblies attached in a thermally-efficient way.

In some cases, the windows can also be pre-installed in the factory for a complete wall assembly that is shipped to the site and installed. This approach can significantly reduce the construction schedule, enclosing the building more quickly and permitting interior finishes to begin sooner.

To assess the environmental impact of the design scenarios, a cradle-to-grave life cycle analysis (LCA) was conducted. The LCA measured global warming, acidification, eutrophication, ozone depletion, and primary energy demand for the building over a 60-year lifespan.



Financial Source: Preliminary Construction Cost Estimate by Altus Group

"Life cycle analyses and other advanced metrics will provide even more valuable insights, going beyond just... initial build costs," says Brant Oldershaw, director of Structural, Mechanical & Electrical Engineering with WSP. "Too often we have seen design teams and their clients deciding their building materials based on familiarity, in lieu of evidence-based decision-making. By engaging in a comparison of materials on identical buildings... Steligence® is tooling the design community to make more informed decisions for their clients."

In the Passive House case study, the steel design outperformed concrete and timber in the majority of the categories on the LCA.

Steel had the lowest potential for acidification, eutrophication, smog formation and energy demand. For global warming, steel and timber were similar, and both were significantly lower than concrete in CO_2 equivalent emissions.

In all three scenarios, annual energy consumption was reduced by 55 per cent compared to the Ontario Building Code SB-10 reference and 50 per cent relative to a similar non-passive building.

The reduction lowered the utility costs by one third or $40,000 per year (assuming electrical and natural gas rates of $0.125/kWh and $0.09/$m^3$). Overall, the LCA determined that the steel-based construction had the smallest environmental footprint.

While there is a perception that environmentally friendly buildings cost more, Riley argues that is an over-simplification and careful analysis at the planning stage can illuminate the true cost. "You invest a little bit more to beef up the insulation on your building so you can minimize your mechanical and electrical systems... Unless you have that analysis that kind of gets lost in the overall numbers."

The case study included construction cost estimates for all three design scenarios. In terms of total cost, the steel design was the most economical at $17.2 million (CAD). The concrete estimate was 7 per cent higher than steel, while mass timber was significantly higher at 19 per cent. The difference was attributed to the increased material and installation costs of the concrete and mass timber in the upper floors and roof.

Both Riley and Oldershaw note that ongoing operating cost for a net zero or passive building will result in significant savings, which can offset additional construction costs.

"Passive house delivers a more comfortable, lower energy building and can result in a more durable asset with higher long-term value," says Oldershaw. "In our experience, the 'cost' of development is opaque and it's not clear to potential consumers how the choice for passive house influences cost –design, cost, or operations. Consumers may opt for passive house over other amenities if the choices were clearly and accurately reflected."

Climate change is one of the biggest challenges the world faces today.

The construction industry and governments have recognized the impact buildings have on greenhouse gas emissions and are in the process of updating the Canadian national building energy codes to

achieve net zero ready buildings for 2030. The Passive House standards will help guide buildings of the future in achieving this goal.

In this Steligence case study, the steel-based design was found to be the most environmentally sustainable and economical compared with concrete and timber alternatives.

As the construction industry continues to move towards net zero energy ready buildings, steel provides both a viable and favourable solution. It can achieve the energy requirement as defined in the Passive House standard, while maintaining the lowest environmental impact and cost of ownership. ■

CASE STUDY TEAM

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Structural Engineering
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Energy Modelling
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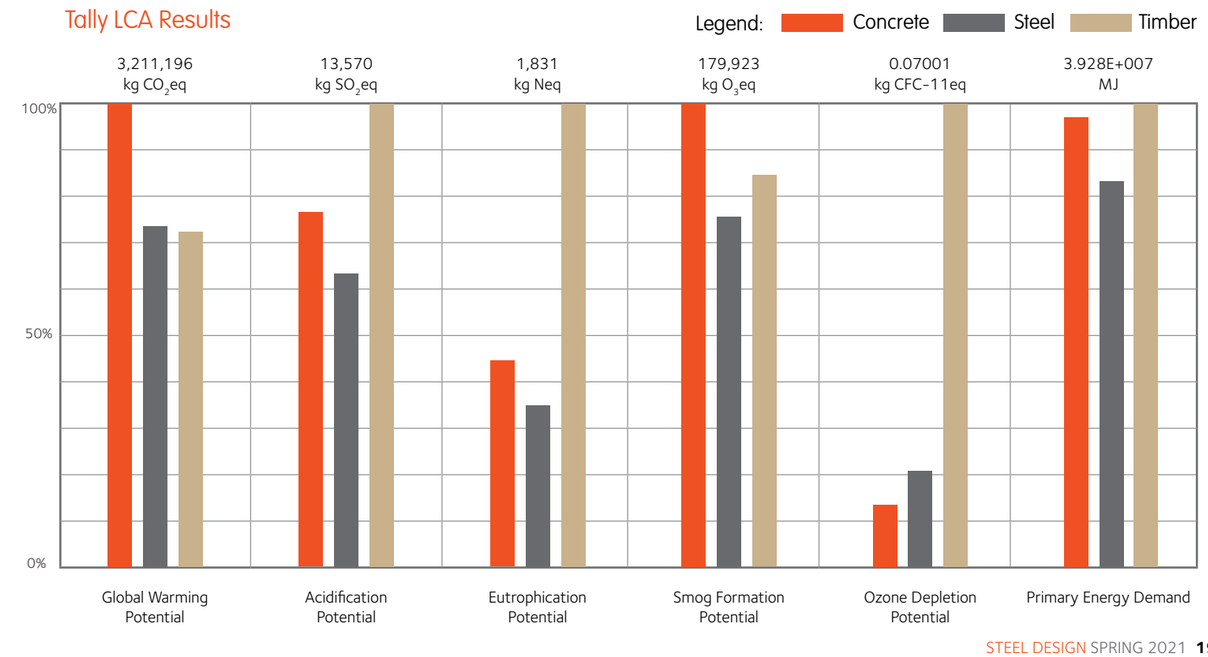
Mechanical Engineering
mcCallumSather
905-526-6700

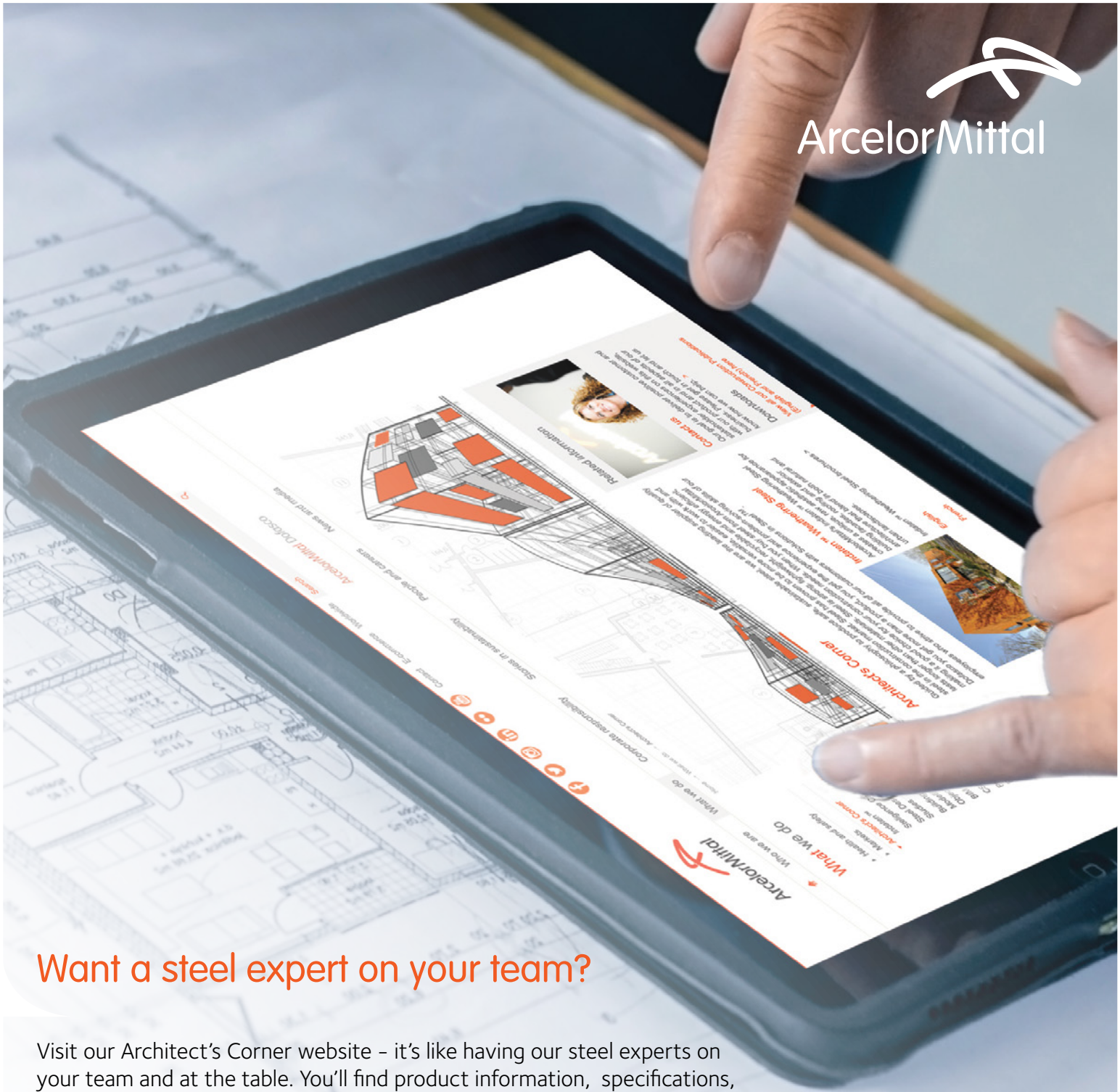
Electrical Engineering
Seguin Engineering
289-284-0954

Cost Consulting
Altus Group
416-641-9500

Schedule Consulting
MPA Consulting
416-317-0670

MINIMIZING ENERGY CONSUMPTION IS KEY TO A NET ZERO ENERGY READY BUILDING, BUT WITH FULL NET ZERO STANDARDS ALSO REQUIRING THAT A BUILDING USE ONLY AS MUCH ENERGY AS IS PRODUCED ON-SITE FROM RENEWABLE SOURCES.





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