# **STEEL DESIGN**

**STELIGENCE®** SOLUTIONS

ISSUE TWO, VOLUME 52 Fall 2020

# STEEL FOR EVERYONE The benefits of using steel in residential construction

Winona House by 25:8 Architecture + Urban Design in Ottawa

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HOME STEEL HOME



Examining the many benefits of using steel in residential construction.

Custom cladding defines the new Peter George Centre for Living and Learning at McMaster University in Hamilton, ON.



#### THE GUIDING SCIENCE OF STELIGENCE®

A plan to build the most sustainable, cost effective, mid-rise building.

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TAINABLE AESTHETIC



REDEFINING RESIDENTIAL ROOFTOPS WITH STEEL

Use metal tiles to replicate alternative natural roofing materials.

"So much of our focus was to make this economical. Steel is a classic cladding. You know how it's going to wear. We can choose colours. We can choose profiles. It gives us a lot of options, so in that sense it's the perfect material to work with."

Project Architect Antra Roze on the Peter George Centre for Living and Learning McMaster University, Hamilton, Ontario See full article on page 10.

## **HOME STEEL HOME** The benefits of steel for residential construction

Story: Julia Preston Photo: Brendan Burden

Steel is the go-to material for industrial and commercial construction. But when it comes to residential projects, steel is underrepresented. Jay Lim, principal at 25:8 Architecture + Urban Design in Ottawa, is working to change that.

"We have been huge proponents of steel for our cladding... on our residential projects," he explains. "We have found that it is an efficient, economical and environmentally beneficial product."

Over the past several years, Lim and his team have used steel to clad residential homes and also for structural elements within the buildings.

The BAM house (an acronym formed from the clients' names) is what Lim calls a "typical 1950s post-war design." It has two small bedrooms and one bathroom. The young couple who own the house were keen to make it bigger and family friendly. Enter Lim and his team at 25:8. "They wanted to make the house a bit more contemporary. They were very progressive," says Lim. "We chose all white for the exterior because of the environmental factor."

The white ribbed metal cladding covers the roof and walls of the entire house and has a high albedo, which means it reflects a substantial amount of sun and heat. High reflection results in lower summertime cooling costs.

The renovation involved adding dormers and a signature 25:8 element, the cape, an extension of the roofline over the front door. This provides protection and privacy at the front of the house. The firm used warm wood tones and trim inside the cape and dormers to provide a natural element to balance the strong industrial lines of the steel.

For Lim, the benefits of using steel are four-fold: economy, efficiency, environment and aesthetics.

"Our clientele that come to 25:8 tend to have the same kind of mission objective. They all like design. They don't tend to have huge budgets. So they're willing to let us be very creative," he says, "One of the ways we're able to manage costs is by managing the number of trades on site and getting bulk orders, and steel allows us to do that."

#### ECONOMY

Lim usually selects corrugated siding profiles that can be used on both roofs and walls. By using just one material, installation can be handled by one trade; there is also less over-ordering and less waste. Lim estimates that this approach saves 20 per cent on



trades. Additionally, by purchasing a larger order of material, the unit costs are reduced.

#### EFFICIENCY

Steel is also speedy to install. Because they come in large sheets, putting up cladding is much faster than masonry or siding. This reduces the time framing is exposed to the elements and allows construction to progress quickly.

#### ENVIRONMENT

Sheets of steel can also be precut at the factory to the specific lengths needed. This limits the amount of work required onsite. When cutting is required, such as around trim or corners, a circular saw with a carbide blade will do the trick—no special tools are required.

#### AESTHETICS

The finishing details, like trim and flashing, are another plus for Lim. "It's all the same stock. It's the same thickness of metal. The colour is going to match exactly the same. It allows us to get the custom profiles we want. What we love about the metal flashing is that we can get really sharp, clean edges versus some other stuff out there. I love the customization of the flashing. We've done a lot of interesting profiles to make the edges look even thinner than they actually are. I think that's a huge benefit."

Among builders, designers and homeowners, there is a growing awareness of the environmental impact of construction and various building materials. Lim notes that while metal can have a high carbon footprint at the manufacturing stage, its overall life cycle impact is the most sustainable choice.

"The fact that you don't have to do anything with steel for 40 years means that there's a lot less labour and cost involved in that," he says. "And at the end of the life cycle of this product, if we have to replace it, we're going to take it down and recycle it. Whereas with asphalt shingles they're just going to the trash. Vinyl siding is going to the trash."

Aesthetically, 25:8's designs tend to have a modern, industrial style. Metal is a key component in achieving that look.

## FOR OVERALL LIFE CYCLE IMPACT HE FEELS METAL IS THE MOST SUSTAINABLE CHOICE.

The ribs of the corrugated sheets reinforce the modern architectural geometry and using one colour gives a monolithic look. But the ribs also follow the 'traditional' forms of the houses, like gables or dormers. Steel helps to balance the old and new in many projects.

For the ONE368 project, 25:8 renovated a 100-year-old home. Much of the work focused on returning to the house to its original state—reopening doorways that had been closed up and enlarging the front window to its former size. Systems



White metal siding creates a modern look, and also has practical benefits. The light colour reflects sun and heat, decreasing the need for air conditioning in summer.

Photo: Brendan Burden



The Winona House employed steel as an aesthetic feature with black and white siding and also as a structural element, using beams and columns to support cantilevers and balconies. Architect Jay Lim explains, "The metal... made the building look more dynamic, very modern and sleek."

Photo: Shaun Blythe

and finishes were updated throughout the interior, but the original floorplan was maintained. The original structure was one and a half stories with a pitched roof; however there had been several additions over the years, each using different materials.

Lim explains, "It just looked very disparate and it didn't connect well. So we decided to clad it with all one material... The steel helped unify the building. [It also] allowed us to get the profile of the original house to keep that aesthetic of this traditional neighbourhood, but it obviously was something very new and modern."

Here, Lim chose black siding with wood accents. He says, "The great thing about metal is that it's robust and industrial looking, but that's also the downside." To give his designs more of a neighbourhood feel, he often incorporates wood and other natural elements to bring a bit of warmth to the façade.

While the ONE368 project challenged Lim and his team to unify a building with old and new elements, the Winona project called for the opposite: to obviously distinguish between old and new.

The original house was a small bungalow; the renovation added a second floor and other additions. Lim decided to "pay homage" to the original structure by cladding existing sections in white and running the siding vertically. On the new additions, he used black cladding run horizontally. "The white was what we call the ghost of the original house."

Winona also employed steel as a structural element, using beams and columns to support cantilevers and balconies. "The metal... made the building look more dynamic, very modern and sleek."

Thin round columns appear almost delicate relative to the building. In the front they nearly disappear, making the cantilever look more dramatic. Lim notes, "We could not have done that with wood. The wood would have been much thicker and it would have been much more intrusive."

Lim also cites that prefabricated trusses, normally used in factories or warehouses, are beneficial for residential construction. "If you want that clear span, that's the way we do it," he says. "It's an economical way. It's prefabricated so we know they fit. Maybe it looks a bit like a barn, but once we clad it, the way that we do our architecture, it works out really well."

"When we want to do dynamic structures, like a large cantilever, steel becomes really valuable. Because of its strength to weight ratio we can get longer spans, use less material. It hides, so in that case we're not showy with steel, but it's playing an integral role in doing the architecture that we need."

Lim notes that there are some challenges using steel in residential construction. For cladding that is riveted together, he emphasizes that proper waterproofing is essential.

Another challenge can be finding tradespeople who are open to working with steel as opposed to other more traditional materials that they may be more experienced with. "They're so used to using a hammer and nails. You have to be able to coach them into saying yeah, this is the appropriate application for steel," he says.



#### B.A.M. HOUSE

Ideal Roofing Cladding Ameri-Cana panel, 80,000 PSI full-hard Galvalume<sup>™</sup> steel, 26 gauge Colour: Perspectra Plus Polar White

#### **DESIGN AND CONSTRUCTION TEAM**

Architect 25:8 Architecture + Urban Design Limited, 647-504-1546

General Contractor DTR Renovations, 613-862-4555

Structural Engineer WSP Engineering, 613-829-8299

#### **ONE368**

Ideal Roofing

Cladding Ameri-Cana panel, 80,000 PSI full-hard Galvalume<sup>™</sup> steel, 26 gauge Colour: Perspectra Plus Black

#### **DESIGN AND CONSTRUCTION TEAM**

Architect 25:8 Architecture + Urban Design Limited, 647-504-1546

General Contractor DTR Renovations, 613-862-4555

Structural Engineer Adjeleian Allen Rubeli Limited , 613-232-5786



"We could not have done that with wood. The wood would have been much thicker and it would have been much more intrusive."

Lim also admits that it's not always easy to get clients to recognize that steel cladding can be the right material for their needs. "If you've only ever been exposed to clapboard siding and wood shake shingles then this looks completely bizarre to you."

Lim feels that the more steel is used in residential construction, the more popular it will become.

"We're using steel in a non-traditional way, but we're doing great architecture. Just because it's industrial doesn't mean it has to be purely functional."

Whether it's prefabricated components, buildings made out of steel, steel frame structures or steel cladding, there are many possibilities for metal in residential construction. The result can be innovative, functional and attractive structures that are suited to the people who live there.

#### WINONA HOUSE

Ideal Roofing

#### Cladding

Ameri-Cana panel, 80,000 PSI full-hard Galvalume<sup>™</sup> steel, 26 gauge

Colour: Perspectra Plus Polar White, Black

#### **DESIGN AND CONSTRUCTION TEAM**

Architect 25:8 Architecture + Urban Design Limited, 647-504-1546

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#### LEFT TO RIGHT:

11,000 panels were custom bent by Agway Metals to create specific shadow lines and give the building façade definition.



# **A SUSTAINABLE AESTHETIC**

# Custom cladding defines new building at McMaster University

McMaster University, Hamilton, ON Story: Julia Preston Photos: Dan Banko

McMaster University in Hamilton, Ontario needed more space. More classrooms, more room for student services, more residence beds, more parking, even a spot for a daycare. So university officials decided to embark on a unique construction project that combined all of these functions in one structure. The result is the Peter George Centre for Living and Learning.

This 14-storey, 335,000 square foot building includes underground parking, three auditoriums with capacity for 410 to 640 students, the Student Wellness Centre, 350 residence rooms offering 518 beds over seven floors, and the McMaster Childcare Centre.

Inside, the building is a blend of steel and concrete construction. The long spans for the auditoriums required a steel truss 26 metres long and more than 4.5 metres high.

On the outside, the building is clad in brick, steel and glass. To minimize the scale of the centre, the design team at Diamond Schmitt Architects envisioned the base as a collection of smaller brick buildings. The lower floors are covered in a dark contemporary brick that is similar to the adjacent buildings on campus.

Steel provided the durability, colour, lightness and reflectance the designers were looking for at an economical price.

Above the brick, more than 11,000 custom bent panels from Agway Metals clad the residential portion of the building. "As this was to be the tallest building on campus, ... we wanted a light colour with some reflectance that would blend with and reflect the sky to minimize the impact of its height on the surrounding context," explains Jeffrey Mitchell, architect and job captain with Diamond Schmitt. The bands of perforated panels offer further articulation for the façade, but come from a place of practicality—they cover the centre's vents. "It used to be that wherever a unit would have an exhaust you'd have an exhaust grill and it would be a different material," explain

Another consideration for the panels was how to give the façade some definition when every floor was the same layout of student residence rooms. Project architect Antra Roze focused on the verticality of the strip windows and the horizontals of the siding. She says, "When we design something like this we're looking at every time you bend the metal or have a different profile you create another shadow line and we're using those shadow lines to create interest in the elevation."

Each panel was custom designed and manufactured at the Agway Metals plant. The steel pushes in and out as it wraps around the building to "express and articulate the facade."

In total, there were just under 11,000 solid pressbroke panels, 1,000 face perforated pressbroke panels and custom mitered corner panels, both perforated and solid.



"It used to be that wherever a unit would have an exhaust you'd have an exhaust grill and it would be a different material," explains Roze. "In this case the siding continues along and it's the same metal that goes over the vents. It's just perforated... You're not stopping at every floor to have another grill. Now we just have a slightly darker line that goes around the building and it's because we have a material that we could do that with."

The steel cladding afforded a high degree of flexibility, especially with the customization Agway offered. For critical areas, installers Bothwell Accurate and contractors Ellis Don worked with Agway and Diamond Schmitt to make mock-ups to test how to bend the steel to get the desired profile without adding additional lines, reveals and shadows. For example, it took several tries to achieve very shallow reveals along the windows and concealed drip edges.

"We were lucky that we had a good group of people who were working with us to try to get what we wanted," explains Roze. "Even though it was drawn, they had to make it into reality and understand that we wanted to keep the lines very minimal so that we didn't have a whole bunch of overlapping, we didn't have a whole bunch of lips."



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Despite the level of customization, much of the cladding decisions were driven by cost. The overall budget for the project was modest at \$118 million. Steel provided the durability, colour, lightness and reflectance the designers were looking for at an economical price.

For Roze, the possibilities were eye-opening. She explains, "So much of our focus was to make this economical...Steel is a classic cladding. You know how it's going to wear. We can choose colours. We can choose profiles. It gives us a lot of options, so in that sense it's the perfect material to work with... When Agway came on board it was woo-hoo we can do anything. What maybe used to be standard isn't anymore... We can cut, bend, perforate differently than we used to be able to." 🔳

#### PETER GEORGE CENTRE FOR LIVING AND LEARNING

Agway

Cladding

18 gauge, 2 prepainted colours light silver and dark silverstorm

18 gauge, pressbroke hidden fastener

22 gauge, 7/8 Corrugated, dark silverstorm

22 gauge, AR50, dark silverstorm

Substrate

Grade 33 Galvanized G90 , Dura Coat Polyester

#### DESIGN AND CONSTRUCTION TEAM

Installer Bothwell Accurate, 416-676-2153

General Contractor Ellis Don, 647-622-7931

Architect Diamond Shmitt Architects, 416-862-8800

Engineer VanBoxmeer & Stranges Ltd. 519-433-4661

#### LEFT:

The upper floors of the 14-storey Peter George Centre for Living and Learning house 350 residence rooms. Steel cladding defines the residential portion of the building.



## **STEEL FROM THE TOP DOWN** Metal tiles replicate natural roofing materials

Featuring True Nature Steel Tiles By Vicwest

By Julia Preston Photography by Russ Druiven Ongoing maintenance is a necessary part of homeownership. Most homeowners are resigned to reshingling their roof every decade or so. But in addition to the financial cost of a new roof, there's an environmental one as well. Eleven million tonnes of asphalt shingles end up in landfills every year.

As awareness of the impact and lifespan of asphalt shingles grows, more consumers are looking for alternative roofing options.

Metal, long the standard in rural areas, is increasing in demand by suburban and urban homeowners. In fact, steel is the fastest growing choice in the roofing industry, outpacing all other materials.

"It's the obvious choice from a product lifecycle standpoint, lasting 50+ years," says Geoff Bernstein, product manager with Vicwest. "It's not only a great investment for a homeowner, but it's also the environmentally sustainable choice."

Vicwest recently launched True Nature, a steel roof system that replicates the look of wood shakes, slate and clay tiles. For some homeowners, premium roofing options like these are appealing but usually unattainable. A slate or wood roof can surpass \$100,000 to install, and natural materials are often vulnerable to water damage and require complex maintenance. True Nature features steel tiles that are cast, modelled and stamped based on their real counterparts. Each tile is painted with a unique, multi-hued colour palette. Edge-sculpting and multi-width imprints lessen the manufactured look and create a more natural appearance.

Tim Eansor, president of Double-AA Metal Roofing Inc. says, "The older metal tiles were a solution for a homeowner wanting the longevity of a metal roof but the design of those older tiles was never a selling feature."

"[Steel]'s the obvious choice from a product lifecycle standpoint, lasting 50+ years. It's not only a great investment for a home owner, but it's also the environmentally sustainable choice." "In the late 90s we saw a turn in the steel roofing industry with new and different styles of sheet steel products that were designed to give the homeowner the look of a more modern looking panel. Coupled with the sheet steel, the introduction of steel tiles made way for looks and patterns consumers demanded."

True Nature steel tiles also offer better protection than other roofing materials. Their water-shedding channels prevent cascading water from traveling laterally and seeping into the underlayment. Instead, they lock water into a channel and divert it down and away, minimizing the chance of water damage. Vicwest developed Quadra-Loc technology, which locks tiles in place on all four sides resulting in unprecedented water-tightness.

For Eansor, installing the True Nature system was a seamless transition from other materials he usually works with. "Their trim selection made the installation process a breeze with a step by step, detailed installation guide to help us along the way. The Vicwest support was excellent when we had questions and after sales follow up was unique asking us for our feedback on how the installation went."

True Nature panels cover four square feet, which allows contractors to cover more area per day and speeds up installation. A pre-drilled screw hem at the top of the tile replaces clips and eliminates guesswork of where to install screws. Trim details ensure a complete roofing system.





Homeowners can achieve the look of premium roofing options such as wood shake and natural slate at a fraction of the cost with better performance to protect their homes.

Like all steel roofs, the upfront costs of True Nature tiles are higher than asphalt. But the lifespan of a steel roof is at least three times that of an asphalt roof. For most homeowners, that means they'll likely never have to re-roof again. And a direct comparison of wood shakes and natural slate with the True Nature Cedar Creek Shake and North Ridge Slate profiles shows a large cost savings.

According to Remodeling magazine, re-roofing pays off better than any other home renovation, with an average cost recovery of 106 per cent. For homeowners who invest in steel roofs, the lack of maintenance can be the greatest value.

Eansor says, "True Nature's value is on point for... a homeowner looking to make a long-term investment in their property."

As consumer awareness of metal roofing grows, so does the appeal of True Nature. Homeowners can achieve the look of premium roofing options such as wood shake and natural slate at a fraction of the cost with better performance to protect their homes.

# THE GUIDING SCIENCE OF STEEL DESIGN

Building the most sustainable, cost-effective mid-rise building

#### Using scientific analysis to guide construction

Mid-rise residential buildings can be found in cities across North America, and more are under construction every day. With commercial spaces at street level and residential units above, this style of structure appeals to developers, tenants and city officials. Is there a tipping of the scales in terms of performance?" Ransom worked to ensure the building was as typical as possible. He used conditions most often found in urban environments and

this style of structure appeals to developers, tenants and city officials. Mid-rises are less imposing than high rises, for both the residents that call them home and the pedestrians on the street outside. For cities which are looking to increase density and preserve green space, mid-rises are an attractive solution. Ransom worked to ensure the building was as typical as possible. He used conditions most often found in urban environments and made the architecture similar to what is seen in the market. "The design doesn't lend itself to one system or another," he explains. "It's more about promoting an understanding of the material and the options available."

Because of their size, mid-rises lend themselves to various construction methods, including wood, concrete and steel. Each approach has advantages and disadvantages.

Tim Smith spent 35 years in the construction business working on institutional and commercial buildings before becoming a consultant. He says, "It's a mix of how mid-rises are constructed... I think what typically happens is people stay in their comfort zone."

To help determine which material is the best for various construction projects, ArcelorMittal developed Steligence<sup>®</sup>. A system that combines both technology and practical knowledge from an independent panel of industry experts to analyse different construction methods. It determines which approach will result in the most sustainable, cost-effective building.

ArcelorMittal Dofasco recently used Steligence<sup>®</sup> to analyse a hypothetical six-storey mixed-use commercial and residential building located in the Greater Toronto and Hamilton area. The building was 6,916m<sup>2</sup> 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 team included a designer, structural, electrical, and mechanical engineers, and scheduling and cost consultants. They analyzed three different design scenarios—steel, concrete, and timber construction. For the purposes of the study, only the structural elements of the core, upper levels and roof were significantly altered.

Willems Ransom, senior designer with mcCallumSather, was part of the Steligence® team. He says, "This case study was about designing one functionally equivalent building and seeing how the



## The goal of Steligence<sup>®</sup> is to provide scientific evidence to help the construction industry achieve the smallest environmental footprint and lowest cost.

The process involves life cycle analysis, detailed cost and scheduling estimates and other assessments.

"In the last decade or two... both the public and private sector have been more in tune with the life cycle costs of a building versus the capital costs," explains Smith. "What is put into the building and its durability and its energy performance... is more the way that people

Steligence<sup>®</sup> combines both technology and practical knowledge from an independent panel of industry experts to analyse different construction methods and determine which approach results in the most sustainable, costeffective building.



think now when they're thinking of capital investments. It's not just the cheapest project."

Building Cost (\$)



To assess the environmental impact of the design, the Steligence® process included a cradle-to-grave life cycle analysis (LCA) for the entire mid-rise building, which covers raw material production, manufacturing, transportation, installation, maintenance and recycling/end-of-life for a 60 year lifespan. The LCA evaluated global warming, acidification, eutrophication, ozone depletion, smog formation and primary energy. The steel design outperformed concrete and timber in the majority of these categories.

On the financial side, people often assume that green buildings are more expensive or that certain materials are more sustainable than others. Ransom sees Steligence<sup>®</sup> as an opportunity to dispel some of these myths.

In the mid-rise case study, cost estimates were obtained for the three design scenarios. In terms of total cost, the steel design was the most economical at \$16 million (CAD). The concrete estimate was 2 per cent higher. Mass timber was even more so, coming in 19 per cent higher, driven mainly by increased material and installation costs for the upper floors.

Steligence<sup>®</sup> also enabled the team to estimate the number of working days required for construction. Smith led this part of the study, and explains, "The data for the scheduling was real input from industry users."

The calculation included number of lifts per day and the average time required for concrete casting, installation of slabs, decking, wall



Financial source: Preliminary Construction Cost Estimate by Altus Group



panels and members. The schedule for the facade and overlap with the structure was found to be the same for all three designs.

At 153 construction days total, the steel design was the fastest, beating wood by eight days and concrete by 20.

Ultimately, steel was determined to be the most environmentally sustainable and economical solution for mid-rise construction, a result that Smith feels will resonate with industry.

"They definitely explored all the possibilities. They tested out different theories. They listened when things weren't practical. It was a really good balance between science and industry practicality," he says. He sees the case study as a starting point for developers, designers and engineers to understand what their options are and whether steel is a fit their projects.

As construction technology and building development systems continue to change, new products are coming to market and dramatically changing the industry.

Ransom hopes that analysis like this becomes standard practice. "This analysis is very easy to integrate early on in the design process. This allows us to choose the best performing and most cost effective solutions right from the start. This analysis is not extraneous. It's very important in making design decisions."

People often assume that green buildings are more expensive or that certain materials are more sustainable than others. Ransom sees Steligence<sup>®</sup> as an opportunity to dispel some of these myths.

#### CASE STUDY TEAM

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Schedule Consulting MPA Consulting 1-800-668-2154



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