Advancements in Fiberglass Window and Façade Technology
Introduction to Cascadia

- Manufacturer of fiberglass construction products
  - Fiberglass windows
  - Fiberglass doors
  - Fiberglass cladding support systems

- Current client base:
  - Primarily along the west coast - California to Alaska
  - Projects also extending across North America

- Supported by internationally recognized building science expertise
Products

Fiberglass windows and doors

Cascadia Clip
Background – Michael Bousfield

- **Logistics Specialist 2000 to 2007**
  - Versacold Group
  - Inventory Coordinator
  - Transportation Coordinator

- **BCIT Building Engineering Technology**
  - Part time studies – 2005 to 2007

- **BCIT Building Science Diploma – 2007 to 2009**
  - BCBEC Building Science Excellence Award - 2009

- **Building Envelope Consultant– 2007 to 2009**
  - RDH Building Engineering
  - Forensic Review of Building Envelope Failures
  - Rehab and New Construction Review
  - Rehabilitation Detailing and Design

- **Fiberglass Window Manufacturing – 2009 and onward**
  - Technical Representative - Cascadia Windows and Doors
The Leaky Condo Crisis
The Leaky Condo Crisis
The Leaky Condo Crisis
A billion-dollar nightmare

Fixing failed condos could cost $1 billion

Martin van den Hemel
staff reporter

It's an estimated billion-dollar problem that scientists warned of more than a decade ago.

Canada Mortgage and Housing Corporation's Jim White says researchers knew the use of wall designs common inside most failing condominiums on the West Coast of Canada indicated that walls without rainscreens (a drainage cavity inside a wall that allows for penetrating water to exit a wall) will not hold up to the Lower Mainland's wet weather. Not only are these walls flawed, they are destined to fail, he says.

But most of the failed three-storey wood-frame condos, which are rotting, have no rainscreens in their walls, he says. White agreed with

You can't admit you were wrong then by
Owners of leaky condos plead for compensation

As the Barrett commission begins its probe into condo building practices, homeowners told of a heavy financial and emotional toll.

IAN MULGREW
VANCOUVER SUN

One after another — some brandishing corroded pipes, others placards — irate homeowners pleaded Tuesday for compensation for their leaky condominiums and townhouses.

As the provincial Barrett commission into shoddy building practices began its first day of hearings in a Vancouver hotel ballroom, angry protesters picketed outside looking for relief from an estimated $1 billion in bills, a staggering toll in emotional turmoil and as-yet-uncalculated health costs.

"The banks must love the rise in personal loans," read one sign.

The commission was appointed earlier this month after growing complaints from consumers, industry organizations and trade unions about problems plaguing the provincial housing market that have affected tens of thousands of people.

Inside, people pounded the presenter's podium and poured out their hearts to commissioners Dave Barrett, former New Democratic Party premier, and his two advisers, Vancouver economist Robyn Allan and Victoria lawyer Peter Larsen.

"I was humiliated having to go on welfare," said a tear-stained woman who provided her name only as "Barbara." "We felt we were taken for a ride," she lamented. A placard leaning beside her stated: "Leaky condo owners are cash cows."

SEE COMMISSION, A2

VAUGHN PALMER, A16

Tourism is B.C.'s top job creator

The booming industry now employs 235,000 people, up about 11,000 over last year.

ALAN DANIELS
SUN TOURISM REPORTER

The burgeoning tourism industry created about 11,000 jobs in British Columbia last year, adding new jobs three times faster than any other sector of the provincial economy, according to figures expected to be released today by Tourism Minister Ian Waddell.

Officials say there are more opportunities than ever in tourism, particularly on the Sunshine Coast, where the tourism office has recently hired a director, a marketing director and a public relations co-ordinator.
The Leaky Condo Crisis
The Leaky Condo Crisis

“Anyone walking past this office tower at West Broadway can see the scaffolding erected to repair a wall that sheared off and fell to the street”

– Vancouver Sun, December 2001

EIFS – Exterior Insulation Finish System “Cladding”
The Leaky Condo Crisis

What caused the leaky condo crisis?

Face Sealed Assemblies + Rain = Leaky Condo Crisis

Solution = Rainscreen Building Envelope Assemblies
Now we have a much bigger problem........

The buildings that we have designed and constructed are unnecessarily a major contributor to excessive energy consumption and related climate change.
Climate Change “Wicked Problem”

GLOBAL GREENHOUSE GASSES

![Graph showing CO₂ levels over time](image)

- **350 PPM**
- **Highest Historical CO₂ Level**
- **Current**
- **1950**

**Thousands of Years before today (0 = 1950)**

*Source: NOAA*
Climate Change “Wicked Problem”

The World Bank says:

“The world’s current trajectory of greenhouse gas emissions poses significant threats to economic development as well as environmental sustainability”.

Barack Obama says:

“We are the first generation to feel the impacts of climate change, and the last ones that can do anything about it.”

Pope Francis says:

"Doomsday predictions can no longer be met with irony or disdain. The Earth, our home, is beginning to look more and more like an immense pile of filth"
Climate Change “Wicked Problem”

Donald Trump says:

The concept of global warming was created by and for the Chinese in order to make U.S. manufacturing non-competitive.

I guess not everyone has the same opinion............
What do we have to do with climate change?

- Residential and commercial buildings account for almost 40 percent of total U.S. and Canadian energy consumption.

Scope of the problem

- Nearly all of the greenhouse gas (GHG) emissions from the residential and commercial sectors can be attributed to energy use in buildings.

BUILDINGS ARE RESPONSIBLE FOR 44.5% OF US CO₂ EMISSIONS.

DATA SOURCE: ARCHITECTURE 2030
ILLUSTRATION: hammerandhand.com
Scope of the Problem

The US accounts for 19% of all energy used in the world

Various studies have shown that windows have the potential to influence up to 50% or more (depending on climate and other factors) of energy used in buildings
The US Department of Energy is strategizing to reduce heating and cooling loads in US homes by **60% by 2020**.

Building enclosure and specifically window technology improvements are a key focus of this program.

Better performance windows for both cold and hot climates is a big part of this strategy.

Reality is that many of the window technologies needed already exist, though not widely adopted (or code mandated yet...)

Program will no doubt influence window energy code requirements for years to come.
Scope of the Problem

Why are our buildings consuming so much energy?
R-WHAT!? All three buildings somewhere between R2 and R3.5
Largest contributors to heat loss:

#1: Poor performance windows

#2: Poor performance walls
The impact of windows on whole-building R-value
Cascadia Support
Effective R-values

Overall Wall R-value for High Rises - Based on Window Type and % Glazing Area

- R-15 - High R-value Wall Assemblies - Thermally efficient cladding supports and at least 3" of exterior insulation
- R-15 Wall/R-8 Windows
- R-15 Wall/R-4 Windows
- R-15 Wall/R-2 Windows
- R-15 Wall/R-1 Windows
- R-8 - Fibreglass w/ Quad Glazing IGU/Argon/Low-E
- R-4 - Fibreglass w/ Double Glazing IGU/Argon/Low-E
- R-2 - Typical Aluminum (TB) w/ Double Glazing/Low-E
- R-1 - Non-Thermally Broken Aluminum/Clear Double IGU

ASHRAE 90.1 Maximum <40%

0% to 100% Glazing Area

Non-Compliant Enclosure <R-3.75
### Multi-Assembly R-Value / U-Value Calculator

This calculator simplifies area-weighted R-value or U-value calculations. Use it to find combined thermal resistance, based on the effect of multiple assemblies.

<table>
<thead>
<tr>
<th>Assemblies</th>
<th>R-Value (effective)</th>
<th>Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windows</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Results

<table>
<thead>
<tr>
<th></th>
<th>area total</th>
<th>Total U-value</th>
<th>Total R-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.00</td>
<td>0.00 (imp)</td>
<td>Infinity (imp)</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td>0.00 (metric)</td>
<td>Infinity (metric)</td>
</tr>
</tbody>
</table>
R-9 overall with R-2 windows – 63% of heat loss through these windows.

Enclosure boosted up to R-13.0 overall with R-4 windows!

R-2.5 overall with R-1.8 aluminum windows – 80% of the heat loss through these windows.

Enclosure boosted up to R-4.5 overall with R-4 windows
Fiberglass Frame Windows

Let’s look at Fiberglass Window Frames - can help minimize excessive heat loss in buildings
Why Fiberglass? Solves Compromises

- Historically, frames were wood...
- Aluminum solved durability; thermal became issue
- Vinyl solved thermal, but gave up strength and dimensional stability
  - Also, steel reinforcing in vinyl lowers thermal performance

Fiberglass:
- Capacity
- Thermal
- Environmental
- Colour
Manufacturing Pultrusion Process

- Pultrusion rather than extrusion
- New fiber and resins composition
  - Stronger
  - Fire Retardant
Manufacturing
Pultrusion Process
Primary Benefits

- Thermal Performance
- Strength & Stiffness
- Low Coefficient of Thermal Expansion and Contraction
- Durability
- Lower Environmental Impact
Why Fiberglass?
Energy Performance

Typical Thermally Broken Aluminum Frame

- Standard IGU:
  - Low-E
  - Argon fill
  - Stainless Steel spacers

R VALUE: 2.0

Typical Fiberglass Frame

- Standard IGU:
  - Low-E
  - Argon fill
  - Stainless Steel spacers

R VALUE: 3.7

85% IMPROVEMENT
REDUCED HEAT LOSS THROUGH WINDOWS using actual NFRC certified U-values from window fabricators
Why Fiberglass?
Condensation Resistance

- Excellent condensation resistance
- About 50% better than an aluminum framed window
- Condensation resistance in the 55 to 67 range (NFRC method)
Why Fiberglass?
Strength and Stiffness

- Fiberglass is 8 to 10 times stiffer than vinyl
- Almost as stiff as aluminum
- Can accommodate larger windows and higher wind loads
Why Fiberglass?

Thermal Movement

- Low thermal movement
- Thermal movement same as glass
- Less stress on joints and seals
- Fiberglass is a thermoset material – it will not creep over time
Why Fiberglass?
Durability and Finishes

- Ideal for all climate types
- Not susceptible to decay or insect attack
- Ideal substrate for paint: AAMA 623, 624 & 625 finishes available (same performance criteria as aluminum)
- Can be easily repainted
Why Fiberglass?
Environment

- Enhanced energy performance
- Low embodied energy relative to vinyl and aluminum
- North American product
- No VOC’s
- Non-toxic: safe to manufacture, refinish and dispose of
- Water-based high durability polyurethane paint
Fiberglass Windows
Cascadia Windows Ltd.

Final Assembly: Langley, BC, Canada
Life Expectancy: 80+ years
End of Life Options: Recyclable (85%), Landfill (15%)

Ingredients:
Glass (Valley, WA); Fiberglass (Shawnee, OH): Glass Strand Mats, Polyester Resin, Styrene, Polyethyl Acetate, Di-(4-tert-butylicyclohexylperoxydicarbonate), Tert-butylperoxy-2-ethylhexanoate, Fatty Acid Esters (Oil), Stoddard Solvent, Calcium Carbonate, Clay (Alumina); Silicone Sealant: Pigment Blue 15, Carbon Black, Titanium Dioxide, Quartz, Cobalt Titanate Green Spinel, Octamethylcyclotetra-Siloxane; Acrylic Paint: Propylene Glycol n-Butyl Ether; Triethanolamine; Amorphous Silica; Homopolymer of Hexamethylene Diisocyanate (HDI); Polyisocyanate based on HDI; Hexamethylene-1,6-Diisocyanate; Shear Blocks: Nylon; Hardware: Stainless Steel; Insulation: EPS - Styrofoam

Living Building Challenge Criteria:

CAW-0001
LBC ZONE 5
06:50:00

Declaration Status
☐ LBC Red List Free
☐ LBC Compliant
☐ Declared

declareproducts.com
Products

- Comprehensive line of windows and doors
- Series designed to integrate with each other
- All have similar excellent performance characteristics
300 Series
T&T, Casement, Awning
325 Series
Casement & Awning Windows
400 Series
Strip Windows
301 & 302 Series
Swing Doors (inswing and outswing)
ADA option available for outswing

Low profile sill pocketed into floor assembly
303 Series
Compression Slider
NEW! – Universal Series
European Passive House Certified

• We will look at this again at the end
Curtain Wall Vent Adapter
Cascadia Clip
Fiberglass Thermal Spacer

Fiberglass Thermal Spacer Wall with 3.5” of Mineral Wool (R-4.2/in)

R-15.8 $ft^2\cdot^\circ F\cdot hr/Btu$

Low-conductivity fiberglass material reduces thermal bridging. This greatly improves the effective thermal performance of the wall.
Fiberglass Thermal Spacer

Other Common Wall Assemblies - with lower R-values

- **Stud Insulated**
  - R-5.5 ft²·° F·hr/Btu

- **Vertical Z-Girts**
  - R-7.4 ft²·° F·hr/Btu

- **Horizontal Z-Girts**
  - R-7.8 ft²·° F·hr/Btu

- **Galvanized Clips**
  - R-11.0 ft²·° F·hr/Btu
Thermal Bridging
Steel Studs & Brick Shelf Angles
Nominal Insulation vs. Effective Insulation

• Nominal R-value
  - The R-value of just the insulation itself

• Effective R-value
  - The overall value of the assembly (wall), including all components, air films, and the effect of all thermal bridging.
Single Continuous Z-girt

Effective R-values

<table>
<thead>
<tr>
<th>Exterior Insulation</th>
<th>Galvanized Z-Girt</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 ½” Mineral Fiber (R-14.7)</td>
<td>7.4</td>
</tr>
<tr>
<td>4” Mineral Fiber (R-16.9)</td>
<td>7.8</td>
</tr>
<tr>
<td>8” Mineral Fiber (R-33.6)</td>
<td>?</td>
</tr>
</tbody>
</table>

- **Not feasible** to meet ASHRAE 90.1 minimum prescriptive requirement of **R-15.6** effective with continuous girts.
Fiberglass Thermal Spacer

**R-15.7**

*Exceeds* the ASHRAE 90.1 minimum prescriptive requirement of R-15.6 ft²·°F·hr/Btu for steel frame walls

**R-7.8**

Common wall with exterior steel girts; not ASHRAE 90.1 compliant (needs to meet R-15.6 effective)
Fiberglass Thermal Spacer

Installation of Fiberglass Thermal Spacer

STEP 1
Layout spacers by clipping to steel girt

STEP 2
Fasten to wall with screw through spacer
Fiberglass Thermal Spacer

Installation of Fiberglass Thermal Spacer

STEP 3

Place insulation between spacers

COMPLETE

Finished installation of fiberglass spacer
Fiberglass Thermal Spacer

- Spacer is an engineered system
- Cascadia provides:
  - Engineering design aids that are easy to use
  - Materials
    - Fiberglass spacers
    - Steel girts
    - Fasteners
Single Family Dwellings

PROJECT EXAMPLES

WINDOWS
Bowen Island Residence
Cedar Grove
Whistler, BC
Cliff Drive Residence
Ladner, BC
BC Residence
British Columbia
New Construction Multi-Family

PROJECT EXAMPLES

WINDOWS
Renewals and Rehabilitations

PROJECT EXAMPLES

WINDOWS
Harbor West
Seattle, Washington
Embassy Tower
Burnaby, BC
Hollywood East
Portland, Or
Hatfield
Portland, Oregon
Institutional & Commercial

PROJECT EXAMPLES

WINDOWS
MG2 World Headquarters
Seattle, WA
Linfield College
Oregon
Glenmore Landfill Office
Kelowna, BC
Penticton Indian Band Health Centre
Penticton, BC
Great Canadian Oil Change
Chilliwack, BC
Cutting Edge Energy Efficient Projects

PROJECT EXAMPLES

WINDOWS
The Belmont
Vancouver, BC

Deep Energy Retrofit Project
• Reduced space heating costs from $18k to $2k per year.

Awards:

2013 Project of the Year Award
Canadian Green Building Council

2013 Sustainability Award
APEGBC

2013 Project Excellence Award
Fenestration West

2013 Beyond Green Award
National Institute of Building Science
Glasswood Passive House Retrofit
Oregon, USA
First Commercial Passive House retrofit in the US
Stellar Passive House Project
Oregon, USA
Olive Passive House Building
California, USA
MEC Store
North Vancouver, BC

2014 Project of the Year Award Winner
- Canadian Green Building Council

WITH PARKING LOCATED AT THE REAR, THE BUILDING COULD BE LOCATED AT THE INTERSECTION OF THE PRINCIPAL STREETS, IMPROVING THE PEDESTRIAN EXPERIENCE.
Harmony House
Burnaby, BC
First truly Net Zero House on west coast of North America
SEED Collaborative
Seattle, Washington
First Living Building Challenge School portable in North America
Messom Lab
San Diego, California
LEED Platinum
MEC Head Office
Vancouver, BC

LEED Platinum & largest fiberglass window project in North America to date
Cascadia Clip Projects
Bullitt Center
Seattle, WA

The greenest commercial building in the world.
Awards

- This has been getting some attention...

VRCA Awards of Excellence 2011
Sustainable Construction and Innovation
SILVER Award

Cascadia in Top 10 Most Innovative Companies

BC Business 2012 Export Awards Winner

Globe-Net The Green Innovators in B.C.

Cascadia Windows & Doors

Fleur-de-lis Interior Design Inc.

The WTN

The World Technology Network

Fortune CNN Time
Introducing the new

CASCADIA UNIVERSAL SERIES
Energy conservation is becoming a real thing in buildings

- Regulatory changes must be based in reality, so...
  - First – you have to have the tech
  - Then – you can change the laws to require higher performance
- New tech *enables* more stringent regulations
The Need for New Tech

Cascadia’s products address **current** demand

- Regulations require less than *half* of the performance of Cascadia’s most basic products
- Our windows are in the top 10% most thermally efficient in North America, and the only commercial-grade product of these
- Now designers push the limits of current products
- Cascadia’s tech was designed many years ago; we can only expand and adapt it so far
- Need new tech
The Vision of a New Product

What are we trying to build?

- Actually two new products, with many similarities
  - A universal frame – to address all our existing applications
  - A window wall – to bring the advantage of fiberglass to full-façade high-rise glazing
- Many criteria
- Design intent is to be uncompromising
Design goals

- Uncompromising is really hard… almost any advance in one area, is a sacrifice in another

- We identified these goals:
  - Thermal performance: R-7.1 (Passive House) is the ante
  - Structural capacity: Better than our current best
  - Aesthetic: Address recent desire for straight, thin lines, and flush appearances
  - Hardware flexibility: All operator types in a single frame system
  - Site tolerance: Improve tolerance to site handling; make coupling easy
  - Cost: Make the largest system cost less than our existing least expensive product
  - Manufacturing-friendly: Fast to produce, to enable the technology to scale-up
Ta-Da!

The Cascadia Universal Series
## The Universal Series

A frame design that addresses every goal

<table>
<thead>
<tr>
<th>Goal</th>
<th>Target</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal performance</td>
<td>R-7.1 (Passive House)</td>
<td>Over R-7.5</td>
</tr>
<tr>
<td>Structural capacity</td>
<td>Better than our current best</td>
<td>Over 50% stronger</td>
</tr>
<tr>
<td>Aesthetic</td>
<td>Straight, thin lines, and flush appearances</td>
<td>Yes – you’ll see</td>
</tr>
<tr>
<td>Hardware flexibility</td>
<td>All operator types</td>
<td>Yes: T&amp;T, project-in, awning, casement, swing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>doors, sliding doors</td>
</tr>
<tr>
<td>Site tolerance</td>
<td>Ease of handling; easy coupling</td>
<td>Robust edges; straight coupling from either</td>
</tr>
<tr>
<td></td>
<td></td>
<td>direction</td>
</tr>
<tr>
<td>Cost</td>
<td>Largest = less $ than existing</td>
<td>Fewest parts = cost effective</td>
</tr>
<tr>
<td>Manufacturing-friendly</td>
<td>Fast for production</td>
<td>Several key labour steps eliminated by design</td>
</tr>
</tbody>
</table>
Contacts and More Information:

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