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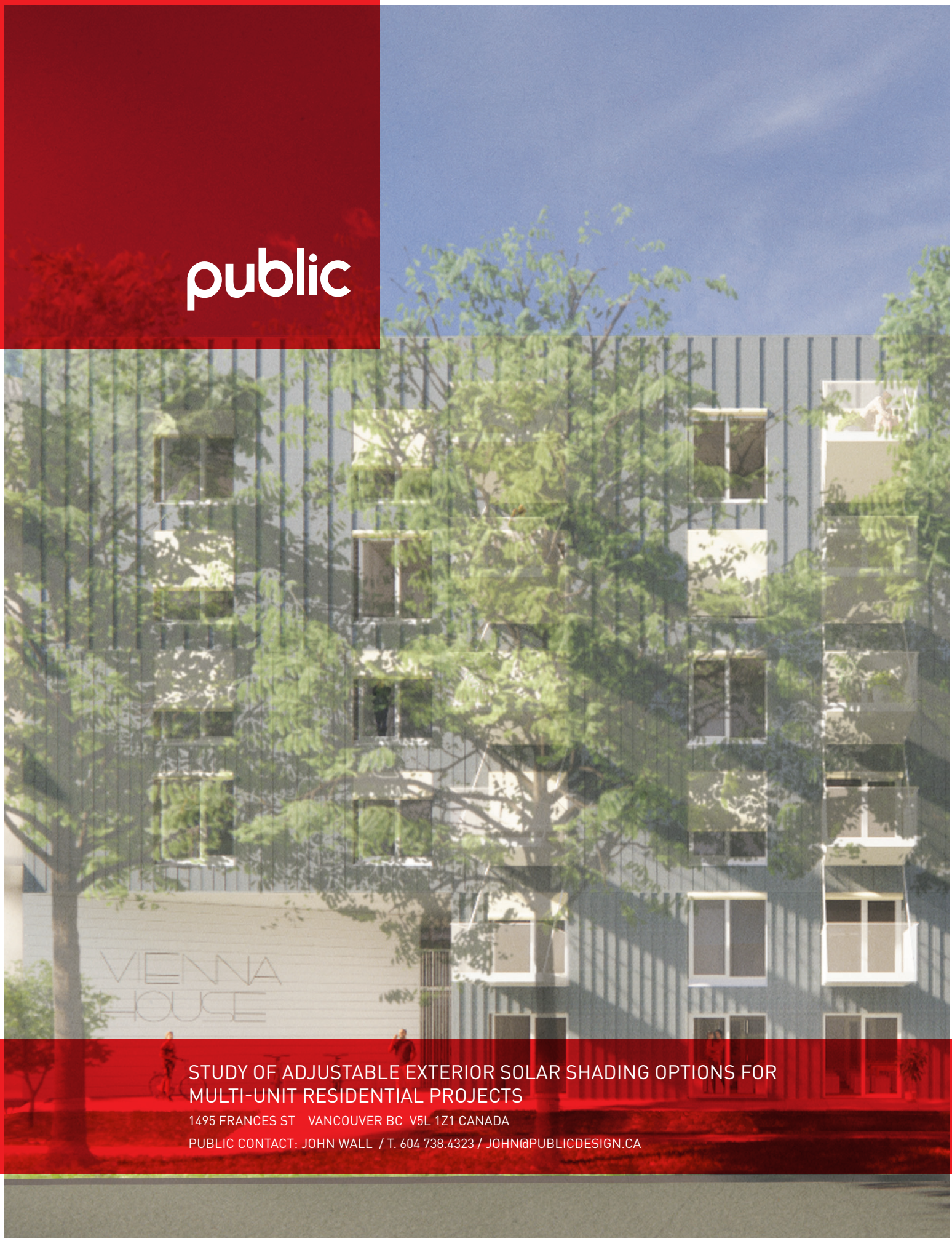

STUDY OF ADJUSTABLE EXTERIOR SOLAR SHADING OPTIONS FOR MULTI-UNIT RESIDENTIAL PROJECTS

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"An adjustable exterior shading solution for windows can provide over 5 times more solar protection than a typical white interior roller blind."

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A. Introduction

OVERVIEW

Exterior window shading is an important consideration for new and existing, single and multi-unit residential buildings. It is one of the most effective tools to achieve occupant thermal and visual comfort in summer months by controlling solar radiation, which contributes significantly to overheating.

PASSIVE VERSUS ACTIVE APPROACHES

Efforts to maintain comfortable indoor temperatures can be either passive, active, or a combination of the two. Passive measures include exterior shading and require no operational energy whereas active measures like mechanical cooling increase the operational energy as they cool the indoor environment. Building standards such as Passive House prioritize a building form and geometry approach to energy efficiency and occupant comfort, which emphasizes passive measures over active ones.

Properly aligned passive shading measures improve building resiliency to extreme events because they function during power outages when active systems fail.

Most existing residential projects in Pacific South Coast region do not have passive shading or active air-conditioning systems, and instead rely on the region's historically mild weather conditions. However, rising summer peak temperatures in recent years have lead to uncomfortable, and at times dangerous, indoor conditions in many residential buildings. Scientific predictions expect that the number of days above 30˚C and the average peak daily summer temperature in Vancouver will rise significantly due to the effects of global heating[1].

The 2021 "heat dome" in BC produced conditions that are comparable to the projected Vancouver 2050 weather file that many designers are now using. As the climate gets warmer, buildings are becoming more cooling dominant. This places greater emphasis on shading and efficient cooling. The percentage of hours where a well-designed building can utilize passive ventilation and cooling will increase.

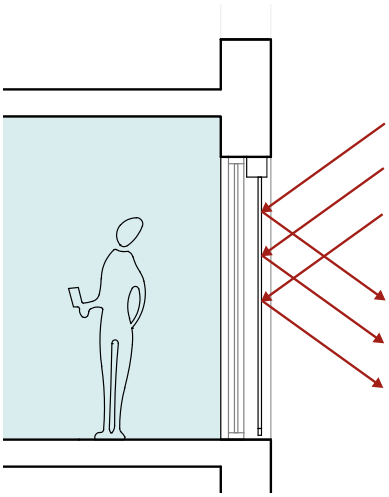
When high ambient temperatures cause interior overheating, effective exterior shading can reduce the cooling load, and therefore the size and capital cost for mechanical cooling system. Effective passive shading results in reduced cooling demand and associated energy use.

EXTERIOR SHADING VS. INTERIOR SHADING

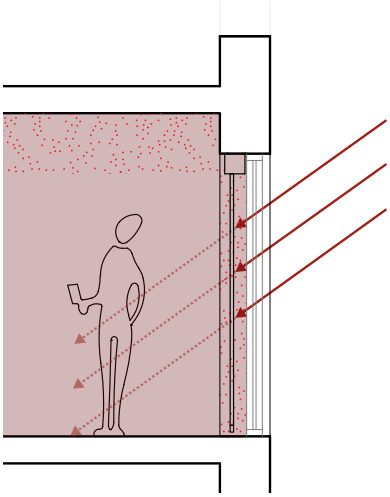
Exterior shading aims to block or reduce solar energy before it passes through the glazing. An adjustable exterior shading solution for windows can provide over 5 times more solar protection than a typical white interior roller blind[2]. Refer to **Appendix A: Integral Group Comparative Shading Studies** for further detail.

[1] www.climatedata.ca

[2] Passive House Planning Package 9, 18.5 Table 13, according to DIN V 18599-2.



EXTERIOR SHADING



INTERIOR SHADING E.G. ROLLER BLIND

A range of options exist for providing exterior window shading;

- Adjustable exterior shading devices
- Fixed exterior shading devices
- Roof overhangs
- Balcony overhangs
- Lower solar heat gain coefficient (SHGC) for glazing
- Electrochromic glazing
- Natural summer shading from deciduous trees
- Reduced window-to-wall ratio

The most appropriate shading solution will vary from project to project and can be influenced by building scale/height, orientation, surrounding built and natural context etc. For example, fixed exterior shading devices, such as a projecting louver above a window, can offer good protection from high-angle-summer sun on south facing windows but no protection from low-angle setting sun in the west. Similarly, roof overhangs can be effective on 1-2 storey buildings but much less effective on 3-6 storey buildings.

ADJUSTABLE EXTERIOR SHADING

This report focuses on adjustable exterior shading devices for residential windows and provides a summary of product types available in the Metro Vancouver market. Such products are adjustable by the resident, either manually-operated or motorized, to adapt to the weather conditions. The adjustable shades generally provide a near-total blocking of direct sunlight when in the closed position and, in some cases, tunable levels of control with one or more control states between fully open and fully closed. For new build and retrofit projects seeking to maximize energy savings, these shades offers the ability to maximize beneficial mid-winter solar heat gain while mitigating the negative effects of summer solar heat gain.

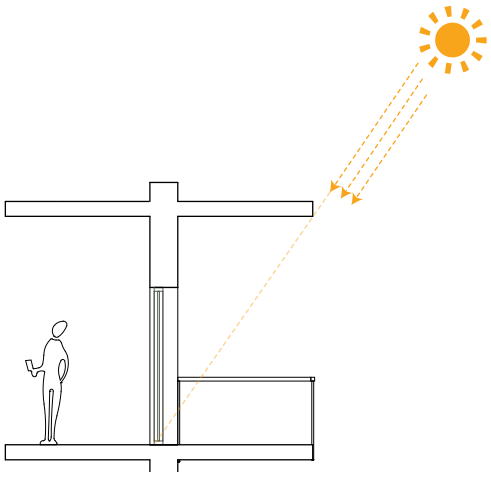
EUROPEAN CONTEXT

The City of Vienna in Austria promotes the use of exterior sun protection and provides a subsidy of up to €1,500 (approx. $2,150 CAD) per dwelling unit for retrofit installations of window solar shading in existing multi-unit residential buildings [3].

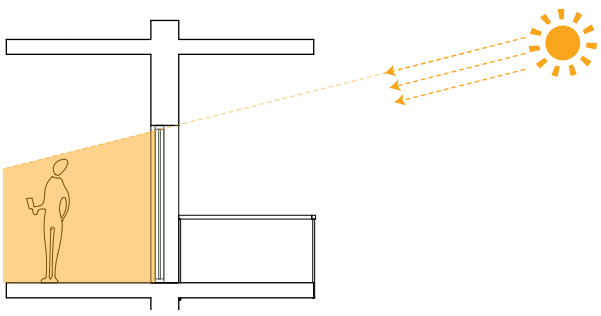
Adjustable exterior window shades or shutters are commonly available in the European market as an alternative to active cooling. Some have been designed with insulated mounting hardware to minimize thermal bridging[3]. The use of many motorized exterior shade products from Europe in Canadian projects is hampered by the cost of providing 240V supply to the fixture, changing the installed motor to North American voltage, and certification costs.

[3] https://www.wien.gv.at/amtshelfer/bauen-wohnen/wohnbaufoerderung/foerderungsantraege/sonnenschutz.html

[4] https://database.passivehouse.com/en/components/list/shutter



EFFECTIVE FIXED SOLAR SHADING FACING SOUTH



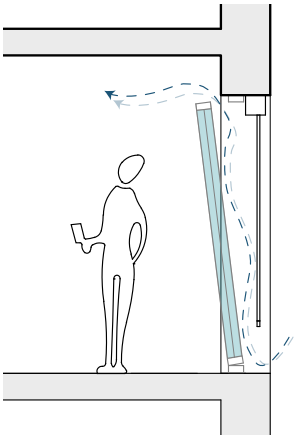
INEFFECTIVE FIXED SOLAR SHADING FACING WEST

DESIGN CONSIDERATIONS

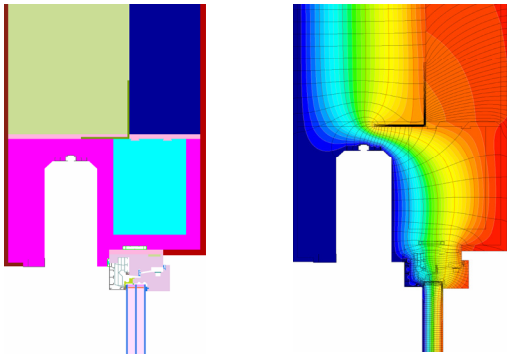
WINDOW TYPE

European-style, inward swinging, 'Tilt and Turn' windows are common in projects pursuing Passive House or other high-performance building standards. Such windows allow for a range of exterior solar shading products as the operation of the window does not conflict with the operation of the shading device. Such windows can also allow natural ventilation while the window is in the 'Tilt' position.

Fixed windows may require a shading device to be electrically operated whereas operable windows may allow for a less expensive manually operated shading device to be used.



EXTERIOR SHADING AND NATURAL VENTILATION WORKING IN COMBINATION



DETAIL: RECESSED EXTERIOR SHADE BOX AT WINDOW HEAD

NATURAL VENTILATION

A slatted or perforated shade will be most compatible with providing effective natural ventilation as it will preserve enough free area for airflow while providing sun protection.

GLAZING TYPE

Projects seeking the benefits of winter solar gain for energy efficiency by specifying high solar heat gain coefficient (SHGC) glazing may be susceptible to poor thermal comfort in the summer. However, adjustable exterior shades will mitigate summer heat gain while preserving the benefits of the winter solar heat gain.

CONFIGURATION

Some exterior shading products are designed to fit individual window openings. While other shading products are better suited for balcony or patio installations where shading for multiple openings and exterior space can be provided.

RETROFIT

Exterior window shade products are commonly integrated into the cladding at the window head, or into the window frame. As a result, exterior shading can be efficiently achieved as part of a cladding replacement, window replacement or envelope upgrade.

DURABILITY

When selecting a shading product, consider the building facade's exposure to high winds and weather. Consider prevailing winds, windbreaks from surrounding trees and buildings, exposure classification, number of storeys and facade orientation when designing for durability.

INSTALLATION AND THERMAL BRIDGING

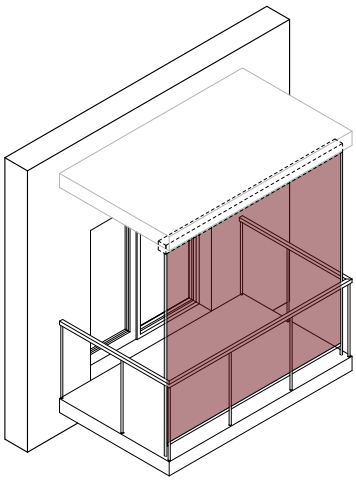
Exterior window shades are often surface-mounted or recessed at the window head. In either case careful consideration should be given to the installation detail to minimize thermal bridging at this location and integrate the fixture into the building envelope.

B. Dynamic Exterior Shading Options

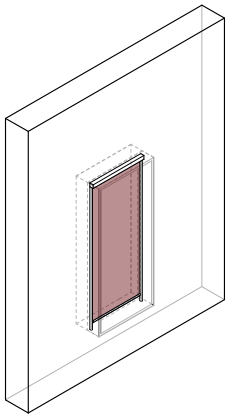
SHADING OPTIONS

The following options represent a general overview of the adjustable shading solutions currently available for projects in British Columbia, alongside a list of criteria for comparing them.

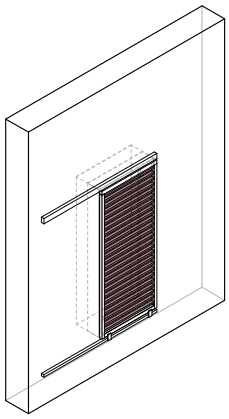
1. Exterior fabric screen for balconies and large openings
2. Exterior fabric blind mounted to window
3. Sliding shade panel
4. Roller shutter
5. Exterior venetian blind
6. Spanish-style roller blind



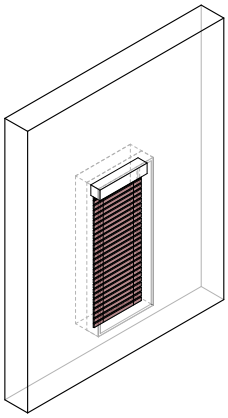
1. EXTERIOR FABRIC SCREEN FOR BALCONIES AND LARGE OPENINGS



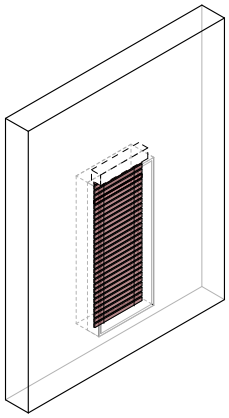
2. EXTERIOR FABRIC BLIND MOUNTED TO WINDOW



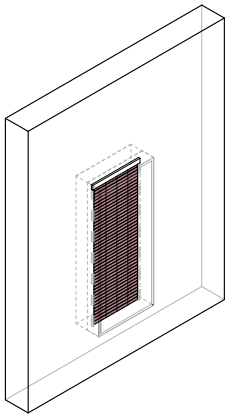
3. SLIDING SHADE PANEL



4. ROLLER SHUTTER



5. EXTERIOR VENETIAN BLIND



5. SPANISH-STYLE ROLLER BLIND

EXTERIOR FABRIC SCREENS FOR BALCONIES AND LARGE OPENINGS

Supplier options: Talius, Fraser Shades, Mitjavila Canada, Atria Designs

East and west facing balconies provide limited solar shading due to the low-angle sun. Exterior fabric screens provide dynamic shading to multiple window and door openings, as well as the outdoor amenity space. Fabric screens can also be used to shade large glazed openings where no balcony is present.

PRODUCT COST $$$$$

When comparing costs consider potential for shading multiple window/ door openings with a single screen.

INSTALLATION COMPLEXITY

Typical installation takes the form of a casing mounted to the underside of a horizontal structure above, usually at the exterior plane of the balcony, close to the guardrail.

For projects with regular, stacking balconies the casing can be installed from the balcony, avoiding the need for a boom lift, thereby reducing installation time and cost.

RANGE OF SHADING PROVIDED

Various fabric openness factors (e.g. 5%, 10%) available, offering high sun protection.

LEVEL OF AUTOMATION

Option to add motorized user-controls with potential to integrate with building monitoring system.

USER ADJUSTABILITY

The blind can be adjusted manually or automatically with a motor and wall-mounted control.

DURABILITY

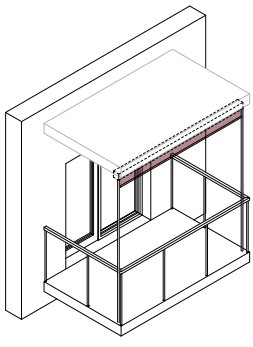
Due to the location of the shade away from the building face it can be exposed to significant wind loading when in the lowered position. Systems are designed to either resist high wind loads and stay in place, or to automatically retract when wind sensors detect wind speeds exceeding a safe level.

LOCAL AFTER SALES SERVICES

Supply and install available by local companies, with local after sales support available.

RETROFIT POTENTIAL

The casing requires solid framing support, so the condition of existing structure should be determined before considering shading options. An automated system will require electrical connection for the motor.



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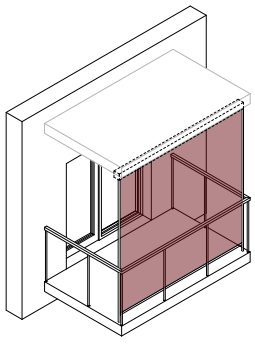

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EXTERIOR FABRIC BLINDS MOUNTED TO WINDOWS

Supplier options: MHZ, Solix by Supreme German Blinds, Rensen by Altria

When shading individual window openings, the exterior blind can be mounted directly to the window frame.

**PRODUCT COST $$$**$$

INSTALLATION COMPLEXITY

The blind can be installed independent of the cladding system, directly to the window frame. When combined with tilt-turn windows, it can be installed from the interior, without the need for exterior lifts or scaffolding, thereby reducing costs. Carefully coordination with the with window supplier is essential, when the shade is fastened to the frame. Options include integrated rechargeable battery or solar panel for motorized operation, and insect screen.

RANGE OF SHADING PROVIDED

Various fabric openness percentages and colours are available, offering a range of sun protection and aesthetic integration.

LEVEL OF AUTOMATION

Option to add motorized user-controls with potential to integrate with building monitoring system.

USER ADJUSTABILITY

Adjustable with remote control.

DURABILITY

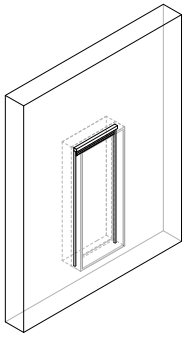
Tested to DIN EN13561, wind resistance class 2, with the window closed. Open window reduces wind resistance.

LOCAL AFTER SALES SERVICES

Supply and installation available by local company, with local after sales support available.

RETROFIT POTENTIAL

May be suitable for buildings with tilt-and-turn operable windows already installed, or as part of a window upgrade project.



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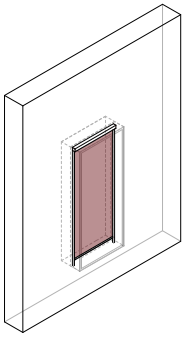

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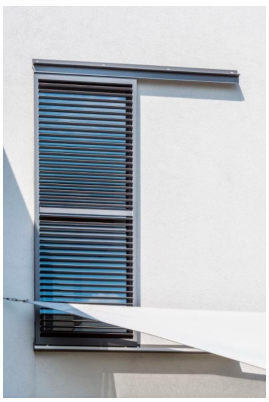


SLIDING SHADE PANELS

Supplier options: Renson by Atria Designs

For shading an individual window or door opening. The shade is attached to wall-mounted tracks.

PRODUCT COST $$$$$

Installation may be added to cladding contractor's scope.

INSTALLATION COMPLEXITY

A sliding shade requires the mounting track to be attached to the cladding beside the window opening. Careful planning of the mounting details and construction sequencing is required.

RANGE OF SHADING PROVIDED

Shades can be specified with fixed-angle or adjustable lamellas so daylight is still available when the shade is in its closed position. This offers a high degree of sun protection.

LEVEL OF AUTOMATION

User-controlled.

USER ADJUSTABILITY

The shade is manually adjusted. Note: this requires an operable window. Motorized options may be available.

DURABILITY

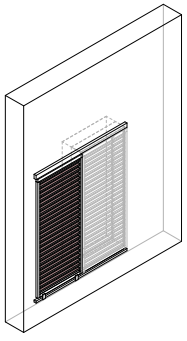
High wind resistance from solid connection to wall assembly. Moving parts may require added maintenance.

LOCAL AFTER SALES SERVICES

Supply and install available by local company, with local after sales support available.

RETROFIT POTENTIAL

May be suitable as part of a building envelope upgrade project.



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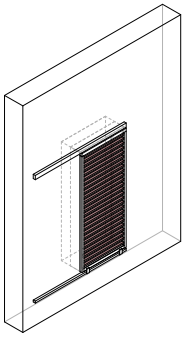

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ROLLER SHUTTERS

Supplier options: Talius, RS Canada

For shading an individual opening window or door opening. The product is generally manufactured in Europe so a motor adapted to North American voltage and certification standards is required.

PRODUCT COST $$$$$

Limited product distribution in Canada at this time.

INSTALLATION COMPLEXITY

Shutters are typically installed in a recessed or face-mounted box at the window head. Integration with exterior cladding and an electrical connection to the motor is required.

RANGE OF SHADING PROVIDED

The shade offers near total sun protection in the closed position. Slats are opaque so the level of protection can only be adjusted by raising/ lowering the shutter.

LEVEL OF AUTOMATION

User-controlled with potential to integrate with building monitoring system.

USER ADJUSTABILITY

The blind can be adjusted manually by a hand crank or automatically with a motor and wall-mounted control.

DURABILITY

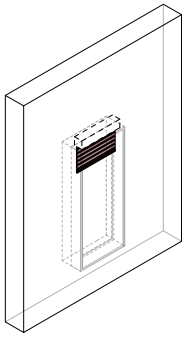
High wind resistance from solid side rails. Durable aluminum finish.

LOCAL AFTER SALES SERVICES

Currently limited local customer support.

RETROFIT POTENTIAL

May be suitable as part of a building envelope upgrade project.



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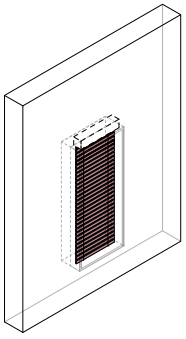

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EXTERIOR VENETIAN BLINDS

Supplier options: Sunpro Enterprises Inc., Draper Inc. (US)
A common solution in the European market but with limited distribution in Canada. A motor adapted to North American voltage and certification standards is generally required. The system consists of a series of aluminum slats which can be tilted, raised and lowered - similar to a conventional interior venetian blind.

PRODUCT COST $$$$$

Limited product distribution in Canada at this time.

INSTALLATION COMPLEXITY

The blind is typically installed in a recessed box at the window head. Integration with cladding scope required. Electrical connection to motor required.

RANGE OF SHADING PROVIDED

Slats are fully adjustable to precisely control the level of sun protection and daylight required. The blind can be fully opened with all slats raised into the top cassette.

LEVEL OF AUTOMATION

User-controlled with potential to integrate with building monitoring system.

USER ADJUSTABILITY

The blind can be adjusted manually by a hand crank or automatically with a motor and wall-mounted control.

DURABILITY

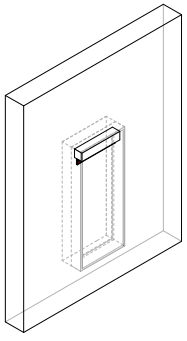
Additional side rails can be specified where high wind loads are expected. Durable aluminum finish on exposed components.

LOCAL AFTER SALES SERVICES

Currently limited local customer support.

RETROFIT POTENTIAL

May be suitable as part of a building envelope upgrade project.



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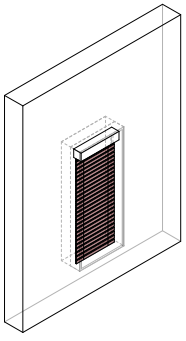

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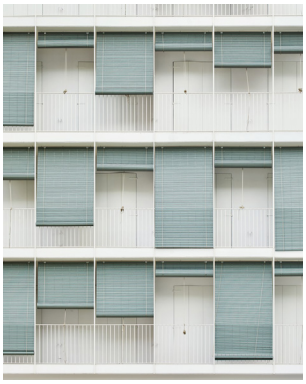


SPANISH-STYLE ROLLER BLIND

Supplier options: Persiana Barcelona (ES)

For shading an individual opening. The product is based on a traditional Alicante blind that is commonplace in Spain. Wooden slats with a water based acrylic lacquer or plastic slats are available.

**PRODUCT COST $**$$$$

INSTALLATION COMPLEXITY

The blind is suspended from a supplied mounting bracket installed at the window head. This may require exterior scaffolding or boom lift, or it could be installed from interior, depending on construction details and sequencing.

It can also be mounted to the underside of the balcony above, at the exterior edge to provide shading for the exterior space.

RANGE OF SHADING PROVIDED

It provides nearly total sun protection in when in the closed position.

LEVEL OF AUTOMATION

User-controlled.

USER ADJUSTABILITY

The blind is manually adjusted with a cord and can be fixed at the desired height. Note: this requires an operable window.

DURABILITY

The bottom edge is not fixed so the blind may be subject to significant movement if left in the closed (lowered) position during high winds, particularly if the window is open.

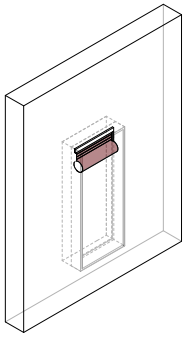
Wood slats may require repainting or other maintenance.

LOCAL AFTER SALES SERVICES

Supplied direct from European manufacturer. Currently, there is no local customer support.

RETROFIT POTENTIAL

May be suitable for buildings with tilt-and-turn operable windows already installed, or as part of a window upgrade project.



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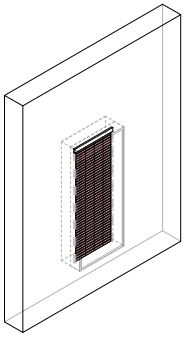

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D. CONCLUSION

CONCLUSION

Exterior window shading is an important consideration for new and existing, single and multi-unit residential buildings. It is one of the most effective tools to achieve occupant comfort in summer months by reducing the severity and duration of overheating (> 25˚C).

ADJUSTABLE SHADING FOR A VARIABLE CLIMATE

Efforts to maintain comfortable indoor temperatures can be challenging in variable climates. In 2021, BC's temperature extremes reach a record of a 75° difference between a record high of 49.6°C and a low of -25.4°C in Lytton. The Abbotsford area had a record high of 41.5°C on June 26th and a low of -15.6°C on December 26th, 2021 - a range of 57.1°C.

External adjustable shades have been used for centuries in regions with variable climates like Europe and Asia. In each location, shading has evolved to respond to variable thermal comfort requirements by allowing a resident to balance cooling, ventilation and daylighting in the summer and passive heating, ventilation and daylighting in the winter.

ADJUSTABLE SHADING FOR A CHANGING CLIMATE

For the Pacific South Coast region,.climate change has resulted in a more variable climate, with more heat, precipitation, wind and cold. Mechanical consultants can no longer rely on historic climate data when designing mechanical systems, because historic data can lead to overheating or under designed systems. When coupled with a high performance building envelope, exterior shading helps residents adapt to a changing climate by allowing them to modulate internal temperatures using time tested passive solutions for temperature control.

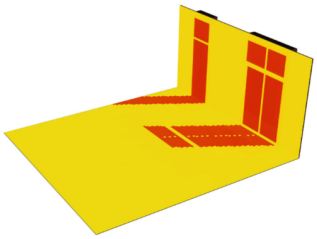
Energy and carbon equivalent savings from reduced mechanical heating and cooling equipment and operations reduces capital and operational costs. This also reduces peak energy demand and green house gas emissions for the region, which saves on additional infrastructure costs and helps the region to move closer to carbon neutrality.

For the reasons outlined in this report, adjustable exterior shading makes sense for most residential developments in British Columbia.

APPENDIX A: INTEGRAL GROUP COMPARATIVE SHADING STUDIES

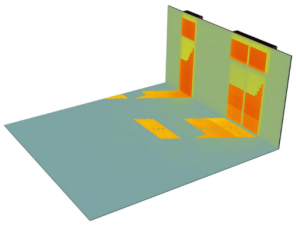
Unshaded

Capacity for daylighting
Visual comfort
Color quality
Thermal comfort
Peak load impacts

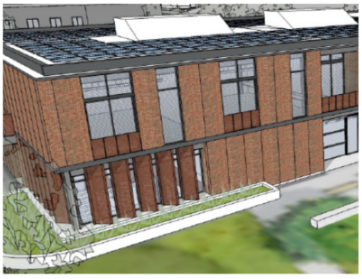


Fixed overhangs and interior blinds

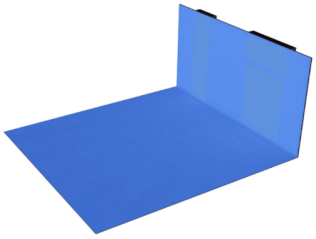
Capacity for daylighting
Visual comfort
Color quality
Thermal comfort
Peak load impacts



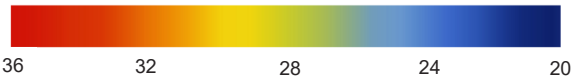
Exterior automated blinds



Capacity for daylighting
Visual comfort
Color quality
Thermal comfort
Peak load impacts



Deg C



These studies map the experienced environment at the floor and facade surfaces, accounting for air temperature, surface temperatures, and assumptions for occupant metabolic rate and clothing. These studies assume no mechanical cooling, and tell the story of how well the building skin alone mitigates the environment on a peak summer day.

High amounts of solar gain through the glass result in a thermally uncomfortable space, and a very high cooling load. Unmitigated direct sun results in a visually uncomfortable and distracting environment. While daylight levels are high, the visual environment is uncomfortable when uncontrolled, and of little usefulness.

The horizontal overhang reduces, but does not eliminate solar gains. This fixed shading hence reduces the cooling load, but not entirely. Interior operable blind offers good control over glare, but heat is dissipated internally.The horizontal overhang both shades the glass and allows for a substantially clear view out to the sky, resulting in good daylighting conditions.

The exterior blinds eliminate all direct solar gain on the glass, and results in dramatic cooling load reductions, also yielding a consistently thermally comfortable environment.The dynamic blinds allow generous amounts of diffuse daylight in, even when the sun is intense and low in the sky, and maximizes daylight contributions under overcast conditions. The visual conditions are finely tuned by the blinds, and create a visually comfortable environment under all sky conditions.

public

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PUBLIC would like to acknowledge that the land on which we gather is the unceded, traditional, and ancestral territories of the Musqueam, Squamish, and Tsleil-Waututh Nations.

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