

Bringing Green Design to Residential Projects

Innovations and alternative products support custom projects

Sponsored by Bison Innovative Products and Cascade Architectural

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Residential buildings come in many different types and categories, but all have a need to address green and sustainable attributes, including outdoor space design and solar control.

Photo courtesy of Cascade Architectural

Residential projects take many different forms. Some people think only of suburban single-family homes which are mostly driven by homebuilder/developers with different levels of involvement by architects. But the reality is that architects design many other types of residential projects too. Completely custom homes have historically been portrayed as ideal opportunities for creatively using architecture to match the lifestyle needs of the owners and the opportunities of the building site. While some of those may be in greenfield locations or remote locations with views of nature, there are plenty that are located in urban settings as well with very different context, lifestyle, and site conditions. In many of these cases, the residence is not new construction but the renovation or adaptive reuse of an existing building. There are also emerging models of housing that are different from single family ownership such as co-housing which has become a popular alternative across North America. And, of course, there are prototypical homes that are used as model designs to portray the latest design thinking and state-of-the-art products, systems, and materials.

All of these various residential settings have one thing in common: the well-established preference for green and sustainable

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Learning Objectives

After reading this article, you should be able to:

1. Identify and recognize the challenges and potential solutions to creating healthy outdoor spaces when site restrictions might otherwise prevent this.
2. Assess the health and energy concerns of providing windows with appropriate solar gain and glare control.
3. Explain the ways that outdoor roof decks and patios/terraces can be sustainably designed using adjustable, modular pedestal deck systems.
4. Determine the energy performance of using coiled wire fabric as a means to control solar heat gain and glare on residential buildings.

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design in the form of higher energy performance, environmental consciousness, and healthy living spaces. Based on these various factors, this course will take a closer look at two very specific strategies that are being used in creative ways for these different types of housing design. The first is the creation of outdoor spaces where that space is at a premium, such as in urban settings or restrictive sites. The second is the innovative use of durable materials on residential interiors or exteriors that help with energy performance, daylight control, and general wellness. These strategies can serve as springboards for creative, sustainable, and well-designed residences of all different types in all climate zones and all geographic areas.

OUTDOOR SPACE DESIGN CHALLENGES

Homeowner desires to have a connection to the outdoors is natural and common. The COVID-19 pandemic has intensified this desire as many people find they are spending much more time at home and yearn for ways to connect with nature. Fresh air and sunshine are the usual desired attributes with a growing recognition that access to the outdoors in general helps with human health and wellness. Such outdoor connections can be easy to access in low-density housing arrangements with larger building lots. But as density increases, such as in urban areas or intentional communities, outdoor spaces become even more valuable. The key is their specific context: What defines them? Are they narrow spaces between other buildings or do roads and infrastructure create boundaries that need to be respected? Perhaps these spaces are not at ground level but are found on roof tops or terrace levels that extend outward from enclosed living spaces? In some cases they may even be overlooked spaces, such as alleys or sidewalk areas, which need the benefit of architectural design to be transformed from unused areas to appealing, outdoor settings.

Ultimately, it is up to the design professional to seek out these outdoor space opportunities and find ways to create them. Indeed, it has been common for centuries to find residences designed with outdoor roof terraces, decks, and even enclosed gardens in many different geographic locations. The primary design issue, of course, is how to take advantage of the available space but still coordinate with the rest of the building design and construction. For example, if the available space is a low-slope (i.e., “flat”)

Photos courtesy of Bison Innovative Products

CUSTOM HOUSING CASE STUDY



Project: E2 Homes Private Residence
Location: Evergreen, Florida
Developer: E2 Homes

The Project: E2 Homes is a luxury custom home developer committed to smart construction. This tropical home features a modern interior, filled with wood flooring and ceiling detail. The warm tropical wood continues into the outdoor space featuring a rooftop terrace using wood tiles supported by adjustable pedestals.

The Design: The selected modular wood deck tiles perfectly complement the custom home, offering a mix of luxury and design flexibility to fit any size or shape of deck. The parquet pattern utilized in this home’s rooftop deck give the wood tiles an intentionally varied appearance instead of a uniform look. The wood tiles are ribbed so they not only add an element of texture to the design, they also ensure the deck is slip resistant and remains scuff free.

roof, then there is a need to protect and preserve the roof membrane system. Since the primary purpose of a roof is to maintain a waterproof barrier to weather, then anything covering the roof to create an outdoor space needs to be consistent with that objective. Hence, a roof terrace or deck support system will need to avoid roofing penetrations that could void a roofing warranty or otherwise create damage to the roof. The second design issue is that even low-slope roofs are still sloped. Therefore, if this is the selected location for an outdoor space, then a means to create a level surface is needed.

A Solution: Pedestal Deck Systems

Recognizing the opportunity and the challenges of creating appealing, healthy, outdoor spaces, the building industry has responded with complete systems for creating rooftop environments. The usual goals are to create spaces that are functional, environmentally friendly, visually appealing, and remain affordable for many budgets. The most widely adopted approach is based on the use of adjustable height pedestals that sit on top of the roof membrane with modular tiles or pavers resting on top of the pedestals. Rain water passes through the joints in the deck tiles and drains down onto the roof as always

intended. In fact, the deck tiles can actually help preserve and protect the roofing since it becomes the primary weathering surface instead of the roof membrane. The adjustability of the pedestals allows the system to be leveled to create a continuous, safe, walking surface.

Rooftop decks constructed this way create a valuable amenity in the form of recreational or leisure space for building owners/residents. Mark Fusco, LEED AP, GRP, national sales manager for Bison Innovative Products, has witnessed this firsthand. Mark points out that architects have been incorporating more roof decks into their projects because of the availability of these systems. “Architects can now design and specify tested, innovative systems for raised decks, including rooftop decks, terraces, and other architectural features. Further, they can do so using maintenance-free adjustable pedestals and low-maintenance deck surfaces.”

From a sustainability standpoint, pedestal roof deck systems contribute to green design in a number of ways. The outdoor spaces offer residents a viable means to help improve their own health and wellness in a controlled manner. Solar heat build-up from dark colored roofing can be mitigated using air-permeable pedestal deck systems which can help

reduce the cooling loads of a residence. The materials used can be specified to meet green building criteria based on life-cycle assessments, product transparency or sustainable wood certification. The materials can also be selected to be durable for a longer service life, can contain recycled content, and/or be recycled/reused when no longer in place on the building. Overall, a modular and versatile pedestal deck system gives architects the design flexibility to create unique, sustainable, and beautiful rooftop environments and outdoor spaces.

SOLAR GAIN CONTROL CHALLENGES

Windows are needed in all residential buildings for both natural light and ventilation in minimum quantities prescribed by codes. Beyond that, many architecturally designed homes seek to use more than the minimum amounts of glazing to take advantage of views, offer greater connection to the outdoors, or, in cold climates, to receive the warmth of solar gains. In these ways, windows become a means to provide home dwellers with a satisfying connection to the outdoors that can add to their general health and well-being. Depending on the type of glass and glazing systems used, the natural daylight and solar gains can provide some welcome light and heat to the home and increase occupant comfort. All of that can

mean that less purchased energy is needed for the home resulting in lower energy bills and greater sustainability.

There are caveats to this idyllic scenario, however. Larger windows can mean too much daylight or light that is too bright becoming a problem by causing glare. That usually causes people to close window blinds or shades and turn on electric lights during the daytime, thus increasing energy costs in the interest of overcoming a visual comfort problem. This has been exacerbated by more people working or schooling at home during the day and needing to keep glare off of computer screens. Similarly, if the weather or the climate are not cold, then solar heat gains from windows may be unwanted since the occupants seek to be cool. The comfort of the residents is then compromised which means more air conditioning may be used and can lead to increased energy costs. The overriding design issue, then, becomes how to control the light and heat coming in through windows or other fenestration so the right amount is available when desired while excess is diverted away when not needed.

A Solution: Coiled Wire Fabric

Many architects have discovered a semi-transparent material that can be used on either the interior or exterior of residential fenestration to achieve the sought after level of adjustable control for daylight and solar heat gains. That material is coiled wire fabric which, although it is made of durable metal wire, has the appearance of fabric drapery or permeable panels. Coiled wire fabric is different from standard wire mesh in that it is manufactured by interlocking metal wire coils via a simple corkscrew method; weaving the spirals together to create a flexible metal fabric panel. Utilitarian versions of this material are often used on the face of wood burning fireplaces as protective, operable screens to prevent ashes or sparks from coming out of the firebox. It provides a separation but still allows for vision through to see the fire. Architectural grade coiled wire fabric is designed for use

as a finish material, not just a utilitarian one. The base metal wire is available varieties of steel, aluminum, brass, copper, or stainless steel. The choice of the wire material and its gauge impact the weight, functionality, and aesthetics of the final fabric. By selecting the fundamental makeup of the fabric (i.e., the base metal, weave thickness, wire gauges, weave pattern, finishes), then the properties of strength, rigidity, and light transmittance can all be determined to meet the design or performance characteristics being sought. Some general characteristics are summarized as follows:

- **Solar transmission characteristics:** The nature of coiled wire fabric is such that it will allow light to pass through between the openings in the wire. The controllable nature of the fabric is such that it can be used for high levels of light transmission or reduced levels for solar shading to contribute to energy savings. How much light comes through and how visually transparent a certain product appears will be based directly on the make up of a particular coiled wire fabric. Those with thicker wires and tighter weaves will obviously allow less light than those with thinner wires and more open weaves. Architects and designers can play with the material's level of transparency by altering these factors to suit their needs to create a material that is simultaneously open and closed at the desired levels. As such it can be used over windows as a diffuser for natural daylight or as room separators where light is intended to be shared. "Fullness" is another factor that designers can alter which will vary the level of light able to pass through the coiled wire fabric. Fullness is achieved by using more material than is required to cover a given area, achieving a billowing drapery effect, causing the mesh to overlap which can be used to control the light.
- **Retrofit applications:** Coiled wire fabric is lightweight making it easy to work into a retrofit or renovation project. The gauge of the wire and the spacing of it will determine the overall strength which can then be selected to suit a particular retrofit condition.
- **Green building design:** Coiled wire fabric is able to contribute to green and sustainable building designs in several ways. First, it is typically made up of metals that have a recycled content as high as 90 percent. It can be subsequently recycled at the end of its service life. This all plays well into a favorable life-cycle assessment of the

Photo courtesy of Cascade Architectural



Coiled wire fabric drapery can be used in residential settings to provide effective solar gain and glare control while still allowing for views to the outdoors.

Image courtesy of Cascade Architectural

Photos courtesy of Bison Innovative Products. Photographer Anthony Carrino

Declare.

Tin-Plated Steel Coil Drapery Cascade Coil Drapery, Inc

Final Assembly: Tualatin, OR, USA
Life Expectancy: 25 Years
End of Life Options: Salvageable/Reusable in its Entirety

Ingredients:

Mesh: Steel, Tin; **Carriers:** Stainless Steel;
Tracks: Stainless Steel; High Carbon Steel,
Nickel, Chromium, Iron; Aluminum; Acrylic
Lacquer: p-Chlorobenzotrifluoride, Acetone,
2-Butoxyethanol, 2-Propanol, Diacetone
Alcohol, 2-Butoxyethyl Acetate, Solvent
Blend: Acetone, Toluene, Isobutyl Acetate,
Heptane, Xylene, 2-Propanol, Diacetone
Alcohol, 2-Methyl-1-Propanol, Ethylbenzene;
Metallic Powder Colors (<1%)

*LBC Temp Exception 110-E4 Proprietary Ingredients <1%

Living Building Challenge Criteria:

CAC-3003 EXP. 01 AUG 2018
VOC Content: N/A VOC Emissions: N/A
Declaration Status
 LBC Red List Free
 LBC Compliant
 Declared

MANUFACTURER RESPONSIBLE FOR LABEL ACCURACY
INTERNATIONAL LIVING FUTURE INSTITUTE™ declareproducts.com

Coiled wire fabric drapery can be specified that is Red List free of harmful ingredients under the Declare program of the Living Building Challenge.

materials used that make up a coiled wire fabric system. Secondly, the products can support a positive indoor environmental quality. The open nature of the fabric supports designs that incorporate natural daylight or ventilation in interior spaces. The prefinished or natural finish of the metals used means that no additional paints, coatings, adhesives, or harmful sealants are needed. Hence, the materials are low-emitting or VOC free. Some products are Living Building Challenge Red List Free, 100 percent recyclable, and use no toxic chemicals in the manufacturing process. Hence, it creates a low carbon footprint by using domestically sourced materials that are durable and easy to maintain.

Overall, coiled wire fabric offers a solution for interior or exterior treatment of fenestration that can improve comfort, contribute to wellness, reduce or eliminate glare, and help with energy savings.

DESIGNING OUTDOOR ROOF DECKS FOR GREEN RESIDENCES

Once the design decision is made to include an outdoor roof deck or terrace in a green

RENOVATION CASE STUDY



Project: Carrino Firehouse Residence

Location: Jersey City, New Jersey

Designer-Builder: Anthony Carrino

The Project: Built in 1896 in Jersey City, this firehouse was the original home to JCFD's Hook & Ladder No. 3. In 2009, after serving the community for more than 100 years, the firehouse was purchased and repurposed as the headquarters of Brunelleschi Construction, a company owned by father-son duo, Alfonso and Anthony Carrino. Ten years later, in 2019, Anthony jumped on the opportunity to purchase the firehouse from his father. His goal was to remodel it into a residential loft for himself and his fiancée and their recently adopted puppy.

The Green Design Innovations: It is often said that the greenest building is the one that is already built since demolition waste is avoided and fewer construction materials are needed compared to building new. This Firehouse home provided that opportunity but was in need of some outdoor living space. Anthony Carrino saw the 800-square-foot roof area that opened off of an upper level as the perfect opportunity to reclaim some outdoor space for the home. An adjustable pedestal roof deck system worked perfectly to sit on top of the existing roof structure without interfering with the roofing membrane. On top of the pedestals, a vibrant and welcoming outdoor space is created using modular wood tiles to create a natural and environmentally friendly surface. The wood tiles not only allow for water drainage, they provide some respite from creating a heat island that could be caused by dark-colored roofing membranes.

On top of the wood tiles rests an outdoor kitchen and furniture. The entire renovation of the firehouse was filmed and created into a digital series, "The Firehouse Project." Episode 07 of the series, titled Roof Deck, aired on TheBuild on May 20, 2020 and features the installation of the roof deck System atop the renovated firehouse.

residential project, then the details of how to construct it become important. Offering tremendous design flexibility and ease of installation, adjustable pedestal deck systems provide a unique and viable alternative to traditional deck building materials and methods. To help understand why, the following paragraphs provide a description of the main component parts of an adjustable pedestal roof deck system, commentary on how they fit together, and methods of integration into a new or renovated residential building.

Deck Supports/Pedestals

Adjustable pedestals are the structural supports for the deck surface, so they are the

starting point for all systems. The use of adjustable pedestals as a support system has become recognized as one of the most labor- and cost-efficient methods of creating a level deck over a moderately sloped surface. Adjustable pedestals are available in a range of heights and weight-bearing capacities to suit a variety of conditions or needs. Deciding on which system to specify for a particular project is dependent on the structural support requirements and the height of the deck above the roof surface. Those carrying more weight or requiring more height to achieve a level condition will need a higher grade of pedestal.

Many commercially manufactured pedestals are made with high-density

polypropylene plastic that is 100 percent recyclable. This material choice means that the pedestals are essentially impervious to common outdoor concerns such as water, mold, and freeze-thaw cycles. As part of a gravity-based system (i.e., no roofing penetrations required), the pedestal supports protect the roof and waterproofing membranes below without causing damage or harm to them. Pedestal deck systems can also be utilized over any other structural surface: on bare structural decks, rooftop decks, existing plazas/terraces, compacted grade, pavement, pool surrounds, inside of water features, or even between green roof areas.

The cavity space created by the pedestals between the deck and the roof can be used strategically to allow for electrical wiring, recessed lighting, duct work, and even irrigation. This means the deck itself or spaces below it can be serviced based on the needs

of a project. The location of the pedestals is typically based on a modular layout that follows the size of the material used on the deck surface. Commonly, this is a 2-foot by 2-foot square module, although many other sizes are possible as well. The modularity and particular design of the deck surface will be used to determine the specific locations of the pedestals.

Deck Surfaces

The versatility of adjustable pedestal deck supports means that they can be used to elevate a variety of decking surface materials. The common options include pavers made from concrete or stone, such as granite or travertine. Similarly, structural porcelain tiles, fiberglass grating, composite materials, or conventional wood decking systems can be used in a grid pattern to meet different design requirements. Typically, a galvanized

steel paver tray is installed on top of the pedestals to support structural porcelain pavers or others.

If a lighter-weight surface material is preferred or needed, then wood tiles are a good alternative weighing only one-third as much as concrete tiles. Typically made from hardwoods in a variety of species, wood tiles are commercial grade and available in standard, responsibly harvested, and FSC Certified options for sustainability. Wood species include fused bamboo, cumaru, garapa, ipê, mahogany, and massaranduba, among others. Not only do these wood tiles contain a rich variety of graining and coloration, they are exceptionally dense and resistant to insects. As such, they weather well and require minimal maintenance. If maintaining the wood color is desired, wood tiles can be periodically cleaned and sealed. Left to weather naturally, the wood

Photos courtesy of Bison Innovative Products. Photographer Peter Vanderwarker

CO-HOUSING CASE STUDY

Project: Coastal Co-Housing Community
Location: Portland, Maine
Architect: Richard Renner | Architects
General Contractor: Wright-Ryan Homes

The Project: While traditional co-housing projects focus on family and children, the Portland, Maine based Coastal Co-Housing units were designed as a retirement community. Considering owners’ desires to be with aging friends and family, architects designed multi-generational senior living spaces. Co-housing differs from standard condominium development and master-planned subdivisions because the development is designed by, or with considerable input from, its future residents. The design process customarily emphasizes fostering social relationships among its residents. Common facilities are based on the actual needs of the residents, rather than on what a developer thinks will help sell units.

The Innovative Green Design: The complex, built for six couples, consists of a main structure and a guesthouse for friends and family. The common space includes a living room, kitchen, laundry, library, art studio, and exercise room. The aim of the 15-acre site is to achieve net-zero energy consumption. Solar panels, a green roof, and a wood pellet boiler all contribute to that goal. The tight-knit housing arrangement allows everyone to live in a flexible, shared community in comfort and style.

Part of the project includes a 4,000-square-foot rooftop above the common parking garage. This reclaimed space provides a shared garden and hot tub surrounded by smooth wood tiles supported by adjustable pedestals. The modular deck system readily converted the space into a contemporary, multiuse space for residents that can be easily maintained.



tiles will develop a silvery-gray patina. Either way, wood tiles are ideal for blending the warm beauty and upscale appearance of real wood with durability and low maintenance.

For a different design look, wood tiles can be laid in a parquet or linear pattern. Of course, the deck design does not need to be limited to a single surface choice—materials such as pavers, river rock, stone, plank decking, or others can be mixed and matched based on the modularity of the system to create unique aesthetics. Many of these deck surface options can be removed from the top of the pedestals for routine maintenance, repairs to the roof, or access to other systems.

Other Deck Design Options

There are a number of other ways that adjustable pedestal roof deck systems can be integrated into roofing designs. For example, green roofs are increasingly popular as a way to expand usable roof space, add gardens, and control rooftop drainage. Designs that include green roofs typically demonstrate an imaginative use of materials that minimize maintenance and the environmental footprint of the building. By incorporating a pedestal system into a green roof, a pedestrian walkway can be provided that keeps footsteps off of the vegetation and allows it to grow properly. It also provides controlled access for maintenance of the green roof or other rooftop items.

Similarly, an elevated pedestal system can be used within a water feature or where the water supply is concealed beneath the deck surface. Since the supports are impervious to water, mold, and most chemicals, they can function well for many years of service. Similarly, recessed lighting can be incorporated into the system by running the wiring beneath the deck surface. This can enhance the ambiance of the outdoor space and improve visibility and safety during nighttime/dark conditions.

Of course, the deck does not need to cover the entire roof in any of these scenarios. It can be sized to suit the needs of the project such that it avoids other rooftop equipment or features, provides a geometry that is visually interesting, or is just sized to accommodate the programmatic needs of the space. Similarly, smaller sections can be located on different parts of a roof or on different levels of a building or site, depending on the building design.

Site Furnishings

With the pedestals and the deck surface in place, it makes sense that manufacturers

Photos courtesy of Bison Innovative Products. Photographer Gary Hewson

PROTOTYPICAL CASE STUDY




Project: Sunset Idea House
Location: Santa Monica, California
Designer-Owner: Gary Hewson
Interior Designer: ETC.etera

The Project: Sunset Magazine's 2019 Idea House could not be in a better location for an outdoor rooftop deck. The Santa Monica Canyon residence is located on a hill which grants sweeping views of the ocean and surrounding coastal vegetation. Brilliantly outfitted by ETC.etera, the collaboration of varying manufacturers' products came together with a stunning result.

The Innovative Design: The rooftop deck features two foot square, smooth wood tiles supported by adjustable pedestals. The rooftop deck is broken into separate areas—a living space with ample seating and a fire pit, an outdoor kitchen with a dining table, grill, and a garden spot with a variety of potted plants. The master bedroom is also wrapped by a patio constructed with porcelain pavers backed by paver trays supported by fixed height pedestals.

offer a series of deck furnishings to fit with the modularity of the deck system. For example, modular wood cubes are available with an array of design options to incorporate seating, storage, and planters. Such cubes are available with a polyurethane lining and drainage holes to host plant life. At other times of the year, the cubes can be repurposed for seating and storage of seasonal items (i.e., cushions and pillows) by placing a manufactured hardwood top on the cube.

If a different look is desired, aluminum cubes are also an option. Designed to withstand temperature extremes, these low-maintenance, durable planters are constructed of lightweight, partially recycled aluminum. Some use an industrial strength powder-coated finishing process that is applied electrostatically and cured under heat, creating a more resilient finish than conventional paint. The process does not emit any volatile organic compounds (VOCs) into the air and allows the cubes to be coated with virtually any paint color. Aluminum cubes typically contain recycled content, are 100 percent recyclable, include drain holes, and have irrigation sleeves.

There is a variety of size and color choices available.

Overall, from reclaiming unused space in the city or creating a relaxing retreat in the suburbs, to creating a luxurious oasis by the sea, pedestal rooftop decks can be a solution for a variety of homeowners while creating valuable outdoor space for them and their guests.

DESIGNING RESIDENTIAL SOLAR CONTROL SOLUTIONS

Architects seeking to control sunlight and solar heat gains in residences, particularly those with large areas of glass or glazing, can use coiled wire fabric as an effective, economical, choice. There are fundamentally two common design strategies in this regard, one for interior applications and one for exteriors.

Interior Designs

In residential design, interior window treatments such as blinds, shades, or drapery, are probably the most common means of addressing solar control. They are inherently controllable with the ability to be readily adjusted for differing lighting conditions over the course of a day, week,

month, or year. While the cost of traditional interior systems can vary, they are generally more economical than traditional exterior systems.

Instead of traditional window treatments, coiled wire fabric has been very successfully used as a durable, attractive, and economical alternative. In some cases, it may be the only treatment used or else it can be combined with other treatments such as black-out shades. Either way, there are multiple opportunities to create interior designs that blend the best of light filtering metal fabric with preferred colors, forms, and textures. Similarly, in cases where skylights or clerestories are part of the building, coiled wire fabric can be suspended below it in artful or simply functional ways to reduce glare, channel the daylight, or provide a curvilinear contrast to an otherwise rectilinear design.

Interior applications are where the fullness of the coiled wire fabric can play a big role. When more material is used than simply what is required to cover a given area, then a billowing, drapery effect may be achieved. This is consistent with other styles of interior window treatments and can create a rather luxurious look. The weave, color, and texture of the selected coiled wire fabric can belie the fact that it is not cloth fabric and therefore offer a warm and comfortable appearance.

Coiled wire fabric with fullness can be installed either as a fixed (i.e., always in one place) or an operable (i.e., able to open and close) drapery system depending on the type of attachment or track system being used. Curved, segmented, and straight systems are all possible so designing a fabric system to match a glazed opening or other feature can be very straightforward. This is true if small, single window units are the focus or if large, continuous glazed areas are part of the design. That is due to the ability of the coiled wire fabric to be provided in long, continuous sizes or to be seamlessly joined in the field such that no window opening size is too large or too small for consideration.

Another significant attribute of using coiled wire fabric for interior applications is its ability to allow for the predictable passage of air as well as light. Many exterior windows have HVAC components installed above, below, or adjacent to them that move air or radiant heat into the space. The coiled wire fabric typically is not bothered by the heat or cooling

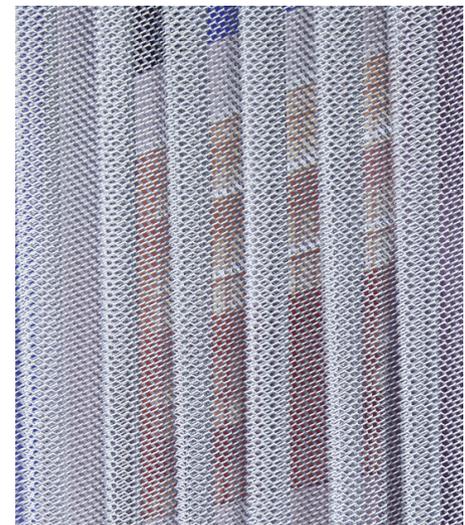
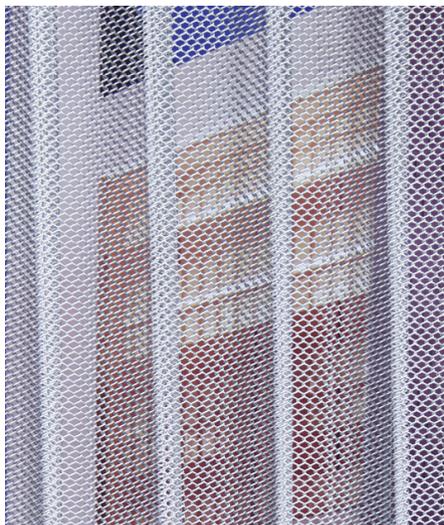
Photo courtesy of Matthew Millman Photography



Designer: Walker Warner Architects

“When we think of sun control and rainwater retention, we’re always searching for products that complement our palette of exterior materials. The copperclad Fabriccoil is a natural choice for us. Whether we use it as a 20-foot-long rainwater diverter or a movable panel to cut the harsh sunlight, we’re always delighted by the results.”
—Thomas Clapper, senior associate, LEED AP, architect, Walker Warner Architects

Photos courtesy of Cascade Architectural



The fullness of coiled wire fabric drapery is an important consideration in design. Fabric at 100 percent fullness is shown here on the left and 200 percent on the right.

temperatures that emanate from these components and the open nature of the weave allows air and temperature to pass through the wire fabric. Hence, the light controlling aspects of the wire drapery will not necessarily interfere with the proper operation of the HVAC system the way that fabric drapery sometimes can.

Beyond the appearance and functional aspects of coiled wire fabric used on interiors, are the other performance capabilities that it provides. Fundamentally, it is a very durable choice since the metal coils are not hampered by many of the usage and wear concerns of other materials such as fabric, plastics, wood, etc. In fact, it may even protect the surfaces and glass that it covers. The overall appeal and durability often means that the material is not limited to covering windows on interiors but can be used elsewhere as a means to separate spaces, create a visual focus, or enhance lighting designs.

Exterior Treatments

In some cases, residential building designs call for exterior components to be used for light and solar gain control. In that regard, coiled wire fabric has been used in several ways. First, the wire fabric can be installed in metal frames that are mounted directly to the building facade. The resulting scrim panels then cover over the glazing or openings and provide shading or penetration as desired. From the inside of the building, the view can be maintained much the same way ceramic frit on glass is used to allow a view but reflect sunlight. In some cases these exterior panels can be mounted on sliding hardware to allow them to move in front of the glazing or out of the way to let the sun shine directly into the building.

Instead of covering the windows or openings directly, panels can be installed so they extend horizontally above the fenestration. This creates shading by means of a projecting surface such that ambient light enters below the horizontal projection but direct light is from above is stopped or filtered. Energy codes recognize this approach as a Projection Factor (PF) that can be used to demonstrate code compliance for fenestration and daylighting.

Finally, there may be a preference for panels to stand up vertically in front of a building facade to provide solar shading particularly for east/west orientations, or

TABLE 4 SPECTRAL PROPERTIES EXPERIMENT RESULTS

SHGC		
	No Scrim	Interior @ 50% Fullness
Clear Single Pane	0.763	0.668
Low-e	0.274	0.246

TABLE 5 HOT BOX EXPERIMENT RESULTS

Glass:	Low-e	Low-e	Single Clear	Single Clear
Drapery Fullness:	0%	50%	0%	50%
U-Value - Window Only	0.27	0.27	0.94	0.94
U-Value - With Drapery	0.26	0.25	0.88	0.82
Heat Transfer Reduction	4%	7%	6%	13%

TABLE 6 ENERGY SAVINGS FROM CCD APPLIED TO SINGLE CLEAR GLAZING

	Portland OR	Phoenix AZ	Anchorage AK
Always Shaded	2.96%	3.90%	2.74%
Optimized Shading	3.12%	2.44%	3.33%

TABLE 7 ENERGY SAVINGS FROM CCD APPLIED TO LOW-E GLAZING

	Portland OR	Phoenix AZ	Anchorage AK
Always Shaded	1.20%	0.99%	1.53%
Optimized Shading	1.10%	0.85%	1.26%

Source: Interface Engineering Report, 2014

to add another design element to a building. Coiled wire fabric can be used this way in framed vertically oriented panels to achieve these objectives. When the panels are attached to the building, they can appear as vertical louvers or accents. When separated from the building, it can help enclose an outdoor space or otherwise add to the three dimensionality of the building.

Energy Performance

With an understanding of how to use coiled wire fabric on the interior or exterior of residential buildings, the logical

question is how well does it perform related to energy usage? To help answer that question, we can turn to an independent study carried out by the private firm of Interface Engineering. As one of the largest independent consulting engineering firms in the country, this 50-year-old firm maintains seven offices located throughout the United States with more than 275 employees. In 2014, it conducted a study of coiled wire fabric and its "Impact on Building Energy, Thermal Comfort, and Daylighting." Using a combination of computational fluid dynamics (CFD) simulations and

independent material testing, it was able to quantify different performance aspects of the material in different situations. Some of the findings reported in this study are summarized in the following paragraphs.

Residential Energy Modeling Methodology

Multiple building energy simulations were conducted which compared energy consumption before and after the application of coiled wire fabric drapery. The energy modeling software eQUEST was used to conduct full year, hour-by-hour simulations to predict overall building energy consumption. A typical 2-story residence with a 25 percent window-to-wall ratio was chosen for simulation. Two different glazing types were simulated (standard single pane clear glazing and high-performance low-e glazing) with two shading strategies: drapery closed all year as well as an optimized strategy where the drapery is open when passive sunlight can be collected during the winter. To investigate how different climates affect the applicability of the material, simulations were conducted in several climates: Portland, Oregon; Phoenix; and Anchorage, Alaska. In total, 18 energy simulations were conducted and the results compiled.

Material Attributes

To create accurate simulations, independent laboratory testing was conducted of coiled wire fabric of different types over both clear and low-e glazing. In those controlled conditions, baseline solar heat gain coefficients (SHGC) and U-factors were determined and showed the following results just for the installed product conditions:

Building Energy Simulations

Based on the methodology and material attributes stated above, separate full building simulations were run to determine energy performance for each of the variable conditions and the different climate locations described. The resulting reduction in yearly energy consumption as a percentage of energy consumption

when no shading device is used is shown as follows:

Interface Engineering interpreted these residential building results by pointing out several things:

- Coiled wire fabric drapery is most effective when applied to the single pane glazing.
- An annual reduction of at least 3 percent is achievable in all climates simulated.
- The drapery is less effective when applied to the high-performance low-e glazing because the glazing has already significantly reduced heat transfer and solar gain capabilities.
- In the case of the low-e glazing, more energy savings is realized in colder climates.
- The “optimized” shading strategy proved effective for the single pane glazing in the cold climates. However, keeping the drapes closed is the most effective strategy for the low-e glazing in all climates.

The source of these reductions is found in the three common areas of heating energy, cooling energy, and fan energy. In cooler climates like Portland, Oregon, it found with the optimized control strategy, heating energy is reduced by 5.5 percent, cooling is reduced by 1.5 percent and fan energy is reduced by 10.6 percent.

Overall, the engineers determined that coiled wire fabric drapery can indeed serve to reduce a residential building’s annual energy consumption by up to 3.9 percent. The actual savings will, of course, depend heavily on local climate and the user’s operation of the shades. If the user is diligent in keeping the shades closed as often as possible, then the maximum benefit will be realized. It also noted that since the product has a more substantial impact on single clear glazing as opposed to low-e performance glazing, it can be a more appealing option in retrofit applications where existing glazing pre-dates current energy codes.

Shading and Glare Performance

Interface Engineering examined the use

of coiled wire fabric drapery for shading and glare performance in residences as well. It found that “the best shading condition for this product is when the product is used in the 50 percent fullness configuration. Additional shading can be achieved when the material is changed either in wire gage or finish color.” It backs this up by pointing out that the material testing showed visible light transmittance (VLT) of 46 percent for the 3/8-inch, 4-gauge 304 Stainless Steel at 0 percent fullness, which is 18 percent lower than the 1/4-inch, 19-gauge Silver Tin Plated. Of course, more fullness means more light and vision is blocked, with direct impacts on the lighting and views in the spaces.

Overall, Interface Engineering states, “The modeling results show that the best application for this product is glare control. The product is able to dramatically reduce the direct sun penetration into the room, even in the 0 percent fullness application. When the product is used in 50 percent fullness this glare control is greatly increased without a significant change to luminance levels further in the room.”

CONCLUSION

Residential projects can take many forms, but they all have a need to incorporate green and sustainable principles into their design. Healthy, outdoor spaces, especially in urban settings or restricted sites can be created successfully using adjustable pedestal deck systems over other surfaces such as roofs or tight ground spaces. Solar gain and glare can be controlled with coiled wire fabric products. Collectively, strategies like these can be used to create well-designed, functional, and sustainable residences.

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