Design Guide

for the MatrixAir™ Solar Air Heating System

A simple and effective exterior metal wall or roof screen that uses solar energy to heat and ventilate indoor spaces

*Patent Pending

VERIFIED CSA® Energy Performance Rendement Énergétique VÉRIFIÉ

SOLAR RATING & CERTIFICATION CORPORATION SRCC OG-100 CERTIFIED ESTABLISHED 1980™

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ENERGY STAR PARTNER

Design Guide

for the MatrixAir™ Solar Air Heating System

All buildings require ventilation to ensure adequate indoor air quality. Heating all that fresh air can be very expensive and preheating it using solar energy reduces building operation costs, reliance on imported fossil fuels and greenhouse gas generation.

Typical HVAC systems are not designed to exhaust toxic chemicals, and can, in fact, create hazards by distributing the chemical gases and vapors throughout the building. In addition, HVAC systems commonly recirculate the air to save energy by avoiding the heating of the outside air (called makeup air) used to replace exhausted air. Unfortunately, recirculating air also results in the recirculation of any toxic contaminants in the air. Often energy conservation and occupant health are in direct conflict with each other. Extensive recirculation or lack of fresh air may result in health problems even in buildings which are not producing toxic contaminants. This is referred to as the Sick Building Syndrome.

In general there are two types of ventilation: Dilution and Exhaust Ventilation. Dilution ventilation involves bringing in clean air to dilute the contaminants in the air to a safe level using a slight positive or negative pressurization of the building to produce the minimal air exchange that is needed. This is far from ideal and creates a number of problems. Dilution ventilation does not eliminate exposure but lowers it. Exhaust ventilation, on the other hand, either captures the contaminants at their source and exhausts them to the outside before the contaminants get into the room air that is breathed or places exhaust fans in such a way to create a uniform flow of fresh air into the building with or without a heat recovery system for subsequent fresh air preheating. New air is introduced to replace the exhaust air and heat recovery systems are not without their limitations.

DESCRIPTION

The Matrix*Air*™ concept is straightforward, simple and efficient. Perforated metal cladding is used to draw in heated fresh air off the surface of south-facing walls, where it can then be distributed throughout the building as pre-heated ventilation air. The genius of this system is in the cladding and overall systems' fundamental simplicity: solar energy is used to heat fresh air, which is then brought into the building via a conventional make-up air or ventilation system. It is easily integrated into new construction or renovations.

Known as a transpired solar collector system, the U.S. Department of Energy call such systems the most reliable, best-performing, and lowest-cost solar heating system for commercial and industrial buildings available on the market today.

Resembling a conventional metal wall the design is simple and inexpensive offering the best ROI of any solar technology in the world.

Matrix*Air*™ Solar Air Heating systems have demonstrated collector efficiencies approaching 70% at flow rates of just 7 CFM/ft^2 of collector areasome five times that of most currently available photovoltaic (PV) systems.

A key feature and design benefit of the Matrix*Air*™ system is the placement of the air inlet to the building below the mid-line of the collector area comprised of the Matrix*Air*™ cladding. Forcing air to collect along the top of the wall and ducting it into air inlets results in the need for a large internal plenum or exterior canopy that usually results in heat losses near the top of the collector or its perimeter.

The air behind the Matrix*Air*™ cladding normally travels downwards to the nearest air intake thereby simplifying the balance of the air movement, reducing the air cavity dimension and ensures that air is drawn through the entire panel surface.

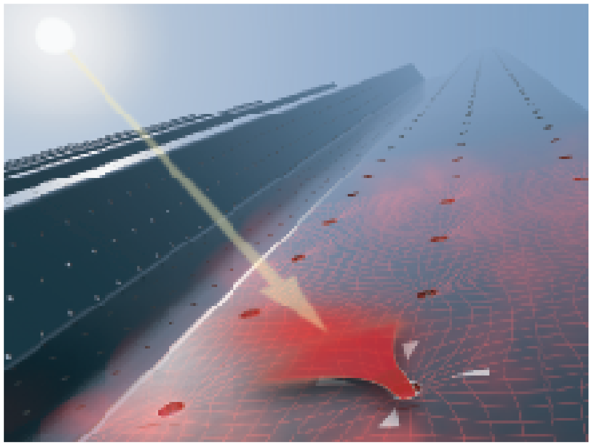

Figure 1: Matrix*Air*™ cladding

Applications

Matrix*Air*™ transpired collector uses the most efficient and cost effective solar air technology available. Ideal building types for the Matrix*Air*™ system include any new buildings and retrofit applications.

In new construction, a Matrix*Air*™ System can easily, and cost effectively complement conventional ventilation or pre-heat makeup air systems while substituting the metal or other façade materials that are typically used.

In retrofit applications, Matrix*Air*™ Systems can be adapted to existing air handling equipment with the perforated cladding simply installed on top of the existing south facing façade.

In either of these situations the solar heat collected by the Matrix*Air*™ cladding may be used in a hybrid scenario to preheat domestic or process water via an air to water heat exchanger. Other excellent applications include providing low temperature process air heating for agricultural or industrial purposes as well as water heating alone.

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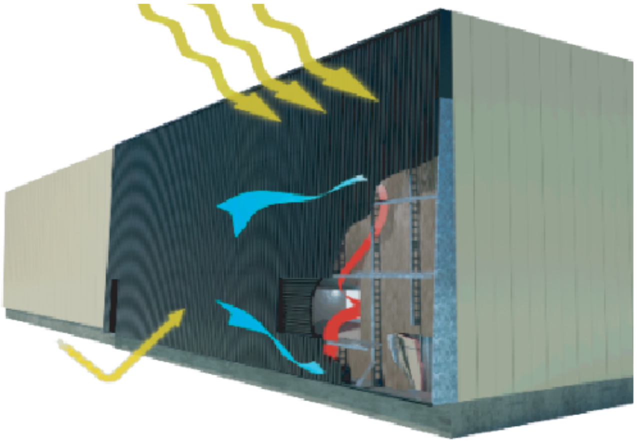


Figure 2: MatrixAir Solar Air Heating System cutaway view

Typical Configurations

1. Wall mounted
   Ventilation air system with destratification (Fig. 3)
   Make-up air system (Fig. 4)

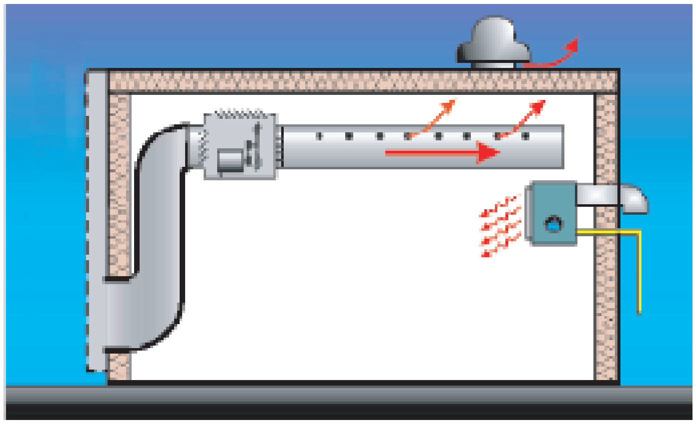


Figure 3: Ventilation air system with destratification

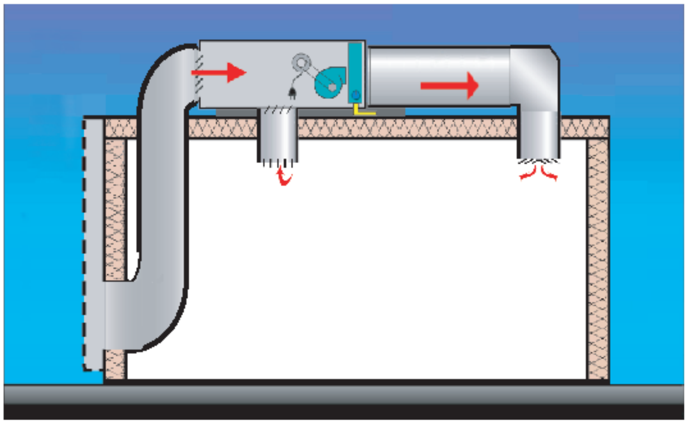


Figure 4: Makeup air system

2. Roof mounted
   Visual screen make-up air system (Fig.5)

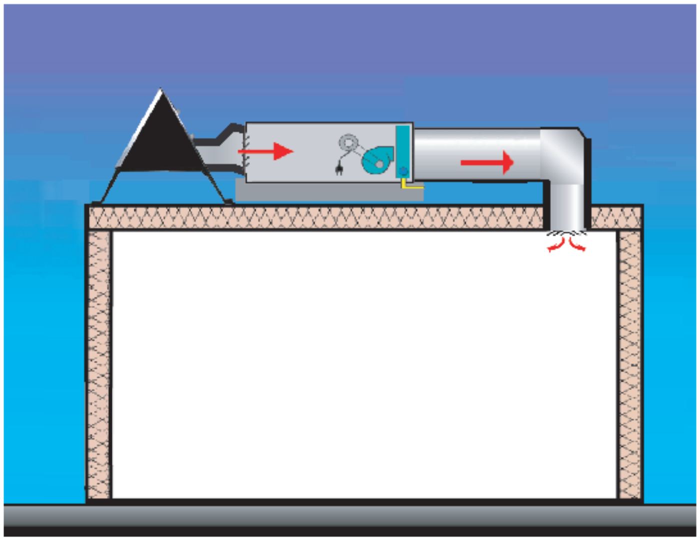
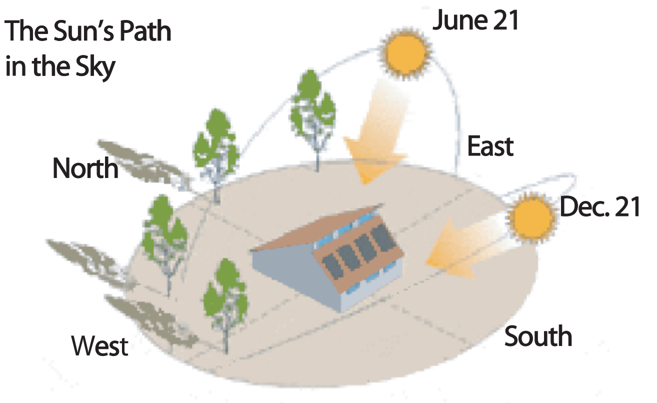


Figure 5: Visual screen make-up air system

DESCRIPTION

1. Select the wall (or roof) area to which the MatrixAir cladding may be installed.

Ideally a wall facing true south (adjusted for magnetic variation) is best though any east or west facing wall plus or minus 45 degrees from due south results in only minor loss of performance. In fact east and west facing walls, with proper mechanical controls, provide both heating and alternatively cooling benefits at different times of the year.



2. Determine the volume of air that is required by the building's ventilation or process heating system

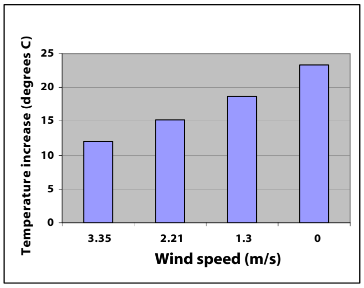
MatrixAir systems are highly adaptable to a wide range of ventilation rates. While the energy delivered will be the same, a trade off is made between the temperature and volume of air heated by the system.

Figure 6: Delivered Air Temperature versus Air Flow and Insolation Levels

Test results information for Matrix*Air*™ TR – solar air heating collectors

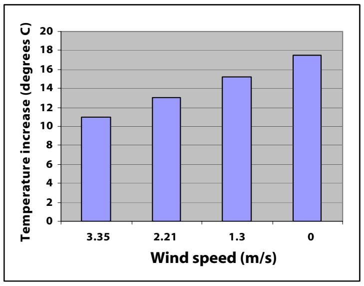
A.) Test conditions:
Airflow suction rate = 3 CFM/ ft^2
= 15.234 (l/s)/m^2;
Solar Radiation = 900 W/ m^2

Wind speed		***Temperature rise***	
	m/s	***°C***	***°F***
High	3.35	12.07	21.73
Medium	2.21	15.28	27.50
Low	1.30	18.74	33.73
None	0.00	23.32	41.98



B.) Test conditions:
Airflow suction rate = 5 CFM / ft^2
= 25.39 (l/s)/m^2;
Solar Radiation = 900 W/ m^2

Wind speed		***Temperature rise***	
	m/s	***°C***	***°F***
High	3.35	10.96	19.73
Medium	2.21	13.00	23.40
Low	1.30	15.27	27.49
None	0.00	17.45	31.41



C.) Test conditions:
Airflow suction rate = 6.57 CFM / ft^2
= 33.363 (l/s)/ m^2;
Solar Radiation = 900 W/ m^2

Wind speed		***Temperature rise***	
	m/s	***°C***	***°F***
High	3.35	9.80	17.64
Medium	2.21	11.06	19.91
Low	1.30	12.67	22.81
None	0.00	14.12	25.42

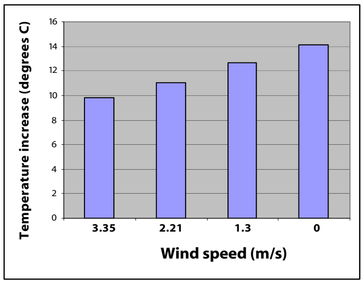


Figure 6 above demonstrates the relation between temperature rise, air flow and the solar radiation striking the collector surface. Simply put the higher the flow rate of air across the cladding the lower the delivered air temperature. While equally effective the highest performance and highest efficiencies are achieved at the higher air flow rates.

The volume of air that can be heated by a given façade area may be calculated by multiplying this area by the desired temperature curve flow rate from Figure 6 or by using the Sizing Guide shown below.

SIZING GUIDE

While systems are capable of capturing 70-80% of available solar energy, including both diffuse and direct sunlight, real world installations typically capture 60-70% of the available solar energy. Because of the continual flow of air into the building caused by the ventilation fan, convective heat loss is kept low as is radiative heat loss, because the absorber stays within a few degrees of the ambient air temperature.

Sizing a Matrix*Air*™ Solar Air Heating System is a relatively simple two step process based on both the air volume and desired air temperature required by the application. The air velocity (shown below as CFM/ft^2, $m^3/h/m^2$ or $l/s/m^2$) is calculated by dividing the air volume to be heated by the Matrix*Air*™ cladding area.

For low volume and high temperature applications typical of process heating applications:

1 to 3 CFM/ft^2 of Matrix*Air*™ cladding area
1.7 m^3/h to 5.1 m^3/h (meters per hour)
0.0005 m^3/s to 0.0015 m^3/s (meters per second)

For most ventilation and make-up air applications:

4 to 6 CFM/ft^2 of Matrix*Air*™ cladding area
6.8 m^3/h to 10.2 m^3/h
0.0018 m/s to 0.0028 m/s

For higher air volumes, and low temperature rise, (highest solar efficiency):

7 to 9 CFM/ft^2 of Matrix*Air*™ cladding area
11.9 m^3/h to 15.3 m^3/h
0.0033 m^3/s to 0.0042 m^3/s

Note: Unless operating in all but the lowest of ambient wind conditions or for process air heating, it is generally not cost effective to install systems operating below the 3.0 CFM/ft^2 air flow rate.

For example, if 10000 CFM of fresh air is required for an industrial warehouse a wall area of between 1111 and 3333 ft^2 is required. In this example, however, the client's need for high temperatures is of lesser importance than cost considerations thus curves C or D (5 or 7 CFM/ft^2) would offer the best combination of cost and delivered air temperature. The recommended collector area would then be 2000 - 1429 ft^2 (10000/5 or 10000/7).

The total pressure drop through the perforated metal façade and into the fan intake will typically range from 170-100 kPa, however, some adjustment may be needed for specific applications where additional ducting, curves etc. are needed to reach the fan intake.

Systems are designed such that the air velocity behind the perforated cladding does not exceed a maximum velocity at the air intake of 1000 FPM or 5 m/s. Multiple air intake positions will reduce these air velocities, operating pressure and/or reduce the overall wall cavity thickness yet maintaining the overall system performance.

CONSTRUCTION

Building Integration

Cladding: With the exception of the tiny holes, the Matrix*Air*™ cladding resembles a conventional metal façade. It is available in a variety of colours, however, black and darker shades will yield the highest effectiveness. The width of each panel is approximately 36 inches, the length however is cut to suit each projects' requirements. Figure 1 shows a close up photo of a typical Matrix*Air*™ cladding while other standard profiles are shown in the Appendix. Other non-standard profiles may be available, contact Matrix Energy Inc. for details and current selection.

The standard perforated cladding may be made of either 32 ga aluminum or 26 ga and 24 ga galvanized steel.

Corrosion experts have examined similar transpired panels which have been in continuous use for more than fifteen years and found no evidence of oxidation or other rust formation. The galvanizing protects the steel from rusting and the air movement through the holes dries any water that may exist. Rain water typically runs off the exterior and surface tension prevents most water from entering the holes.

Colour: A non selective colour and 8000 series paint system is used with standard industry warranties. Darker colours work better, as dark colours absorb more heat. Black is the best followed then by dark brown, blue, green and red respectively, see the Appendix for details.

Note: Not all colours are available in each of the two material gauges.

Air cavity: A certain air gap is necessary to allow the heated air into and across the collector to the nearest fan intake near the middle or lower portion of the wall area. Multiple air intakes will reduce the depth of the wall cavity since the volume of air going to any one intake is obviously lower.

Note: A number of installation methods are possible, however, for best performance all air intakes should be located centrally, and evenly spaced near the bottom of the wall area.

Vertical Wall: The entire wall mounted out at a same distance from the exterior wall but not more than 300 mm.

Inclined Wall: The cladding tapered with larger distance at bottom and smaller distance at the top (500 mm to 50 mm) of the exterior wall.

Systems Mounted on Roofs: Installed in much the same way as a mechanical systems' visual screen the collector is positioned in front of the air intake either vertically or inclined. Roof mount systems that resemble architectural mechanical equipment screens are equally efficient and suitable to low volume requirements or where local bylaws inhibit the use of metal wall systems.

Systems Mounted on Inclined Roofs: The perforated cladding is mounted parallel to the existing roof angle leaving up to 150 mm of air cavity. These systems are suited to warm locations where drying or process applications are operated. Designs are based on volume of air required by the system, desired cost envelope and aesthetics. Certainly the larger the air volume required the lower the cost per installed foot of Matrix*Air*™ cladding area. Aesthetics and budgetary restraints will influence the final design.

The higher the volume of air to be delivered per square foot of collector area the more air space is needed between the cladding and façade to which the cladding is installed.

The means used to secure the cladding to the exterior wall is generally the same for all buildings constructed using a metal sandwich type of wall. A combination of vertical and/or horizontal Z-bars will be used to create the air space behind the cladding

Masonry buildings typically use a much simpler clip type system. A pull-out test must, however, verify that the exterior wall would be sufficient to support the approximate 1 lb/ft² weight of the cladding and framing hardware, the wind loads and other applicable loads according to thebuilding code.

If the architect is planning to include an architectural feature along the top of the wall such as a canopy or mansard roof then design it to also act as the plenum to collect the solar heated air. In such cases vertical ducting will be needed to direct the air entering the cavity at the lower portion of the wall to upper canopy section. Consult Matrix Energy Inc for details on your specific project.

Variations

Backpass systems: For air volumes of less than 8 - 9 CFM/ft² of Matrix*Air*™ area, all of the air required can normally be accommodated in the air gap between the perforated absorber and the wall. For the larger air volumes, either multiple air connections to the fan(s) or a larger air space is needed.

Where air flows exceed 9 CFM/ft² of collector area a method of collecting the solar heated air at the top of the collector by means of a plenum on the outside of wall is used. These systems are known as backpass systems. Using mainly horizontally-oriented un-perforated cladding the lower wall and canopy area are optimized as is the depth of the canopy itself. These systems generally offer lower performance and are not recommended.

In some cases, the canopy will extend above the exterior wall, which is not perforated to collect the solar heated air as it rises up the exterior of the wall. This design variation may be suitable for walls with numerous windows or doors.

FEATURES & BENEFITS

- **Highly efficient** - Matrix*Air*™ systems achieve upwards of 70% conversion efficiency, even higher in northern climates resulting from snow reflectance.
- **Maintenance Free** - the Matrix*Air*™ cladding requires no maintenance, while the mechanical equipment involved requires nothing other than its scheduled maintenance for ease of use.
- **Air Filtration** - Transpired collectors remove 50% of air borne particulates further improving indoor air quality and lowering filter maintenance costs.
- **Aesthetics** - With its wide variety of cladding profiles and colours Matrix*Air*™ cladding looks just like any other metal siding. Once the cladding is installed the tiny holes are barely visible to the naked eye from even a short distance away.
- Return on Investment - Matrix*Air*™ yields a high ROI versus conventional ventilation or make-up air heating.
-

Environmental - On average one square foot of Matrix*Air* cladding providing 7 CFM during the heating season in Canada will reduce CO emissions by 0.013 - 0.025 tonnes annually versus a conventional natural gas fired system.

LEED Accreditation - The incorporation of a Matrix*Air* system can bring up to six LEED points to a project (3- energy efficiency; 3 - renewable energy).

Heat Recovery - Our system recovers the heat that is otherwise lost through the exterior wall to the outside. Heat losses are picked up by the air flow behind the cladding and returned to the building when the fans are running.

Affordable - the use of conventional cladding modified for air heating applications significantly reduces cost versus other systems.

Air mixing: To reduce heat losses at the ceiling level in industrial ventilation applications the cooler air that may emanate from the Matrix*Air* system is mixed with hotter ceiling air using perforated air ducts expressly made for this purpose resulting in significant heat destratifcation savings.

Passive summer cooling - Matrix*Air* shields the inner wall from direct sunlight during the summer season. For some buildings in warm climates, this actually saves more money than the heating effect during the winter. As the wall becomes heated warm air begins flowing off the collector from the top of the wall creating an intake of cooler ambient air near the bottom of the wall and the interior wall is spared the direct solar radiation, reducing the cooling demands of the building.

The installation of a motorized bypass damper (Fig. 7) directly in front of the air inlet allows for the intake of unheated, ambient air during periods when heating is not required.

Figure 7: Summer bypass damper

Energy Performance

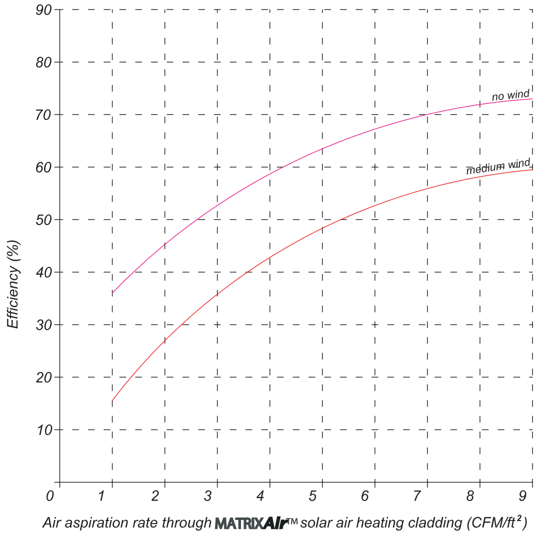
Tests by the Canadian National Solar Test Facility have found that the collector can absorb and utilize up to 60 percent of the available solar energy it comes in contact with during medium wind conditions (see Fig. 8 below). In contrast, common solar air heaters which use glazed, flat-plate collectors are only 35-40 percent efficient in ideal conditions.

The unglazed collector receives 100% of the sun's energy. Ironically, snow actually boosts the transpired collector's heating performance because snow ground-cover can reflect up to 70 percent additional solar radiation onto the panel, enabling it to absorb more heat.

In low wind conditions, heat loss is minimal as the layer of air in front of the metal is pulled through the collector's perforations before the heat can be radiated or convected externally.

Collection efficiency is highest at high air flow rates and even on cloudy days, the unglazed panels will collect heat as can be shown in the graph below.

The delivered air temperature to a ventilation system will vary in temperature depending on the flow rate per unit area of collector area, available solar radiation, ambient air temperature and surface wind velocity. The brighter the sun the higher the temperature rise, the lower the air flow through the collector surface the higher the temperature vise and vice versa. At constant air flows, efficiency remains constant and the collector will continue to generate air temperature increases even in overcast conditions.



Installation Methods

With the exception of the air cavity that is created using a combination of wall clips, horizontal and/or vertical `Z-bars the Matrix*Air* cladding is installed in a similar manner as other metal wall facades.

Photo credit: Sico-Akzo Nobel Project

Installation is generally made on metal sandwich type construction with the vertical Z-bars attached to structural building supports with sufficient strength to support the MatrixAir™ framing and cladding according local building codes. Horizontal z-bars are then placed at right angles to these vertical members onto which the cladding is attached. The cladding may also be installed horizontally by simply reversing the framing order of installation.

Exterior wall insulation must be isolated from the air flow and ultraviolet light. The insulation may be isolated and protected via the use of an aluminized, reinforced kraft paper designed for this purpose and installed horizontally up the wall starting from the bottom so as to ensure each layer is opposite to air flows.

Exterior wall insulation must be isolated from the air flow and ultraviolet light on masonry walls as well. The insulation may be isolated and protected via the use of an aluminized, reinforced kraft paper installed so as to ensure each layer is opposite to air flows.

See the Appendix for MatrixAir™ cladding profile specification sheets.

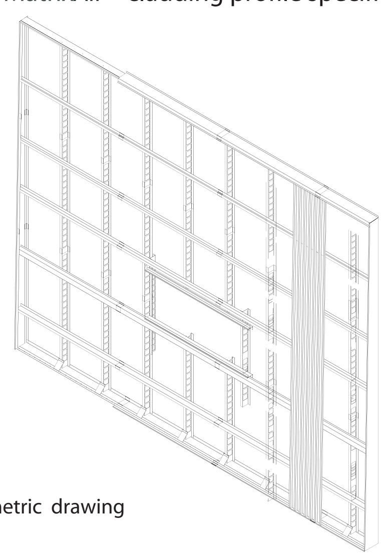


Figure 8: Isometric drawing

Heat Storage

Matrix Energy is undertaking research into various heat storage means or other hybrid uses that maximize the utility of the heat generated when it is not required. This research is currently being conducted with a prominent Canadian firm exploring the use of phase change and other materials that will store energy captured during the day for evening use, or energy that is captured over longer non-heating periods for use later on.

Computer Models

Natural Resources Canada has two programs available that independently simulate the performance of solar air heating systems.

- Using hourly or monthly weather data SWIFT2 is a recognized Solar Air Handling feasibility software program that simulates solar energy savings and performance of our MatrixAir™ Solar Air Heating System. Contact Matrix Energy for details.
- Using monthly-average weather data and available at http://retscreen.gc.ca, RETScreen4 is simple, pre-feasibility, Excel™ based software used for a quick analysis of ventilation solar air heating.

The wall area considered for the installation of the collector need not be void of windows or doors. Wall surfaces around doors and windows may be suitable if they can be connected together or to wall outlet which connect the heated air to the inside of the building. Consider using the MatrixAir™ cladding as the building's exterior façade. If parts of the wall are shaded or not readily accessible for uniform air flow distribution, again, do not sacrifice appearance for highest efficiency instead design the air flow for a range of heating curves, as long as some air is moving through the perforations. In new construction, the capital cost of a transpired solar collector system is similar to conventional walls. In retrofit situations, our cladding can be applied over most existing walls materials including of precast and concrete block, metal, or wood.

APPENDIX

1. Solar Absorptivity Chart for Selected Colours

Code	Colour	Absorptivity	Availability 26ga	24ga
6068	Black	0.94	yes	no
6062	Dark Brown	0.91	yes	yes
6154	Metro Brown	0.89	yes	yes
6073	Dark Green 0.89	yes	yes	
6072	Charcoal	0.89	yes	yes
6084	Navy Blue	0.87	no	yes
6079	Heron Blue 0.85	yes	no	
6078	Green	0.84	yes	yes
6067	Slate Blue	0.80	yes	yes
6083	Deep Water Green	0.79	yes	yes
6082	Regent Grey	0.75	yes	no
6156	Pacific Turquoise	0.71	yes	yes
6074	Tan	0.68	yes	yes
6066	Tile Red	0.68	yes	yes
6070	Gold	0.61	yes	yes
6071	Stone Grey 0.60	yes	yes	
6080	Bright Red 0.59	yes	yes	
6162	Antique Linen	0.45	yes	no

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For our purposes, absorptivity is a measure of a collector ability to retain solar energy. Colours with high absorptivity and low emmissivity such as those incorporated within MatrixAir™ offer the best overall performance and colour longevity. A collector colours' absorptivity will contribute significantly to the energy that may be collected by the MatrixAir™ system. For example, a black collector with 94% absorptivity would capture about 10% more solar energy than a medium blue coloured collector surface.

2. Colours available for Matrix*Air*™ profiles

Dark Brown 6062	Tile Red 6066	Slate Blue 6067	Black 6068
Bone White 6069	Gold 6070	Stone Grey 6071	Charcoal 6072
Dark Green 6073	Tan 6074	White White 6076	Green 6078
Heron Blue 6079	Bright Red 6080	Royale Blue 6081	Regent Grey 6082
Deep Water Green 6083	Navy Blue 6084		Ivory 6090
Metro Brown 6154	Pacific Turquoise 6156	Cambridge White 6161	Antique Linen 6162

Quality and performance specification for COLORITE™ HMP

Exterior Exposure (Weathering)

When installed in Canada, each COLORITE HMP colour of proven durability shall successfully meet the following weathering standards:

Film Integrity

During the first 25 years of exterior exposure (and in the absence of aggressive fumes and/ or other chemicals not normally encountered in the atmosphere), the paint film shall have no evidence of cracking, chipping, peeling, crazing, spotting or loss of adhesion apparent on normal outdoor visual observations.

Chalking

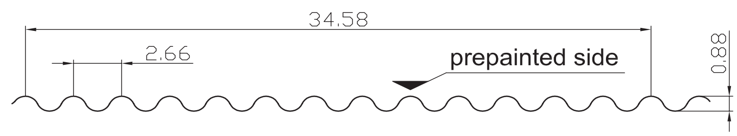
During the fist 25 years of exterior exposure, the chalking in vertical applications shall not exceed a No. 8 rating and in non-vertical applications shall not exceed No.6 per ASTM D$214, method D659, or NCCA 5.5.2.

Colour Change

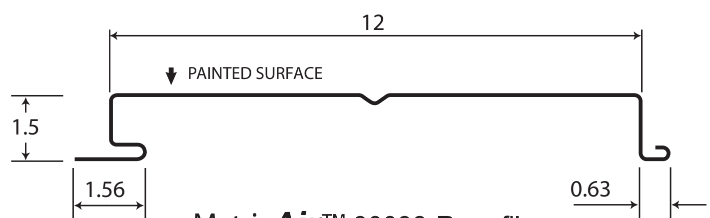
During the first 25 years of exterior exposure, the colour change in vertical applications shall not exceed five (5) colour units, and in non-vertical applications the colour change shall not exceed eight (8) colour units per ASRM D2244 or NCCA 6.1.5.

Colour change is measured on any accepted colourimeter designed to produce reflectance readings in the Tristimulus Filter System of X, Y and Z base on the CIE values of illuminant C and measured in Hunter L, a and b units.

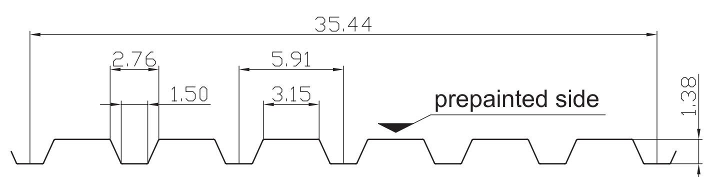
3. Available Profiles*



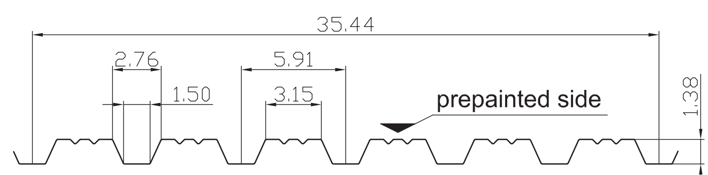
Matrix*Air*™ 22068 profile



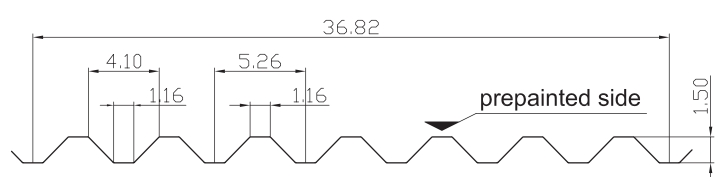
Matrix*Air*™ 30038-R profile



Matrix*Air*™ 35150-B profile



Matrix*Air*™ 35150-BR profile



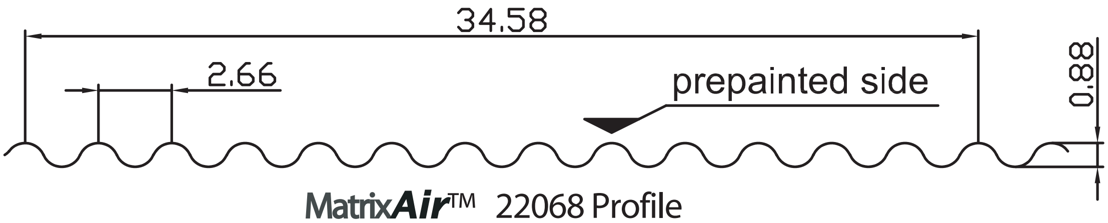
Matrix*Air*™ 38134 profile

**Dimensions and profiles subject to change without notice.*

4. Profile Specification sheets

Cladding Specifications for MatrixAir™ Solar Air Heating Collector - imperial **22068**

22068 is available in base steel nominal thicknesses of 0.018" (26ga) and 0.024' (24ga).



MatrixAir™ 22068 Profile

Physical Properties

(per foot width) In accordance with CSA Specification S136-01

Gauge	Base steel nominal thickness (inches)	Nominal thickness with Z275 coating (inches)	Mass with Z275 coating (lb/ft^2)	Section Modulus: Midspan ($inches^3$)	Section Modulus: Support ($inches^3$)	Moment of inertia midspan ($inches^4$)	Factored Resistance – Moment: Midspan (lb-in)	Factored Resistance – Moment: Support (lb-in)	Factored Resistance – Reaction: Exterior (pounds)	Factored Resistance – Reaction: Interior (pounds)
26 gauge	0.018	0.02	1.12	0.0506	0.0506	0.0217	1502.6	1502.6	-	-
24 gauge	0.024	0.026	1.448	0.0671	0.0671	0.0289	1994.2	1994.2	-	-

Load Table

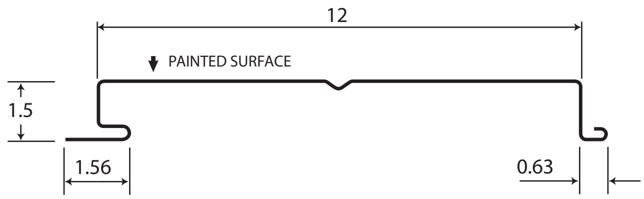
Maximum Specified Uniformly Distributed Load in lb/ft^2 (psf)

Support spacing		1-Span: Base steel nominal thickness (inches) 26ga 0.018	1-Span: 24ga 0.024	2-Span: Base steel nominal thickness (inches) 26ga 0.018	2-Span: 24ga 0.024	3-Span: Base steel nominal thickness (inches) 26ga 0.018	3-Span: 24ga 0.024
4' - 0"	B	42	55	42	55	52	69
	D	30	40	R	R	R	R
4' - 6"	B	33	44	33	44	41	55
	D	21	28	R	R	39	52
5' - 0"	B	27	35	27	35	33	44
	D	15	20	R	R	29	38
5' - 6"	B	22	29	22	29	28	37
	D	11	15	R	R	22	29
6' - 0"	B	-	25	-	25	23	31
	D	-	12	-	R	17	22
6' - 6"	B	-	21	-	21	-	26
	D	-	9	-	R	-	17
7' - 0"	B	-	-	-	-	-	23
	D	-	-	-	-	-	14
7' - 6"	B	-	-	-	-	-	-
	D	-	-	-	-	-	-
8' - 0"	B	-	-	-	-	-	-
	D	-	-	-	-	-	-
8' - 6"	B	-	-	-	-	-	-
	D	-	-	-	-	-	-
9' - 0"	B	-	-	-	-	-	-
	D	-	-	-	-	-	-

NOTES - LIMIT STATES DESIGN:
1. Properties and loads are based on Grade 33 Steel with a minimum yield stress of 33,000 psi, and a maximum stress under factored loads of 29,700 psi.
2. Row B indicates the load capacity based on strength. Strength capacity should be checked against [Specified Live Load] + [0.833 x Specified Dead Load].
3. Row D indicates the load capacity based on deflection of 1/180th span. For allowable deflection of 1/90th span, values in Row D can be doubled, but must not exceed the value in Row B. The symbol "R" indicates the load for strength governs. Deflection capacity should be checked against Specified Load(s).
4. An * indicates capacity has been reduced to account for web crippling.

Cladding Specifications for MatrixAir™ Solar Air Heating Collector -Imperial ***30038-R***

"R" - denotes profile with strengthening rib; also available as 30038 only without rib.



ALL DIMENSIONS ARE IN INCHES

Section Properties

(Per Foot of Width)

Base Steel Thickness (in.)	Weight G90 (psf)	Yield Stress (ksi)	Section Modulus Mid Span (in^3)	Section Modulus Support (in^3)	Deflection Moment of Inertia Mid Span (in^4)	Specified Web Crippling Data (lb) End P_{e1}	End P_{e2}	Interior P_{i1}	Interior P_{i2}
0.030	1.87	33	0.0903	0.132	0.0817	195	48.7	376	63.9
0.036	2.23	33	0.120	0.158	0.106	287	71.8	553	94.0
0.048	2.96	33	0.184	0.210	0.163	527	132	1011	172

Live Load Factor = 1.4; Importance Factor ($I_{W\text{-}SLS}$) = 0.75; Importance Factor ($I_{W\text{-}ULS}$) = 1.0

Load Table

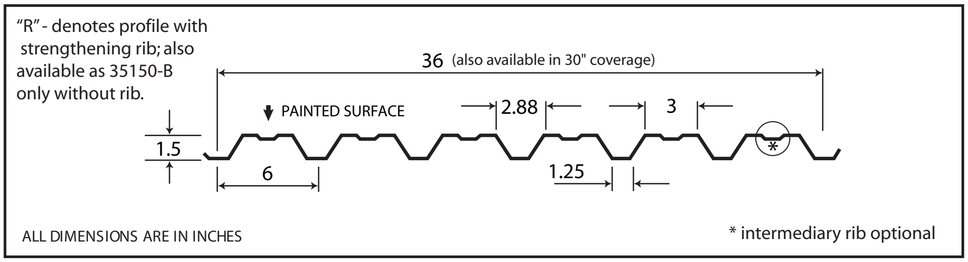
Maximum Specified Uniformly Distributed Loads in psf

Span (ft.)		1-Span Base Steel Thickness (in.) 0.030	0.036	0.048	2-Span Base Steel Thickness (in.) 0.030	0.036	0.048	3-Span Base Steel Thickness (in.) 0.030	0.036	0.048
4'-0"	S	80	106	163	117	140	185	125	166	232
	D	149	192	296	356	461	709	281	363	559
4'-6"	S	63	84	128	92	110	146	99	131	183
	D	104	135	208	250	324	498	197	255	392
5'-0"	S	51	68	104	75	89	119	80	106	148
	D	76	98	151	182	236	363	144	186	286
5'-6"	S	42	56	86	62	74	98	66	88	123
	D	57	74	114	137	177	273	108	140	215
6'-0"	S	35	47	72	52	62	82	55	74	103
	D	44	57	88	106	137	210	83	108	165
6'-6"	S	30	40	62	44	53	70	47	63	88
	D	35	45	69	83	107	165	65	85	130
7'-0"	S	26	35	53	38	46	61	41	54	76
	D	28	36	55	67	86	132	52	68	104
7'-6"	S	23	30	46	33	40	53	35	47	66
	D	23	29	45	54	70	108	43	55	85
8'-0"	S	20	27	41	29	35	46	31	42	58
	D	19	24	37	45	58	89	35	45	70
8'-6"	S	18	24	36	26	31	41	28	37	51
	D	15	20	31	37	48	74	29	38	58
9'-0"	S	16	21	32	23	28	37	25	33	46
	D	13	17	26	31	40	62	25	32	49

Notes:

1. Steel conforms to ASTM A653.
2. Section properties are in accordance with CSA-S136-07.
3. Values in row "S" are based on strength.
4. Values in row "D" are based on a deflection limit of 1/180 of the span.
5. Web crippling not included in strength values. See example calculation in notes to designer.
6. Oil canning may be present due to thickness and coverage. Oil canning is not a valid reason for rejection of this product.
7. Contact the sales department for stocked colours and gauges.
8. The load table contained on this data sheet was prepared by Dr. R.M. Schuster P.Eng. Professor Emeritus of Structural Engineering, University of Waterloo, Ontario, Canada.

Cladding Specifications for MatrixAir™ Solar Air Heating Collector - imperial *35150-B*



Section Properties

(Per Foot of Width)

Base Steel Thickness (in.)	Weight G90 (psf)	Yield Stress (ksi)	Section Modulus Mid Span (in^3)	Section Modulus Support (in^3)	Deflection Moment of Inertia Mid Span (in^4)	Specified Web Crippling Data (lb) End P_{e1}	End P_{e2}	Interior P_{i1}	Interior P_{i2}
0.018	1.04	33	0.0888	0.0940	0.0796	58.0	14.5	113	19.1
0.024	1.36	33	0.127	0.136	0.119	109	27.3	211	35.8
0.030	1.69	33	0.162	0.175	0.157	177	44.2	341	57.9
0.036	2.02	33	0.198	0.208	0.194	262	65.4	503	85.5

Live Load Factor = 1.4; Importance Factor = 0.75; Importance Category = 1.0

Load Table

Maximum Specified Uniformly Distributed Loads in psf

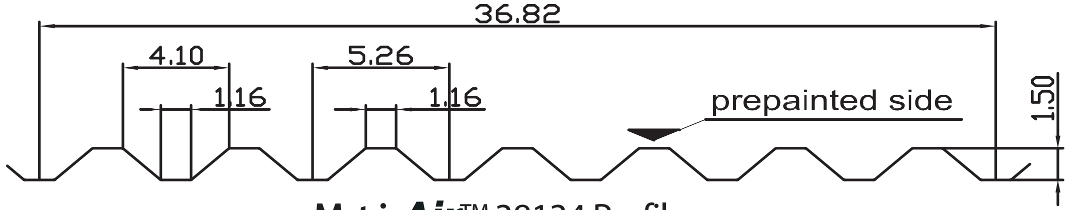
Span (ft.)		1-Span Base Steel Thickness (in.) 0.018	0.024	0.030	0.036	2-Span Base Steel Thickness (in.) 0.018	0.024	0.030	0.036	3-Span Base Steel Thickness (in.) 0.018	0.024	0.030	0.036
4′-0″	S	79	112	144	175	83	120	154	184	104	150	193	230
	D	145	216	285	353	347	518	684	847	273	408	539	667
4′-6″	S	62	89	113	139	66	95	122	145	82	118	152	182
	D	102	152	200	248	244	364	481	595	192	287	379	468
5′-0″	S	50	72	92	112	53	77	99	118	67	96	123	147
	D	74	111	146	181	178	265	350	434	140	209	276	342
5′-6″	S	42	59	76	93	44	63	82	97	55	79	102	122
	D	56	83	110	136	133	199	263	326	105	157	207	257
6′-0″	S	35	50	64	78	37	53	69	82	46	67	86	102
	D	43	64	84	105	103	154	203	251	81	121	160	198
6′-6″	S	30	42	54	66	31	45	58	70	39	57	73	87
	D	34	50	66	82	81	121	159	197	64	95	126	155
7′-0″	S	26	37	47	57	27	39	50	60	34	49	63	75
	D	27	40	53	66	65	97	128	158	51	76	101	124
7′-6″	S	22	32	41	50	24	34	44	52	30	43	55	65
	D	22	33	43	54	53	79	104	128	41	62	82	101
8′-0″	S	20	28	36	44	21	30	39	46	26	37	48	58
	D	18	27	36	44	43	65	86	106	34	51	67	83
8′-6″	S	17	25	32	39	18	27	34	41	23	33	43	51
	D	15	22	30	37	36	54	71	88	28	43	56	70
9′-0″	S	16	22	28	35	16	24	30	36	21	30	38	45
	D	13	19	25	31	30	45	60	74	24	36	47	59

Notes:

1. Steel conforms to ASTM A653.
2. Section properties are in accordance w CSA-S136-07.
3. Values in row "S" are based on strengt
4. Values in row "D" are based on a deflection limit of 1/180 of the span.
5. Web crippling not included in strength values. See example calculation in notes to designer.
6. Contact the sales department for stock colours and gauges.
7. The load table contained on this dat sheet was prepared Dr. R.M. Schuster P.E Professor Emeritus o Structural Engineerin University of Waterlo Ontario, Canada.

Cladding Specifications for MatrixAir™ Solar Air Heating Collector - imperial *38134*

38134 is available in base steel nominal thicknesses of 0.018” and 0.024”.



MatrixAir™ 38134 Profile

Physical Properties *(per foot width) In accordance with CSA Specification S136-01*

Gauge	Base steel nominal thickness (inches)	Nominal thickness with Z275 coating (inches)	Mass with Z275 coating (lb/ft^2)	Section Modulus		Moment of inertia midspan ($inches^4$)	Factored Resistance			
							Moment		Reaction	
				Midspan ($inches^3$)	Support ($inches^3$)		Midspan (lb-in)	Support (lb-in)	Exterior (pounds)	Interior (pounds)
26 gauge	0.018	0.02	1.0506	0.1012	0.1012	0.0834	3005.2	3005.2	233	343
24 gauge	0.024	0.026	1.36	0.1442	0.1443	0.1114	4281.3	4286.8	404	603

Load Table *Maximum Specified Uniformly Distributed Load in lb/ft^2 (psf)*

Support spacing		1-Span		2-Span		3-Span	
		Base steel nominal thickness (inches)		Base steel nominal thickness (inches)		Base steel nominal thickness (inches)	
		26ga	24ga	26ga	24ga	26ga	24ga
		0.018	0.024	0.018	0.024	0.018	0.024
4’ - 0”	B	78*	119	46*	80*	52*	91*
	D	R	R	R	R	R	R
4’ - 6”	B	66	94	41*	71*	46*	81*
	D	R	R	R	R	R	R
5’ - 0”	B	53	76	37*	64*	42*	73*
	D	R	R	R	R	R	R
5’ - 6”	B	44	63	33*	58*	38*	66*
	D	44	59	R	R	R	R
6’ - 0”	B	37	53	30*	53	35*	61*
	D	34	45	R	R	R	R
6’ - 6”	B	32	45	28*	45	32*	56*
	D	27	35	R	R	R	R
7’ - 0”	B	27	39	26*	39	30*	49
	D	21	28	R	R	R	R
7’ - 6”	B	24	34	24	34	28*	42
	D	17	23	R	R	R	R
8’ - 0”	B	21	30	21	30	26*	37
	D	14	19	R	R	R	36
8’ - 6”	B	-	26	-	26	23	33
	D	-	16	-	R	22	30
9’ - 0”	B	-	23	-	24	21	29
	D	-	13	-	R	19	25

NOTES - LIMIT STATES DESIGN:
1. Properties and loads are based on Grade 33 Steel with a minimum yield stress of 33,000 psi, and a maximum stress under factored loads of 29,700 psi.
2. Row B indicates the load capacity based on strength. Strength capacity should be checked against [Specified Live Load] + [0.833 x Specified Dead Load].
3. Row D indicates the load capacity based on deflection of 1/180th span. For allowable deflection of 1/90th span, values in Row D can be doubled, but must not exceed the value in Row B. The symbol “R” indicates the load for strength governs. Deflection capacity should be checked against Specified Load(s).
4. An * indicates capacity has been reduced to account for web crippling.