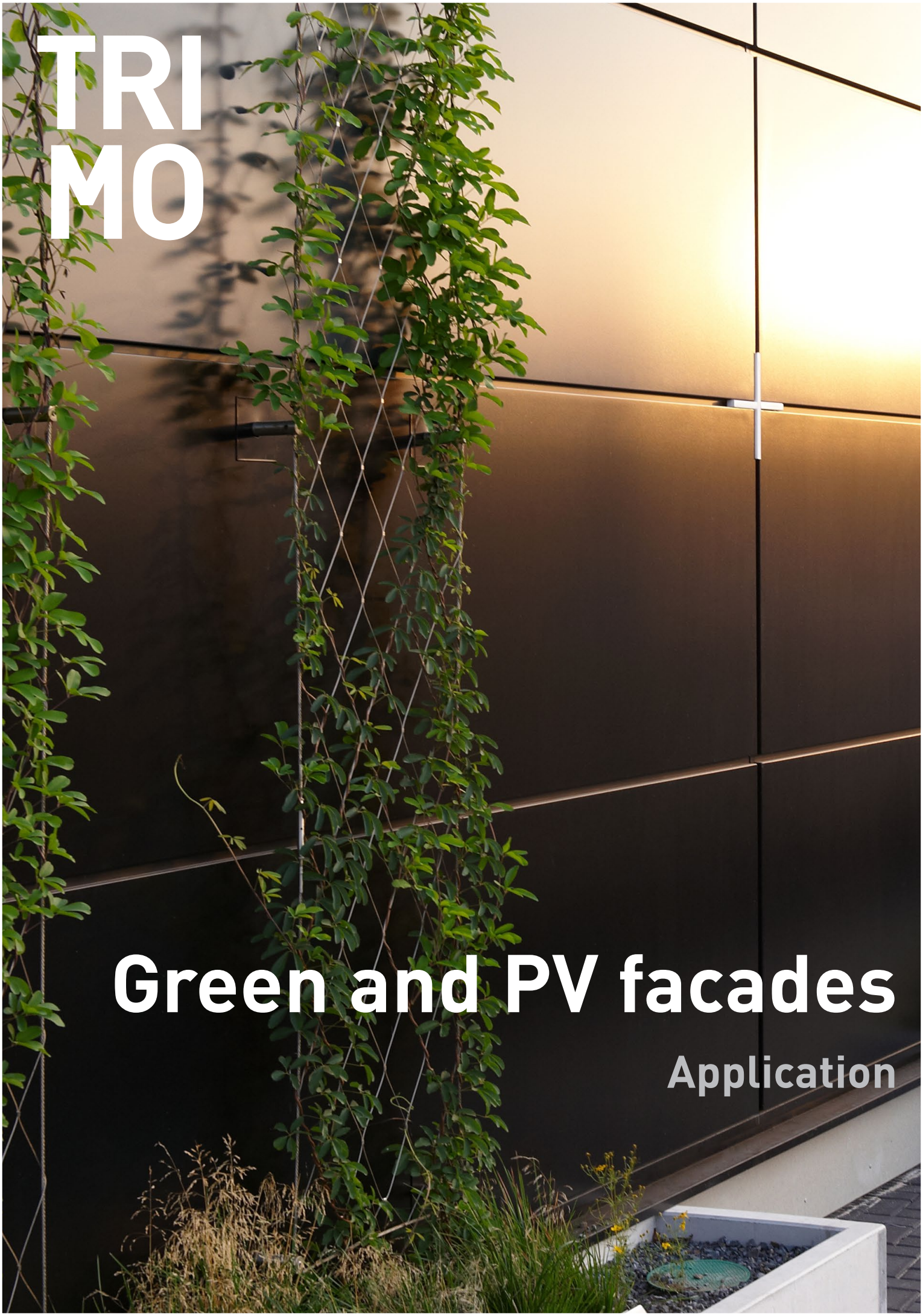


TRIMO

Green and PV facades

Application

For design and installation teams!

Trimo
Green and PV facades

Table of contents

COVER: Avion Retail building, Architect Pavel Suchánek, Ostrava, Czech republic, 2016/2017

A Introduction

In the era of rapid urban development and rising environmental challenges, 'smart buildings' have become central to sustainable urban design discussions. These advanced structures, integrating cutting-edge technologies, automation, and energy-efficient systems, offer a promising solution for sustainable urban growth.

A key element of a smart building is the facade, which plays a significant role in enhancing energy efficiency and overall sustainability. Smart buildings present a remarkable opportunity to transform the built environment, steering it towards a more energy-efficient future.

Historically, facades were primarily seen as aesthetic features of a building's architecture. However, contemporary urban design and sustainable architecture have re-evaluated the importance of facades, emphasizing not only their visual appeal but also their performance and environmental impact.

In this context, 'green facades,' which incorporate vegetation into a building's exterior, have gained recognition for their numerous benefits, such as energy conservation, improved indoor air quality, and carbon sequestration. Green facades are now considered a vital step towards achieving sustainable smart building design, given their multifunctional role in mitigating urban heat islands, reducing greenhouse gas emissions, and enhancing the aesthetic and sensory quality of the built environment. Additionally, green facades and renewable energy technologies offer viable solutions to the environmental issues caused by urbanization.

Moreover, integrating photovoltaic modules into facades represents a significant advancement, converting sunlight into clean electricity and promoting a sustainable urban environment. These building-integrated photovoltaics (BIPVs) convert sunlight into clean electricity, directly providing a renewable energy source directly from the building's exterior. Photovoltaic facades not only contribute to energy efficiency but also enhance the aesthetic appeal of buildings with their sleek, modern designs.

HRANIPEX WAREHOUSE EXTENSION, OK PLAN ARCHITECTS
KOMOROVICE, CZECH REPUBLIC, 2010

B
Green facades

B1 Green facade types

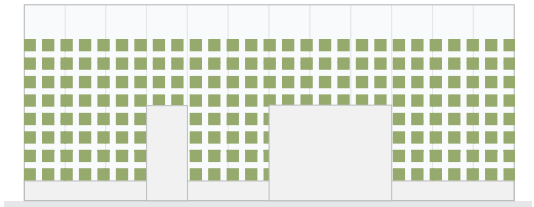
Green facades are building facades partially or completely covered with vegetation, typically using climbing plants that grow upward on the wall's surface or on a support structure. In practice, a green facade often employs a trellis or cable system to support vines rooted either in the ground or in planters either positioned at the base or mounted on the facade. Over time, the plants spread over the vertical surface, creating a living layer of greenery. There are a few common types of green facade systems:

- Direct attachment (self-climbing plants): Certain vines (e.g. ivy) attach directly to the wall with tendrils or adhesive rootlets. These require minimal supporting structure but need the base wall to be suitable and free of cracks (to avoid any root intrusion). Not suitable for attachment to panels.
- Trellis-supported (framework needed): Many green facades use metal trellises, cable nets, or maesh panels mounted in front of the wall. Climbing plants twine around or through this support structure. An air gap (150-200 mm. min 100 mm) is often left between the climbing aids and the building wall, which can be beneficial for ventilation and for preventing moisture accumulation. Additional watering is generally unnecessary outside dry periods, if soil volume, water storage capacity, and natural water supply are sufficient. Trough-based vegetation requires watering. The greening effect depends on the plants' growth time.
- Modular green facade gardens: These involve planters or panelised modules attached to the wall, each containing soil or substrate and plants. They can create an immediate "green wall" effect even on surfaces where in-ground planting isn't possible. However, they tend to be heavier and require more intensive care (irrigation system, fertilisation) and strong structural support.

Materials used in green facade construction typically include stainless steel cables or wire mesh (for trellises), metal anchor brackets for fixing the support structure to the wall, planter boxes (often metal or durable plastic) for soil if plants cannot be ground-rooted, and an irrigation system (drip lines or sprinklers) to water the plants. The vegetation itself can range from climbing ivy and vines to hanging planters with a variety of species. A well-designed system will incorporate proper waterproofing and drainage to protect the building wall and safely channel excess water away.

Ivy attached directly to the wall (photo Anna Shvets)

Ground based and trellis-supported green facade



Wall based modular green facade

System	Minimum distance to Facade
Independant structure	250 mm
Planters	500 mm
Tension Cables	150 mm
Modular Cassette System	50 mm

B

B2 Structural Requirements

Stability analysis

Each design must consider various operating and constructions states. For new buildings, expected impacts must be incorporated into the design at an early stage. In the case of retrofiting greening measures, the suitability of the existing building fabric must be determined, with particular regard to stability and existing load capacities. Generally, lightweight metal constructions are suitable for ground-based plants with climbing aids in load classes 1 to 3. Heavier systems in load class 4 may also be used under certain conditions. Wall-based systems should be anchored into the structure. On high or exposed buildings wind loads must be considered.

Load transfer

Additional forces from wall- and trough-mounted systems, as well as the expected vertical load or tension from climbing ropes and nets in ground-based systems, must be transferred into the supporting structure or absorbed by a separate foundation.
Point connections (such as wall brackets) can support vertical climbing ropes, surface-area climbing nets, or trellises. Load transfer principles are summarized in Table 2.

		Load class				
	Unit	1 very light	2 light	3 medium	4 heavy	5 very heavy
Weight with flat growth (trellis 2 m wide)	kg/m²	6	11	15	17	24
Weight with narrow growth (trellis narrow; vegetation 1 m wide)	kg/m²	6	14	19	26	42
Weight with linear growth (trellis: single profile or rope; vegetation 0.7 m wide)	kg/m height	6	13	18	20	28
Wind loads - possible reduction factors due to air flow	-	0.55	0.6	0.6	0.65	0.7

TABLE 1: Load classes and load assumptions for climbing plants
Source: Gebäudebegrünung im Metallleichtbau, Richtlinie für die Planung und Ausführung von Dach-, Wand- und Deckenkonstruktionen aus Metallprofiltafeln (IFBS)

Panel installation type	Unit
Vertically laid	Loads must be transferred to the supporting structure or absorbed via foundations.
Horizontally laid	Loads must be transferred to the supporting structure or taken up via foundations.
Trimoterm Backing Wall (vert. oder horiz.)*	Load application possible via spacer profiles in the sandwich element **.

TABLE 2: Load transfer principles (actual project loads must be taken into account)
* Backing wall systems are sandwich elements approved for direct attachment to the outer shell
** The boundary conditions can be found in the respective regulatory compliance document
Source: Gebäudebegrünung im Metallleichtbau, Richtlinie für die Planung und Ausführung von Dach-, Wand- und Deckenkonstruktionen aus Metallprofiltafeln (IFBS)

Wall based modular green facade
Hranipex, OK PLAN ARCHITECTS
Komorovice, Czech republic, 2010

B

B3 Other Requirements

Thermal load

Metal surfaces heat differently under sunlight. Colours from groups I and II are preferred. Plants resistant to high temperatures should be chosen, and air circulation can be improved by the distance of the greening from the facade. A well-developed facade greening reduces thermal load through shading.

Colour group	Brightness value H	Surface temperature in summer (unvegetated)
I	90 - 75 %	≤ +55 °C
II	75 - 40 %	≤ +65 °C
III	39 - 8 %	≤ +80 °C

TABLE 3: Definition of the colour group according to DIN EN14509
Source: Gebäudebegrünung im Metallleichtbau, Richtlinie für die Planung und Ausführung von Dach-, Wand- und Deckenkonstruktionen aus Metallprofiltafeln (IFBS)

Fire protection

Climbing aids and fastening systems are classified as construction products, usually metal and non-combustible. Vegetation is not a construction product and is generally flammable. Flammability is influenced by plant species, maintenance practices, coverage density, height, and moisture levels. To minimise fire risk, choose plants with low heat release potential and low calorific value. Regular removal of dry foliage and dead plant material further reduces susceptibility to ignition. The facade must comply with building regulations. Openings for smoke ventilation must be fully operable and not obstructed by greening. Fire gases can be vented over the facade, so appropriate distances must be maintained.
See local fire regulations for more requirements.

Lightning protection

Electrically conductive components connected to the facade must be integrated into the building's lightning protection system as per DIN EN 62305-3. Regular maintenance ensures vegetation does not damage or overgrow lightning protection components.

Corrosion Protection and Material Combinations

Due to reduced self-cleaning from precipitation, a robust corrosion protection system in combination with greening is recommended for facade components. Adaptive wall brackets and other elements should be made of non-corrosive materials. Material combinations must prevent contact corrosion, for example by using separating materials such as EPDM tape.

B

Scratches from branches or stems
Plant stems and branches can cause scratches on coated surfaces. The coating system should be chosen based on plant type, greening distance, and abrasion resistance.

Humic acid, fertilisers, and pesticides
Excess precipitation or watering of trough-bound systems containing humic acid, fertilisers, or pesticides must not make contact with corrosion protection systems and must be properly drained.

Water ingress
Adaptive wall brackets and penetrations must prevent water ingress. Separating materials must be durable and compatible with coated surfaces, e.g., made of EPDM.

Greening-free areas
To prevent overgrowth of the roof edge, climbing aids should be about 1,000 mm from the roof edge. Plants should match the planned building height. For downpipes and drainage lines, a distance of 500 to 1,000 mm from the plants should be planned.

B4 Maintenance and care

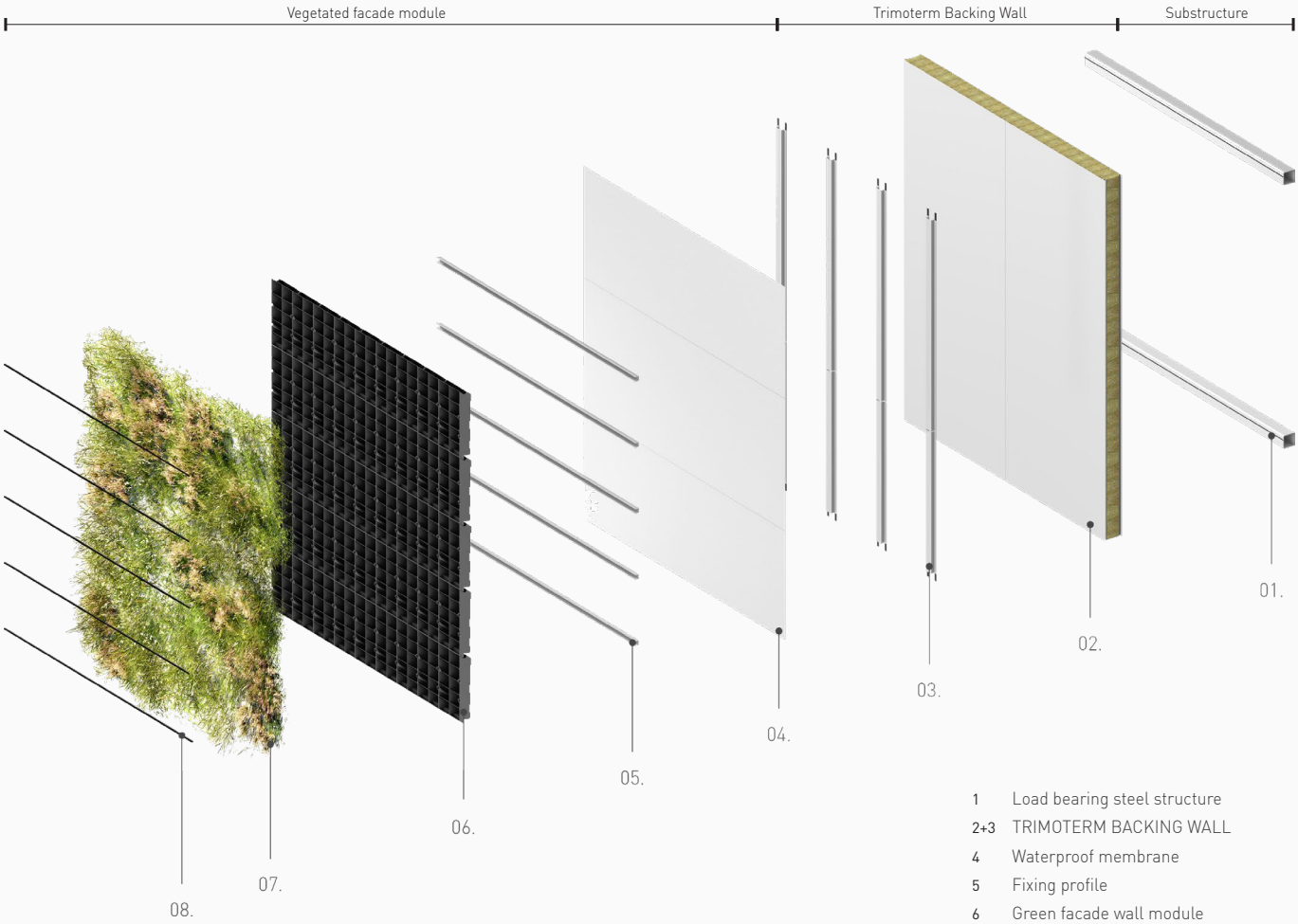
Irrigation and drainage
Ground-based systems are generally watered by rainfall and/or ground-level irrigation, with excess water seeping into the soil. Wall-based systems require manual or automatic irrigation and drainage systems.

Vegetation Management
Regular maintenance and pruning are essential for controlling plant growth, for preventing the overloading of climbing structures, and for removal of invasive species. These activities directly influence fire safety, surface protection, structural load, and the functionality of lightning protection and smoke ventilation systems. Maintenance also ensures that safety distances and openings remain unobstructed. Depending on the greening system and design intent, maintenance should be scheduled quarterly to semi-annually. Biomass from pruning can be repurposed for energy production in biomass plants or returned to the nutrient cycle through composting.

Access and fall protection
For maintenance purposes, suitable access to the facade or work areas must be ensured, e.g., via lifts, facade elevators, or maintenance walkways. For heights of moer than one metre, a risk assessment must determine necessary protective measures , such as suitable anchor points and personal fall protection equipment, according to occupational safety standards. Safety devices must remain usable and must be used as required.

GREEN FACADE BENEFITS
- Quality of stay and Environment, Design diversity
- Cooling effect in summer / Thermal protection in winter
- Protection from weather conditions such as UV rays, rain, and wind
- Improved air quality through pollutant filtration
- Noise reduction
- Rainwater retention reduction
- New habitats for insects, birds, and other species
- Reduction of urban heat islands
- Increase in property value

CASE STUDY
Vegetated facade wall module (Viritopia) to Trimoterm Backing Wall



1	Load bearing steel structure
2+3	TRIMOTERM BACKING WALL
4	Waterproof membrane
5	Fixing profile
6	Green facade wall module
7	Vegetation
8	Irrigation pipe

CASE STUDY
Vegetated facade wall module (Viritopia) to Trimoterm Backing Wall

B

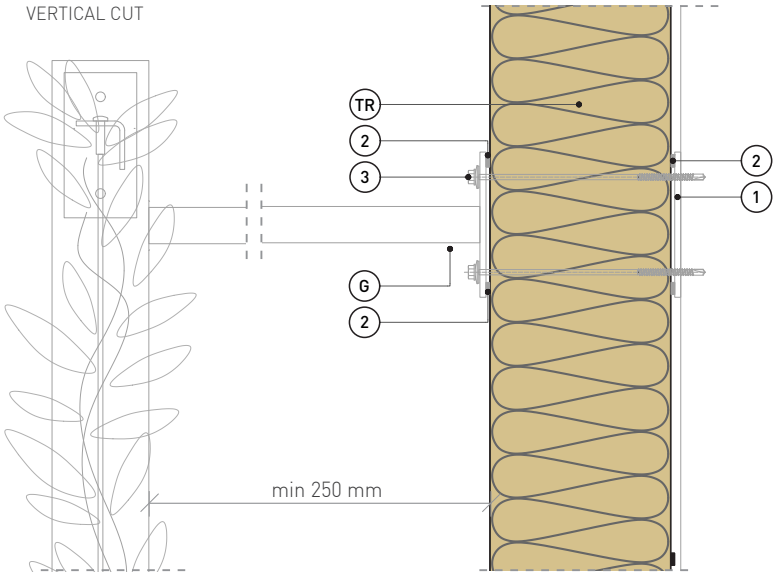
B5 Green facade options

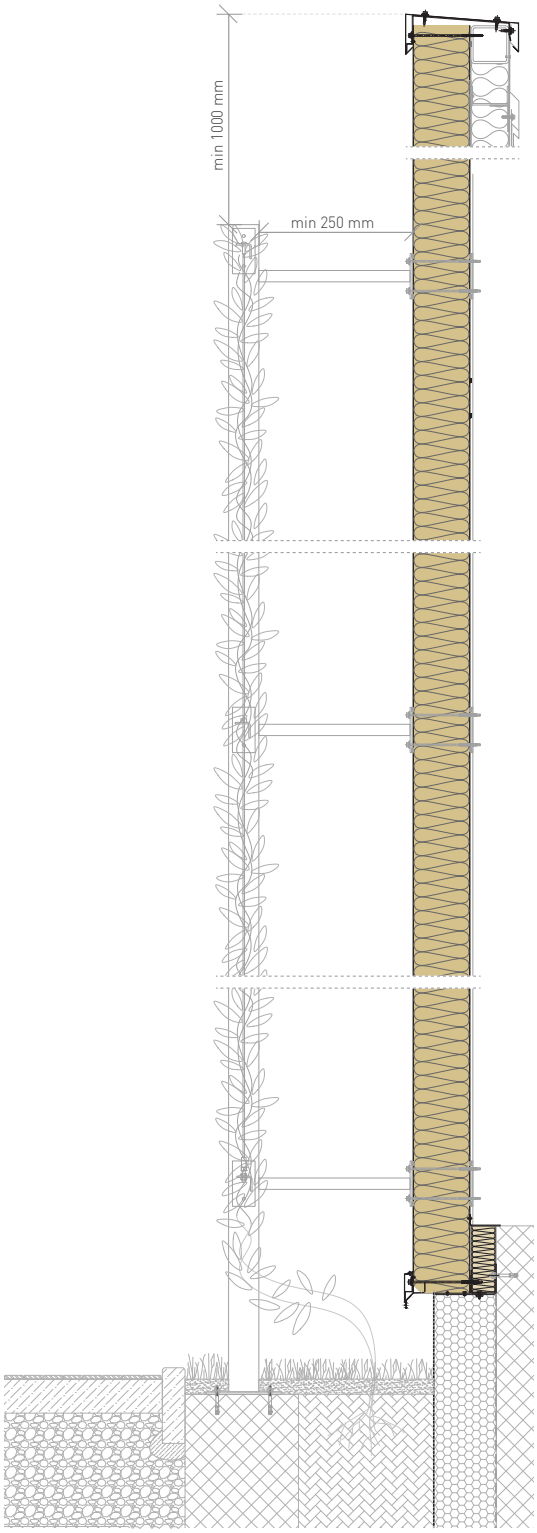
B5.1 Independent Structure

NO THERMAL BRIDGES

Green facades separated from the building and based on a freestanding structure allow installation without major interventions in the facade envelope. The only connection to the facade is horizontal stabilisation of the structure – which can be done directly to the Trimoterm facade panel without penetrations. This means no thermal bridges are created in the facade, significantly improving the building's energy efficiency.
In certain cases, the panel itself can absorb part of the horizontal load, eliminating the need for additional steel elements behind the panel. However, if higher loads are expected, additional steel crossbars are installed before panel mounting. The green facade attachment points are then simply screwed through the panel into these crossbars.

VERTICAL CUT





TR Trimoterm facade system, T (width) ≥ 150 mm
G Vegetation carrying structure with foundation (Stainless steel/ Galvanised steel / Powdercoated aluminium)
1 Substructure
2 Sealing
3 Fixing screw

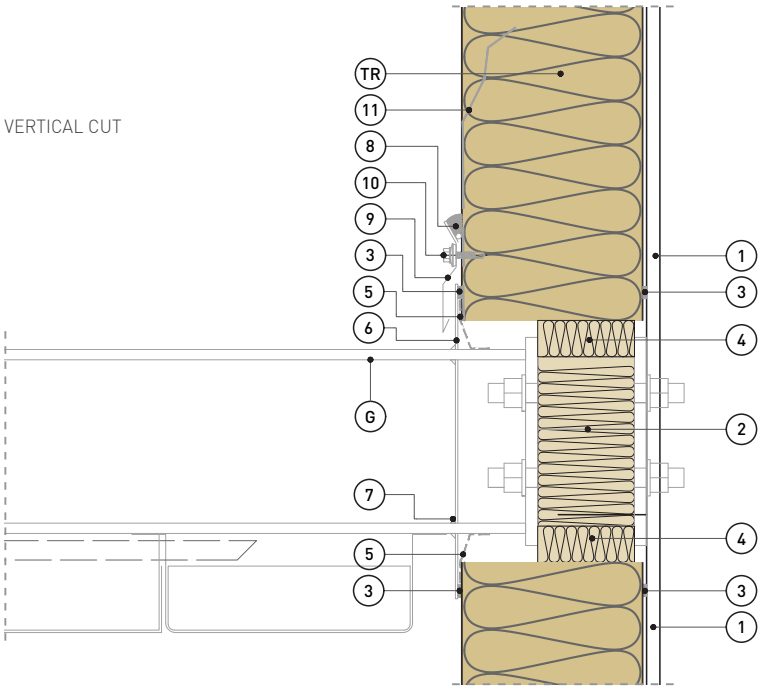
B

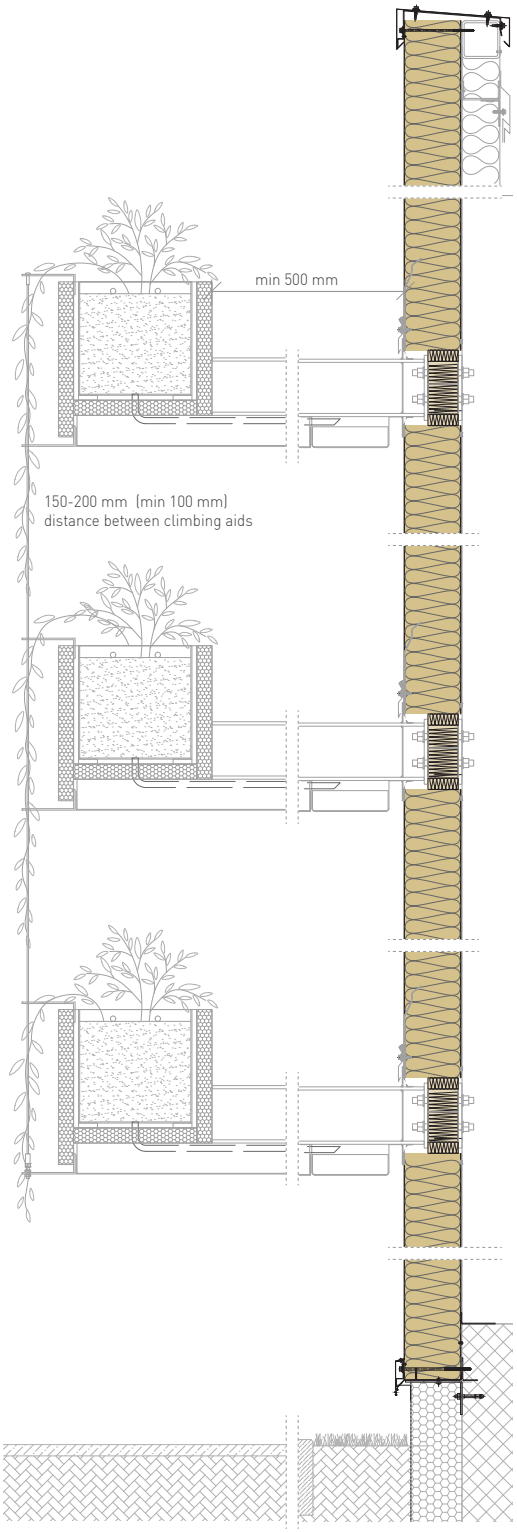
B5.2 Planters

AESTHETIC AND FUNCTIONAL SOLUTION

Green facades with planters offer a unique solution where the planters are not just plant holders but become an integral part of the facade, significantly contributing to its final appearance. This is a structurally more demanding system that requires custom attachment planning and involves relatively large penetrations through our facade system. For assistance with planning and implementation, contact our technical support team to assist you at technical@trimo-group.si.

VERTICAL CUT





TR Trimoterm facade system, T (width) ≥ 150 mm
G Console (Stainless steel/ Galvanised steel / Powdercoated aluminium) with trough for vegetation
1 Substructure
2 Load bearing thermal insulation element
3 Sealing tape
4 Insulation
5 Sealing tape
6 2 mm galvanised steel plate
7 Sealant on all connections
8 PE rope and mastic seal
9 Flashing
10 Fixing screw
11 Mastic seal (panel joint)

B

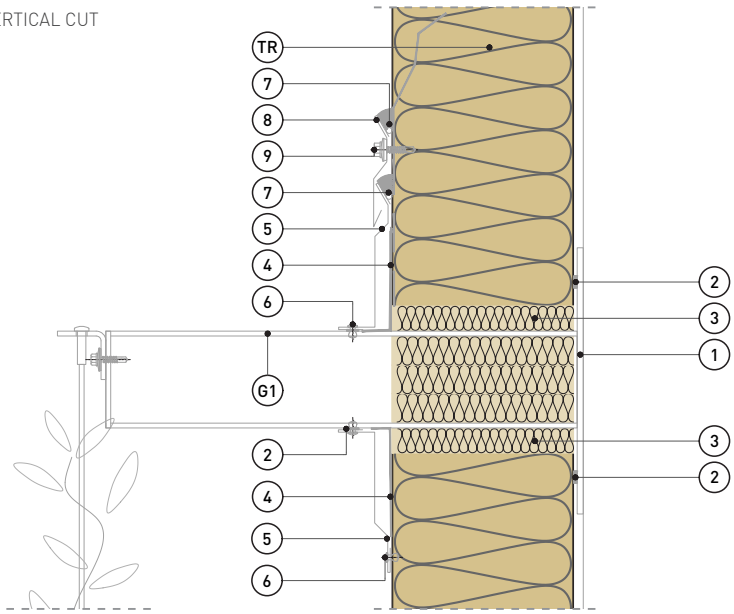
B5.3 Tension Cables

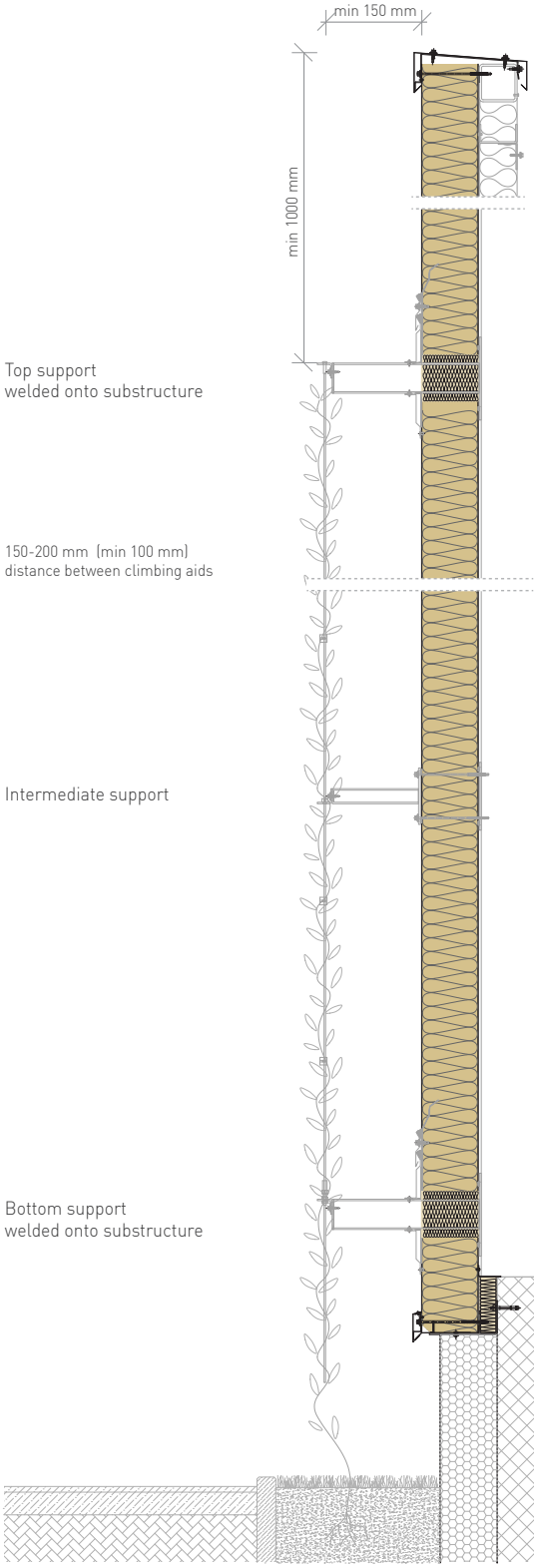
SIMPLE, COST-EFFECTIVE SOLUTION

Green facades with tension cables represent a simple, economical greening system, making them the most commonly used solution. They complement our sandwich panels perfectly, enabling aesthetic, functional integration into the facade envelope.
Cantilever elements, which must be rigidly attached to the load-bearing structure, require a watertight penetration through the facade. On the other hand, intermediate supports, which serve only as horizontal wire supports, can be installed without penetrations. This results in fewer thermal bridges and better energy efficiency.
The installation method depends on the type of base load-bearing structure. Below, we present solutions for:

a. steel load-bearing structures, and
b. precast concrete columns.

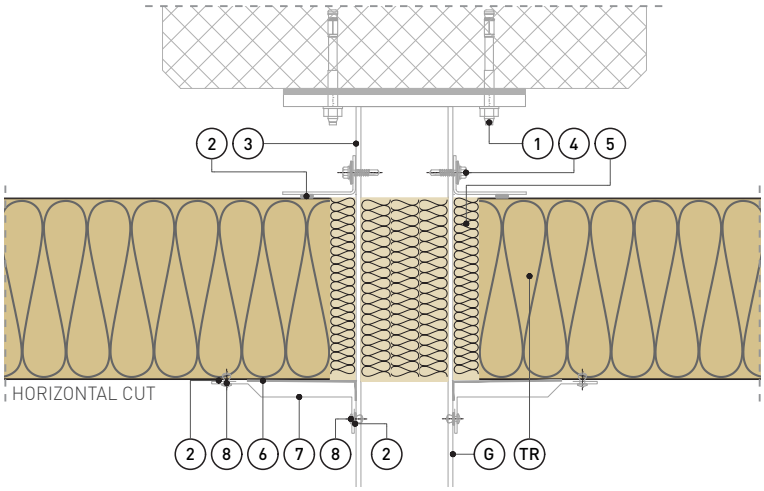
VERTICAL CUT





TR Trimoterm facade system, T (width) ≥ 150 mm
G1 Load bearing part of the vegetation carrying structure welded onto substructure (Stainless steel/ Galvanised steel / Powdercoated aluminium)
1 Substructure welded onto object structural elements
2 Sealing
3 Insulation
4 Sealing
5 Flashing
6 Rivet
7 PE rope and mastic seal
8 Flashing
9 Fixing screw

B



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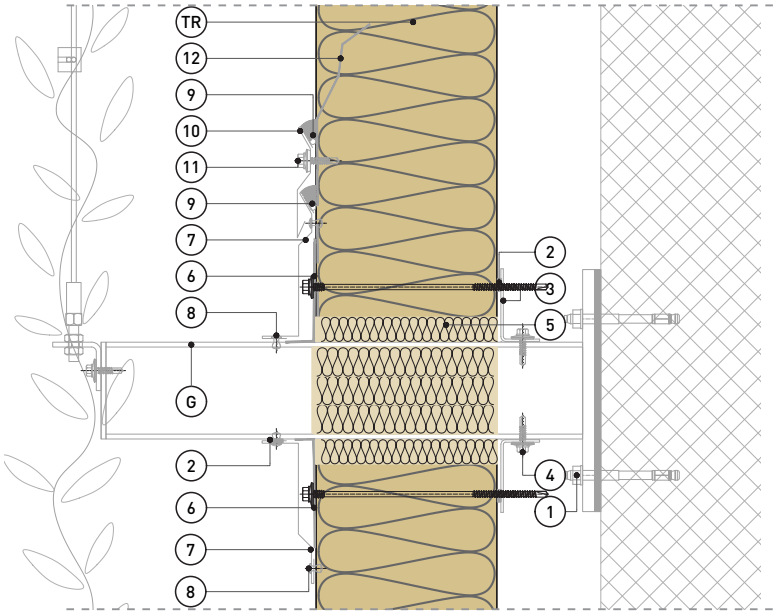
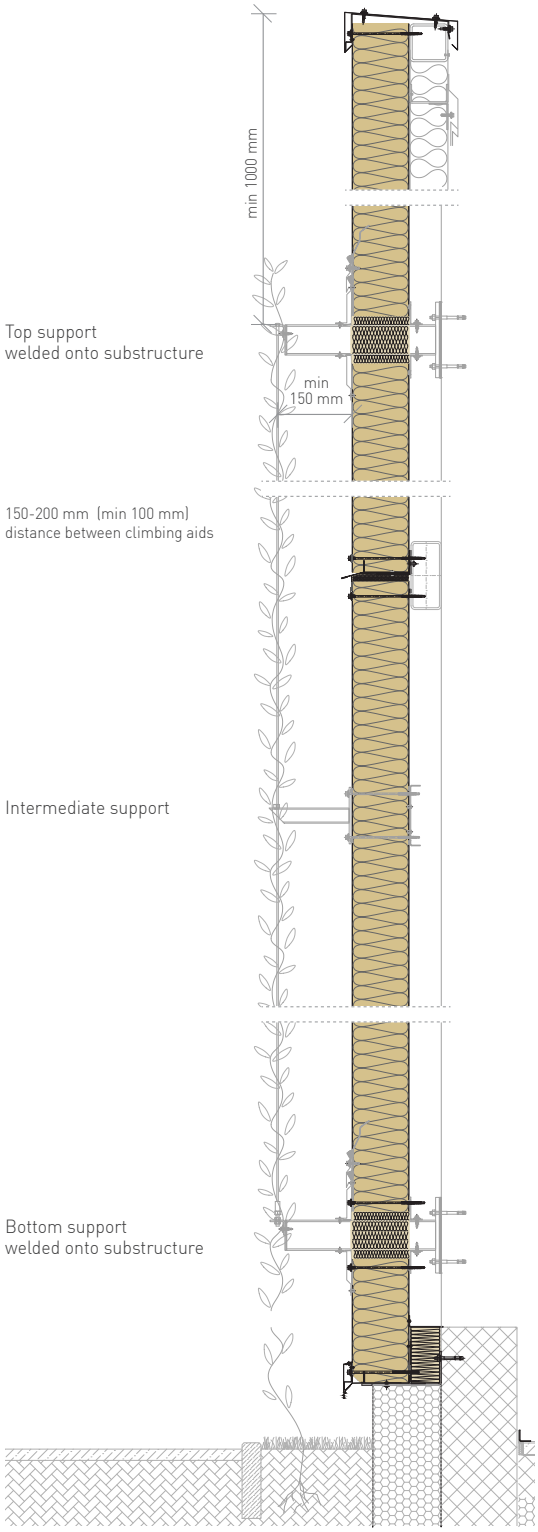


TR Trimoterm facade system, T (width) ≥ 150 mm
G Load bearing part of the vegetation carrying structure (Stainless steel/ Galvanised steel / Powdercoated aluminium)
1 Fixing screw
2 Sealing
3 L-corner
4 Fixing screw short
5 Insulation
6 Sealing
7 Flashing
8 Rivet
9 PE rope and mastic seal
10 Flashing
11 Fixing screw
12 Mastic seal (panel joint)



B

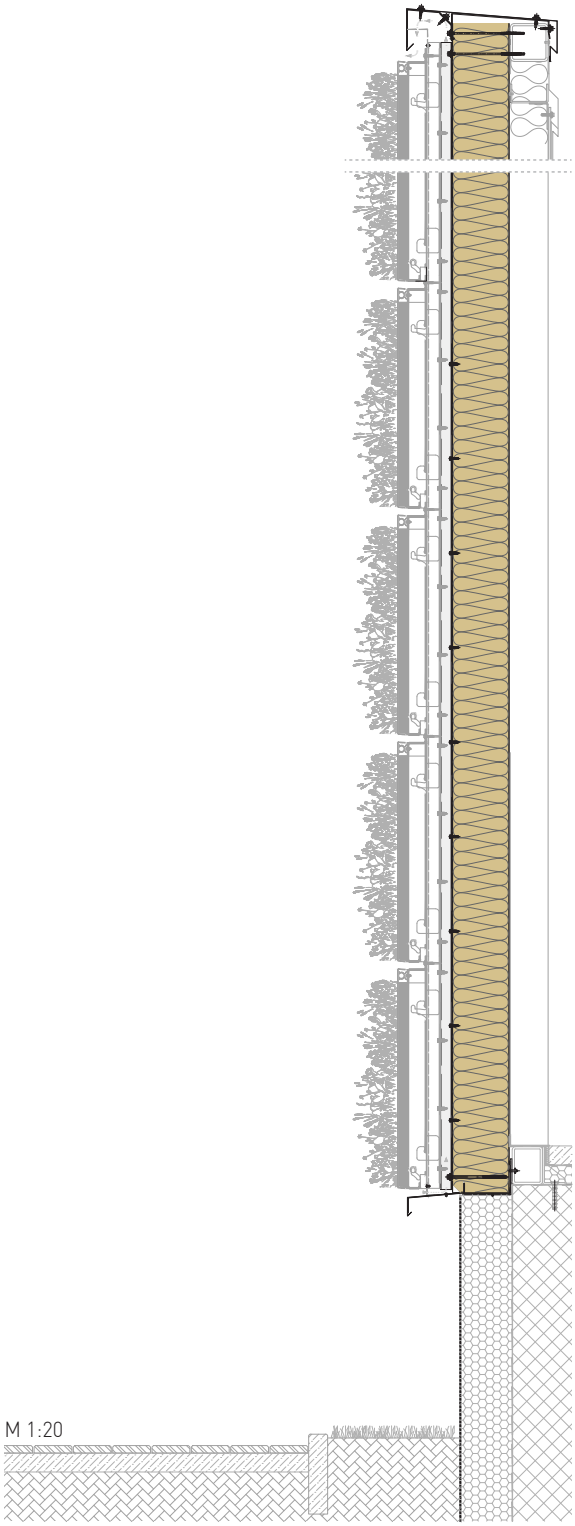
B5.4 Cassette System

ROBUST SOLUTION WITHOUT THERMAL BRIDGES

The cassette system for green facades is an excellent complement to our sandwich panels, as it allows direct attachment to the facade. Our panels are tested for additional loads like this system, ensuring safe and reliable installation.
Using our Trimoterm Backing Wall, you can attach additional weight of up to 60 kg/m² to the facade without creating thermal bridges. Despite the added load, the panels maintain a high level of fire resistance – up to EI120.
For more information about Trimoterm Backing Wall, see the available brochure and details or contact our technical support team at technical@trimo-group.si.

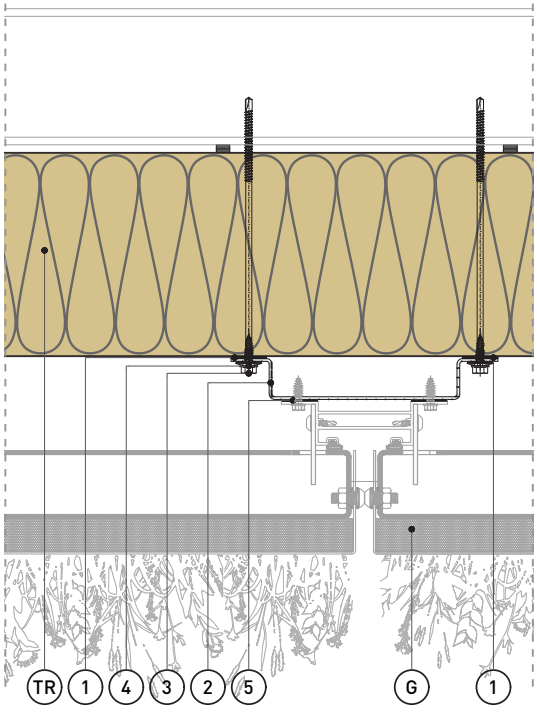
Link to Trimoterm Backing Wall Brochure

BW Trimoterm Backing Wall
Trimoterm panel
BW Sealing tape (EPDM)
BW profile
BW Fixing screws
S Separating tape
G Green facade module system

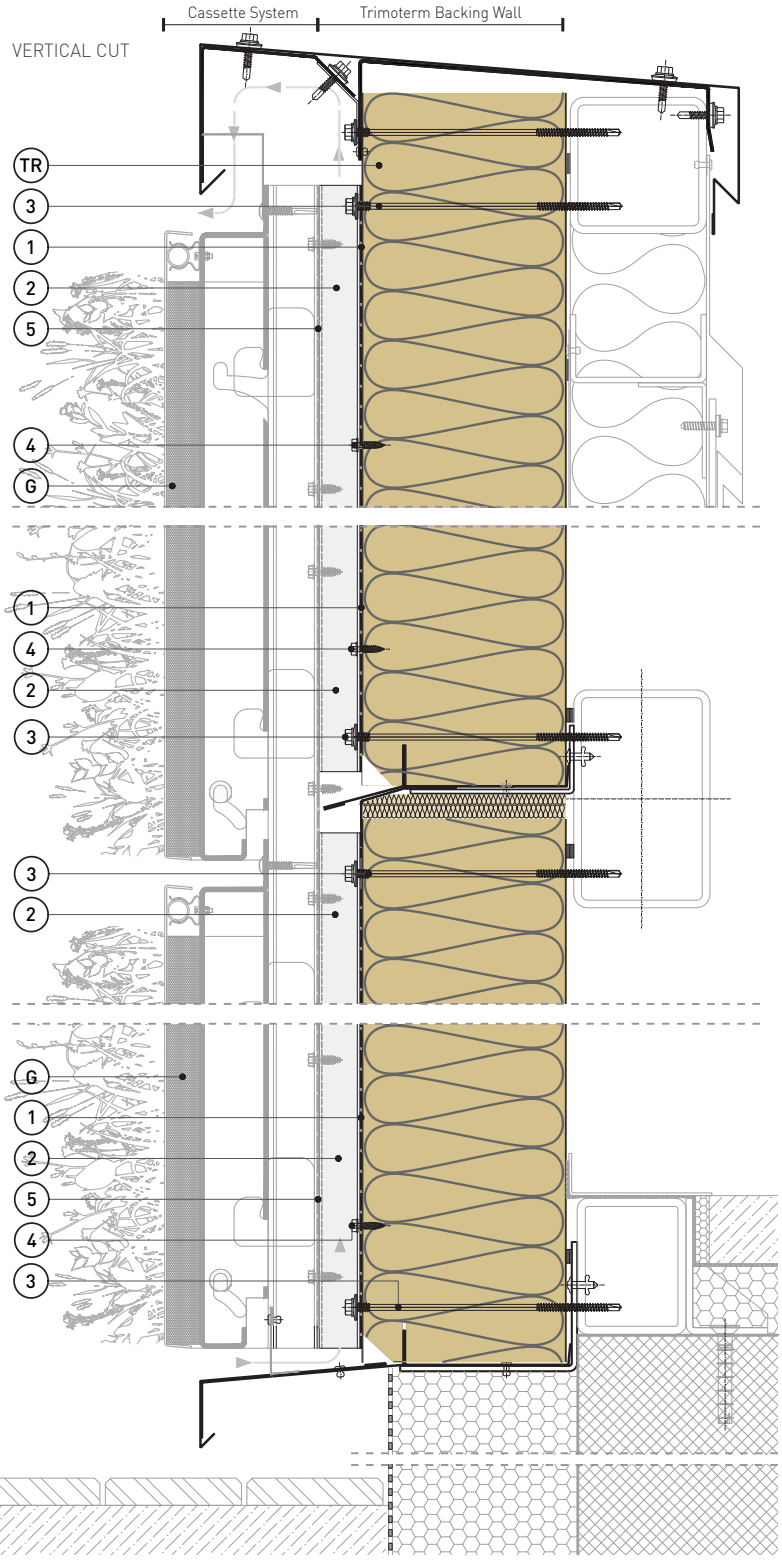


B

HORIZONTAL CUT



VERTICAL CUT



TRIMOTERM Backing Wall

TR	Trimoterm panel
1	Sealing tape
2	BW Profile
3	BW fixing screw
4	BW fixing screw - short
5	Separating tape
G	Green facade cassette module system

KRKA FACTORY
NOVO MESTO, SLOVENIA, 2010

Miran Kambič

C
Photovoltaic (PV) modules

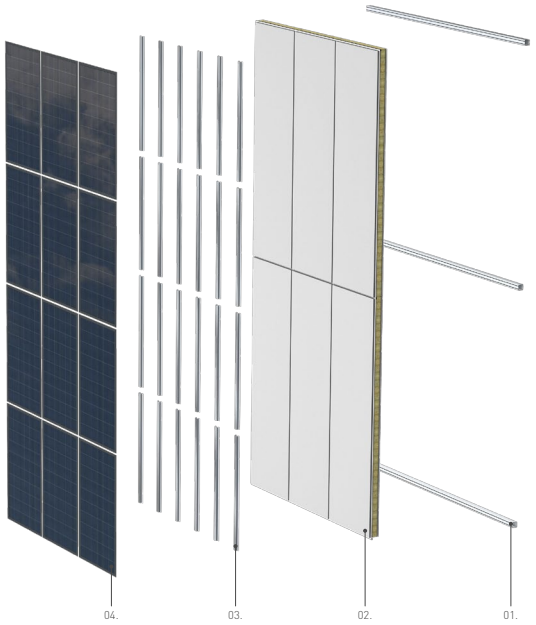
C1 Types of photovoltaics

As the demand for renewable energy continues to rise, photovoltaic (PV) modules on building facades transform vertical surfaces into clean energy generators, adding a new functional layer to architecture.

These systems come in two main types:

- BIPV (Building-Integrated Photovoltaics): integrated into the building envelope, serving both as cladding and energy source. Ideal for new builds.
- BAPV (Building-Applied Photovoltaics): mounted onto existing facades, offering flexibility and easier maintenance, especially suitable for retrofits.

Facade-mounted PV is particularly valuable in urban areas where roof space is limited. Beyond energy production, PV modules contribute to the building's visual identity, becoming an active design element.
Trimoterm panels are especially well-suited for BAPV systems, combining the visual coherence of BIPV with the flexibility of BAPV. They support PV modules without additional steel substructures, maintain a weatherproof and thermally efficient envelope, and prevent thermal bridging—ensuring long-term performance and easy upgrades.
When combined with sandwich panels, solar facades offer numerous benefits, including enhanced energy generation, improved building performance, and aesthetic appeal.



1 Load bearing steel structure
2 QBISS ONE vertical installation
3 Vertical omega profiles
4 PV module

C2 Structural Requirements

Static calculation
When sandwich panels are intended to support photovoltaic (PV) modules, the structural integrity of the panel system must be verified. In addition to other effects on the panel, the additional weight of the photovoltaic (PV) modules must be taken into account.
For new buildings, PV integration should be considered during the design phase. For retrofits, a structural engineer must evaluate the existing load-bearing capacity of the sandwich panels and substructure

Load Transfer
To transfer the load of photovoltaic (PV) modules onto the panel, we use our Trimoterm Backing Wall, which enables the installation of final facade layers on the Trimoterm FTV panel. The system supports additional loads of up to 60 kg/m^2.
While seemingly simple in appearance, Trimoterm Backing Wall incorporates advanced solutions for thermal expansion, prevents thermal bridges in the building envelope, and offers flexibility in the selection of PV modules.

Fire Protection
From a fire safety perspective, Trimoterm Backing Wall is classified as A2-s1, d0, indicating non-combustibility and low smoke emission. When loaded with additional layers (i.e. PV modules), the system can achieve fire resistance ratings up to EI120, ensuring both insulation and structural stability for up to 120 minutes in the event of fire.

Material Compatibility
Omega rails (BW profile) installed over the sandwich panel facade are cold-formed profiles made from hot-dip galvanised steel sheet (DX51D+Z275). To meet corrosion protection class C4, the profiles can optionally be powder-coated.
When aluminium components are used in PV modules, it is essential to ensure material separation in order to prevent galvanic corrosion. Appropriate insulation between dissimilar materials must be applied to maintain long-term durability and system integrity.

C3 Maintenance and Care

Maintenance of photovoltaic (PV) modules must be carried out in accordance with the supplier's instructions. A key advantage of the Trimoterm Backing Wall is that PV modules can be removed, serviced, or replaced without dismantling the facade envelope—ensuring uninterrupted operation within interior spaces. Regular inspection and cleaning of the cavity between the panel and PV modules is essential, as dirt accumulation or nesting of birds or insects may occur. To mitigate this, the use of insect protection mesh is recommended.

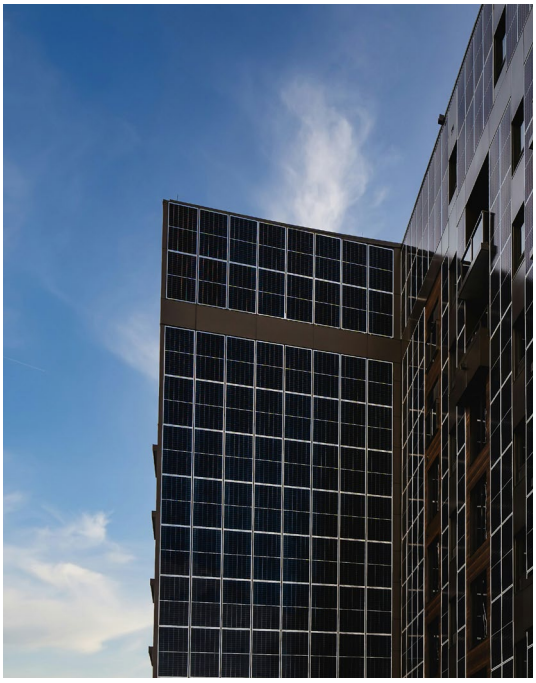


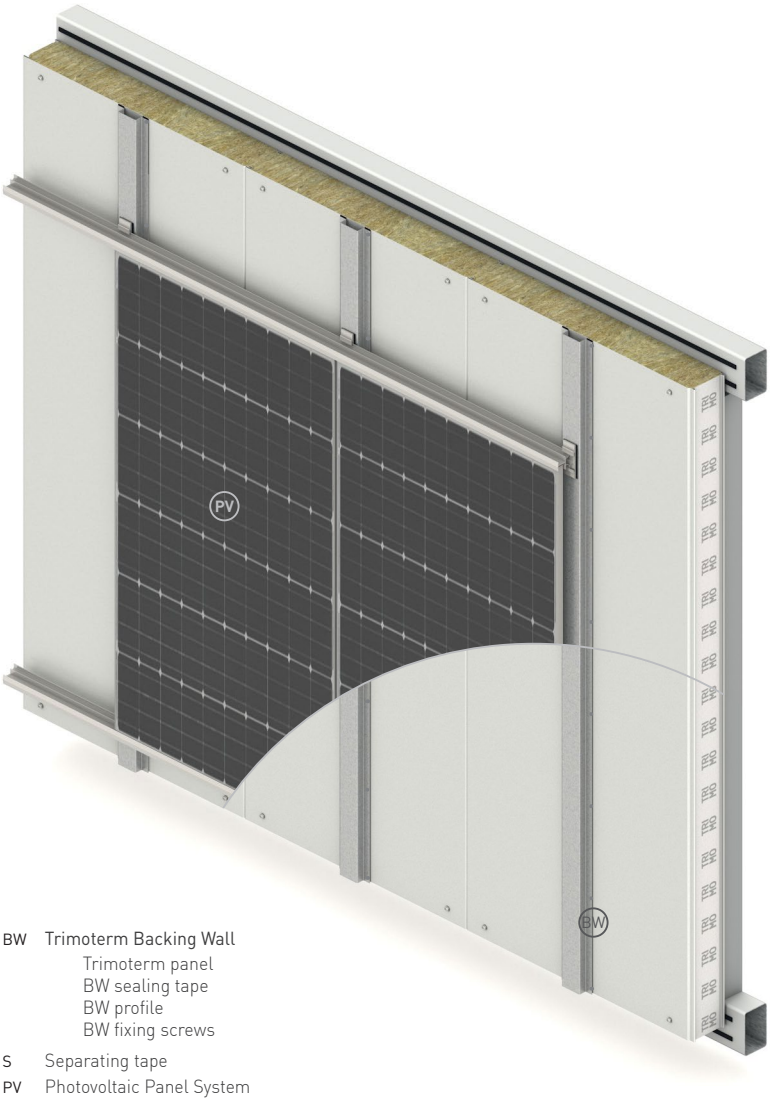
Photo by LEDC on Unsplash

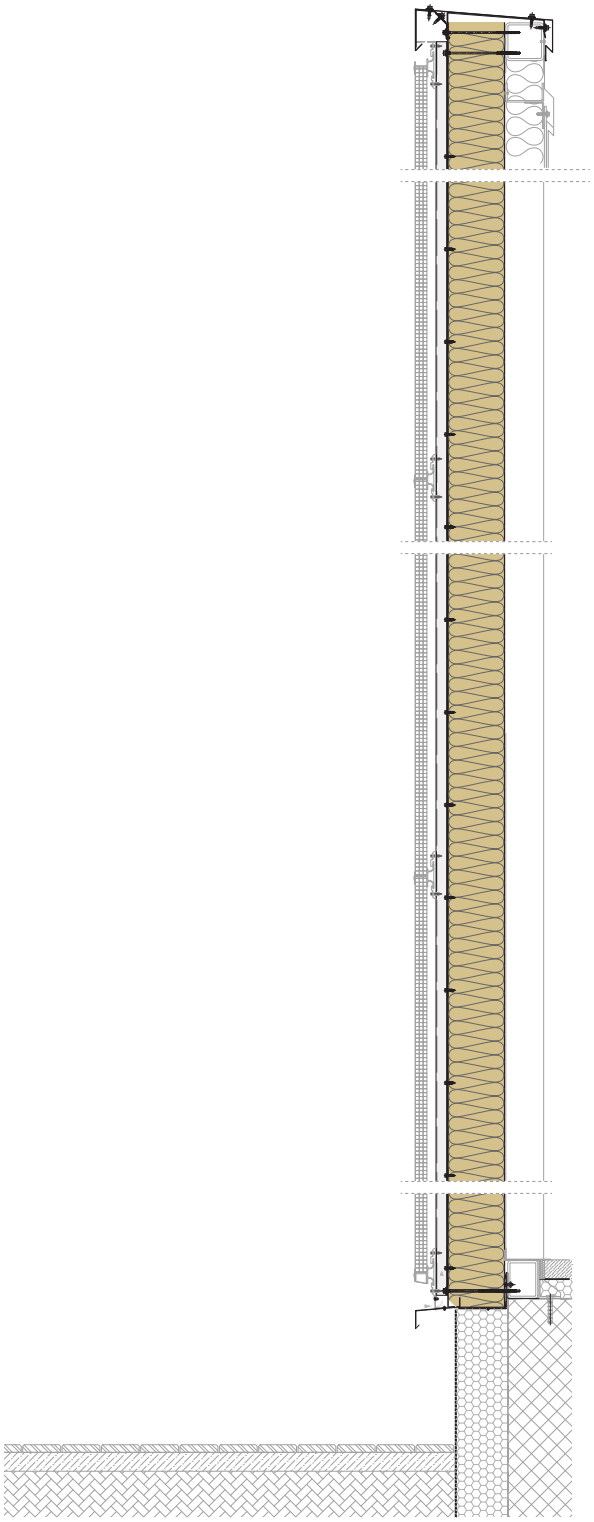
C

C4 Trimoterm Backing Wall + PV panels

The Trimoterm Backing wall solution is a special Insulated Facade System, which is made up of the unique customized product formula of the Trimoterm FTV panel.
Trimoterm Backing Wall provides a strong, load-bearing, weatherproof substrate for solar panels.

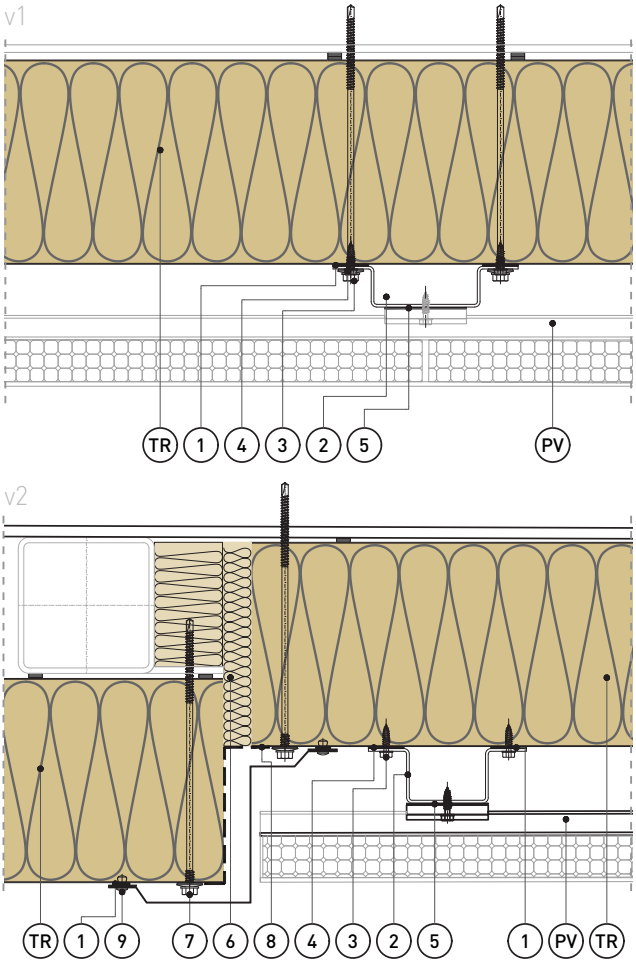
Link to Trimoterm Backing Wall brochures

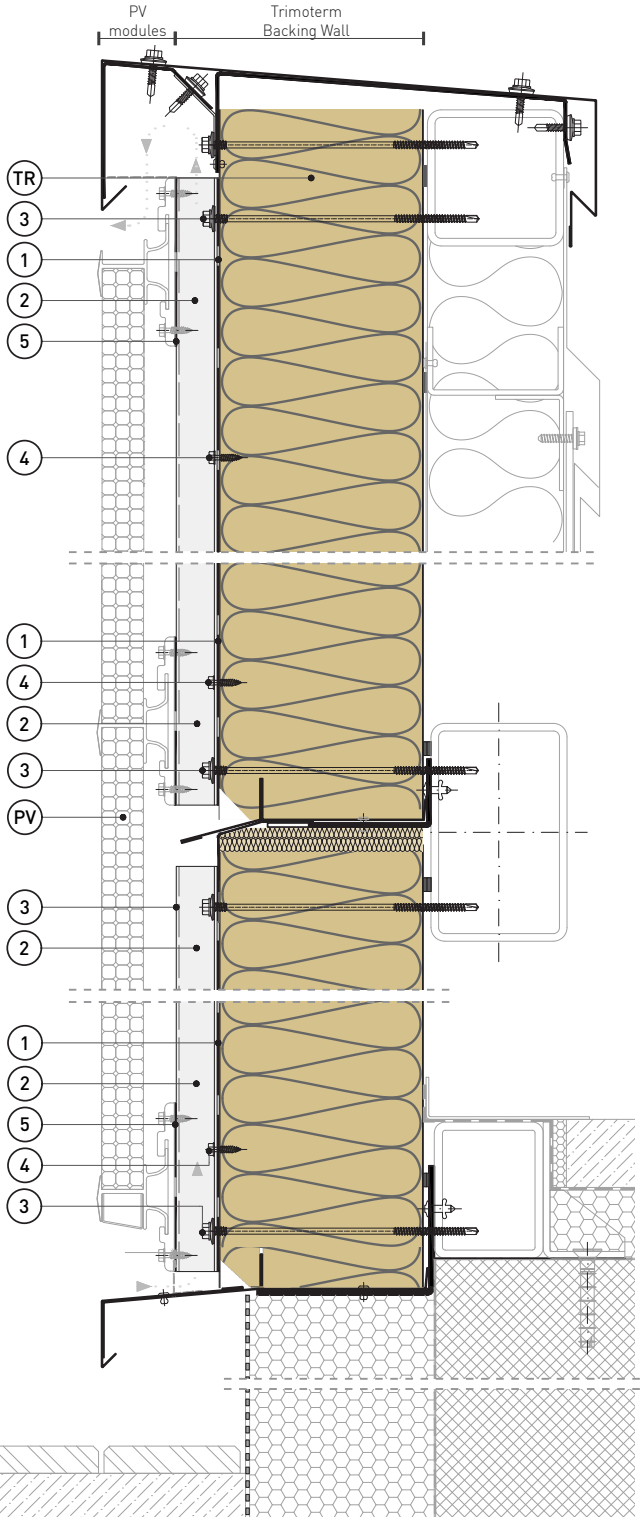




BW Trimoterm Backing Wall
Trimoterm panel
BW sealing tape
BW profile
BW fixing screws
S Separating tape
PV Photovoltaic Panel System

C



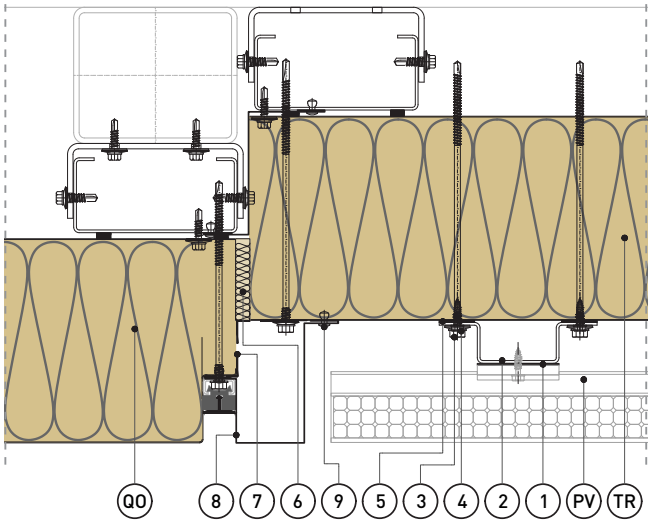


TRIMOTERM Backing Wall

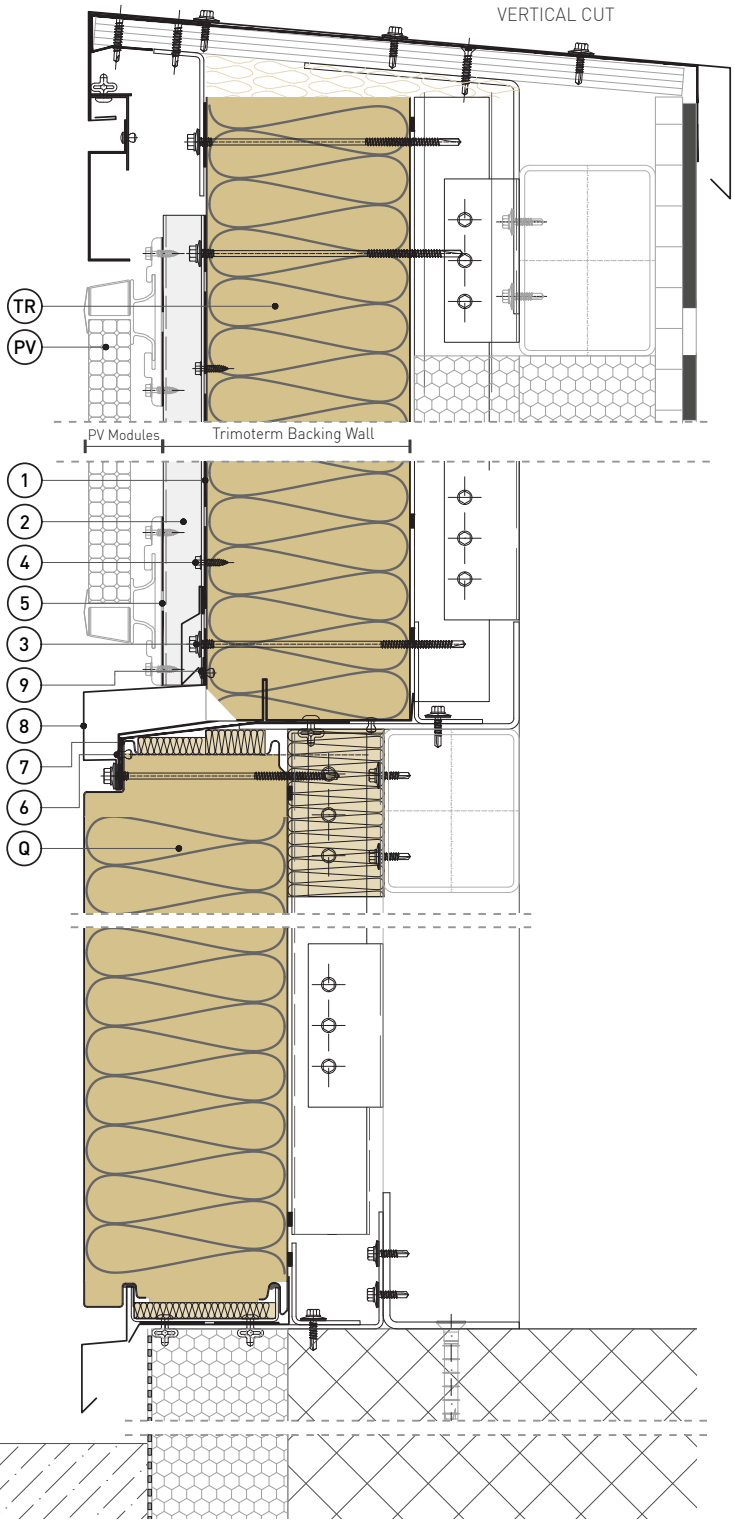
TR	Trimoterm panel
1	BW Sealing tape
2	BW profile
3	BW fixing screw
4	BW fixing screw - short
5	Separating tape
6	Insulation
7	Vapour permeable tape
8	Flashing
9	Rivet
PV	Photovoltaic modules with mounting system

C

HORIZONTAL CUT



VERTICAL CUT



TRIMOTERM Backing Wall

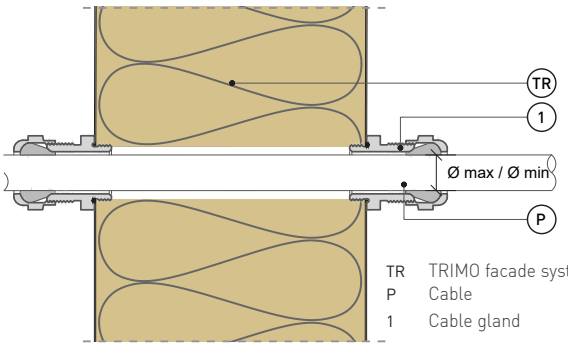
TR	Trimoterm FTV panel
1	BW Sealing tape
2	BW profile
3	BW profile fixing screw
4	BW profile fixing screw - short
5	Separating tape
6	Insulation
7	Vapour permeable tape
8	Flashing
9	Rivet
PV	Photovoltaic modules with mounting system
Q	TRIMO QBISS ONE facade system

C

C5 Cable penetration

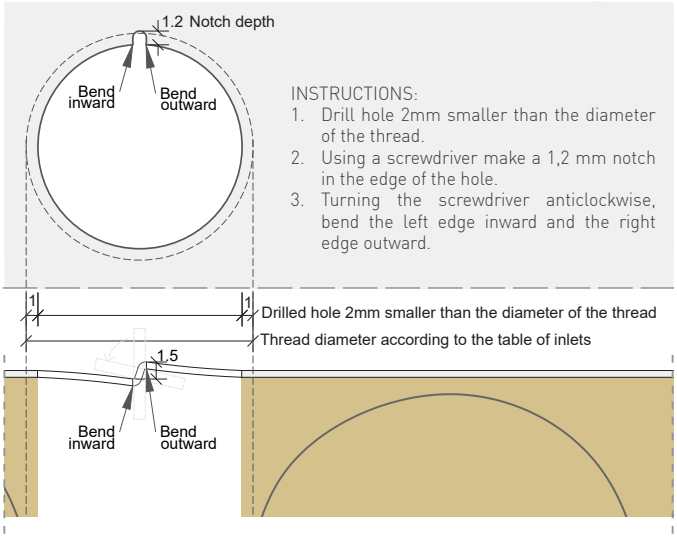
Sealing around penetrations is critical to in preventing water ingress and air leakage. Use appropriate sealants, gaskets, or prefabricated sleeves.
Penetrations must not compromise the load-bearing capacity or thermal performance of the wall. Placement and size should be carefully planned.

C5.1 Single cable penetration



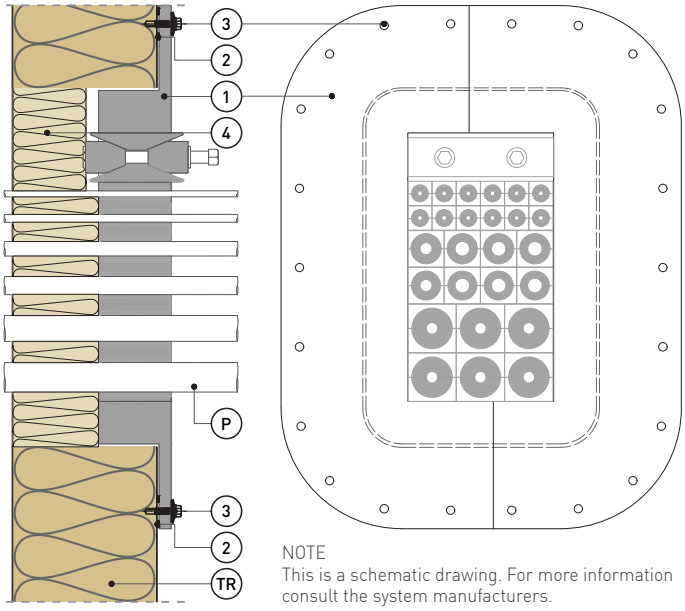
TR TRIMO facade system
P Cable
1 Cable gland

Connection thread	Seadling range Ø max / Ø min
M12x1,5	8,0 mm - 2,0 mm
M16x1,5	11,0 mm - 4,0 mm
M20x1,5	14,0 mm - 5,0 mm
M24x1,5	20,0 mm - 11,0 mm



C5.2 Multi-cable penetration

Penetration sealing systems offer flexible, modular sealing solutions for sandwich wall penetrations. They provide excellent protection against water, fire, gas, and pests, while allowing easy upgrades and multiple cables or pipes through a single opening. Their adaptability and speed of installation make them ideal for both new builds and retrofits.



TR TRIMO facade system
P Pipe penetration
1 Penetration sealing system (frame and modular pipe seals, e.g. Roxtec)
2 Sealing (2 rows)
3 Self-tappping screw or rivet
4 Insulation

NOTE
This is a schematic drawing. For more information consult the system manufacturers.

D
Associated documents

D1 Trimo associated documents

This chapter contains all the relevant technical documents for additional information on Trimoterm panels. These documents include structural design data, technical specifications, guidelines and other resources that are essential for a comprehensive understanding of the subject. Further information about the panels visit:

www.trimo-group.com/en/downloads/technical-documents

Backing wall - insulated facade system - Trimoterm FTV

Insulated facade system - Trimoterm FTV

Insulated facade system - Trimoterm FTV HL

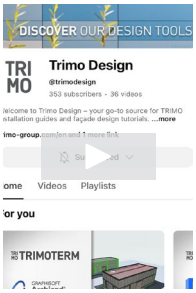
Insulated facade system - QBISS ONE

DESIGN DETAILS Trimoterm FTV

DESIGN DETAILS Trimoterm FTV HL

Trimoterm Backing Wall Vertical

Trimoterm Backing Wall Horizontal



TrimoDesign YouTube channel

D2 Sources

Gebäudebegrünung im Metallleichtbau, PA12, Richtlinie für die Planung und Ausführung von Dach-, Wand- und Deckenkonstruktionen aus Metallprofiltafeln, IFBS unter Mitarbeit des BuGG, January 2025

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Notes

HEADQUARTERS

TRIMO D.O.O.
PRIJATELJEVA CESTA 12,
8210 TREBNJE, SLOVENIA
T: +386 (0)7 34 60 200
F: +386 (0)7 34 60 127
TRIMO@TRIMO-GROUP.COM
WWW.TRIMO-GROUP.COM

GLOBAL PRESENCE

www.trimo-group.com/en/company/about-trimo/global-presence

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