MWHC PLANNING

MODULAR WALL. HEATING AND COOLING.

VPLAN6 | e62217

www.variotherm.com

VARIOTHERM

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1 PRINCIPLES

Variotherm ModuleWall is a source of well-being. It provides heating through horizontal radiant heat instead of the ascending warm air provided by conventional heating systems. This avoids the permanent movement of air and the associated stirring up of dust. Rooms are evenly heated without different temperature zones in the heated rooms.
By the way, solar heat is also radiant heat.

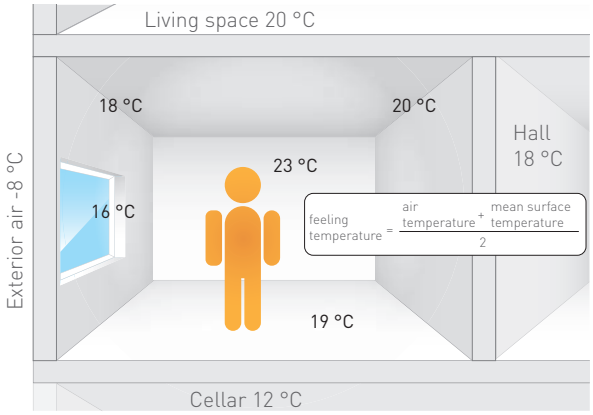
1.1 Comfort

Comfort is not only created through a certain air temperature in the room. The temperature of the surfaces enclosing the room is of equal importance. The felt temperature is roughly consistent with the arithmetic mean of both temperatures.

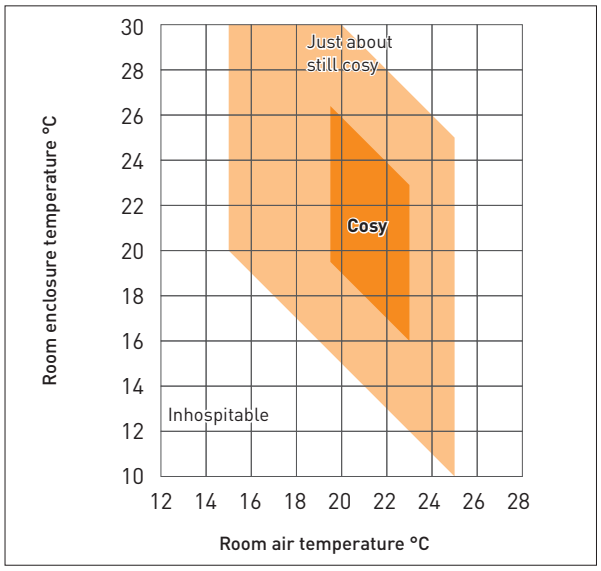
What makes people feel comfortable?

People feel comfortable when the following basic 'thermal comfort' equation holds:

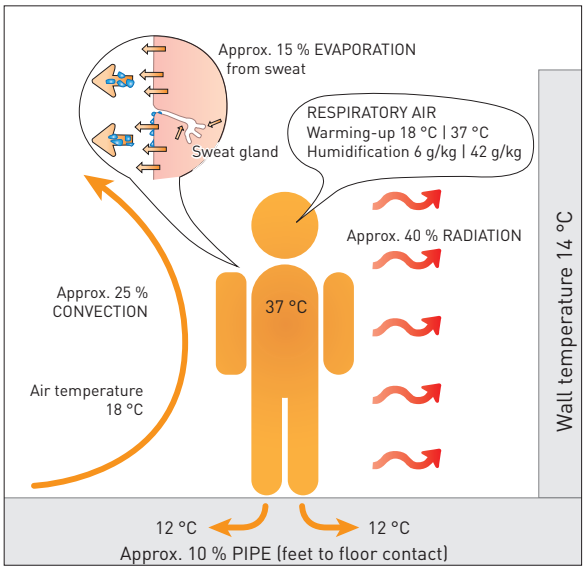
Heat production = heat loss



▲ Impact of the room on felt temperature



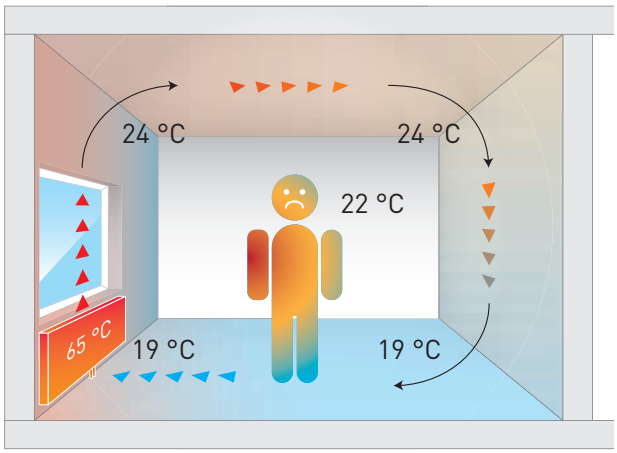
▲ Zone of cosiness



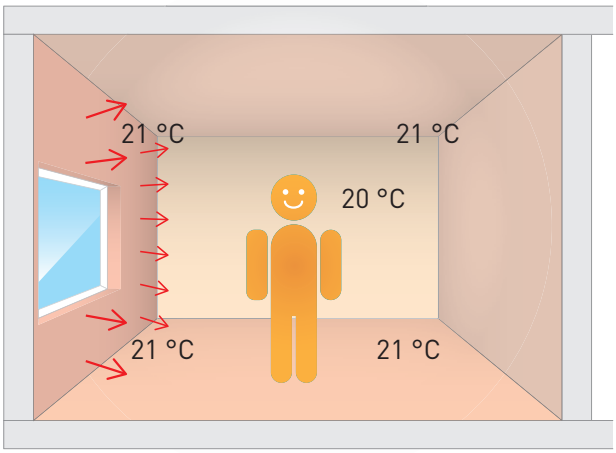
▲ Human heat balance

In this context, it is important that heat loss from the human body is as evenly distributed in all directions as possible. We feel uncomfortable if too much heat is lost in one particular direction (e.g. cold surfaces, draughts) or the heat loss is prevented in one direction (hot surfaces or vapour-tight, thick clothing).
The lower the inside air temperature is, the warmer the surrounding surfaces (wall surfaces, floor and ceiling, as well as doors and windows) must be to ensure cosiness.

Compared to other heating systems, the ModuleWall installations significantly increases cosiness. The installation of surface heating on an exterior wall, especially under windows, can largely cancel out the unpleasant effects from the radiation exchange between your body and cold exterior walls and windows. You can set the room temperature lower than you would with convection heating, since radiant heat raises the perceived air temperature.



▲ Discomfort with radiators



▲ Comfort with wall heating

1.2 Energy savings

A lowered room air temperature along with increased cosiness significantly minimises energy losses. The approximate heating cost savings per 1 °C lower room air temperature are 6 %. The low room air temperature has the additional great physiological advantage of significantly increasing the absorption of oxygen in the body. The wall heating system is ideal for use with low-temperature energy sources such as condensing boilers, heat pumps and solar collectors because it operates with low surface and heating medium temperatures.
With Variotherm wall heating you can achieve energy savings of up to 30 % compared to conventional heating systems.

1.3 Adapts to suit your home

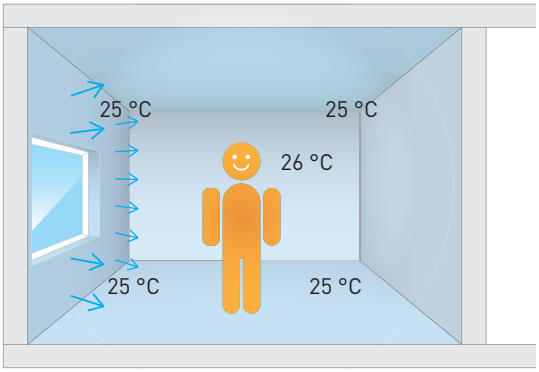
The Variotherm modular wall heating surfaces can be individually adapted to suit the local situation (windows, doors etc.). Visible radiators under the windows are a thing of the past.

1.4 Cooling

One reason for the frequent lack of satisfaction with air-conditioning systems is the inadequacy of the thermal ambient conditions in the air-conditioned rooms. Most frequently mentioned is the presence of uncomfortable forced air. Cooling via wall surfaces offers the advantage of gentle radiation exchange between the cooled wall surface and the human body. In addition, the room temperature is reduced to a comfortable level.

Effects of surface cooling on the room

When a wall surface is cooled, all warmer objects in the room (floor, interior walls, persons, equipment, etc.) radiate heat into this cooled surface. This loss of heat through radiation leads to a reduction in the surface temperature of these objects, thus providing a cooling effect. The ambient air in the room is also cooled to a comfortable level.



▲ Comfort with wall cooling

Cooling mode

Based on experience, cooling makes sense at a room temperature of 26 °C or more. To achieve a noticeable effect and to cool the body, a reduction of the wall surface temperature to a maximum of 15 °C is possible (dew point!).

Efficiency

- Water transports heat much better than air. The costs incurred by pumping in surface cooling systems are significantly lower than the costs incurred by using fans. A surface cooling system does not replace an air-conditioning system (no dehumidification and no ventilation). A 100% coverage of the cooling load, as per VDI 2078 (calculation of the cooling load for air-conditioned rooms), is possible in buildings designed for low energy consumption with shadowing equipment and low internal loads

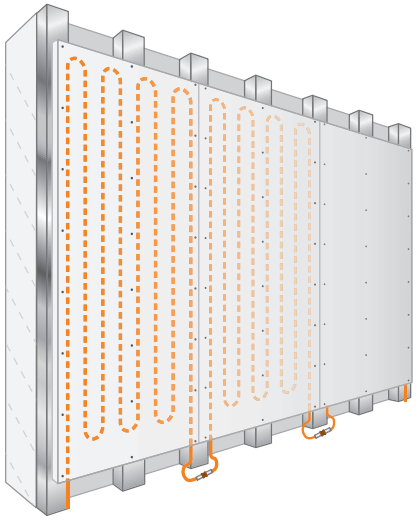
- One of the major advantages of wall heating/cooling systems is the low additional investment costs. A single system is used for the heating and cooling modes. The same wall surface, the same pipe system, and the same heating/cooling distribution manifold with supply lines and circulation pump are used for both modes. Only the generation of cooling (chiller/heat pump/cooling from the floor and ground water) is planned in parallel to the heating unit.

Combination of displacement ventilation and wall cooling

Displacement ventilation is an air-conditioning system with low air exhaust speeds and laminar flow of the escaping air at the exhaust vents. Low turbulence in the air flow through the room is achieved through the type of air routing in the room, blowing of air at floor level at a slightly subnormal temperature and extraction of the exhaust air at the ceiling level. This type of displacement flow, known as „displacement ventilation“ can achieve almost complete freedom from draughts. The combination of wall cooling and displacement ventilation allows significantly higher cooling performance to be achieved compared to using only a displacement ventilation system, without exceeding thermally comfortable air speeds. If the supplied air is dehumidified then low wall surface temperatures, and thus high radiant cooling performance, can be achieved without the formation of condensation, even on hot and humid days.

1.5 Description and advantages of the ModuleWall

The Variotherm ModuleStandardWall is an extremely energy efficient heating and cooling system. As a flexible panel system, it is pre-assembled for installation in walls and pitched ceilings. Here, heating, cooling and complete wall are perfectly combined in a single product. The desired room temperature is achieved by using hot and cold water circulation to make sure you feel completely comfortable all year round.

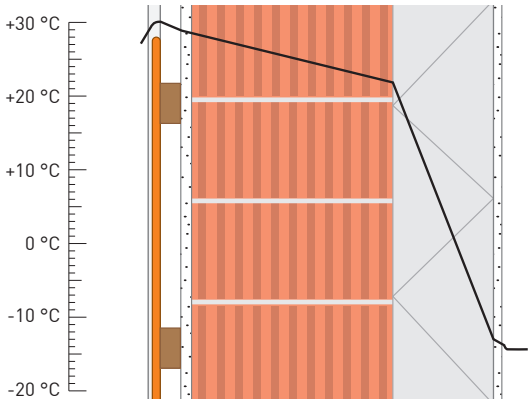


The advantages:

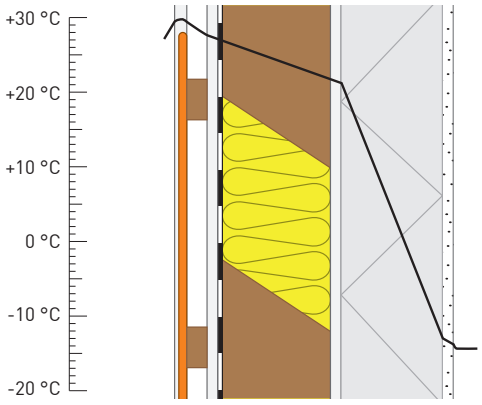
- Heating, cooling and finished wall in one!
- Ideal for timber-framed buildings, pre-fabricated houses, attics and renovation
- Heating system: large-surface, extremely energy-saving low temperature system
- Cooling system: silent, no draughts, energy-efficient
- A totally flexible panel system:fulfil all building requirements
- Gypsum fibreboards and components which has been tested for their healthy building properties
- Fire protection assessment (IBS Linz)

1.6 Temperature variations/wall structure

Various different wall fittings at a wall surface temperature of 30 °C and a standard outdoor (air) temperature of -14 °C



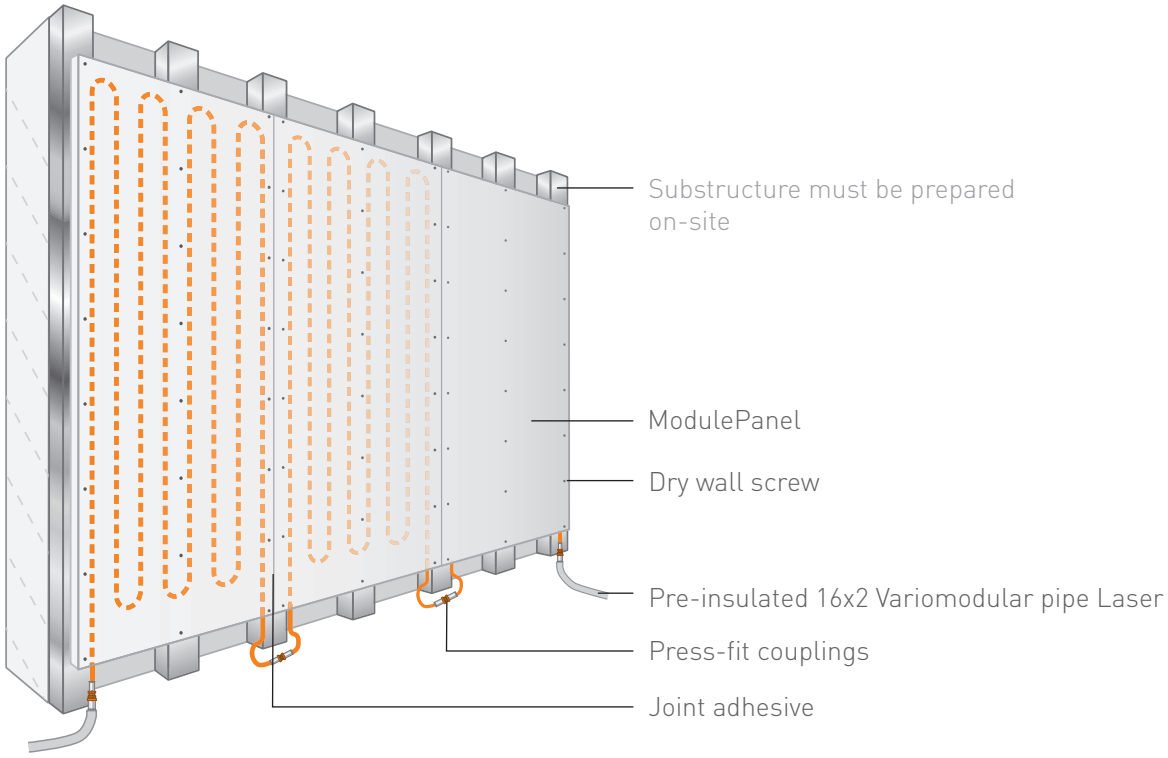
▲ Example with solid brick, structure from left to right: ModuleWall, recessed formwork, 300 mm vertically perforated bricks, 160 mm thermal insulation (EPS), exterior plaster/paint



▲ Example with timber-framed building, structure from left to right: ModuleWall, recessed formwork, 15 mm gypsum fibreboard, vapour retarder, 160 mm timber-framed construction with mineral wool, 15 mm gypsum fibreboard, 160 mm thermal insulation (EPS), exterior plaster/paint

2 COMPONENTS

2.1 Overview



Pre-insulated 16x2 Variomodular pipe Laser

serves as a supply pipe between ModuleWall and distribution manifold.

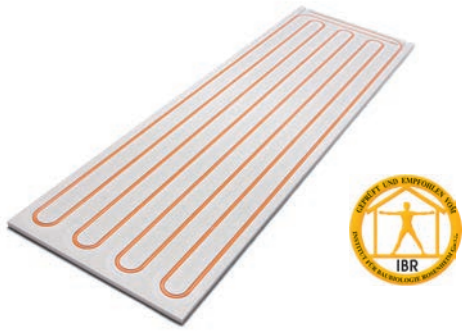
- Aluminium multi-layer composite pipe 16x2 Laser
- 100 % oxygen diffusion-tight
- 95 °C, 10 bar
- Insulation: Polyethylene soft foam, fire resistance as per EN 14313: CL-s1,d0, insulation thickness 6 or 9 mm

Greenline joint adhesive

for connecting the blunt adjoining ModuleStandardPanels.
1 cartridge (310 ml) sufficient for approx. 7 m²

ModuleStandardPanels

- 18 mm thick gypsum fibreboard which has been tested for their healthy building properties
- With pre-installed Variomodular pipe 11.6x1.5 Laser at a grid size of 75 mm
- Marking of the screwing points (fastening area) on the front side



Panel characteristics:

Panel: gypsum fibreboard which has been tested for their healthy building properties
Fire resistance as per DIN EN 13501-1: non-flammable, A2
Identification as per DIN EN 15283-2: GF-I-W2-C1
Thermal conductivity λ: 0.32 W/mK
Apparent density ρ_K: 1150 ± 50 kg/m³
Water vapour diffusion resistance factor μ: 13

Notes:

- With load bearing wall construction the Variotherm ModulePanels must not carry any static ceiling loads and must not be used for building reinforcement.
- The relative humidity must not exceed 70 % during storage, installation and additional processing of the ModulePanels and during the construction phase and normal use of the building. Wet plaster and wet screed must be applied and have dried before installation of the ModulePanels. The ModulePanels can be used in rooms up to moisture class W3 (ÖNORM B 3407). They are not approved for installation from moisture class W4 (e.g. canteens and shower blocks) upwards.

Dry wall screw

for mounting ModuleStandardPanels on wooden/metal structures,
incl. corresponding bit.
Consumption see table, chapter 2.2

Press-fit couplings / Press-fit brackets 90°

for connecting individual modular panels (11.6x11.6) and connection to the supply pipe (11.6x16),
TH press-fit contour, tested as per EN 21003.

And much more ...

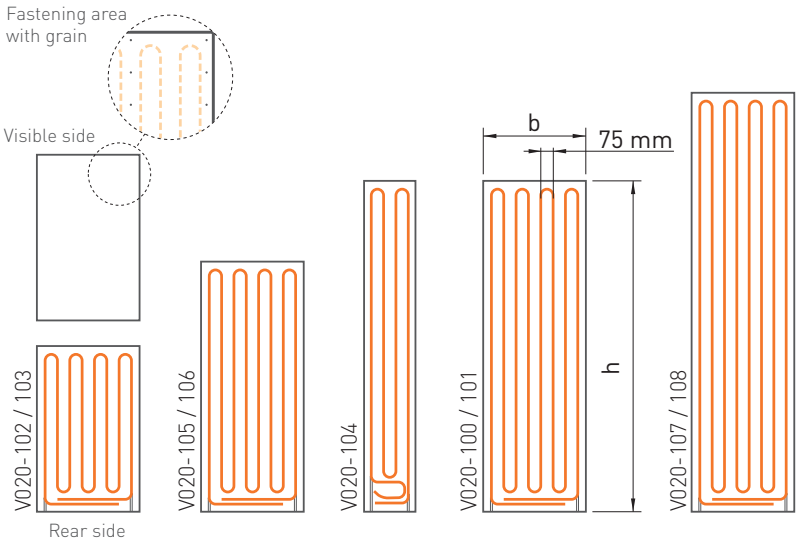
The product range is rounded off by cold shrink tape, ModuleExpansionPanels to compensate for free and unheated areas, heating/cooling distribution manifolds and correspondingly calibrated room thermostats.

2.2 ModuleStandardPanels

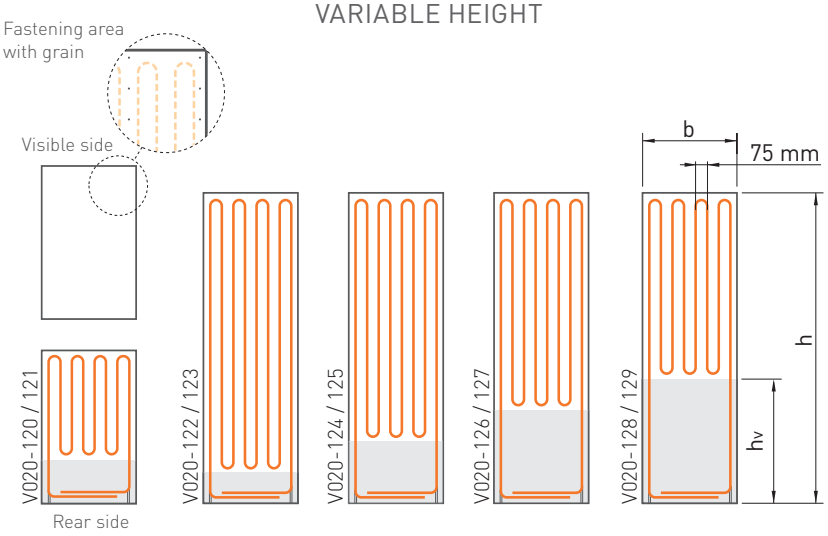
Fixed height:
The entire surface of the ModulePanel serves as a heating/cooling area.

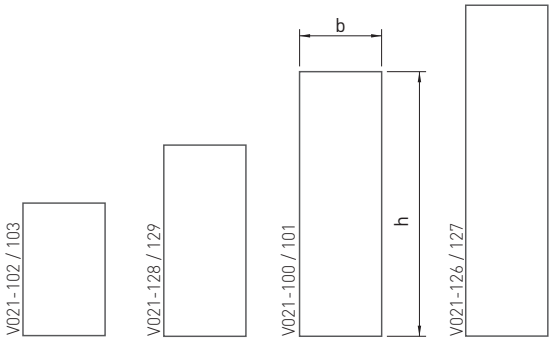
Variable height:
Only part of the panel surface is used as a heating/cooling area, the unused area (grey) can be individually cut to size.

FIXED HEIGHT



VARIABLE HEIGHT

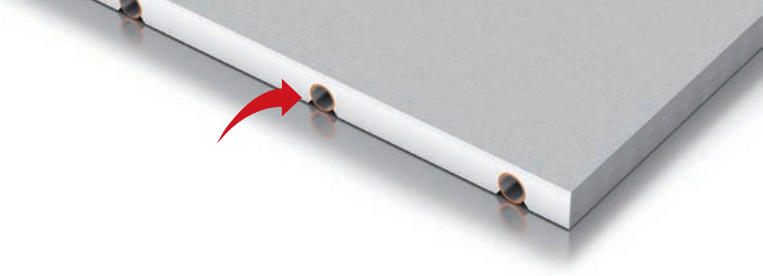




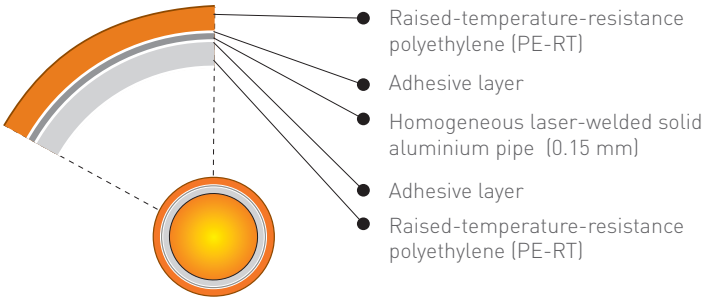
ModuleExpansionPanels

Part no.	Product code	Dimensions [h x b], [mm]	Height h_v [mm]	Panel surface [m²]	Effective surface [m²]	Laid pipe in panel	Weight/ panel	Required quantity[1] dry wall screws/panel	
								Longitudinal joists	Transverse joists
ModuleStandardPanels-Classic									
V020-100	MSWC-2000-625	2.000 x 625	-	1.25	1.25	16.2 m	25.5 kg	27 pcs.	30 pcs.
V020-101	MSWC-2000-600	2.000 x 600	-	1.20	1.20	16.2 m	24.5 kg	27 pcs.	30 pcs.
V020-102	MSWC-1000-625	1.000 x 625	-	0.63	0.63	8.2 m	12.8 kg	15 pcs.	20 pcs.
V020-103	MSWC-1000-600	1.000 x 600	-	0.60	0.60	8.2 m	12.2 kg	15 pcs.	20 pcs.
V020-104	MSWC-2000-312	2.000 x 312	-	0.62	0.62	8.2 m	12.6 kg	18 pcs.	18 pcs.
V020-105	MSWC-1500-625	1.500 x 625	-	0.94	0.94	12.2 m	19.2 kg	21 pcs.	25 pcs.
V020-106	MSWC-1500-600	1.500 x 625	-	0.90	0.90	12.2 m	18.4 kg	21 pcs.	25 pcs.
V020-107	MSWC-2500-625	2.500 x 625	-	1.56	1.56	20.2 m	33.8 kg	33 pcs.	35 pcs.
V020-108	MSWC-2500-600	2.500 x 600	-	1.50	1.50	20.2 m	30.6 kg	33 pcs.	35 pcs.
V020-120	MSWC-1000-625-V300	1.000 x 625	300	0.63	0.48	6.7 m	13.0 kg	15 pcs.	20 pcs.
V020-121	MSWC-1000-600-V300	1.000 x 600	300	0.60	0.46	6.7 m	12.5 kg	15 pcs.	20 pcs.
V020-122	MSWC-2000-625-V200	2.000 x 625	200	1.25	1.17	15.4 m	25.7 kg	27 pcs.	30 pcs.
V020-123	MSWC-2000-600-V200	2.000 x 600	200	1.20	1.12	15.4 m	24.6 kg	27 pcs.	30 pcs.
V020-124	MSWC-2000-625-V400	2.000 x 625	400	1.25	1.04	14.2 m	25.8 kg	27 pcs.	30 pcs.
V020-125	MSWC-2000-600-V400	2.000 x 600	400	1.20	1.00	14.2 m	24.8 kg	27 pcs.	30 pcs.
V020-126	MSWC-2000-625-V600	2.000 x 625	600	1.25	0.92	13.0 m	26.0 kg	27 pcs.	30 pcs.
V020-127	MSWC-2000-600-V600	2.000 x 600	600	1.20	0.88	13.0 m	24.9 kg	27 pcs.	30 pcs.
V020-128	MSWC-2000-625-V800	2.000 x 625	800	1.25	0.79	11.8 m	26.2 kg	27 pcs.	30 pcs.
V020-129	MSWC-2000-600-V800	2.000 x 600	800	1.20	0.76	11.8 m	25.1 kg	27 pcs.	30 pcs.
ModuleExpansionPanels-Classic									
V021-100	MAC-2000-625	2.000 x 625	-	1.25	-	-	27.1 kg	27 pcs.	30 pcs.
V021-101	MAC-2000-600	2.000 x 600	-	1.20	-	-	26.0 kg	27 pcs.	30 pcs.
V021-102	MAC-1000-625	1.000 x 625	-	0.63	-	-	13.6 kg	15 pcs.	20 pcs.
V021-103	MAC-1000-600	1.000 x 600	-	0.60	-	-	13.0 kg	15 pcs.	20 pcs.
V021-128	MAC-1500-625	1.500 x 625	-	0.94	-	-	20.4 kg	14 pcs.	15 pcs.
V021-129	MAC-1500-600	1.500 x 600	-	0.90	-	-	19.5 kg	14 pcs.	15 pcs.
V021-126	MAC-2500-625	2.500 x 625	-	1.56	-	-	33.9 kg	22 pcs.	21 pcs.
V021-127	MAC-2500-600	2.500 x 600	-	1.50	-	-	32.6 kg	22 pcs.	21 pcs.

[1] Apart from the quantity, in the case of fire protection requirements test verification/certification may result in different specifications!



2.3 Variomodular pipe 11.6x1.5 Laser

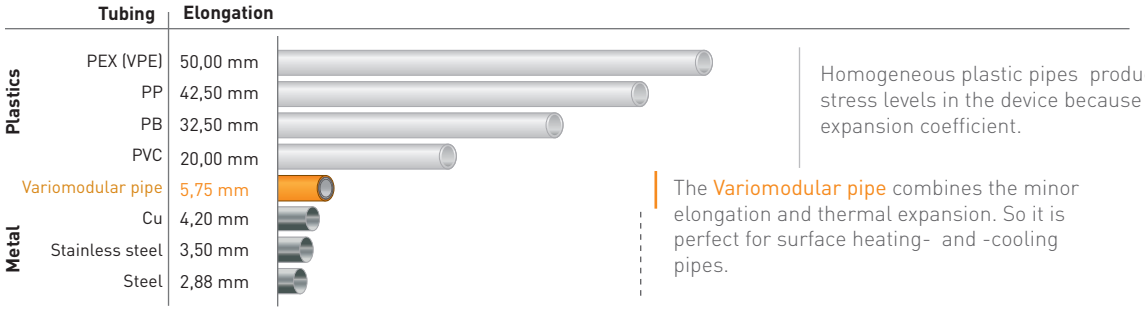


Advantages

- Fully corrosion-free
- Optimum creep behaviour
- Just as light as a plastic pipe
- 10-year guarantee with certificate
- Flexible, easy to bend, extremely stable form
- Resistant to hot water additives (inhibitors, antifreeze)
- Mirror-smooth inner surface – less pressure loss – no encrustation
- High pressure and temperature resistance (10 bar, +95 °C)
- 100 % oxygen diffusion-tight
- Low linear coefficient of expansion, low heat expansion forces
- Tested as per EN 21003 (IMA Dresden), SKZ A 397

Elongation

with 10 m and temperature difference Δt 25 °C (e.g. 20 °C to 45 °C):



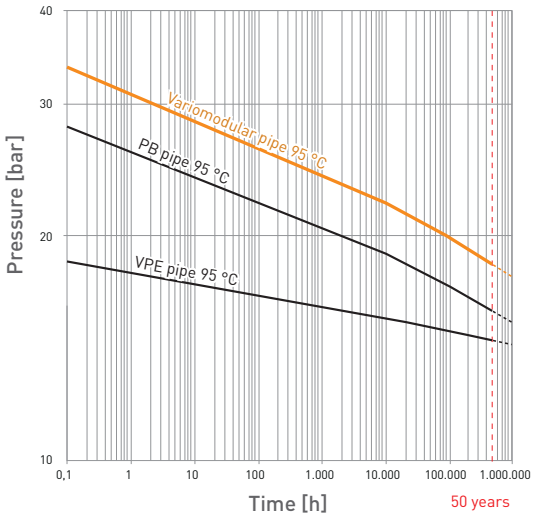
Homogeneous plastic pipes produce high stress levels in the device because of their expansion coefficient.

The Variomodular pipe combines the minor elongation and thermal expansion. So it is perfect for surface heating- and -cooling pipes.

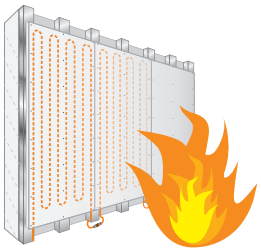
Technical data

Pipe diameter:	11.6 mm
Pipe wall thickness:	1.5 mm
Aluminium pipe thickness:	0.15 mm
Water content:	0.058 l/m
Special narrow bending radius (use a suitable bending device):	30 mm
Max. operating temperature:	t_{max} = 95 °C
Short-term resistant:	t_{mal} = 110 °C
Max. operating pressure:	p_{max} = 10 bar
Linear expansion coefficient:	$2.3x10^{-5}$ [K^{-1}]
Mean heat conduction coefficient:	λ = 0.43 W/mK
Heat transmission resistance:	R_λ = 0.0033 m²K/W

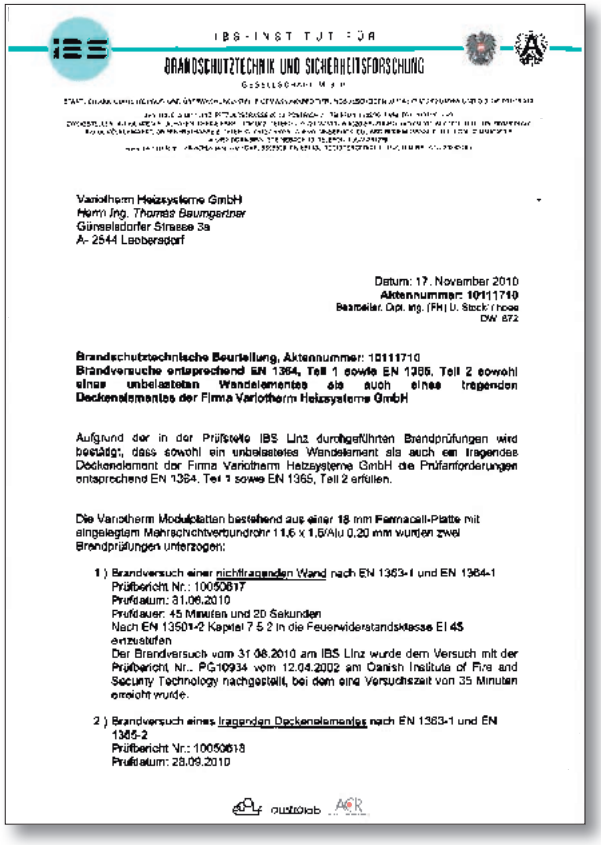
Creep behaviour



3 FIRE PROTECTION



From a fire protection perspective, the 18 mm Variotherm ModulePanels correspond to a 12.5 mm FERMACELL gypsum fibreboard panel (Test IBS-Linz No. VFA2001-0389.01, fire protection assessment file number 10111710). Please observe the corresponding FERMACELL regulations and FERMACELL fire protection assessments.



IBS-INSTITUT FÜR
BRANDSCHUTZTECHNIK UND SICHERHEITSFORSCHUNG

Variotherm Heizsysteme GmbH
Herrn Ing. Thomas Baumgartner
Günselsdorfer Strasse 3a
A- 2544 Leobersdorf

Datum: 17. November 2010
Aktenummer: 10111710
Bearbeiter: Dipl. Ing. (FH) U. Stöckl / hose
DW 672

Brandschutztechnische Beurteilung, Aktennummer: 10111710
Brandversuche entsprechend EN 1364, Teil 1 sowie EN 1365, Teil 2 sowohl eines unbelasteten Wandelementes als auch eines tragenden Deckenelementes der Firma Variotherm Heizsysteme GmbH

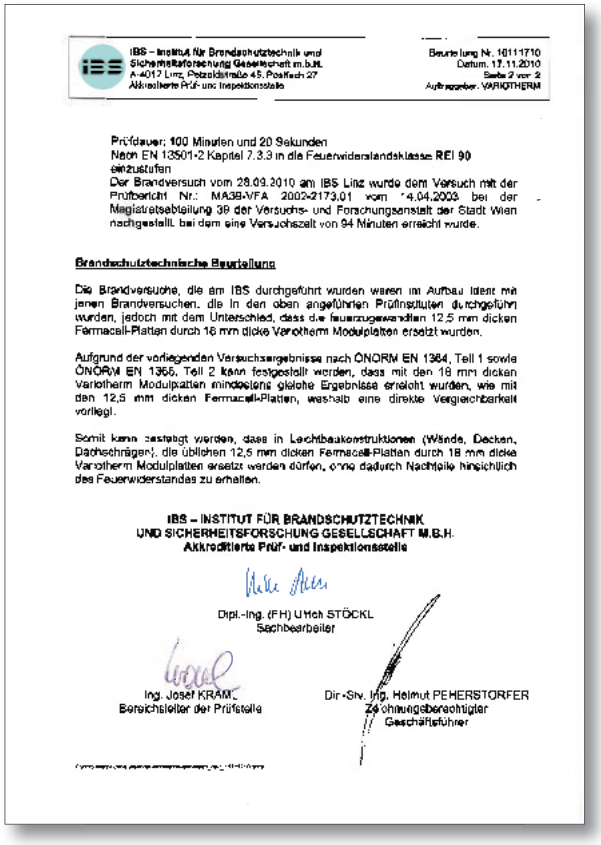
Aufgrund der in der Prüfstelle IBS Linz durchgeführten Brandprüfungen wird bestätigt, dass sowohl ein unbelastetes Wandelement als auch ein tragendes Deckenelement der Firma Variotherm Heizsysteme GmbH die Prüfanforderungen entsprechend EN 1364, Teil 1 sowie EN 1365, Teil 2 erfüllen.

Die Variotherm Modulplatten bestehend aus einer 18 mm Fermacell-Platte mit eingelegtem Mehrschichtverbundrohr 11,6 x 1,5/Alu 0,20 mm wurden zwei Brandprüfungen unterzogen:

1) Brandversuch einer nichttragenden Wand nach EN 1363-1 und EN 1364-1
Prüfbericht Nr.: 10050617
Prüfdatum: 31.08.2010
Prüfdauer: 45 Minuten und 20 Sekunden
Nach EN 13501-2 Kapitel 7.5.2 in die Feuerwiderstandsklasse EI 45 einzustufen
Der Brandversuch vom 31.08.2010 am IBS Linz wurde dem Versuch mit der Prüfbericht Nr.: PG10934 vom 12.04.2002 am Danish Institute of Fire and Security Technology nachgestellt, bei dem eine Versuchszeit von 35 Minuten erreicht wurde.

2) Brandversuch eines tragenden Deckenelementes nach EN 1363-1 und EN 1365-2
Prüfbericht Nr.: 10050618
Prüfdatum: 28.09.2010

austrian AGR



IBS – Institut für Brandschutztechnik und Sicherheitsforschung Gesellschaft m.b.H.
A-4012 Linz, Petzoldstraße 45, Postfach 27
Akkreditierte Prüf- und Inspektionsstelle

Beurteilung Nr. 10111710
Datum: 17.11.2010
Seite 2 von 2
Auftraggeber: VARIOTHERM

Prüfdauer: 100 Minuten und 20 Sekunden
Nach EN 13501-2 Kapitel 7.3.3 in die Feuerwiderstandsklasse REI 90 einzustufen
Der Brandversuch vom 28.09.2010 am IBS Linz wurde dem Versuch mit der Prüfbericht Nr.: MA39-VFA 2002-2173.01 vom 14.04.2003 bei der Magistratsabteilung 39 der Versuchs- und Forschungsanstalt der Stadt Wien nachgestellt, bei dem eine Versuchszeit von 94 Minuten erreicht wurde.

Brandschutztechnische Beurteilung

Die Brandversuche, die am IBS durchgeführt wurden waren im Aufbau ident mit jenen Brandversuchen, die in den oben angeführten Prüfinstituten durchgeführt wurden, jedoch mit dem Unterschied, dass die feuerzugewandten 12,5 mm dicken Fermacell-Platten durch 18 mm dicke Variotherm Modulplatten ersetzt wurden.

Aufgrund der vorliegenden Versuchsergebnisse nach ÖNORM EN 1364, Teil 1 sowie ÖNORM EN 1365, Teil 2 kann festgestellt werden, dass mit den 18 mm dicken Variotherm Modulplatten mindestens gleiche Ergebnisse erreicht wurden, wie mit den 12,5 mm dicken Fermacell-Platten, weshalb eine direkte Vergleichbarkeit vorliegt.

Somit kann bestätigt werden, dass in Leichtbaukonstruktionen (Wände, Decken, Dachschrägen), die üblichen 12,5 mm dicken Fermacell-Platten durch 18 mm dicke Variotherm Modulplatten ersetzt werden dürfen, ohne dadurch Nachteile hinsichtlich des Feuerwiderstandes zu erhalten.

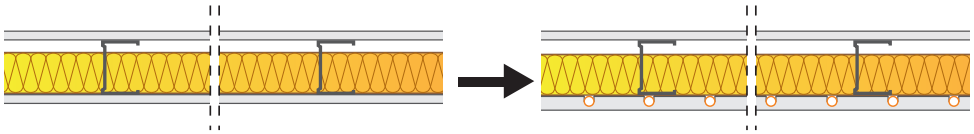
IBS – INSTITUT FÜR BRANDSCHUTZTECHNIK UND SICHERHEITSFORSCHUNG GESELLSCHAFT M.B.H.
Akkreditierte Prüf- und Inspektionsstelle

Dipl.-Ing. (FH) Ulrich STÖCKL
Sachbearbeiter

Ing. Josef KRAML
Bereichsleiter der Prüfstelle

Dir.-Stv. Ing. Helmut PEHERSTORFER
Zeichnungsberechtigter
Geschäftsführer

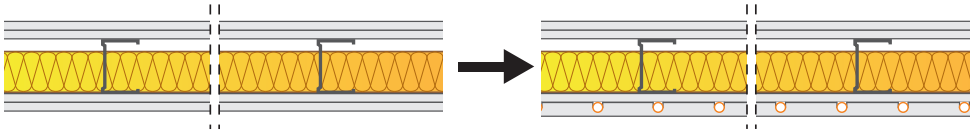
Examples of fire protection fittings



wall structure with 12.5 mm Fermacell gypsum fibreboards

with Variotherm ModulePanel

Fire resistance as per ÖN EN 13501-2: **EI 60***



Fire resistance as per ÖN EN 13501-2: **EI 90***

* **For details regarding wall fittings, please refer to the Fermacell planning documents.**

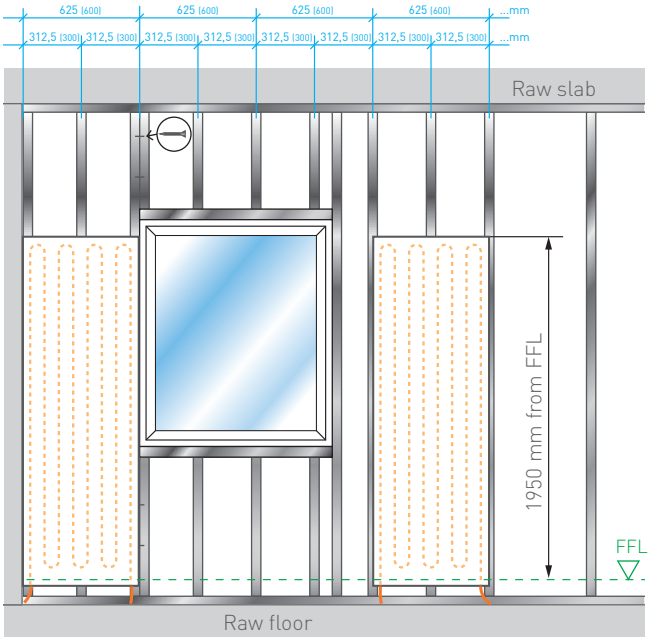
4 SUBSTRUCTURE

Depending on the requirements, substructures are made of wood and/or metal, with or without surface planking, cavity insulation and vapour retarders (vapour barriers).
Please observe the planning and installation guidelines of the manufacturer of the wooden or drywall system used for your wall and pitched roof ceiling construction.

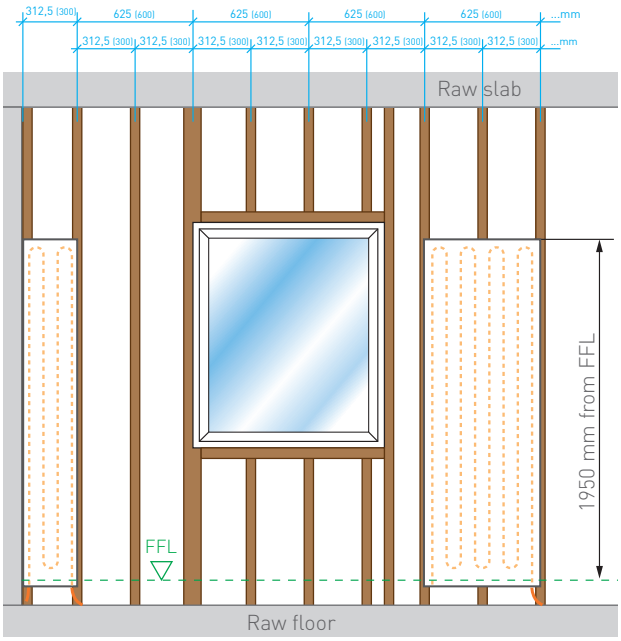
- With wooden constructions, the timber used must be sufficiently dry and straight, and conform to the Austrian standard EN 338 (sorting class C24).
- With metal constructions, the profiles must be made of soft, non-alloyed steel with double-sided galvanising of at least 100 g/m² according to the Austrian standard DIN 18182-1.
- It must be ensured that the construction is designed to carry the weight of the ModulePanels (20.5 kg/m²) and any eventual cladding (tiles).
- Do not glue the ModulePanels directly to solid wall structures (plaster).

4.1 Vertical stud construction (standard variant)

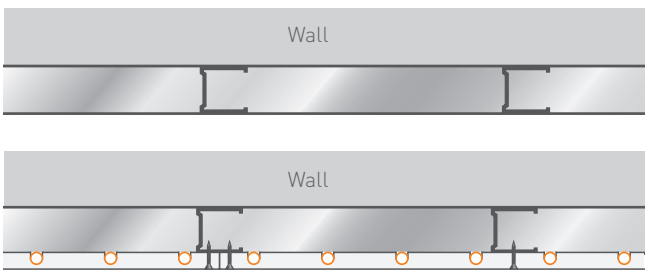
Substructure with wooden or metal profiles at a stud clearance of 312.5 mm, with or without insulation as required. With larger existing stud clearances, extra vertical studs are used at the intended heating/cooling surfaces.



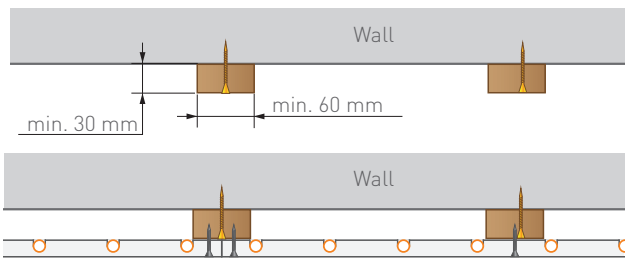
▲ Example of CW stud profile construction



▲ Example of wooden stud construction



▲ Section through a CW/UW profile steel substructure with a 312.5 mm stud clearance, without cavity insulation.



▲ Section through a softwood wooden construction with a 312.5 mm stud clearance, without cavity insulation.

4.2 Stud construction with full-surface FERMACELL planking

Under the following conditions, the ModulePanels can be screwed directly to the FERMACELL planking:

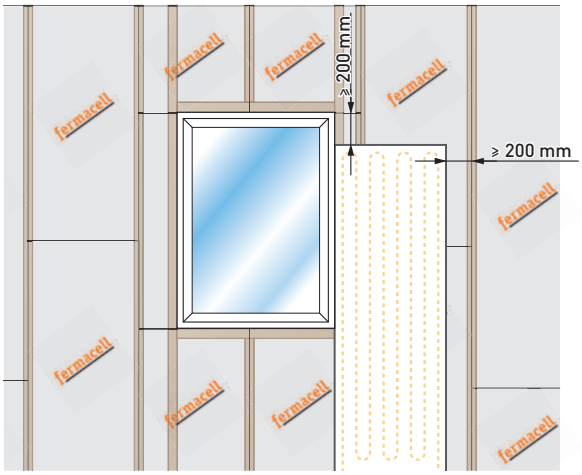
- The substructure is fully planked with FERMACELL panels (minimum thickness 12.5 mm).
- The stud clearance of the FERMACELL substructure corresponds to the values in the table:

Application area / Construction type	Max. stud clearances of the substructure in mm for the following thicknesses of FERMACELL panels[1]		
	12.5 mm	15 mm	18 mm
Vertical surfaces (partition walls, wall cladding, single wall panels)	625 mm	750 mm	900 mm
Pitched roof ceiling cladding (10 - 50° pitch)	420 mm	500 mm	550 mm

[1] Limiting conditions:
- In the case of fire protection requirements, the specifications of the test verification/certification should be observed.
- Not possible in rooms where use results in constant high humidity (wet rooms etc.).

Caution:

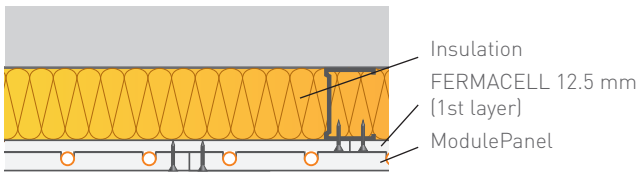
- Ensure a minimum seam offset of 200 mm to the FERMACELL planking.
- Avoid cross joints.
- With multi-layer Fermacell planking only the ModulePanels (last layer) are glued and stopped.



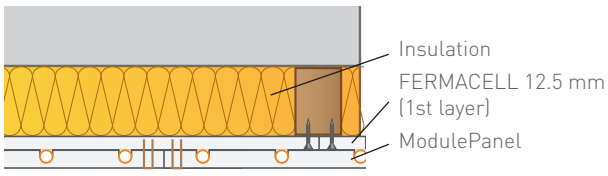
The ModulePanels are attached directly to the FERMACELL planking (minimum panel thickness of the first layer: 12.5 mm) with the following fasteners:

FTC40 dry wall screw
- See the table in section 2.2 for the number of screws

Straddle staples
- Galvanised and treated with resin
- Wire diameter ⩾ 1.5 mm
- Saddle width: ⩾ 10 mm
- Leg length 2 – 3 mm shorter than the thickness of both panel layers (ModulePanel + FERMACELL panel)
- Distance between staples: max. 150 mm
- Distance between rows of staples: 312.5/300 mm

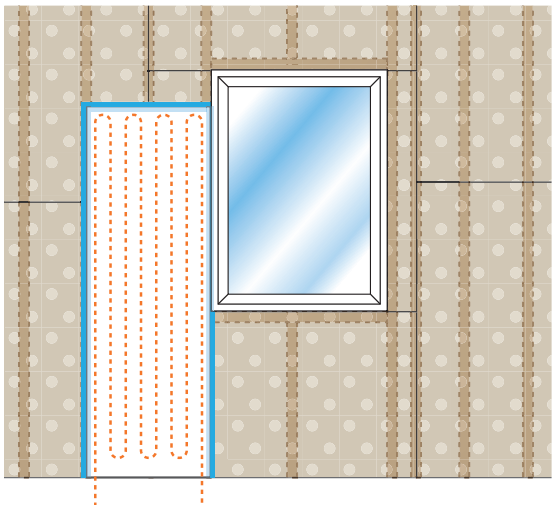


▲ Section through a CW/UW profile **steel construction**, single-sided with **12.5 mm thick FERMACELL** panels, single-layer planking with cavity insulation and installed ModulePanel (**screwed**).

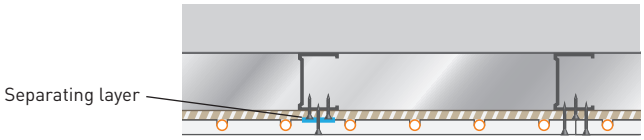


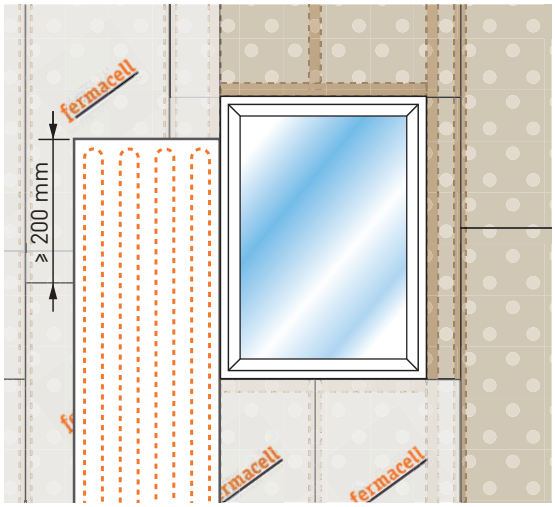
▲ Section through a softwood **wooden construction**, single-sided with **12.5 mm thick FERMACELL** panels, single-layer planking with cavity insulation and installed ModulePanel (**clip fasteners**).

4.3 Stud construction with plasterboard planking

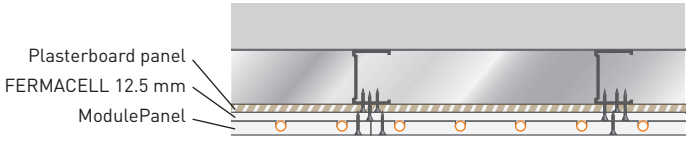


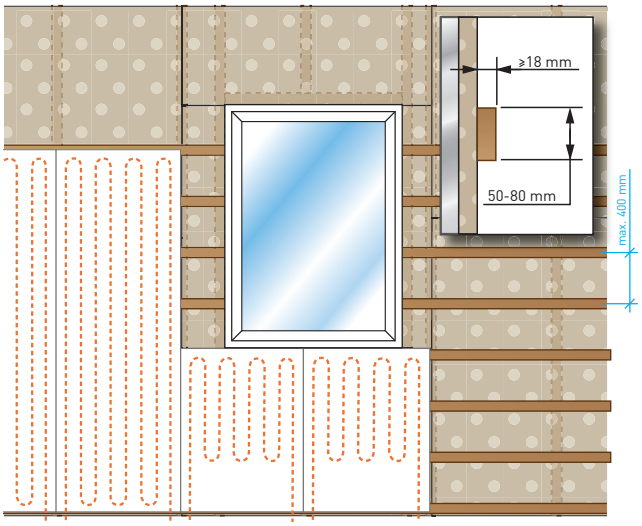
The lack of screw retention strength in the plasterboard panels means that the ModulePanels can only be directly fastened to the underlying stud construction with offset seams. A separating layer ▬ (adhesive tape) is always inserted in the glued seam area.
The stud clearance of the plasterboard stud construction must be as specified in section 4.1 (stud clearance of 312.5 mm).





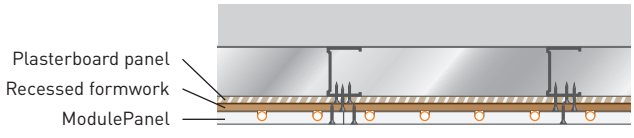
If the substructure can no longer be changed, appropriately thick FERMACELL panels (see table in chapter 4.2) are screwed to the stud construction behind the plasterboard planking.
The seams of the FERMACELL planking are not glued or stopped.
See section 4.2 on fastening the ModulePanels to the FERMACELL planking!



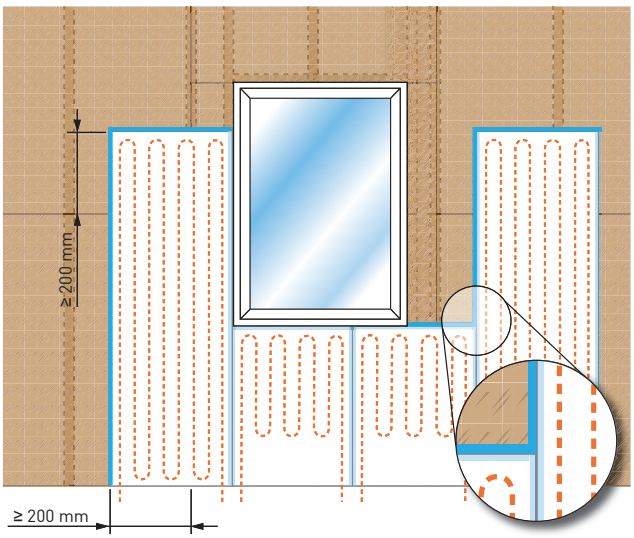


If the substructure is also unsuitable for full-surface FERMACELL planking, additional horizontal battens (recessed formwork) are screwed to the underlying stud construction instead.

See section 4.5 for information on installing the recessed formwork and fastening the ModulePanels!



4.4 Full cladding or chipboard panel planking



Chipboard panels and ModulePanels (FERMACELL gypsum fibreboards) have different expansion and contraction behaviour under climatic fluctuations. The fastening variants described below can be recommended when the chipboard panels are not subjected to moisture loads.

Caution:

- Ensure a minimum seam offset of 200 mm to the planking.
- Avoid cross joints.
- A separating layer ▬ (adhesive tape) is always inserted into the glued seam area.

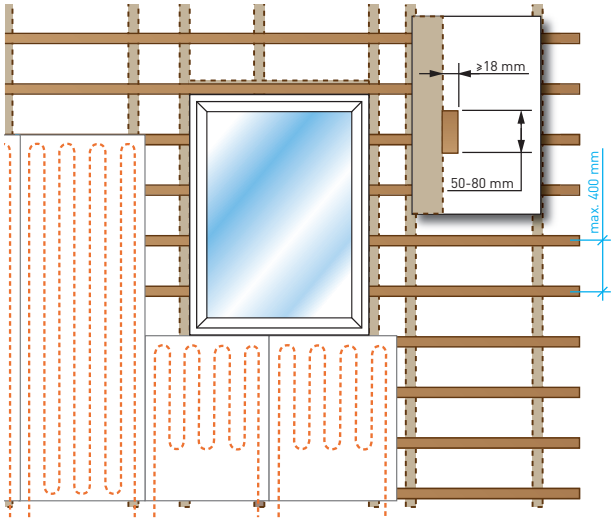
The ModulePanels are installed with the following straddle staples:

- galvanised and treated with resin
- wire diameter ≥ 1.5 mm
- Saddle width: ≥ 10 mm
- Leg length 2 – 3 mm shorter than the thickness of both panel layers
- Distance between staples: max. 150 mm
- Distance between rows of staples: 312.5/300 mm

The ModulePanels can be screwed to the planking (special case):

With chipboard panels having expansion and contraction values of max. 0.02 % (for changes to the material moisture of 1 % below the fibre saturation) the Module Panels can also be screwed to the planking. According to DIN EN 1995 Table NA.7 this includes plywood, cross-laminated timber and OSB/4 panels. In this case it is important that the panels have adjusted to the relative humidity of the working climate. The humidity during installation, construction and used of the building must be 30 – 65 %.

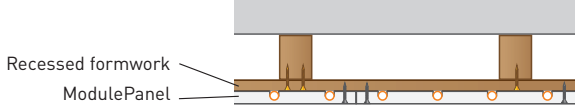
4.5 Recessed formwork



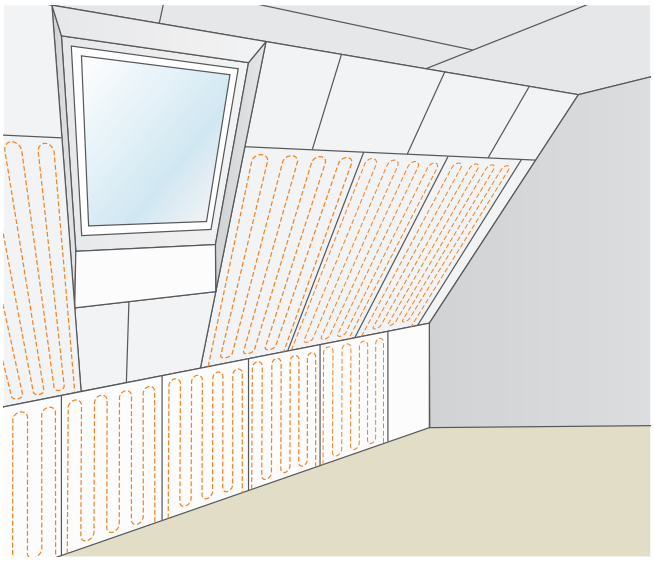
Extra recessed formwork is installed if the substructure does not have the correct batten clearance (300 or 312.5 mm). Horizontal wooden battens and ModulePanels have different expansion and contraction behaviour.

Batten guidelines (recessed formwork):

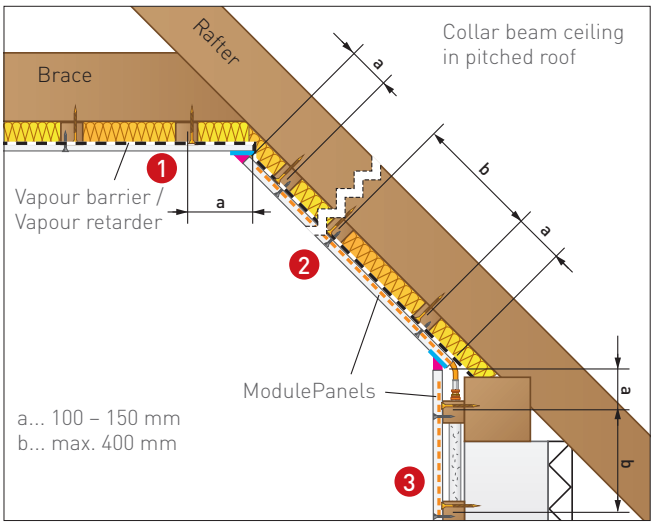
- Height: 50 – 80 mm
- Thickness: min. 18 mm
- Stud clearance: max. 400 mm



4.6 Pitched roof substructure



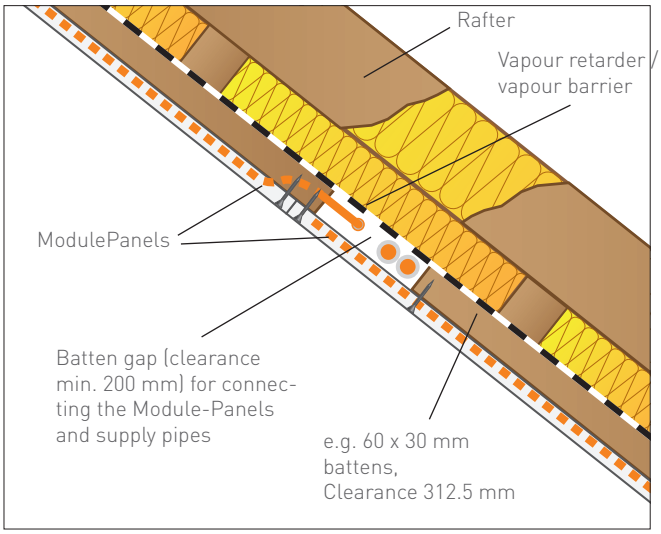
For a pitched roof, the same substructure possibilities apply as for walls (chapter 4.1 – 4.5).



Cross-section – horizontal battens

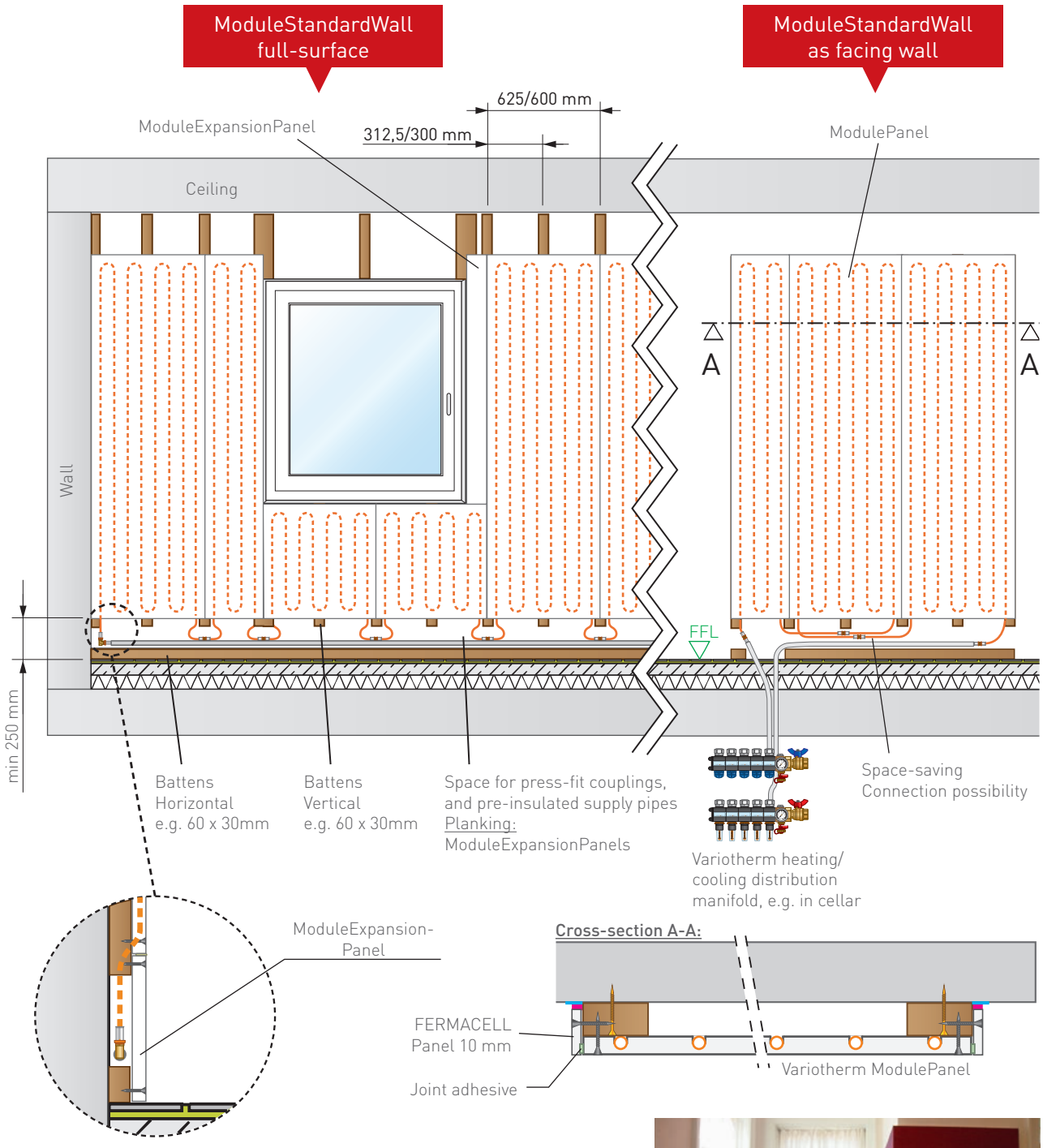
Installation process:

1. Horizontal surfaces
2. Pitched surfaces
3. Vertical surfaces



When two ModulePanels are abutted above each other in a pitched roof then additional vertical battens for the supply pipes are absolutely necessary!

4.7 Substructure variant for existing floors



FFL ... Upper edge of the finished floor

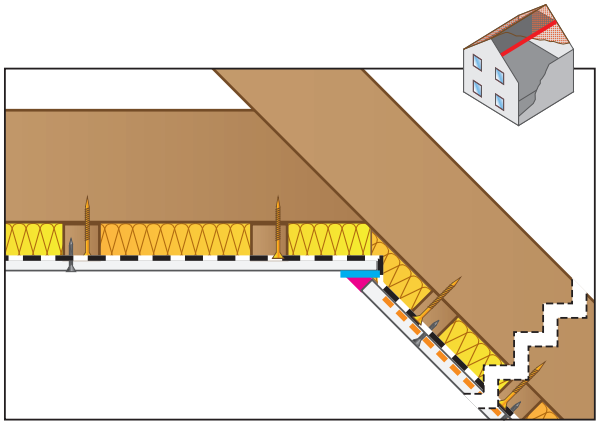
Connect a maximum heating/cooling area of 6.25 m² to a circuit!

▲ Example of ModuleWall as attached wall

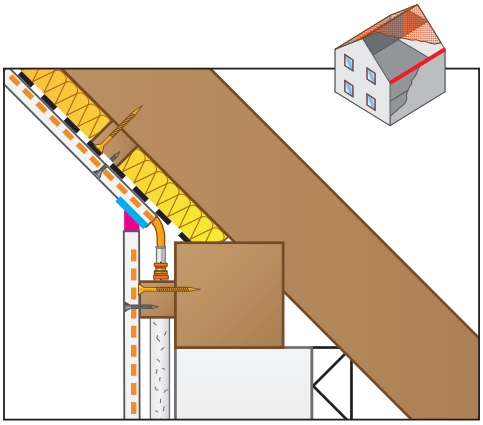
4.8 Remaining areas and panel transitions

The areas at the sides of the ModuleStandardPanels are filled out using ModuleExpansionPanels (please observe the FERMACELL guidelines). These panels without pipes are also glued with joint adhesive on the front side.
Cross joints are to be avoided. The width of the ModuleExpansionPanels should not be less than 200 mm.
Inner and outer corners and T-joints are to be constructed as grouted joints (approx. 7 mm) ■ with a separating layer ▬ (decoupled connection).

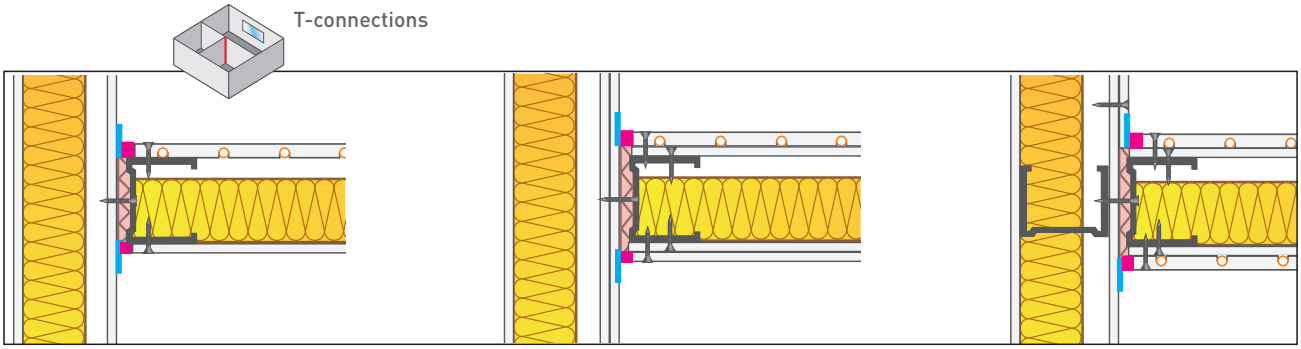
▲ ModuleExpansionPanels



▲ Pitched roof to ceiling



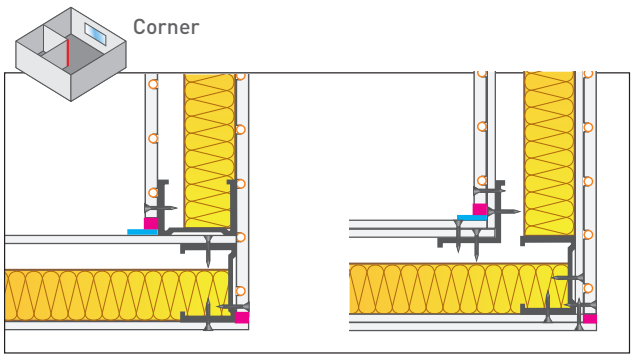
▲ Pitched roof to jamb wall



▲ Single-layer planking

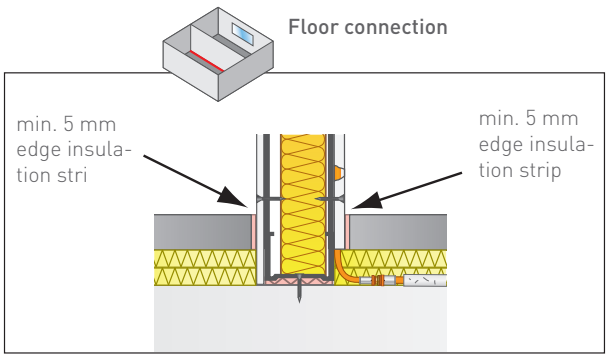
▲ Double-layer planking

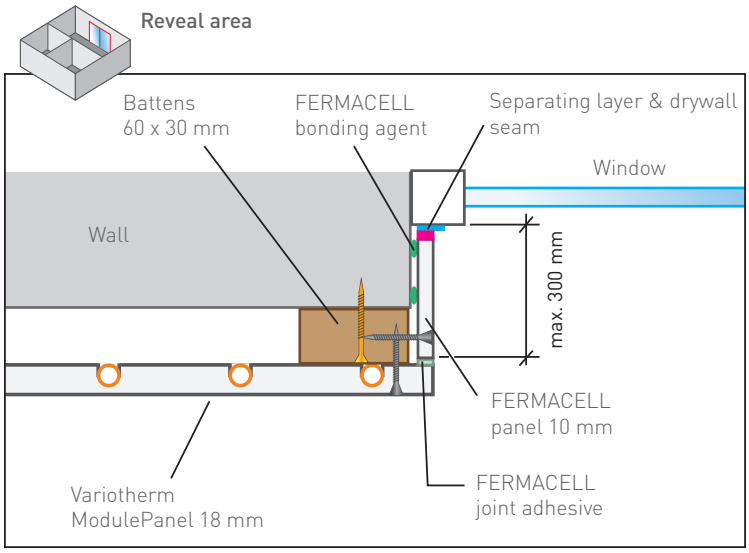
▲ Double-layer planking, CW profile screwed to CW profilet



▲ Single-layer

▲ Double-layer





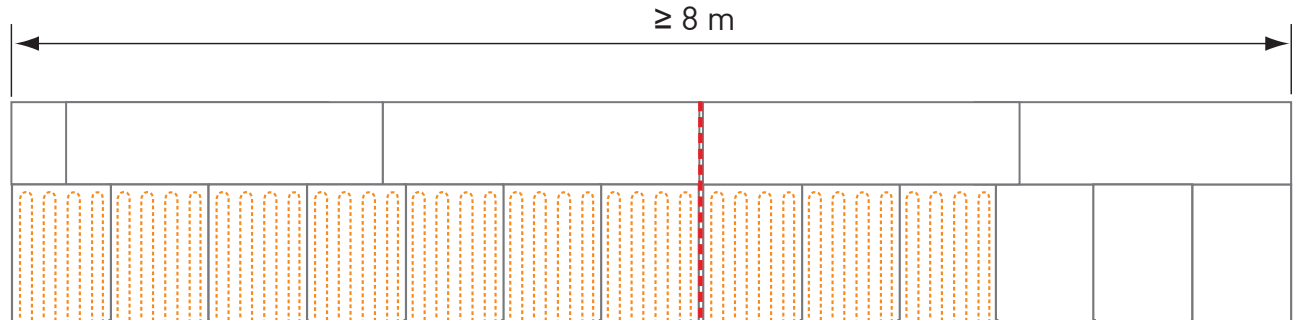
ModulePanel to plasterboard panels:

Variotherm provides no guarantee for transitions to products from other panel manufacturers.
Please observe the specifications of the respective (panel) manufacturer.
We can however provide you with four practical examples of transition methods:

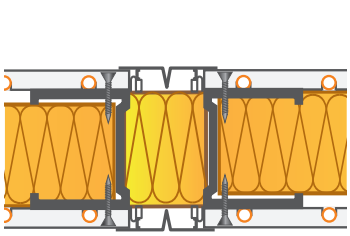
- Grouted joints (approx. 7 mm) ■ with a separating layer ▬ (decoupled connection). Advantage: intentional straight crack (usually hardly visible)
- Elastic seam (acrylic mass), (maintenance seam, not suitable for fire prevention constructions)
- Fascia
- Wooden strip fastened on one side for covering the transition

4.9 Movement joints

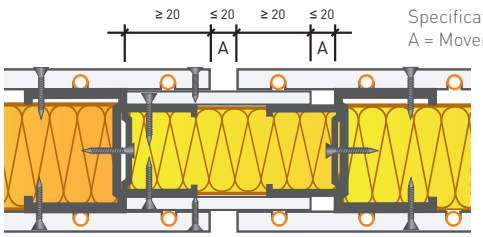
Movement joints are to be provided every 8 m in wall constructions and pitched roofs.



▲ Movement joint at (e.g.) 10x V020-100 and 3x V021-100 (13x 0.625 m = 8.13 m)

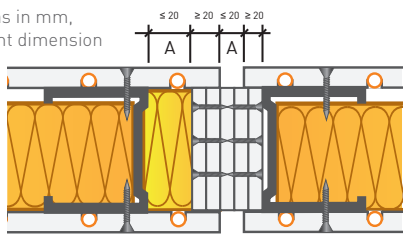


▲ Movement joint with additional profile



▲ Movement joint with panel strip

Specifications in mm,
A = Movement dimension



▲ Movement joint with strip bundle

5 THERMAL/COOLING PERFORMANCE

5.1 Calculation of the heating and cooling load

The EN 12831 standard with the respective national annex applies to the heating load calculations for the heated rooms. Every room is considered individually. For the outside temperature, the locally acquired and standardised outdoor temperature T_{ne} is used.
Variotherm also conducts cooling load calculations (subject to a fee) according to the new VDI 2078 guideline (valid since June 2013). For calculation purposes, precise information must be provided on the building and the rooms to be cooled (U-values with layer composition, shading, internal loads). This is the precondition for useful, accurate results.

Übersicht der Bauteile

Code	Bezeichnung	U-Wert W/m²K	Rges m²K/W	Rsi m²K/W	Rse m²K/W	R-Baut m²K/W
AF01	Außenfenster	1.100	0.909	0.130	0.040	0.739
AT01	Außentür	1.700	0.588	0.130	0.040	0.418
AW01	Außenwand	0.220	4.545	0.130	0.040	4.375

Raum Nr.	Bezeichnung	Θ_{int} °C	A_R m²	Φ_{Tx} W	Φ_T W	Φ_V W	$\Phi_{Netto/m²}$ W	$\Phi_{Netto/m²}$ W	Φ_{Netto} W	Φ_{RH} W	Φ_{HL} W
Haus, EG			180.88	5427		3396			9160	0	9160
00.001.001	Eltern	20.0	29.10	833	833	501	46	15	1335	0	1335
00.001.002	Kinder	20.0	20.49	762	762	343	54	19	1106	0	1106
00.001.003	Vorraum	20.0	24.40	571	571	409	40	14	980	0	980
00.001.004	Bad	24.0	12.26	300	324	459	64	22	783	0	783

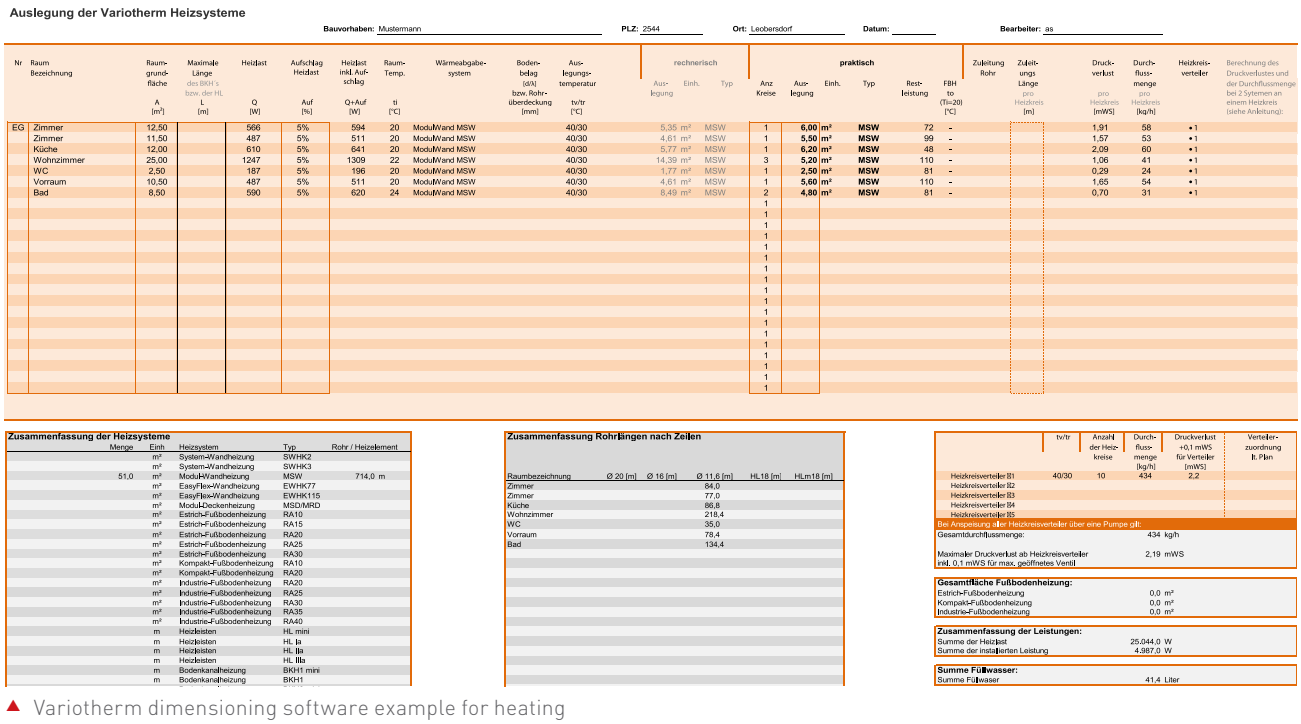
▲ Extract from a heating load calculation

Bezeichnung	Fläche m²	Kühllast W	Kühllast W/m²	t_{Raum} °C	$t_{op. Raum}$ °C
Schlafzimmer	21.70	-1601	-73.76	24.0	23.9
Wohnen, Kochen, Essen	84.50	-2906	-34.39	24.0	24.8
Wirtschaftsraum	13.00	-455	-35.01	24.0	24.6
WC	4.60	-73	-15.89	24.0	24.1
Corridor + Stiege	29.40	-1822	-61.96	24.0	25.4
Lounge + Stiege	22.00	-459	-20.85	24.0	24.3
Küche II (Pantry)	30.50	-956	-31.35	24.0	24.8
Vorraum	10.00	-239	-23.94	24.0	24.5
Küche II (Pantry)	14.00	-414	-29.55	24.0	24.6
Gästezimmer 1	23.50	-613	-26.08	24.0	24.6
Flur + Stiege	12.40	-342	-27.59	24.0	24.6
Gästezimmer 2	28.70	-746	-25.98	24.0	24.5
	294.30	**-10625**	**-36.10**		

▲ Extract from a cooling load calculation

5.2 Variotherm dimensioning softwares

Key values for individual heating/cooling circuits (the amount of water, pressure loss, number of circuits, allocation of the manifolds etc.) can be quickly and easily calculated by inputting the heating or cooling load into the Variotherm dimensioning softwares. It can be found in our Professional Area at *www.variotherm.com/profi.*



▲ Variotherm dimensioning software example for heating

5.3 Heat output tables

Caution! The maximum flow temperature for the ModulePanels is 50 °C

t_f/t_r [°C]	t_{mH} [°C]	Heat output [W/m²] at room temperature ...					T_0 [°C] (at T_r = 20 °C)
		... 15 °C	... 18 °C	... 20 °C	... 22 °C	... 24 °C	
30/20	25.0	90	59	38	18	-	25
30/25	27.5	108	77	56	36	18	26
35/25	30.0	127	95	74	55	36	28
35/28	31.5	137	105	84	65	46	28
35/30	32.5	144	113	92	73	54	29
37.5/32.5	35.0	162	131	111	91	73	31
40/30	35.0	162	131	111	91	73	31
40/35	37.5	179	149	129	108	91	32
45/35	40.0	197	167	147	126	109	34
45/40	42.5	214	184	164	143	126	35
50/40	45.0	232	201	181	161	143	37
50/45	47.5	239	214	201	181	162	38

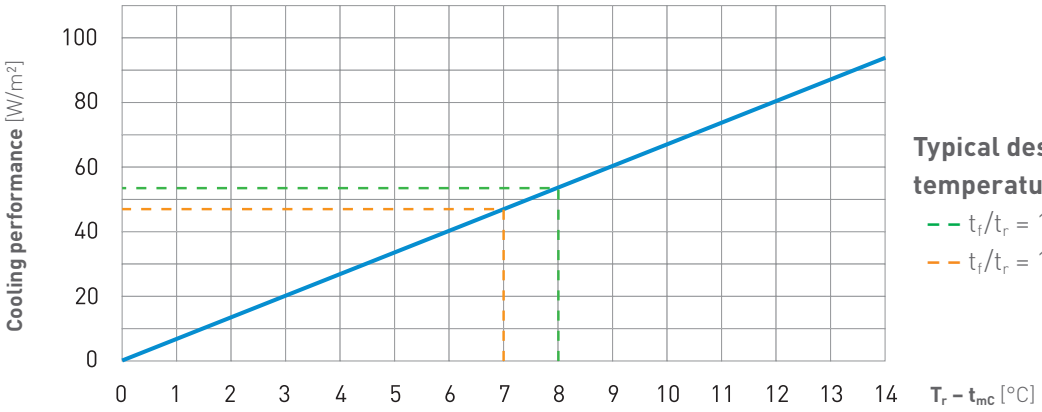
t_{mH} = mean hot water temperature = $\frac{t_f + t_r}{2}$ [°C]

T_0 = mean surface temperature [°C]

T_r = room temperature [°C]

t_f/t_r = flow temperature / return temperature [°C]

5.4 Cooling performance



Typical design temperatures (at T_r = 26 °C):

- t_f/t_r = 16/20 °C
- t_f/t_r = 17/21 °C

The surface temperature must not reach or fall below the dew point temperature!
The mean surface temperature T_0 corresponds approximately to the return temperature t_r.

Relative humidity [%rH]	Room temperature [T_r]				
	24 °C	25 °C	26 °C	27 °C	28 °C
70 %	18.0	19.0	20.0	21.0	22.0
60 %	15.5	16.5	17.5	18.5	19.2
50 %	13.0	14.0	15.0	15.8	16.8
40 %	9.8	10.5	11.5	12.5	13.2

t_{mC} = mean cooling water temperature = $\frac{t_f + t_r}{2}$ [°C]

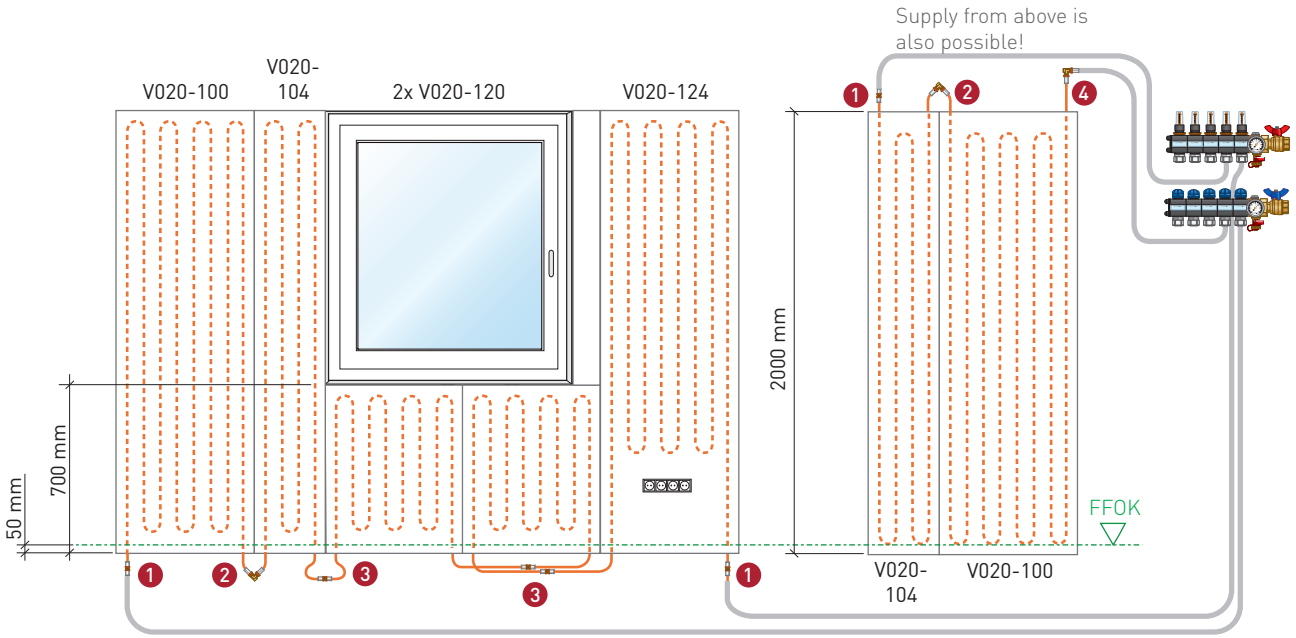
T_0 = mean surface temperature [°C]

T_r = room temperature [°C]

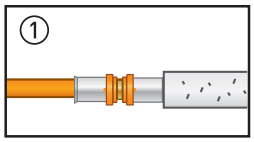
t_f/t_r = flow temperature / return temperature [°C]

6 PIPING

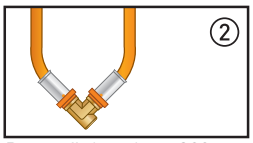
Caution: Connect max. 6.25 m² heating/cooling surface to a single circuit (e.g. 5 pcs. V020-100)!
For the heating/cooling surfaces of all ModulePanels, see the table in section 2.2.



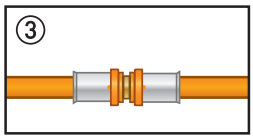
Supply pipes: pre-insulated Variomodular pipe 16x2 Laser



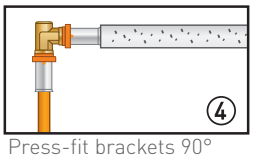
Press-fit coupling 16x11.6



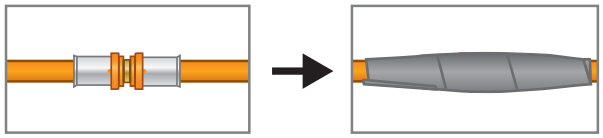
Press-fit brackets 90° 11.6x11.6



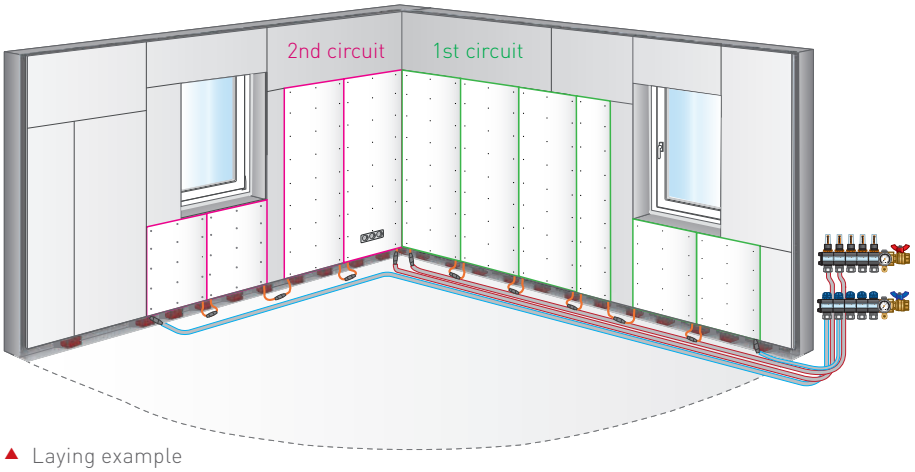
Press-fit coupling 11.6x11.6



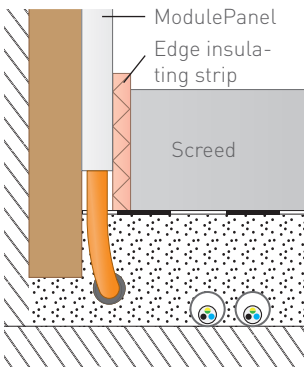
Press-fit brackets 90° 16x11.6



Corrosion protection measures:
According to ÖN H 5155, the joints should be protected after the pressure test (e.g. using cold shrink tape or corrosion protection tape).



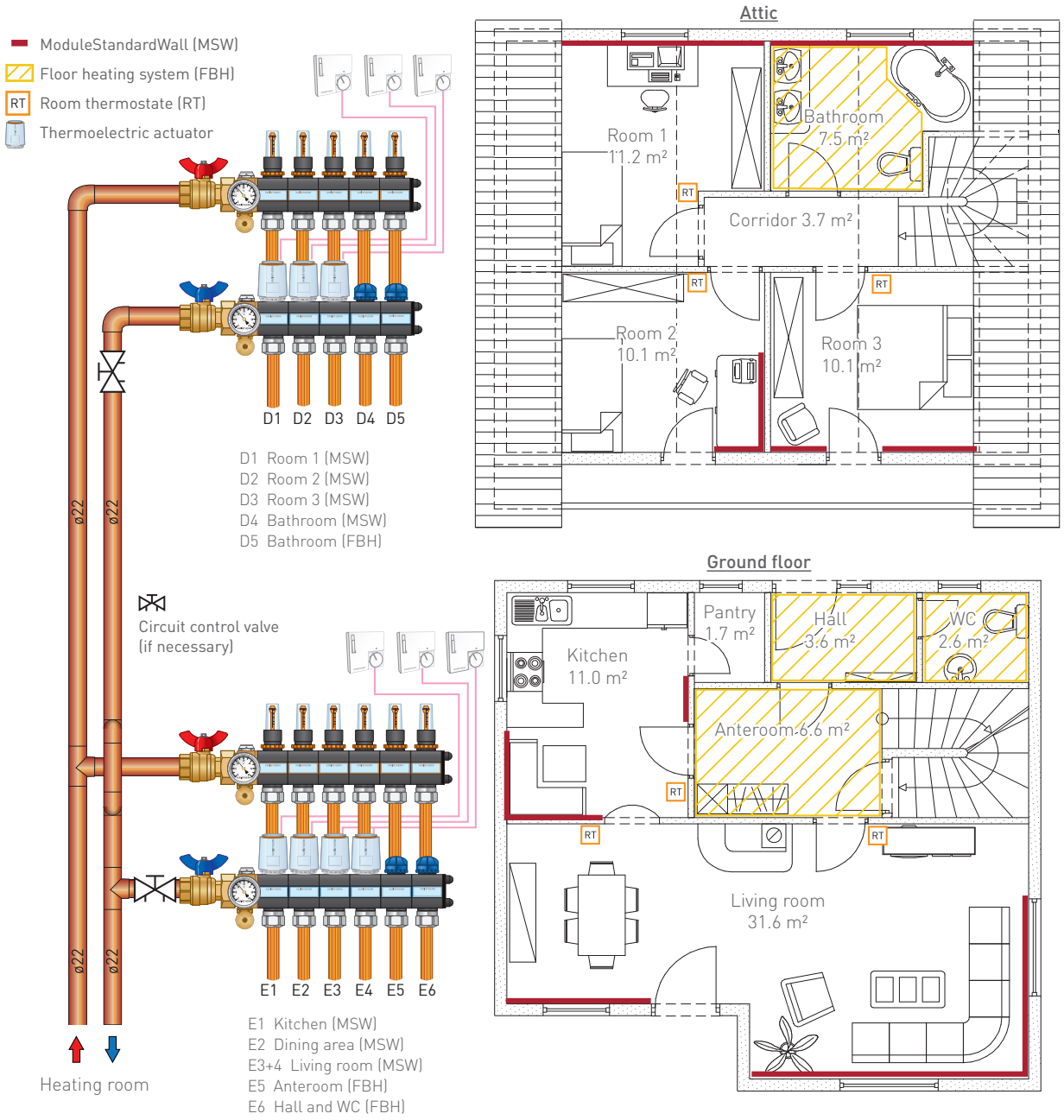
▲ Laying example

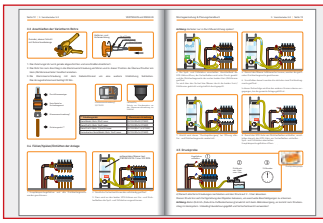


▲ Example cross-section

Single-family house connection example

In the example provided, the heating system has been adapted to suit the rooms: A floor heating system is planned for tiled rooms (anterooms, toilet, bathroom) and wall heating surfaces are planned for the living room, work room and bedrooms. A room thermostat for controlling the room temperature is planned for the kitchen, dining area and living room (influence of external heat sources from kitchen appliances, south-facing glass surfaces and tile stoves).



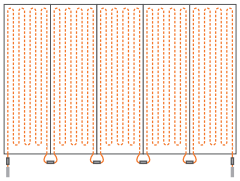


<< Details regarding the system and heating circuit pipes and the room temperature control are provided in the DISTRIBUTION and CONTROL design and installation manual

7 PRESSURE LOSS

Example: The total pressure loss Δp_{Total} of a 6.25 m² ModulWall (5 pcs. V020-100 at 1 heating circuit) is to be calculated. The desired flow/return temperature is 40/30 °C, resulting in a heat output of 111 W/m² at a room temperature of 20 °C.
The total pressure loss Δp_{total} is calculated using the following components:

- Pipes and press-fit couplings
- Heating/cooling distribution manifold
- Boiler house (mixing valve, boiler ...)



1. Pipes and press-fit couplings

Calculation of the flow rate ω from the pressure loss diagram:
Q = 694 W (111 W/m² x 6.25 m²)
ΔT = 10 K (t_f/t_r = 40/30 °C)
Flow volume m = Q / c / ΔT = 694 W / 1.163 Wh/kgK / 10 K = 59.6 kg/h

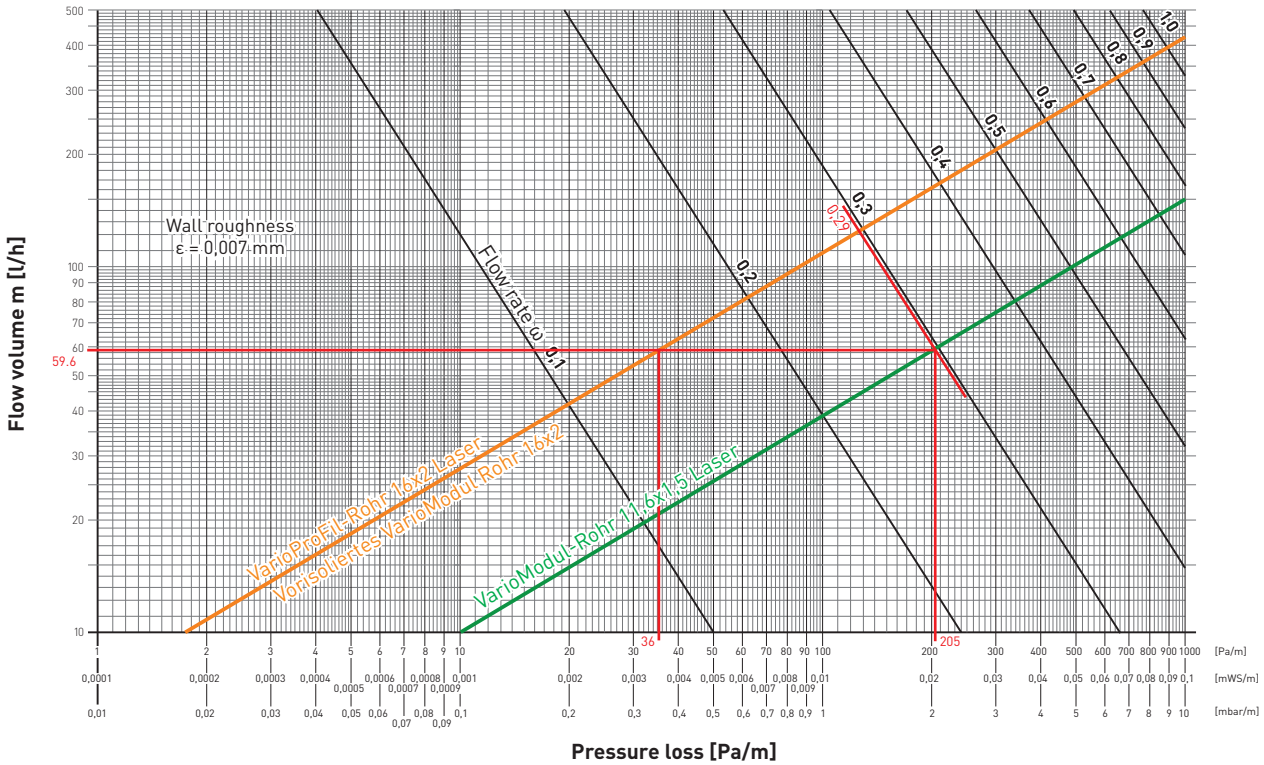
A flow volume m = 59.6 kg/h (= l/h) yields a flow rate ω = 0.29 m/s

Pipe length in ModulePanel (see table chapter 2.2)		
V020-100	MSWC-2000-625	16.2 m

Press-fit coupling	Coefficient of resistance ζ (Zeta)
16 x 11.6	6.9
11.6 x 11.6	7.2

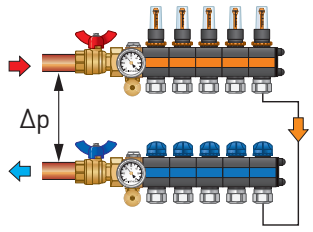
Density of water ρ (Rho)	1,000 kg/m³
Specific heat capacity of water c	1.163 Wh/kgK

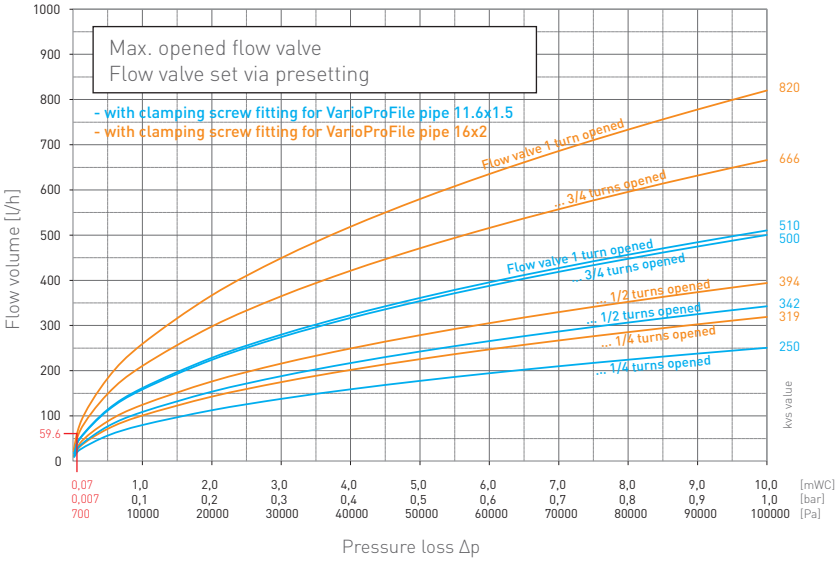
- **Δp for 15 m pre-insulated Variomodular pipe 16x2:** 36 Pa/m × 15 m = 540 Pa
- **Δp for 6.25 m² ModulPanels (5 pcs. V020-100):** 205 Pa/m × (5 pcs. × 16.2 m = 81 m) = 16,605 Pa
- **Δp for 4 pcs. press-fit couplings 11.6 x 11.6:** ζ × ρ/2 × ω² = 7.2 × 500 kg/m³ × (0.29 m/s)² = 303 Pa × 4 pcs. = 1212 Pa
- **Δp for 2 pcs. press-fit couplings 16 x 11.6:** ζ × ρ/2 × ω² = 6.9 × 500 kg/m³ × (0.29 m/s)² = 290 Pa × 2 pcs. = 580 Pa



2. Heating/cooling distribution manifold

The flow rate characteristic curves for calculating the pressure loss of the heating/cooling distribution manifold for the heating circuits in question.





- **Δp of the heating/cooling distribution manifold with an open valve up to 59.6 l/h =** 700 Pa

3. Boiler house (assumptions)

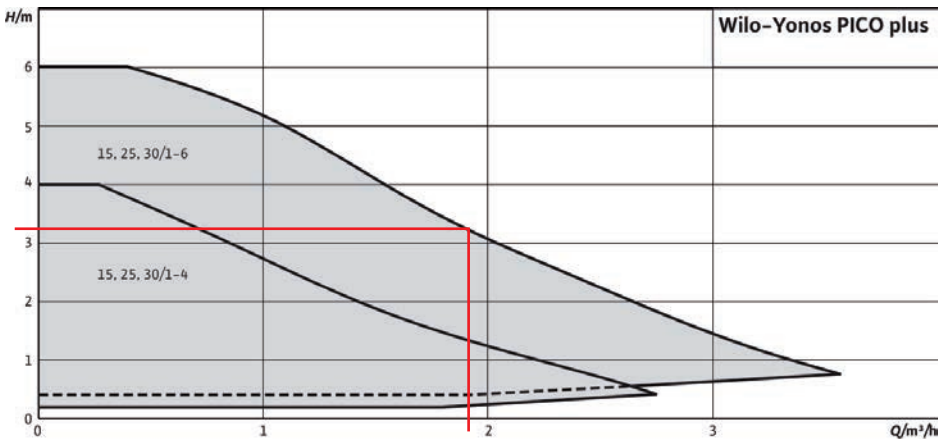
- **Δp Mixing valve** = 6,000 Pa
- **Δp Connection piping** = 3,500 Pa
- **Δp Boiler** = 3,000 Pa

4. Total pressure

- **Δp_{total} = 32,137 Pa = 3.21 mWC**

5.) Selection of the heating circulation pump (example: Wilo Yonos PICO Plus 25/1-6)

At the calculated pressure loss of 3.21 mWS the pump supplies a maximum volume flow of 1.9 m³/h.

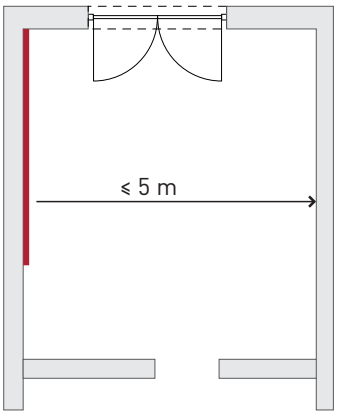


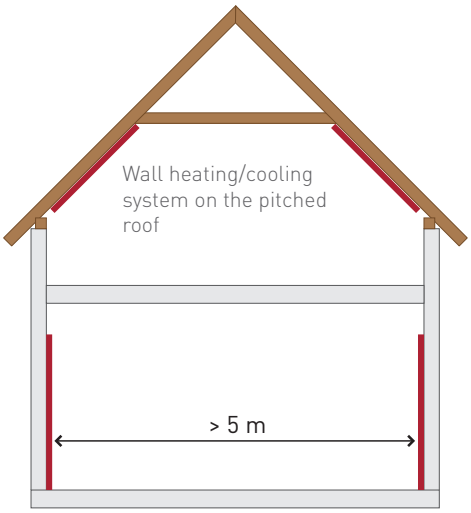
▲ Example:
Wilo Yonos PICO Plus 25/1-6
heating circulation pump

8 ARRANGEMENT OF THE SURFACES

Wall heating installations are used for heating occupied areas. For this reason, they should be evenly distributed over the interior sides of exterior walls. At normal ceiling heights (up to 3 m) in buildings with good thermal insulation, designing the ModuleStandardWall to a maximum height of 2 m above the finished floor level is sufficient. In special cases (ceiling height > 3 m, e.g. halls, stairwells, therapy areas) the wall heating installations must be designed higher than 2 m.

Experience has shown that the comfort effect is perceived at a distance of up to 5 m from the heated wall. In larger rooms it is therefore advantageous to install wall heating systems on two opposing walls because the radiance effect on the body declines in proportion to the square of the distance.





Estimated values for dimensions:
~ 40 % wall surface of the room area for heating
~ 80 % wall surface of the room area for cooling
Caution: Observe the heating/cooling load calculation for precise dimensioning of the area required!

With a good arrangement of the radiant heating surfaces and U-values (exterior wall) of ≤ 0.3 W/m²K, the room air temperature can be reduced by up to 3 °C while retaining the same perceived temperature (comfort). Seating and glass surfaces (e.g. windows) must be taken into consideration when choosing the arrangement of wall heating surfaces.

Issues relating to furniture:
Since the radiant heat should penetrate into the living area, this is to be taken into consideration in the furniture planning. Wall fittings, full bookcases, built-in cupboards etc. should not be planned in front of wall heating systems. Desks, chests of drawers, open seats, small boxes, kitchen corner banks, pictures etc. usually present no problem. General rule of thumb: maximum of 15% furnished area.
Tip: Beds (especially the bedheads) should not be placed directly in the radiation area of wall heating elements.

9 FINISHED SURFACE

9.1 Stopping

Caution: Stopping must not be performed until all wet work has dried out (wet screed, plastering work, etc.)!

The following work is to be performed, depending on the surface quality required:

Q1	• Stopping of visible joints and adhesive seams with FERMACELL grouting
Q2	• Q1 + burr-free and step-free stopping of the seams and joints
Q3	Full-surface stopping: • Stopping of the visible joints with FERMACELL grouting or plaster • Wide stopping of the seams • Full-surface coating and sharp pulling-off using FERMACELL grouting or fine stopper or other suitable stopping material
Q4	Full-surface coating: • Stopping of the visible joints with FERMACELL grouting or plaster • Wide stopping of the seams • Full-surface coating and smoothing using FERMACELL fine stopper or plaster or other suitable stopping material

9.2 Painting

Commonly available paints such as (e.g.) latex, emulsion or enamel paint can be applied to the ModulePanels. Mineral-based paints such as (e.g.) limewash and silicate paints must be approved by the manufacturer for use on gypsum fibreboards. The paint is usually applied in two steps.

9.3 Fastening loads to the ModuleStandardWall

Single loads hanging on the wall

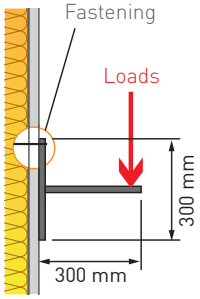
Light single loads parallel to the wall surface with low outreaches, such as (e.g.) pictures or decorations, can be fastened directly to the the FERMACELL planking using commonly available fasteners without using an additional substructure. Suitable for this are (e.g.) nails, picture hooks with single or double nail mounts, or screws and dowels.

Picture hooks[1] fastened with nails	Permissible load[2] per hook on ModulePanel (≙ 12.5 mm FERMACELL Panel), (100 kg = 1 kN)
	0.17 kN
	0.27 kN
	0.37 kN

Cabinet loads[3] on ModuleStandardWall

The listed loading values can be added when the dowel clearance is ⩾ 500 mm. At lower dowel clearances, 50% of the respective maximum permissible load for each dowel is used. The sum of the individual loads must not exceed 1.5 kN/m for walls and must not exceed 0.4 kN/m for free-standing single wall panels and double stud walls that are not connected to each other. Higher loads must be specially checked and approved.

Cabinet loads fastened with dowels[4] or screws	Permissible loads for individual hanging on ModulePanel (≙ 12.5 mm FERMACELL Panel), (100 kg = 1 kN)
	0.50 kN
	0.30 kN

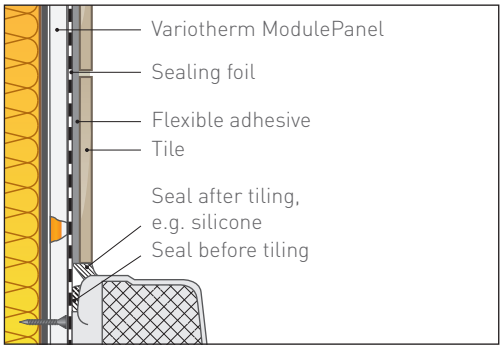


[1] Breaking force of the hooks per brand. Hooks fastened corrosion-neutral only in the planking
[2] Safety factor 2 (constant load at rel. humidity up to 80 %)
[3] Introduced as per DIN 4103, safety factor 2
[4] Observe the instructions of the dowel manufacturer.

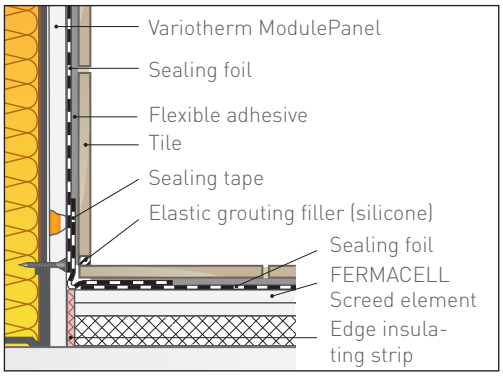
9.4 Tiling

See also the appropriate standards for laying tiles, panels and mosaics.
Points to be observed:

- The weight of the tiles (incl. adhesive) must not exceed 56 kg/m².
- The surface of the ModulePanels must be dust-free.
- The moisture content of the ModulePanels must be less than 1.3 % (min. 48 h at 70 % humidity and room temperature > 15 °C).
- Sealing systems must be used on surfaces subject to the effects of moisture (see table below). The wall boundaries must be sealed using appropriate sealing tape.
- A flexible adhesive is used to bond the tiles. A primer must be applied if this is stated by the adhesive manufacturer. This is particularly the case for flexible cement adhesives.
- Flexible grouting mortar must be used for grouting.
- After laying the tiles, boundaries with the walls are additionally sealed with silicone



▲ Connections between shower or bath and Variotherm ModulePanels



▲ Wall-screed structure in areas subjected to water loads

Use of primer and sealing system: (composite waterproofing):

Operational demands group ÖN B 3407	Operational demands group ZDB composite waterproofing (Germany)	Which Room?	Adhesive mortar with tile coverings	Sealing system	Primer
W1	–	Residential sector: living rooms, corridors, toilets, offices and the like	Calcium sulfate flexible adhesive mortar	Not required	Not required
			Cement flexible adhesive mortar	Not required	Required
W2	–	Residential sector: kitchen and rooms with similar usage Commercial sector: toilet systems	Only cement flexible adhesive mortar	Recommended	In addition to the sealing system, when recommended by the manufacturer
W3	A0	Wall and floor surfaces without drainage (e.g. bathroom with shower tub), toilet systems without floor drainage, porch	Only cement flexible adhesive mortar	Required	In addition to the sealing system, when recommended by the manufacturer
W4 – W6	B0, A, B, C	Wall and floor surfaces with drainage (e.g. shower with flush drain at the same level as the floor), shower systems, industrial kitchen, balconies, terraces ...	No ModuleWall possible.		

Product examples for primer or sealing system (composite waterproofing):

Manufacturer/Brand	Primer	Sealing system
FERMACELL	Deep primer	Flüssigfolie
Ardex	Ardex P51	Ardex 8 + 9
Murexin	Tiefengrund LF1	Duschdicht / Flüssigfolie 1KS
Cimsec	Gipsgrundierung	Flexible sealant DU15
PCI	Gisogrund	Lastogum
Schönox	Schönox KH	Schönox HA oder 1K-DS
Mapei	Primer G	Mapegum WPS
Weber	weber.prim 801	weber.sys 822
Ceresit	Solvent-free deep primer	Ceresit shower & bath sealant

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