MOISTURE GUIDE

PAROC STONEWOOL

OWENS CORNING PAROC

MOISTURE GUIDE

Contents

1. MOISTURE

We are surrounded with water. It covers 71% of the Earth's surface and is vital for all known forms of life. Water is present in the form of a solid, liquid, or gas.

The sun's heat recycles our planet's water as it evaporates into the atmosphere from the oceans, lakes, soil, people, and vegetation. The term *humidity* generally refers to the amount of water vapor in the atmosphere. Humidity is most often used to describe how the air feels, often in conjunction with heat. If it is hot and humid, the air is usually uncomfortable.

The term *moisture* is used for all forms of water. Moisture is a measurable amount of water in air or another material.

1.1. MOISTURE TRANSPORT MECHANISMS

Building science is concerned with four different moisture transport mechanisms and their effects in buildings: transport of bulk moisture; humidity transported through the air by convection; water vapor diffusion; and capillary moisture movement. This means that moisture does not only enter a building in the form of liquid water or snow. The moisture movement can also be invisible and thus harder to control.

1.1.1 Bulk moisture and building moisture

"Visible" bulk moisture is the most frequent and widespread cause of building moisture problems. The primary sources of bulk moisture are external to the building and come from the climate (e.g., rain) and the earth (e.g., ground water). However, internal sources, such as plumbing leaks and wet cleaning processes, are also considered bulk moisture.

Liquid water can enter the building from unexpected directions. Wind-driven rain or driving rain is rain to which the wind has given a horizontal velocity component. It is one of the most important moisture sources affecting building façades.

Building moisture is the excessive moisture that building materials are subjected to during their manufacturing process, storage, or installation. This moisture is meant to evaporate or dry during the construction process and building use. Building moisture is the amount of water that is removed from the structure before the structure is in moisture balance with its final environment. The moisture content of building materials varies from 0 to 320 kg/m^3.

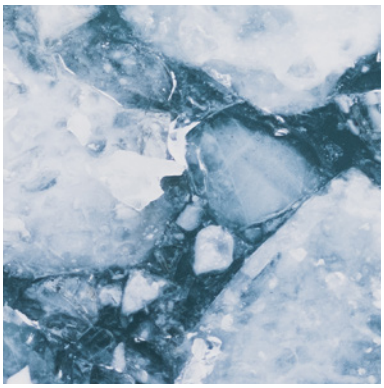
(Source: Terveet tilat 2028 -ohjelma Ympäristöministeriö, Rakennusfysiikkaa rakennusinsinöörille, Kosteus)

1.1.2 Convection

"Invisible" moisture is more difficult to understand and avoid. In convection, moisture moves from place to place due to warm air flow. This air flow can be either forced (air ventilation) or natural. The maximum amount of water which the air can contain depends on the air temperature. The amount of vapor in the air is described in either of two ways: as vapor pressure (p, [Pa]) or as partial vapor density (v, [g/m^3]).

Saturation density (v_k) and saturation pressure (p_k) tell us the maximum amount of vapor in the air at a specific temperature (either as density [g/m^3] or as pressure [Pa]). When the saturation pressure is exceeded, water vapor starts to condensate as liquid water if a suitable condensation surface is available. The surface can be any solid.

The amount of water vapor in the air is usually less than that required to saturate the air. The *relative humidity* is the percentage of saturation humidity, generally calculated in relation to saturated vapor density.



Humidity is calculated as a percentage (%)

Relative humidity (RH) =

$$\frac{\textbf{Actual water vapor density (v)}}{\textbf{Saturation water vapor density } (v_k)} \times 100\,\%$$

The most common unit for vapor density (v) is g/m³.

The relative humidity is a consistent measurement of the humidity only if combined with the corresponding temperature. For example, if the actual vapor density is 10 g/m³ at 20 °C and the saturation vapor density at 20°C is 17.3 g/m³, then the relative humidity is 57.8%:

Relative humidity =

$$\frac{10\ g/m^3}{17{,}3\ g/m^3} \times 100\,\% = 57{,}8\,\%$$

A comfortable relative humidity for indoor air is 40–60%.

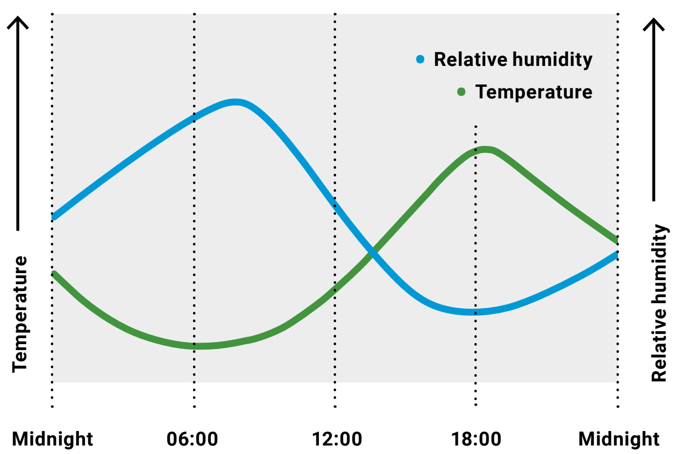
The term *absolute humidity* is easier to understand as it describes how much water there is in a certain volume of air (g/m³). For example, if we had 1 m³ of dry air in a vessel at a temperature of -10 °C and we add 5 g of water to it, what would happen? From the table below, we can see that the saturation content of air at -10 °C is 2.2 g. Therefore some of the water (2.2 g) would vaporize into the air and the rest of the water (2.8 g) would freeze in the bottom of vessel. The absolute humidity value changes as air volume expands and contracts.

Common water vapor sources in buildings include diffusion due to vapor pressure difference, evaporation from people, wet surfaces and processes, generation from combustion, infiltration from outside, and ventilation airflow. A reduced ventilation level inside the house increases the relative humidity. With proper ventilation, the vapor content will remain within feasible limits.

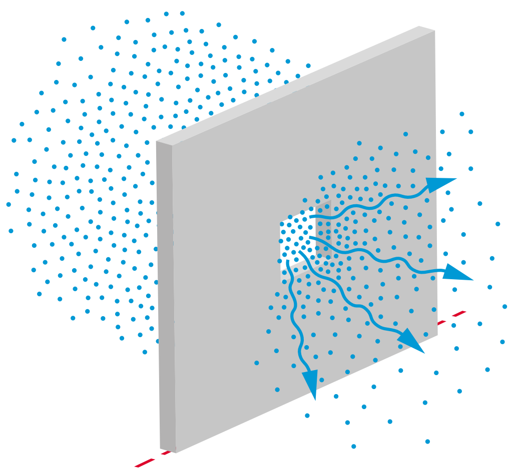
Water vapor is transported by warm air. The warmer the air, the greater the amount of moisture that moves with it. When air finds a hole or crack in the envelope structure, warm indoor air leaks outwards through it due to the temperature difference between outdoors and indoors. These small defects in the envelope might cause a large problem, since one 10 mm hole throughout the whole structure, with 2 Pa air pressure difference across the structure, can cause 1 liter of water transfer per month. It should be noted that this kind of moisture transportation requires a hole or crack that extends through the whole structure. A small hole in a vapor barrier behind an intact gypsum board will not cause any damage.

As humid air travels through a building envelope, the moisture in it will condense on any tight surface with a temperature below the dew point, i.e., the temperature when the saturation vapor pressure is reached.

The dew point is the temperature at which water vapor becomes transformed into liquid water. This is a function of both the temperature and the amount of moisture in the air. Water vapor will only condense onto another surface when that surface is cooler than the dew point temperature, or when the water vapor equilibrium in the air has been exceeded. The dew point can be calculated using the following formula:



The relative humidity of the air varies according to the temperature changes of the day.



Convection

Table: Saturation vapor density, v_k, and saturation vapor pressure, p_k.

(Source: Terveet tilat 2028 -ohjelma, Ympäristöministeriö, Rakennusfysiikkaa rakennusinsinöörille, Kosteus)

t °C	V_k g/m³	P_k Pa	t °C	V_k g/m³	P_k Pa	t °C	V_k g/m³	P_k Pa
-20	**0,87**	102	-3	3,89	485	14	12,10	1602
-19	0,95	111	-2	4,19	524	15	12,86	1708
-18	1,04	122	-1	4,51	566	16	13,65	1820
-17	1,14	135	**0**	**4,85**	611	17	14,49	1939
-16	1,25	149	1	5,21	658	18	15,37	2064
-15	1,38	164	2	5,58	708	19	16,30	2197
-14	1,52	181	3	5,98	762	**20**	**17,28**	2337
-13	1,67	200	4	6,40	818	21	18,31	2484
-12	1,83	221	5	6,84	878	22	19,40	2640
-11	2,01	242	6	7,31	941	23	20,54	2805
-10	**2,20**	266	7	7,80	1008	24	21,74	2979
-9	2,40	292	8	8,32	1079	25	23,00	3162
-8	2,61	319	9	8,87	1154	26	24,32	3355
-7	2,84	348	**10**	**9,45**	1234	27	25,71	3559
-6	3,08	379	11	10,06	1318	28	27,17	3773
-5	3,33	412	12	10,71	1408	29	28,70	3999
-4	3,60	447	13	11,38	1502	**30**	**30,31**	4237

It is easy to see from the table how low the internal surface temperature of the window can drop before condensation happens in a room with, for example, a relative humidity of 50% and a temperature of +22 ˚C. When relative humidity is 50%, vapor density is v_k = 0.5 x 19.4 = 9.7 g/m³. When looking at the saturation vapor density at a level of 9.7 g/m³, we can see that the saturation temperature is around 10–11 ˚C. That means that we have to keep all surfaces above 11 ˚C to avoid condensation.

$$T_d = T - \frac{(100 - RH)}{5}$$

Calculation of the dew point (T_d) from the temperature (T) and relative humidity (RH).

For example, if we have a dew point of 10 °C, any surface in the room with a temperature of less than 10 °C will have liquid water on it due to condensation. To prevent this, we can either raise the surface temperature or lower the relative humidity.

The easiest way of controlling damage from water vapor and moisture is to reduce the amount of moisture generated.

1.1.3 Diffusion

Diffusion occurs due to differences in the vapor density/partial vapor pressure between two different spaces. At the times of the year when heating is used, the air is typically more humid on the inside. Due purely to differences in density/pressure, the humidity of the indoor air tries to reach a balance with that of the outdoor air, causing humidity to transfer as vapor from indoors, through the building envelope, to outdoors. In the absence of a vapor-tight barrier, the vapor density/partial water vapor pressure tends to even out by diffusion. However, if the water vapor diffusing through the structure meets a cold surface, it may condense. Diffusion occurs without any movement of the air itself. Vapor barriers are used on the interior (warm) side of the envelope to prevent moisture intrusion into the structures.

All materials allow water vapor to pass through them to some degree. Condensation will usually not occur as long as two-thirds of the insulating value of the wall is located outside the vapor barrier.

1.1.4 Capillarity

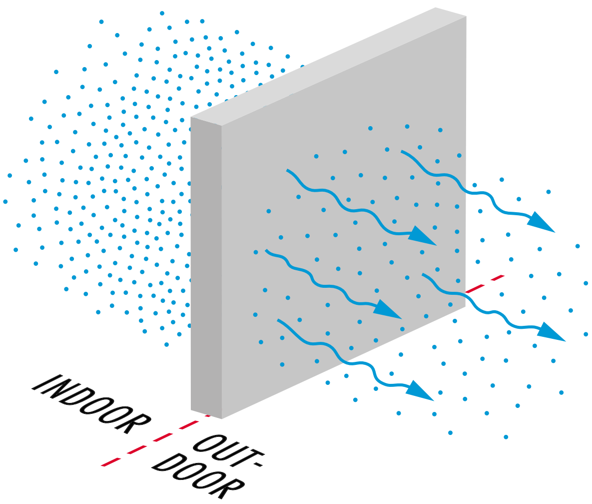
Capillarity is the ability of a liquid to flow in narrow spaces without the assistance of, and in opposition to, external forces like gravity. This phenomenon occurs in soil, for example.

Similar to water moving upwards through a tube against the force of gravity, water moves upwards through soil pores or the spaces between soil particles. The level to which the water rises depends on the pore size.

Capillary rise commonly occurs in the footing of the foundation wall and when there is capillary suction of water behind a siding. Capillarity can be controlled by sealing the pores or making the pores very large.

1.2. THE MYTH OF "BREATHING STRUCTURES"

The term "breathing structure" is vague and misunderstood. It is widely used for marketing purposes to create an image of a green or traditional non-plastic structure or material. Explanations refer to air/gas movement through construction layers or the capability of structures to balance indoor air moisture. Both of these phenomena should be considered separately.



Diffusion

1.2.1 Air leakage

Even though structures may be permeable to air/gas, they cannot substitute for the proper ventilation needed in every building. In fact, an air-leaky building envelope makes it very difficult to control the pressure caused by the wind and the temperature differences between indoor and outdoor air. Uncontrollable ventilation may cause poor indoor air quality, low thermal comfort, and unwanted energy losses.

According to several studies*, an airtight building envelope is the first requirement for achieving good indoor air conditions in energy-efficient buildings. Air-leaky structures are undesirable and they have nothing to do with the possible positive effects (moisture buffering of indoor air humidity) of breathing structures.

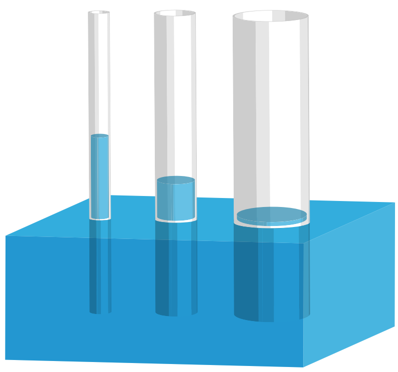
* Zhivov et al. (2025), AIVC / TightVent Europe (2012–2025), Wills et al. (2022), Zahed et al. (2023), Heibati, Maref & Saber (2021/2022), IEA EBC Annex 68 (2020)

1.2.2 Moisture buffering of indoor air humidity

Hygroscopic structures that are in direct contact with indoor air can moderate the relative humidity levels of the indoor air. This is called *the moisture buffering effect*. The ability of surface materials to buffer moisture loads reduces the risk of condensation in structures, and this prevents the risk of biological growth in surface materials, for example mold growth on walls.

Since moisture buffering is based on the surface layer material, it can also be utilized in structures having a vapor barrier (PE- or aluminum foil). In these cases, hygroscopic material layers should be installed on the interior side of the vapor-tight layer.

In many cases, the ability of hygroscopic material to buffer moisture is significantly reduced or even totally prevented by using different surface treatments (like paints, wallpapers, or sheathings). With more vapor-tight materials, like wood, the vapor transfer is limited to layers close to the surface. It is more likely that textiles and furniture buffer more moisture from indoor air than any construction material.



Capillarity

2. MOISTURE AND BUILDING ENVELOPE DESIGN

Damage to health and buildings due to moisture can be very expensive. Liquid water is usually easy to detect but many water-related problems are less obvious and difficult to diagnose or see.

Moisture control is fundamental to the proper functioning of any building. A well-designed building envelope protects its occupants from adverse health effects and the building from physical or chemical damage. Good moisture control does not require all the building materials to be totally dry, only that moisture-sensitive materials remain dry enough to avoid problems.

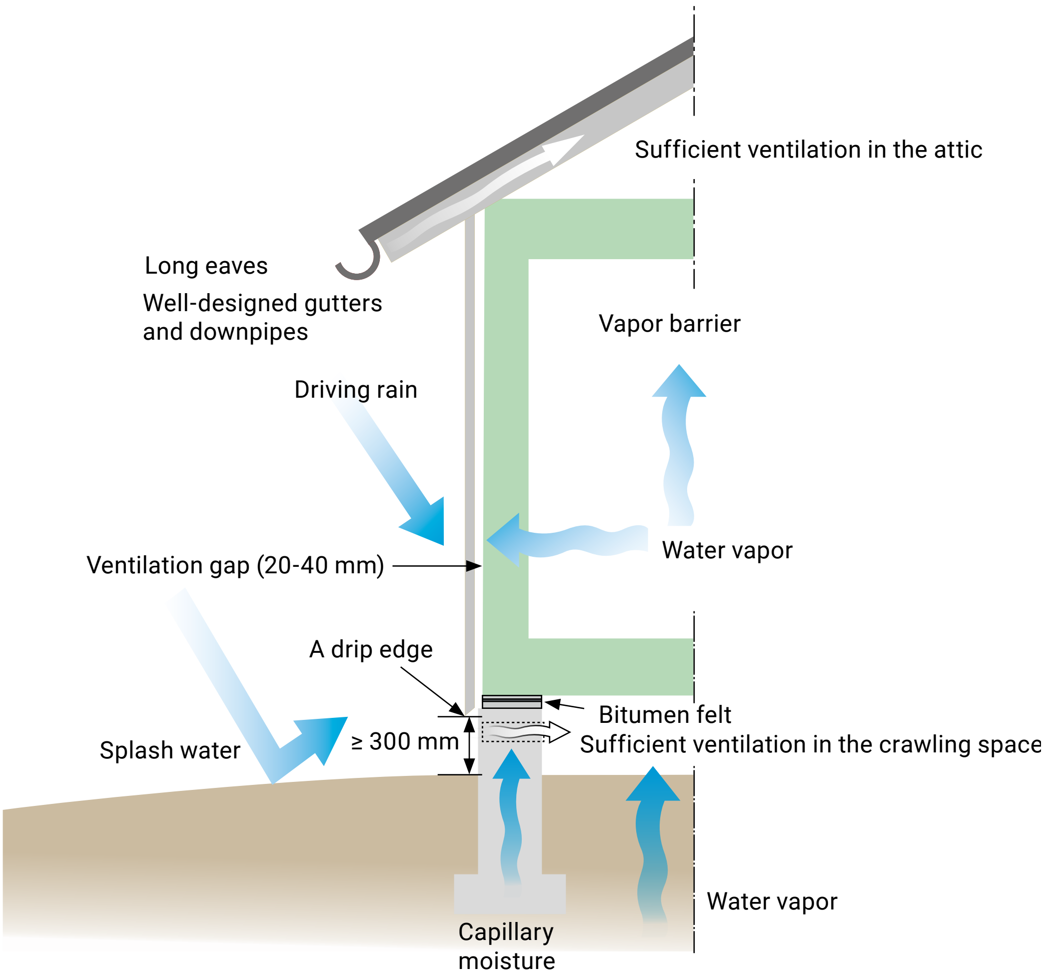
Most of the structural moisture problems in buildings are caused by ground moisture, rain or water used inside the building. Moisture control is an essential part of the building design phase.

Fortunately, the design rules are rather simple:

- **Prevent moisture from getting inside the structures;**
- **Make material choices that ensure the moisture inside the structure is able to dry.**

2.1 FOUNDATION

Controlling moisture-driven capillary movement is one of the most important defenses against moisture and humidity from the ground. A good gravel-based building site makes ground moisture handling easier. Unfortunately, the best building sites are often already occupied, so we have to utilize the ones that remain. If the soil is not suitable for building, it must be changed.



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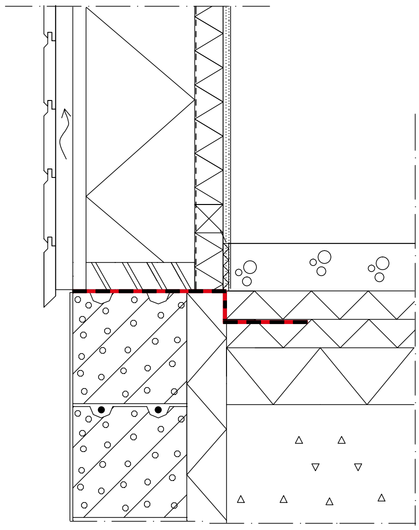


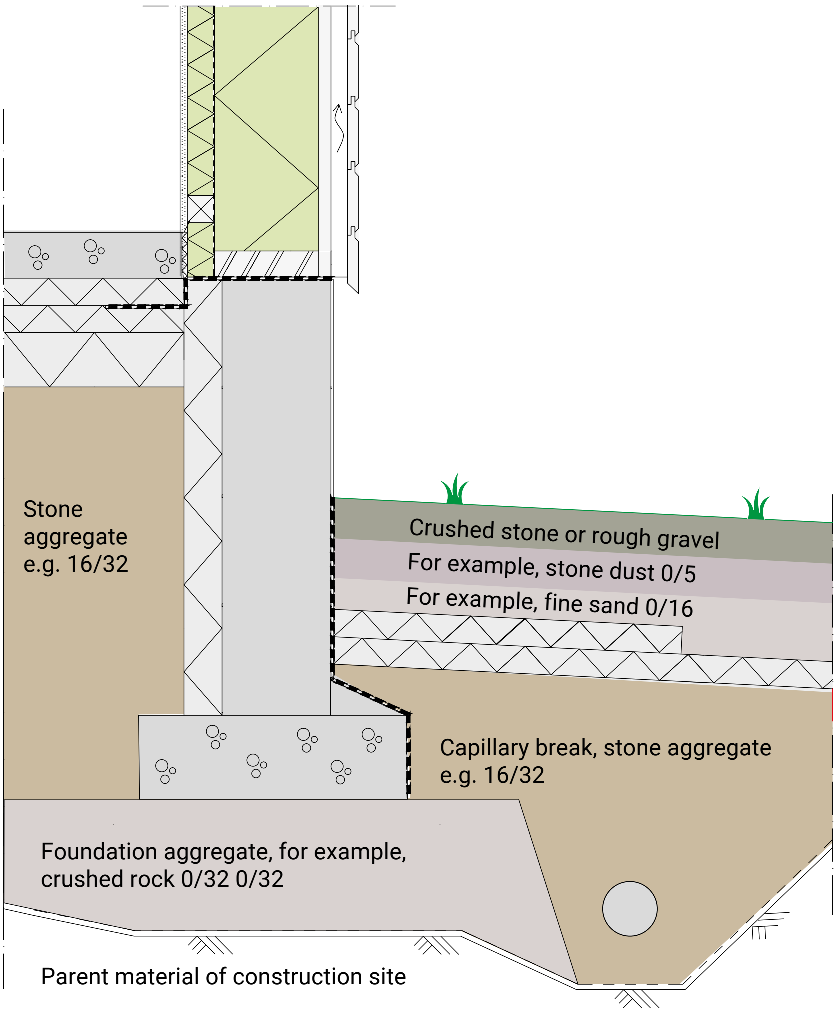
Capillary break

A capillary break can be created beneath the foundation slab and outside the foundation by means of a layer of suitable gravel. The picture below shows an example of the different gravel and sand types used in foundations.

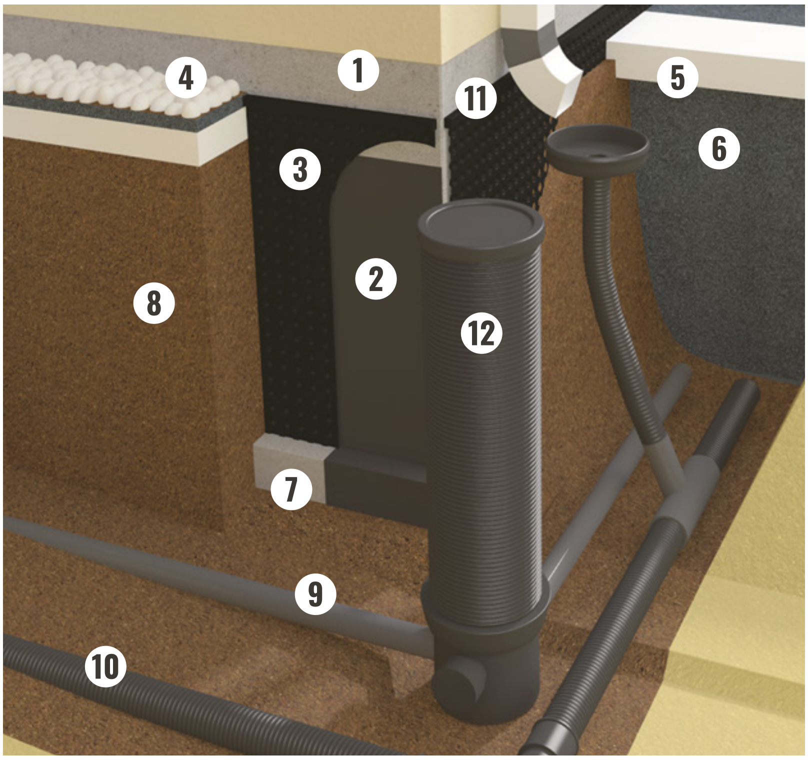
Perimeter drains are used around the outside of the foundation or basement footings to collect and transport subsurface water away from the building. If groundwater is likely to present a major problem, the soil may not be ideal for a full basement foundation.

The picture on the next page shows an example of a drainage system used for managing moisture in the ground.

When the foundation is ready, it is important to add a capillary break between the concrete foundation and the wall structure. This capillary break can be achieved by using suitable bitumen felt (welded or glued). The bitumen felt strip should be well fixed and wide enough so that it can be installed 150 mm under the floor slab. Bitumen felt makes the slab and foundation connection tight enough to prevent radon and other impurities from entering the building.



Subsoil layers as part of moisture control



1	**Foundation**
2	**Bitumen felt**
3	**Foundation waterproofing sheet**
4	**Ground surface**
5	**Frost insulation**
6	**Filling with gravel**
7	**Geo-textile**
8	**Sand/gravel**
9	**Perimeter drain**
10	**Rain water system**
11	**Plastic batten**
12	**Drainage inspection chamber**

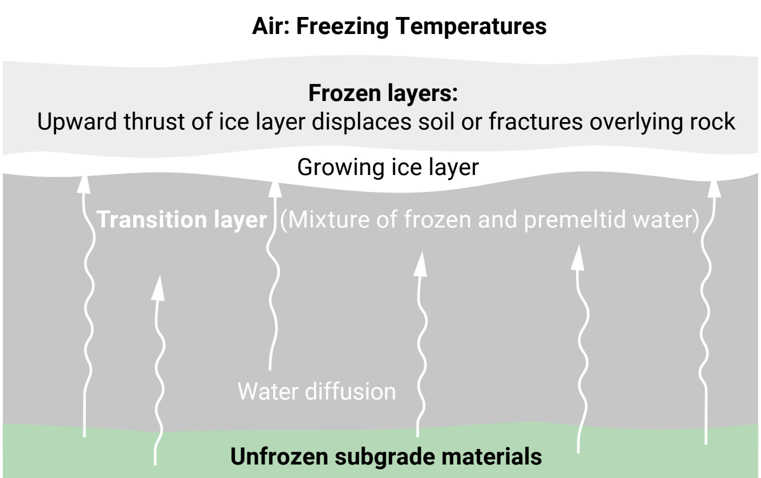
Underground drainage and rainwater drains

2.2 FROST AND FLOOR INSULATION

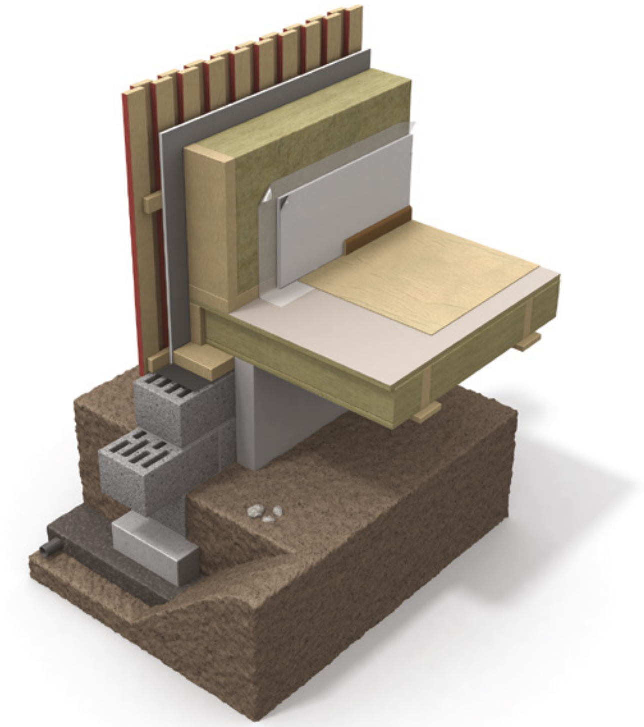
Frost heaving (or frost heave) is an upwards swelling of soil during freezing conditions, caused by an increasing presence of ice as it forms upwards, towards the surface, from the depth of soil to which freezing temperatures have penetrated. Growth of the layer of ice requires a water supply that delivers water to the freezing front via capillary and diffusion action in certain soils. If not controlled, frost heave can seriously damage buildings and other structures in cold climates.

Underground capillary breaks made from gravel or built draining systems help to keep water away from the vicinity of foundations but they will not stop the upward movement of water vapor via diffusion. Therefore the ground must be prevented from freezing by using frost insulation around the foundation. The amount of frost insulation required depends on the building location, climate, and building site.

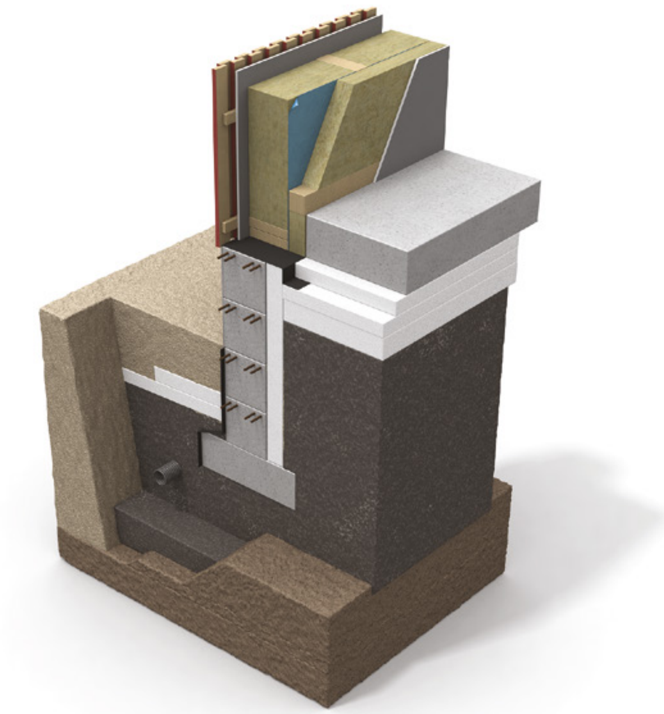
The depth of frozen soil ranges from very shallow to more than 3 meters in northern areas. The colder the environment, the more insulation needed. Frost insulation is installed on the external side of the foundation according to the foundation designer's instructions. Building corners should be 40% more insulated than other perimeter areas.



Ground frost heave



Ventilated floor



Ground slab

The foundation should also be insulated. Insulation can be installed on the outside or inside of the foundation, or in the middle of the foundation.

The floor can be either ventilated or a ground slab cast on top of the ground insulation layer.

Ventilated floor:

In the case of a ventilated floor, it is important to ensure that rainwater cannot get under the building and that there is sufficient natural ventilation in the crawling space. The crawling space must be free from all organic material due to the risk of mold related to very high humidity. (Ground moisture has an RH of 100%.)

The ventilated floor is built in a similar fashion to an external wall. Due to the high humidity level beneath, the wind protection boards must be well supported and resistant to moisture.

Ground slab:

The base floor of a building is typically built on top of the subsoil itself or on concrete slabs laid partly onto the foundation. The floor surface level should be at least 30 cm above the base floor.

Insulation can go above or below the slab, but take into account how the occupants of the building use heating. If the building will be in continuous use, install insulation under the concrete slab in order to utilize the thermal mass of the slab as a cover over the insulation.

In base floors, moisture transport moves in either one or two directions: by diffusion or capillarity.

It is important that moisture be removed from the structures after the concrete has been laid, either downwards, in which case the structure should not have a vapor-tight barrier, or upwards, in which case the floor should not have a moisture-tight coating before the concrete has dried.

At the building stage, the temperature of the subsoil under the base floor is normally between +6 and −16 °C. At this stage, the structure dries easily from indoors outwards if the insulation under the slab allows diffusion.

During building usage, the temperature of the subsoil is usually between +15 °C and +16 °C. The less insulation there is in the base floor, the warmer the subsoil. When the temperature of the subsoil rises and vapor density increases, the direction of diffusion in the structure can change and moisture can pass from the subsoil to indoor spaces. This often happens in the summer, when both the indoor air and the subsoil are warmer than during other seasons.

When planning to build the base floor on subsoil, it is important to ensure that the direction of vapor through diffusion is mainly from indoors outwards. One can ensure a moisture-safe solution through proper insulation of the base floor. The insulation layer under the concrete slabs should be thick enough to ensure that the temperature difference between the inner and outer surfaces of the insulation is at least 2–3 °C. In addition, indoor temperatures should be kept at a level that allows the building to function as planned and that prevents the moisture in structures from exceeding critical levels at any time of year.

There should be a sufficiently thick subsoil/gravel layer under the insulation to prevent capillary moisture from rising. The insulation should also help in this. The phenomenon of rising capillary moisture is independent of the temperature.

There are also mechanical requirements on insulation installed under concrete slabs, so the choice of insulation should not be made purely on the basis of moisture properties.

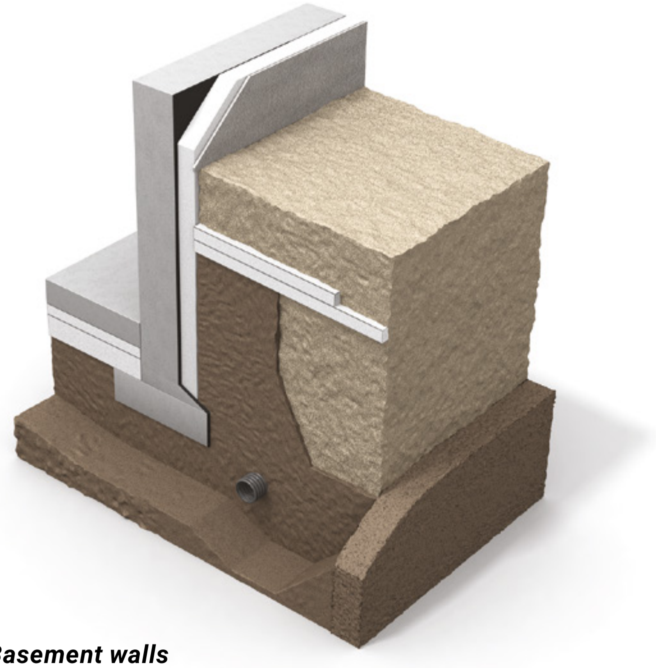
Basement walls:

The safest way to insulate a basement wall is to do it from the outside. The wall construction (concrete, blocks, etc.) must be protected on the external side against moisture with a watertight bitumen layer or an equivalent solution. If the basement wall is constructed out of blocks, the surface should be smoothened with rendering prior to waterproof membrane installation.

Thermal insulation is installed on the external side of waterproof layer.

The internal surface of the basement wall must be vapor permeable so that it allows structural humidity to dry inwards.

In this construction, it is important to ensure that moisture cannot get behind the waterproof layer.



Basement walls

2.3 EXTERNAL WALLS

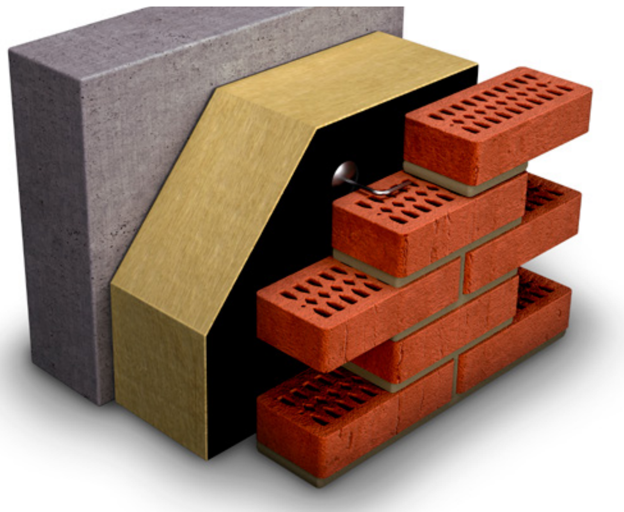
Exterior cladding must resist wind-driven rain or snow, which may push moisture into the structures from different directions. Therefore it is essential that materials (all the details and connections in this “rain jacket”), are well designed and installed.

Ventilated facades

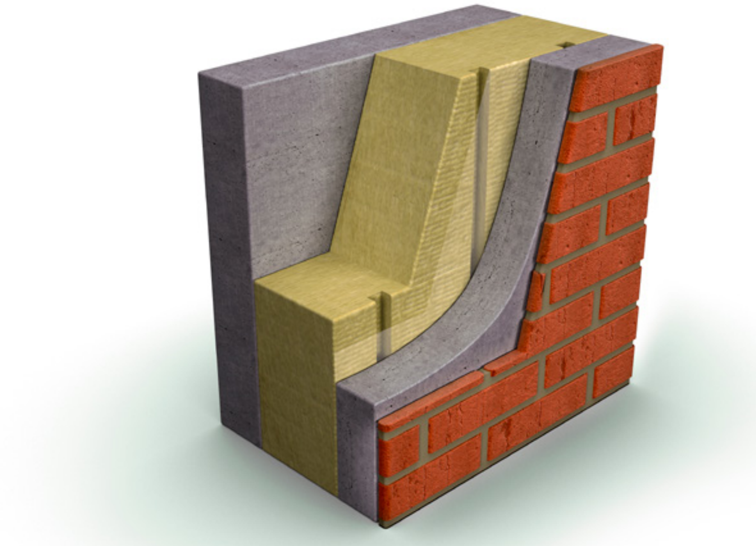
In a ventilated exterior wall, an air gap should be placed behind the façade cladding. The purpose of this gap is to remove moisture entering the building through the façade cladding or by diffusion from the structure.

In the gap, the air circulation transfers the moist air up and releases it outdoors through the openings at the top part of the cladding.

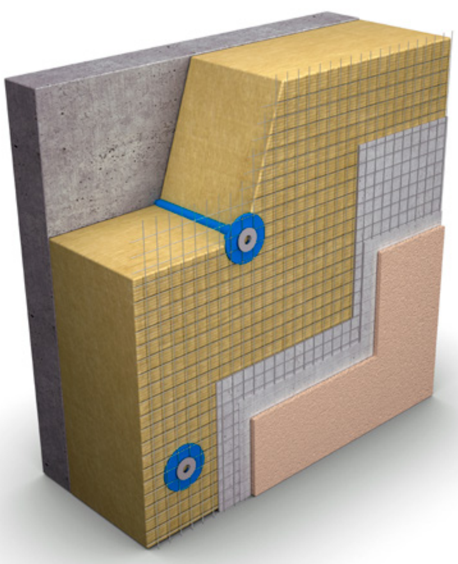
As the cladding is not totally airtight and stone wool insulation is porous, the insulation needs to be protected from the wind. The wind resistant layer needs to be airtight but water-vapor permeable to allow indoor



Ventilated facades



Concrete sandwich elements



Rendered facades

moisture to pass through. A general rule of thumb is that the wind resistant layer should be five times more vapor permeable than the vapor-tight barrier (1:5). To allow drying, the outer wall structure must always be designed so that the layers are consecutively more permeable the further one moves from the inner to the outer layers of the structure.

Fire barriers installed in the ventilation gap should not block the ventilation nor collect moisture in the structure.

On the inside, the construction must be air and water-vapor tight so that moist indoor air cannot cause the structures to become wet via diffusion. The vapor barrier prevents diffusion and stops invisible moisture from entering the structure. It forms a tight inner layer throughout the whole building envelope. All the seams and construction connections need special attention.

Massive constructions do not need a continuous vapor barrier. In massive constructions, the most challenging areas are connections and joints, which require efficient tightness.

Concrete sandwich elements

Fresh concrete incorporates approximately 150 kg/m^3 (100% RH) of moisture. Before concrete structures can be finished with surface coatings, the moisture content of the core structure must decrease to a low enough level, typically to 80–85% RH*, corresponding to about 85–93 kg/m^3 moisture content. Coating too early with vapor-tight layers may allow high humidity reactions, where emissions (VOCs) may adversely affect the indoor air quality.

Thermal insulation has a large effect on the drying time of the inner concrete layer. Porous insulation allows drying, both outwards and inwards.

If the external surface of a concrete sandwich panel is vapor tight, it is recommended that grooved stone wool insulation be used to ensure fast drying of the structure.

In structures having boundaries with fresh concrete and thermal insulation, biological growth (mold) is not possible due to the pH conditions created by the drying concrete. This also applies to rendered structures.

Rendered facades

The moisture performance of a rendered façade is based on sufficient water resistance and vapor permeability of the rendering layer. When rendering and all connection details are completed properly, the structure works well.

The drying mechanisms of rendered insulated walls are almost the same as those of the concrete sandwich element. The inner concrete core dries out significantly faster with stone wool than with more vapor-tight insulations.

PAROC Stonewool in external wall applications

Stone wool is an ideal insulation material for use in different kinds of wall structures. Good-quality installation of stone wool, avoiding cracks and gaps, is easy. Stone wool insulation is stable over the long term: it maintains its dimensions in different climate conditions and temperatures. No changes are expected to the moisture performance of stone wool insulation throughout the lifetime of the building.

An open stone wool insulation structure allows significantly faster drying of the inner concrete layer than thermal insulations with lower air/vapor permeability. According to VTT simulations, for stone wool the average 85% RH level for the inner concrete layer is reached in about 140 days, while for materials with lower vapor permeability (EPS & PIR), the 85% RH level is attained in 460–470 days. For aluminum-covered PIR insulation, it takes about 715 days to reach 85% RH.* A large difference in drying times naturally means large savings in project times and costs.

Insulation	Outer wall structure	Drying time, 85 % RH	Dry coating of inner surface	Drying time, 80 % RH
PAROC Stonewool, 220 mm	BSW Thin rendering Ventilated façade	135 days 125 days 178 days	~4,8 months	342 days 184 days 336 days
EPS, 220 mm	BSW Thin rendering Ventilated façade	474 days 457 days 514 days	~16 months	756 days 707 days 808 days
PIR, 170 mm	BSW Thin rendering Ventilated façade	458 days 440 days 490 days	~15,4 months	621 days 701 days 762 days
PIR (Aluminium surface), 170 mm	BSW Thin rendering Ventilated façade	716 days	~23,8 months	913 days
Phenolic foam 130 mm	BSW Thin rendering Ventilated façade	402 days 392 days 441 days	~13,7 months	493 days 486 days 541 days

Drying time for an inner building envelope of 120mm-thick concrete with various insulation materials.

During the wall insulation installation phase, the insulation surface may be exposed to wind-driven rain. According to study and simulations* by VTT, moisture loads from driving rain to the exterior surface of the unprotected stone wool insulation do not cause moisture accumulation in the structures, even during a four-month unsheltered period. Insulation tends to dry out very fast when the rain stops.

However, driving rain may generate risks for the construction with an unprotected thermal insulation layer due to non-idealities in material layer boundaries. This risk is always present, regardless of insulation material. Liquid water might get into the structure, leading to the risk of wetting.

Porous and diffusion open stone wool insulation allows for effective drying of a wet construction. This also adds a safety margin for wind-driven rain, where water can enter the structure via leaking connection details (e.g., around windows). Stone wool will not lock the moisture into the structure in the way vapor-tight insulation materials may.

Due to the open fiber structure, moisture cannot condense on the inside of the stone wool insulation layer. As a consequence, if moist air enters the insulation layer via cracks and holes in the vapor barrier, condensation will occur on the first airtight layer on the external side of the wall structure, when its temperature is below the dew point.

Stone wool quickly reveals any leaks or damage in the structures or in water pipes inside the structures. This is because the insulation does not absorb moisture but lets water leak through the insulating layer to a place where it can be detected. As the fault can be detected straight away, it can also be repaired quickly. Rapid action prevents extensive structural damage and prevents mold formation.

The stone wool is hydrophobic, i.e., it repels moisture in liquid form. It does not absorb water from the surrounding air even in extremely high relative humidity (RH 98%). Only dry insulation works as planned.

* [Source: Research reports VTT-R-04783-17 ja VTT-R-05677-17]

2.4 ROOF

Roofing prevents rainwater from accessing the structures. Well sloped roofs with long eaves typically give good protection from rain. Most leaks on roofs happen around penetrations through the roof, such as plumbing vent exhaust fans or a skylight. Flashings and sealant joints around these penetrations can fail and leak.

Moisture enters the roofing system and creates problems in three different ways:

1. During installation: rain and moist materials
2. Air leakage: indoor air humidity migrates from the building interior into the roofing system through the gaps in supporting structures or vapor barriers
3. Roofing material failure: a break in the roofing material allows water to enter the roofing system from the exterior

Pitched roofs

To ensure proper moisture removal in attic constructions, the ventilated space above the insulation layer must be high enough: at least 200 mm when the roof pitch is <1:20, and at least 100 mm in roofs steeper than that.

The exhaust air ventilators must be as high up as possible and the replacement air ventilators must be placed low. Natural ventilation in the ventilation gap/space dries the structure due to the level difference and the tendency of warm air to rise. Ventilation from the eaves can be ensured with a wind diverter and a ventilation gap above the wind diverter of at least 50 mm.

In cases of discontinuous roofing material (e.g., roofing tiles) underlayment should be installed to protect the structures from moisture penetrating the seams of the roof. The underlayment should be sealed around roof penetrations.

When the indoor air is warm and humid, and the air on the exterior side of the insulated structure is colder and drier, there will be a vapor pressure difference between the interior and exterior sides of the structure. Driven by diffusion emanating from the vapor pressure difference, water vapor will attempt to flow through the material layers from the inside to outside.

Continuity and airtightness of the vapor barrier from the wall systems to the roof is essential for satisfactory moisture performance of the structure. To avoid moisture damage, seal all joints, conduits, and connections.

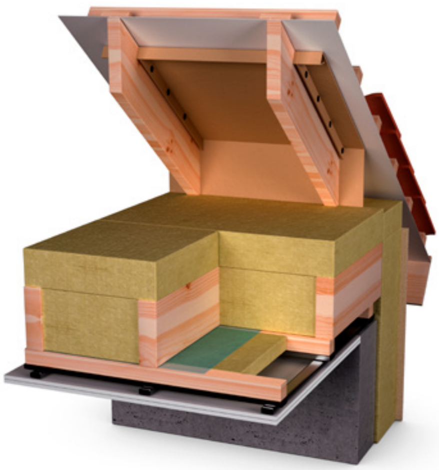
Low sloped roofs

Flat roofs are roofs with a slope of between 1:10 and 1:80. Roofs with a pitch of less than 1:80 are not recommended due to risk of poor moisture handling possibilities.

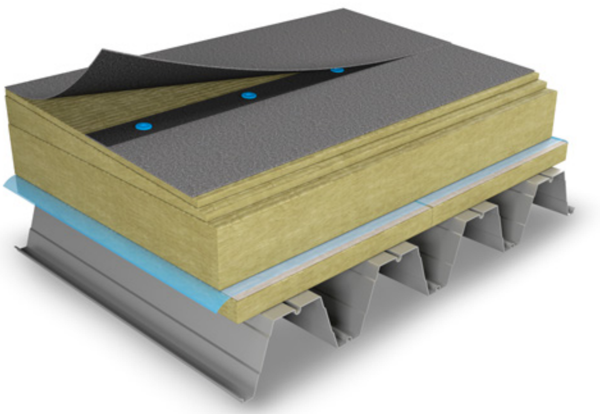
A low sloped roof structure is a complete system. It typically consists of a supporting structure, a vapor barrier, insulation, waterproofing, and effective ventilation. The supporting structure is usually a double T slab, trapezoidal steel sheet, reinforced concrete slab, or hollow core slab.

Effective roof insulation has three or four insulation layers. The lowest insulation layer forms a flat platform for the vapor barrier. The vapor barrier prevents moist air from leaking into the upper insulation layers. Due to the continuous stone wool platform, the vapor barrier remains intact even during small structural movements.

All penetrations must be in tight contact with the vapor barrier and waterproofing layer.



Pitched roof



Low sloped roof

PAROC Stonewool in roof applications

Due to schedule and budget constraints, it is seldom possible to carry out the building process entirely during sunny and dry weather conditions. There may be rain or snow, which increases the moisture level in all the exposed structures. Therefore it is essential to install only one area at a time, protect it against possible rain showers, and ensure that any moisture can dry freely.

The ventilated insulation system PAROC Air allows the building moisture to leave the roof structure very quickly through grooves in the insulation layer. The air temperature in grooves is generally warmer than the outside air temperature so it is able to carry moisture out of the structure via ventilation hoods.

It is good to note that a ventilated solution is only suitable for heated buildings. For cold storage spaces and freezers we recommend using a non-ventilated solution.

The diffusion resistance factor (μ) for stone wool is 1. This means that water vapor moves in the stone wool insulation layer in a similar way to pure air. Effective natural ventilation will carry evaporated moisture out of the structures via ventilated spaces or ventilation grooves. A porous insulation therefore does not constitute a barrier to drying even for the deeper structural layers.

2.5 EAVES AND ROOF DRAINAGE SYSTEMS

The roof slope and the overhang of eaves determine how efficiently rain is deflected away from the enclosure. Good protection against rain can be achieved with adequately long eaves and enough roof slope.

All water entering the roof should be led away from the roof by sufficient sloping. The water flow should be controlled all the way from the roof through the drainage channels and directly into the rainwater streams to avoid splashing on the façade. The selection of the right roof drain system depends on the type of roof, roof pitch, average rain volume, and rate of drainage, among other factors.

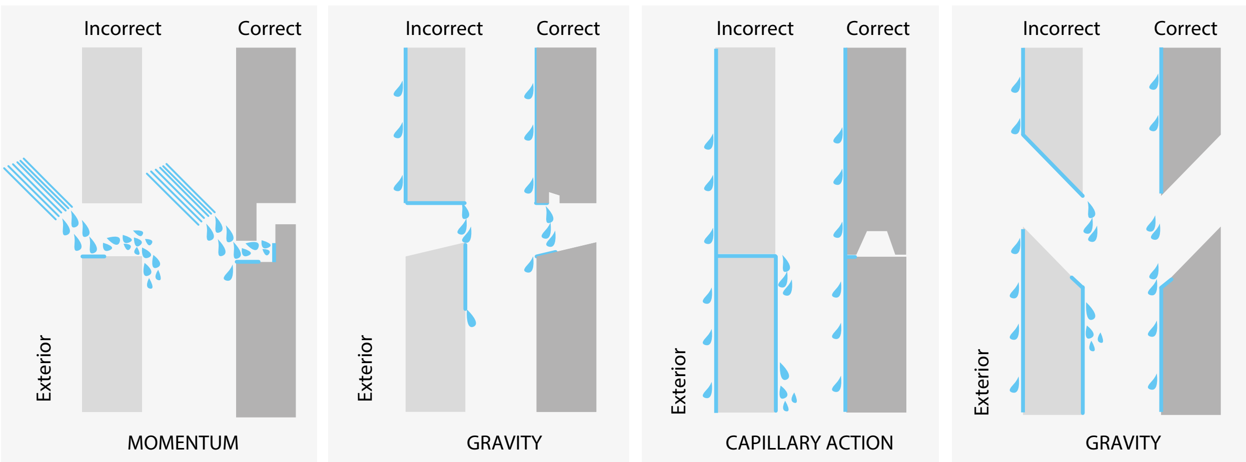
2.6 DESIGN DETAILS (JOINTS, FLASHINGS, AND OTHER CONNECTIONS)

Joints in cladding are inevitable and are a necessary aspect of rain screening. In some cases, joints are sealed with caulking. When detailing the joint width and geometry, the modulus of elasticity of the caulking material must be taken into consideration to accommodate movement from expansion and contraction of the joint. For open joints, it is critical to analyze the various moisture penetration mechanisms at play, and to devise joints that satisfy the aesthetic style of the cladding while providing acceptable performance.

The design of joints between panels, sheets, or board stock used for cladding in rain screen wall assemblies is an important aspect. While the drainage cavity may have the capacity to convey water penetration away to the exterior, the material forming the cladding may become very wet, compromising its appearance and durability. In climate zones with freezing rain events, ice formation may induce stress, resulting in deformation of the cladding.

Flashings are needed to manage rainwater on surfaces because most buildings have transitions between materials, assemblies, and components that represent either discontinuities and/or changes of the geometry in the water-resistive barrier and drainage space.

Design details



2.7 AIR VENTILATION AND PLUMBING

Air ventilation
Air ventilation is necessary in buildings to maintain air quality and remove moisture.

Extra water vapor in indoor air caused by showering or cooking can be removed by dehumidification or effective air ventilation. For example, a shower room should be dry shortly after use. If not, the air ventilation is not effective enough and the risk of mold increases.

In the winter, when the air ventilation system brings fresh air into the building (–10 °C / RH 95%), the air is first warmed up to +20 °C, implying that its relative humidity drops from 95% to 12%. Relative humidity indoors that is too low has effects on health similar to those of mold: eye irritation, dry skin, nasal stuffiness, throat irritation, etc. A very low relative humidity is not beneficial for the construction either; dry indoor air tends to pull out all the moisture from wooden surface materials, causing shrinkage and cracking of the surfaces.

Air ventilation also has a significant effect on the air pressure difference between outdoors and indoors. Higher air pressure indoors (over pressure) pushes hot and humid indoor air into the wall and roof constructions. Lower air pressure indoors (low pressure) pulls in air from outdoors through the building envelope via porous building materials, cracks, and gaps. This leaking air is never pure.

Natural ventilation works effectively only in colder climate conditions as its performance depends on temperature difference across the building envelope as well as wind conditions outdoors. A balanced ventilation system is designed to keep indoor conditions at the best possible level. The required air pressure and indoor air conditions can be achieved only with an airtight building envelope.

A balanced ventilation system needs a constant supply of energy. Unfortunately, energy efficiency as well as cost saving targets may encourage the property owner to switch the air ventilation and warming off for the time the building is not occupied (e.g., weekends and holidays). This creates a high moisture risk as the indoor air temperature drops and moisture from the air starts to condense on the surfaces. Alternatively, the direction of diffusion from the ground can change.

Plumbing
Water is brought into the building intentionally via water pipes. Leakage in plumbing is the most common cause of water damage, potentially causing unnoticed problems within the building structures, particularly when the pipes are hidden inside the structures.

Leaks in plumbing are always accidental but they can be taken into account in the building design phase by locating plumbing lines and components so that they are easy to inspect and repair. Many leaks are caused by freezing: it is important to make sure that pipes are properly insulated. Insulation is also essential to prevent moisture condensation on the surface of a cold water pipe.

PAROC Stonewool in HVAC applications

Without insulation, cold water pipes and ventilation channels might "sweat". This means that moisture from the warm air condenses on the colder pipe or duct surface, the temperature of which is below the dew point. When water condenses, it can cause damage to the HVAC system (corrosion) or drip onto building structures, causing secondary moisture problems.

Secondary condensation effects can be mitigated with proper insulation. Thermal insulation with an airtight surface prevents secondary moisture risk by creating a barrier layer outside the insulation at a temperature above the dew point. All the joints should be sealed so that moisture cannot penetrate the insulation layer.

PAROC Stonewool in HVAC applications

3. MOISTURE RISKS

3.1 CORROSION

Any insulation material that is in contact with metal may contribute both passively and actively towards corrosion if water or moisture is present.

Insulation material may actively contribute to the progress of corrosion by increasing water's electrolytic capacity via the release of water-soluble ions or by significantly altering its hydrogen potential (pH). In PAROC Stonewool, the level of water-soluble ions is very low and the chemical balance does not promote corrosion.

Certain other types of insulation material may contain substances that directly contribute to events that cause corrosion, such as fire-retardant salts. PAROC Stonewool is non-combustible and contains no such materials.

Insulation material can passively contribute to corrosion if it binds water against the exterior of the metal.

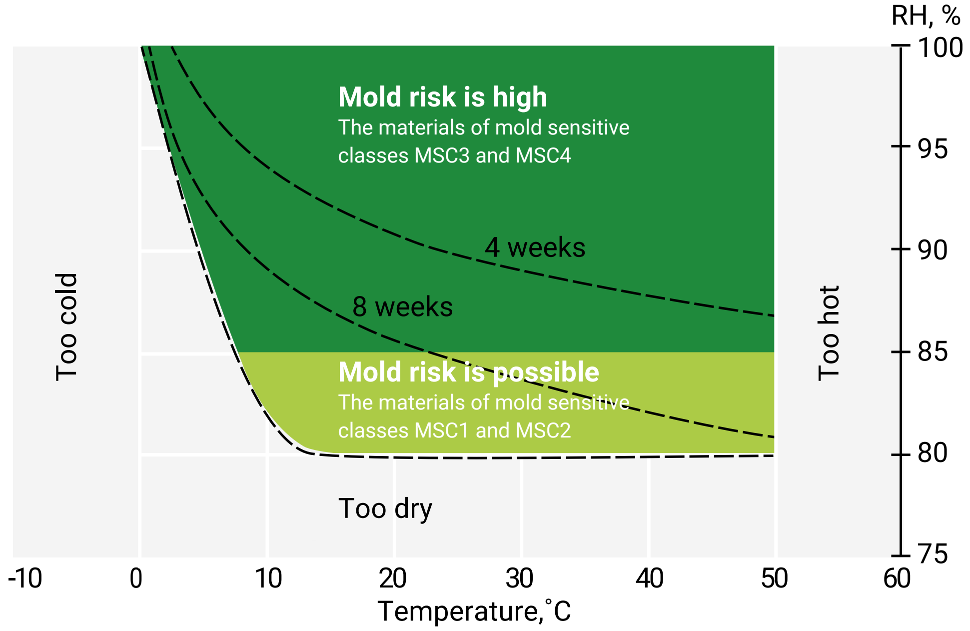
3.2 MOLD

Mold is everywhere – in the air and on many surfaces in nature. Molds and fungi have been on Earth for hundreds of millions of years and are a crucial part of the global ecosystem. Despite their coexistence and coevolution with humans, biological growth in buildings may cause health problems in modern society. Mold spores are tiny and lightweight, so they can enter homes in many different ways, such as through open doorways, windows, vents, and heating and air conditioning systems. However, problems only arise when the extent of mold growth in a residence is exceptionally large and when the mold species dwelling in the structures causes the occupants to suffer symptoms.

Mold grows where warmth, nutrition, and moisture are present. It starts to grow when the relative humidity is high (≥ RH 80–85 %), the temperature is above 10 °C and there is enough organic material for them to feed on. Mold growth also needs time. Brief moisture exposure is not dangerous.

In buildings, the most favorable substrates for mold growth are paper and wood products but molds can also grow in dust, paints, wallpaper, insulation, drywall, carpet, fabric, and upholstery. The best way to prevent mold growth is to keep constructions dry, surfaces clean, and the indoor air humidity level low enough.

Presented below is one well known model (H. Viitanen/VTT) that is used to estimate the probability or risk of mold growth. It shows the time it takes to develop mold growth on wood at various temperatures and relative humidities. The same model can be used for other building materials by scaling coefficients for equations. Different construction materials have been divided into different classes based on their sensitivity to mold growth, according to the table below.



The Finnish Mold Index Model (VTT)

Source: TTY/VTT (Viitanen 2001)

Sensitivity class	MSC	Description
Very sensitive	1	Untreated wood, which contains a high level of nutrients
Sensitive	2	Planed timber, materials and films with paper coating, wood-based boards
Medium resistant	3	**Mineral wool**, cement or plastic-based materials
Resistant	4	Glass and metal, products containing mold-preventive additives

Table: Favorable relative humidity and temperature conditions for mold growth in different mold sensitivity classes.

Exposure to damp and moldy environments may have a variety of health effects, or none at all. For sensitive people, molds can cause nasal stuffiness, throat irritation, coughing, or wheezing, eye irritation, or, in some cases, skin irritation. For people with allergies, the symptoms might be more severe.

Stone wool is an inorganic material. Volcanic stone makes up 96–98% of its weight. The remaining 2–4% is organic binder. PAROC Stonewool products have been tested in an external laboratory* and found to be resistant to mold growth. The test was conducted with the most typical mold species found in buildings at a relative humidity of 95–100% and a temperature of 22 °C for 28 days.

*SP Sweden, test report ETi PXX07404 / 17 February 2011

3.3 LOSS OF PERFORMANCE

Dimensional stability

Dimensional stability is important for the insulated structure to function properly over time. Requirements are set either for dimensional stability at a constant temperature or for stability over the temperature and humidity cycle. If the thermal insulation shrinks or swells due to the influence of the surrounding conditions, cold bridges and tensions are formed in the structures, which might contribute to the moisture behavior of the structures.

Dimensional changes in materials can be caused by their thermal expansion coefficients, for example. This is the rate at which materials shrink or expand when they are cooled down or heated. Practically all materials have an expansion coefficient that is dependent on the chemical composition of the material. Dimensional changes may also originate from thermal expansion of foaming agents or other gases embedded in the insulation material, or moisture from uptake (swelling).

Stone wool is an inorganic material and it keeps its shape and dimensions in all conditions.

Mechanical stability

When insulation is used as a structural component in a construction, such as low-slope roofs or sandwich panels, more properties need to be declared, such as compressive, tensile, or shear strength. Products with an extensive list of declared properties may be more sensitive to environmental effects, e.g., UV radiation, chemical exposure, and moisture.

Naturally stable stone raw material ensures the very good moisture durability of stone wool product properties. Due to the low organic content, minor changes are possible if the products are heavily exposed during transportation, storage, and/or installation.

In practice, the stone wool is totally dry when it comes from the factory. In normal conditions (relative humidity of air between 30% and 80%), the moisture content in stone wool is ca. 0.3 kg/m^3. The water absorption properties of the structural wool are excellent and can be easily verified by pouring a small amount of normal tap water onto the wool. If the water droplet keeps its spherical form on the wool surface, the liquid water repellency is guaranteed.

Irrespective of the selection of insulation material, the insulation products must be protected at the building site. For PAROC Stonewool, any water exposure – such as exposure to rainwater – is normally confined to a thin surface layer (1–6 mm) of the wool. This layer can be totally wet but it will not affect the strength properties of the whole construction.

Our recommendations are therefore:

1. Check that the stone wool is dry and that the water absorption properties are adequate.
2. Protect the stone wool from heavy rain and water during both storage and installation.
3. If the wool surface is totally wet (1–6 mm), the product should be allowed to dry or changed before closing the construction.

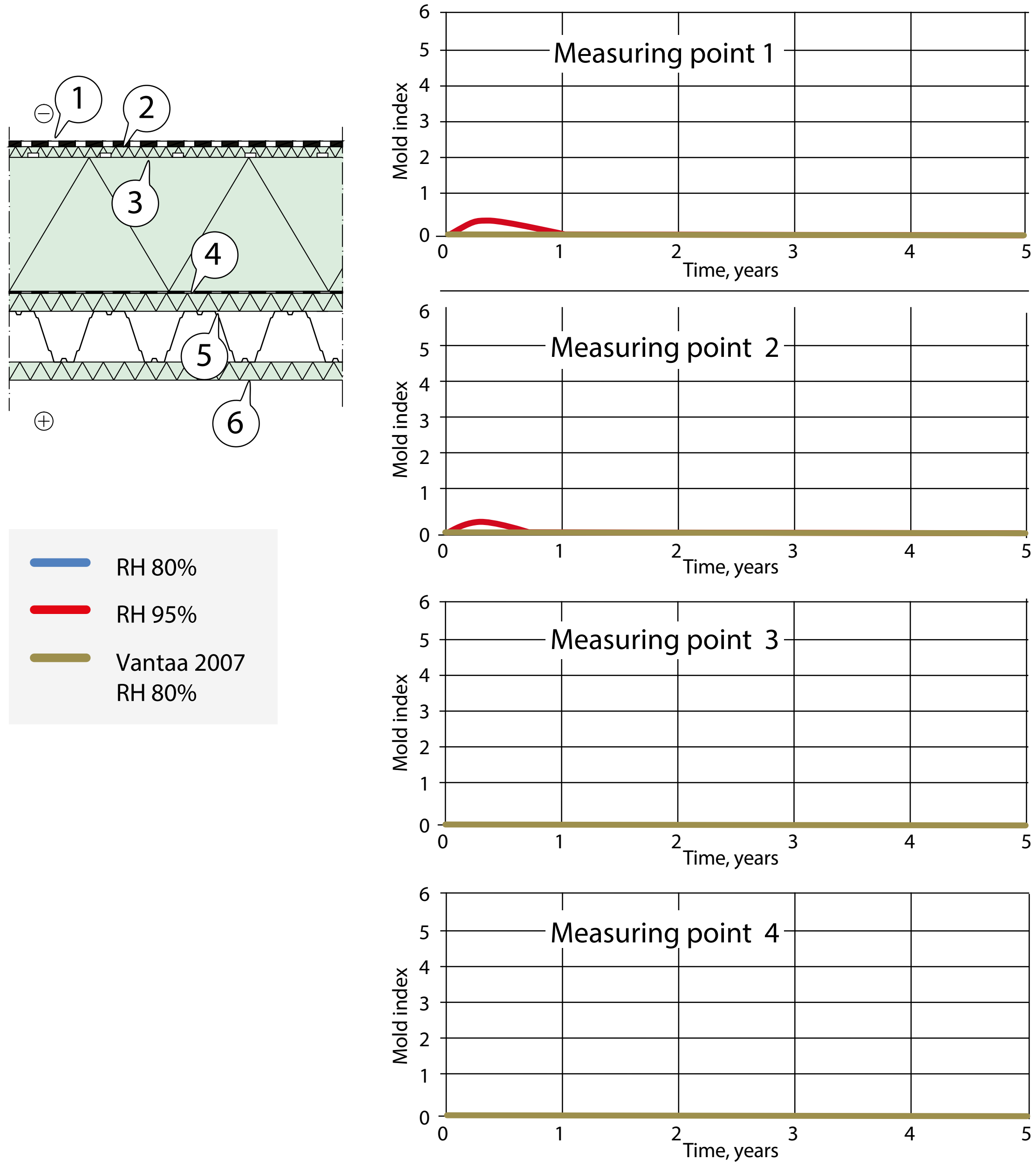
4. MOLD CALCULATION FOR THE MOST TYPICAL CONSTRUCTIONS

The real moisture performance of insulating material is demonstrated when it is part of a construction. Therefore it is essential to assess insulation products in their application conditions to verify that the building physics of the whole structure is functioning as planned.

According to external studies, calculations, and simulations carried out for 13 different well insulated structures, no moisture or mold risks were detected in any parts of the structure. PAROC Stonewool insulated structures were studied in anticipated 2030 climate conditions, setting the relative humidity parameter to RH 80% and RH 95% by using the Mold Index model developed by VTT (Viitanen 2001). The higher relative humidity level reflects a situation where the structure has become wet during the installation phase.

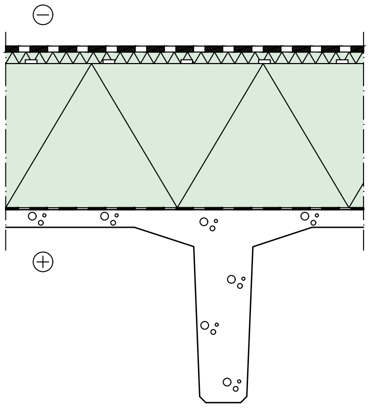
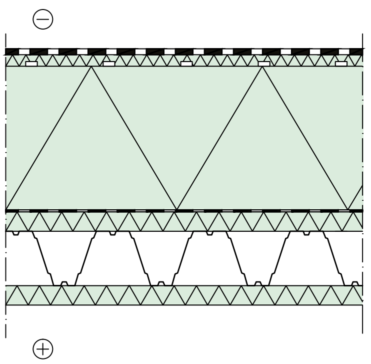
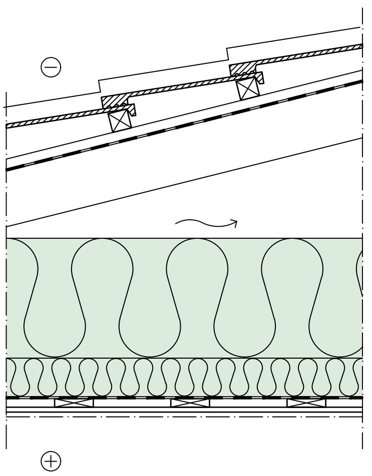
Example:

*Sweco RA08_61351 / 16 December 2015

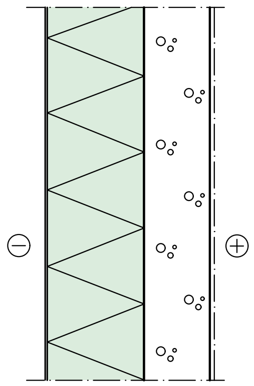


Here are some examples from studied constructions:

ROOFS

	1. roofing membrane 2. PAROC ROB 100grl 30 mm 3. PAROC ROL 30 370 mm 4. vapor barrier, bitumen 5. load bearing structure	Roof construction with PAROC Stonewool insulation is a technically functional construction for moisture control. No mold risk detected. *Moisture management at the construction phase is important for all low-slope roof solutions, regardless of the insulation material used.*
	1. roofing membrane 2. PAROC ROB 100grl 30 mm 3. PAROC ROL 30 370 mm 4. vapor barrier, bitumen 5. PAROC ROS 50 6. Load-bearing structure, trapezoidal steel sheet 7. PAROC Figra 170 for fire protection – if needed	Roof construction with PAROC Stonewool insulation is a technically functional construction for moisture control. In the calculation, the vapor permeability of steel sheet was not taken into account, and it was assumed that indoor air can flow freely through the seams. Therefore this calculation is also valid for perforated steel sheets. No mold risk detected.
	1. roofing 2. underlay 3. wooden roof trusses 4. ventilated attic 5. PAROC BLT 6 310 mm 6. PAROC eXtra 100 mm 7. wooden frame from the truss 8. vapor barrier 9. wooden joists 10. gypsum board 11. surface	Roof construction with PAROC Stonewool insulation is a technically functional construction for moisture control. Ventilation of the attic must be sufficient. No mold risk detected.

EXTERNAL WALLS



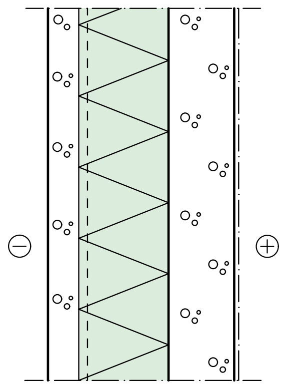
1. thin rendering
2. PAROC Linio 80
   220 mm
1. concrete 150 mm
2. surface

ETICS is a widely used external wall structure. The moisture performance of this structure is based on sufficient waterproofing and water vapor permeability of the thin rendering layer.

When the surface layer is intact, the structure is working well.

No mold risk detected.

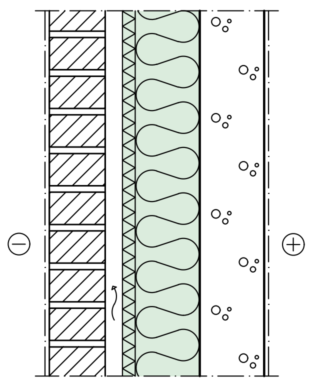
The detail of the design as well as implementation of the design of the structure is important for all rendered façade solutions regardless of the insulation material used.



1. surface
2. concrete
3. PAROC COS 5ggt
   210 mm
4. concrete
5. surface

External wall construction with grooved PAROC Stonewool insulation is a technically functional construction for moisture control.

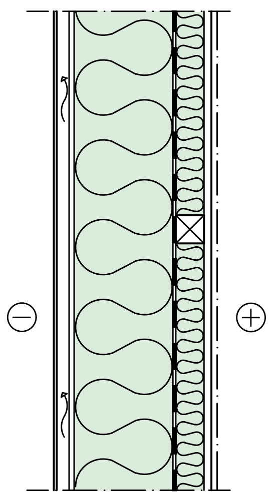
No mold risk detected.



1. surface
2. brick façade
   130 mm
3. ventilation gap
   40 mm
4. PAROC Cortex pro
   50 mm
5. PAROC eXtra
   150 mm
6. concrete 150 mm
7. surface

External wall construction with PAROC wind resistant and stone wool insulation is a technically functional construction for moisture control.

No mold risk detected.



1. façade cladding
2. Ventilation gap
   22 mm
3. wind protection,
   gypsum board
   9 mm
4. PAROC eXtra
   175 mm / wooden
   studs 50x175 mm
   cc600
5. vapor barrier
6. PAROC eXtra
   50 mm
7. Gypsum board
   13 mm
8. surface

External wall construction with PAROC Stonewool insulation is a technically functional construction for moisture control. The width of the ventilation gap is suitable for both wooden and panel façades.

No mold risk detected.

The Finnish mold growth model used in this study is based on the original mold growth model for wood. The model can be used to evaluate the mold risk on the surface of different material samples or inside structures in changing temperature and relative humidity conditions. The mold risk is described by the mold index M, which is calculated from hourly temperature and relative humidity values. The mold risk is graded on a scale from 0 to 6.

The differences in the mold growth sensitivity of building materials have been taken into account. Every mold sensitivity class and mold decline class has its own factors for calculating the mold index.

Mold index M	Mold growth	Notes
1	No growth	Clean surface
2	Growth seen under microscope	Growth is beginning in a couple of places.
3	Clear growth seen under microscope	Mold growth covers 10% of area studied (microscope). The growth is in many places in the area.
4	Growth visible to naked eye. Abundant growth seen under microscope.	Growth covers 10% of area studied (eyes). Growth covers 50% of area studied (microscope).
5	Abundant growth visible to naked eye.	Growth covers 50% of area studied (eyes).
6	Very abundant growth	Growth covers 100% of area studied, dense mold growth.

Table: The Finnish Mold Index model (VTT/TTY).
The Mold index M describes the mold growth rate in/on the surface of the material.

5. MOISTURE PROPERTIES OF PAROC STONEWOOL

5.1 MOISTURE PROPERTIES

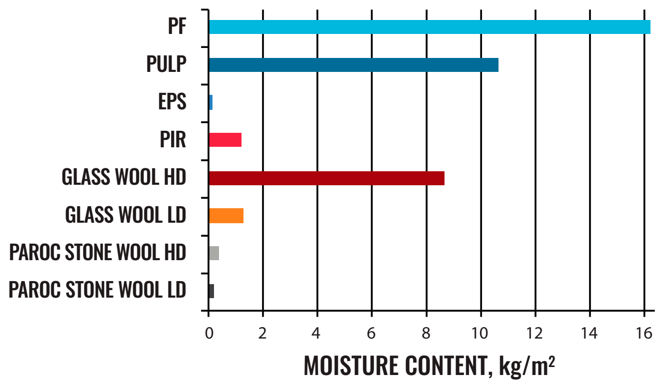
PAROC Stonewool insulation is one of the best-performing insulation materials when it comes to overall moisture properties. Our confidence is based on long experience. It is also based on extensive experimental study of and simulations with various building insulation materials carried out by an external independent laboratory.

The comparative study* presented below included stone and glass wool, EPS, PIR, phenolic foam, and cellulose insulations. It measured the materials in terms of hygroscopic properties, water absorption in partial immersion, water absorption by diffusion and capillary water absorption, as well as measuring specific properties related to thermal insulation capacity. The drying of wet test specimens was also monitored. The measurements made under laboratory conditions correspond to the wetting and drying of materials in practical situations.

The following diagrams show clearly the exceptional performance of PAROC Stonewool in a moist environment. The tests were performed for both low- and high-density products (abbreviated “SW, LD” and “SW, HD”, respectively).

*VTT-S-05337-17 Moisture in Building Insulations. Determination of the effect of moisture to the technical properties of building insulations / 2 October 2017

Equilibrium moisture content of materials (EN ISO 12571)



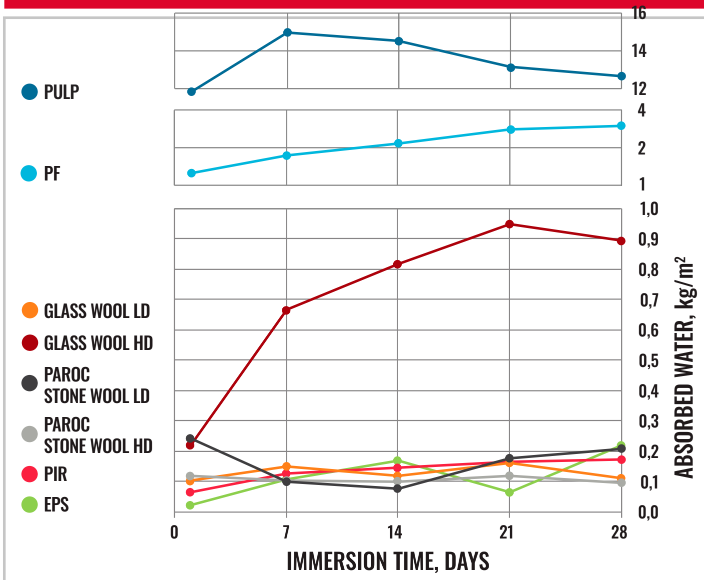
This diagram presents the equilibrium moisture content of the various insulation materials at 98% relative humidity measured at 23 °C.

The measurement results correspond to conditions where the insulation materials are exposed to high air humidity but are not in contact with liquid water.

This property is important to measure because it directly reflects the quantity of water vapor that is retained by the material.

Conclusion:
PAROC Stonewool does not absorb moisture from the surrounding air. It stays dry even in very humid conditions.

Water absorption by partial immersion (EN 12087)



Water absorption in insulation with partial immersion corresponds to conditions where, for instance, an insulation package or insulation installed on a flat roof is exposed to rain.

Conclusion:

When PAROC Stonewool is partially immersed in water, water penetrates only the open fibre structure when the material is held submerged, as stone wool slabs tend to float.

Water penetration happens only in the part of the insulation which has been submerged under the surface.

When the insulation is lifted out of the water, the water runs out of the open fiber structure.

Regardless of the immersion time, whether one day or one week, the stone wool does not absorb water. The water absorption level of PAROC Stonewool is very similar to plastic-based insulation materials (not excluding phenolic foam).

Drying time of insulation after partial immersion test

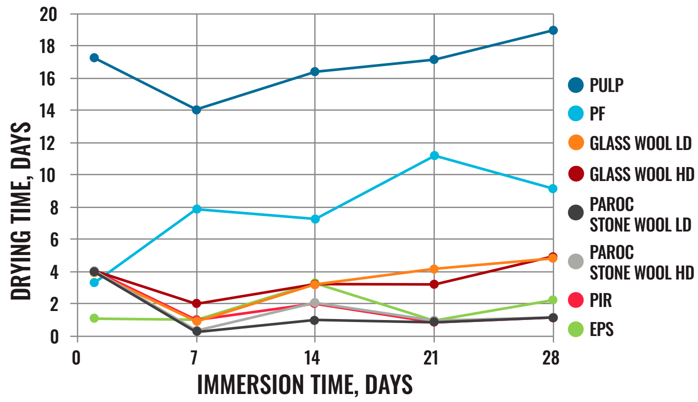
After completing the four-week immersion test, PAROC Stonewool products dried in 1–2 days. The drying happened at normal room temperature (+23 °C) and a relative humidity of 50%.

The thermal conductivity of stone wool was measured both before and after the partial immersion test. The insulation capacity remained the same.

The dimensional stability of the stone wool slab was estimated by comparing percentage changes in the test specimen length, width, and thickness after the 28-day immersion test.

Conclusion:

PAROC Stonewool dries very fast at normal room temperature. It maintains its thermal performance and dimensions after moisture exposure.

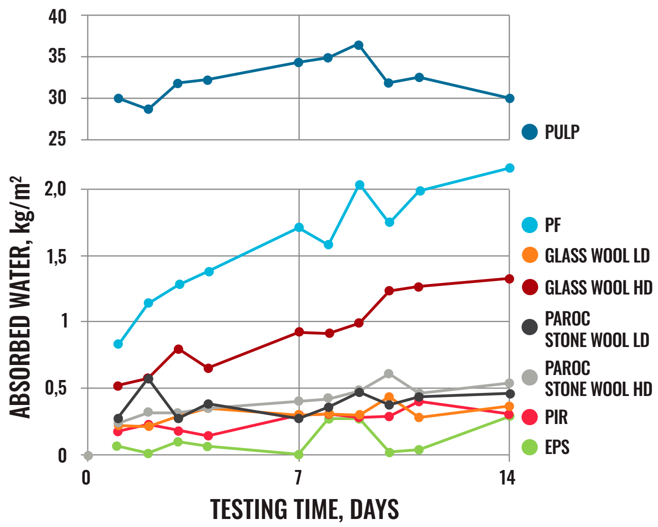


Capillary water absorption (EN 480-5)

The capillarity of the insulation material was examined using a measurement method developed especially for measuring capillary water absorption, although the partial immersion method presented in the section above partly measures the corresponding properties.

Conclusion:

Based on the results, stone wool is one of the best insulation materials when used in applications where capillary water absorption may occur.



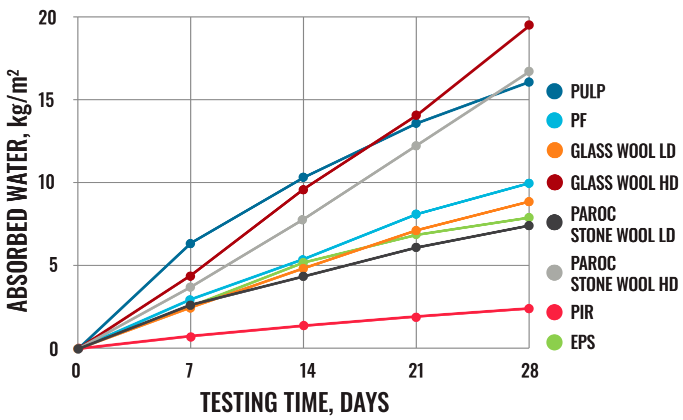
Water absorption by diffusion (EN 12088)

A test conducted in accordance with standard EN 12088 simulates water vapor transfer into insulation materials caused by partial pressure differences. It uses a heated water basin that maintains a temperature difference of 50 °C across the test specimen.

The test sample was turned over at seven-day intervals.

Conclusion:

PAROC Stonewool is a porous, diffusion-open material, so it allows water vapor transportation through it. The lighter the material, the faster the water vapor transmission.



The study shows that there are significant differences in the moisture absorption and drying ability of the various insulation materials. None of the materials studied will work on site without proper weather protection.

PAROC Stonewool insulation is of great benefit in moisture removal during the construction period, increasing building safety, and shortening construction times. In the event of damage, wet structures need extensive repair in order to prevent long-term effects, regardless of the insulation material.

5.2 AIR AND MOISTURE CONTROL

Modern building envelopes are rather complex. Insulation continuity and air tightness should be considered early in the design process. Airtightness measurements, together with the use of a thermal imaging camera, make sure that the structures are sufficiently tight already at the construction stage.

1. Simplify the building layout wherever possible.
2. Minimize the number of joints and connections.
3. Stop moisture penetration into the structures with a vapor barrier. Define the continuous line of the vapor barrier as early as possible. Protect the vapor barrier during construction. Decide and specify which materials will form the air/vapor barrier. Give the vapor barrier seams a 100–200 mm overlap.
4. To achieve good overall air and moisture tightness in a building, seal and safeguard all joints, corners, walls adjoining ceilings and foundations, air barriers between window and door sills, penetrations for pipes, electrical installations, and ducts and chimneys.
5. Stop forced convection and wind-driven rain by using a wind barrier on the external side of the insulation.

Picture: Airtightness measurement detects the building leakage points even before the sealing of structures.

6. THE IMPORTANCE OF A DRY CHAIN IN THE BUILDING PROCESS

The dry chain is a moisture management approach in the building process that reduces the risk of moisture damage during the life cycle of a building. The operating model includes a risk list and a checklist showing ten key moisture risks. The management of these moisture risks avoids over 80% of the cost of tracking moisture damage.

RISK LIST BY KUIVAKETJU10:

1. **Moisture from outside can damage the foundations and floor structures.**
2. **Rainwater can penetrate the external wall structure.**
3. **Rainwater penetrates the roofing material and underlayment, and leaks into the roof constructions.**
4. **Moisture passes from the leakage points of the air barrier layer to the external wall and roof structure, where it condenses into water.**
5. **Improperly dimensioned and adjusted ventilation does not remove excess moisture, but forces it into structures.**
6. **Water pipe breaks cause considerable water damage to the property.**
7. **In poorly executed wet rooms, moisture will damage the surrounding structures.**
8. **Coating moist concrete structures causes damage in the coating material.**
9. **The wetting of materials and structures damages the building.**
10. **With poor maintenance, the building will slowly but surely be ruined.**

This guide aims to answer most of the risk list points from with regard to insulation material. No one in the construction process can avoid moisture risks alone. Moisture management in a building process is teamwork that provides an uninterrupted moisture-safe chain between different functions.

The starting point for this chain is the goals and requirements that the owner of the building sets for the building's design and implementation. The designer is responsible for achieving the objectives with good moisture engineering design, and it is the designer who gives the contractor instructions for the various stages of work. The contractor plans the steps of the construction process and instructs other contractors to work in accordance with the dry chain principles. In accordance with the contracts, the main contractor arranges for the various building materials to be delivered to the site at the agreed time in the agreed manner.

OWNER

Sets targets, requirements, and design instructions for a moisture-safe building.

Assures quality by monitoring.

DESIGNER

Designs detailed moisture-safe constructions.

Chooses the right materials based on their overall moisture performance in constructions.

When ordering and delivering construction materials, it is advisable to follow the just-on-time principle in order to avoid external storage. Product packaging for building materials is often inadequate for workplace conditions where variable weather and mechanical stresses can damage the packaging. It is therefore very important that building materials be raised off the ground and protected from rain and snow with separate weather protection.

Some building materials, such as wood, always contain natural moisture that dries fairly quickly. Some building materials are wet at the construction phase, being either wet by nature (fresh concrete) or intentionally installed wet (wet-sprayed cellulose). In most cases, this short-term moisture load at the construction stage will not be a problem, as the structures are designed to dry outwards. But if a wall or a whole building is closed on both sides with vapor-tight material, and the moisture therefore stays in the structure for a long time, there may be a problem. A construction schedule that is too tight is the builder's worst enemy.

MATERIAL MANUFACTURER

Shares correct information about materials, moisture properties, and storage.

CONTRACTOR

Plans and executes moisture management in the installation phase.

Allows sufficient drying times for different materials.

Stores materials according to manufacturers' instructions.

Guides the user.

USER

Learns how to use the building.

Monitors the installations and machines which use water.

Takes care of maintenance.

DURABLE

REUSABLE

SOUND ABSORBING

FIRE RESILIENT

MOISTURE RESISTANT

ENERGY EFFICIENT

PAROC® stands for energy-efficient and fire resilient insulation solutions of stone wool for new and renovated buildings, HVAC and industrial applications. Behind the products, there is nearly 90-year history of stone wool production and know-how backed by technical expertise and innovation.

Going under the product name PAROC® and in the instantly recognizable red-and-white-striped packages, our products include building insulations for thermal, fire and sound insulation of exterior walls, roofs, intermediate floors and partitions as well as technical insulations for HVAC systems, industrial processes and OEM industry.

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