

Capillary Tube Systems



The ideal radiant heating and cooling system
for solar power systems and heat pumps:
flat, fast, comfortable, efficient,
environmentally friendly, and long lasting.



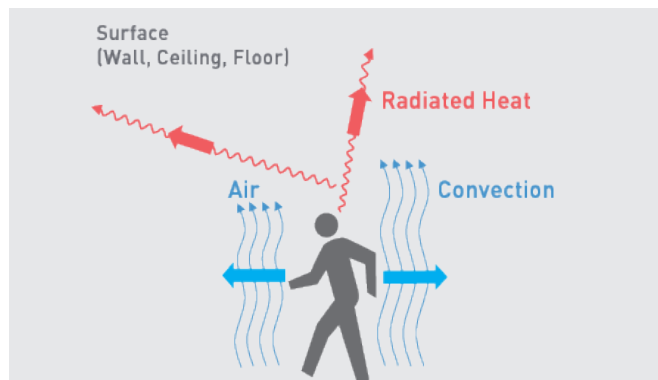
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Characteristics of the Clina system for heating and/or cooling

High demands are placed on the heating technology of modern buildings today. One goal is to noticeably reduce energy consumption without limiting comfort or the operating safety of the system for the benefit of the environment and the pocketbook of the operator. This goal can only be reached through a more efficient use of resources, particularly the use of environmental energy. This in turn requires a technology which works at significantly lower hot water temperatures. The Clina capillary tube system meets this demand better than any other heating system.

In addition, you can also use it quite simply for COOLING. The user profits from the extremely large exchange surfaces of the Clina capillary tube mats here as well.

Even at water temperatures between 16 and 18 °C, a comfortable "silent cooling" without uncomfortable noise or draft effects is possible. People in the room are cooled or warmed mainly by radiation from the Clina mats which corresponds to the natural temperature regulation in the human body. This makes them feel more comfortable.



Dry dissipation of heat of persons through convection from the persons to the air and through radiated heat from the persons to the surfaces in the room.

Functioning and features of the Clina system for heating and/or cooling

The heart of the Clina system are the capillary tube mats, which have been used very successfully in cooling ceilings for over fifteen years (see reference list on page 18). These are high performance heat exchangers consisting of plastic pipes with an exterior diameter of just 4.3 mm, which join two 20 mm thick distribution/collection pipes.

For the heating and/or cooling of rooms, warm and/or cold water flows through capillary tubes. The water bearing capillary tube mats are installed closely underneath the surfaces of room sealing areas and thus enable a gentle temperature regulation of ceilings, walls, and floors.

Due to the large exchange areas, large amounts of energy can be transferred even at low temperature differences between the active room surfaces and the room air. For heating, warm water at approximately 28–32 °C flows through the Clina system. Even while using the maximum dissipation of heat of 100 W/m², the homogenous surface temperature is always below the allowable upper limit of 29 °C.

In order to be able to use the Clina system for cooling in the summer too, it is preferably installed in wall and ceiling areas. During cooling, for example, the surface temperature of the ceiling is 17–19 °C with a supply water temperature of 16 °C. Depending on the way the Clina system is installed up to 85 W DIN-cooling capacity per square meter of installed mats can be achieved.

Especially in older buildings, with their limitations caused by wooden floors and/or load limits, the use of wall and ceiling areas offers the highest level of comfort.

Unlike conventional floor and wall heating systems, the Clina capillary tube mats do not use thick water pipes. They are manufactured from high quality, long lasting polypropylene (PP). Due to their material characteristics, they are especially suitable for use in low energy heating and cooling systems. Like all weldable plastics, polypropylene is also air diffusing. This means that oxygen enters the water through the walls of the pipe until the saturation limit is reached.

So that this oxygen cannot cause any corrosion damage to the system, two separate water circuits are installed in the Clina system and separated from each other using a stainless steel heat exchanger.

This creates two completely separate hydraulic circuits which are designated as a primary circuit (heat producer to separation system) and a secondary circuit (from separation system to the Clina capillary tube mats).

All components which come into contact with water in the secondary circuit are made from corrosion resistant materials such as plastic, stainless steel, bronze or brass, so that the oxygen entering cannot cause any damage. An accumulation of silt in the system is definitively ruled out, the use of inhibitors or similar materials is therefore not necessary.

Advantages of the Clina system

Flat, invisible installation which needs only a minimum of space

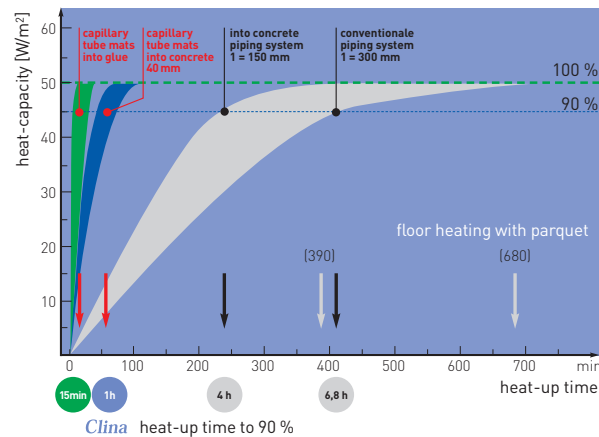
The Clina capillary tube mats can also be installed directly under the flooring surface. All flooring surfaces are suitable for this, such as tiles, laminate, linoleum, parquet, PVC or carpet.

The low installation height (minimum 5 mm) and the flexibility of the capillary tubes do not only offer a large degree of freedom in design for new buildings, but also often enable the installation of floor heating in older buildings. Conventional floor heating systems are completely unusable in older buildings, as one usually does not want to remove the old screed. By removing radiators, the modernized older building does not only provide an increase in living comfort, but an increase in usable area as well.

Problems with statics can be ruled out, as the water of capillary tube systems while filled with water only amount to approximately 900 g/m².

Quick reaction

Thanks to the installation of the Clina capillary tube mats directly underneath the flooring surface, the Clina system reacts very quickly. The desired surface temperatures are reached after only a few moments. Even with traditional installation in the screed, the Clina capillary tube system only requires approximately ¼ of the heating time compared to conventional floor heating systems. The system reacts faster than conventional floor heating systems also when turning the heat off.



Comparison of the heating times of the Clina capillary tube mat system with traditional floor heating systems.

Source: Dr. Bernd Glück

Comfortable and maintenance free

The Clina capillary tube system homogeneously warms the rooms due to its large exchange surfaces and the equal flow through the parallel tubes which are set very close to each other. Temperature differences within heated/cooled surfaces are not perceptible.

Thus people in the room are cooled or warmed mainly by radiation from the Clina mats which corresponds to the natural temperature regulation in the human body. This makes them feel more comfortable. The temperature felt is approximately 2–3 °C higher than the room temperature, which additionally reduces the consumption of heating energy.

Every room can have its temperature regulated individually. To do so, separate heating circuits are installed which can be controlled by individual room thermostats.

The Clina capillary tube mats are absolutely maintenance free. Due to the narrow diameter of the individual capillaries and the surface tension of the water, they are self ventilating.

Efficient and environmentally friendly

The surfaces of the Clina tube mats are a multiple larger than those of conventional floor heating systems. This allows the system to provide the same heat to a room with 8–10 °C lower supply water temperatures. Clina is the most effective heating system, particularly in combination with a heat pump.

In addition, the heat gained from solar panel systems can also be used for heating in the winter.

The polypropylene used for the production of Clina capillary mats, tubes, and fittings has a positive ecological balance, is entirely recyclable, and can be reused if selective refurbishment is carried out. Production of capillary tube mats generates no waste and does not pollute water or air; the production remnants are 100% recycled.

Safe and long lasting

Clina capillary tube mats are manufactured under strict quality control with a high level of precision and security. Thus, no mat leaves the factory before being inspected for leakages with a pressure test at 20 bar. This pressure test corresponds to 10 times the operating pressure! There is a 10 year warranty for Clina capillary tube mats.

After installation, the entire Clina capillary tube system will be subject to a 10 bar pressure test allowing possible damage from the subsequent work with the screed or plaster to be recognized immediately and repaired on location. After the conclusion of the work, the entire Clina capillary tube system will be subjected to a multi-step pressure test as per factory guidelines.

Even air diffusion is not a problem with the Clina capillary tube system. Unlike in conventional floor heating systems, the air diffusing in the water cannot lead to corrosion and the accompanying accumulation of silt as the entire Clina capillary tube system consists of corrosion free materials such as PP, stainless steel, bronze or brass.

This system, designated as the secondary circuit, is separated from the heat producer and the primary circuit by a stainless steel heat exchanger plate, insofar as these contain corrosive materials.

Long term tests have revealed that capillary tube mats made from PP have a lifetime of at least 50 years, without losing quality. At the same time, the water used as a cooling/heating medium remains clear and clean due to the air saturation.

Heating and cooling in one system

The Clina capillary tube system can also be used for cooling if the capillary tube mats are not installed in the floor, but in the walls and/or ceiling instead. The Clina capillary tube mats are simply installed under plaster or to the rear side of gypsum plaster boards.

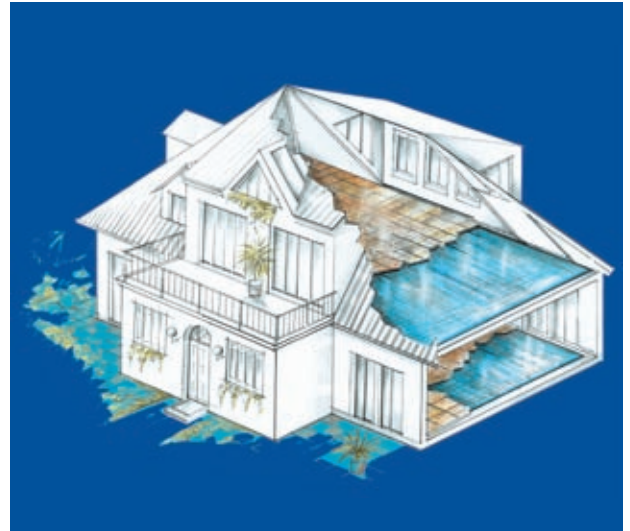
Warm water flows through the system for heating during colder periods; cold water is used for cooling in the summer. A prerequisite for the double application of heating and cooling is the existence of heat and cold producer. The use of a reversible heat pump will fulfill these requirements for heating and cooling in a single system.

When using the Clina system in walls or ceilings all advantages of floor heating will be gained as well.

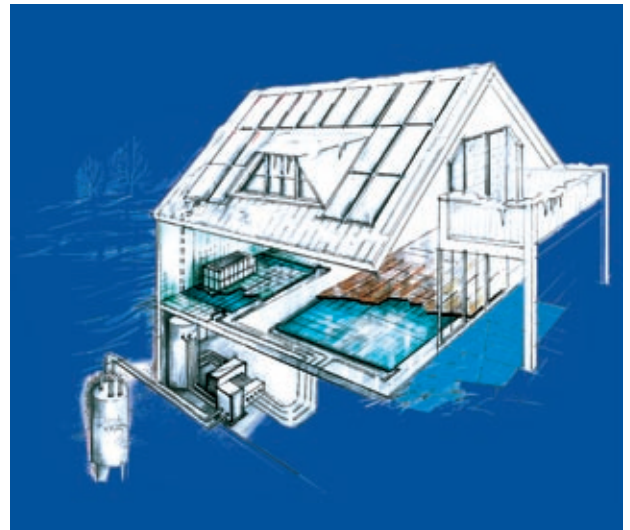
During cooling applications in addition to radiation (see page 4) the physical property of warm air being lighter than cold air is used. The warm air rises and thus cools the active walls and/or ceiling. Air cooled in this manner then sinks again, due to its greater density and provides a comfortable room climate. With this gentle cooling method, no additional air is blown into the building as with conventional air conditioning systems. The Clina capillary tube system neither causes draught nor noise.

As with all panel cooling systems, care must be taken not to fall below the dew point with capillary tube systems. Otherwise, the water vapor in the air will condense on the cooled surfaces. This can be reliably prevented by the installation of dew point sensors in the corresponding areas.

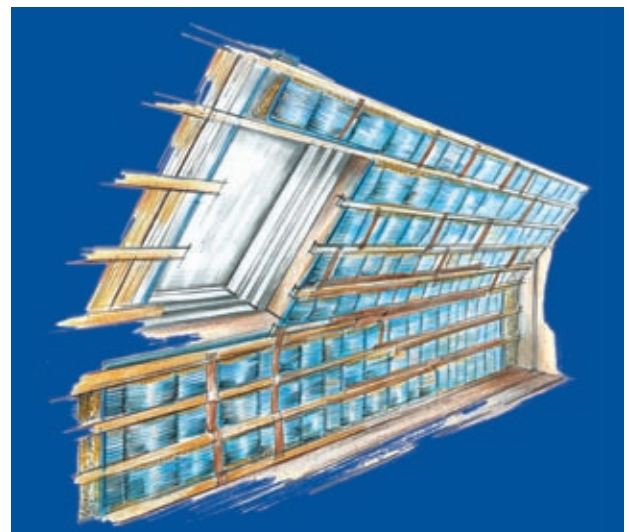
To ensure equal distribution from the Clina capillary tube mats, the piping within a heating and/or cooling circuit should lead into "Tichelmann system" whereby mats approaching equal size with equal pressure loss must be planned for this area. The length of the capillary tube mats is primarily decisive for this. A hydraulic comparison of the individual heating and/or cooling does not need to be necessary.



By 8–10 °C lower supply temperatures than in conventional floor heating systems.



Ideal for the use of renewable energies.



The Clina capillary tube system is safe against corrosion as it operates in its own closed circuit and therefore cannot accumulate silt.





“OPTIMAT” heating/cooling mats in screed

“FOLIMAT” heating/cooling mats directly underneath the flooring surface

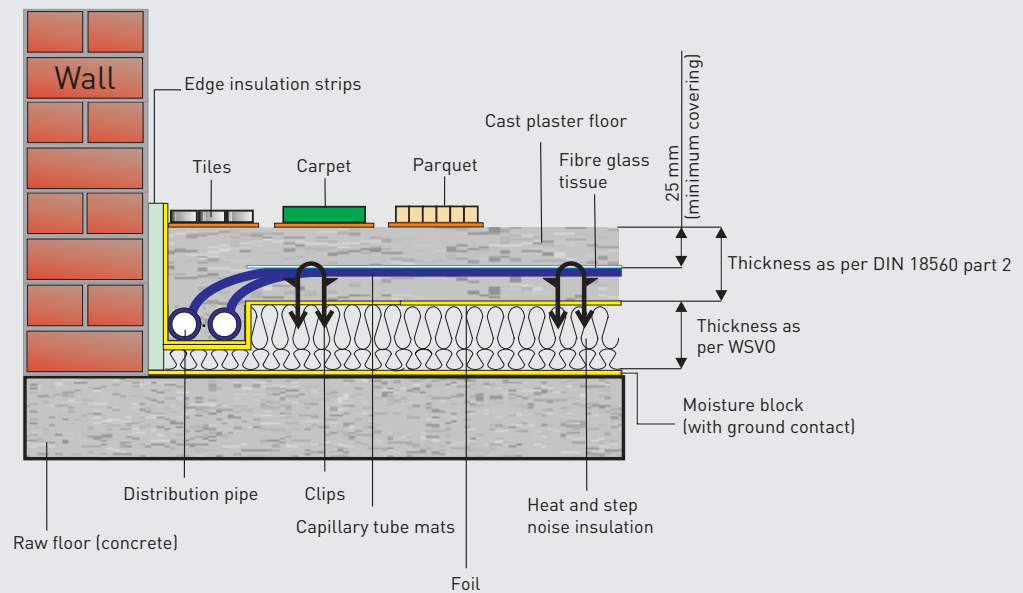


“FOLIMAT” heating/cooling mats in walls and ceilings

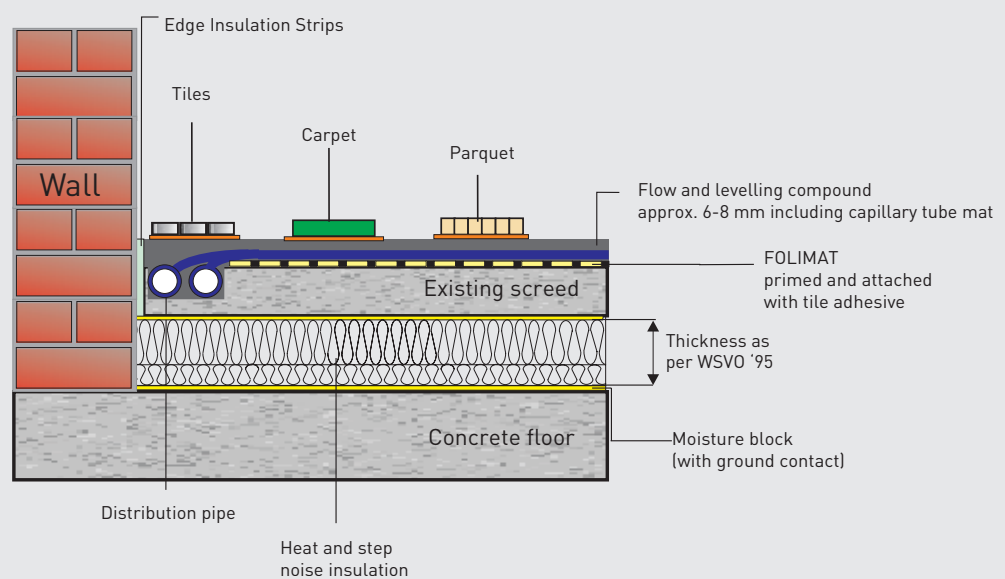


“OPTIMAT” heating/cooling mats in walls and ceilings

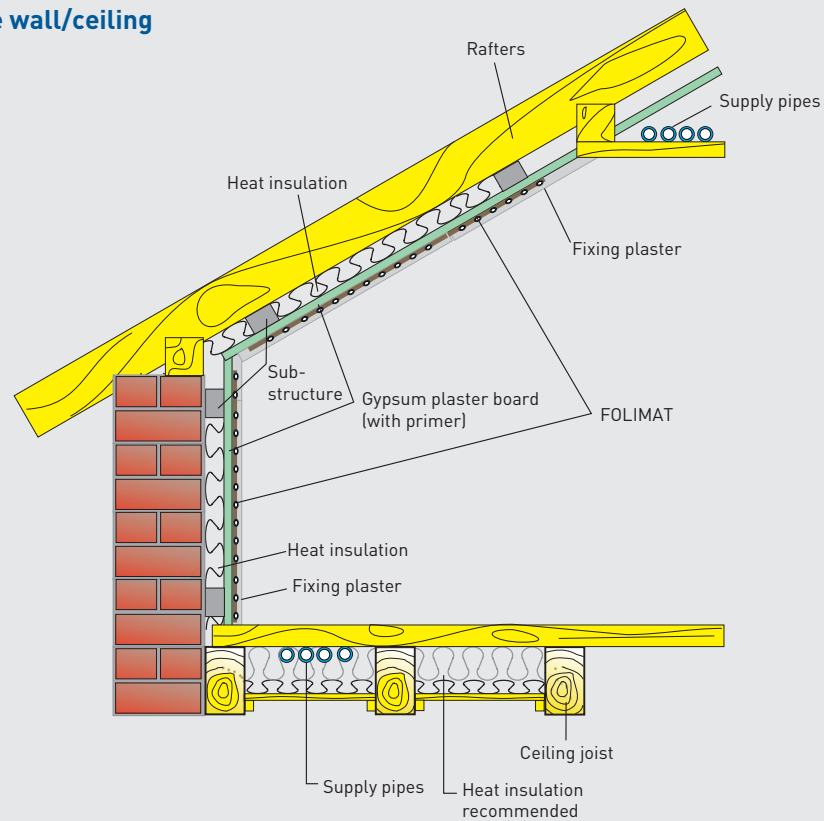
Capillary tube mat in cast plaster floor (as per DIN 18 560 Part 2)



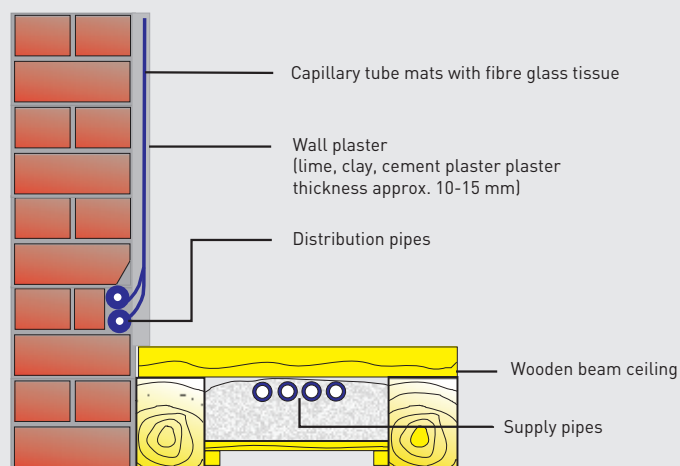
FOLIMAT in existing screed



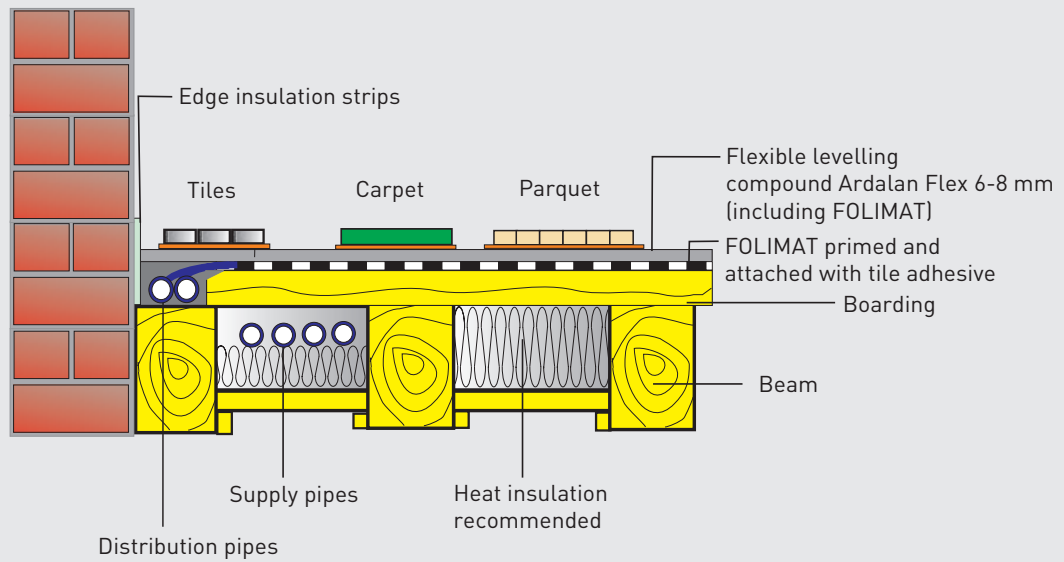
FOLIMAT attached to the wall/ceiling



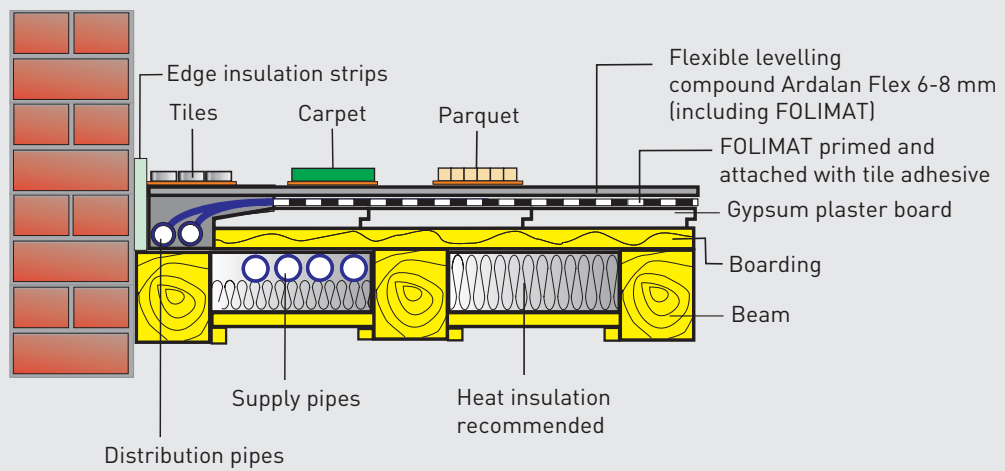
Capillary tube mats attached to the wall



FOLIMAT on timber flooring



FOLIMAT on gypsum plaster boards

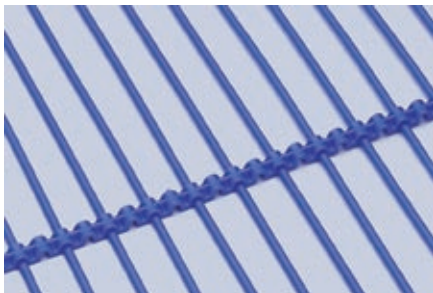


Heating/cooling mats

The Clina capillary tube mats are composed of individual PP capillary tubes between 3.4 or 4.3 mm in diameter. They are connected to feeder and return pipes, the so-called distribution pipes. The capillaries are arranged parallel to each other at intervals of 15 and/or 30 mm. The delivered lengths are 1.0 m to 6.0 m with variable mat widths up to 1.0 m. This allows the Clina capillary tube mats to fit even the most complicated room conditions.

Depending upon the type of installation (in screed or above the finished load distribution layer) and the floor construction, Clina capillary tube mats are delivered in two factory preassembled variations.

1. Clina capillary tube mats with spacers ("Omega Bands") and fibre glass tissue (optional) for:
 - Placement in cast plaster floor as well as in earth-moist cement screed
 - Use as a wall and ceiling system



If they are to be used as wall and ceiling systems, the mats are stapled, nailed, screwed and/or attached directly to the surface using plaster or grout sealant with the help of factory preinstalled fibre glass tissue.

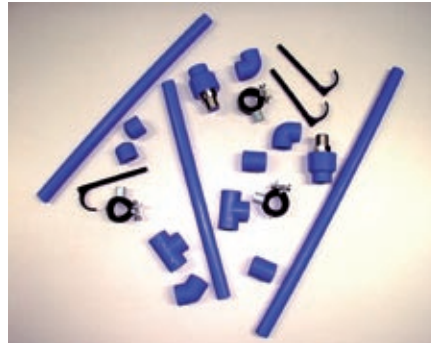
2. Clina capillary tube mats in punched in-set foil ("grooved foil") for:

- Adhesion to the existing floor
- "Wallpapering" on walls and ceilings



As the capillaries are surrounded by the grooved foil, they are accessible without risk of damage even before the floor covering is installed.

Piping



The Clina heating system is intended for use in detached houses and multifamily residences and can be retrofitted step by step with a detailed planning.

All living areas can be separately or jointly connected and supplied via a central pipe system. It is also possible to install and put into operation different areas at different times, independently from each other.

The central pipe system enables, with corresponding planning, the separate regulation of individual areas and separate calculation of the heating costs through heat meters to be installed on site.

The connection of the heating and cooling mat to the floor manifold and/or heat exchange station takes place via PP pipes in the channels provided for this purpose, recesses and/or in the heat or footstep noise insulating layers in the flooring.

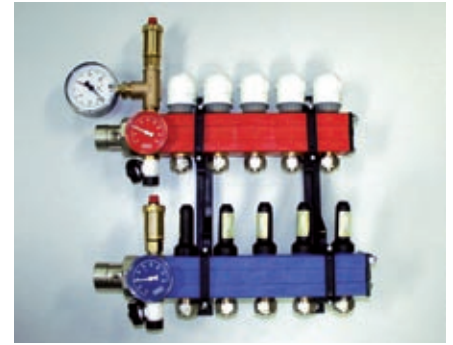
As only sleeve connections are intended, the number of different fittings and small parts is strictly limited, which has an economic effect on the material stock required.

The PP pipes are delivered at lengths of 5 m and can be cut to length with pipe cutters. The connection pipe made from PP is flexible, which allows impreciseness during construction to be levelled.

The components include:

1. Piping and socket fittings in the dimensions of 20 x 2.0 mm to 75 x 6.9 mm.
2. T pieces, reducers
3. Connection sleeves and end caps
4. 90° and 45° arches
5. Threaded connexion pieces
6. Holding clamps, peg hooks, other fastening material

Manifold with actuators



The Clina manifold is made from corrosion resistant plastic with red brass screws and thus guarantees a long lifetime and reliability.

The manifold is self insulating due to integrated air chambers and thus requires no additional insulation.

The individual heating circuits can be connected and separately regulated with the Clina manifold. For this purpose, there are regulator valves with thermal actuators in the manifold feed which regulate the flow quickly and safely and ensure the advantage of quick regulation in minutes.

The adjustable valve spindles in the manifold return modules provide the hydraulic adjustment of the heating circuits and with that the homogenous supply to all connected mats. Connection to the central pipe system is realized via corrosion resistant connection screws.

The automatic exhauster guarantees an efficient exhaust of all connected heating and cooling mats, even when in use as wall heating or if connected to a single mat on the floor above.

The components include:

1. Feed and return collectors with valves in modular constructions, attachment screws
2. Adjustable valve spindles for flow regulation
3. Thermometer for feed and return, ball valve, automatic exhauster, manometer
4. Wall holder with screws and screw anchors
5. Thermal actuator 24/230 V

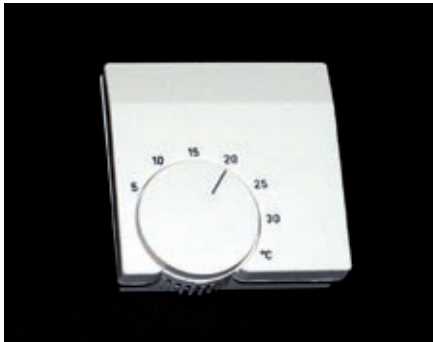
Electrical regulator



The components include:

- Distributor box 230/24 V
- for connection to 6 room thermostats and a maximum of 12 thermal actuators, including overload protection and integrated pump cut-off module

Room thermostat for heating



The room thermostat measures the room temperature via a sensor and compares it with the set target temperature. If there is a temperature variation, the thermal actuator opens or closes the appropriate regulator valve in the feed of the heating circuit manifold.

This allows the temperature of each room to be set individually according to the wishes of the user. A nighttime decrease of 4 degrees Celsius can also be set using an additionally required timer. Even in Clina capillary tube mats installed in screed, the regulating system guarantees a fast reaction to changing room temperature conditions.

The room thermostat can be operated at 24 or 230 volts, depending on the planning. Corresponding planning and installation instructions are included.

The components include:

1. Room thermostat for heating at 24/230 V [on-wall mounted] [connection cable 4 x 0.75 mm² must be provided on site]

Heating and cooling bundle



For the dual use of the Clina system for heating and cooling a suitable room thermostat which can only be operated at 24 volts is available. Connected with this is a corresponding dew point sensor which interrupts cooling if the air moisture is too high and thus ensures that no condensation forms on the active wall and ceiling surfaces.

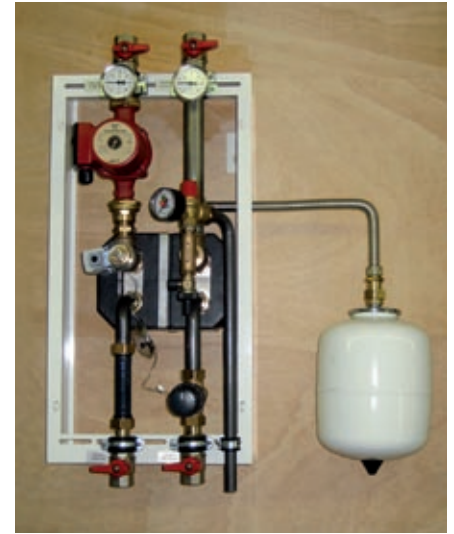
If special in-wall temperature sensors are required, such as those offered by well-known German manufacturers for switching programs, these must be specially requested.

Only regular components are available for two channel individual room control for heating and cooling.

The components include:

1. Room thermostat convertible for heating or cooling in 24 volt model (connection cable 7 x 0.75 mm² must be provided on site)
2. Dew point sensor
 - to be attached to the capillary tube mats or on the pipe
 - to switch the room thermostat between heating and cooling – 24 V

Standard separation system (heating)



Separation system, corrosion resistant, with insulated stainless steel heat exchanger, circulation pump in the secondary circuit, filling and drainage devices, safety fixtures, expansion tank, thermometer, manometer, over-temperature protection, constant temperature regulation with auxiliary energy, completely installed in a mounting frame

Performance	Old Building	New Build.
TSS – 8-1	max. 80	115 m ²
TSS – 10-1	max. 100	145 m ²
TSS – 15-1	max. 150	215 m ²
TSS – 20-1	max. 200	290 m ²
TSS – 30-1	max. 300	430 m ²

Separation system – buffer reservoir

As previously described, with additional primary circuit circulation pump (illustration similar to above)

Performance	Old Building	New Build.
TSP – 8-2	max. 80	115 m ²
TSP – 10-2	max. 100	145 m ²
TSP – 15-2	max. 150	215 m ²
TSP – 20-2	max. 200	290 m ²
TSP – 30-2	max. 300	430 m ²

Separation system (heating) – mini



Separation system, corrosion resistant, with stainless steel heat exchanger, circulation pump in the secondary circuit, filling and drainage device, safety valve, expansion tank, manometer, constant temperature regulation with auxiliary energy

Separation system (heating) – mini ca. 35 m²

Grundfestiger – special primer



Solvent free, ready to use, watery artificial resin dispersion for the priming of surfaces on which heating mats will be grouted (surfaces containing plaster)

Consumption: 80 – 150 g/m²
Delivery container: 5 kg bucket

Ardalan N – sealing compound



Equalization and leveling compound for sealing heating mats

Surface: cement screed
Consumption: 1.6 kg/m² per mm level height
Delivery container: 5 kg bucket
Accessible: after approx. 3 hours at 20 °C
Required accessory: Primer (e.g. Ardapren)

Ardapren – primer



Solvent free Neoprene dispersion priming coat for the priming of surfaces on which heating mats will be grouted (screed, wood, et cetera)

Consumption: 90 – 150 g/m²
Delivery container: 5 kg bucket

Ardaflex Top – tile adhesive



For the attachment of mats in punched in-set foil (FOLIMAT) to gypsum plaster boards and cement surfaces such as screed or concrete

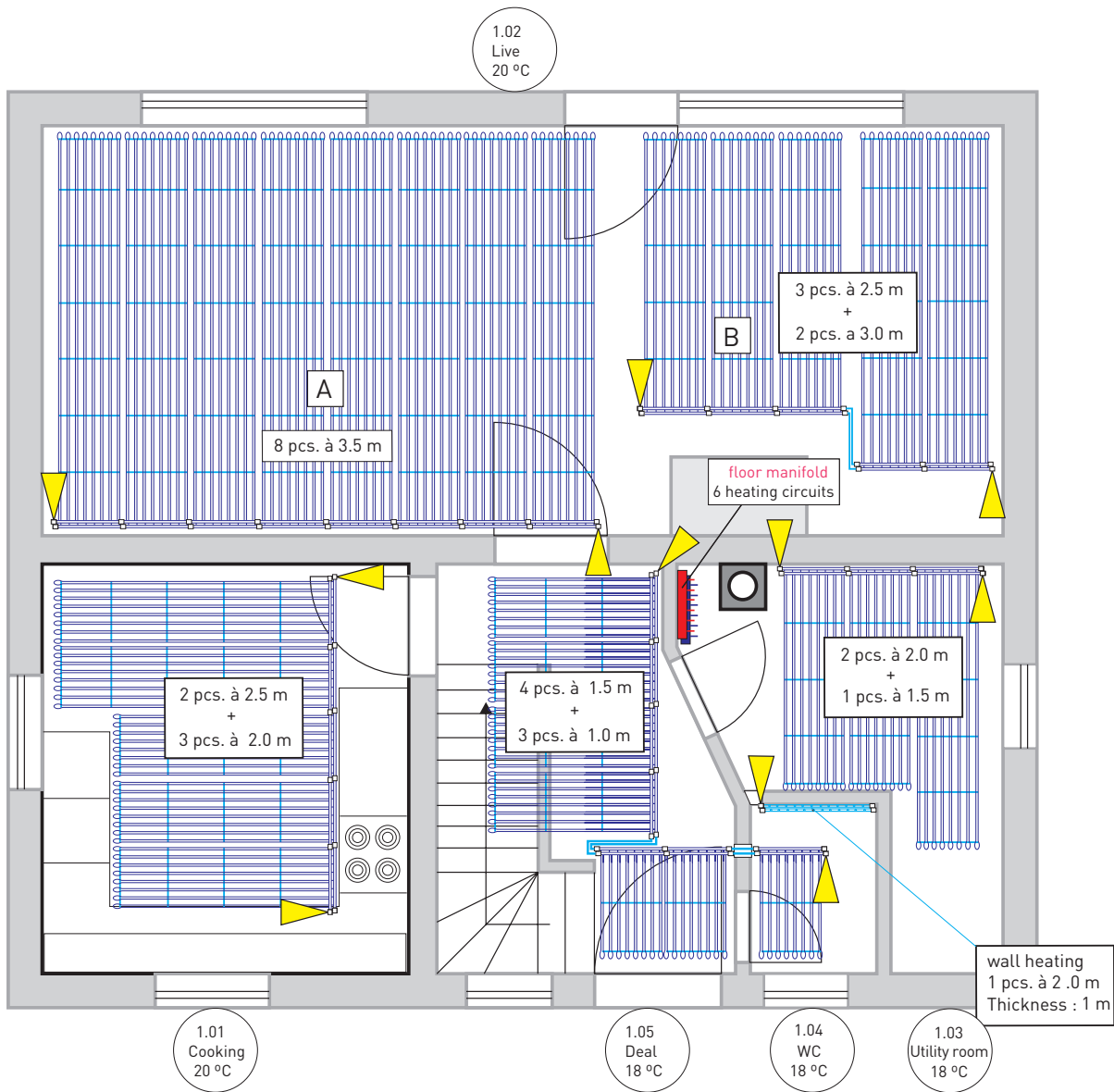
Consumption: ca. 1.5 – 3.0 kg/m² as per notched trowel
Delivery container: 25 kg sack
Required accessory: Primer (e.g. Ardapren)

Ardalan Flex – sealing compound



High performance equalization and leveling compound for sealing heating mats

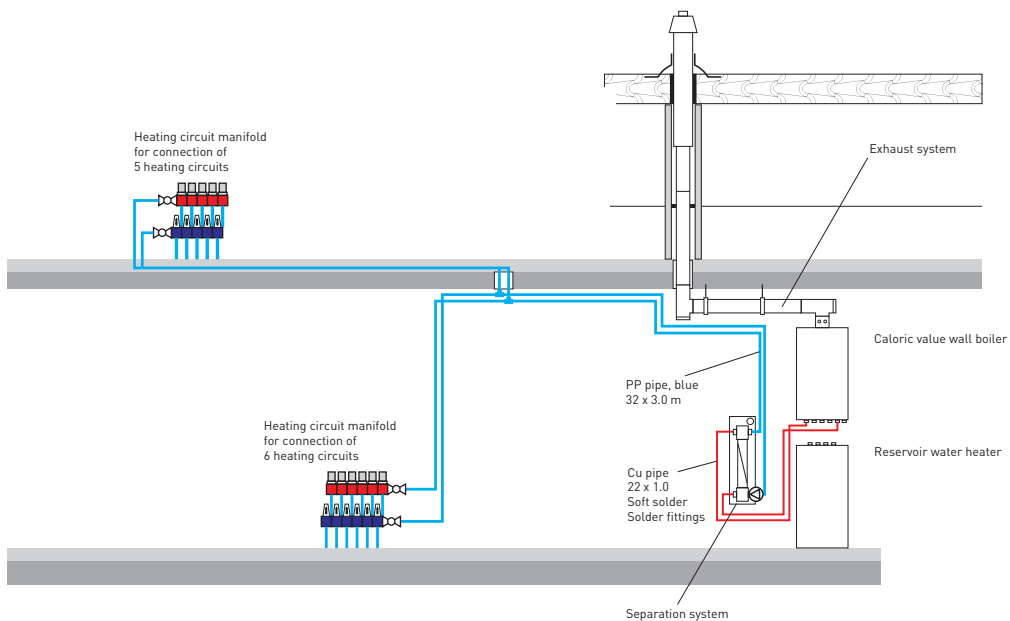
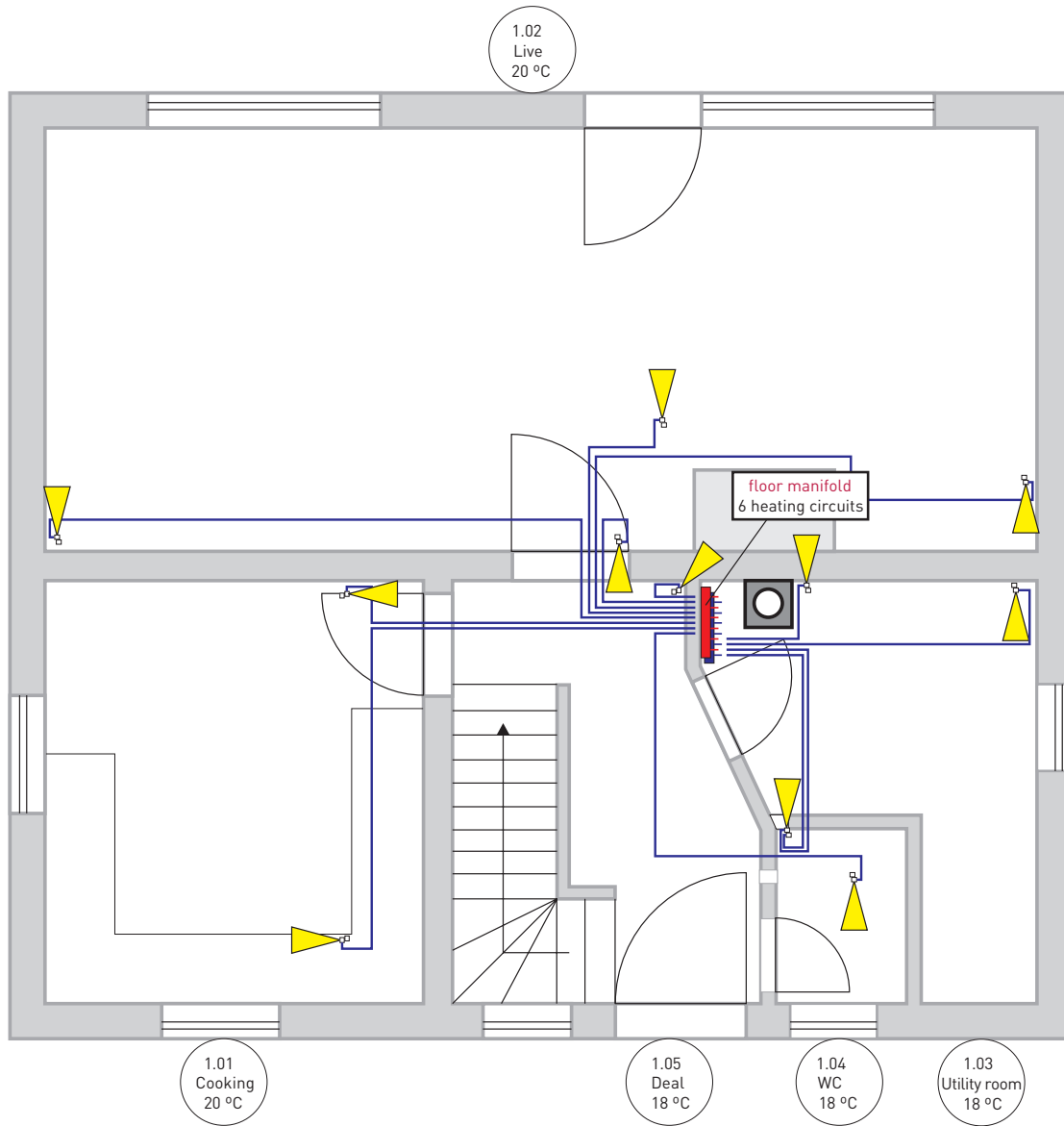
Surface: Timber floor boards
Wooden particle boards
Cement screed
Consumption: 1.6 kg/m² per mm level height
Delivery container: 25 kg bucket
Accessible: after approx. 4–5 hours at 20 °C
Required accessory: Primer (e.g. Ardapren/Special Primer)



After comprehensive consultation of the client in which all necessary questions are discussed, the project planning for the construction project will take place on the basis of the existing plans and an existing heat need calculation by project personnel. This includes:

- Creation of the mat placement and supply pipes plan
- Creation of the central pipe system scheme
- Description of the corresponding floor, wall and/or ceiling installation
- Installation guidelines and instructions
- Creation of a parts list of all required components for the construction project

At the end of the project planning, the customer will receive an individualized planning folder in which the entire installation of the Clina capillary tube system is presented.



Heater circuit side piping and sanitary system connections not shown

Cooling/heating ceilings in office and administrative buildings (selection)

Current no.	Project	Location	Installed Area
01	Reichstag, German Parliament Building (designed by Sir Norman Foster)	GER – Berlin	7.000 m ²
02	Landesbank Berlin	GER – Berlin	1.615 m ²
03	Rosmarin – Carrée	GER – Berlin	3.800 m ²
04	ZDF Zollernhof	GER – Berlin	4.100 m ²
05	Dt. Telekom	GER – Berlin	1.900 m ²
06	Saxon Parliament	GER – Dresden	2.000 m ²
07	Kempinski Hotel	GER – Dresden	300 m ²
08	Savings Banks Financial Centre	GER – Erfurt	2.000 m ²
09	Benteler AG, Plant Talle	GER – Paderborn	3.900 m ²
10	Heart Centre Bad Oeynhausen	GER – Bad Oeynhausen	800 m ²
11	Lufthansa, Main Administration	GER – Cologne	11.500 m ²
12	RTL	GER – Cologne	5.900 m ²
13	Renovation of Public Building	GER – Berg.-Gladbach	4.600 m ²
14	Nokia	GER – Düsseldorf	3.800 m ²
15	Japan Centre	GER – Frankfurt	9.000 m ²
16	Labour Union Bau Steine Erden	GER – Frankfurt	6.555 m ²
17	Boehringer Ingelheim AG	GER – Ingelheim	12.900 m ²
18	Braun AG	GER – Kronberg / Taunus	4.800 m ²
19	Motor-Presse-Verlag (Publisher)	GER – Stuttgart	1.400 m ²
20	Bavarian State Bank	GER – Munich	7.500 m ²
21	Deutsche Bank	GER – Munich	5.000 m ²
22	Maybach Centre	GER – Munich	250 m ²
23	FC Bayern München, Administration	GER – Munich	250 m ²
24	Twintowers	A – Vienna	28.000 m ²
25	Creditanstalt	A – Vienna	3.600 m ²
26	LKW-Walter	A – Vienna	4.100 m ²
27	Patek Philippe	CH – Geneva	3.300 m ²
28	Nestlé Headquarter	F – Paris	15.000 m ²
29	Hôtel de Beaune	F – Paris	2.000 m ²
30	Imprimerie Saint Paul	L – Luxembourg	5.020 m ²
31	Ariane Espace	L – Luxembourg	6.100 m ²
32	Anova Insurance Company	NL – Amersfoort	21.000 m ²
33	Interpolis Insurance Company	NL – Tilburg	22.200 m ²
34	Stade Louis II	Monaco	400 m ²
35	Slovak National Bank	SK – Bratislava	10.900 m ²
36	Interbanka	CR – Prague	11.100 m ²
37	Kensington Palace	GB – London	300 m ²
38	Hypobank	GB – London	1.600 m ²
39	EU Embassy	GE – Tbilissi	450 m ²
40	Passage Garden	J – Tokyo	2.600 m ²



Reichtstag, German Parliament Building, Berlin
(designed by Sir Norman Foster)



Japan Centre, Frankfurt



Floor/wall and ceiling systems for heating and cooling of residential buildings (selection)

Project	Location	Installed Area
Mansion	GB – London	400 m ²
Mansion	GB – London	300 m ²
Mansion	GB – London	300 m ²
Detached house	GER – Thierbaum	107 m ²
Detached house	GER – Halle	147 m ²
Education and Recreation Centre	GER – Rehmsdorf	380 m ²
Detached house	GER – Berlin	238 m ²
Loft	GER – Berlin	1080 m ²
Detached house	GER – Berlin	320 m ²
Detached house	GER – Berlin	274 m ²
Church	GER – Berlin	70 m ²
Detached house	GER – Berlin	72 m ²
Medical Centre	GER – Berlin	570 m ²
Detached house	GER – Berlin	99 m ²
Multifamily residence	GER – Potsdam	554 m ²
Detached house	GER – Potsdam	450 m ²
Two Family Home	GER – Teltow	336 m ²
Museum	GER – Glashütte	730 m ²
Detached house	GER – Oranienburg	97 m ²
Detached house	GER – Artlenburg	480 m ²
Detached house	GER – Löhne	372 m ²
Detached house	GER – Bad Oeynhausen	95 m ²
Detached house	GER – Kirchgandern	131 m ²
Detached house	GER – Solingen	82 m ²
Detached house	GER – Münster	99 m ²
Detached house	GER – Jülich	30 m ²
Detached house	GER – Kirchen	127 m ²
Detached house	GER – Freiburg	121 m ²
Detached house	GER – Eisenach	144 m ²

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