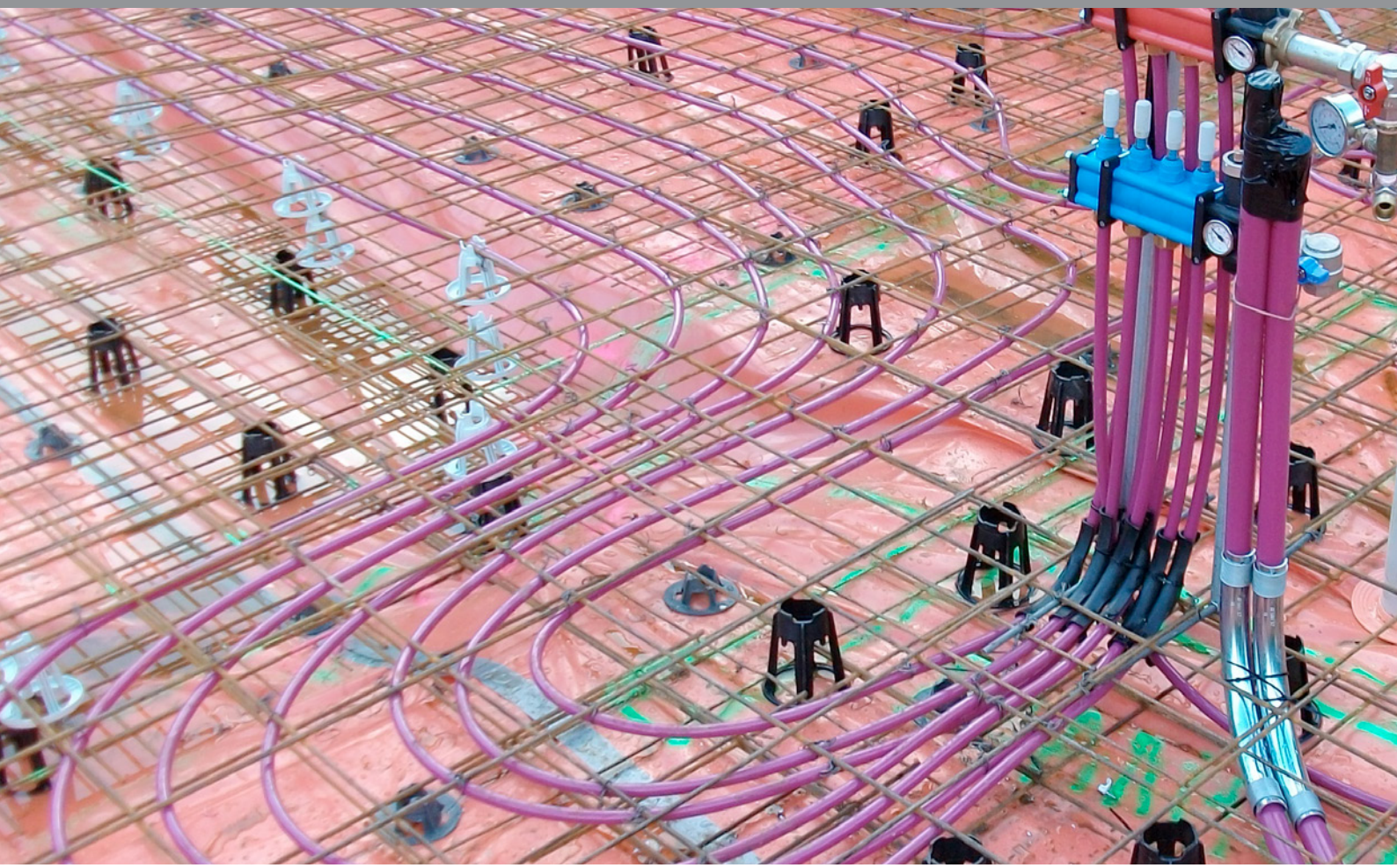
FROM THE GROUND UP: THE DESIGN IMPLICATIONS OF HYDRONIC HEATING SYSTEMS



ComfortHeat
Superior Floor Heating Systems

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INTRODUCTION

Increasingly unpredictable climate conditions and the market's growing concern for the environment and sustainability have impacted the design and construction industry. Today's designers and specifiers are tasked with identifying climate control solutions that are energy efficient and have minimal impact on the environment, yet deliver top class performance and functionality. Properly specified, hydronic underfloor heating systems can meet these demanding requirements in residential applications.

When installed in a house with 2.7m ceilings, a hydronic floor heating system requires on average 20% less energy to operate when compared to ducted heating systems.[1] This is due to the elimination of duct loss.[2] Against the backdrop of rising energy prices – a trend that The Guardian predicts will continue[3] – this energy saving represents a significant reduction in operational costs. However, in order to achieve such savings, designers and specifiers must navigate the complex specification process for hydronic floor heating.

This whitepaper provides a close examination of the key considerations that designers and specifiers must consider when specifying hydronic floor heating. The design implications of installing hydronic floor heating in residential projects are also considered.

UNDERSTANDING HYDRONIC HEATING

'Hydronics' refers to systems that use water as the primary medium in a heating or cooling system. Hydronic heating systems warm interior spaces by piping heated water around a house or building to heating panels, heating convectors or through the sub-floor using a series of under-floor PEX pipes.[4] Hydronic floor heating typically involves the transfer of water via PEX pipes through the slab or topping slab, providing radiant and convective warmth that emits from the floor into the interior space above. [5]

The liquid used in such systems can be heated in a number of ways including:[6]

- a boiler (gas, electric, wood or oil);
- a wood fire stove or heater;
- solar panels or evacuated tubes (typically installed on the roof);
- geothermal pumps (utilising heat from the soil); or
- air-sourced heat pumps (extracting heat from the air).

Installation of hydronic floor heating follows a specific process. Hydronic floor heating pipes must be installed before the slab is poured or laid in a 50mm (minimum) screed bed; the pipes can be attached to a mesh or to separate reinforcing rods. After the piping has been laid, it must be covered by a concrete slab at least 30 mm thick over the pipes.[7]

THE BENEFITS OF HYDRONIC HEATING

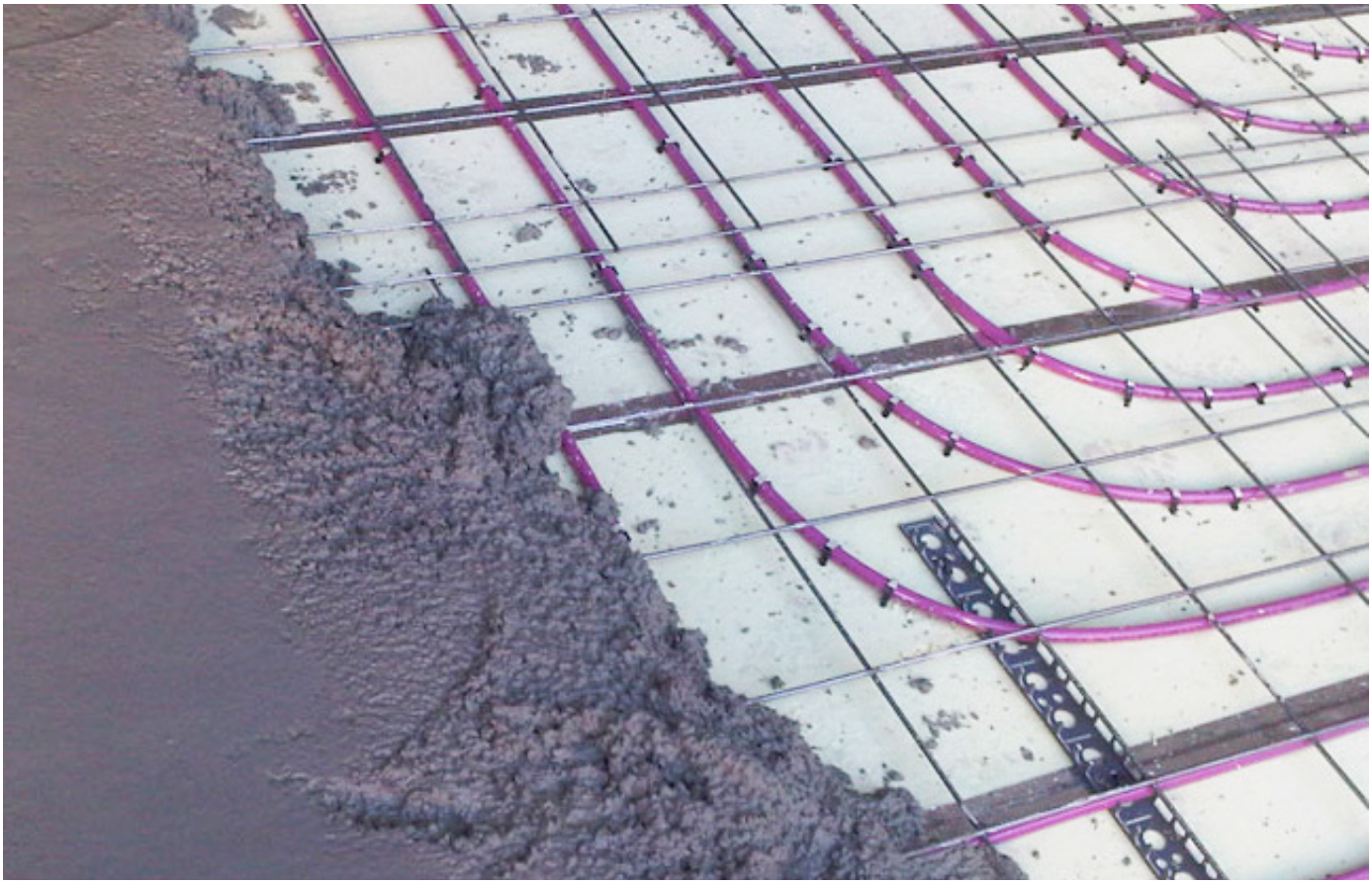
Hydronic heating delivers a number of short and long-term benefits that should be considered by designers and homeowners. These benefits include:[8]

- Clean, natural heat distribution that does not dry air or circulate allergens;
- Even and consistent heating, resulting in superior occupant comfort compared to traditional forced air systems that may have cold or hot spots due to poor circulation;[9]
- No electrical connections or exposed flames, allowing a higher degree of safety than other heating systems; and
- Superior energy efficiency and reduced operating costs when compared to other conventional heating systems.[10]

THE RIGHT PLACE, THE RIGHT TIME

Given the installation requirements for hydronic floor heating systems, such systems should be specified early in the building process. Accordingly, the responsibility for incorporating hydronic floors should lie with the designer, rather than the builder or homeowner, during the early stages of design.

Hydronic floors need to be considered as part the building design well before the slab is poured, to allow incorporation of the system into the structure of the building. Structural considerations that need to be accounted for include the correct slab thickness, giving ample allowance for the full hydronic system which includes pipes, manifolds, supply lines and the heat source. It is advisable for designers to work closely with the manufacturer and supplier of the desired hydronic system to ensure that the installation environment is suitable and optimised to accommodate the system.



SPECIFYING HYDRONIC HEATING: KEY CONSIDERATIONS

Architects, designers and specifiers should account for the below considerations when specifying hydronic heating and incorporating hydronic floor heating.

Floor type and construction

Hydronic heating systems can be installed in the following ways:[11]

- In-slab, wherein the pipes are embedded directly into the concrete floor slab. In-slab systems leverage the thermal mass and passive solar gains of cement flooring to deliver low, even and continuous heating of an interior space.
- Above the sub-floor, where the pipes are installed in a minimum 50mm thick layer of concrete, gypsum or other similar material.
- Under timber flooring on battens, which requires the pipe to be installed over insulation on diffusion plates between the battens.

Floor coverings

The floor coverings specified for a project impact the performance of hydronic heating systems. Different floor coverings offer varying levels of insulation, given as R-Value, which measures the resistance to heat flow through the material.[12] The higher the R-Value, the poorer the covering's heat conductivity.[13] Floor coverings with high R-Values deliver poor heat conductivity and are less suitable for use with a hydronic floor heating system. The Radiant Professionals Alliance provides information on the comparative R-Values of flooring and sub-floors.[14]

Materials that deliver high thermal conductivity include hard surfaces such as tile, concrete, stone and marble. These materials have low R-Values and enable heat to flow up through the floor covering. Thick carpet or pads can act as an insulation layer that reduces the effectiveness of the radiant heat emitted from a hydronic heating system. Vinyl flooring can be heated, but requires a uniform, flat sub-floor. Where timber flooring is the desired floor covering, the manufacturer and/or supplier must first approve this for that particular use; however, it should be noted that the thermal conductivity of wood is relatively low compared to the thermally conductive materials discussed above.[15] Rubber-backed or cork floor coverings should not be used in conjunction with floor heating systems.

Heat loads

"Heat load" or "heating load" refers to the amount of energy that must be added to a space to maintain the desired temperature.[16] Low thermal loads typically mean that the building requires less energy to maintain a comfortable temperature and therefore is more energy efficient than buildings with high thermal loads. The heat load is usually expressed as kilowatts (kW) of energy, which is the energy required by a heating system to overcome the speed and amount of heat that escapes from an interior space to the outside. Typically, heat loss is greatest through the windows.

Determining the amount of heat required for an interior space is an important factor when designing for, specifying, and incorporating a hydronic heating system for a building. A heating system that does not emit enough heat may not allow a space to reach a comfortable temperature, and may have other energy efficiency impacts.

Heat source selection

As discussed above, hydronic systems can be powered by different sources including natural or liquefied petroleum gas, electricity, solar energy or wood. Designers and specifiers should factor in the environmental conditions of the installation context as well as the ongoing costs and spatial requirements to run the source, as these vary significantly. Note, for example, that solar powered heating sources may not be appropriate if the environmental conditions are not optimal for solar energy generation.

Manifold locations

The optimal location for the distribution manifold is in close proximity to the heated floor. This is the location where the 16mm pipes in the floor, which are installed in 100 lineal metre circuits, receive hot water from the supply lines from the heat source. The heated water is distributed through the floor via the manifold; accordingly, the manifold should be placed in the appropriate location for the floor to heat evenly.

HYDRONIC UNDERFLOOR HEATING

Comfort Heat is one of Australia's largest designers and suppliers of hydronic underfloor heating systems. The company can accommodate large floor areas, delivering energy efficient heating that creates a comfortable living environment for occupants. Comfort Heat's solutions reduce operating costs and also provide the flexibility to select environmentally friendly heat sources including natural gas boilers, solar evacuated tubes, heat pumps or wood stoves.

Comfort Heat's hydronic heating system is designed by highly qualified engineers, ensuring site specifications, metrics and other relevant information is factored in and the best outcome is delivered for any individual project. Committed to delivering the highest quality and best performing solution, Comfort Heat is able to design and supply a complete hydronic system and ship it to any Australian location.

Utilising a PEX pipe designed specifically for floor heating, Comfort Heat's hydronic system is made with reliable, effective and energy efficient performance in mind. The pipe is multi-layered and includes an oxygen barrier. With a typical maximum pipe length of 100 M per circuit, the pipe can be laid above the slab between battens with respect to natural wood flooring, in a 50mm screed bed, or under the top reinforcing mesh if a screed of 50mm cover is not possible.

Comfort Heat also offers a range of heating controls such as thermostats, sensors and control stations that can automate and maximise the performance and efficiency of the heating system.

COMFORT HEAT

Proudly Australian-owned, Comfort Heat is a leading supplier and installer of hydronic and electric underfloor heating systems. From large industrial projects to small residential bathrooms, Comfort Heat has a heating solution for any application context.

Ensuring the most efficient and effective heating solution is delivered, the company works closely with architects and designers at the design phase of a project. At this stage, specifications are properly documented and all stakeholders in the project, including structural engineers and builders, are made aware of the impact of hydronic systems and the installation process. Comfort Heat also collaborates closely with builders to ensure complete understanding of the heating system's technical requirements. Comprehensive post-sales support and service are also provided, ensuring success of the solution throughout its lifecycle.

Delivering superior quality in terms of products and service, Comfort Heat is committed to designing superior installations that meet the requirements of the customer.

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