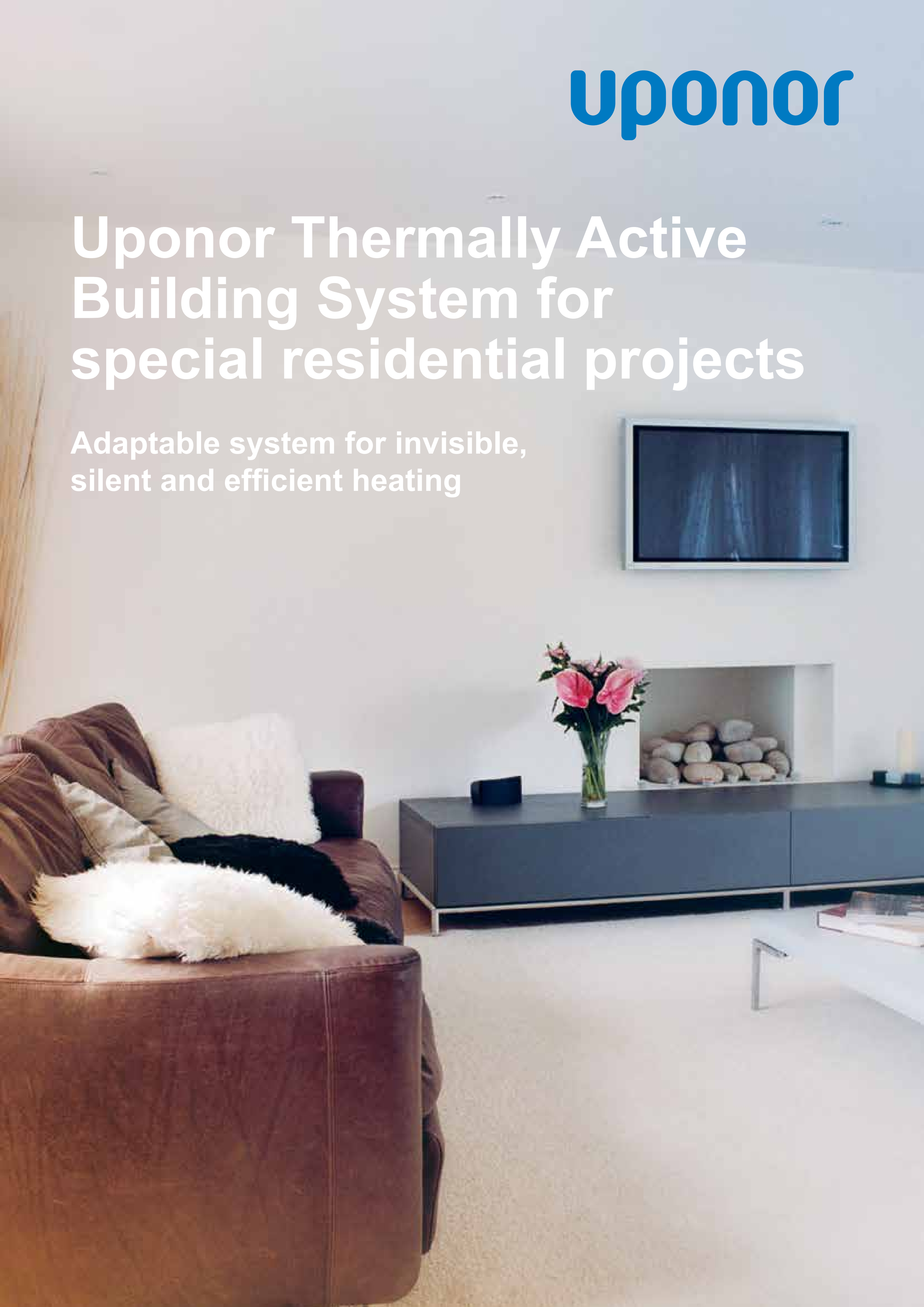
Uponor Thermally Active Building System for special residential projects

Adaptable system for invisible, silent and efficient heating



Introduction
Solution description

A Thermally Active Building System (TABS) installed in a residential building can offer the best comfort for the occupants in an efficient way and can be considered a real alternative to conventional heating systems for this type of building.

Pipes embedded into the slabs to provide heating in winter and cooling in summer (if needed) could be the best solution, both in low investment and operating cost providing a comfortable space for the occupants of the building.

Due to the significant increase of the thermal insulation of the building envelope, the heating energy demand of buildings has been also significantly reduced. That is why low-temperature heating systems such as radiant heating have established themselves as energy efficient and comfortable alternative to conventional systems.

Uponor TABS turns the ceilings into thermally active elements with integrated modular pipe loops positioned in the slab structure, using the thermal storage capacity of concrete ceilings offering a cost efficient method for space conditioning.

This solution has been widely used in large commercial buildings such as office blocks or administrative premises and can be used also in residential buildings offering the same advantages and benefits.

- **Thermal comfort for occupants**
- **Optimised utilisation of renewable energy sources**
- **System components are largely maintenance free**
- **Complete freedom of room utilisation (no restrictions in room design)**

Simulation
Building description

To prove the concept of this widely used solution in non-residential type of buildings, Uponor has developed a simulation to check comfort conditions and also energy consumption of this type of solution.

The building energy simulations data is provided by EQUA solutions AB and developed with help of IDA Indoor Climate Energy 4.6 software.

Base building description

Multi-storey residential building with 3 floors and 2 independent apartments per floor:

- Apartment 1 and 2 located on the bottom floor
- Apartment 3 and 4 located on the first floor
- Apartment 5 and 6 located on the top floor

Building size	870 m^2
Size per apartment	113 m^2
Storey height / Number of storeys	2.7 m/ 3 storeys
Total heated area	667 m^2
Location	London

Building data

- **External wall:** U-value 0.26 W/m^2K
- **Roof:** U-value 0.18 W/m^2K
- **External floor against ground:** U-value 0.22 W/m^2K (including ground)
- **Internal Slab:** 280 mm concrete with TABS pipes at 70 mm from the soffit, floor covering parquet (10 mm) and step insulation (5 mm). Total U-value 2.09 W/m^2K
- **External window:** U-value 1.6 W/m^2K, g value 0.6 plus blinds when needed
- **Frame:** 10%, U-value 1.6 W/m^2K
- AHU system with heat recovery to provide ventilation to the building

Base building

Base building. Floor distribution

Uponor Contec simulated case

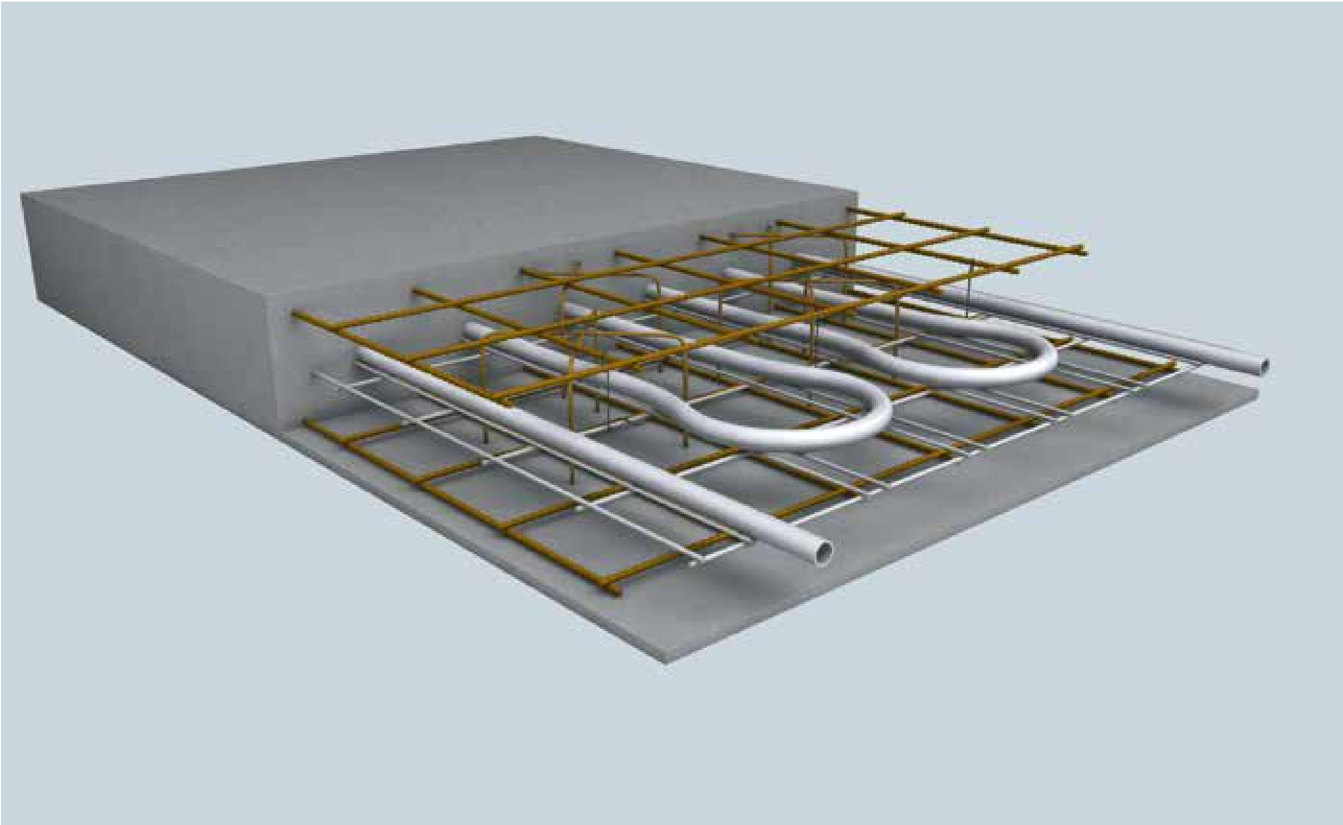
Uponor Contec is a hybrid version of TABS, without thermal insulation between floors, but only with thin step-sound insulation. The characteristic of the system is the absence of any room controls. Principal feature of the system is that the heat transfer between the floor and the room is driven by the temperature difference.

In that sense, when the room gets warmer the heat transfer gets lower so in one way the system is self-regulated.

Heating energy source is an air to water heat pump.

The only regulation of the system is found in the facility room, were the supply temperature is controlled. Constant flow to the loops is provided during the year except for the summer when the pump is switched off.

- **Type of pipe: 20 mm PE-Xa pipe**
- **Constant pipe distance: 200 mm**



Simulation results

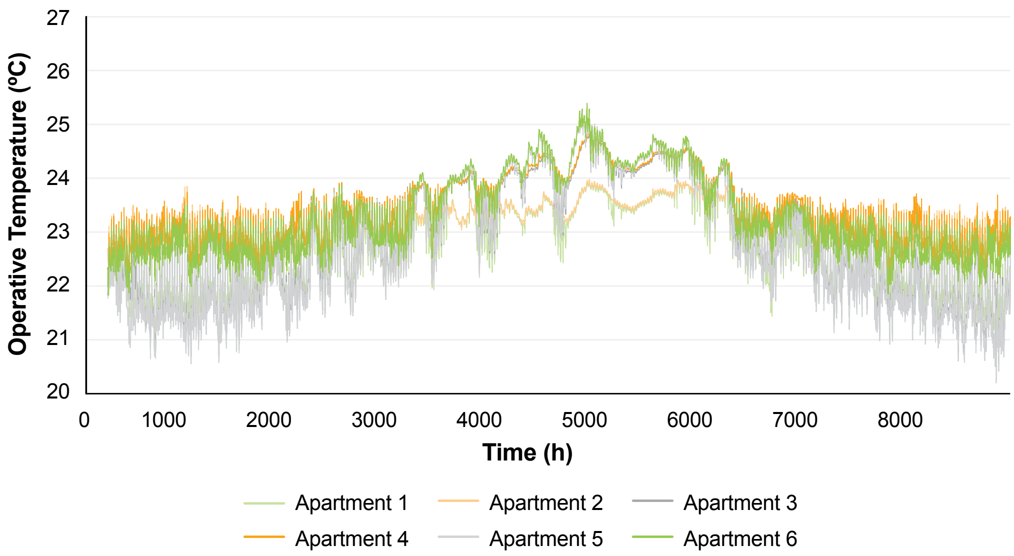
Results of simulation shows that the total heating energy consumption and the total facility energy consumption (including lights, fans, DHW and other facillity electricity) is as follows:

Location	Total yearly heating energy consumption (kWh/m² year)	Total yearly facility energy consumption (kWh/m² year)
London	41.1	76

The following charts shows the operative temperature in the six apartments during the year.

Minimum operative temperature

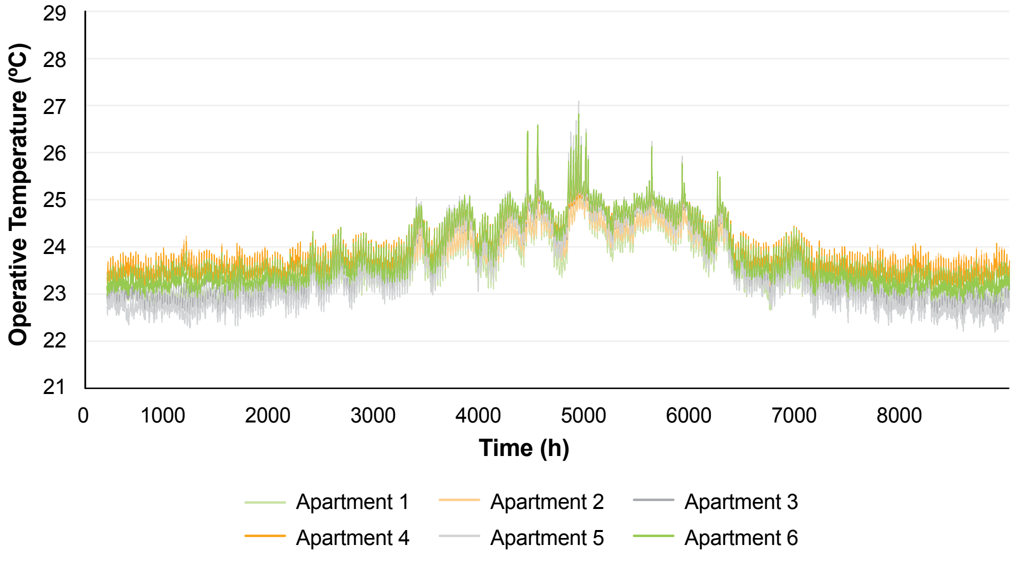
Period: From 01/01/2014 to 31/12/2014



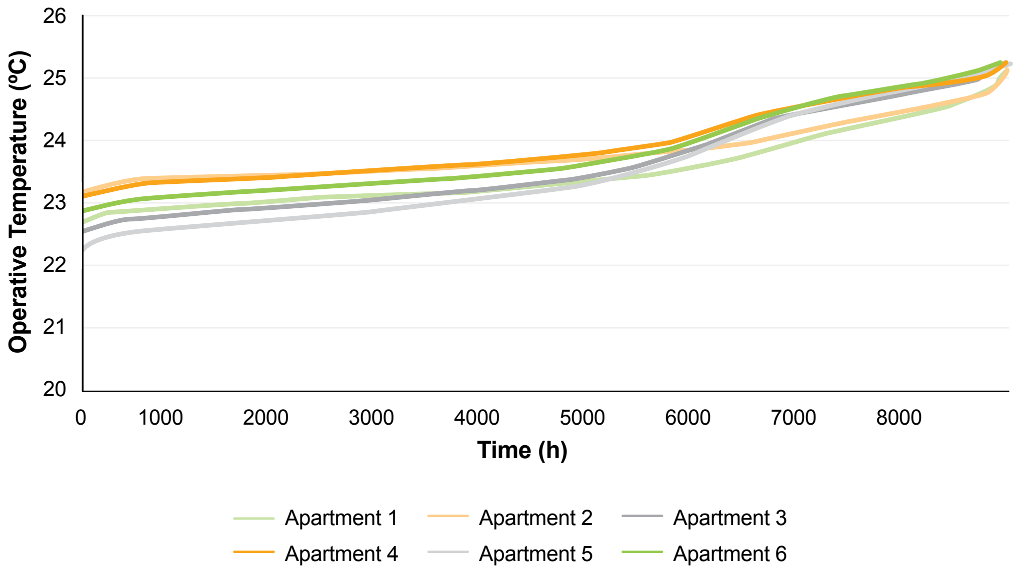
Simulations results

Mean Operative Temperature

Period: From 01/01/2014 to 31/12/2014



Mean Operative Temperatures Duration Curves



Simulation conclusions

As conclusions from the previous charts, we can highlight:

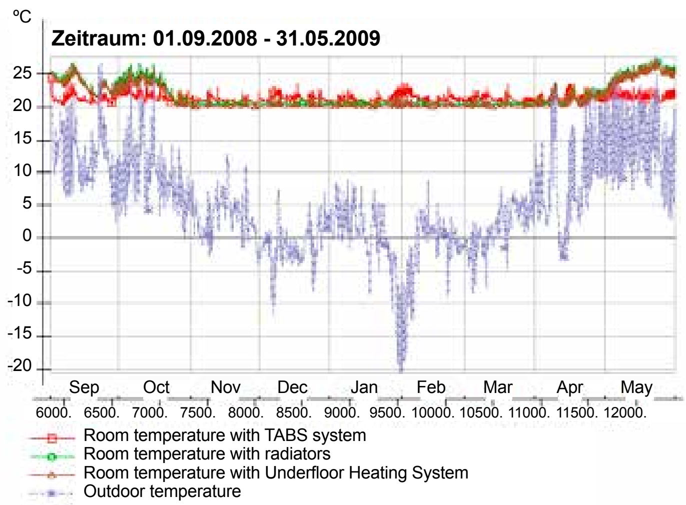
- **Indoor thermal comfort can be considered acceptable in all cases**
- **Minimum operative temperature in all the apartments is always higher than 20.5ºC**
- **Mean operative temperature is maintained between 22-23.5ºC during most of the winter time**
- **Difference between apartments is maximum 1ºC**
- **High indoor temperatures during summer can be considered normal, as no cooling is provided (only opening windows when temperature is over 25ºC)**

External studies

External studies also shown the advantages of TABS solution in residential buildings compared with other typical solutions as underfloor heating and radiators.

An University Thesis made in Technical University of Munich, Institute for Building Climatology and Building Technology called “Potential and limitations of Concrete core activation in residential buildings” (Potential und Einsatzgrenzen der Bauteilaktivierung im Wohnungsbau), shows a comparison in energy consumption between three different systems (based in simulations) in a residential building located in Munich:

- TABS with a geothermal heat pump as energy source (28/25ºC)
- Underfloor heating system with geothermal heat pump as energy source (40/30ºC)
- Radiators system with geothermal heat pump as energy source (60/40ºC)



Result of the simulation shows that the thermal comfort even in the worst day of the winter is even better with TABS than with the other systems.

About energy consumption there is also a considerable energy saving with TABS:

	TABS	UFH	Radiators
End energy (kWh/m²)	4.93	5.13	8.14
Primary energy (kWh/m²)	13.32	13.86	21.97

Reference cases in Germany

Gewog, Bad Salzungen

Building and system description:

Residential building with rental apartments; specifically developed for elderly people. Particular attention is paid to the development of age-appropriate, accessible apartments.

The building consists of three floors and 39 apartments between 50-75 m^2 with a total of 1250 m^2 living space.

Heating installation consists of a TABS modules for all floors and an additional Renovis ceiling heating system for the attic. The supply hot water is provided by a district heating system from a highly efficient gas turbine power plant (primary energy factor fp=0.48).

In addition to comfort, TABS has an advantage in the total cost compared to a conventional heating system with radiators.

Thanks to the good location, the comfort offered to the tenants and the innovative system, many people were interested on the rental before the completion of the building.

In this particular case, the room temperature is set as a modern underfloor heating single room control.

The system consists of a prefabricated filigree slab with 16 mm pipes with a pipe spacing of 15 mm and a concrete cover of 5 cm.

The precise time scheduled plan allowed the delivery of the 55 elements with the integrated TABS modules just in time on the site. After the connection of the modules to the heating loops, the 80 mm thickness prefabricated elements were covered in situ with 120 mm of concrete.

Reference cases in Germany

Pipes positioned in the prefabricated filigree slab before the concrete pouring.

View of the prefabricated filigree slab in the manufacturing site.

Reference cases in the UK

HMP Highdown, Surrey

The project

The design of 2 new house blocks and education buildings in 2006 led main contractor Kier Southern to a precast solution. The external envelope of the building is constructed of a precast concrete sandwich panel – inner wall insulation and a face brick work outer skin, providing fast on site erection.

The building is currently held by NOMS as an example for house block construction and the features and construction processes have earned a BREEAM “excellent” rating-the first time it has been achieved on this type of custodial building.

The solution

Uponor designed and fabricated tested pipe mats which were cast into the precast floor units off site. On site engineers from Uponor then installed primary pipework and manifolds providing a fully tested and commissioned system.

Uponor engineers assisted in the design development for the building which is naturally ventilated and incorporates north-facing roof lights to reduce solar glare.

Benefits

The Uponor system is linked to ground source heat pump which provides heating in the winter and a cooling capability in the summer months.

The requirement for any exposed heating element in the occupied space and the associated maintenance is eliminated.

The Uponor system is designed to last the life of the building.

The team

Client: Ministry of Justice
Main contractor: Kier Southern
Architect: Pick Everard
M&E consultants: Faber Maunsell
M&E contractor: LX Engineering

Installed system
Uponor TABS (precast system) - approx **2,800m²**

Reference cases in the UK

uponor

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