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**Thomas Friedrich - Innogration GmbH**  
**Multifunctional precast concrete elements –**  
**More than heating and cooling (integrated)**



**Development of building ceilings:  
Conventional ceiling construction with beam ribs –  
first construction by F. Hennebique (ca. 1895)**



## Development of building ceilings – first flat slab construction with column head Robert Maillart / Schweiz (1910)





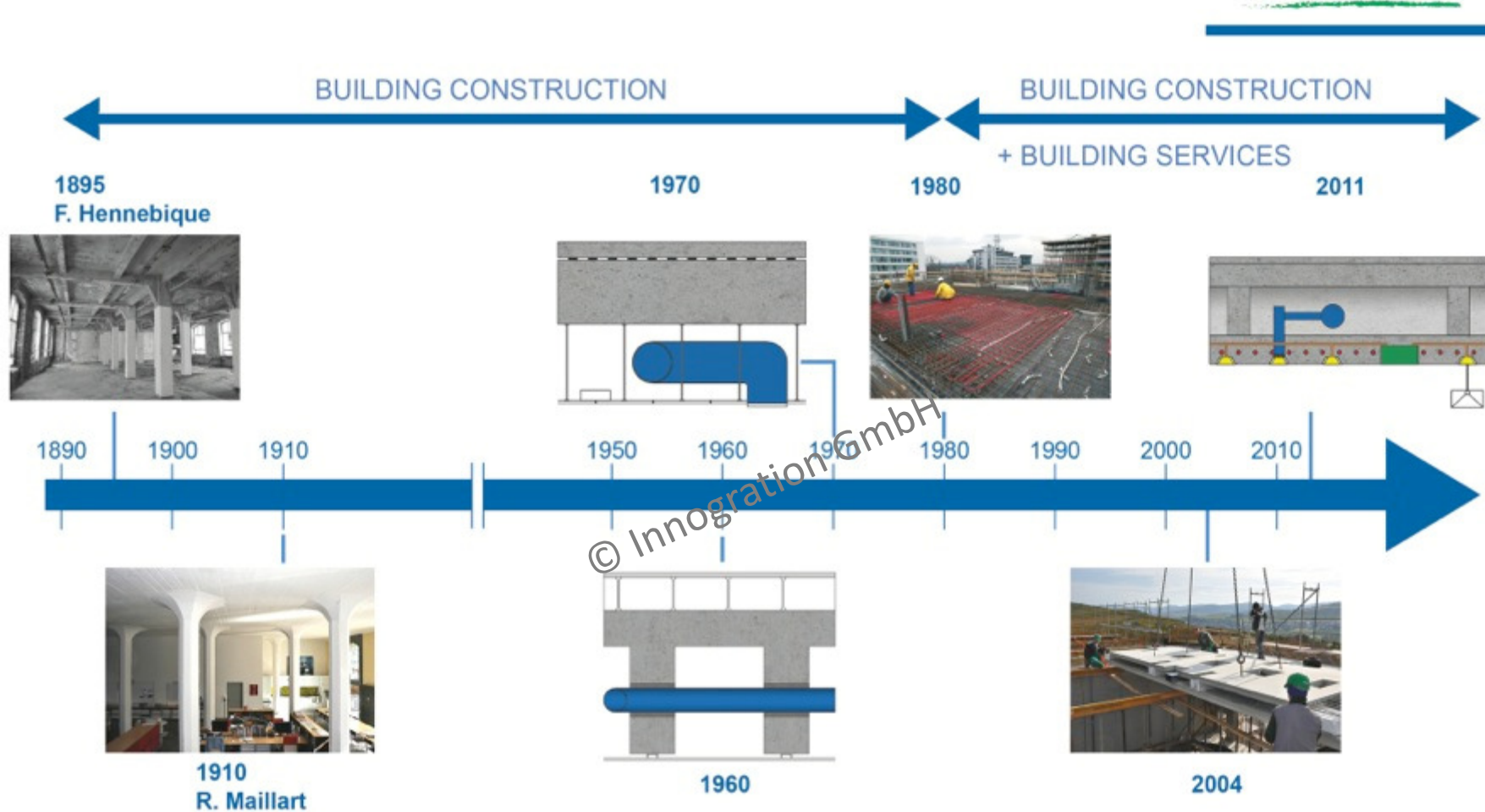
## Actual slab system for building construction: traditional beams and installation between the beams





# HISTORY OF DEVELOPMENT FOR BUILDING CONSTRUCTION

**CEILTEC®**



- FUNCTIONAL INTEGRATION TOWARDS MULTIFUNCTIONAL PRODUCTS
- COMPACT DESIGN
- GREATER COMFORT

**Precast elements: optimum in light weight and just used for large spans**





## Precast elements: structural elements with prestressing





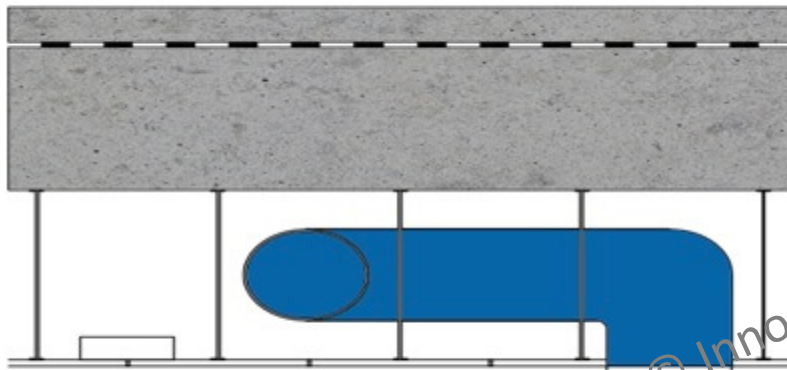
**Precast elements: structural elements can be used further to offer additional functions like heating and cooling**



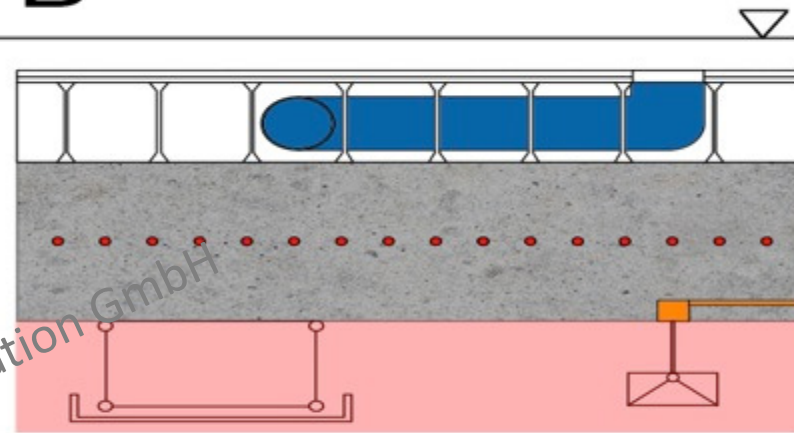


Where to install the elements for the building service  
when thermal activation is used with the cross-section

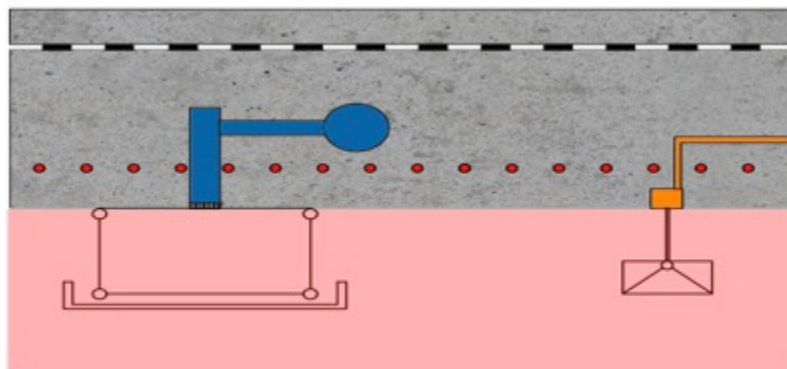
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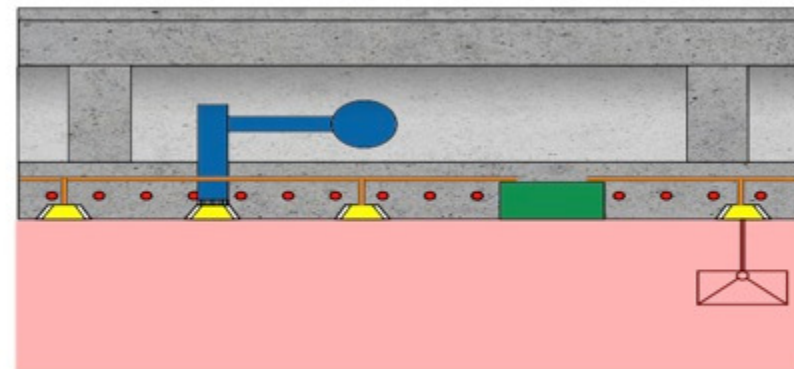
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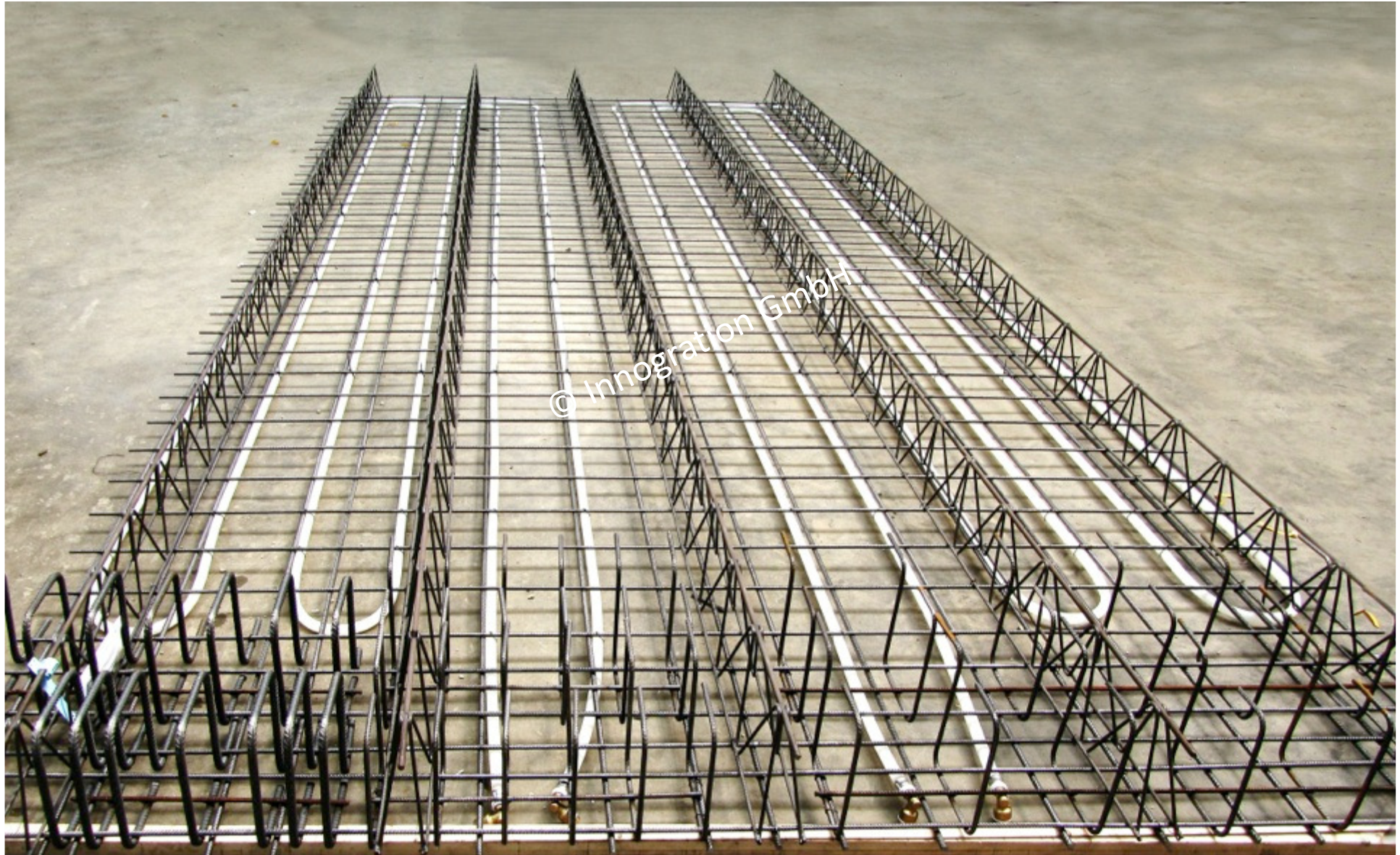
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**Industrial production with traditional structural elements  
Combined with further elements for additional use**





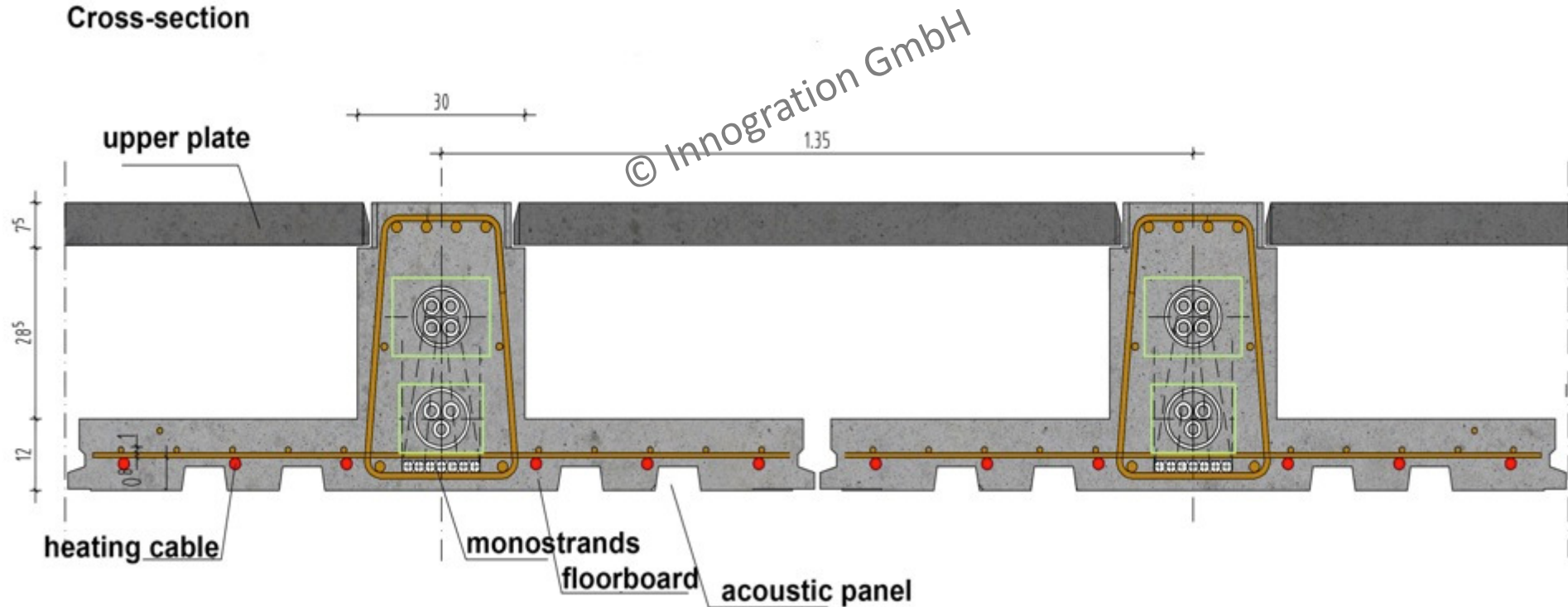
## Production in the factory: more than a simply reinforcement mesh



## New development due to energy saving reasons:

- sandwich construction = less material / save resources
- new possibilities (integration of technical building equipment and construction)
- thermoactive material performance: heating and cooling

Cross-section





## Sandwich cross-section for slabs with large span

Integration of building service (HVACR) within the shallow cavity



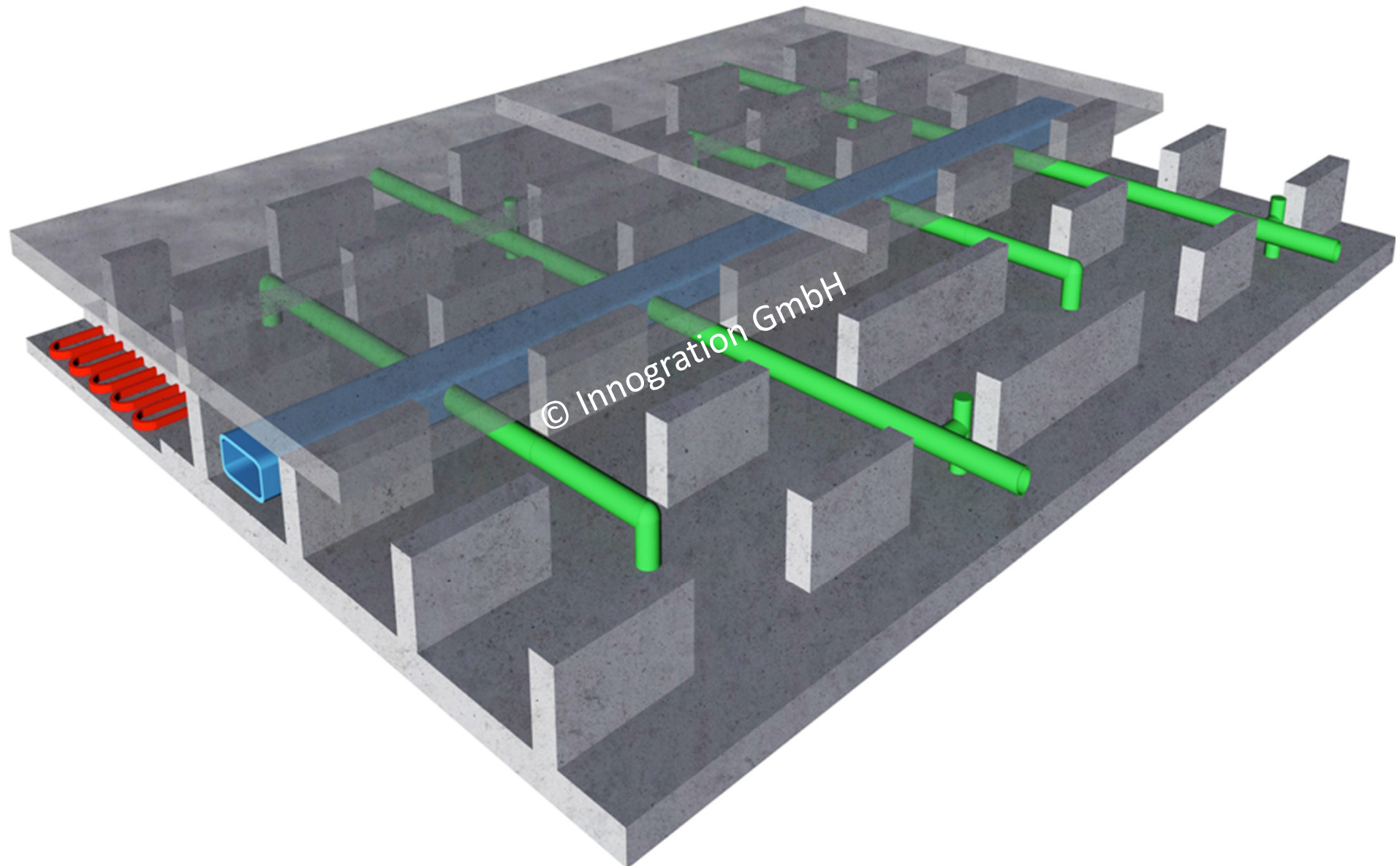
## Strutural elements combined with additional elements

Prestressing devices and tubes for heating/cooling





**Shallow cavity and large opening in the load bearing ribs allows tubes and pipes to be placed in each direction**





**Composite Structure for large openings: steel plate incorporated as reinforcement within the girder and additionally reinforced by prestressing steel**

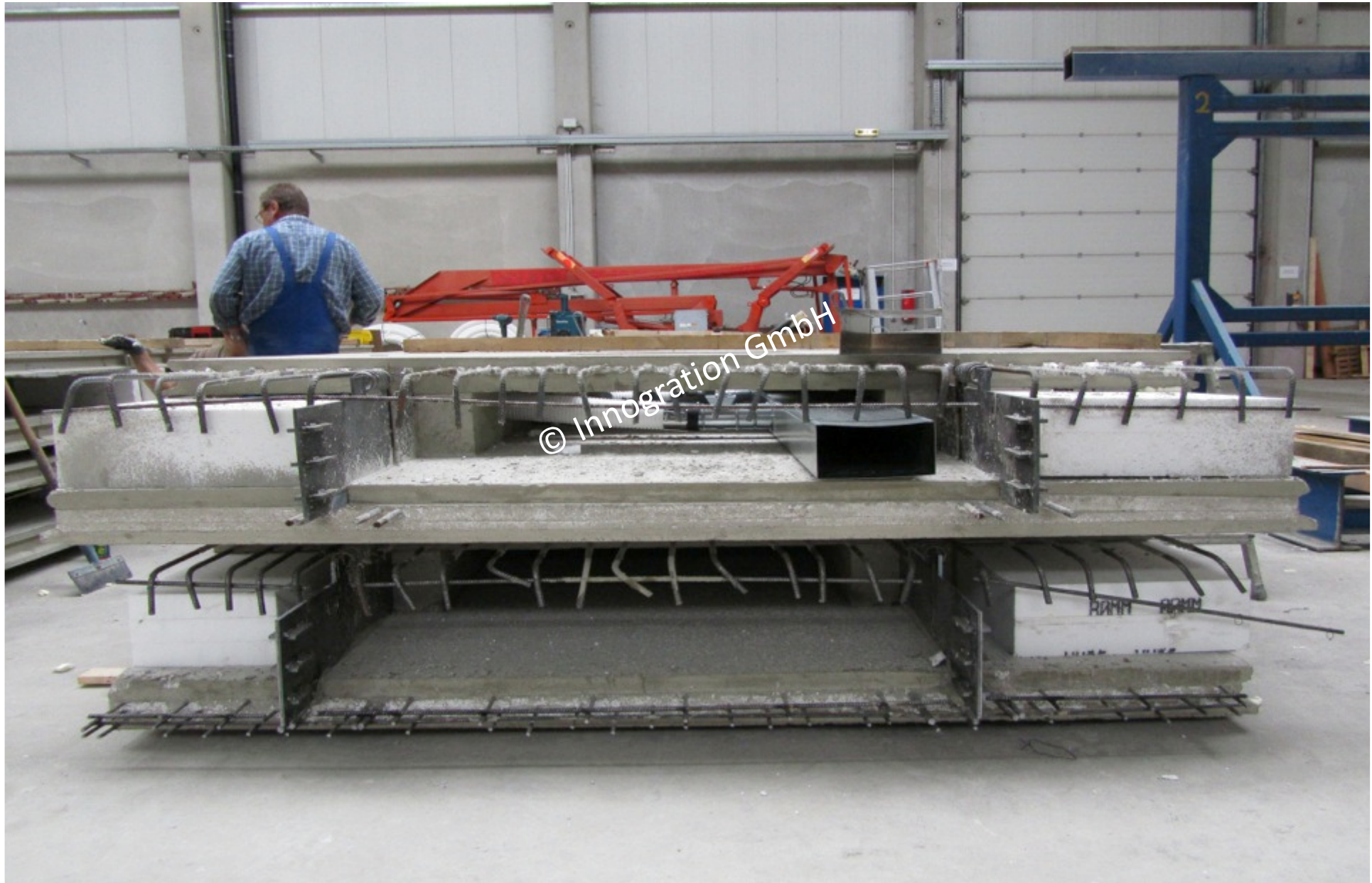




## Strutural elements with multiple options for the installation of building service (HVACR) devices



**Precast elements: more than structural concrete but spiked with all kinds of pipes, tubes and terminal devices for the building service**





**Precast concrete elements: all building service elements are installed  
Within the precast plant and connected on site**





## Sandwich cross-section for slabs with large span

Service lines, pipes, tubes are integrated in the precast factory





## Tubes for ventilation: integrated in the precast plant



## Prefabricated slab elements with large tubes for ventilation

Pipes are integrated in the precast factory and connected on site





**Shallow cavity between the load bearing ribs  
Will be used for installation of building service elements**





**Shallow cavity between the load bearing ribs and openings  
Will be used for installation of integrated service lines**





**Precast slab element fully spiked with building service device and placed as a complete package on side**





**Connecting lines on side together to complete the fuctions for building services**





**Shallow cavity between the load bearing ribs is used for the preassembled heat distributor in order to organize heating and cooling with thermoactive component system**





## Strutural slab element combined with addional elements

Shallow formwork to incooperate acoustic panels later (reverberativ surface)





## Precast slab element with different installation device for multifunctional use





## Precast slab elements with integrated building service elementes





**Building service devices completely finished – ready to place the cover slab**





## Industrial production of elements within the precast factory

Assembly works on site: individual elements with integrated building services

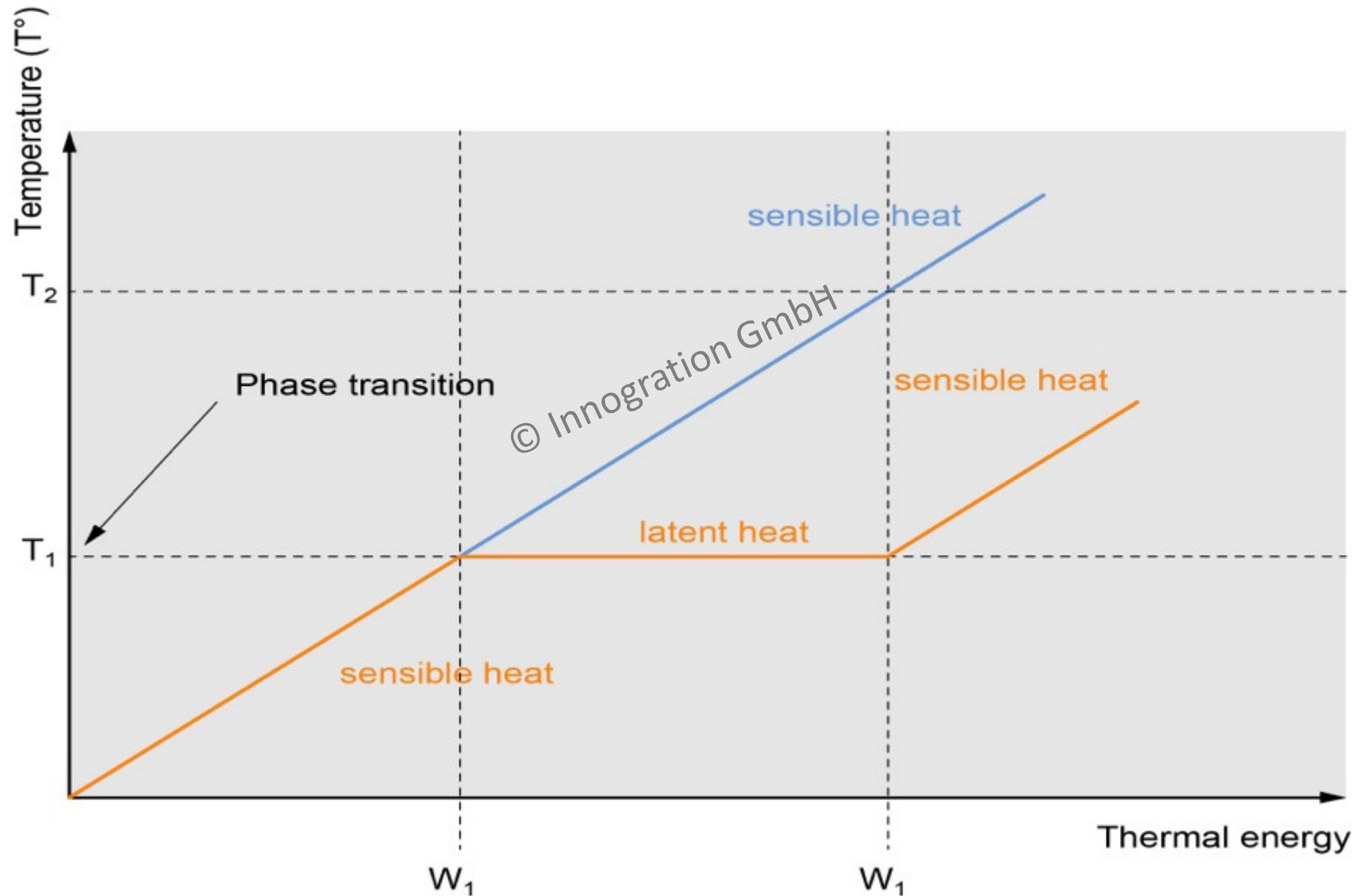




**All activities on side: place the lower part of the slab; fulfill the building service lines; place the upper part of the slab**



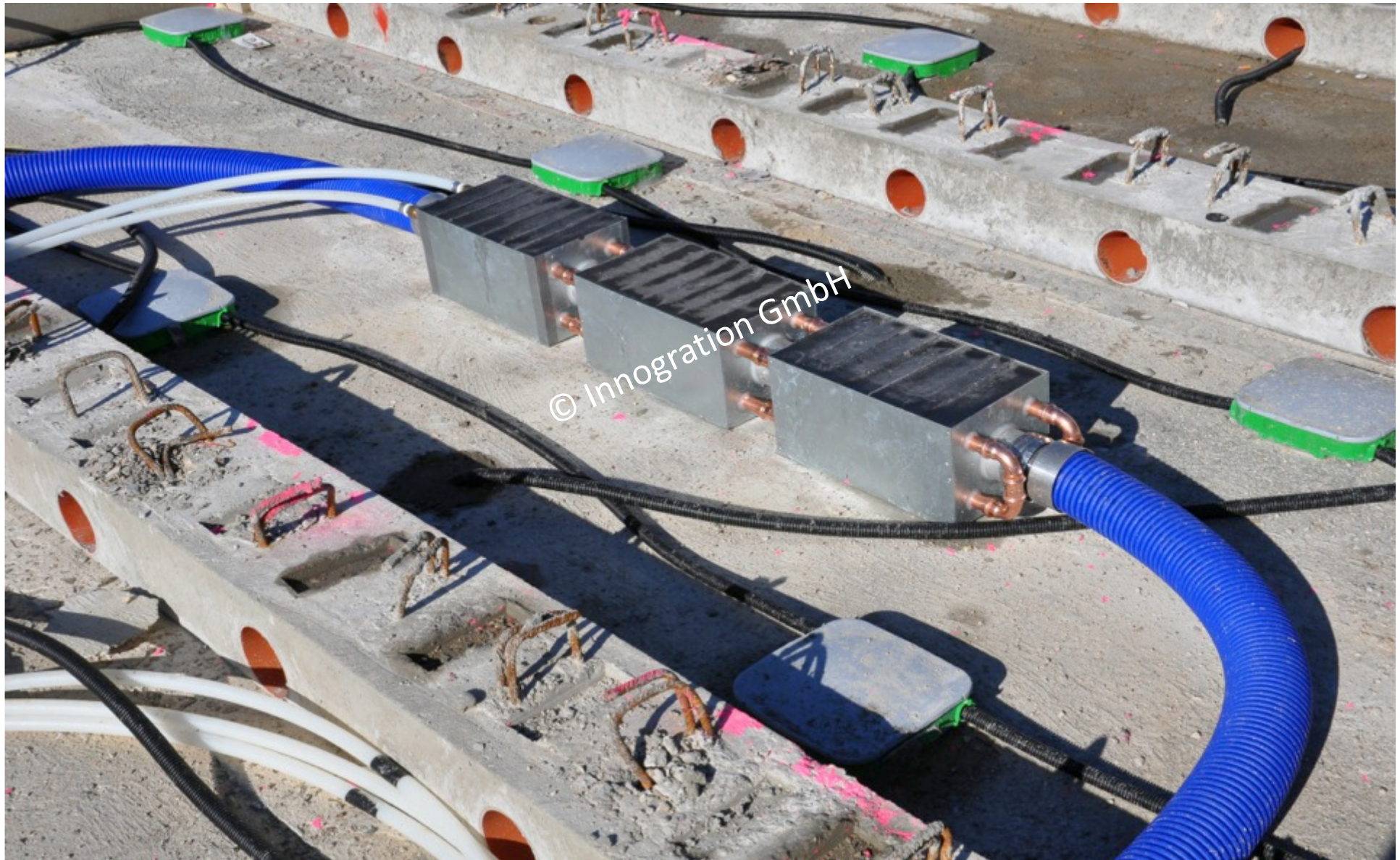
**Saving thermal energy with latent heat in boxes, which are installed within the vavity of the slab with sandwich cross-section**





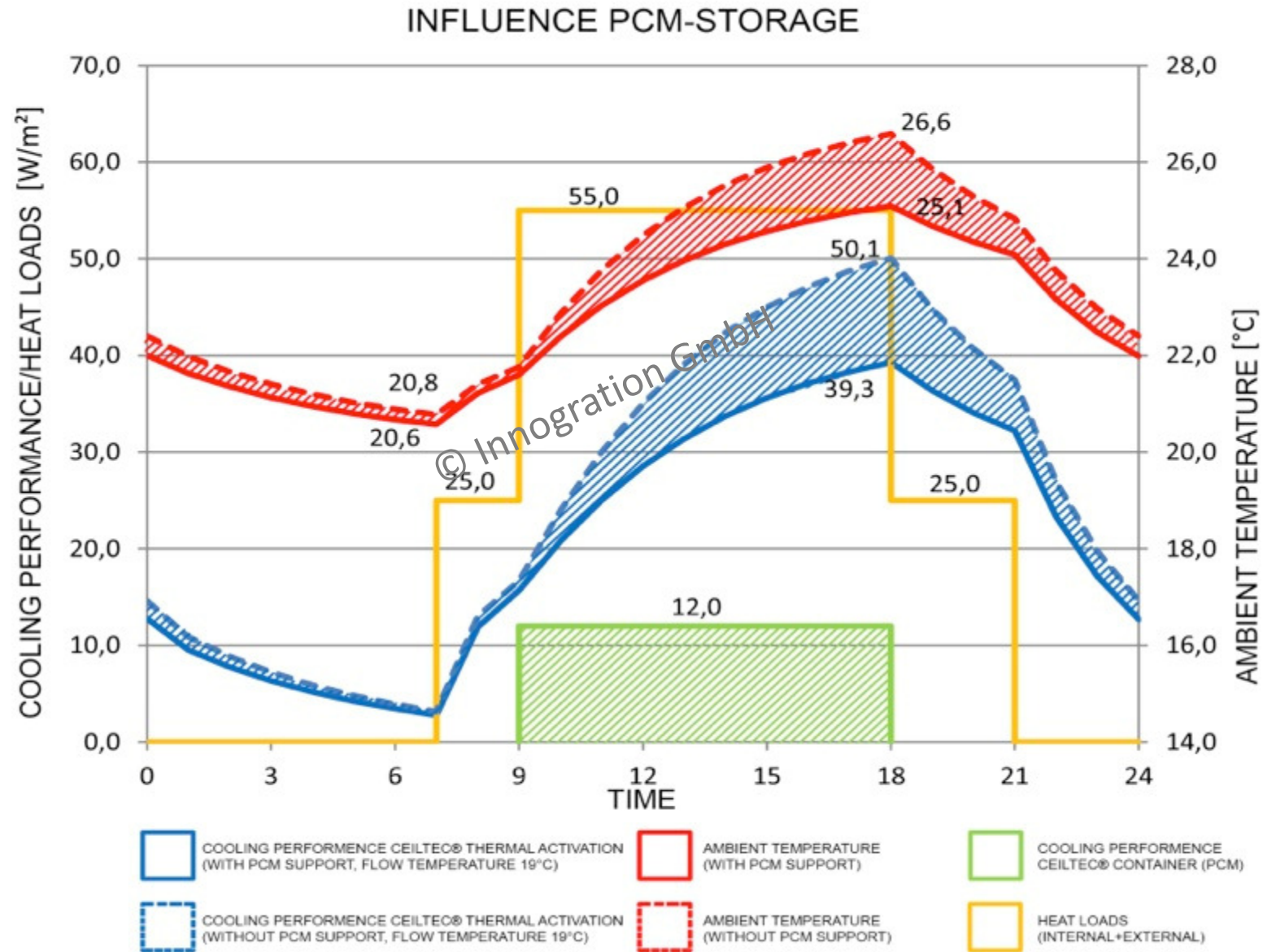
**Seperate thermal storage device, to cover for cooling performance, heating performance**

**Flexible input wheather by air or by water conducted pipes (Ceiltec® PCM-Container)**





## Advantages with additional thermal storage elements





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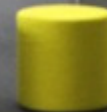




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**Self-sufficient energy supply will only be fulfilled with multifunctional slab systems and different storage devices ( structural concrete, water tank, PCM-device)**

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Best thanks for your  
attentions