BREM
RADIATORS FOR ARCHITECTURE

HEAT, SAVE and DECORATE
RADIANT PANEL A RADIATOR PERFORMANCE COMPARED

Looking for sparing energy costs of heating is everyone research.
Designers, builders and legislators try to reduce polluting emissions, optimize performance and reduce energy consumption.

Making the right choice to heat your home is essential: the economic advantages of radiant panel systems has been proved as untrue for new buildings in energy class from A1 to A4.

The research made by Ing. Francesco Paoletti in agreement with the Department of Energy “Sergio Stecco” of the University of Florence and Global srl, showed a lower thermal and electrical consumption of radiators, from 5% up to 40%, compared to the heating floor system.

In floor panel system the heat is first transmitted to the screed and to the floor, and then to the rooms (fully operational time is about 6 or 4 hours); the time between the request/ interruption of heat emission and perception in the room is important and leads to higher energy consumption.

Thanks to insulation of buildings in the best energy classes, the possibility to turn off and on the heating quickly remains the most suitable solution for saving energy.

No radiators on the walls and any visual impact is proposed as an advantage from floor heating system, but a choice of beautiful radiators, with original shapes saves your money and can identify real interior architectures customized by refined finishings and colors.

Elegant or minimal, artistic or design, choose a BREM radiator (also customized) and complete your home with your personal style.

HEAT, SAVE, and DECORATE

HEAT WHILE SAVING MONEY: THE GREAT CHALLENGE IN BUILDING CLIMATE CONTROL. *ENG. FRANCESCO PAOLETTI*

HEATING and SAVING

Everyone, and every designer, systems engineer, builder, and lawmaker is looking for ways to save on energy costs today in order to:

- reduce polluting atmospheric emissions;
- optimize comfort performance;
- lower energy consumption.

The world's two most common heating systems are:

THE RADIATOR SYSTEM,

The classic heating system with a boiler or heat pump and radiators that thanks to rapid heat transmission **(low thermal inertia)** can:

- work with both low and high system water temperatures;
- ensure nearly instantaneous adjustments to temperature variation with user-friendly and inexpensive regulation systems in single rooms or entire areas;
- facilitate installation with lower costs;
- minimize pump electric power consumption.

The low thermal inertia of the radiators makes it easy to keep the room at comfort temperature (20 °C) only when necessary, in this way permitting significant energy savings.

THE UNDERFLOOR RADIANT HEATING SYSTEM

(only with **high thermal inertia**) consists of cross-linked polyethylene or multilayer pipes laid on insulating panel incorporated in the floor's substrate screed and one or more circuits for the area to be heated.

- Floor surface temperature must never exceed 29 °C in the living areas and 35 °C in the service areas.
- Room temperate regulation can be either on/off type with water circulation interruption or delivery water temperature modulation type.
- Temperatures in single rooms/areas are adjusted by motorized valves in every circuit.
- Because the panels cannot ensure adequate comfort, bathrooms are supplied with a heated towel rail with either mixed or electric power.

The heat is initially transmitted to the floor screed and then transferred to the room for heating (high thermal inertia) with a substantial delay of usually no less than 6 hours between the request for/interruption of heat emission and the perception of heat in the room, in this way leading to higher energy consumption.

IN SHORT: THE ENERGY NEED DEPENDS ON THE BUILDING.

A BUILDING'S ENERGY REQUIREMENT

depends on numerous physical phenomena associated with thermal exchange, heat transmission, and the type and characteristics of the heat generators and heating elements.

The main factors Involved in determining the energy required to heat a building are therefore:

- the thermohygrometric characteristics of the building's constructive materials;
- the efficiency of the technological systems;
- auxiliary electric power consumption;
- building/heating system interaction;
- the building's intended use.

Maximum efficiency and sustainability means achieving the maximum level of every parameter involved.

THE BUILDING ENVELOPE

is the most important element in determining the energy required to meet its heating needs. The quantity of heat needed to heat a building and therefore its energy requirement depends solely on its constructive features.
The thermal power that must be provided by the heating system to keep the building at a temperature of 20 °C Is always the same regardless of the type of heating system used.

For example:

Energy class	Heated area	Thermal power required
- Class A	100 sq m	4,050 W
- Class G	100 sq m	13,000 W

The thermal power requires depends on the building's insulation.

BUILDING/HEATING SYSTEM INTERACTION

The building's intended use affects the heating system's operating modes:

- continuous;
- discontinuous.

For this reason, the heating system must be capable of optimizing its output as required by the operating mode.
Residential buildings, offices and schools are not occupied uninterruptedly and for such reason can be heated discontinuously, which is very useful whenever energy must be saved (current regulations specify heating system operation to different temperatures during the day).

A home's comfort temperature (20 °C) must be constantly maintained only when its inhabitants are at home.

THE DELIVERY OF THE ENERGY NEEDED DEPENDS ON THE HEATING SYSTEM.

HEATING SYSTEM EFFICIENCY

is the heating system's performance in terms of:

- output, which depends on the characteristics of the heat generator;
- distribution, which depends on the characteristics of the hydraulic network;
- emission, which depends on the characteristics of the radiators in the room;
- regulation, which depends on the thermal inertia of the radiators.

- OUTPUT EFFICIENCY depends on the characteristics of the heat generator and the heating elements. The combustion efficiency for condensing boilers or the COP (coefficient of performance) for heat pumps depends on the average temperature of the system water. The lower this average temperature is, the higher the efficiency is.

- COMBUSTION EFFICIENCY depends on:

- the length of the connection network between the heat generator and the heating bodies (the length of the piping must be kept as short as possible and efficient insulation must be used);
- the average temperature of the water inside the piping and above all, its insulation (low temperature: < 50 °C);
- electrical power consumption (circulation pumps, motorized valves): the higher the consumption, the lower the efficiency.

The use of the following heating elements that operate at low temperature is also advised:

- fan coils;
- radiant panels;
- heating elements/radiators.

Regardless of their constructive material, all radiators are suited operation at both high and low temperature.

- EMISSION EFFICIENCY is one characteristic of heating elements.
The thermal power delivered is indicated in the manufacturers' catalogs.

- REGULATION EFFICIENCY depends on numerous parameters, the most important of which is the heating system's thermal inertia. One positive aspect of radiators is the possibility they offer to take advantage of "bonus" temperature rises (sunshine, mid-seasonal rises, indoor heat, the presence of people, etc.) because their low thermal inertia allows them to immediately Interrupt heat delivery (a form of regulation that is scarcely efficient for radiant panel systems).

Low thermal inertia systems follow variations in temperature rapidly (both inside and outside the building) and vaunt higher regulation efficiency than high thermal inertia systems.

THE PERFORMANCE OBTAINED BY THE EFFICIENCY OF REGULATION OF DELIVERY IS FUNDAMENTAL.

RADIANT PANEL and RADIATOR PERFORMANCE COMPARED

RESEARCH CONDUCTED BY ENG. FRANCESCO PAOLETTI PUBLISHED IN: www.brem.it/riscaldare-risparmiare

RESEARCH AGREEMENT between the "Sergio Stecco" Energy Department at the UNIVERSITY OF FIRENZE and GLOBAL Srl.

The comparison was made in 2 test chambers of identical dimension, constructive type, and energy needs equivalent to an approx. 50-60 sq m Class A building, one with radiant panels and the other radiators, both equipped with a 7.5 kW heat pump. The thermal profile of the two test chambers may be considered reasonably comparable and therefore assumed as representative. The comparison between the energy consumed by the two systems is unconnected to the type of heat source used and is and based on the actual heat entering each system.

ANALYSIS OF THE RESULTS

Analyzing the energy charts and consumptions of the two systems shows that under all circumstances and operating modes (continuous/discontinuous):

- the radiant panel heating system consumes more energy than the radiator heating system;
- the electrical power consumptions of the radiant panel systems are always higher than those of the radiator system;
- at equivalent temperature set points, and despite the more refined regulation, the temperature of the room heated by radiant panels tends to be always higher than the other room. In particular, during time-band operation, higher temperatures are observed even with the system switched off, which in practice corresponds to moments in which the building is not occupied and therefore no need for heating exists.

This becomes more evident as outdoor temperatures rise and daily temperature variations increase (in mid-season), a condition typical to most heating system operating hours in most parts of Italy.

Also in the tests conducted with radiator water set at higher temperatures that seriously penalized consumption, significant savings were observed in radiator systems (in demonstration of the fact that the optimization of output efficiency may be all in vain if the emission system is not in the condition to maximize regulation efficiency).

In addition to thermal consumptions being always higher, also the electric consumptions of the radiant panel system were also always higher due to the higher pumping power necessary for the circulation of a higher quantity of water than in the radiator circuit.

RESULTS OF FIRST TEST CAMPAIGN

Total energy consumed from 10/02 to 01/05
Continuous 24 hour operation
Discontinuous operation with 2 time-bands
Discontinuous operation with 3 time-bands
Radiant panel on/off regulation
Radiator on/off regulation
Radiant panel average delivery temperature: 40 °C
Heat pump set-point temperature: 45 °C
Radiant panel active energy: 861,898 kW
Radiator active energy: 638,999 kW

RADIANT PANEL ENERGY CONSUMPTION +34.9%

Days from	Days to	Energy Consumption Panels kWht	Energy Consumption Radiators kWht	Energy Consumption DIFFERENCE Panel-Radiator
16/2	20/2	87,4	79,0	+ 10,6%
24/2	3/03	115,9	82,9	+39,8%
19/3	8/04	221,7	178,2	+24,4%

RESULTS OF SECOND TEST CAMPAIGN

Total energy consumed from 23/11 to 15/04
Continuous 24 hour operation
Discontinuous operation with 3 time-bands
Radiant panel on/off regulation
Radiator on/off regulation
Radiant panel average delivery temperature: 35 °C
Heat pump set-point temperature: 40 °C
Radiant panel active energy: 1.756,700 kW
Radiator active energy: 1.591,400 kW

RADIANT PANEL CONSUMPTION +10.4%

The second test campaign was conducted with a structure oriented at optimizing the radiant panel system (continuous operation at low temperature) while feeding radiators with water at higher temperatures at the same time (a choice that penalizes heat pump efficiency and consumption)

THE ENERGY CONSUMPTIONS OF THE RADIANT PANEL system exceeded those of the RADIATOR system by 10 - 40%

COMPARISON OF THE PERFORMANCES OF THE TWO SYSTEMS

The data selection criteria permitted the identification of the five days that may be considered representative of the different conditions of operation of the two systems in question.

Radiant panel systems clearly show higher thermal consumptions than radiator systems with differences in the range of 4 - 44% on the typical test days considered.
The differences are minimal under continuous operation but increase significantly with time-band operation, in this way confirming the tendency of radiant panels to operate continuously due to their high thermal inertia.

The thermal consumptions of each of the two systems were obtained from the differences in water delivery and return temperatures and the ambient temperature after electrical absorption values were detracted

The results showed the radiator system to have less thermal consumption, varying from 5% under continuous operation (optimum for radiant panels) to 40% for highly discontinuous operation.

The difference between the electric power consumptions and the thermal consumptions of the two systems gradually increased as the warmer months approached in which reduced requests for heat increased the incidence of the heating circulators.

- In all tests, the average temperature of the room with radiant panels was observed to be higher than the room with radiators due to the higher thermal inertia of the radiant panels.
- This explains also why the radiant panel system generally consumes more energy than radiators during hours in which operation is discontinuous.

The table provides total thermal and electric power consumptions in the 24 hours of the five typical days

TYPICAL DAY	Tot. Thermal Consumption PANELS kWht	Tot. Thermal Consumption RADIATORS kWht	DIFFERENCE Thermal consumption Panel-Radiator	Electric Power Consumption PANELS kWht	Electric Power Consumption RADIATORS kWht	DIFFERENCE electric consumption Panel-Radiator
1	41,5	39,7	+ 4,5%	17,1	15,2	+12,5%
2	33,1	26,5	+24,9%	15,0	10,3	+45,6%
3	19,3	16,7	+15,6%	10,2	9,2	+10,9%
4	17,7	9,9	+78,8%	9,6	7,2	+33,3%
5	13,6	11,6	+17,2%	8,5	3,6	+ 236%

THE USER CAN ASSESS HOW MUCH SAVING CAN BE MADE USING THE RADIATOR HEATING SYSTEM IN DISCONTINUOUS OPERATION

The inadequacy and economic disadvantages of radiant panel heating for newly constructed Class A civil buildings characterized by very low heating loads and very low thermal inertia is plainly clear to see.

The absence of radiators occupying wall space is proposed as an advantage offered by floor heating, which makes no visual impact of its own, but choosing attractive radiators with original shapes built expressly for the spaces available can enable authentic interior architecture that can be personalized by color or rendered nearly invisible by matching the finishing given to the walls

Making the right decision to heat your home is a choice of fundamental importance: the highly vaunted economic advantages of the radiant panel system have been proven to be untrue.
The possibility to switch heating on and off quickly and suddenly (the one and only real saving in energy) is still the most appropriate solution today.