NEW CONCEPT OF BALANCED THERMAL DYNAMIC SYSTEM.

X.Boulanger

Aldes, Research Department,
Prologue 2, rue Ampère BP 9707,
Labège, F 31312-France

ABSTRACT

Studies on buildings have shown that airtightness and insulation increased in family buildings and detached houses too, due to new thermal regulations.

In the same time, studies concerning health and indoor air quality have shown that the need of fresh air will increase too. Ventilation becomes the only way to avoid booth moisture and a stuffy atmosphere: in urban areas, it becomes impossible to open the windows due to breaking and entering, filtering the air is needed, and inlet devices on windows are prohibited due to much outside noise.

Therefore, ALDES developed a preheated and refreshed air balanced system witch assure the all part of the thermal lose, winter and summer, supported by the air without improving the air flow needed for indoor air quality and without recycling the indoor air .

The objectives of this paper is to present both this new air quality and comfortable concept and measurements on an experimental building consisting of eight dwellings south of France. We present both summer and winter results recording each five minutes in each room. We analyse the performances of this concept in regard to comfort and spreading.

Results are very heartening and better than French requirements .

KEYWORDS

Ventilation, Field measurements, Thermal comfort summer and winter, Thermal dynamic system.

BACKGROUND

During the last decade, there is in general a tendency to pay more attention to the indoor climate (thermal comfort, indoor air quality, visual comfort, acoustics) and energy efficiency aspects of buildings and systems. Studies on buildings have shown that airtightness and insulation increased due to energy performance requirements. Ventilation becomes the only way to avoid booth moisture and a stuffy atmosphere Ventilation in buildings is today in most countries considered as an essential aspect in each building project. In France, mechanical ventilation is widely used in residential buildings. Air conditioning system wished to assume the all part of heating and refresh but without renewing the air and with recycling the indoor pollution from one room to the others.

A NEW CONCEPT

Whereas in the past, ventilation was automatically linked to indoor air quality control, there is a growing interest in ventilation as a mean of transport of energy in order to refresh or to warm. But most of the system were too strongly dimensioned because they wanted to answer to all solar loads in a short time. Therefore this type of system need large air flow which generate acoustical problem. Moreover the largest part of the power was needed to heat the surplus of air flow that that air quality didn't need.

Principle

The principle of Temperation is based on the following idea: Why not benefit from the need to renew the air by supplying cooled or heated air depending on seasons, but according to the right air flow the air quality needed?: it is to say about 0,5 volume per hour. For example a dwelling consisting of a large living-room, a kitchen and 2 sleeping-rooms could be ventilated and refreshed with a filtered and cooled air from 100 m3 per hour. The philosophy is completely opposite to air conditioning. Whereas it develops a power of 3 kW in a short time, Temperation produces 1 kW of cooling air but most of the time. It is controlled by means of a keyboard, usually placed in a living room. In winter the power produced by the engine varies from 1100 W to 1400 W depending on outdoor temperature. Thanks a well adapted aeraulics ductwork system, the integration of it in the heated air volume is carried out in a false ceiling in the circulation only and at a height of 15 cm. The filtering air offers a high level air quality in each room independently for wind or seasons and adjusted at a certain regulated value.

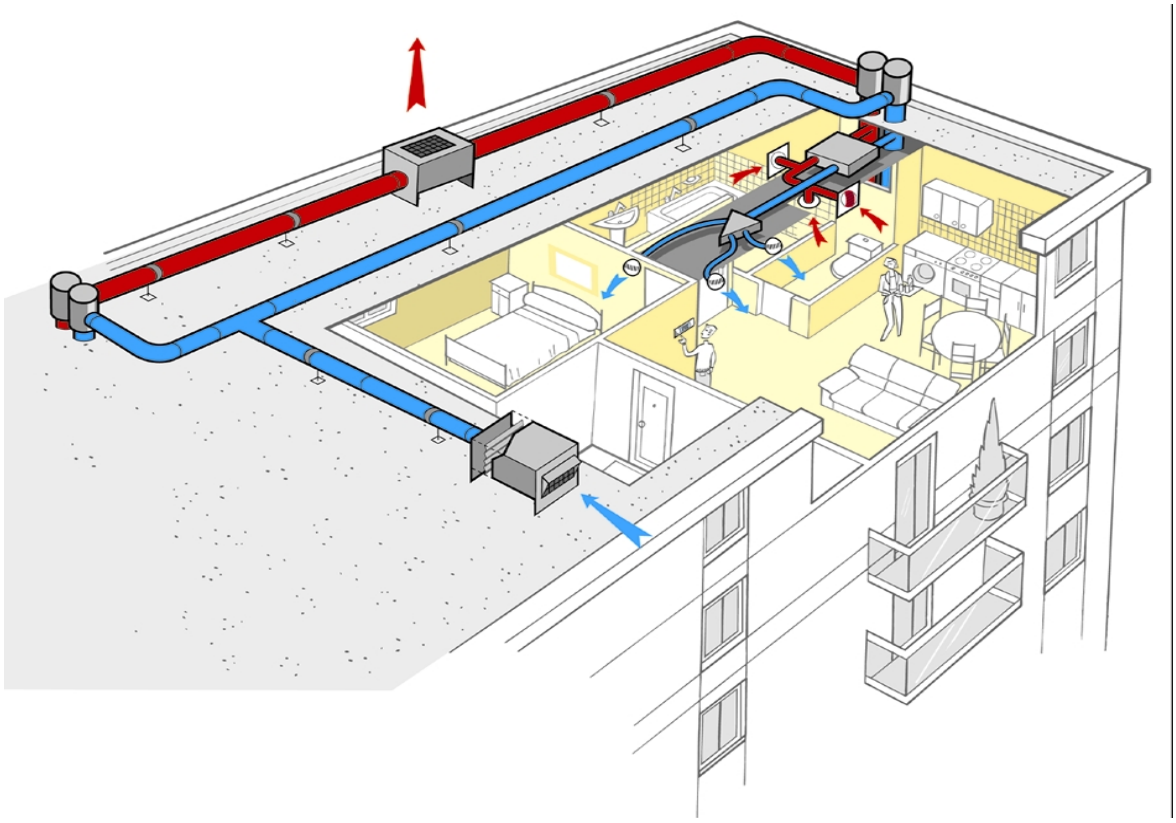

Figure 1: Principle of Temperation applied on residential building

The system does exist in one-family building, but needs recycling the air in summer to assure the comfort and produce the 2, 5 kW needed in summer.

EXPERIMENTAL RESULTS

Test location

In order to test the summer benefits, ALDES equipped one building consisting of eight dwellings (from 70 m2 to 90 m2), south of FRANCE, near BIARRITZ.

Figure 2: South wall from the building

Temperature measurements

Temperature measurements were carried out with small devices, included in keyboard in each room, which were in connection with the main electronic keyboard in each dwelling.
Every main keyboard collected about 50 measurements in each 5 fives minutes: it was for example the temperature in the inlet duct or in the system, but 8 outside temperature measurements were necessary to control the outdoor temperature.
The accuracy of temperature measurements is estimated to be about 0,2 °C.
A modem collected all these measurements and sent it by e-mail every day.

Heating and refresh energy consumption measurements

In the case of this building only monthly readings of electricity usage were made by the habitants. These readings were compared to the modelling of the system which was tested for each outside temperature. Three counters for each type of consumption equipped each dwelling::1) For the system 2)For the electric heating 3)For other type of consumption like cooking, lightening.

Summer 2001

The summer measurements began the 19 of July and ended September the third.
During this time, the outside temperature reached 17 times more than 32 °C and 7 days more than 35°C. It was one of the hottest summer France has never known. See Figure 3 for a graph showing the outside temperature

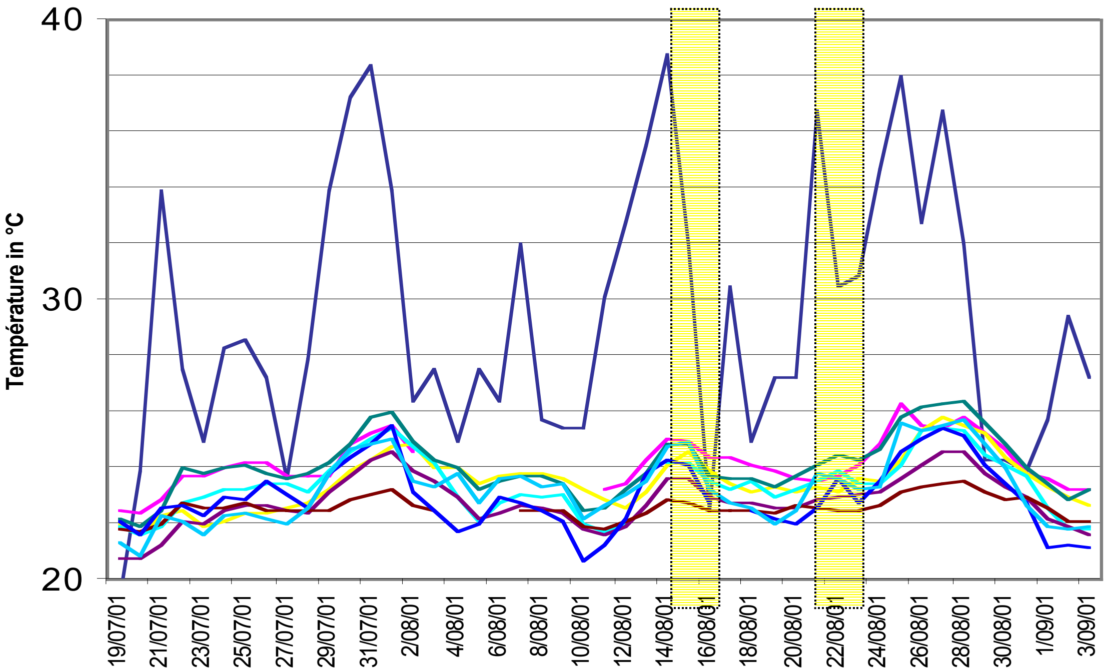

Figure 3: Indoor dwellings temperature and maximum outdoor temperature during summer 2001 in TOSSE (FRANCE)

We will analyse two of the hotter days from Figure 3: but first off all, we proved that the limit comfort temperature from 27 °C wasn't reached in this hot period. The building was made out of brick size 20 cm and normally isolated by 80 mm from expanded polystyrene.

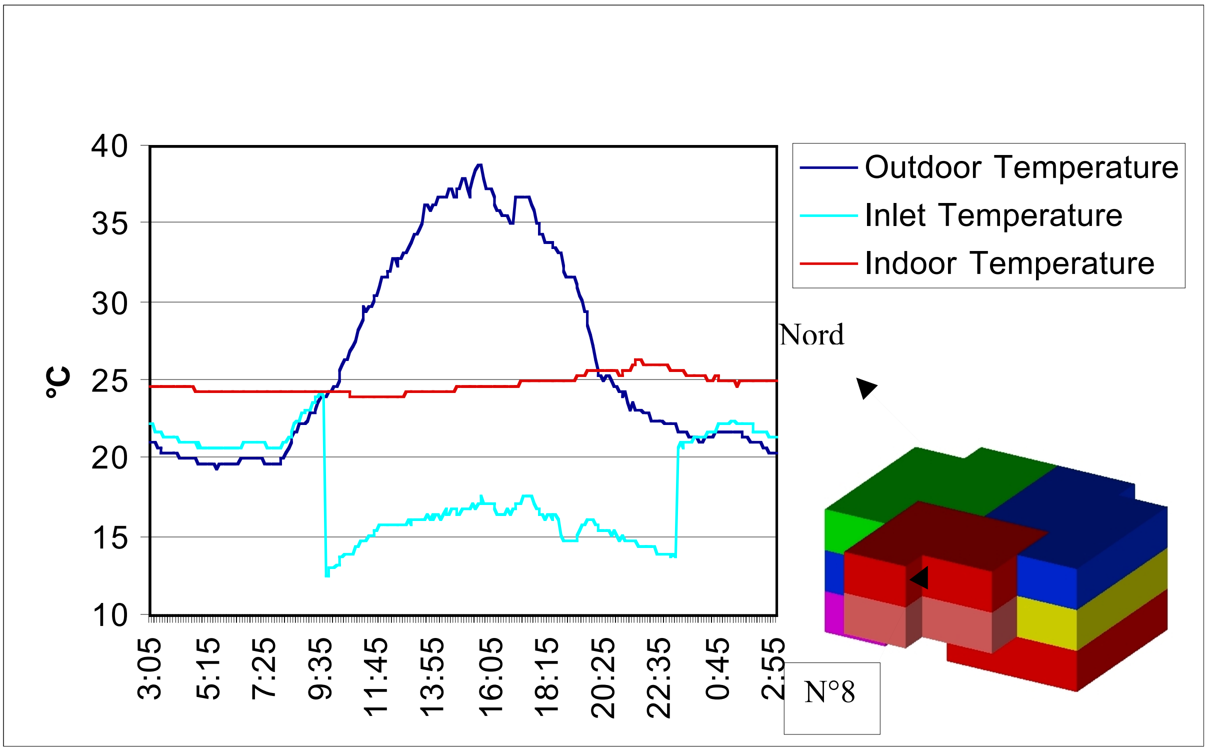

Figure 4: Temperatures measured the hottest day , dwelling N°8 exposed south-west

As you can see on Figure 4, the indoor temperature in the most solar-exposed dwelling N°8 increased from 24,2°C to 26,2°C whereas the outdoor temperature reached 38,8°C. The outdoor temperature was over 30 °C between 11 o'clock and 8 o'clock pm. The thermal dynamic system maintained a inlet temperature at about 15 °C, with a slow speed of spreading. Temperation worked most of the time (about 15 hours in this day) without any discomfort. In the same time humidity decreased from about 8 litters in the dwelling for the maximal thermal comfort. For the whole building, effective time of working reach 50% depending on the level of comfort whished by the habitants: for example, on Figure 5, the user's choice was only 23 °C. Due to the thermal exchange with the ground, this temperature was maintained and sometime overshot. It explains the variability of the inlet temperature.

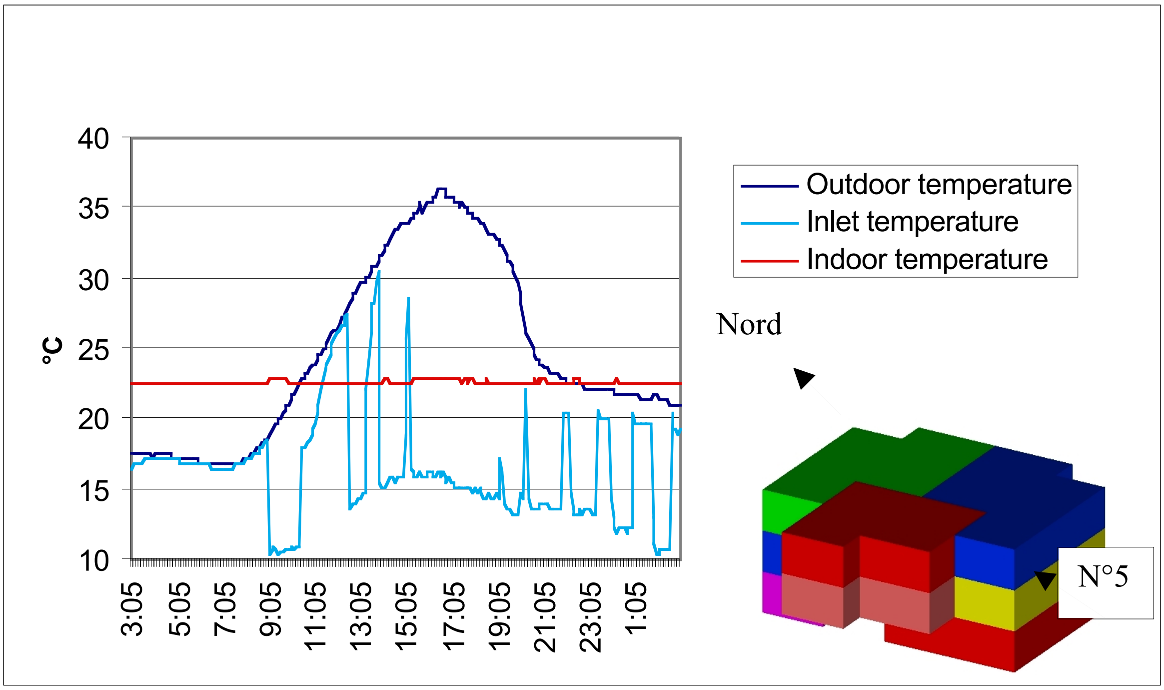

Figure 5: Temperatures measured dwelling N°5 the 21 August 2001, mainly exposed south-east, ground level

For the all summer season, the average consumption for cooling was only 250 KWh corresponding to about 0,25 euros/m2 load included.

Winter 2001-2002

In winter the engine won't be perturbed by low outside temperatures, because the hot source is extremely constant like the indoor temperature. Moreover the engine produces more power for less consumption (for example 1200 W produced at 7°C and 1400 W at –7°C). After a hot summer , the winter was cold enough with a serial of eleven days freezing (two days down to -8°C). The outside temperatures were measured from 2001-09-16 to 2002-05-26. Compared with the indoor reference at 18°C, it corresponds to 1750 DJU. (The heating period in Paris needs 2200 DJU). Nevertheless the balanced thermal dynamic system represented 65% of the heating needs, and the global costs for electric heating was reduced from 40% at a global cost of 2,2 euros /m2. As we can see on Figure 6, the level of inlet temperature is adapted to spreading and comfort. The indoor temperature is adapted with the keyboard by users depending on the needs at each time of the day.

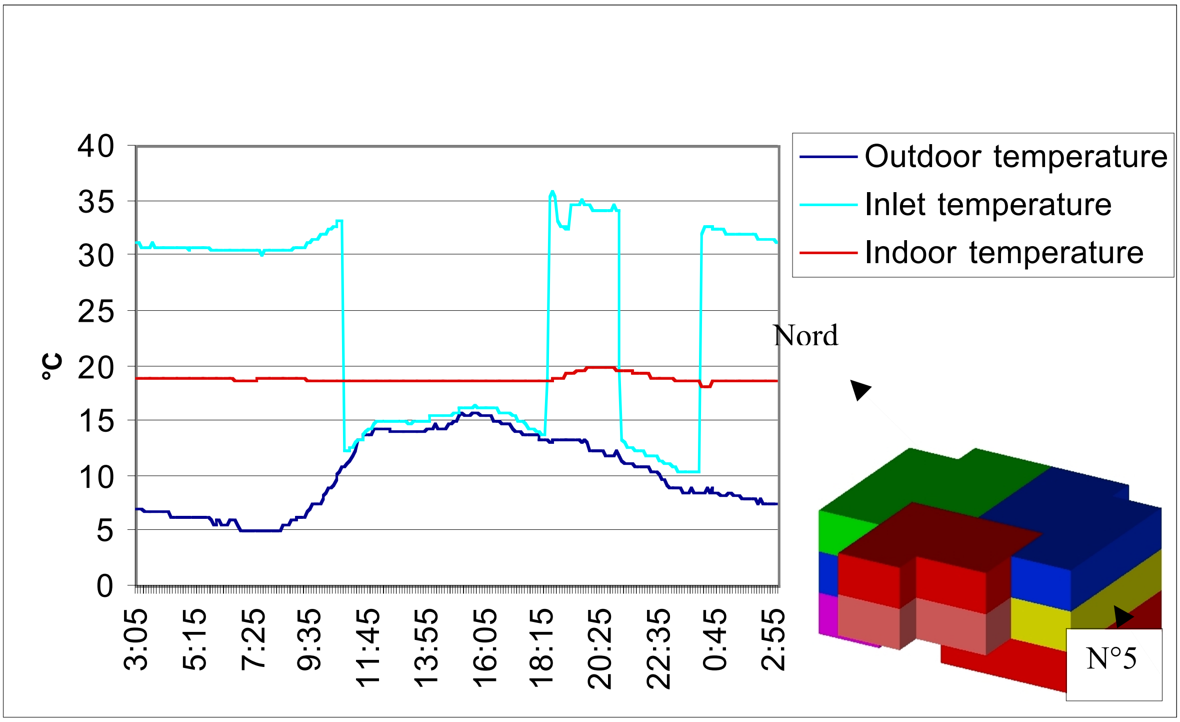

Figure 6: Temperatures measured dwelling N°5 the 13 February 2002

Acoustic performances

Ten acoustics measurements were achieved and the acoustic level didn't overshoot 23 dB(A), summer or winter. One of the reason is the place of the common fan, exhaust and inlet and the ducts networks in the circulation. Moreover, there is no inlet devices on the windows. Dwellings are protected from the outside noise.

CONCLUSION

This fields measurements have shown that the 1000 W constant power of refresh of Temperation is enough to refresh dwellings in multi-family buildings under European climates, cheaper and easier than other building conceptions. Thermal winter performances can cover 65% of the heating needs participating to a 40% reduction of the electric heating cost. Regarding to the requirements, the building is better than thermal French requirements. Filtering and acoustic attenuation are well appreciate by users.

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References

Rigaud Franck. (2002).Les trophées de l'innovation. *Chauffage, Ventilation, Conditionnement d'air* **33 :3,** 14.

Boulanger Xavier. (2002). Innovation : Températion rafraîchit aussi l'air du collectif. *Direct résidentiel* **121 :3,** 10-12.

Chardon François. (2002). L'événement : Extension de Températion au logement collectif. Clim pratique 45 :3, 26.