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OUTDOOR AIR INLET WITHOUT DRAUGHT PROBLEMS

Goran Werner

AIB Anlaggningsteknik AB
Box 1315
171 25 Solna
Sweden

The author is also working part time in the evaluating group for the Stockholm Project at EHUB at the Royal Institute of Technology, Stockholm, Sweden

1. SYNOPSIS

This paper presents a new technique for supply of outdoor air directly through external walls into a dwelling room without any draught problems.

A new type of air inlet unit has been developed based on the experience from the study of indoor climate in the "Stockholm Project".

This Swedish experiment including six new residential buildings, where the indoor climate together with different solutions for ventilation is evaluated, shows that draught from air inlets is one of the greatest problems with bad indoor climate.

Further results show that for other ventilation aspects except draught, there are less problems in buildings with mechanical exhaust systems than in buildings with other ventilation systems.

This paper presents an air inlet principle that is integrated into the external wall construction. Measurements carried out show that a test unit works without draught problems and with a lower heat demand for cold down draught protection than with ordinary ventilators and radiators.

2. INTRODUCTION

The experience from the Stockholm Project shows that almost all types of ventilation systems have draught problems from air inlets (Ref. 1).

The new building code in Sweden has increased the demand of air changing in dwellings. The minimum rate is stated to 0.35 l/s,m^2 floor area. For bedrooms an additional condition states a rate of 4 l/s per bed, which in most dwellings gives a higher rate than 0.35 l/s,m^2. This means that there will be a higher demand on the air inlets, especially on direct outdoor air inlets, to prevent draught problems.

In Sweden it is now becoming more and more common to build apartments with only exhaust air fans due to installation costs and operation and maintenance problems.

With this background we can see that there is a great need to develop and improve the function of outdoor air inlets.

With support from the Swedish Council for Building Research (BFR), a new air inlet principle has been developed and a test unit has been measured in a climate chamber at the Swedish Institute for Building Research (SIB).

The research and development work has been carried out by a group of ventilation engineers, energy engineers and building engineers from the consulting firm AIB in Stockholm.

One of the basic ideas for the air inlet concept is to integrate the ventilation technique into the building construction.

The aim of the air inlet principle is to supply the room with outdoor air without any draught problems. It has also to be kept at a low cost construction level as there is a very low cost limit for this kind of installation in apartment buildings.

3. THE PRINCIPLE FOR OUTDOOR AIR INLET WITHOUT DRAUGHT PROBLEMS

In solutions of ventilation with ordinary air inlets the air flow has a rather high velocity which makes cold air pass through the warm convective air stream from the radiator. This cold air stream will often cause a direct draught feeling.

The cold air can also flow down to the floor level which gives cold floors. Even the cold down draught from windows will increase when it mixes with an extra cold air stream.

To reduce this kind of draught problem the basic principle for the new air inlet concept is to have a very low velocity of the incoming air flow, lower than 0.02 m/s. This will be possible by letting in the air through a large surface in the external wall.

The idea is to enable the convective air stream from the radiator to "catch" the cold air flow and mix with it. This will also increase the air stream from the radiator and improve the prevention of cold down draught from windows.

In the test unit the air inlet is made by a hard mineral woolboard (insulation board) that is placed in a frame and integrated into the wall. The surface is just a little smaller than the radiator (in this case about 0.6 m^2.) Behind the board in the wall there is an air space and a connection to the outdoor air through an ordinary slit in the facade. (The outdoor air can hereby also get a very good filtration when it is necessary in polluted areas.)

Due to the low air velocity the air flow is very uniformly distributed over the air inlet surface.

A test unit has been built after a principle construction shown in Figure 1. The test in the climate chamber has been measured in order to analyse the draught problems.

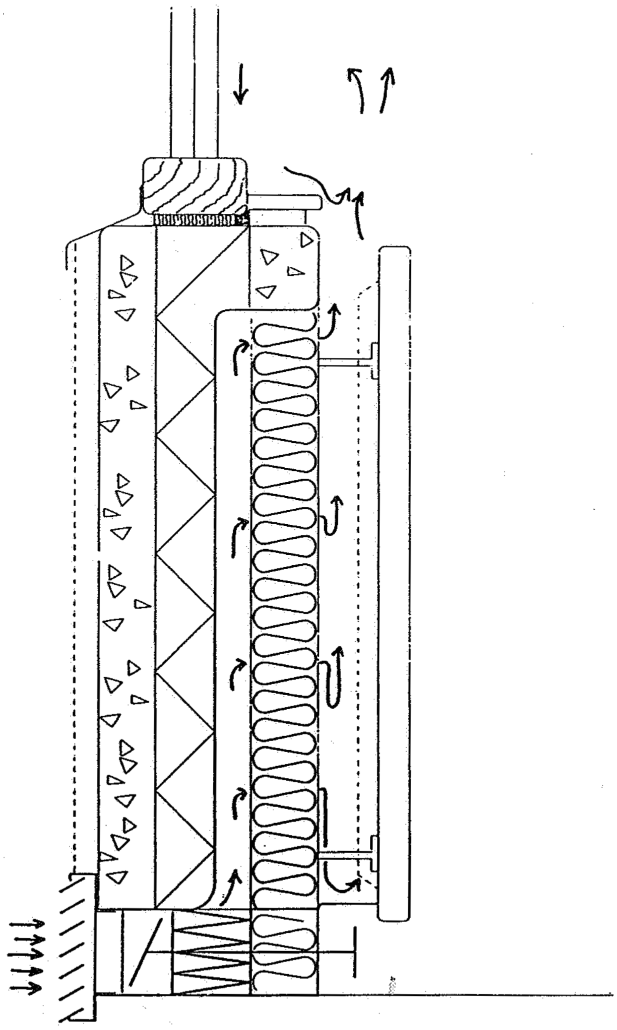

Figure 1 The figure shows the principle for the outdoor air inlet construction

4. MEASURING AND TESTING METHOD

The test unit has been tested in a climate chamber where outdoor temperatures at -20°C and ±0°C were simulated (Figure 2).

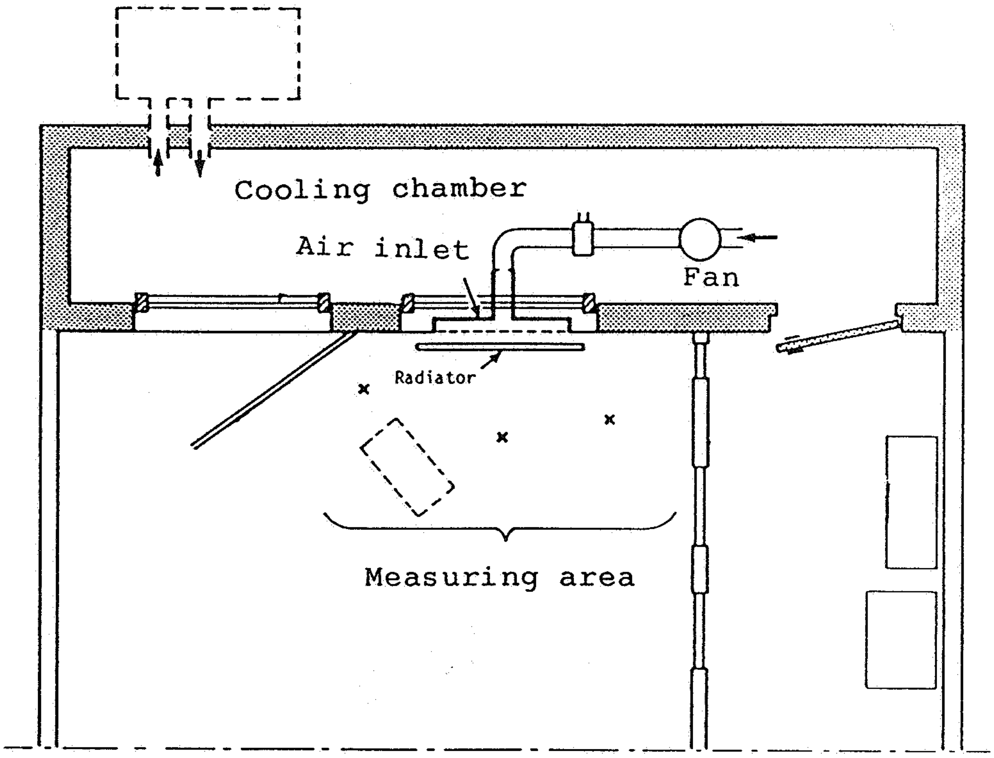

Figure 2 Climate chamber and test room at SIB

Room temperatures in the living space were registered at different levels with thermoelements. Air movements were studied with smoke and recorded on video tape.

The air velocity was also registered with an anemometer (type Disa 54N50).

The air flow through the air inlet was 25 m^3/h which could be a normal air flow for a bedroom in a dwelling in Sweden according to the new building code.

The surface area of the air inlet was 750 mm x 600 mm = 0.45 m^2. This gives an inlet velocity of 0.015 m/s.

The pressure drop over the air inlet with the air flow of 25 m^3/h was 12-14 Pa.

The heat load on the radiator was regulated with the water temperature to the radiator.

Tests were made with different heat loads on the radiator at the same outdoor temperature with the intention to evaluate at which level the draught problem was to be prevented.

The same tests were carried out to investigate the freezing risk of the radiator water if e.g. the heating system will be out of order.

5. RESULTS

The test results are shown in Figures 3-6.

The draught tests show that with the air flow of 25 m^3/h and an outdoor temperature of -20°C there is a need for 600 W heat load on the radiator to prevent cold air to flow out on the floor and cause draught problems.

If the outdoor temperature is at a level of ±0°C, a heat load of 300 W will be enough.

The experience at SIB from other tests with ordinary outdoor air inlets indicates that these results show a relatively low heating demand.

In the tests with ordinary air inlets 1000 W was normally required at -20°C, respectively 500 W at ±0°C to prevent draught problems.

In the tests to investigate the freezing risk of the radiator water it was established that there is no risk of freezing if there is a minimum basic water flow of 5 l/s through the radiator, even if the water temperature is only +20°C.

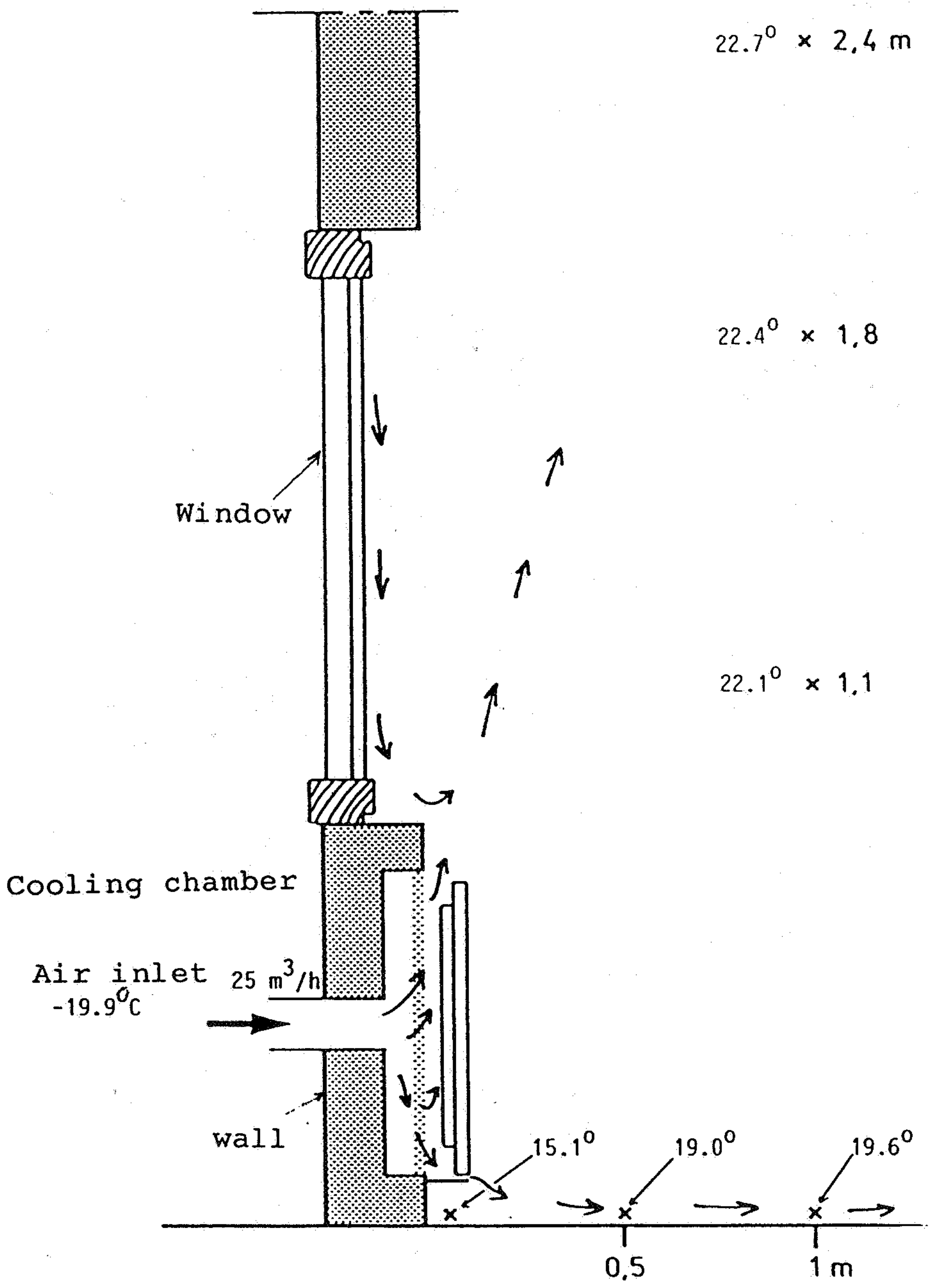

Figure 3 Test No. 1

The figure shows the air flow and the temperatures at outdoor temp. = -19.9°C and radiator heat load = 430 W.

It can be seen that the cold draught at floor level is not prevented.

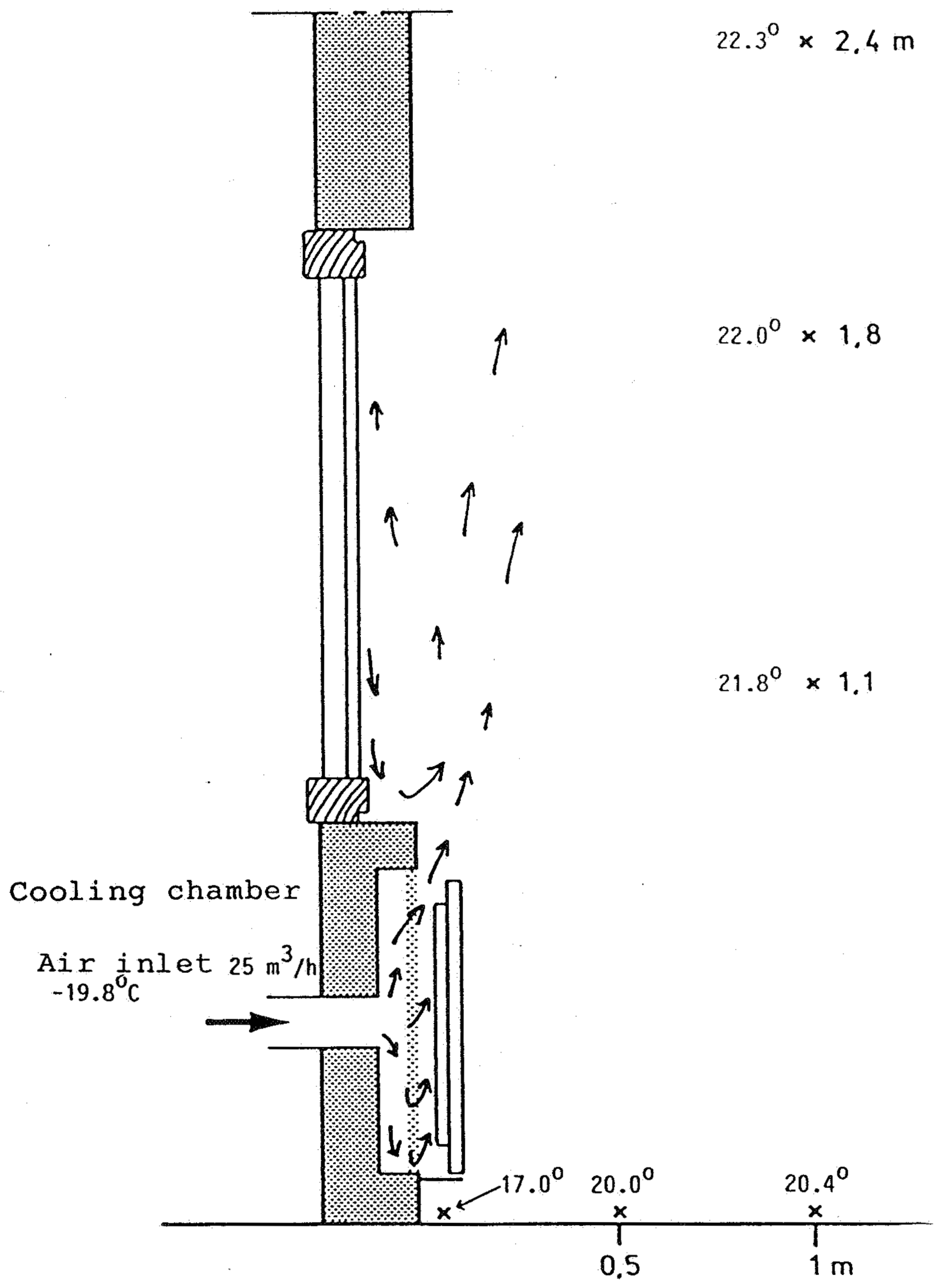

Figure 4 Test No. 2

The figure shows the air flow and the temperatures at outdoor temp. = -19.8°C and radiator heat load = 582 W.

It can be seen that the radiator takes care of all the outdoor air from the inlet and that there are no draught problems.

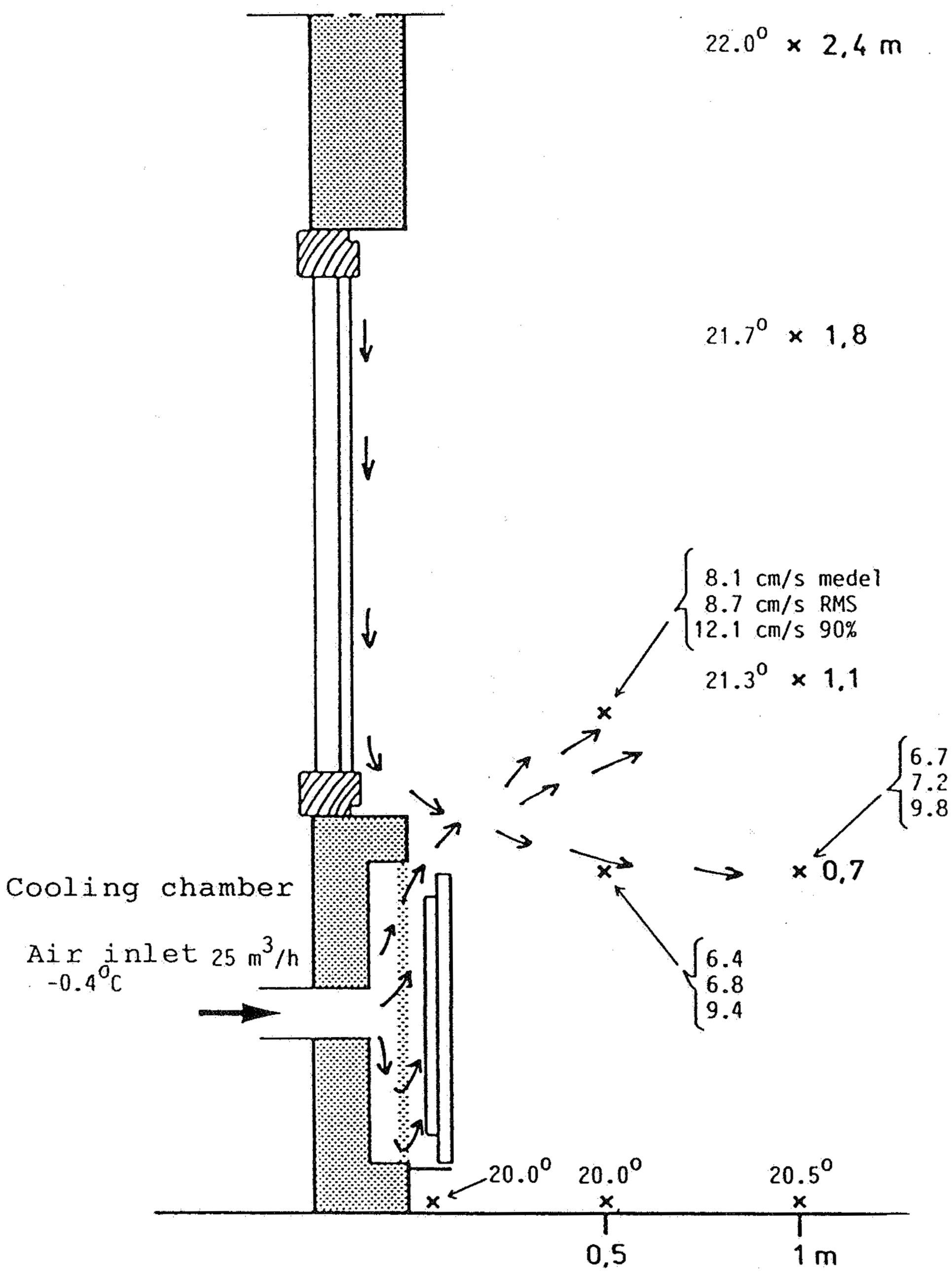

Figure 5 Test No. 3

The figure shows the air flow and the temperatures at outdoor temp. = -0. 4°C and radiator heat load = 206 W.

It can be seen that there are down draught problems.

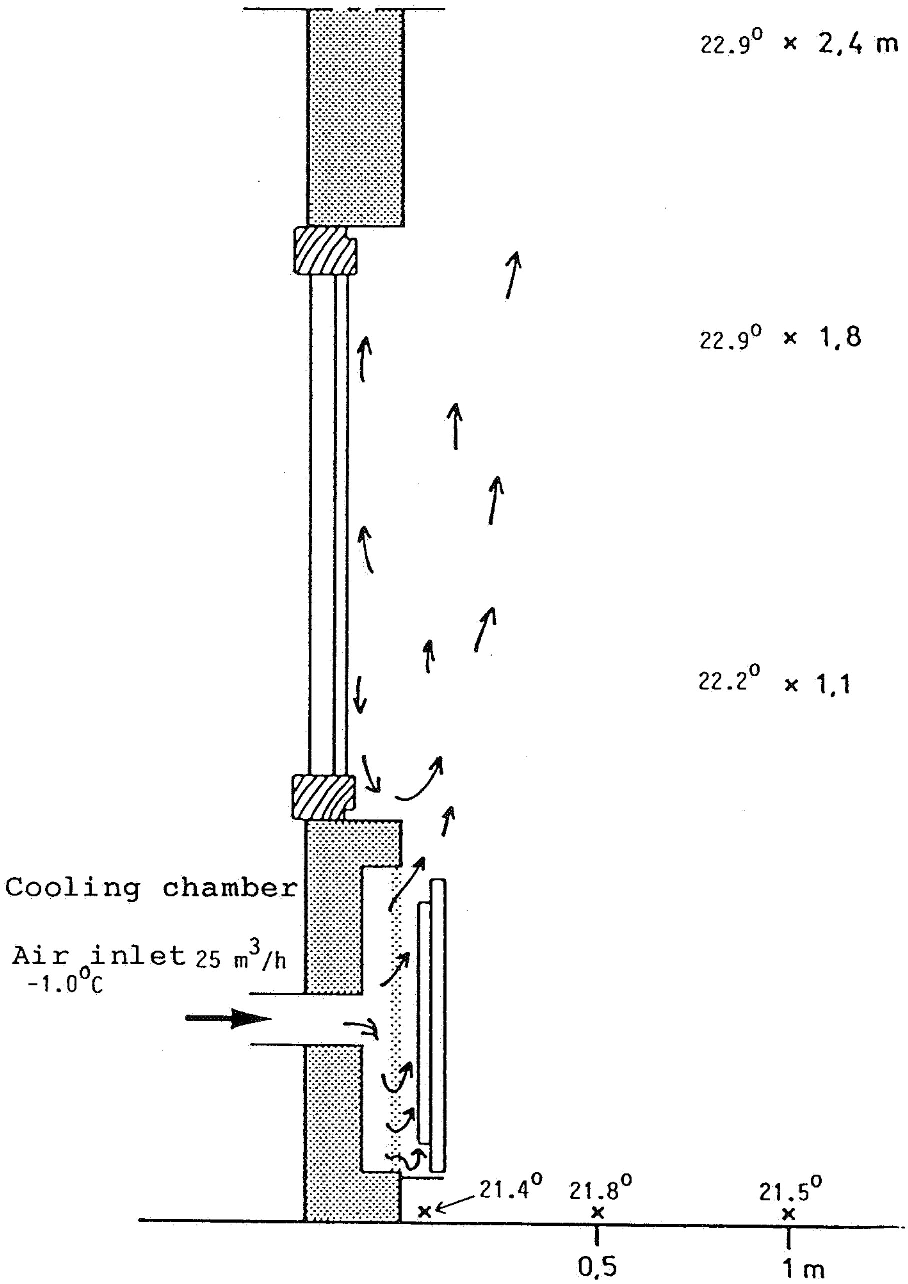

Figure 6 Test No. 4

The figure shows the air flow and the temperatures at outdoor temp. = -1.0°C and radiator heat load = 302 W.

It can be seen that there are no down draught problems or problems with cold air at floor level.

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