PAPER 15

AIRTIGHTNESS IN TERRACED HOUSES

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INTRODUCTION

Testing detached houses using the pressurization technique, applying a negative and a positive pressure, is nowadays an accepted test method. The test is simple to perform and the obtained test results are a measure of the air leakage through the climatic barrier of a building.

When pressurizing a terraced house two kinds of air leakage will be measured; firstly the air leakage through exterior walls, ceiling, and certain parts of the floor over the crawl-space will be measured, secondly the air leakage through walls common with the neighbours i.e. from one apartment to another. These two leakage paths have different signification from an energy point of view.

The air leakage through the facade, the ceiling, and certain parts of the floor is unfavourable because it will result in important energy losses. The indoor climâte can also deteriorate if the air leakage is extensive. The air leakage from one apartment to another will however not influence the energy consumption to any noteworthy degree. The air leakage through walls separating apartments is anyway small for normal running conditions. The reason being that as the temperature difference between different apartments is small, the driving forces for air leakage are almost nonexistant.

From an energy point of view it is therefore above all the air leakage through the surfaces of the apartment facing the outside which should be stopped and a pressurization should therefore only include these parts of the building.

Several different methods for only measuring the air leakage through the exterior surfaces have been tried out with varying success. It has been shown that a theoretical determination of the different leakage paths is very difficult because construction techniques and production techniques vary very much.

For certain constructions more attention is paid to sound transmission problems than to airtightness. Other constructions are primarily designed to suit the production techniques of the site. The discrepancy in constructional design is as can be seen large. The Testing Institute therefore chose to develop instrumentation for the simplest principle of measurement. This means that the apartments adjoining the apartment which is to be tested is depressurized or pressurized to the same pressure as the test apartment. No air leakage between the apartments will occur during the test. The only air leakage will be through exterior walls, ceiling and if there is a crawlspace the floor.

INSTRUMENTATION

The instrumentation consists of the following parts: (see figure 1)

a) Fan with measuring duct for measuring air flows.

b) Two fans for obtaining negative or positive pressures in adjoining apartments.

c) Micromanometer for measuring the pressure difference between the inside and the outside.

d) Micromanometer for reading air flows.

e) Three doorleafs with connections for the fans.

The measuring fan (a) is driven by a DC motor and is connected to one of the two measuring devices, which have a range of 0 - 1100 m^3/hr and 700 - 4000 m^3/hr.

The measuring ducts work on the pitot tube principle where the dynamic pressure is measured with a punched cross tube in the air flow and the static pressure is measured at four points on the wall of the tube.

The two pressure supporting fans (b) are axial-flow fans without any air flow measuring device. The micromanometer (c) for measuring the pressure drop across the exterior wall is connected to a manifold with valves. Three apartments can be connected to the manifold. One at a time can then manually be connected to the micromanometer.

The micromanometer (d) is used for measuring the dynamic pressure in the measuring duct. The registered pressure corresponds to a specific air flow.

The micromanometers (c) and (d) can be connected to a x/y-plotter. The doorleaf (e) are made of aluminium frames with reinforced plastic foil. The frames can be expanded with screws in order to tighten against a door frame. The complete instrumentation has been put together in a rig which is located in one of the vans belonging to the Testing Institute.

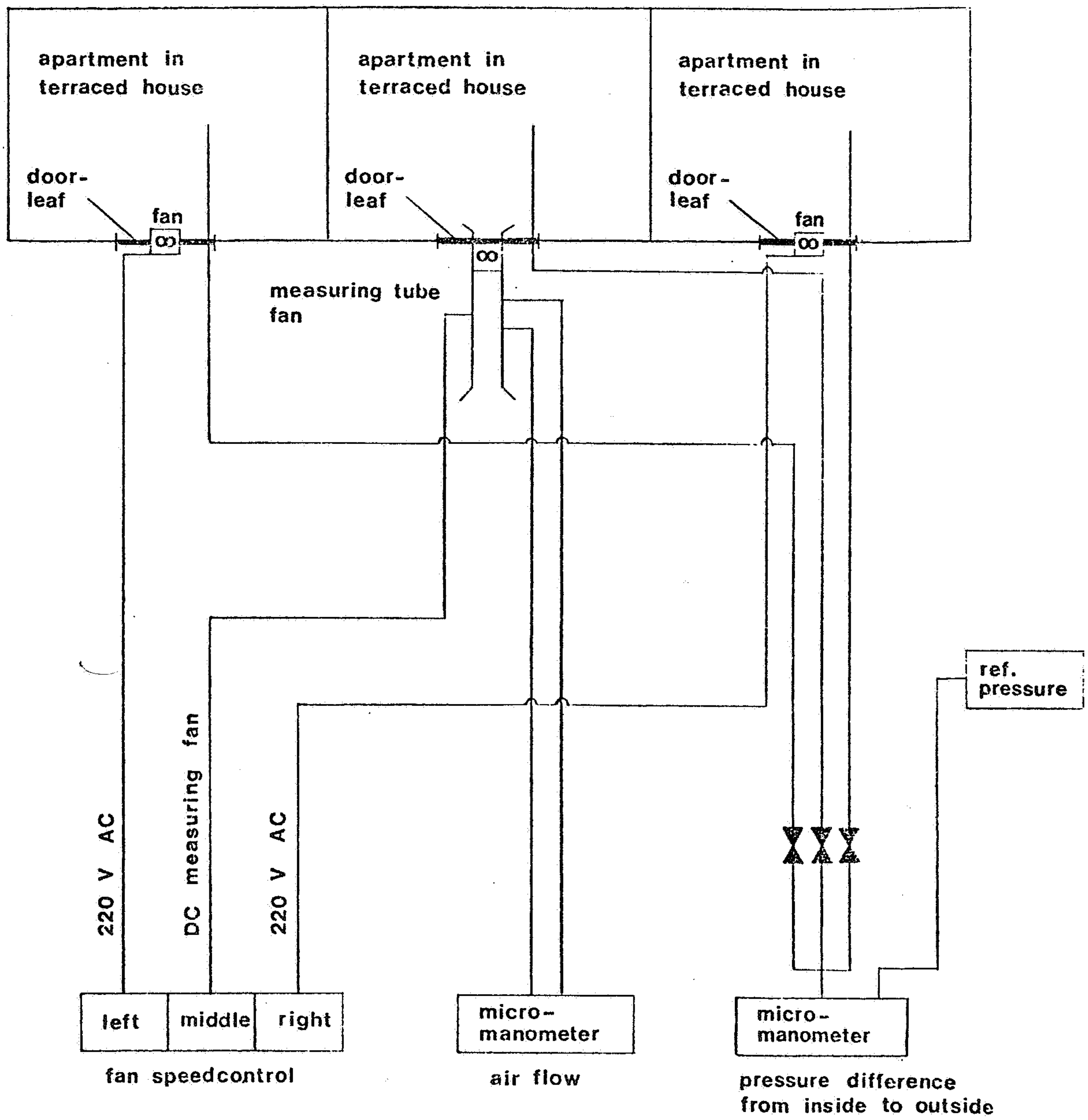


Figure 1 Instrumentation

PROCEDURE

All the openings for controlled ventilation should be tightened before a test can be started. Windows, shutters and exterior doors are closed. The doorleafs are mounted and the fans are connected.

The pressure is then adjusted step by step to +10, +20, +30, +40, +45, +50, +55 Pa. After that the fans are turned around and the pressure is adjusted to -10, -20, -30, -40, -45, -50, -55 Pa. When a pressure has been adjusted in the apartment which is being tested this apartment is disconnected from the micromanometer. One of the adjoining apartments is connected to the micromanometer and the pressure is adjusted to the same pressure level as in the test apartment. The pressure is adjusted in the same way for the other adjoining apartment. The pressure in the test apartment is read once again and adjusted if necessary. When the pressures in all three apartments are equal then the air flow through the fan is registered. The air flow is a measure of the air leakage through exterior walls, ceiling and for certain constructions also the floor above crawlspace in the apartment. The test method is also useful for pressurization of semi-detached houses.

RESULTS

In the following results from measurements in two different terraced houses are presented. The results include measurements with and without supporting fans. In house A there is a continuous air/vapor barrier in the envelope. In house B the vapor barrier is non-continuous, but breaks occur at walls separating apartments.

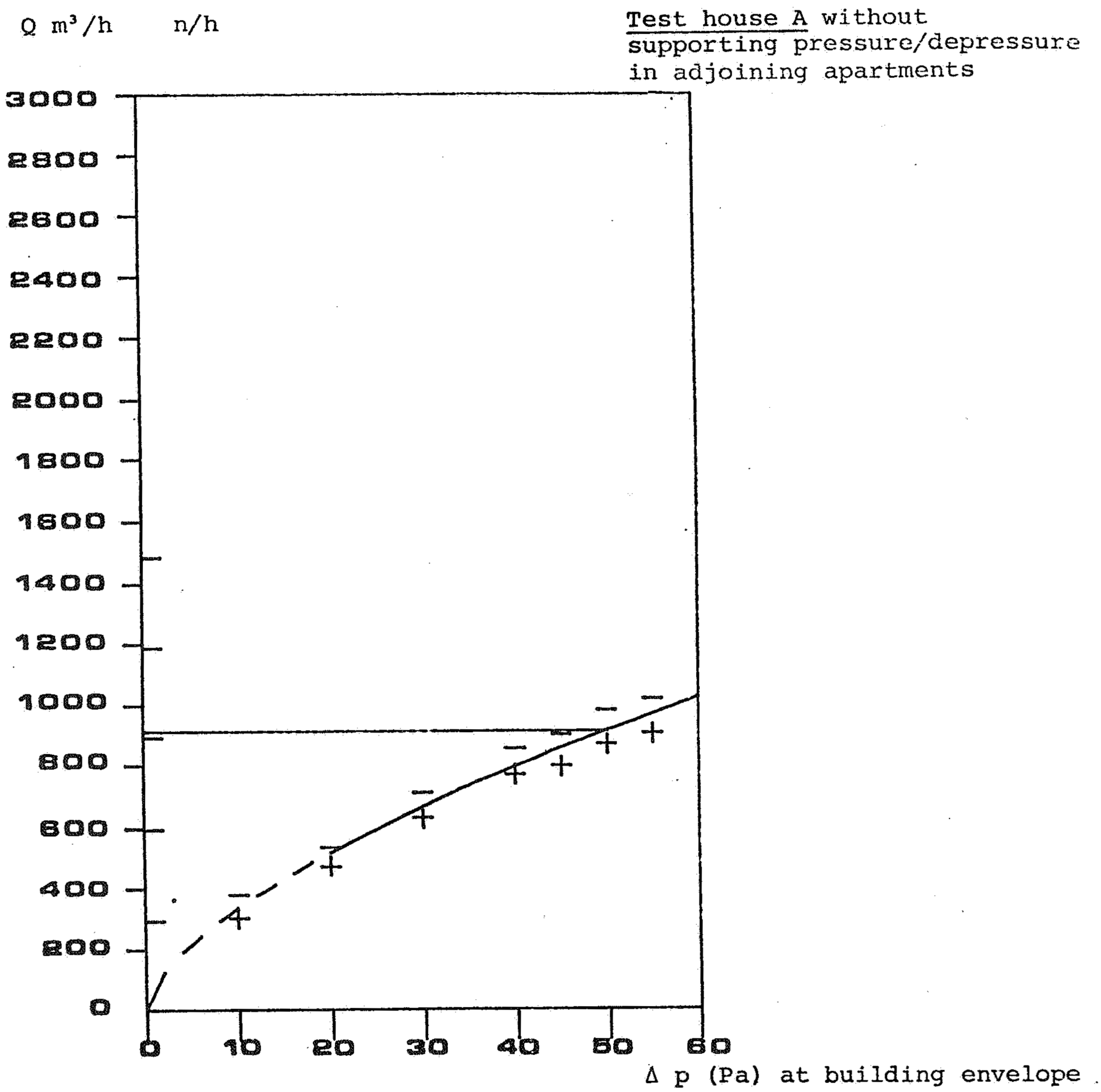
A pressurization test whitout supporting fans in the adjoining apartments was made in test house A (see fig. 2). The test results (3,1 ach at 50 Pa) show that the tested apartment is not very tight, the value is however close to the code value. Next step was to perform a pressurization test with supporting fans in the adjoining apartments (see fig. 3). The result was now 2,5 ach at 50 Pa. The difference in air changes rates (0,6 at 50 Pa) depends on the fact that the supporting pressures prevented any air flow through walls separating apartments from occuring.

The pressurization tests in house B was performed in the same way as in test house A. The two results from house B are close to each other in this case and that is the point (see fig. 4 and 5). In test house B the air/vapor barrier in the exterior walls is cut and folded into the joint between the exterior walls and the apartment separating walls. The results show that the air/vapor barrier does not cover the part of the apartment separating wall wich is part of the exterior wall. This design principle for wood frame house cause serious air leakage to occur.

The test method described above could be a helpful tool to point out leaky constructions. It could also change the design principals to either constructions with continuous air/vapor barrier or construction where each apartment is a separat unit seen from an airtightness point of view.

A continuous air/vapor barrier must cover all the inside of the wooden frame i.e. apartment separating walls must be connected to the inside of the exterior walls. This will mean just a minor change in the production methods of today and it is probably the simplest way to reach the goal 2 ach at 50 Pa wich was the primary recommendation given in the Swedish Building Code.

FIG 2



+ = pressure, - = depressure

Volume of building: 297 m^3

Indoor temperature: +15 °C

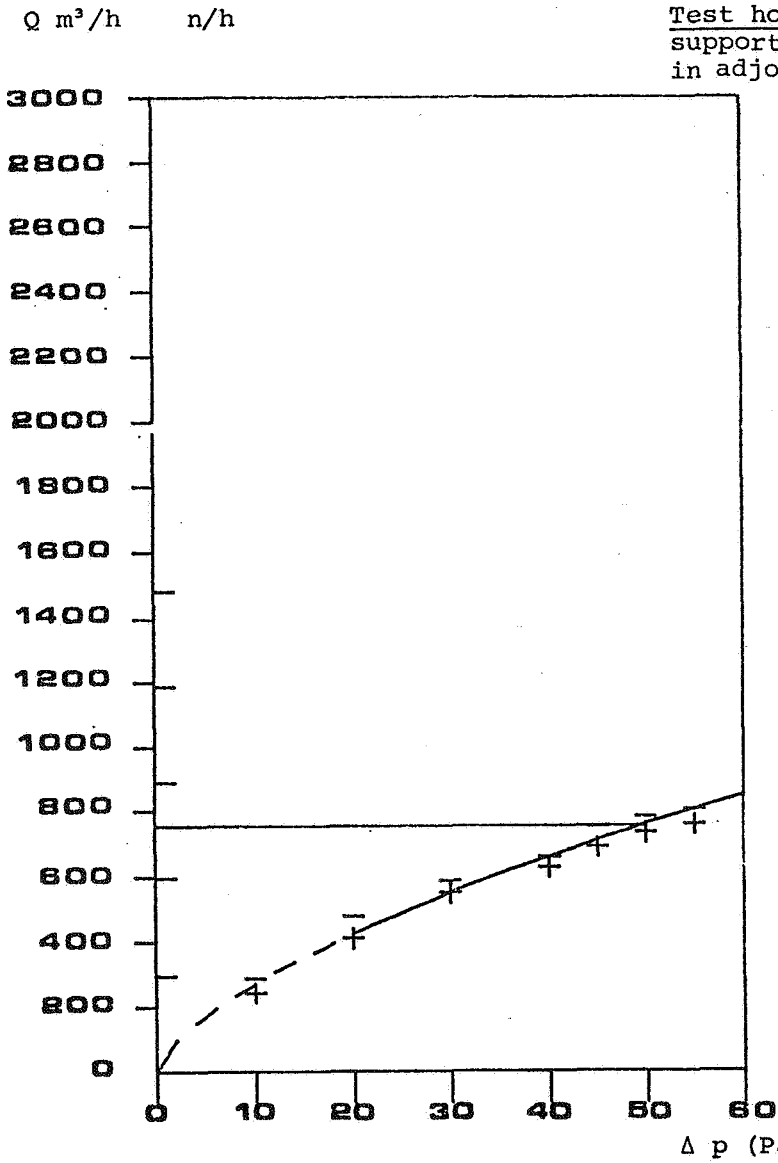
Outdoor temperature: +15 °C

Average airflow at 50 Pa: 911,2 m^3/h

Air changes per hour at 50 Pa: 3,1

FIG 3

Test house A with supporting pressure/depressure in adjoining apartments



+ = pressure, - = depressure

Volume of building: 297 m³

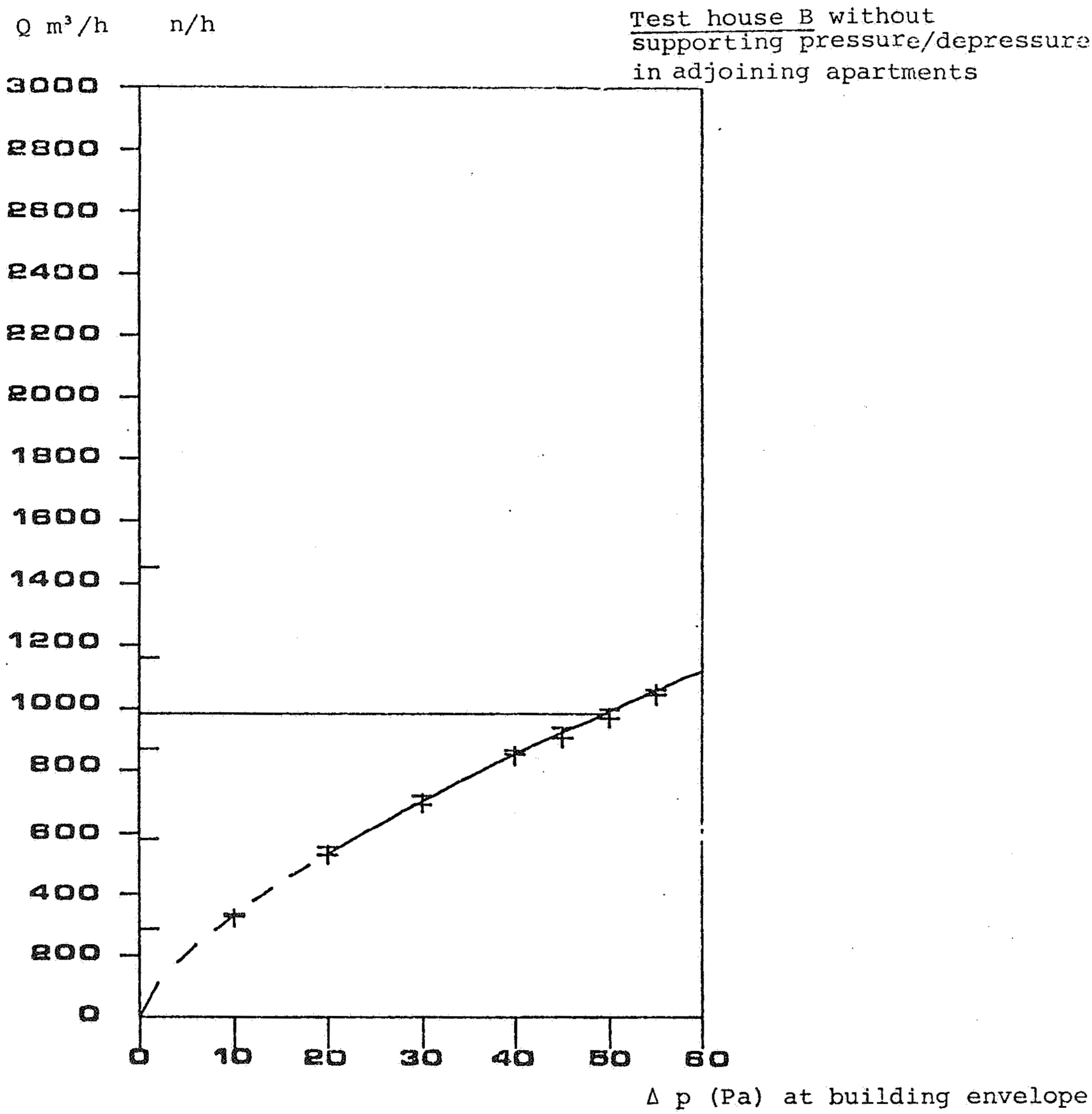
Indoor temperature: +15 °C

Outdoor temperature: +15 °C

Average airflow at 50 Pa: 753,2 m³/h

Air changes per hour at 50 Pa: 2,5

FIG 4



+ = pressure, - = depressure

Volume of building: 290 m^3

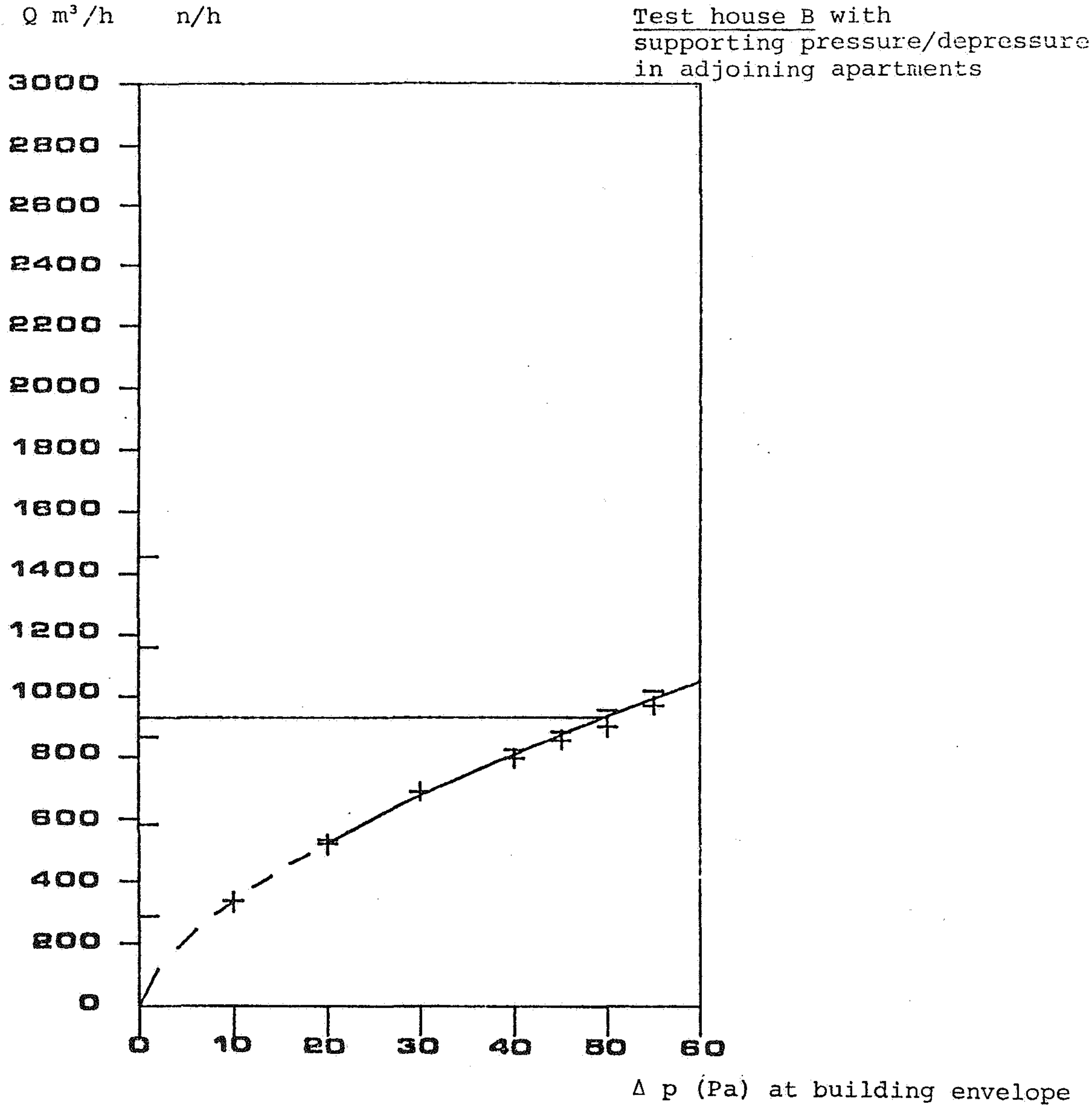
Indoor temperature: +15 $^{\circ}C$

Outdoor temperature: +15 $^{\circ}C$

Average airflow at 50 Pa: 982,4 m^3/h

Air changes per hour at 50 Pa: 3,4

FIG 5



+ = pressure, - = depressure

Volume of building: 290 m^3

Indoor temperature: +15 °C

Outdoor temperature: +15 °C

Average airflow at 50 Pa: 925,5 m^3/h

Air changes per hour at 50 Pa: 3,2