Control of Rain Penetration Through Pressurized Cavity Walls

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ABSTRACT

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This dissertation deals with leakage problems of walls, i.e. the major cause for building ''serviceability failure''.

Walls of buildings --mainly, masonry walls-- experience rain penetration problems in many cities. Cavity walls and rain-screen walls will exclude rain penetration effectively, if they are properly constructed. The size of compartments and vent holes play a significant role in equalizing wind and cavity pressure. Non-compartmentalization of cavity is a typical problem of rain-screen walls which increases the risk of rain penetration.

An analytical model of cavity pressures, wind pressures, area of cracks and vent holes has been developed. It has been validated and its coefficients have been determined with full scale experiments at the experimental station. Many cases of rain-screen walls without or with vent holes have been tested.

Furthermore, a new Pressurized Cavity Principle has

been proposed and developed; one which excludes rain penetration more effectively by creating a second protective layer of air at uniform high pressure around the building. Experimental field work tested the performance of this new principle and gave satisfactory results.

ACKNOWLEDGEMENTS

This dissertation would not have been completed without the painstaking guidance, encouragement, recommendations, suggestions and contributions of my advisor, Dr. Paul Fazio, who went beyond the call of academic commitment by offering me even financial support. Words will never suffice to express my deepest appreciation and sincerest gratitude for all his efforts.

Financial support was also provided by NATO, and gratitude and thanks are accordingly due.

Finally, I would like to offer special thanks to all academic, social, and personal friends who provided encouragement and support throughout my degree program. Only they know fully well what I owe them.

DEDICATION

to our Lord Jesus Christ, Saviour of us,

and

to His great gift for me, my wife Voula.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS

Q = leakage rate or volume flow rate (m^3/sm^2)

Δp = pressure difference (N/m^2)

$\bar{P}$ = mean wind pressure

P_c = cavity pressure

P_j = wind pressure

P_i = interior pressure

A_j = area of vent hole (m^2)

a_j = area of cracks of outer wythe

c_j = discharge coefficient of the vent hole

S_j = the wall area of the outer wythe exposed on wind pressure P_j (m^2)

ρ = air density

n = constant

m = constant

k = $c/a\ (2/\rho)^{1/2}$

X = $A/S\ \sum(P_j - P_c)^{1/2}$

Y = $\bar{P} - P_c$

CHAPTER 1

1 THE BUILDING ENVELOPE

1.1 FUNCTIONS AND LOADS ON THE BUILDING ENVELOPE

The building envelope's major function is environmental, i.e. to separate the external environment from the internal volume of the building, and to maintain the internal conditions which building's users require. It has other purposes as well. It may have a structural function, a visual function in its appearance to passers-by, and its contribution towards the creation of a pleasant land or townscape. Finally, it has a security function of allowing controlled passage for physical objects, people and goods [1].

The environmental function has only recently begun to receive its due share of attention and many architects, while being well equipped to handle building designs of traditional types, are less effective in dealing with enviromental design when faced with new building techniques and materials. In these circumstances, traditional solutions and knowledge derived from previous experience become less relevant, and a new approach is needed, based on a theoretical understanding of fundamental principles and an ability to apply them to design.

The external environment (or it can be referred to as local climate) provides loading conditions which may include solar radiation, extreme temperature, rain, humidity, air movement, light, noise, dust and pollution. These loads generally vary from the need and desires of the people for whom the building is being designed, except for limited periods of time. So, the desired internal climate (endoclimate), which the building is intended to create, is an ideal condition. In some respects, the building's envelope acts as a barrier, in some respects as a filter.

Rain is one of the loads and should be excluded from the interior altogether by the building envelope. This research work investigates only the rain penetration through external walls of a building envelope [2].

1.2 STATE OF THE ART: WALL SYSTEMS AND THEIR FEATURES

The existing wall systems can be divided into five categories for the purpose of this research work and each of them has a different degree of rain resistance (Figure 1.1):

1. Single wall
2. Wall with impervious outer wythe
3. Cavity wall
4. Filled cavity wall and
5. Rain screen wall.

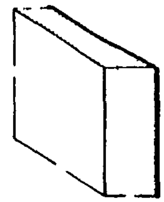
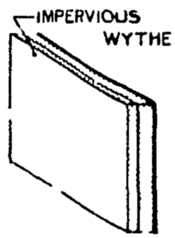
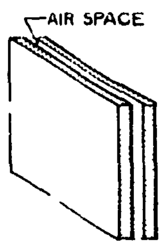
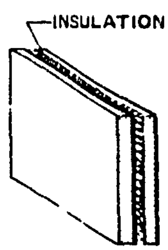
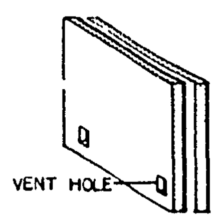
WALL SYSTEM	WALL AXONOMETRIC	RAIN RESISTANCE
1. SINGLE WALL		POOR
2. WALL WITH IMPERVIOUS OUTER WYTHE		EXCELLENT
3. CAVITY WALL		VERY GOOD
4. FILLED CAVITY WALL		GOOD
5 RAIN SCREEN WALL		EXCELLENT

Figure 1.1 Taxonomy of exterior walls to resist rain penetration

1.2.1 Single Wall

The single wall consists of a permeable barrier thick enough to allow the water that penetrates the outer face to evaporate in dry periods before it reaches the inner face in appreciable quantities. This was a traditional solution for masonry walls; but while it may be satisfactory for dry climates, it performs poorly in long, damp winters. Furthermore, the thickness necessary for such a barrier to be effective is far from what is required structurally. It was soon realized however, that masonry walls were not preventing rain penetration and research work to rectify this situation got underway in the 1930's. An attempt was made to determine the variables which affected the permeability of masonry walls and to build non-leaky masonry walls. Consequently, the solid permeable wall has been superseded by other methods of construction.

1.2.2 Wall with Impervious Outer Wythe

The wall with impervious outer wythe is popular for commercial or office buildings; it entails an impervious barrier on the outer face of the wall and it can be very effective, provided proper consideration is given to certain problems regarding joints. Rain can penetrate only the outer wythe through the joints and the joint design will determine the effectiveness of the wall [3-12].

1.2.3 Cavity Wall

The cavity wall employs a double skin (wythe) separated by a continuous air gap (cavity) to break the capillary paths along which water may travel from the outer wythe to the inner wythe [13]. This however requires that careful attention be paid so as to avoid bridges, for example badly detailed lintels or lumps of mortar adhering to wall ties, which may carry water across the cavity [14]. Cavity walls exclude unwanted moisture effectively and economically [15-19]. Moreover, they are popular because they have the additional advantage of good thermal resistance.

1.2.4 Filled Cavity Wall

In these walls the cavity is filled with insulation material to increase the thermal resistance of the wall. This method is usually applied to existing cavity walls. However, there is an increase in the risk of rain penetration, which depends on the type of insulation used to fill the cavity [20-23].

1.2.5 Rain Screen Wall

It has been recently realized that cavity walls can be improved, and that the water which may enter into the cavity by moisture migration through the outer wythe may be reduced if the exterior pressure is equal to cavity pressure.

The rain screen wall is an unfilled cavity wall, but this cavity has to be vented to equalize the pressures outside and inside the cavity; in this regard, it may have one or more openings called 'vent holes' in the outer wythe, Figure 1.2. This is a relatively new wall system and offers resistance to rain penetration [24,25]. A rain screen wall may also be called a 'vented cavity wall' or 'open rain screen wall'. When the cavity of a rain screen wall has been divided into compartments, it may be called a compartmentalized rain screen wall or, in the case where it has not been divided into compartments, it may be called non-compartmentalized rain screen wall.

In Canada, in 1963, G.K. Garden wrote a paper entitled "Rain penetration and its control" [26]. This was the first Canadian publication on the subject of the rain screen principle and is still considered as a prime reference source.

General agreement has been found among researchers, that a rain screen wall, properly designed and built, is the best way to avoid rain penetration [27-30]. Based on accumulated references the main requirements are:

i. The air space should be free from obstructions such as mortar droppings which may bridge the cavity and may carry water to the inner wythe [31]; weepholes should not be blocked with mortar droppings, and metal ties should be properly constructed with drip in the middle to drain out the water drops;

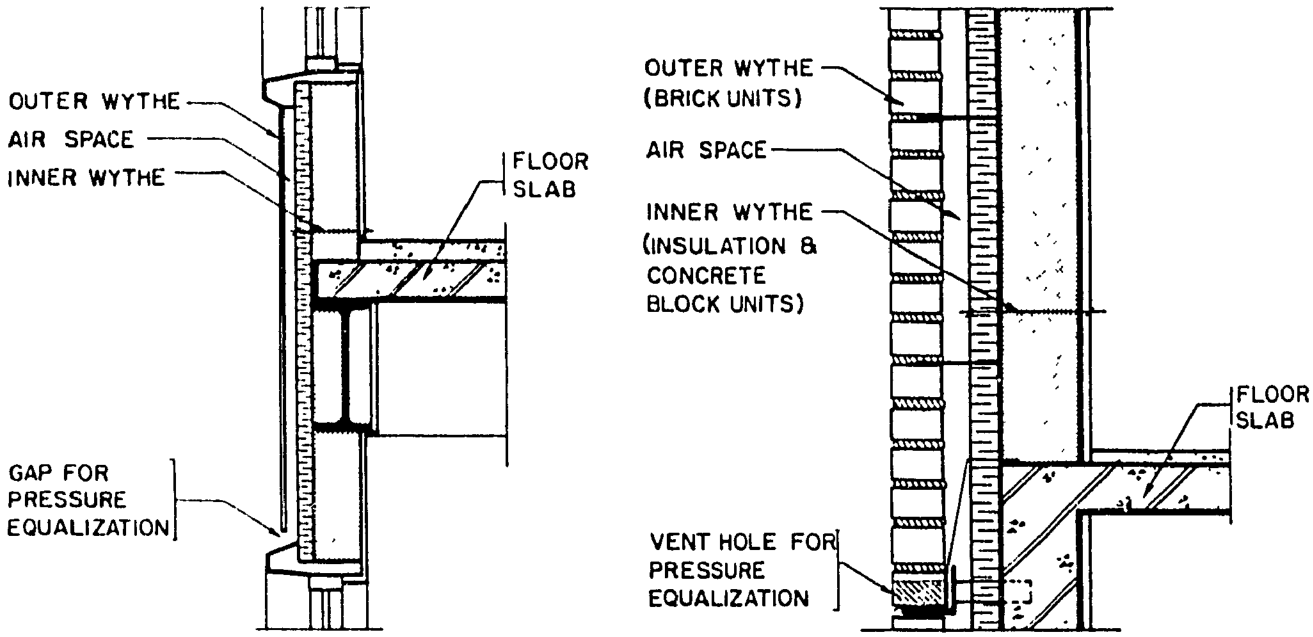


Figure 1.2 Rain screen walls [32]

ii. Rigid insulation placed in cavities should be tightly and securely fastened to the inner wythe. Insulation, loosely placed in a cavity, will be thermally ineffective due to the air circulating around it, and it may also form a water bridge across the cavity.

iii. The compartmentalization of cavity is an essential requirement of the rain screen wall and has two purposes; first, to minimize the air flow along the cavity and second, to minimize the pressure drop across the outer wythe.

iv. Vent holes on the outer wythe are necessary to allow pressure equalization. The air pressure in the cavity must always be equal to that on the wall face. This can be accomplished by providing sufficient openings on the outer wythe to allow wind pressure to remain equal to cavity pressure; such openings are called vent holes and must be distinguished from weep holes which are for water drainage. The size of a vent hole can be small, for example 10mm x 60mm, by omitting the mortar on the vertical joint between two brick units, or it can be large. In the latter case, it should be protected from direct entry of rain by nibs, laps and baffles. The total area of vent holes per compartment varied in the studies contacted by various researchers. Garden [26] suggested providing vent holes as large as possible and to make the inner wythe as air tight as possible. Other authors suggested that the total area of vent holes should be between 25 and 40 times larger than those in the inner wythe [32]. A rule of thumb is one vent hole per compartment and each compartment should be small to achieve pressure equalization between cavity and wind pressure.

v. Flashing is required at the sections of brickwork with beams, slabs, and shelf angles. Flashing should be continuous through mortar joints, it should be formed on the exposed edge to provide a positive drip, and it should be sloped towards the outer wythe. Drainage is achieved by providing weep holes at 600mm intervals, in head joints in the masonry wythe above the flashing; mortar must be kept out of the cavity to ensure drainage.

vi. Airtightness and rigidity of inner wythe are essential for good performance of a rain screen wall. The airtightness is achieved with the air barrier which has been analyzed elsewnere [33-35]. The rigidity of the inner wythe will affect the time response to pressure equalization. The more rigid the wall the less time will be required to equalize the wind and cavity pressure.

1.3 RAIN PENETRATION

One definition of rain penetration states: 'the penetration of water into a wall either through the surface of the wall or through leakage at openings such as windows and doors. It is not necessary for water to penetrate so far that it is apparent on the inside face of the wall' [36].

1.3.1 Rain Penetration Mechanism

Rain penetration results from a combination of the following conditions (Figure 1.3) [27]:

a) A film of rain water on the wall;

b) An opening in the wall such as pores, cracks, poorly bonded interfaces and joints to permit the entry of the water;

c) A force (kinetic energy of rain drop, capillary suction, gravity and air pressure differences) to drive the water through the opening.

Rain penetration can be prevented by eliminating any one of these conditions.

a) Water (Rain)

In the absence of wind, rain would fall vertically, and projections on the wall with appropriate drainage details generally would protect the wall from getting wet. A condition of complete calm is unusual. In the presence of

RAIN PENETRATION WILL OCCUR UNDER THE FOLLOWING CONDITIONS:

WATER + **FORCE(S)** + **OPENING(S)** THEN ► **RAIN PENETRATION**

WATER

The amount of wind-driven rain deposited on wall will be determined from:

- -quantity of rain on horizontal surface
- -wind velocity
- -wind direction
- -length of rain period

FORCE(S)

The forces are:

- -kinetic energy of rain drop
- -capillarity
- -gravity
- -air pressure difference

OPENING(S)

As openings are concerned with the following

- -porosity
- -cracks
- -bad and poorly bonded interfaces
- -joints between elements of materials
- -faults of workmanship

Figure 1.3 Conditions for rain penetration

wind, the rain is swept at an angle striking thus the vertical surfaces of the buildings; it may be defined as wind-driven rain [37].

The wind-driven rain effect is influenced by a number of climatic factors such as: precipitation rate, momentum of rain drops, size of rain drops, angle of incidence of the wind-driven rain, wind pressure, and drying effect of the air [38]. Clearly the larger the rain drops, the greater their tendency to fall vertically; and thus greater wind velocity is necessary to induce an angle of deviation.

The British [39] have developed a driving rain index which is calculated using the following formula:

$$\frac{\text{Annual Rain fall (mm)} \times \text{Average Wind Speed (m/sec)}}{1000}$$

and is expressed in m^2/sec. It does not give an absolute value, although an index of 1 m^2/s corresponds approximately to 200 litres/m^2 catch of driven rain on a vertical surface. The system of exposure classification in use in the U.K. is given by Marsh and summarized under in Table 1.1.

Table 1.1 Exposure classification

Exposure	**Driven Rain Index**
sheltered	up to 3m^2/s
moderate	3m^2/s to 7m^2/s
severe	7m^2/s to 20m^2/s

Maps showing contours of driven rain indices have also been developed for England [40]. Given the accumulated practical experience of 23 weather stations in England, approximately 20-40 litres/m^2 of rain would be expected to fall on a vertical surface in one hour [39]. This rate would tend to be predominant on the most exposed parts of the building shell, near the corners while rates for the facade as a whole would amount to about half of this quantity. Observations of window failure on long elevations suggest that the parts of the facade most severely exposed are those closer to the edge of the building, as shown on Figure 1.4 [37]. Additional information on wetting patterns is easily obtainable elsewhere [41,42].

The driven-rain index map can be used to assess the severity of exposure of a particular site with considerable accuracy. This assessment can then be modified, to take into account any pertinent special local conditions such as protection from wind by a hill or belt of woodland on the windward site and protection from wind in a windward slope on top of even the slightest hill.

In relation to this, Lacy has given an impressive outline of history of driven rain gauges and methods of recording the onslaught of rain on buildings [43].

In a similar vein, the results of studies on the amount of rainfall deposited on a wall under storm conditions were presented by Ishizaki and Mitsuta, in 1970 [44]. They argue therein, that according to field experiments with real buildings, the deposition of rain water on a wall of the

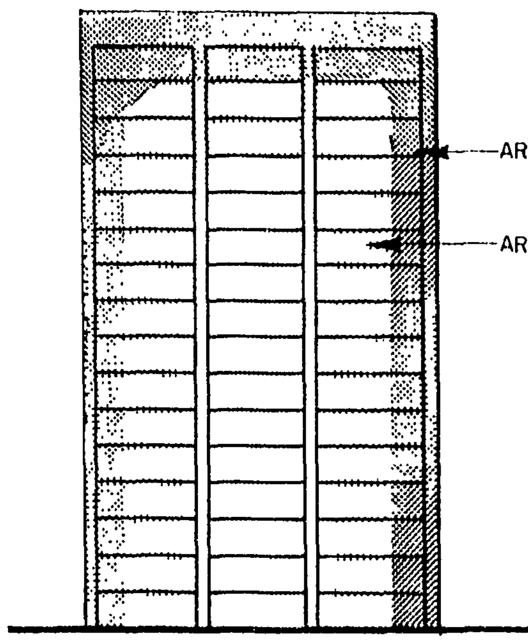


Figure 1.4 Typical wetting pattern on the face of a multi-storey building subjected to wind-driven rain [37]

vertical rainfall is proportional to the product of the wind speed and the horizontal rainfall in heavy rain. The propotional constant is about 0.14.

b) Forces

The presence of forces (gravity, capillary, and other) is the second condition for rain penetration (Figure 1.5). Gravity forces are always present and cannot be changed. Capillary forces depend on the structure of the material of the outer wythe. Other forces such as the kinetic energy of rain drops and air pressure differences are subject to wind velocity and wind direction.

Figure 1.6 shows wind pressure coefficients on a cube in a constant velocity wind field [37], while Figure 1.7 depicts air flow patterns around a tall building [45]. The wind velocity is increased at the corners of the building whereas the pressure is decreased. The highest positive wind pressure occurs on the windward side at the stagnation point.

c) Openings

Openings (such as cracks, holes and porous structure of the material) are those conditions which can be changed; the area of openings can be reduced, having thus a similar effect on rain penetration. Practically all masonry units and the mortar have such a porous structure, that under the forces of capillarity and external pressure, water is able to pass through them. The time for water passages varies

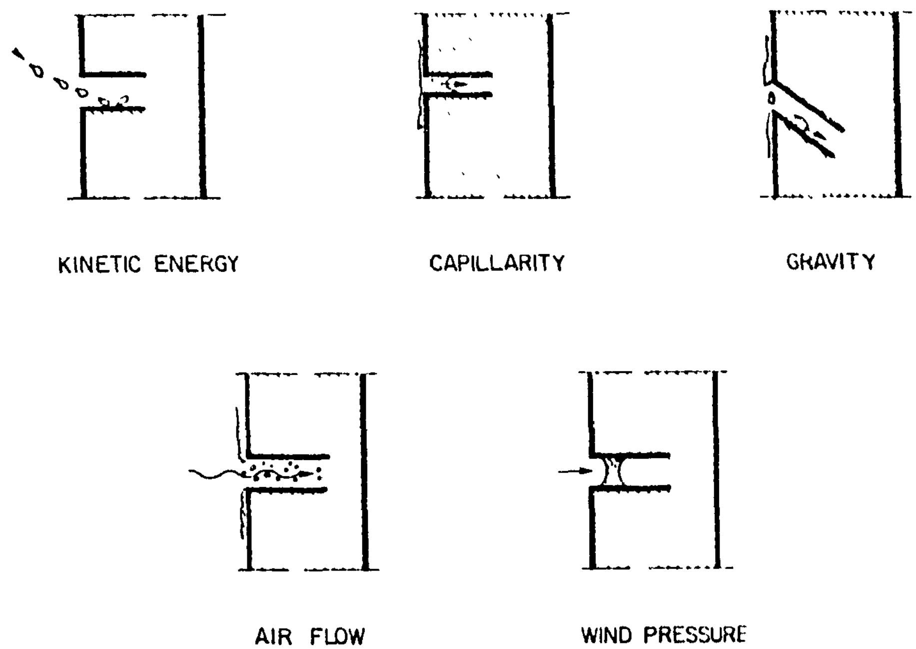


Figure 1.5 Forces producing rain penetration

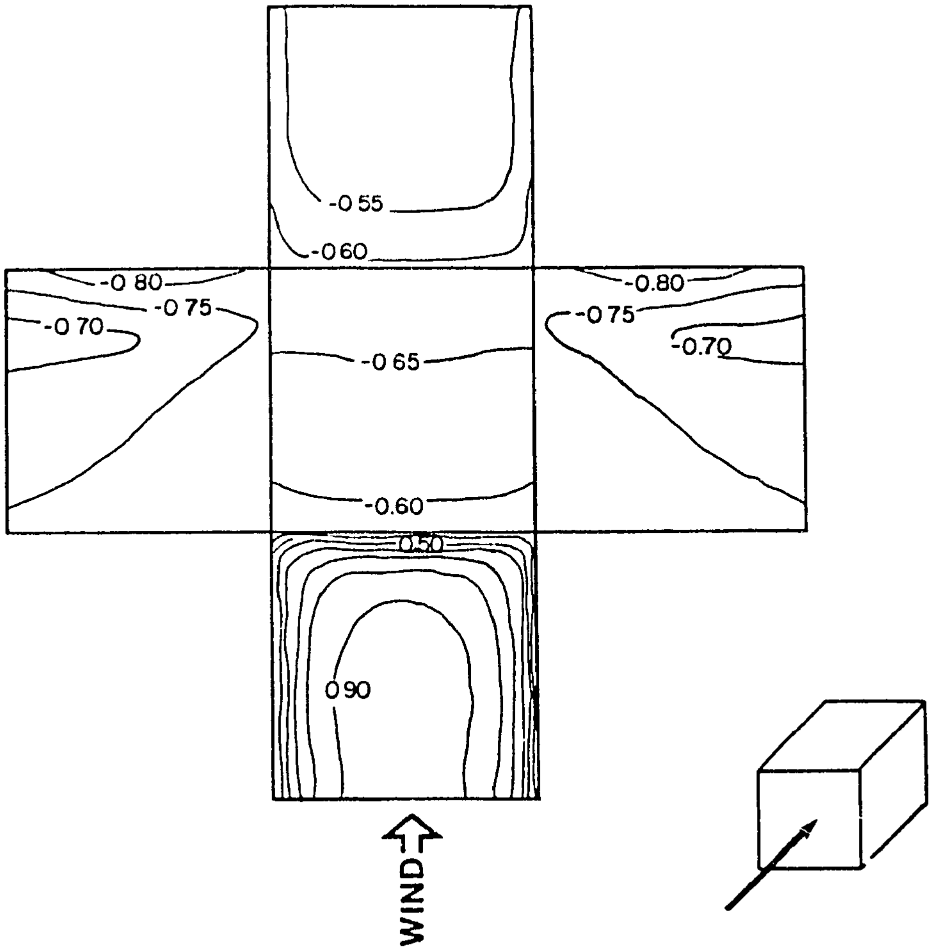


Figure 1.6 Pressure coefficients on a cube in a constant velocity wind field [37]

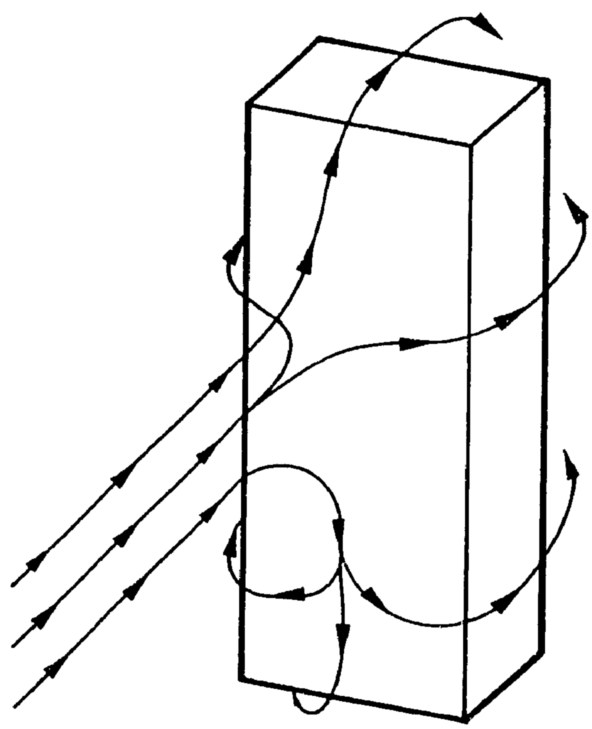


Figure 1.7 Wind air flow pattern around a tall building [45]

from a few minutes to hours or even days depending on the permeability of the material and its thickness. In the past, attempts were made to reduce the total area of openings of walls by improving the workmanship or by sealing the porous structure of masonry walls or by using bricks of a less porous structure. Many masonry walls have been tested and guidelines about their leakage have been laid down.

1.3.2 Rain Penetration Wall Tests; Review of the Pertinent Literature

Rain penetration through masonry walls was noticed early in the century and, as mentioned above, research work commenced in the 1930's. Single wythe masonry walls have been extensively tested in the laboratory and in the field and various causes of leakage have been determined; while cavity and rain screen walls have limited tested.

A rain penetration apparatus was developed in the 1930's by the U.S. National Bureau of Standards for testing water permeability of masonry walls, and most researchers have used similar devices in laboratories. In these tests, masonry wall specimens about 1m long and 1.2m high (dimensions depend from the experimental procedure) were constructed by a bricklayer, attached to a rain chamber and were tested for rain resistance. Water was applied to one face of the wall at a particular rate (for example 40 gal/hr or water equal to 140mm of rain per hour). The air pressure (for example simulating 100km/h wind) was maintained within the chamber. Data on the permeability of the walls were obtained from observations made during these wetting exposures. Usually, the permeability levels of wall specimens were categorized as excellent, good, fair, poor and very poor. Only in a few cases, the permeability of wall specimens was determined by measuring the quantity of water passing through the wall. Table 1.2 shows the rating of some brick-wall specimens before and after treatment with paraffin by way of example [46]. Finally, different materials under different conditions were also tested.

Today a similar testing procedure is the Standard Test Method ASTM E514-74 of water permeance of masonry (Figure 1.8) [47,48], the Standard Test Method for water penetration of exterior windows, curtain walls and doors (ASTM E331-83) [49,50], (ASTM E547-83) [51], and the test method for evaluating the resistance of walls to penetration by rain which are used at the National Building Research Institute [52].

Furthermore, various testing procedures have been used in the field. In this respect, Figures 1.9 and 1.10 show a method of spraying water on walls and a method of applying pressure differences across the wall respectively [53]. Another piece of equipment known as the SIROWET rig has been developed for testing facades in the field [54,55].

Several important investigations have been carried out to determine the factors which affect masonry rain resistance; the most important of which are:

Table 1.2 Performance of walls before and after treatment with paraffin and tung-oil solution [46]

WALL	DESIGNATION (of wall specimen)	DURATION OF TEST (DAYS)	MAXIMUM LEAKAGE THROUGH WALL (LITERS /hour)	RATING
55-62	bb8A1	1	20	VP
		1	4	VP
65-31	cc8A1	1	0.9	F
		1	0.03	F
18-17	aa8B1	1	11	VP
		1	13	VP
39-63	bb8B1	1	1	VP
		1	2	VP
69-30	cc8B1	0.1	11	VP
		1	11	VP
24-A7	bb12A1	7	0	E
		7	0	E
48-A8	cc12A1	1	0	G
		2	0	G
7-16	aa12B1	1	18	VP
		1	13	VP
31-72	bb12B1	1	0.3	VP
		0.3	0.1	VP

NOTE: The first letter shows the material used in facing wythe
a: brick (low absorptive)
b: brick (medium absorptive)
c: brick (high absorptive)
The first arabic numeral shows nominal wall thickness in inches
The last arabic numerical shows the mortar number;
number 1 has proportions of cement, lime and sand 1: 0.25:3
The capital letters show workmanship
Rating: VP-very poor, F-fail, E-excellent, G-good

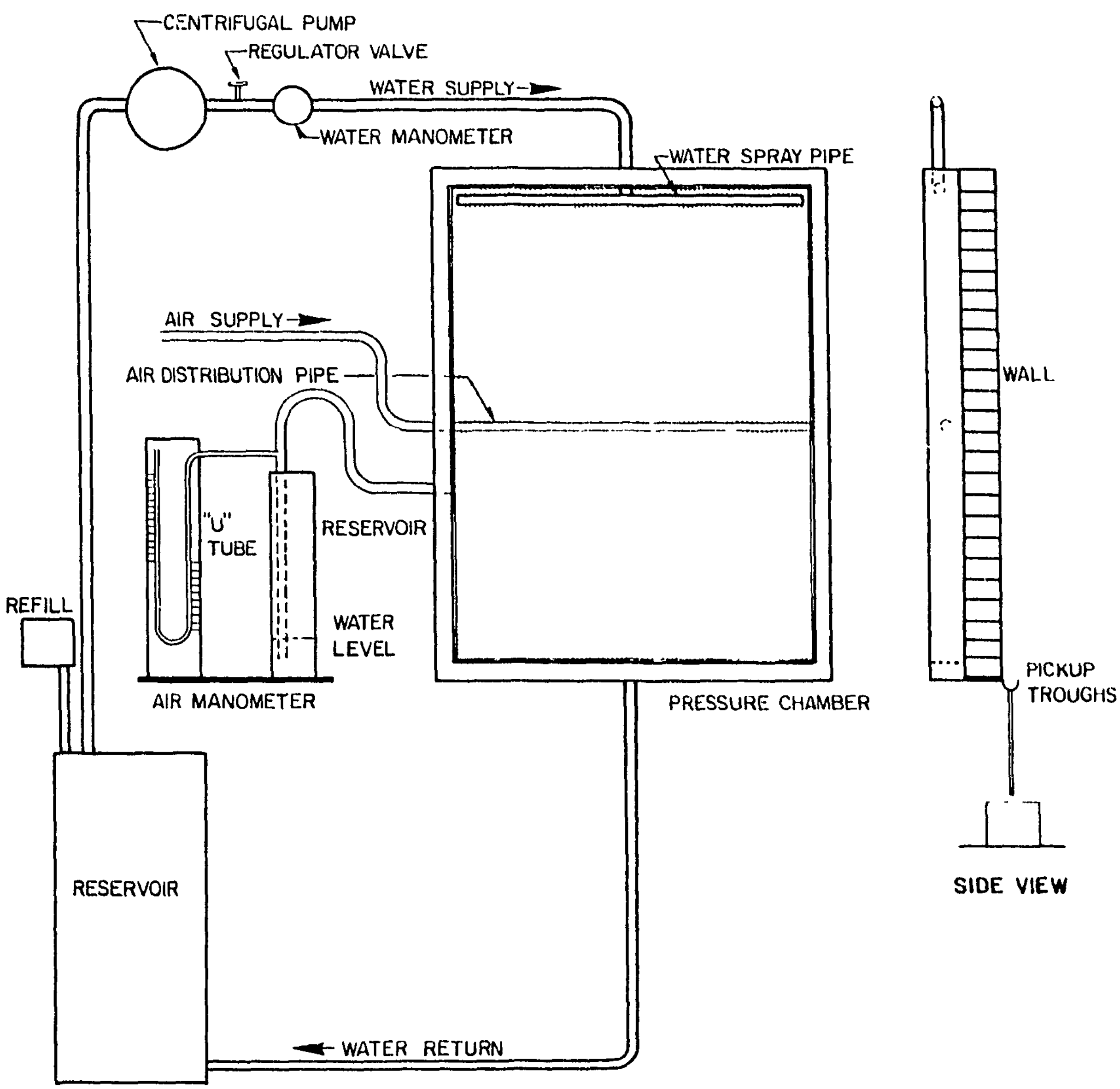


Figure 1.8 General arrangement of water permeability testing chamber system [47]

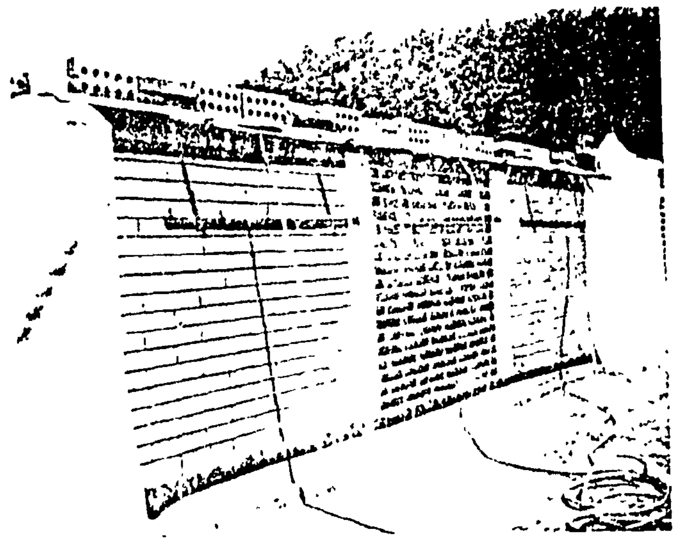


Figure 1.9 ·ıethod of spraying water on the walls [53]

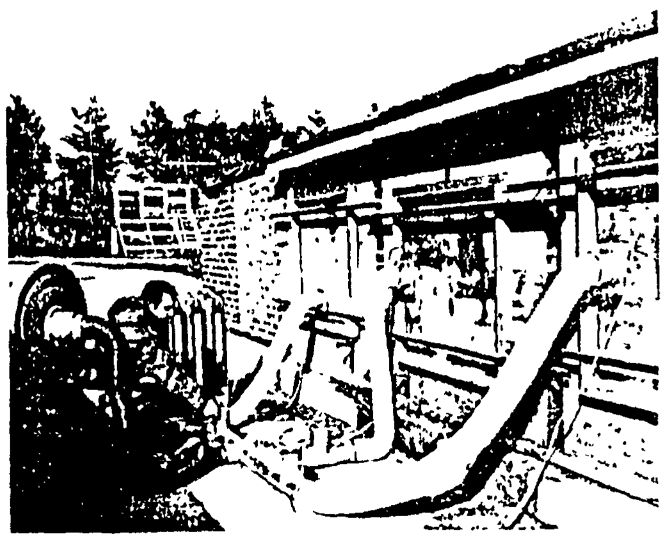


Figure 1.10 Method of applying a difference of air pressure across the walls [53]

a) **Bricks**

- Absorption rate of bricks

The absorption rate is the most important brick property affecting the leakage rate of brickwork [46,53,56-60]. The most watertight walls were obtained with smooth impervious bricks set dry, and smooth porous bricks set wet. These walls are almost impermeable. Bricks of very low rate of absorption may yield uncertain results in the field, strongly suggesting that bricks should probably have a minimum suction rate of 5 grams per minute. An upper limit to the desirable range may tentatively be set at about 25 grams per minute per brick.

Connor found that bricks with absorption rates of less than 5 grams per minute contained high percentages of cracks between bricks and any mortar [61]. Bricks with an absorption rate from 5 to 20 grams per minute per brick consistently suffered less cracking between bricks and mortar, while providing the best conditions for a high degree of rain resistance. Connor suggests that bricks of moderate rate of absorption tend to retain water which penetrates minor cracks, and in so doing, reduce the leakage. With impervious bricks, however, brickwork will leak readily through the wall even with the slightest defect in workmanship [62].

The performances of walls of structural clay tile covered with portland-cement stucco was somewhat better than the average for the walls of brick [46]. In turn, calcium silicate brick walls were considerably more resistant to water penetration than the clay brickwork.

- Frogs and cores of bricks

Some bricks are formed with frogs or cores instead of smooth faces, a process which increases the mechanical key between brick and mortar. Fishburn noted that test walls of cored bricks were less permeable than walls of solid bricks but that the difference was not large enough to be of much practical significance [57].

- Surface texture of bricks

Researchers have ascertained that when bricks have a rough surface, all the small surface indentations are not likely to be filled, unless the mortar is very workable [56,63-64]. Rough surfaces may achieve higher bond strength owing to a stronger mechanical key to which the mortar can adhere. Bond strength is not, however, an absolute criterion for rain resistance. Thornton showed that smooth-surfaced bricks produced walls which were more resistant to leakage than rough surfaced bricks [63].

Further special tests indicated that water can be drawn along the surface of a brick by what is called 'surface capillarity.' Rough or sanded bricks showed this effect much more than bricks that were smooth but otherwise similar.

Brick pattern have also an effect on rain penetration [65].

b) Mortar and joints

Davison and Atkins studied the effect of brick types, mortar quality and moisture content of mortar on water penetration [66,67]; and, Copeland and Carlson [68] as well as Skeen [69], Brown [70], Gillam [71], and the National Lime Association [72] studied the effect of mortar composition and types on water permeance of masonry. The permeability of the specimens was low when the vertical joints were filled or partly filled with grout, when the suction of the bricks was low, and when a highly retentive mortar was used [57]. The effect of retentive mortars on the permeability of the walls was greatest when the brick suction was high. A low retentive mortar stiffened rapidly when it came into contact with dry, highly absorptive bricks; and units with a low suction floated out of alignment when they came into contact with such mortar.

Thick plastic mortar requires expert bricklaying [73]. Great care is required when forming the cross joints, as these are of the utmost importance in producing watertight brickwork. Under no circumstances are the cross joints to be filled from above.

As regards the water penetration of walls with various mortar qualities, the best performance was achieved by walls constructed with a 1:1:6 cement: lime: sand mortar [73].

Approximately 20% of a brick wall consists of mortar joints; and it has been established that rain penetration usually occurs at the unit-mortar interface. The mortar should be soft and plastic when placed in the wall. The mason obtains the desired degree of workability by tempering the mortar by adding water and remixing accordingly. Mortar containing cement not used within two hours after mixing, at an air temperature of 27°C, should be discarded. Fishburn et al. [46], as well as other researchers [56,57] have shown that the water resistance of walls with completely filled joints was markedly greater than for walls having unfilled interior joints.

Anderegg [74] and Newman [75] have found that thin joints are stronger and more watertight than thick joints.

General agreement appears to have been reached that concave tooled joints provide the greatest resistance to rain penetration [46,64,74-75]. According to Newman, cut-flush and raked joints are so difficult to construct properly. He also recommends that they should not be used for buildings exposed to wind-driven rain [75]. He also found that weathered or concave type joints provide the best protection.

In one brick-laying technique the mortar is spread along the bed first, later on the bricks are placed and then the mortar is furrowed with the point of the trowel. This is done to speed up the work, and in certain cases, also to make it easier to lay the bricks to line and level. Fishburn, however, found no significant difference in the water permeability of brick walls where mortar for the bed joints was furrowed before placing the bricks [57].

c) Workmanship

Most authorities have found that workmanship is the most important factor affecting the rain resistance of brick walls [53,57,75-76]. As commonly used, the term applies not only to the care and technique with which the bricks are laid but also to certain factors that are, strictly speaking, part of the wall design specifications, which depend, nevertheless, on the bricklayer for proper execution.

- Tapping bricks into place

Bond strengths were higher as a result of tapping bricks into place more heavily; but greater uniformity of results was obtained when the bricks were tapped and pressed into place by hand.

- Brick-laying method

Fishburn noted that there was little difference with respect to water resistance of the wall, whether mortar was slushed into the joints from above, or grout poured in, or the bricks shoved into a heap of mortar, placed on the bed (pick-and-dip method) [57].

d) Parging and other waterproofing methods

In general, parging masonry walls and/or waterproofing increases rain resistance.

- Stucco-faced and gunite-faced walls

Fishburn investigated the water permeability of small and gunite-faced walls, and denoted that all of the stucco- and gunite-faced walls were highly resistant to water penetration [77].

- Cement-water paint and other waterproofing means

Fishburn and Parsons investigated the water permeability of many small masonry wall specimens treated with cement-water paint and other types of waterproofing [46,78].

Two coats of cement-water paint applied to exposed faces of masonry walls were highly effective as a means of waterproofing. Coatings of an oil-base paint and of emulsified resin paints, applied with a paint brush to walls made of concrete blocks, were permeable and much less waterproof than cement-water paint. Colorless waterproofing solutions, except for a water emulsion of wax known as Gargoule Ceremul-W, did not stop leakage through openings in the joints, but were effective in improving the performance of walls of absorptive brick when the openings in the joints had been sealed.

Ritchie investigated the silicone pretreatment on wetting of bricks [79,80]. High absorption bricks were treated with a water soluble silicone before they combined with mortar into brick masonry. The resistance of the masonry to moisture penetration was much improved compared with that in which untreated brick had been used. Brown also investigated the effect of clear coatings on water permeance of mansory [81]. Comparison of results revealed a significant reduction in the amount of leakage, and a decrease in the percentage of damp area as a result of the application of the coating. Kunzel evaluated the renderings and paintings with respect to rain penetration [82]. Exterior renderings are considered water repellent under heavy or medium driving rain; in case of light driving rain wall constructions need not have any rendering.

e) Weather conditions

- Heating and cooling

With the changing seasons, the average temperature of the exterior walls of buildings varies depending on the geographic location of the buildings. Since the coefficients of thermal expansion of masonry units and of mortar are not the same, temperature variations produce differential volume changes which may result in the formation or enlargement of cracks in mortar joints. It was found that the exposure to heating and cooling did not have a significant effect on the permeability of 30cm (12") all-brick masonry walls [83].

The water permeability of about 100 small masonry wall specimens was measured before and after they had been exposed to the weather elements; this exposure did not have an important effect on the permeability of all brick or brick-faced walls 20cm (8") thick or more [84]. The permeability of stucco faced walls was slightly increased.

- Wetting and Drying

The effects of about 12 cycles of alternating wetting and drying on 20cm (8") small masonry walls have been studied by measuring the permeability levels of the walls [85]. It was found, that exposure to alternate wetting and drying had no significant effect on the permeability of 20cm (8") low absorptive brick masonry walls, nor on the permeability of a stucco-faced wall.

f) Design details

It is generally agreed that much wall leakage is caused by faulty design details of parapets, coping, sills, eaves, horizontal surfaces, and it also occurs at points where the exposure is severe or water is likely to accumulate [64,74-75,86,87]. West and Ford tested wall details such as wall/floor junction, wall/wall junction and window details to rain penetration [88].

- Thickness

Ritchie and Plewes studied the influence of wall thickness on leakage [53,58]. Copeland and Carlson concluded that where the workmanship was poor there seemed to be little advantage in a 30cm (12") wall over an 20cm (8") wall [68].

In tests on brick panels, it was noted that if the interior joints of the brickwork were left open, both 20cm and 30cm brick panels were highly water permeable, and that there was no consistent correlation between the absorptive properties of the bricks [46].

- Header bricks

It was found that where the bricks were highly absorptive, header bricks increased the permeability of 20cm brick walls by providing a direct connection between the inner and outer faces of the wall [57,62]. When the two wythes of 20cm wall were bonded together with metal ties instead of header bricks, the permeability of walls of high absorption brick was observed to be less; but with low or medium absorption bricks there was little difference in the two bonding methods.

1.3.3 Results of Rain Penetration Tests

As already mentioned, research work on rain penetration commenced in the 1930's. After extensive tests on single masonry walls in the laboratories and in the field, various causes of leakage were identified. It was realized that a single masonry wall cannot prevent water penetration and that a cavity wall constituted a good method for preventing rain penetration. More specifically, the cavity (air space) in question will break the capillary paths of water; and when they are properly constructed, effectively resist rain penetration. Recently, it was noted that open rain screen walls may prevent rain penetration even better than cavity walls, but their effectiveness on rain has been little researched. The rain penetration problem still exists.

1.4 FRAMING THE PROBLEM

Rain leakage through walls is a problem of considerable importance in many areas of Canada [89] and in other countries [90-92]. The following investigations confirm that it occurs more frequently through the walls than through any other part of the building.

During the period 1970-1974, the Building Research Advisory Service carried out detailed investigations on 510 defective buildings [93,94]. Half of the defects investigated were with varieties of dampness; they were related to rain penetration (48%), condensation (32%), entrapped water (10%), dampness (8%), and other effects (2%). Figure 1.13 shows the patterns of 538 building defects [95]. It is worth noting that rain penetration through walls came first (57 bldgs), in comparison with others such as through roof (49 bldgs) and through windows (17 bldgs).

F.J. Eppell, in the proceedings of the Third Canadian Masonry Symposium 1983, presented "A Report on a Cross Canada Survey of Rain Penetration Risk in Masonry Buildings" [96]. In his first survey, he confirmed that the majority of buildings suffering leakage problems were in fact constructed of masonry. In his second survey, he addressed himself specifically to masonry building problems in order to pinpoint problems and causes of leakage, ascertaining that leakage through walls was the major problem, Table 1.3.

Table 1.3 Distribution of leak location [96]

LOCATION	LEAKAGE
Through wall	43%
Roof	39%
Wall/roof junction	18%
Wall/window junction	18%
Wall/wall junction	10%
Window	8%
Floor	6%
Door	3%
Wall/door	2%

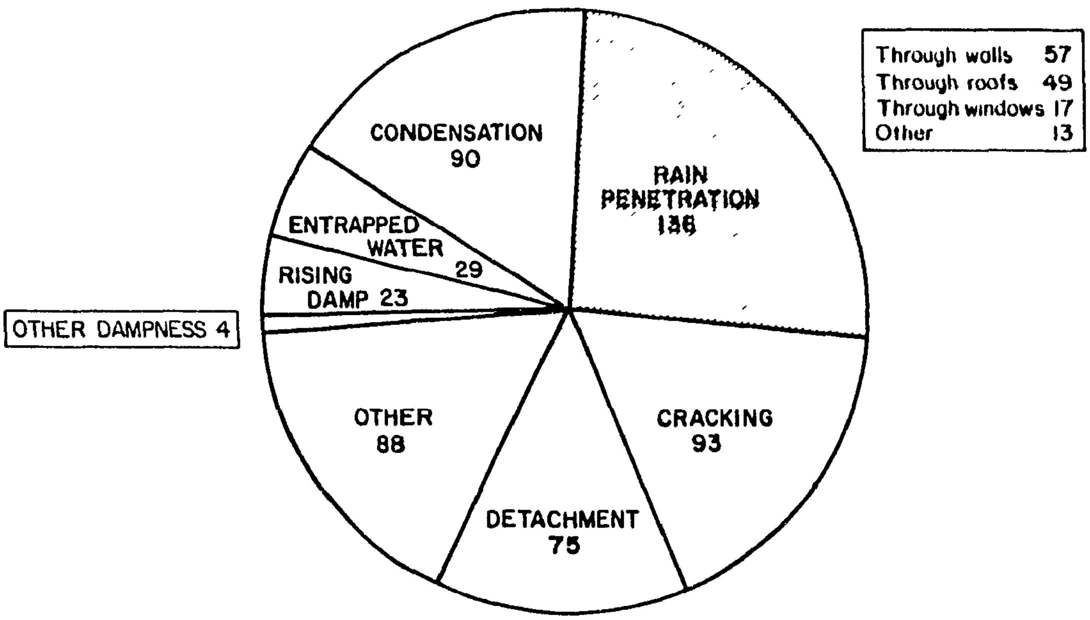


Figure 1.13 Pattern of building failures [95]

In the past, many who examined the question of rain penetration of walls pointed out that the problem is of considerable economic importance and of frequent occurence. Thus in 1953, in the U.S., Thornton noted: "Leaky masonry walls have plagued the building industry and building owners for many years" [63]. Copeland and Carlson wrote that "Leaky masonry walls persist today as one of the most perplexing problems in the construction of masonry structures. ...
Some of the finest buildings having unit masonry bearing or enclosing walls have leaked so badly a few months after completion that extensive waterproofing and repairs were required" [97]. In Connor's opinion: "Moisture penetration through walls above grade has been one of the most serious problems in brick masonry construction" [64].

It was already suggested as early as 1931 by workers, who had looked into the matter in the United States, that the problem had become more widespread in relatively recent times because of the following changes in masonry buildings: use of thinner walls and more freely-exposed masonry; increase in speed of construction; and greater diversity of building units and cementing materials [56].

Buildings with rain penetration problems or "Leaky Buildings" exist in many cities. Minor leakage may not be cause for great concern. A major leakage, on the other hand, can be very expensive to repair. In either case, leakage will continue to deteriorate the building fabric. Although tenants often complain about their leaky apartments, landlords are usually not predisposed to fix them. It is difficult to identify leaky buildings in a city, since leaks are not evident externally. Furthermore, consultants dislike reporting their leaky buildings, to avoid a bad reputation.

In 1970, Latta and Ritchie visited a variety of apartment and other residential buildings and reported leakage problems among those which had brick masonry walls [98].

Ray McClearly Towers, a 21-storey, non-profit senior citizens complex located in the Riverdale section of Toronto and the 16-storey student residence at Queen's University in Kingston had chronic water and air penetration problems. Both buildings are undergoing exterior retrofit to rectify many of these defects [99].

Blackall and Baker, having carried out numerous inquires on rain penetration of exterior walls, reported on the wooden window frame in relation to the principles of water penetration [100].

Similarly, an architectural firm reported that six of the buildings they had built, were experiencing leakage problems. These buildings are located on open sites in Montreal and are exposed to wind-driven rain. The firm in question underscored that they have always had difficulties in trying to build masonry buildings with no leakage problems on open sites.

A report of the city of Scarborough, Ontario 1978, itemized a high incidence of leakage [101]. Water penetration through roofs, masonry and around wall openings was presented as being the major problem in multi-storey residential buildings constructed in the Borough in the past two decades. The report also contained addresses of the buildings, details and types of defects. The author emphasizes that: "... To my knowledge only ten apartment buildings in Scarborough do not leak..." demonstrating thus the magnitude of leakage in Scarborough.

In conclusion, water leakage through walls occurs frequently and this research work proposes a method to be reduced. It proposes a method to reduce the air pressure defference across the outer wythe, which also reduces rain penetration across it.

1.5 OVERVIEW OF THESIS

1.5.1 Overview of Chapter 1

Chapter 1, entitled 'The Building Envelope', deals with the major serviceability problem of the building envelope i.e., rain penetration through walls.

In this chapter existing wall systems such as cavity and rain screen walls are analyzed. Furthermore, rain penetration mechanism is presented. Rain penetration tests on walls are also reviewed.

Cavity and rain screen walls have emerged out to be alternatives to single masonry walls with respect to resist the rain penetration. However the leakage problem even in those types of walls is not totally removed and further research work is required on this issue.

1.5.2 Overview of Chapter 2

In chapter 2, entitled "Literature Survey", some of the variables involved in the mechanism of rain penetration are reviewed.

Cavity pressure is an important variable of rain screen wall systems which affects rain penetration. It depends on wind pressures and the area of wall openings. From the review of literature it was found that very little attention was given to these aspects.

1.5.3 Overview of Chapter 3

Chapter 3, entitled "Theory and Modeling Procedure", develops an analytical model.

A new wall system, the pressurized cavity wall, is presented which prevents rain penetration better than either cavity or rain screen wall systems.

An analytical model has been developed which relates the cavity pressure to wind pressures and to wall openings (vent holes and cracks).

1.5.4 Overview of Chapter 4

Chapter 4, entitled "Experimental Field Work", deals with the experimental field work carried out.

Many experiments were performed on the Experimental Station. Wind and cavity pressures were recorded under different wind conditions and wall openings (vent holes). Analysis was done to determine the values of the coefficient for the analytical model.

1.5.5 Overview of Chapter 5

Chapter 5, entitled "Analysis and Discussion", analyses the coefficients of the analytical model, which were determined from field experiments. This chapter also gives guidelines to use the coefficients in order to estimate the required area of openings (vent holes or valves).

1.5.6 Overview of Chapter 6

Chapter 6, entitled "Applications", suggests ways for implementing the pressurized cavity wall system in new and existing buildings; such a system increases cavity pressure and reduces rain penetration. Possible problems arising from the implementation of this system are discussed.

1.5.7 Overview of Chapter 7

Chapter 7, entitled "Conclusions", presents the contribution of this dissertation.

CHAPTER 2

2 REVIEW OF LITERATURE AND IDENTIFICATION OF RESEARCH AREA

2.1 IDENTIFYING THE RESEARCH PROBLEM

2.1.1 Introduction

Research work on rain penetration commenced in the 1930's. After extensive tests on single masonry walls the cavity wall was developed to prevent rain penetration and then, the rain screen wall.

The new system, the rain screen wall, minimizes risk of rain penetration by achieving pressure equalization between cavity and wind pressures. Water leakage of the outer wythe is proportional to pressure difference across it; if there is no pressure difference across it, then, less water will penetrate it, and less water will be driven into the cavity space; therefore, less water will reach the inner wythe [103]. Figure 2.1 shows experimental results of masonry wall specimens and it is clear from the figure that a leakage reduction occurs when the pressure difference across a wall specimen is reduced to zero. Figure 2.2 shows other experimental results with no leakage at all, when the

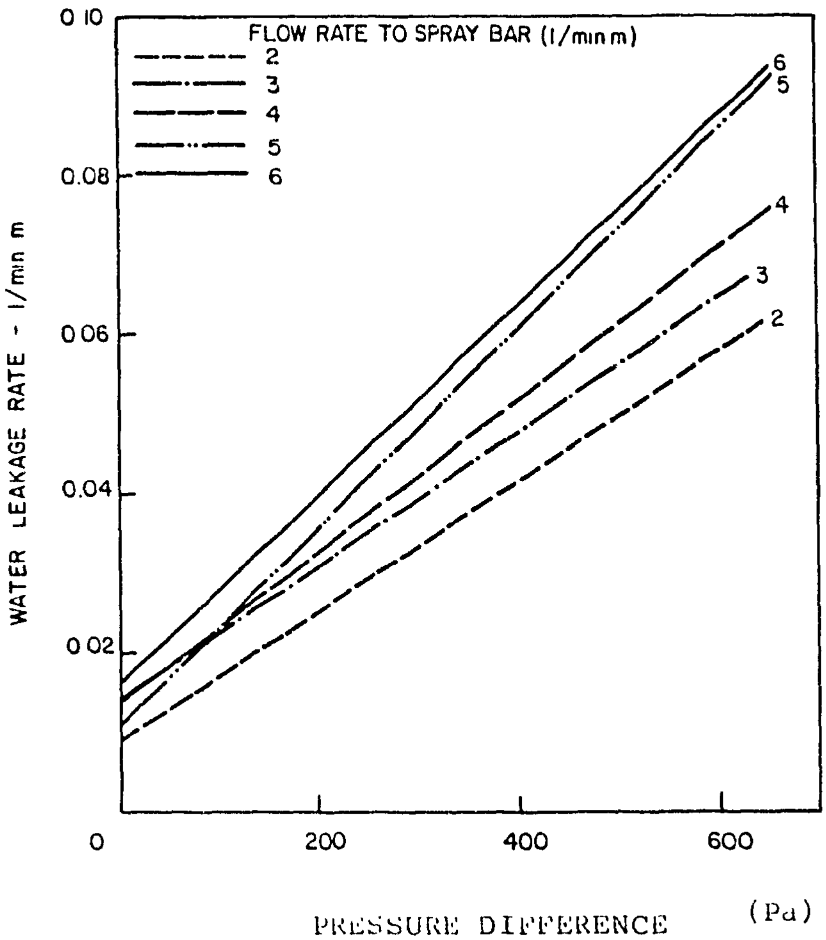


Figure 2.1 Effect of air pressure upon water penetration [102]

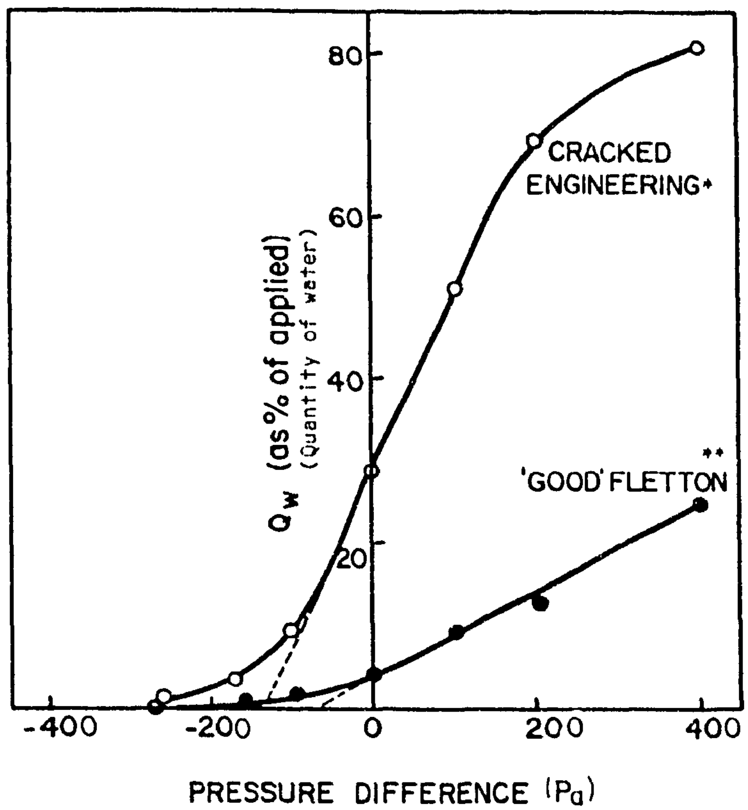


Figure 2.2 Effect of negative pressure difference across a wall [31]

Note: *cracked - bad workmanship
engineering - type of brick
**good - good workmanship
fletton - type of brick

pressure difference across wall specimens became negative (inside pressure greater than outside pressure) [31].

In the previous chapter it has been shown that even today's buildings are leaky. Cavity walls and also rain screen walls may have leakage problems. The causes of leakage problems will be reviewed next, and the area requiring research will be identified.

2.1.2 Existing Research Work on Cavity Walls

Cavity walls and causes of leakage problems have already been investigated in previous research work [103]. A properly constructed cavity wall has no rain penetration problem, but usually this is not the case. Briefly, attention should be given to the following important issues.

The cavity should be free from obstructions such as mortar droppings which may bridge the cavity and may carry water to the inner wythe, Figure 2.3; weepholes should not be blocked with mortar droppings, Figure 2.4 [104]; and metal ties should be properly constructed with drip in the middle to drain out the water drops, Figure 2.5 [105]. In addition, rigid insulation placed in cavities should be tightly and securely fastened to the inner wythe. Insulation should not be loosely placed in a cavity, because not only will it be thermally ineffective due to the air circulating around it, but it may also form a water bridge across the cavity [15,106].

The improperly constructed cavity wall system failed to

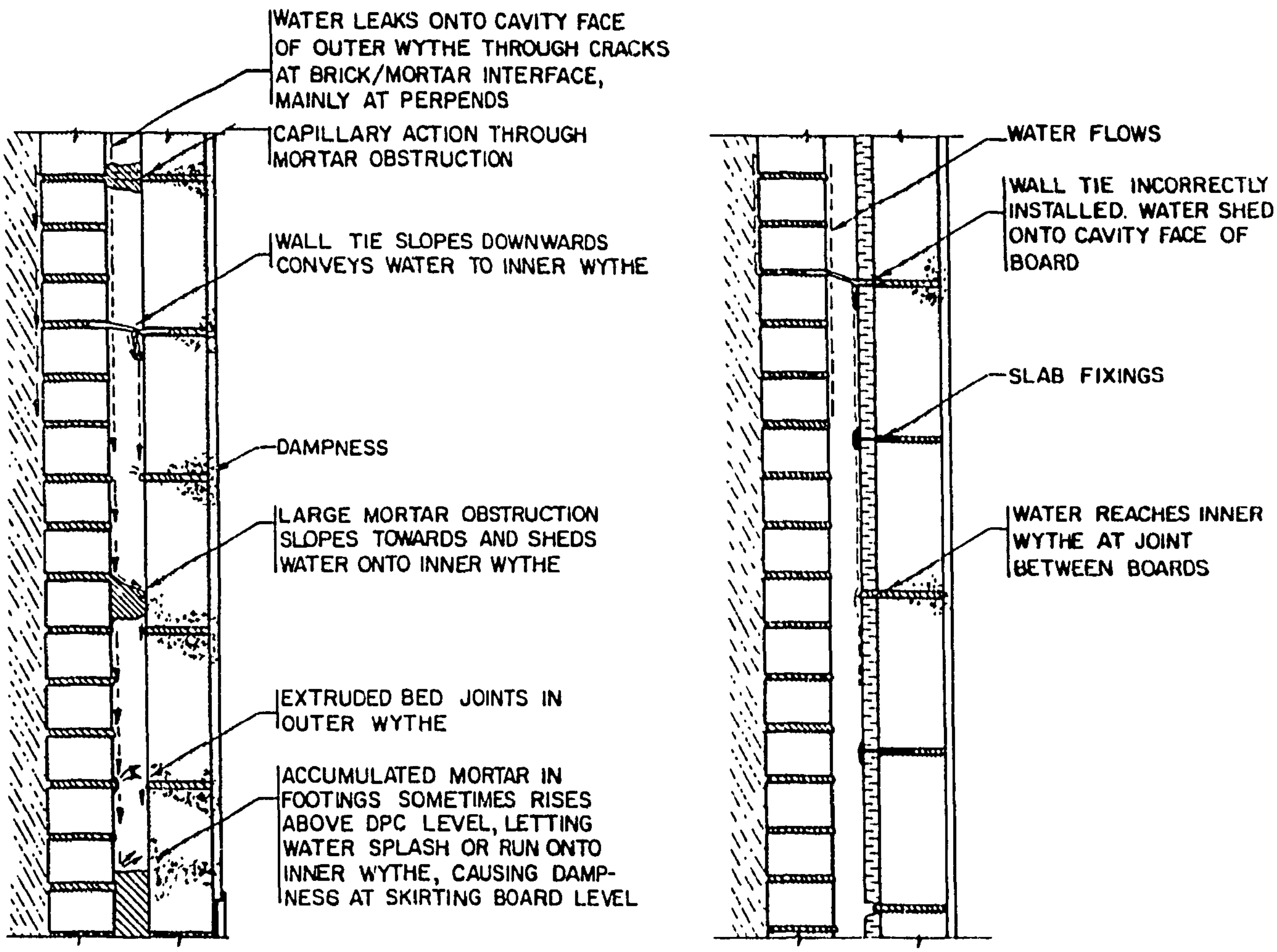


Figure 2.3 Routes for water penetration across cavity walls [105]

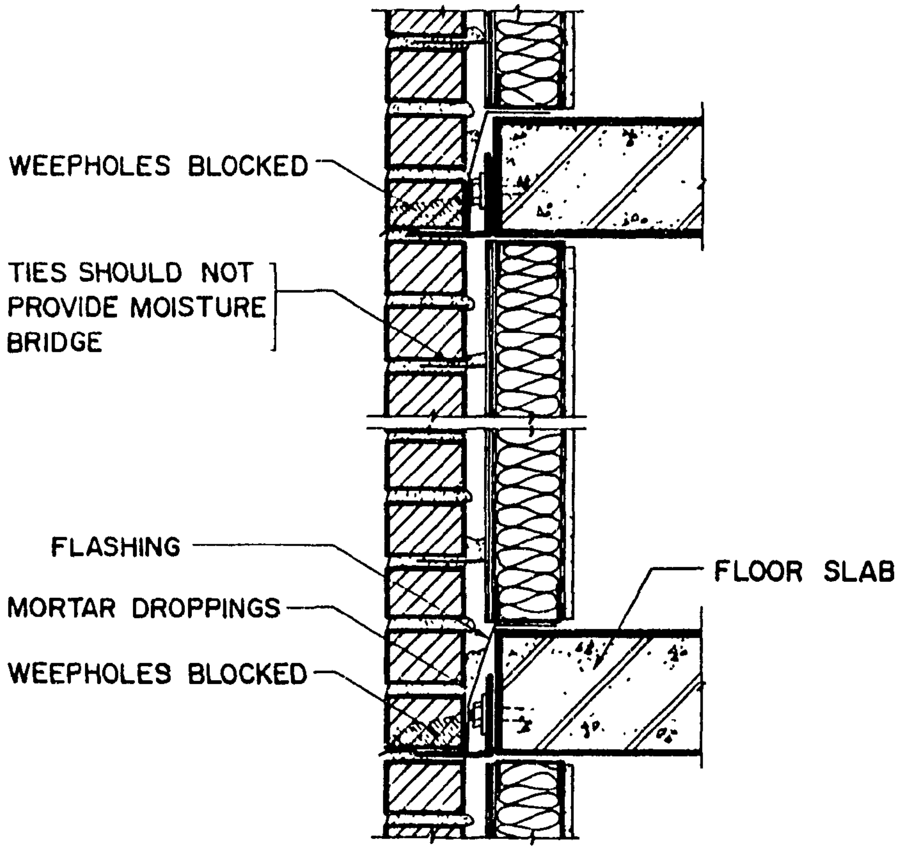


Figure 2.4 Plugged weepholes [104]

Figure 2.5 Metal ties with drip in the middle for proper drainage [105]

eliminate rain penetration and consequently the rain screen wall system was introduced.

2.1.3 Existing Research Work on Rain Screen Walls

The rain screen wall is a new wall system and a limited research work has been done on this type of wall system. Literature review on this system suggests that the compartmentalization (division into sections) of the cavity is an essential requirement and has the following purposes:

i. To minimize air flow along the cavity. The air pressure on the outer wythe varies from the positive pressure caused by stagnation of the wind down to suction several times greater in magnitude [38,107]. Because of this variation of wind pressure, a pressure drop occurs that causes air to flow from an opening of high pressure through the wall and along the cavity, to come out at an opening of lower pressure, Figure 2.6, as in the case of non-compartmentalized cavity. As this air flow can move a large amount of water or snow into the cavity, with the risk of rain penetration, the cavity should be interrupted at suitable intervals to minimize air movement.

ii. To minimize the pressure drop across the outer wythe. Minimum pressure drop (preferably pressure equalization) across the outer wythe is required for the open rain screen wall system. The wind and

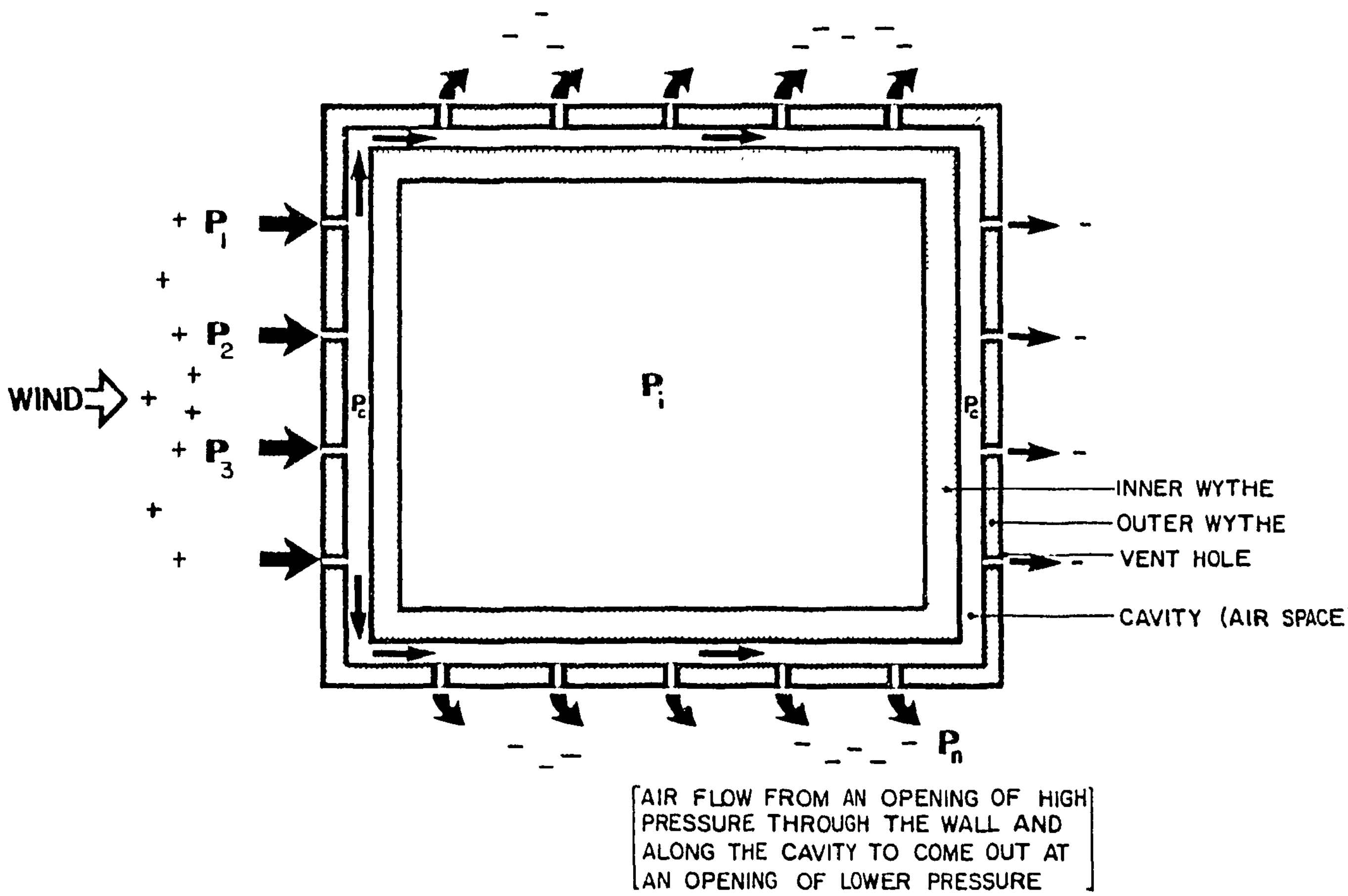


Figure 2.6 Schematic Plan of a building with non-compartmentalized rain screen walls; cavity pressure P_c is not equal to wind pressure P_n

cavity pressure respectively of a rain screen wall should be equal in order to minimize the force which acts on rain drops to penetrate the outer wythe. In order to achieve pressure equalization between wind and cavity pressure, --given that the wind pressure varies from positive to negative-- frequent compartments should be constructed to keep the pressure drop across the outer wythe of any compartment at an acceptable minimum.

A literature search suggests that a rain screen wall should have frequent compartments with one vent hole in each of them, Figure 2.7. In such case, there is no air flow along the cavity and pressure equalization is achieved.

The size of compartments could vary over the facade, being relatively small near the extremities of the wall such as the top and corners --where the rate of wind pressure change is the greatest-- and quite large over the central position where there will usually be only a slight wind pressure variation. The cavity must, however be closed at all corners of the building to prevent air from going around the corners to feed the high suctions that occur on the adjacent wall face. Next are presented examples of typical buildings, one with compartmentalized rain screen walls and another with non-compartmentalized ones, to identify which one required research.

a) Buildings with compartmentalized rain screen walls.

Figure 2.8 shows an office building in Montreal with

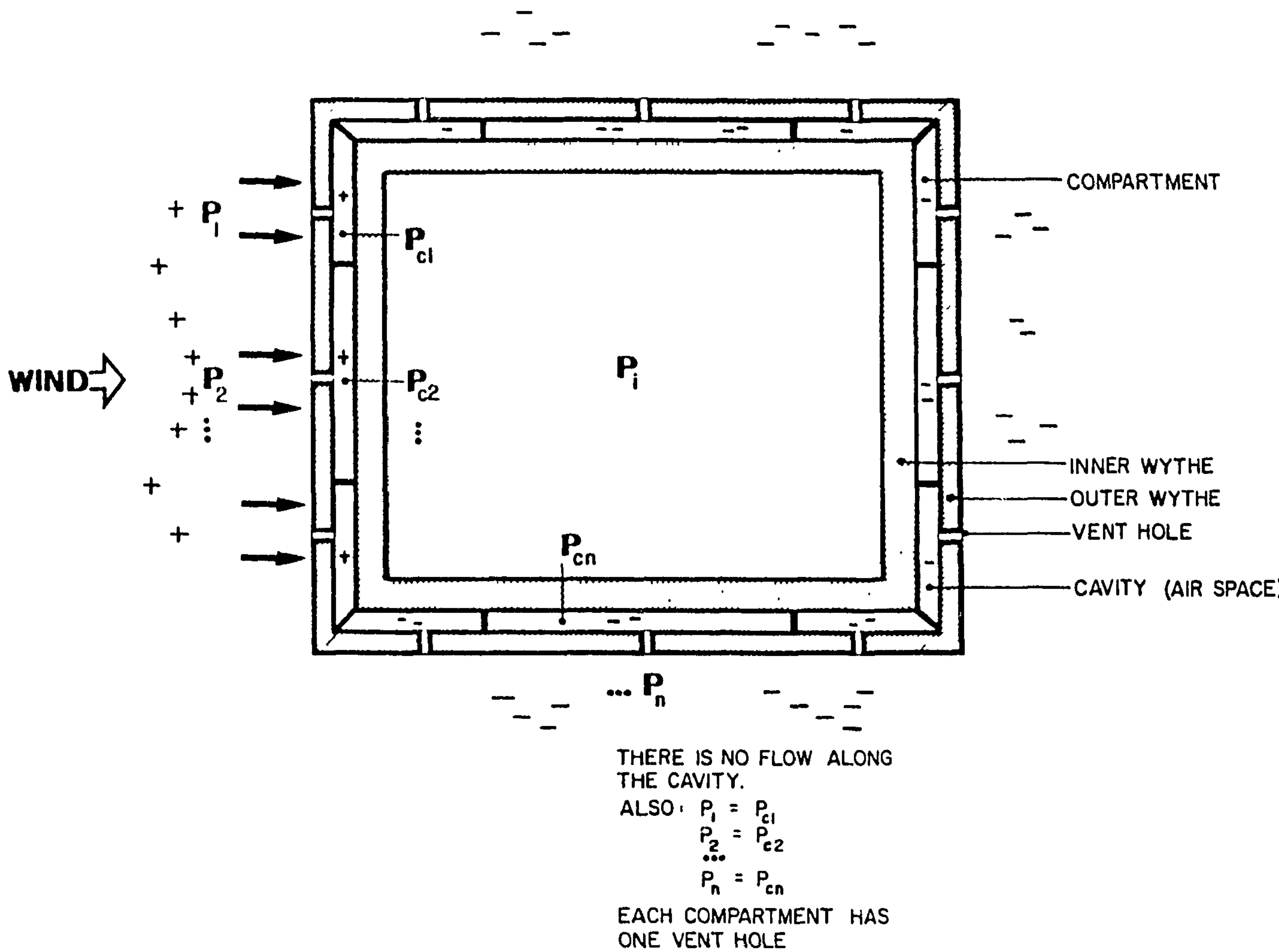


Figure 2.7 Schematic plan of a building with compartmentalized rain screen walls; pressure equalization has been attained

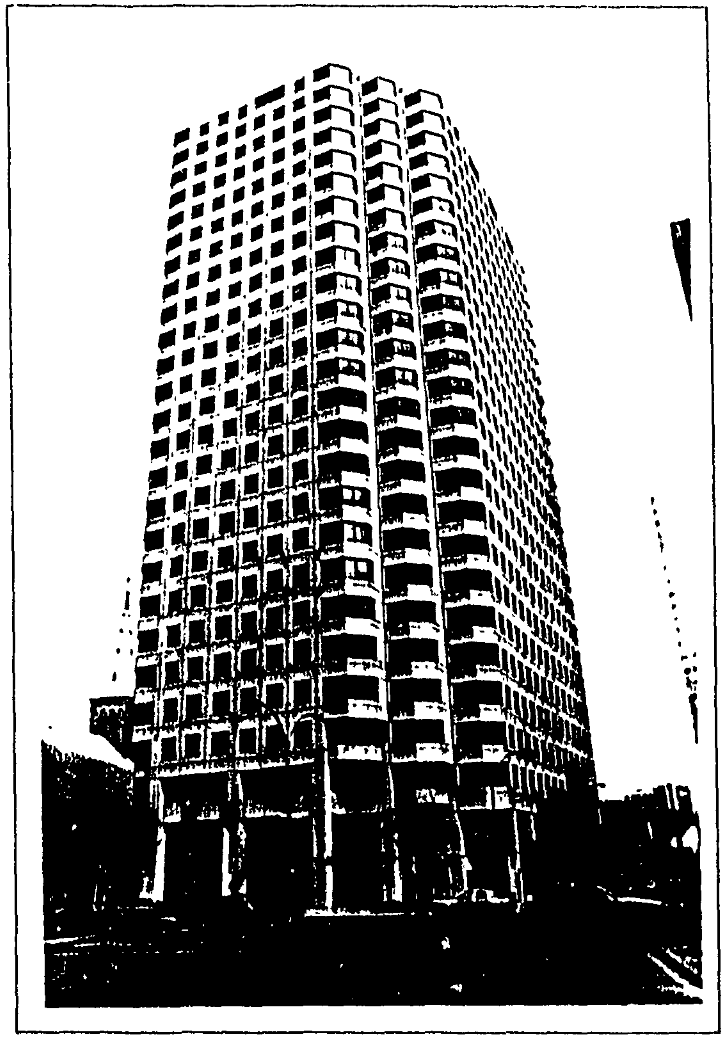


Figure 2.8 'Place Air Canada' office building in Montreal; the exterior walls are compartmentalized rain screen walls

precast concrete panels on the outer wythe. Each concrete panel measures 3.04mx3.64m, Figure 2.9. The width of the cavity is 13mm. Each panel has two long openings (vent holes) 13mm wide for pressure equalization, Figure 2.10. Ganguli and Dalgliesh studied the wind pressure differences across these panels [108]. Model tests similar to panels of Place Air Canada building were carried out by Schuyler and Irwin [109].

In this case, the facades consist of panels and no rain penetration occurs. Each panel (of outer wythe), consists of one compartment. The cavity has been kept free from obstructions, thus, avoiding bridging. Panel details were carefully studied by designers since panels are repeated many times on facades. The only passage of rain into cavity is through the joint. If joints are protected against the entrance of rain, then, no rain penetration will occur. For the above reasons the performance of rain screen walls with panels depends on the joint design. Pressure equalization has been achieved and, generally, there are no complaints from the occupants on the performance of exterior walls.

b) Buildings with non-compartmentalized rain screen walls

Figure 2.11 shows an example of a residential building in Montreal with non-compartmentalized rain screen walls. Figures 2.12 and 2.13 show the outer wythe and vent holes.

In this case, facades consist of small masonry units (eg concrete blocks on the outer wythe), and rain penetration may occur because rain screen walls are not

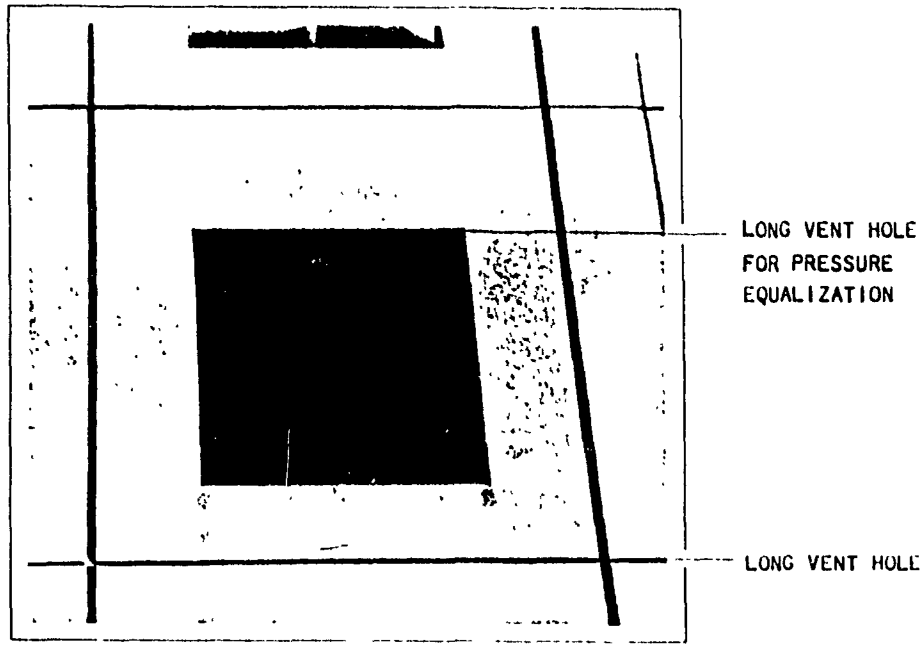


Figure 2.9 Precast concrete panels of Place Air Canada; each panel consists of one compartment

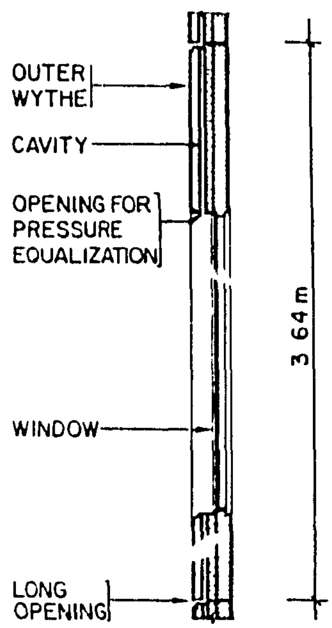


Figure 2.10 Vertical section of the precast concrete panel

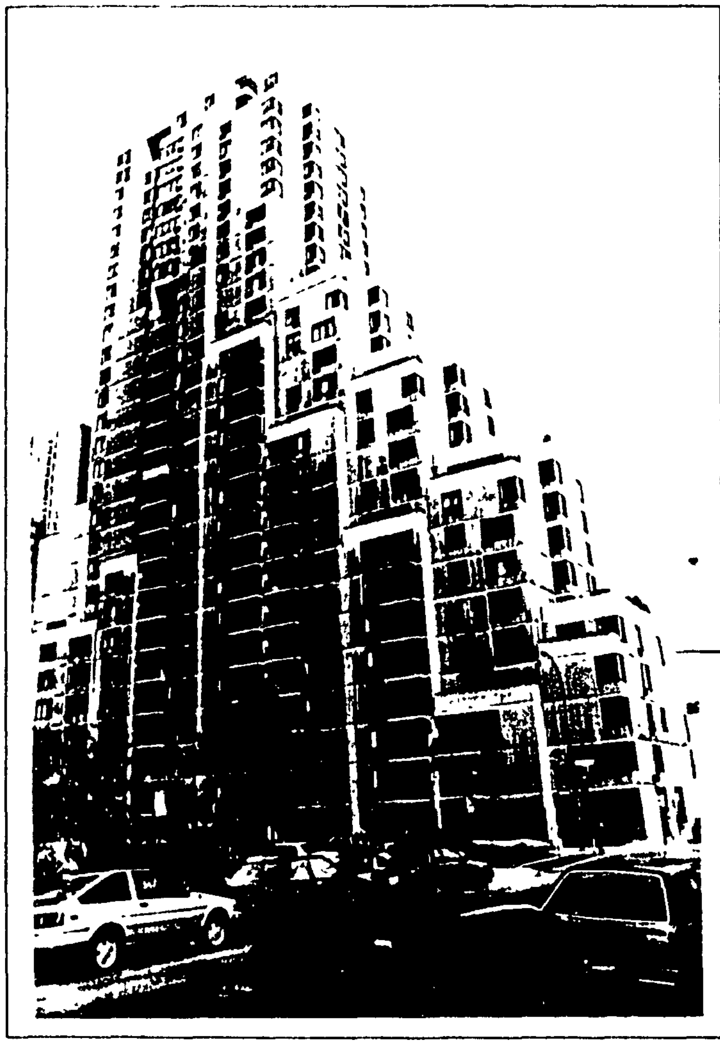


Figure 2.11 Apartment building at Montreal; the exterior rain screen walls are non-compartmentalized

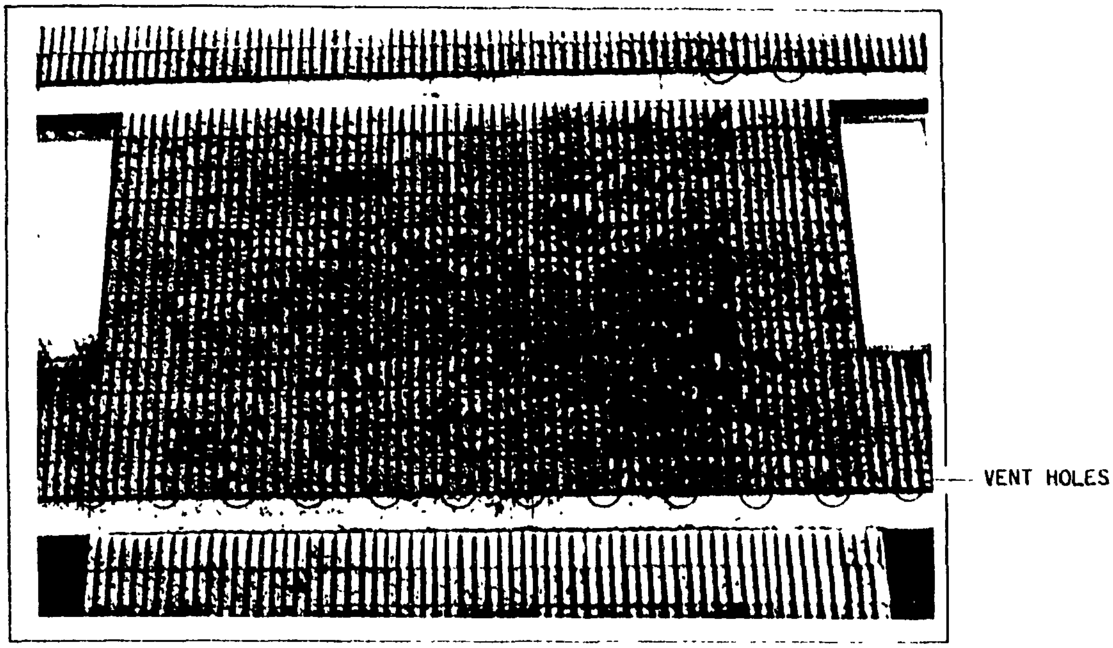


Figure 2.12 The exterior wall of the apartment building has many vent holes

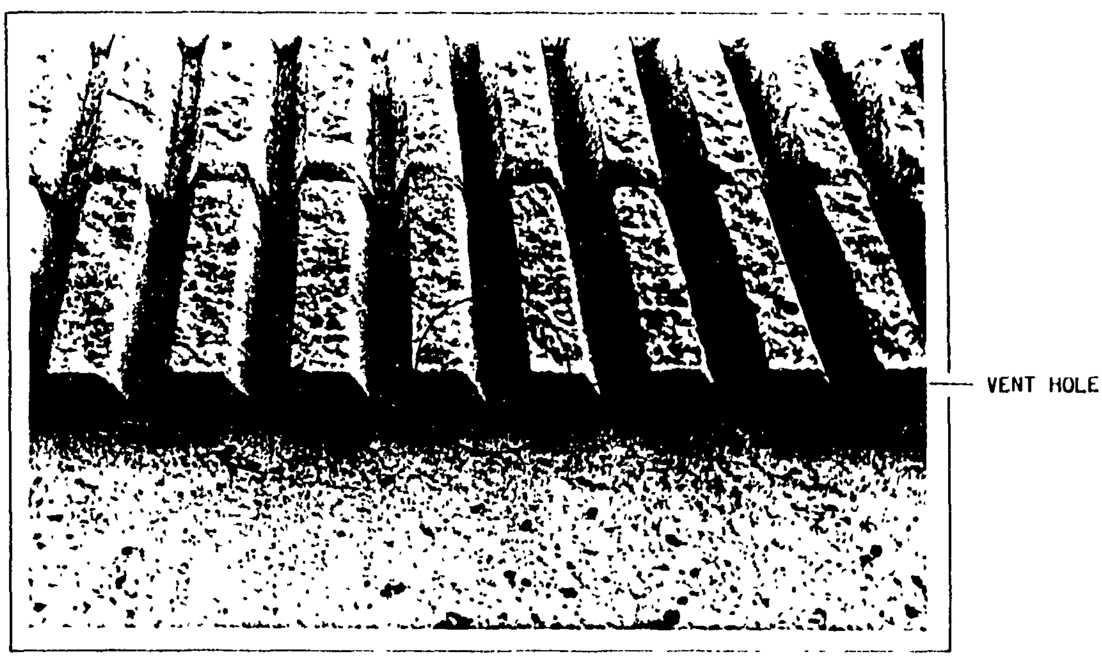


Figure 2.13 Detail of one vent hole; the mortar between two masonry units has been omitted

properly constructed; there is no compartmentalization of the cavity. Pressure equalization has not been attained and occupants have noticed that the corners of walls at top floors have leakage problems when exposed to wind driven rain.

The compartmentalized rain screen wall system does not have rain penetration problems but the non-compartmentalized one has problems, which have not been investigated adequately.

2.2 POINTING OUT THE VARIABLES OF THE RESEARCH AREA

The compartmentalized rain screen wall system was developed to prevent rain penetration, but in the construction process, by omitting the dividers, it becomes a non-compartmentalized rain screen wall system. The second one does not prevent rain penetration as well as the first one but it is the typical construction process of residential buildings. The outer wythe of these buildings consists of masonry units and the cavity is not divided into sections (usually, the cavity is divided from floor to floor but is not subdivided in each floor). Builders and designers omit the dividers to avoid the extra cost and to avoid bridges in cavities.

The difference in the performance between the above two systems is due to the magnitude of cavity presure, which has not yet been searched adequately. The compartmentalized system achieves pressure equalization across the outer wythe while the non-compartmentalized one, as well as the cavity wall system, do not. However, very limited reseach work deals with cavity pressures of such wall systems. The increase or decrease of cavity pressure will determine the resistance of a wall system to rain penetration. It depends on the following variables which are taken into account in this research work:

- area of cracks of outer wythe and inner wythe
- area of vent holes and
- wind pressures.

2.3 LITERATURE SURVEY

2.3.1 Introductory Remarks

Research work concerned with the variables such as cavity pressures, wind pressures and openings is limited. The most relevant deals with the air quantity passing through an opening, the airtightness of masonry walls and the airtightness of buildings. The latter is of great interest for today's research because it is related to the heating load attributed to air leakage and ventilation.

2.3.2 Air Flow Through Openings

The basic equation of the air flow through the openings is:

$$Q \propto A\ (\Delta p)^n \qquad (2.1)$$

where Q is the quantity of air flowing through an opening, A is the area of opening, Δp is the pressure difference across the wall, and n is an exponent. The following literature survey confirms the equation (2.1).

Kimura (1977) gave the following equation for air flow through cracks such as in complicated parts of a window sash [110]:

$$Q = a\ l\ \Delta p^{1/n} \qquad (2.2)$$

where Q is the rate of infiltration ($m^3 s^{-1}$), l is the crack lenth (m), a and n are sash constants depending upon the airtightness of the window sash. The tighter the sash, the smaller values of a and n.

It is interesting to find that $1<n<2$. Generally speaking the case of n=1 implies that the flow is proportional to the difference in potential. On the other hand the case n=2 corresponds to the case of air flow through openings.

Tamura and Wilson [111,112] proposed another way of defining the coefficient of air leakage instead of using a and l; that is, equivalent orifice area is to be taken over the exterior wall concerned, including the cracks at joints of curtain walls. It gives:

$$b\,S = a\,l \tag{2.3}$$

where S is the gross wall area (m^2) and b is the equivalent orifice area coefficient. Then the rate of air leakage through cracks over the gross exterior wall is to be given by:

$$Q = b\,S\,\Delta p^{1/n} \tag{2.4}$$

When a difference in pressure is applied across an opening, a flow of air will take place through the opening. The magnitude of this flow depends upon the dimensions, shape and the Reynolds number. Using dimensional analysis to summarize this relationship, the flow rate, Q, is given by [113]:

$$Q = A\,F(\text{Re,geometry of opening})\left(\frac{2\Delta p}{\rho}\right)^{1/2} \tag{2.5}$$

The Reynolds number, Re, is defined for convenience in terms of pressure as follows:

$$\text{Re} = \frac{D}{v}\left(\frac{2\Delta p}{\rho}\right)^{1/2} \tag{2.6}$$

where D is a length scale appropriate to the cross section of the opening, eg the diameter for a circular opening.

For small openings the form of function F is much more complicated. For very low values of Re, F is proportional to Re and the flow rate will be proportional to Δp. This leads to a variation of flow rate with Δp expressed in the form:

$$Q = l\ m\ (\Delta p)^n \qquad (2.7)$$

where $0.6<n<0.7$ and m is a constant for which a typical value for cracks of pivoted window is:
average of m = 0.2, and range of m = 0.06-0.80 [113].

For openings with a typical dimension greater than about 10mm, the function F may be regarded as a constant, and is usually referred to as the discharge coefficient c_d. Thus,

$$Q = A\ c_d \left(\frac{2\,\Delta p}{\rho}\right)^{1/2} \qquad (2.8)$$

It becomes conventional to give c_d a value equal to that for a sharp-edged opening, which at high Reynolds numbers is 0.61, and to refer to the area so defined for any particular opening as the 'equivalent' area. This will be close to the geometric area for openings such as windows and doors, but may be larger in the case of openings such as those in bricks (where mortar has been omitted to create an opening) which are long in the flow direction in comparison with their width.

The m and c_d in the above two equations do not have constant values.

Existing research work on air flow through complicated cracks of building components is beyond the scope of this research work, and is not reviewed here [114-116].

2.3.3 Airtightness of Masonry Walls

Some research studies were devoted to the permeability of air through walls [31,102,117,118]. The equations 2.1-2.8 were used but different coefficients were determined. The typical testing procedure was similar to the rain penetration testing procedure.

A wall panel being tested was clamped to the open face of an airtight box. A fan connected to a section in the side of the box removed air at a rate which could be adjusted. For measurement of air leakage Q, the pump was connected through a flow meter, and corresponding values for the pressure difference across the wall dP were obtained from a manometer fitted at the opposite side of the box. The relationship obtained between air leakage and pressure difference are shown graphically for different cases of wall panels.

In his experimental work, Rathbone determined the coefficients (c, n, p_o) of the curve of best fit which has the form [102]:

$$Q = c\,(\Delta p - p_o)^n \qquad (2.9)$$

where:

Q = leakage rate or volume flow rate (m^3 / s m^2)

Δp = differential pressure (values in tests were 100-600N/m^2)

p_o = the pressure intercept; ie the pressure at which no air leakage occurs (values in tests were $0\text{-}100N/m^2$)

n = a power (values were 0.44-0.98 at $500N/m^2$ differential pressure)

c = a permeability coefficient.

2.3.4 Airtightness of Buildings

A number of figures have been used by various authors to rate the air tightness level of buildings. These criteria have generally been in the form of:

- equivalent orifice area
- air flow at a reference pressure difference
- air flow per unit volume at a reference pressure difference.

None of these criteria relates directly to the area of openings (holes and cracks) with pressure differences across the wall which are of interest to this research work. Similarly, various authors have used the same basic equation 2.1 to determine the air flow through cracks, but, they have attained different coefficients. These coefficients, which were established experimentally, cannot determine the area of openings (holes and cracks), which is the concern of this research work. The works reviewed hereunder demonstrate that the experimental values of the coefficients cannot be used to determine the area of openings.

Tamura and Shaw (1976) carried out experiments on the leakage of Canadian buildings; in the process they used measurements of flow rate into buildings from a fan pressurization system [119]. They deduced that flow through a building envelope depends on the type of construction, and conforms generally to a relationship:

$$Q = c\ A\ (\Delta p)^n \qquad (2.10)$$

where:

Q = air leakage rate through the exterior walls

c = a flow coefficient

A = the area of exterior walls

Δp = the pressure difference across exterior walls

n = a flow exponent.

Although the flow exponent can vary, ranging from 0.5 to 1.0, multi-storey commercial buildings with HVAC systems appear to converge on a value of n=0.65. The value of c varies over the exterior of the building, while the average varies from building to building. Shaw's results give the following values for the mean and the range of c [119]:

Table 2.1 : Air flow coefficients in buildings

NUMBER OF BLDGS		c m/s/(kPa)	(a/Aw)equiv.
high rise bldgs	8	0.018±0.010	0.0006
schools	11	0.043±0.018	0.0015
supermarkets	10	0.081±0.056	0.0028

Dumont, Orr and Figley identified the airtightness levels of a group of detached houses in the Saskatoon area [120,121]. In their tests houses of different ages, construction types, and methods of achieving air-tightness were included. The pressure test procedure and the apparatus used are described elsewhere [113]. They used the relationship:

$$Q = c\ (\Delta p)^{n} \qquad (2.11)$$

where:

Q = rate of air flow per unit area

c = coefficient

n = exponent

They determined the values of the exponent coefficient n and the values of the coefficient c for Δp = 10Pa. The area of openings (holes or cracks) was never estimated but its effect was included in the coefficients.

The above works show that the area of openings was never estimated, and different coefficients have been determined among authors, as the attempt was to estimate the air leakage of buildings and not the characteristics of openings. They started from the basic equation 2.1 or 2.2. Only the experimental work of Latta, Killip and Cheetham attempted to relate the area of openings to the pressure drops, for cases of uniform exterior pressure in lab tests. In cases of large rain screen walls, however, each compartment is exposed to uneven wind pressure, and should be further investigated.

Davenport and Surry [122] used the equation 2.10 to calculate the internal pressure of a building. If the leak has an area a and the difference between internal and external pressure is Δp, then, the amount of air which passes through the opening per second must be proportional to a $(\Delta p)^{1/2}$. The volume of the air inside the building is constant, therefore:

$$\sum a_j \, (\Delta p_j)^{1/2} = 0 \tag{2.12}$$

where the sign for $(\Delta p_j)^{1/2}$ is plus if the external pressure is greater than the internal and minus for the reverse condition.

2.3.5 Pressure Equalization

Research work on pressure equalization or on pressure difference across the outer wythe of a rain screen work is limited. Latta (1973) used the basic equation 2.1, and for simplicity's sake, assumed that the total area of openings for each wythe may be regarded as the equivalent of a sharp faced orifice and that the pressure was uniform over the wall area in question [123]. The error in assuming that the total area of the openings is equivalent to a sharp faced orifice may be considered to be negligible, since, similar conditions exist for both wythes. If Q is the quantity of air flowing through the openings, A the total area of openings, p the pressure and suffixes e, i and c represent external, internal and cavity pressures (Figure 2.14), then the flow of air through each wythe will be proportional to the product of the areas of openings and the square root of the pressure drops across the wythes:

$$Q \propto A\ (\Delta p)^{1/2} \qquad (2.13)$$

where Δp is the pressure drop.

Assuming that air is incompressible, conservation of flow yields:

$$Q_e = Q_i$$

$$A_e\ (\Delta p_e)^{1/2} = A_i\ (\Delta p_i)^{1/2}$$

it follows that:

$$\Delta p_e = \Delta p_i\ (A_i / A_e)^2 \qquad (2.14)$$

where:

$\Delta p_e = P_e - P_c$

$\Delta p_i = P_c - P_i$

P_e = exterior pressure

P_i = interior pressure

P_c = cavity pressure

A_e = area of outer hole

A_i = area of inner hole.

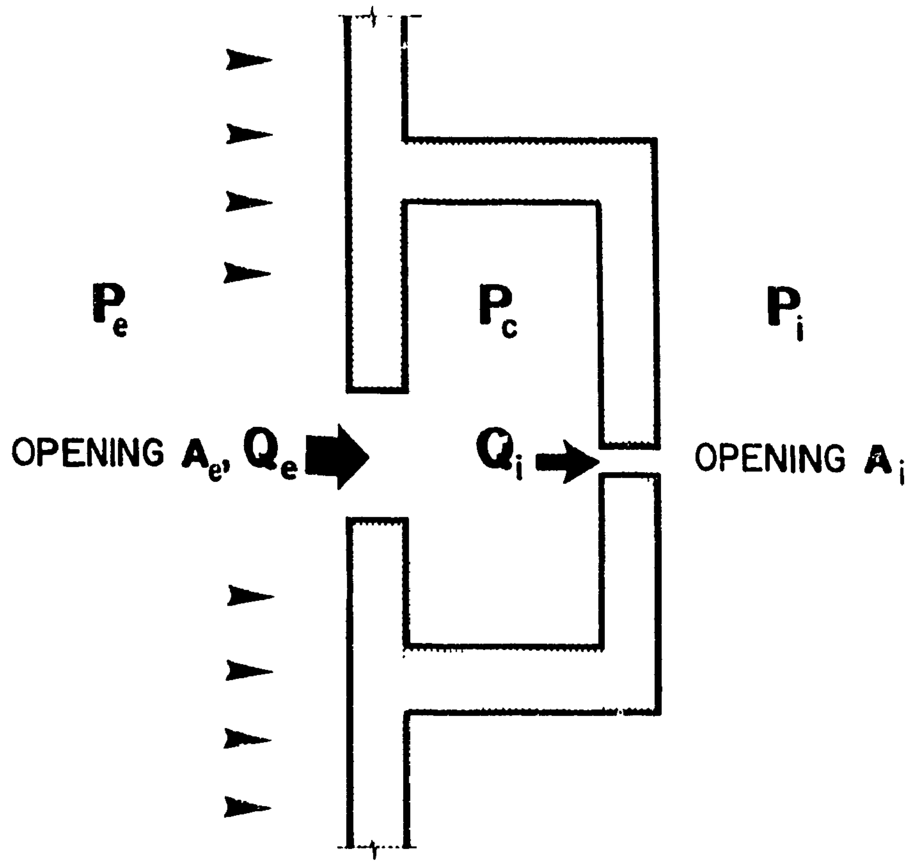


Figure 2.14 Latta's model of an open rain screen wall [98]

The relative pressure drop changes with the square of the ratio of hole sizes.

If:

$$dP \rightarrow 0 \quad \text{or} \quad P_e = P_i, \text{ then, } A_i / A_e \rightarrow 0$$

Therefore, the outer holes should be made as big as possible so as to equalize the exterior and cavity pressure.

Killip and Cheetham's work took into account the dimensional characteristics of real openings (vent holes and capillary cracks); they applied Kimura's equation 2.2, and showed that [32]:

$$\Delta p_e = \left(\frac{a_i \quad L_i}{a_e \quad L_e}\right)^2 \Delta p_i^{\,2} \qquad (2.15)$$

where:

a_e = crack coefficient of outer hole

a_i = crack coefficient of inner hole

L_e = characteristic dimension of outer opening

L_i = characteristic dimension of inner opening.

The proportion of the pressure drop across the wall taken by the outer wythe varies depending on the square of inner wythe pressure drop. Figure 2.15 shows their experimental results and also Latta's work. For the open rain screen wall, they considered large holes on the outer wythe, and small holes on the inner wythe, while Latta had

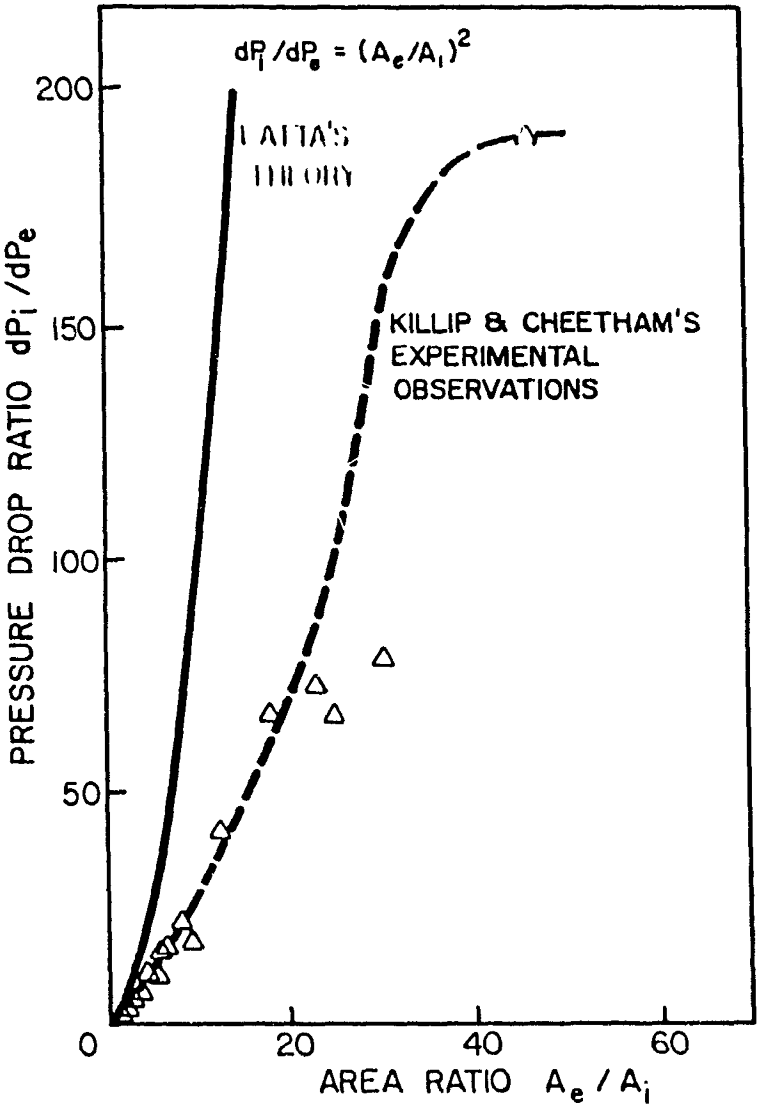


Figure 2.15 Comparison of Killip and Cheetham's results with Latta's theory [32]

considered large holes on inner and outer wythes.

2.4 JUSTIFICATION FOR THE STUDY

It has been established that the existing research work deals with air leakage of walls and not with the pressure difference across the outer wythe of a cavity or rain screen wall. Only Latta's, Killip and Cheetham's work addressed such a problem of pressure difference, but their work was limited to a few lab experiments.

This research work investigates the pressure differences across the outer wythe of a rain screen wall. The wind pressure is not assumed to be uniform and the openings of the outer wythe (vent holes and cracks) are taken into consideration. An analytical model with these variables has been developed and tested.

CHAPTER 3

3 THEORY AND MODELING PROCEDURE

A new system, which creates higher cavity pressures than a rain screen or cavity wall does and consequently controls better the rain penetration, is presented.

3.1 A NEW SYSTEM: 'PRESSURIZED CAVITY WALL'

The new system is called 'Pressurized Cavity Wall' and it consists of a rain screen wall but the outer wythe has one-way valves instead of vent holes, Figure 3.1. One-way valves are installed on each facade and allow the higher wind pressure to enter into the cavity. Figure 3.2 shows an example of a valve which can be used. Since wind pressures vary around a building, the pressurized cavity principle attempts to create a second envelope of air at uniform high positive pressure around the building. A high positive pressure, almost equal to the pressure of the stagnation point, is introduced into the cavity through the open valves. When wind changes direction some other valves will

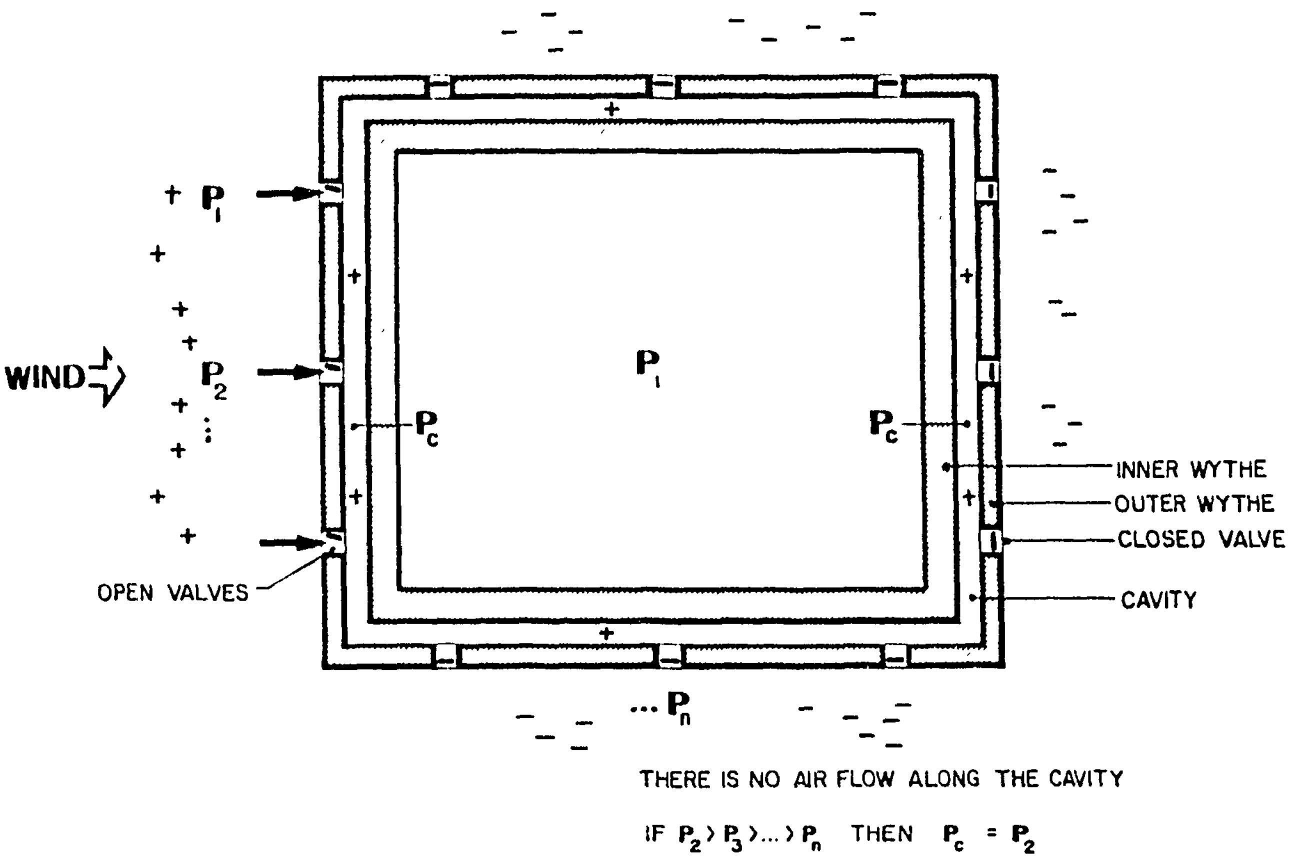


Figure 3.1 Schematic plan of a building with pressurized cavity walls; the pressure of cavity is high positive

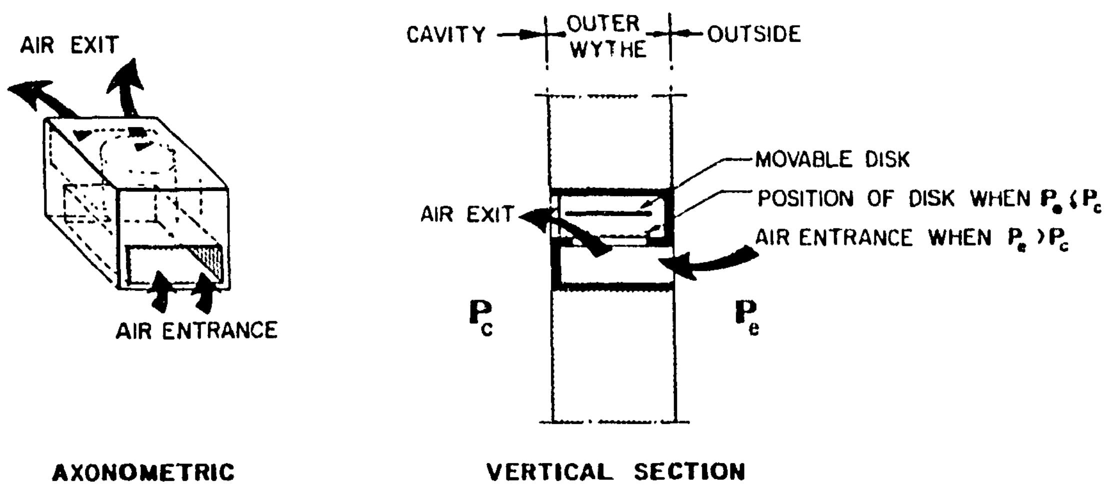


Figure 3.2 Air valve

open while others will be closed. At all times, the cavity pressure is greater than the mean wind pressure for a large part of the building facades. The corners of a building, which are the most vulnerable to rain penetration, will have a cavity pressure greater than the outside wind pressure.

The pressurized cavity wall creates higher cavity pressures than does a cavity wall or a non-compartmentalized rain screen wall. Past research work in the laboratory has demonstrated, Figure 2.2, that if on a wall specimen the inside pressure is greater than the outside pressure (negative pressure effect), then, less or no water will penetrate the wall [31]. Consequently, if the cavity pressure of the new system is higher than the cavity pressure of a cavity or rain screen wall, then, less or no rain will penetrate the outer wythe of the new system and the risk of rain penetration is minimal.

Beyond the analysis of variables, in the experimental verification of the analytical model, the performance of the new wall system is investigated.

3.2 CONFIGURING AN ANALYTICAL MODEL

3.2.1 Initial Comments

An analytical model of cavity pressure is developed where cracks, vent holes and wind pressure variations are taken into consideration, while past research work had eliminated some of these variables to simplify the problem.

The outer wythe of a rain screen wall has cracks and vent holes, while the inner wythe has only cracks; also, the wind pressure is not uniform. The case of a rain screen wall can be represented by the model of Figure 3.3. A cavity wall is a rain screen wall without vent holes and can be represented by the same model. The outer wythe is divided schematically into small sections (1,2,...j) and each one is exposed to uniform wind pressure. If the vent holes are relatively small and if there are no window openings or doors in the facades, then the cavity and the interior pressures can be considered uniform. Next, some cases with different variables are presented and at the end of this chapter, a general case with all variables is presented.

3.2.2 Case of Cracks and no Vent Holes on the Outer Wythe, and no Cracks on the Inner Wythe

In this case, only capillary cracks and pores of materials exist on the outer wythe. Such a case can be represented by Figure 3.3 (all vent holes A_j as well as the capillary cracks a_i on the inner wythe of this figure should be eliminated).

Tamura and Wilson's basic equation 2.4 can be used to estimate the air quantity passing through each section S_j of the outer wythe of S area, of uniform wind pressure P_j.

$$Q = a\ S\ \Delta p^{1/n} \qquad (3.1)$$

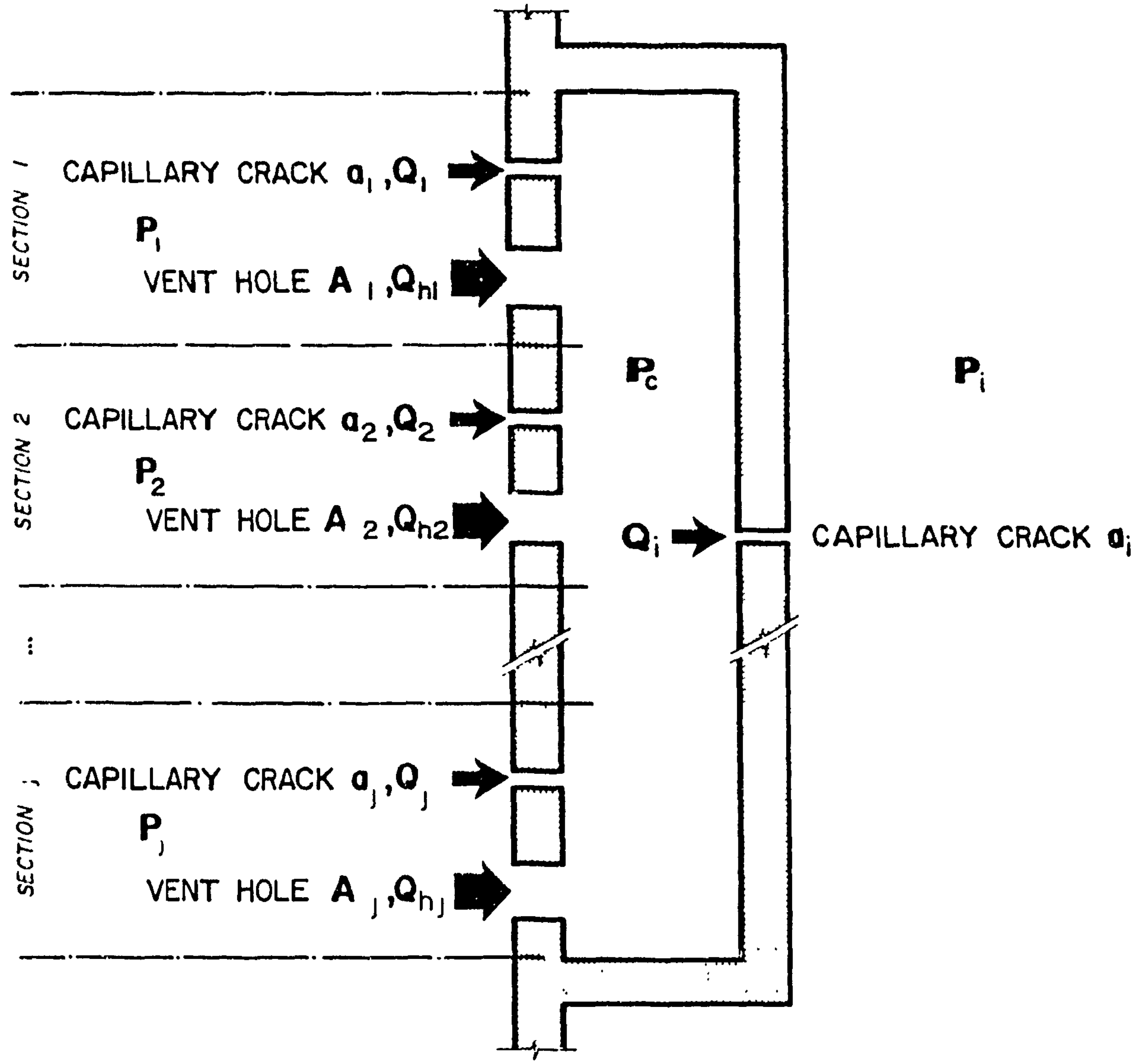


Figure 3.3 A model for one large compartment of an open rain screen wall

where

Q = rate of air passing through the outer wythe ($m^3 s^{-1}$)

S = gross wall area of outer wythe (m^2)

a = equivalent orifice area coefficient

Δp= pressure difference across the wall ($P_j - P_c$)

Kimura [96] gives the value n=1 for small capillary cracks or pores of material where the flow is laminar and equation 3.1 becomes:

$$Q = a\, S\, \Delta p \tag{3.2}$$

The volume of the air inside the cavity (Figure 3.3) is constant; assuming that the air is incompressible, conservation of flow yields and the equation 3.2 applies for each section S_j:

$$\Sigma a_j\, S_j\, \Delta p_j = 0 \tag{3.3}$$

where sign for Δp_j is positive if the wind pressure is greater than the cavity pressure and minus for the reverse condition,

$$\Delta p_j = P_j - P_c \tag{3.4}$$

where

P_j is wind pressure and P_c is cavity pressure

S_j is the gross wall area of outer wythe exposed on P_j

wind pressure

a_j is equivalent orifice area coefficient of the wall area S_j.

Since $a = a_1 = a_2 = \ldots = a_j$ is constant coefficient for the entire outer wythe, and in regard to equation 3.4, then the equation 3.3 becomes:

$$a \sum S_j (P_j - P_c) = 0 \quad \text{or}$$

$$a \sum S_j P_j - a\ P_c \sum S_j = 0 \tag{3.5}$$

where: $\sum S_j = S_1 + S_2 + \ldots + S_j$ (3.6)

If it is denoted

$$\sum S_j = S \tag{3.7}$$

then equation 3.5 becomes:

$$a \sum S_j P_j - a\ S\ P_c = 0 \tag{3.8}$$

or dividing by S

$$a \frac{\sum S_j P_j}{S} - a\ P_c = 0 \tag{3.9}$$

If it is denoted

$$\frac{\sum S_j \; P_j}{S} = \bar{P} \quad \text{(mean wind pressure)} \tag{3.10}$$

then the equation 3.9 becomes:

$$a\ (\bar{P} - P_c) = 0 \tag{3.11}$$

or $$\bar{P} - P_c = 0 \tag{3.12}$$

The equation 3.12 is the model applied in the case of cavity walls with cracks on the outer wythe.

3.2.3 Case of Vent Holes on the Outer Wythe and no Cracks on Inner and Outer Wythe

This case can be represented by Figure 3.3 (but with the elimination of all cracks). To estimate the air flow through each vent hole, equation 2.8 can be used:

$$Q = A\, c_d \left(\frac{2\Delta p}{\rho}\right)^{1/2}$$

or $$Q_{hj} = A_j c_j \left(\frac{2\Delta p}{\rho}\right)^{1/2} \tag{3.13}$$

where

Q_{hj} is the air quantity passing through the hole A_j

A_j is the area of each vent hole (m^2)

c_j is the discharge coefficient which is a function of Reynolds number and may be regarded as constant in openings greater than about 10mm

ρ is the air density.

The volume inside the cavity is constant; therefore, for the case of only vent holes (j is the number of vent holes) on the outer wythe, conservation of flow yields and the equation 3.13 applies for each section S_j:

$$\sum A_j c_j \left(\frac{2\Delta p_j}{\rho}\right)^{1/2} = 0 \qquad (3.14)$$

A is the area of each vent hole (m^2)

c_j is the discharge coefficient of each vent hole j

$\Delta p_j = P_j - P_c$

P_j is the wind pressure on the vent hole j and

P_c is the cavity pressure.

Also, the sign for Δp_j is plus if the wind pressure is greater than the cavity pressure and minus for the reverse condition.

For vent holes of the same size ($A_1 = A_2 = \ldots = A_j = A$), then also $c = c_1 = c_2 = \ldots = c_j$, equation 3.14 becomes:

$$A\ c \left(\frac{2}{\rho}\right)^{1/2} \sum \left(\Delta p_j\right)^{1/2} = 0 \qquad (3.15)$$

or

$$A\ c \left(\frac{2}{\rho}\right)^{1/2} \sum (P_j - P_c)^{1/2} = 0 \qquad (3.16)$$

Equation 3.14 is the analytical model which can be used in cases of rain screen walls with many vent holes (of different sizes), while equation 3.16 can be used in cases of the same size vent holes.

3.2.4 Case of Cracks and Vent Holes on the Outer Wythe and no Cracks on the Inner Wythe

This case can be represented by Figure 3.3 (but with the elimination of cracks a_i of inner wythe). For simplicity, it is assumed that the vent holes have the same size. The volume inside the cavity is constant. Based on law of conservation of flow the result is the combined effect of the two previous cases 3.2.2 and 3.2.3. Therefore, the analytical model is the summation of equations 3.8 and 3.16:

$$a\sum S_j P_j - aSP_c + Ac\left(\frac{2}{\rho}\right)^{1/2}\sum(P_j - P_c)^{1/2} = 0$$

or dividing by aS

$$\frac{\sum S_j P_j}{S} - P_c + \frac{A}{S}\frac{c}{a}\left(\frac{2}{\rho}\right)^{1/2}\sum(P_j - P_c)^{1/2} = 0$$

or by replacing the $\frac{\sum S_j P_j}{S}$ by $\bar{P}$, equation 3.10, then:

$$\bar{P} - P_c + \frac{c}{a}\frac{A}{S}\left(\frac{2}{\rho}\right)^{1/2}\sum(P_j - P_c)^{1/2} = 0 \qquad (3.17)$$

where

a is the equivalent orifice area coefficient of outer wythe

$\bar{P}$ is from equation 3.10

P_c is the cavity pressure

P_j is the wind pressure on the vent hole j

j is the number of vent holes

A is the area of each vent hole (m^2)

c is the discharge coefficient of the vent hole.

3.2.5 Case of Cracks on the Outer and Inner Wythe and Without Vent Holes

This case can be represented again by Figure 3.3 (but all vent holes should be eliminated). Equation 3.3 can be used twice, once for the cracks of the outer wythe and again for the cracks of the inner wythe. Similarly, the volume of the cavity is constant and based on the law of conservation of flow:

$$\Sigma a_j S_j \Delta p_j + a_i S \Delta p_i = 0 \qquad (3.18)$$

where

a_j is the equivalent orifice area of outer wythe of area S_j

a_i is the equivalent orifice area of inner wythe of area S_i

S_j is the gross wall area (m^2) exposed on wind pressure P_j

S is the gross wall area of inner wythe, equals to $S_1+...+S_j$

$\Delta p_j = P_j - P_c$ is the pressure difference between wind pressure P_j and cavity pressure P_c

$\Delta p_i = P_i - P_c$ is the pressure difference between interior pressure P_i and cavity pressure P_c (interior pressure is assumed uniform).

Since

$$a = a_1 = \ldots = a_j$$

and

$$S = S_1 + S_2 + \ldots + S_j = \sum S_j$$

equation 3.18 becomes:

$$a(\sum S_j P_j - \sum S_j P_c) + a_i (SP_i - SP_c) = 0$$

or dividing by S

$$a \left(\frac{\sum S_j P_j}{S} - \frac{\sum S_j P_c}{S} \right) + a_i (P_i - P_c) = 0$$

or (by replacing $\bar{P}$ from equation 3.10)

$$a (\bar{P} - P_c) + a_i (P_i - P_c) = 0 \qquad (3.19)$$

Equation 3.18 is an analytical model which can be used in cases of cavity walls (cracks on inner and outer wythes).

3.2.6 General Case of Vent Holes and Cracks

This case can be represented by Figure 3.3. It is the combined effect of the cases 3.2.5 and 3.2.3. Therefore, the summation of equations 3.19 and 3.16 gives [124]:

$$a(\bar{P}-P_c) + a_i(P_i-P_c) + Ac\left(\frac{2}{\rho}\right)^{1/2}\sum(P_{hj}-P_c)^{1/2} = 0 \qquad (3.20)$$

where

a_j is the equivalent orifice area of outer wythe of S_j area

a_i is the equivalent orifice area of inner wythe of S_i area

$S = S_1+S_2+...+S_j$

S_j is the wall area of the outer wythe exposed on wind pressure P_j

$\bar{P}$ is from equation 3.10

P_c is the cavity pressure

P_{hj} is the wind pressure on the vent hole hj

hj is the number of vent holes

A is the area of each vent hole (m^2)

c is the discharge coefficient of the vent hole.

Equation 3.20 is the general case of the model of Figure 3.3 and it determines the cavity pressure P_c as a function of average wind pressure $\bar{P}$, the interior pressure P_i the wind pressures P_j on each vent hole and the characteristics of vent holes and cracks. The values of the coefficients a, a_i and c are not constant as was shown in previous chapter.

Laboratory experiments were undertaken to demonstrate the variation of coefficient c on a simplified experiment with two vent holes. Equation 3.14 was used and the discharge coefficient was proven to have a small variation. During experiments, pressure differences were varied from 0±100Pa.

3.3 LABORATORY VERIFICATION OF THE ANALYTICAL MODEL FOR THE CASE OF TWO VENT HOLES

A simple set-up was used in the laboratory to determine the effect of the ratio of areas of two vent holes A_e and A_i on the pressure drop across a rain screen wall. A model wall in scale 1:2 was built in the laboratory from plywood, in L shape, Figures 3.4 and 3.5, to simulate a rain screen wall. All the joints of plywood were carefully sealed. Two holes A_e and A_i were opened on the outer plywood in order to simulate two vent holes. The dimensions of each wall face was 800mm x 1200mm, and the cavity width was 25mm. A fan was placed in front of the hole A_e to simulate the wind effect. The distance l between the fan and the wall was changed to vary the exterior pressure P_e on the vent hole A_e. Cavity pressure (P_c) and outside pressure (P_e, P_i) on both holes were measured with a fluid manometer. Different hole sizes from 5cm^2 to 35cm^2 under different pressures from 20 to 180Pa were tested.

The equation 3.14 for the case of two vent holes becomes:

$$A_e c_e (2/\rho)^{1/2}(P_e - P_c)^{1/2} - A_i c_i (2/\rho)^{1/2}(P_c - P_i)^{1/2} = 0 \qquad (3.21)$$

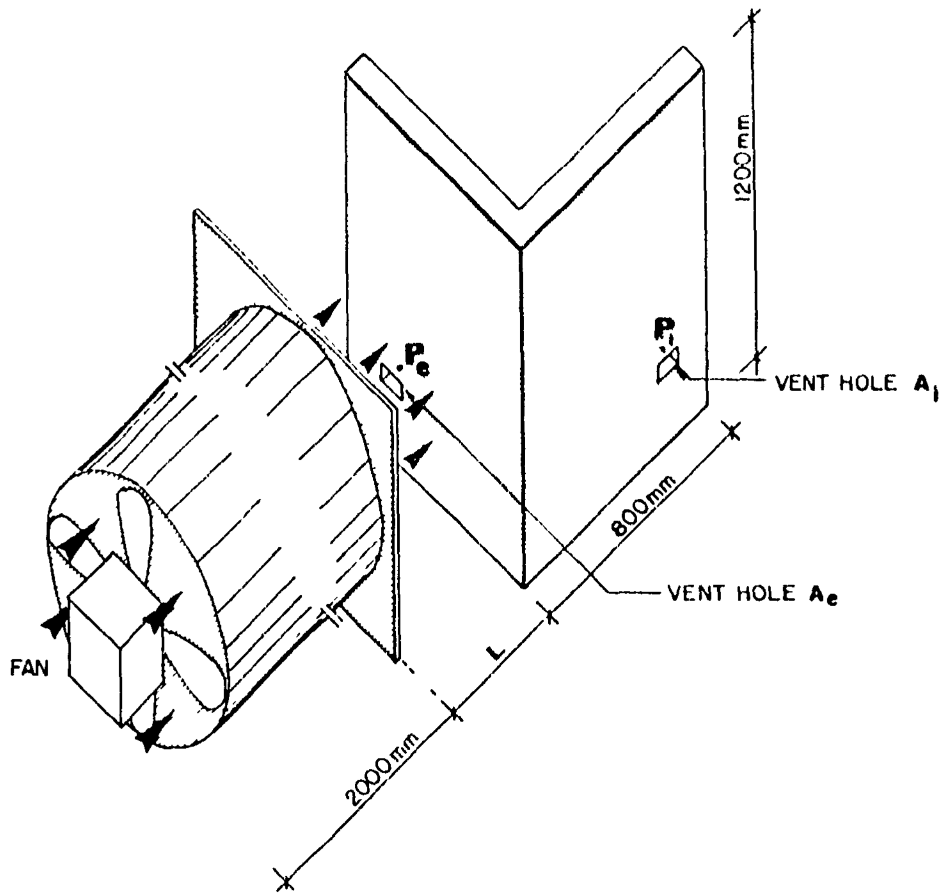


Figure 3.4 Isometric of the equipment used in the laboratory

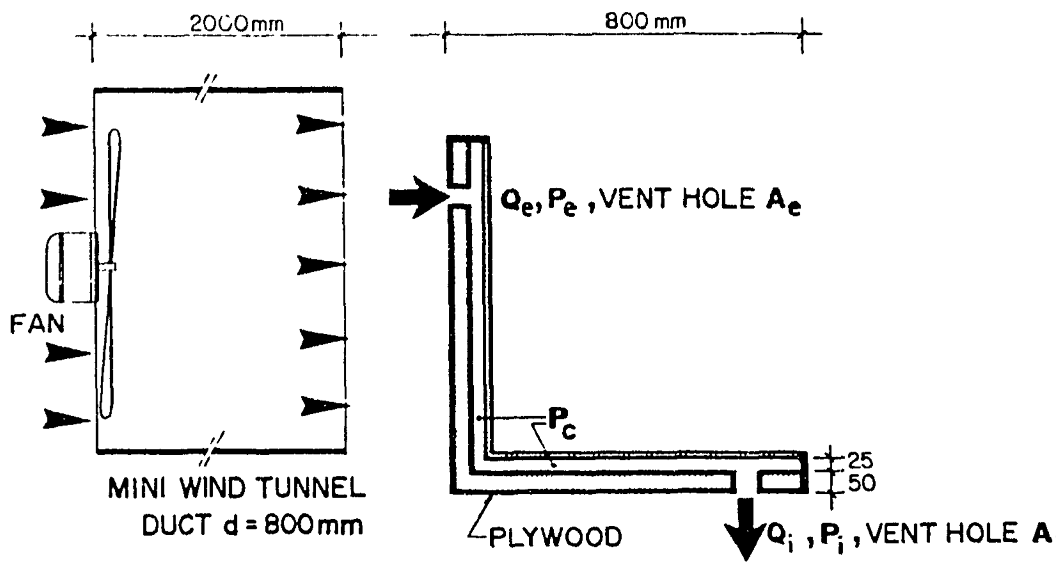


Figure 3.5 Plan of the equipment used in the laboratory

$$\frac{A_e}{A_i}\frac{c_e}{c_i} = \left(\frac{P_c - P_i}{P_e - P_c}\right)^{1/2} \tag{3.22}$$

$$\left(\frac{A_e}{A_i}\right)^2 \left(\frac{c_e}{c_i}\right)^2 = \frac{P_c - P_i}{P_e - P_c} \tag{3.23}$$

The experimental observations of the relationship between the areas of vent hole ratios and the pressure ratios are plotted in Figure 3.6. It is observed that when the ratio of areas of vent holes A_e/A_i were constant, then, the pressure ratios $(P_c-P_i)/(P_e-P_c)$ were not constant. This is due to the variation of c_e/c_i, caused by the air flow type (laminar in low pressure or turbulent in high pressure). The observed variation was found to be as follows:

$$1.05 < \frac{A_e}{A_i}\frac{c_e}{c_i}\left(\frac{P_e - P_c}{P_c - P_i}\right)^{1/2} < 0.90 \tag{3.24}$$

During the experiments, when $\frac{A_e}{A_i} = 1$ then

$$\frac{c_e}{c_i}\left(\frac{P_e - P_c}{P_c - P_i}\right)^{1/2}$$

was constant and almost equal to 1; but when

$$\frac{A_e}{A_i} = 5$$

then

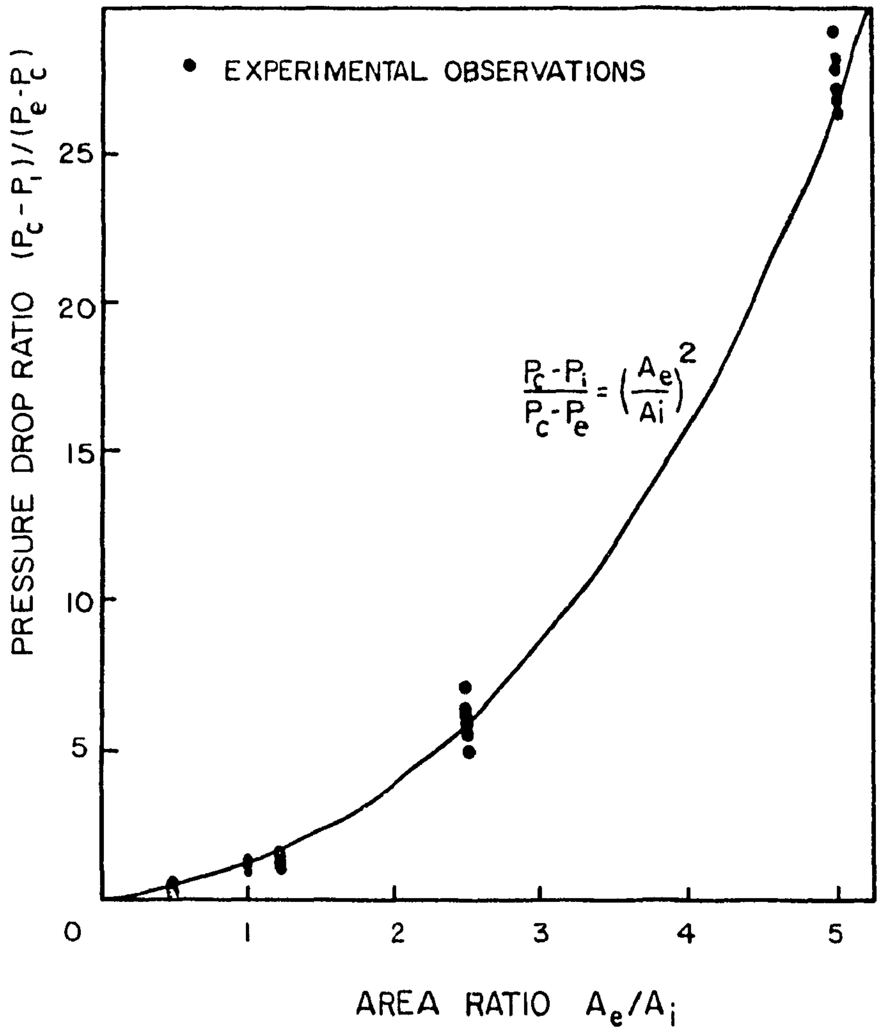


Figure 3.6 Experimental results of the ratio of vent holes and pressures

$$\frac{c_e}{c_i}\left(\frac{P_e - P_c}{P_c - P_i}\right)^{1/2}$$ was not constant.

The observed variation of (3.24) may be due to the variation of c_e/c_i.

CHAPTER 4

4 EXPERIMENTAL FIELD WORK

4.1 GOAL OF EXPERIMENTAL FIELD WORK

The goal of the experimental field work was to validate the analytical model, (equation 3.19), to improve the design of the building envelope, and to consider the following variables:

- wind pressures P_j
- cavity pressure P_c
- area of vent holes A
- area of cracks of outer wythe a.

Also, it was undertaken to validate the performance of a pressurized cavity wall. To simplify the problem, all the cracks of the inner wythe were eliminated.

Model tests in a wind tunnel, which is the popular method to determine pressure coefficients on a building, were not carried out, because the cavity of a such building model should have width of 0.2mm-0.5mm in the scale 1:100 (such scale is usually used), and the viscous effects of flow would in turn have an effect on measurements; furthermore, the surface roughness of the cavity cannot be properly simulated. Therefore, a small building with rain screen walls called 'experimental station' was built and the wind and cavity pressures were measured. In these experiments the size of vent holes was changed and therefore cavity pressures varied.

4.2 DESCRIPTIVE PRESENTATION OF THE FIELD WORK

4.2.1 Experimental Set-up

The experimental station was used for field experiments. It had the advantages of full scale experiments, e.g. the exterior pressures resulted from the wind and the vent holes were openings on a brick cavity wall. Many taps were installed on the inner and outer wythes for pressure measurements. An existing building was not used because cracks and holes into the cavity could not be controlled and measured properly.

The experimental station, was built on a small hill on the football field at the Loyola campus of Concordia University, Figure 4.1, in Montreal during the fall of 1985. The site was open, Figure 4.2, and the wind velocity was high. The experimental station is a one storey building with exterior dimensions 2.4m x 3.5m x 2.6m, Figure 4.3. It is a building with brick veneer (rain screen), and wood stud back-up wall: bricks outside, air space (cavity) 3-5cm, sheating, air space instead of insulation, polyethylene film

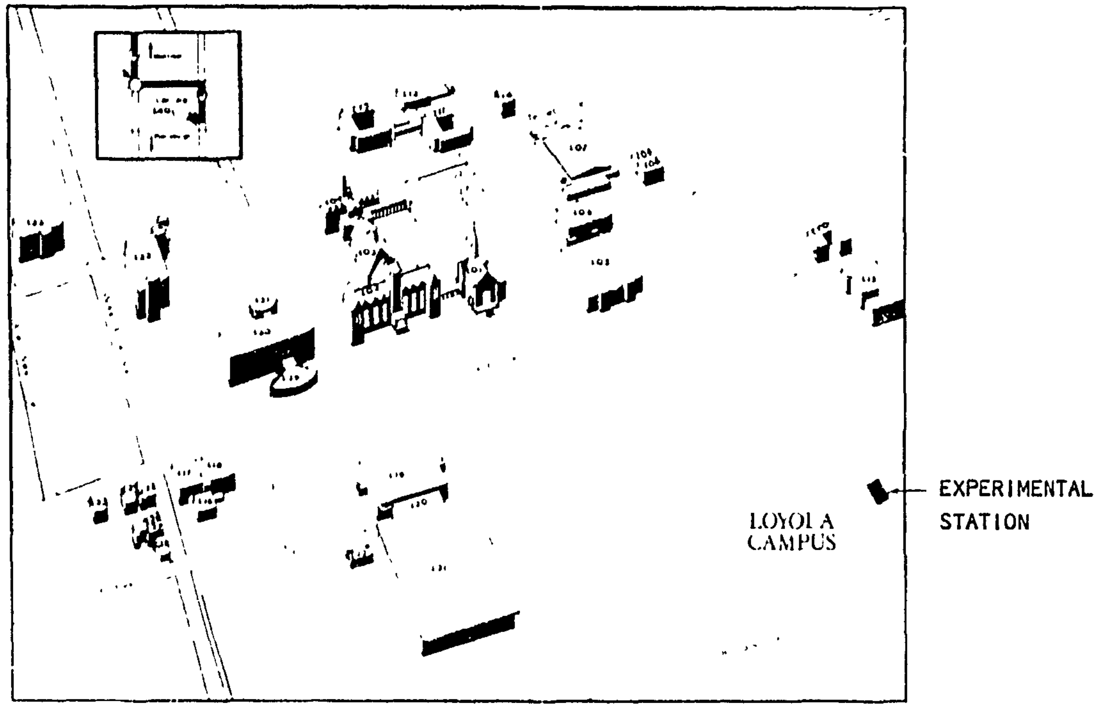


Figure 4.1 Location of the experimental station at Loyola campus

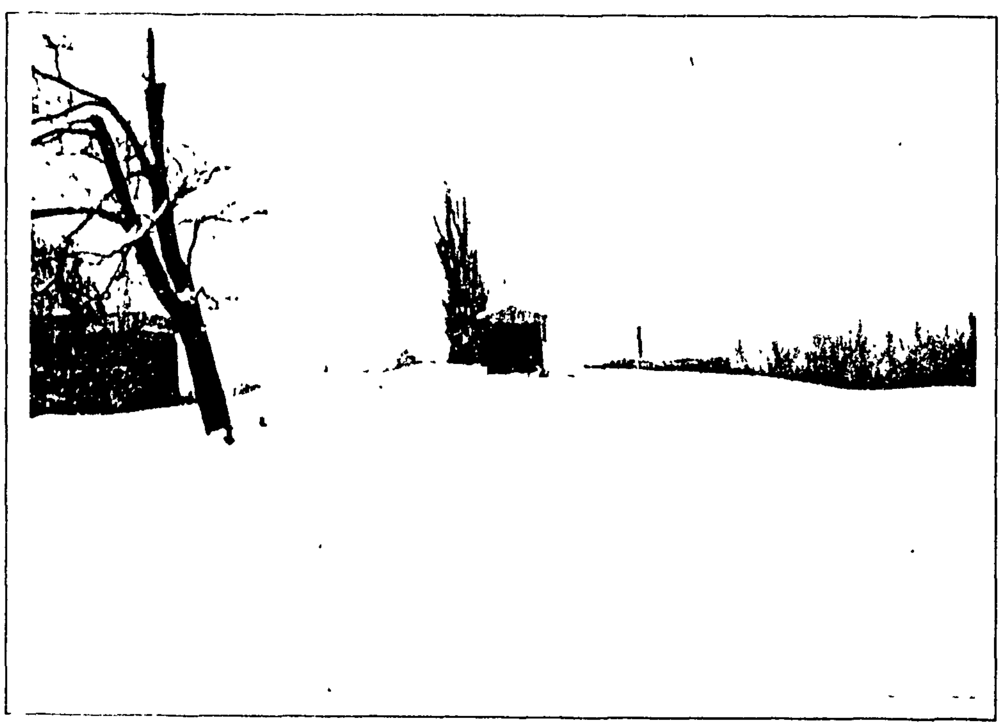


Figure 4.2 The open site of the experimental station

and gypsum. The insulation in the walls and roof was omitted since no experiments relevant to heat transfer were done. The floor slab was concrete, also without insulation.

Figure 4.4 shows the wooden frame of the building and Figure 4.5 shows the installation of sheathing. Before laying the bricks, about 150 tubes were installed (75 tubes on the outer wythe and 75 tubes on the inner wythe) in order to measure the wind and cavity pressures, Figure 4.6. The taps were protected with caps and were kept clean from mortar droppings, Figure 4.7. The top of the cavity was covered and sealed with a wooden strip 25mmx150mm, Figure 4.8, to isolate the cavity from the attic air space. Since cavities of most masonry buildings are not subdivided into compartments, the cavity of the Experimental Station was left non-compartmentalized.

All cracks in the inner wythe were carefully sealed. Also, all cracks around the window and the door were sealed, therefore the only air path into the cavity was through the porous brick units or through the cracks and vent holes of outer wythe.

Four hollow wooden boxes were installed on each facade, Figure 4.8, to simulate vent holes. The vent hole area was controlled by fixing plexiglass sheet on the boxes with screws.The plexiglass could be easily removed to leave the box open, or another smaller plexiglass sheet could be fixed with screws to leave the box partially open. In addition to the earlier mentioned four vent holes, another set of small vent holes between the bricks have been left on

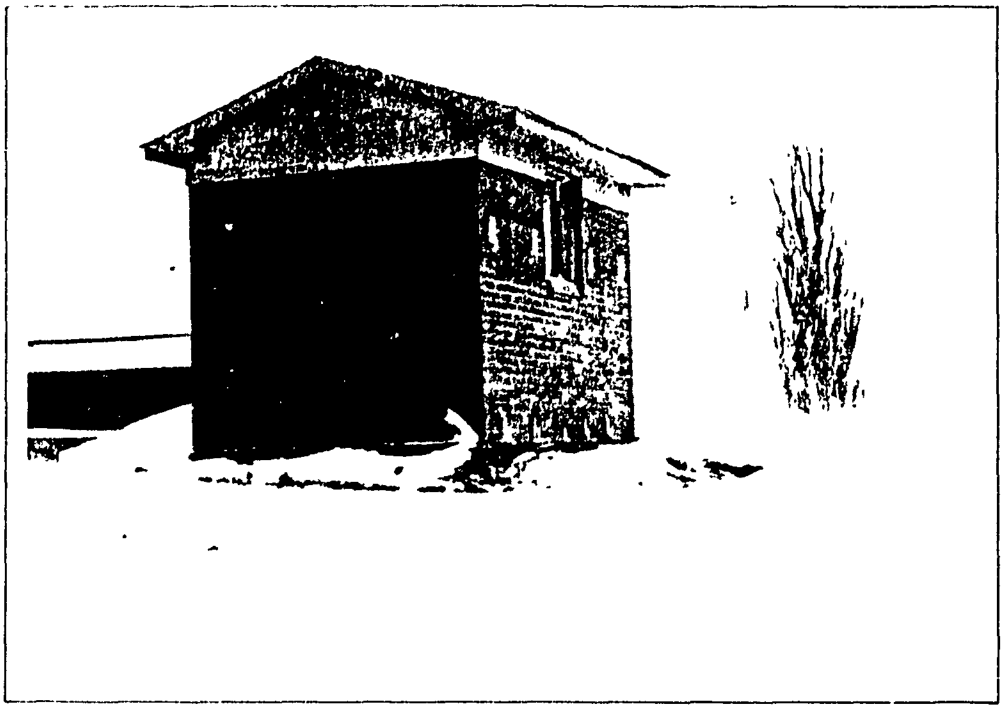


Figure 4.3 Experimental station

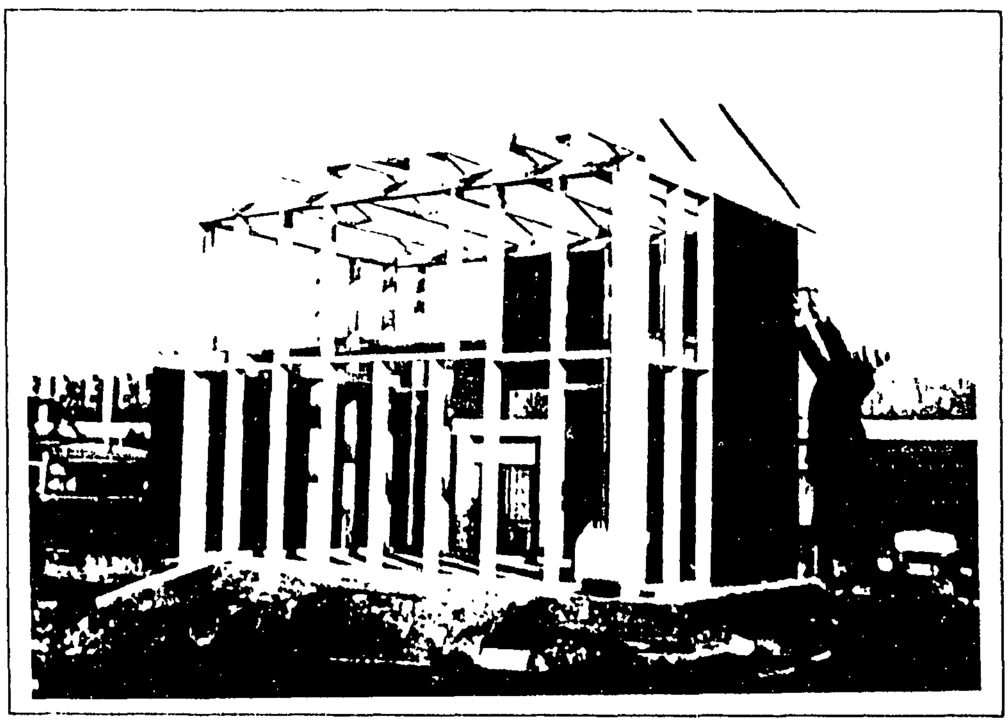


Figure 4.4 The wooden frame of the experimental station

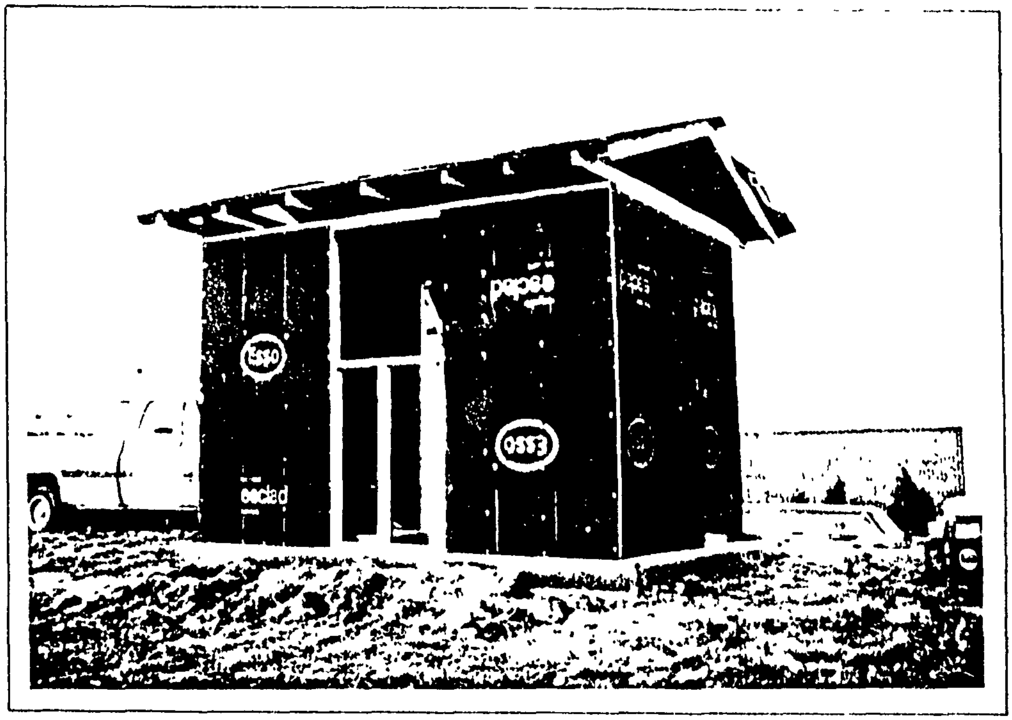


Figure 4.5 Installation of sheathing

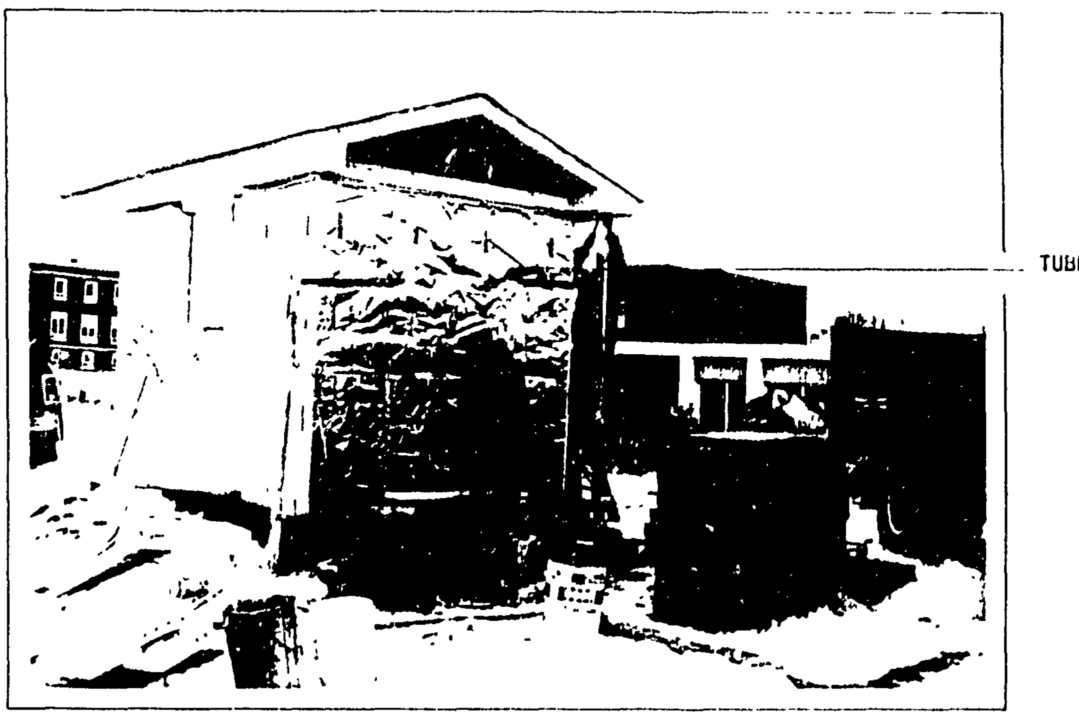


Figure 4.6 150 tubes have been installed before laying the bricks

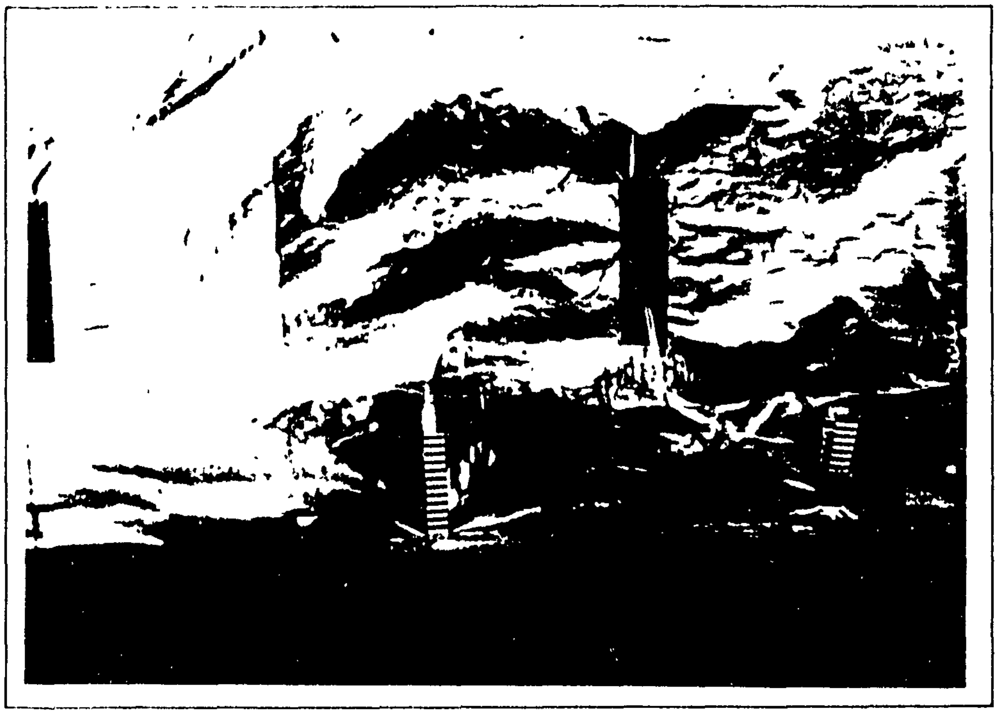


Figure 4.7 Tubes have been kept clean and free from mortar droppings

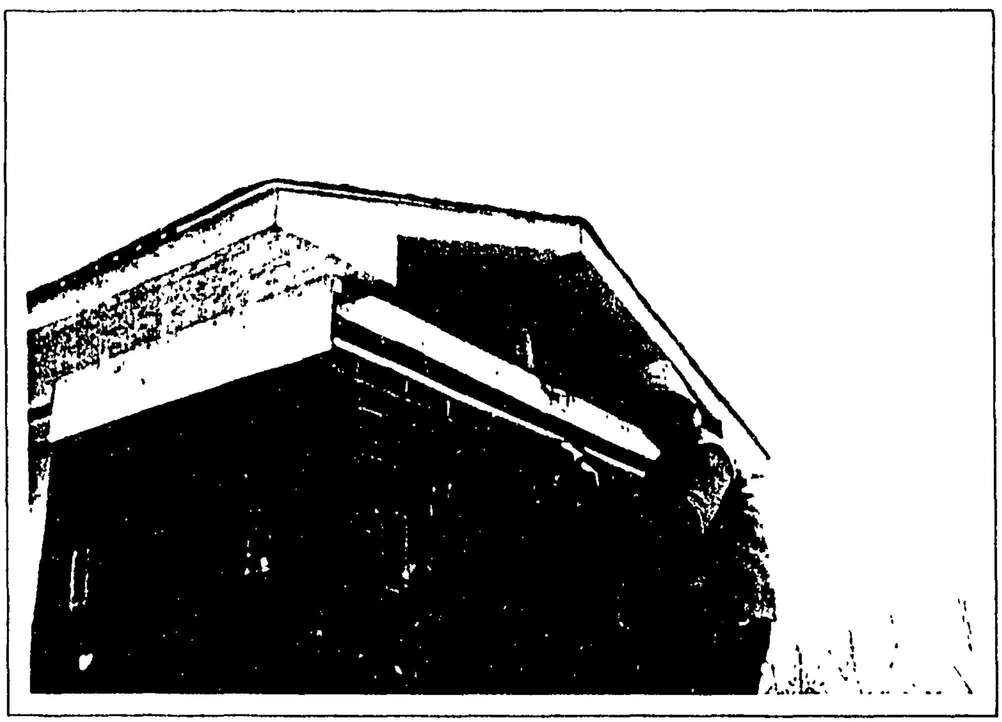


Figure 4.8 The top of the cavity has been covered with a wooden strip and sealed

the top and bottom of each facade (Figure 4.10).

Figure 4.9 shows the plan of the experimental station. Figures 4.10-13 show the elevations A,B,C and D, and a section of the station. The location of taps are also indicated on each elevation and the wall area corresponding to each tap.

4.2.2 Instrumentation

Wind and cavity pressures of the experimental station were measured with a fluid multi (65 channel) manometer, Figure 4.14. The pressure transducers which are very popular were not used, because, they appear to entail certain problems such as:

The experimental process of this work requires wind and cavity pressures from 65 taps to be recorded simultaneously. The magnitude of the wind pressure, which is expected to be measured, is low (from -50Pa to 50Pa). Pressure transducers able to read such low pressures can be purchased on the market but they should be installed directly on the wall and are very expensive. Consequently, not many could be purchased. In addition, there was no electric power in the Station to operate a data acquisition system which records pressures from many pressure taps. Moreover, existing data acquisition systems in the market usually have only a few channels (five to ten) and a special system with 65 channels is also of extremely high cost. In Canada, only NRC has such facilities as pressure transducers and data acquisition

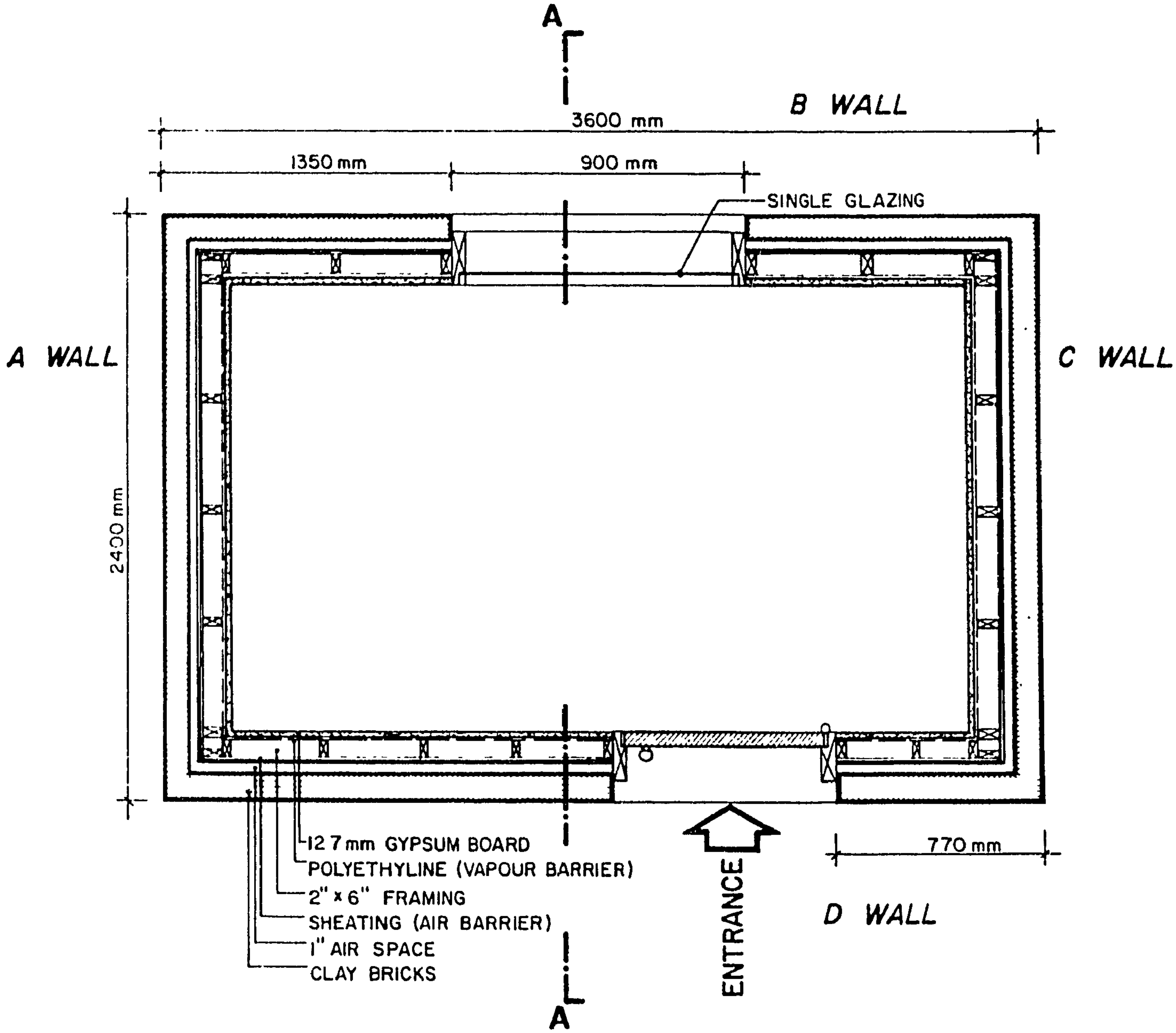


Figure 4.9 Plan of the experimental station

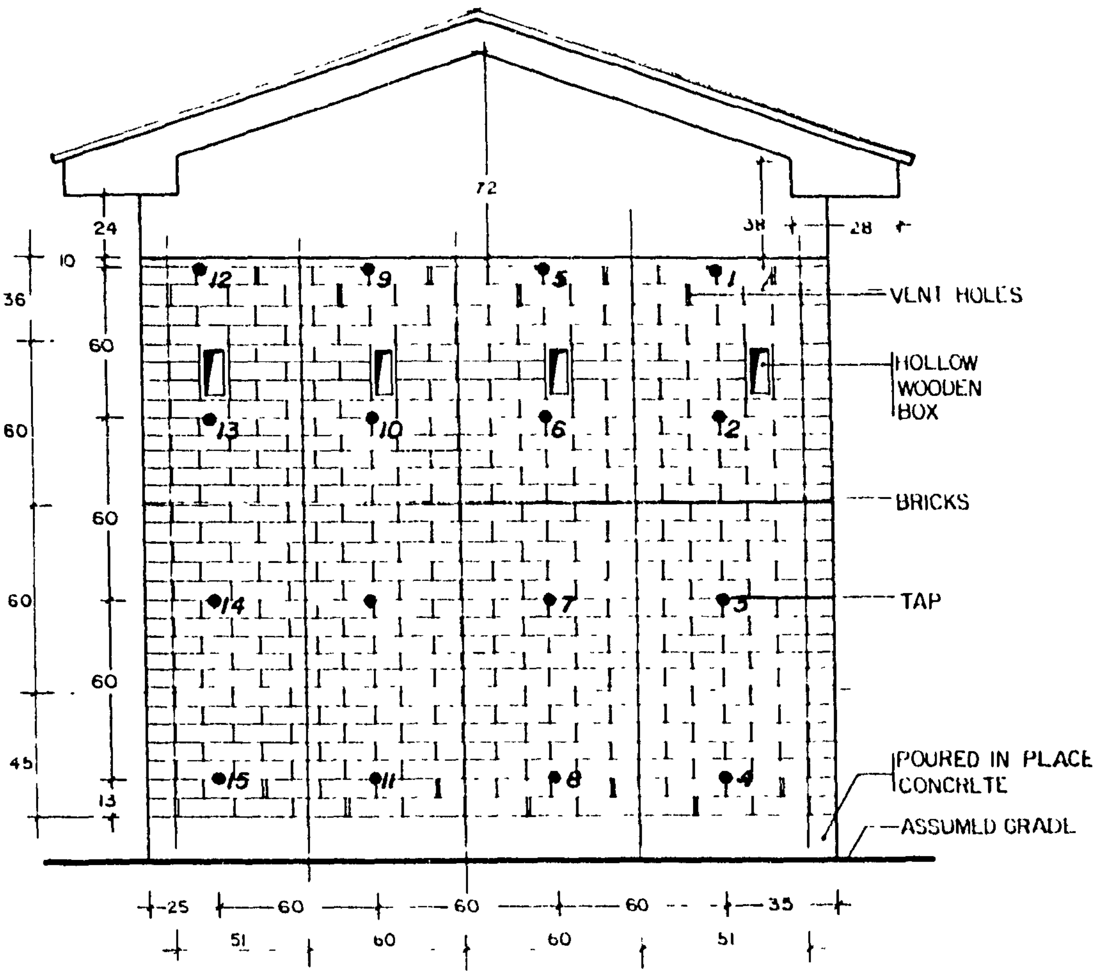


Figure 4.10 Side elevation; A or C wall

Note:

Pressure Tap no	Wall area in cm²
1.	36x51=1836
2.	60x51=3060
3.	60x51=3060
4.	45x51=2295
5.	36x60=2160
6.	60x60=3600 or 60x90=5400
7.	60x90=5400
8.	45x60=2700

Pressure Tap no	Wall area in cm²
9.	36x60=2160
10.	60x60=3600 or 0
11.	45x60=2700
12.	36x51=1836
13.	60x51=3060 or 60x81=4860
14.	60x81=4860
15.	45x51=2295
TOTAL	222x201 =44622 cm²

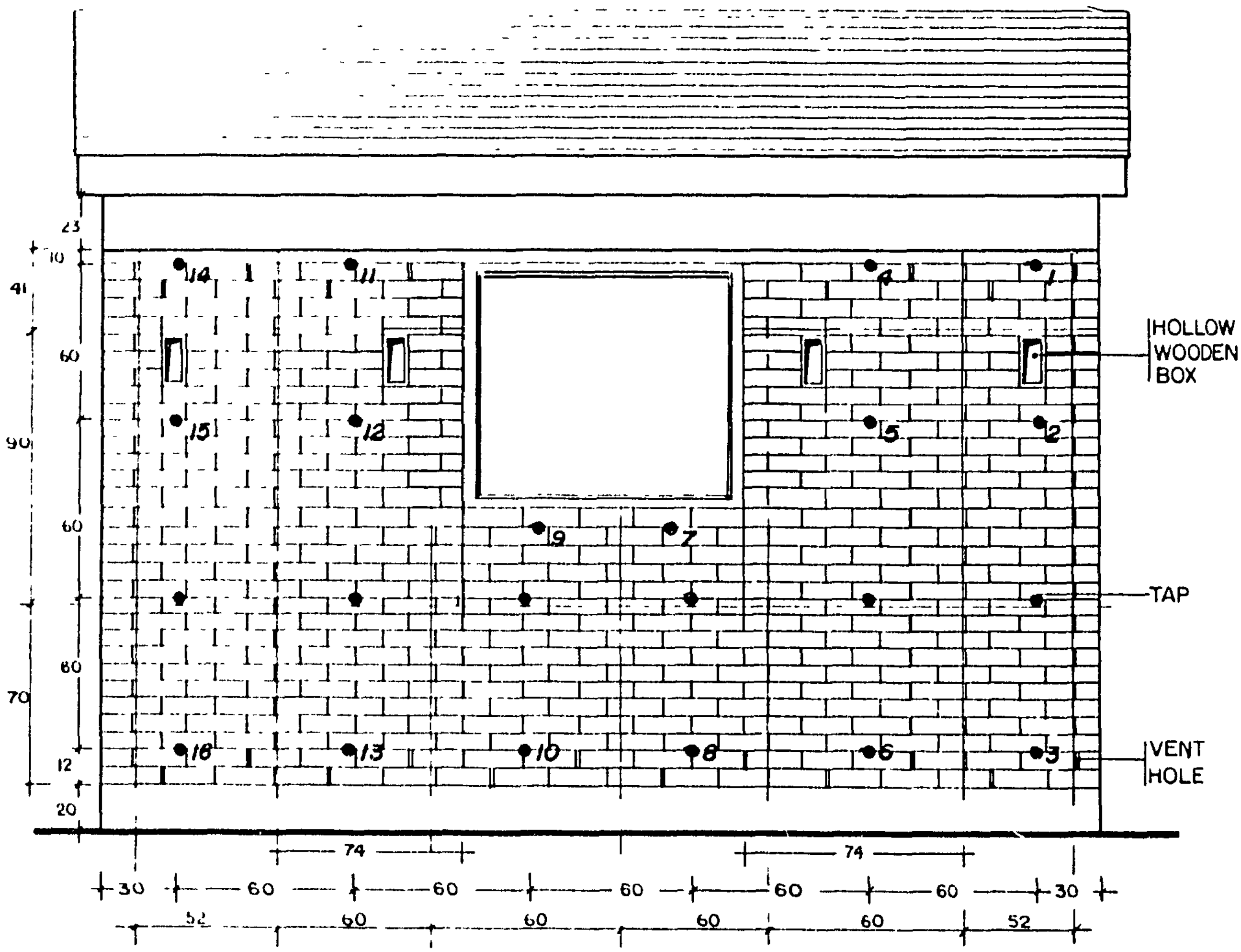


Figure 4.11 Back elevation; B wall

Note:

Pressure Tap no	Wall area in cm²	Pressure Tap no	Wall area in cm²
1.	41x52=2132	9.	55x46=2530
2.	90x52=4680	10.	70x60=4200
3.	70x52=3640	11.	41x74=3034
4.	41x74=3034	12.	90x74=6660
5.	90x74=6660	13.	70x60=4200 or 7840
6.	70x60=4200	14.	41x52=2132
7.	55x46=2530	15.	90x52=4680
8.	70x60=4200	16.	70x52=3640 or 0

TOTAL (344x201)- (76x92) = 62152 cm^2

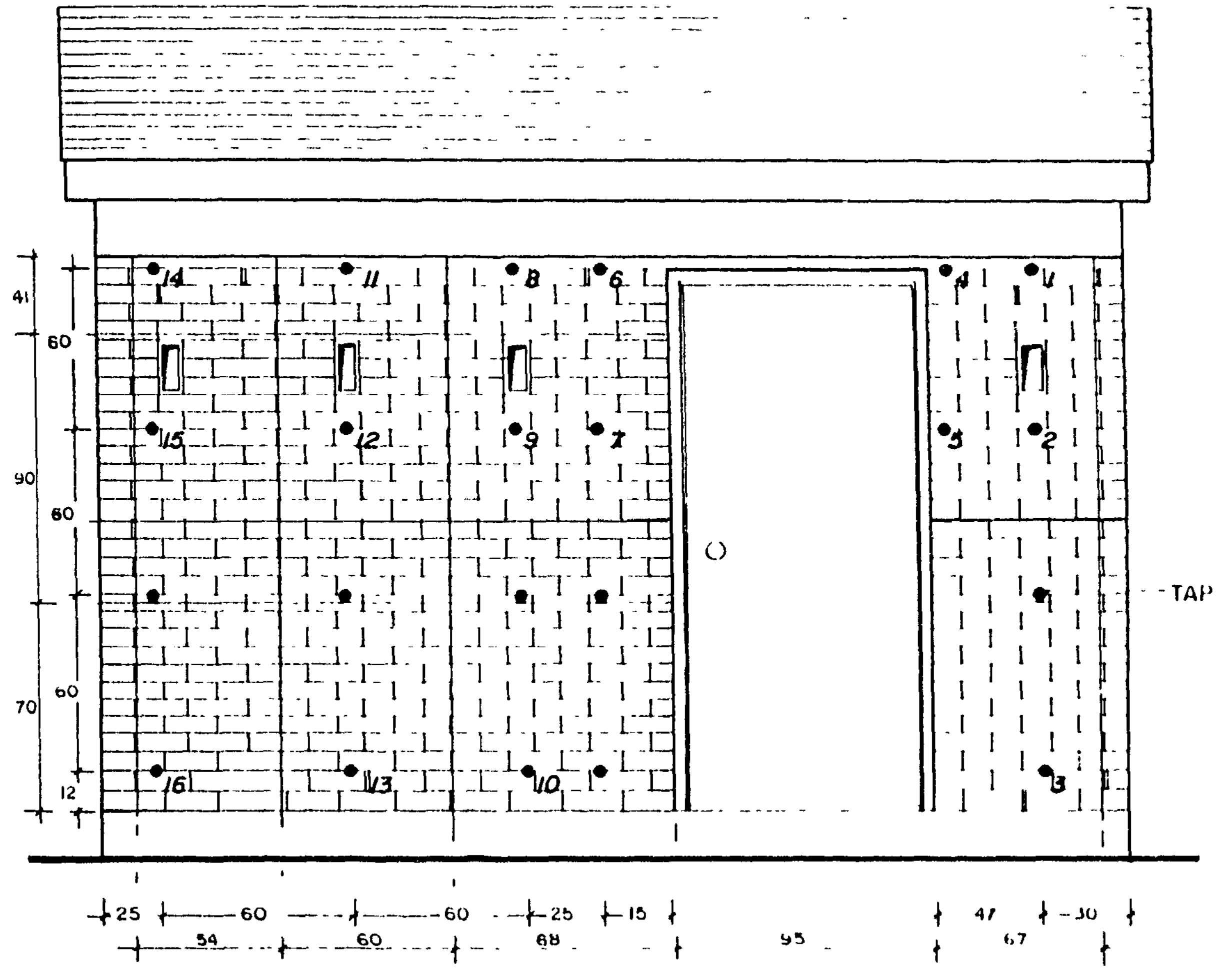


Figure 4.12 Front elevation; D wall

Note:

Pressure Tap no	Wall area in cm^2	Pressure Tap no	Wall area in cm^2
1.	41x67=2747	10.	70x68=4760
2.	90x67=6030	11.	41x60=2460
3.	70x67=4690	12.	90x60=5400
6.	41x25=1025	13.	70x60=4200
7.	90x25=2250	14.	41x54=2214
8.	41x43=1763	15.	90x54=4860
9.	90x43=3870	16.	70x54=3780

TOTAL (344x201)-(95x201)=50049 cm^2

Wall area in cm^2
WALL A 44622
WALL B 62152
WALL C 44622
WALL D 50049
201445cm^2 or 20.1445m^2
TOTAL WALL AREA

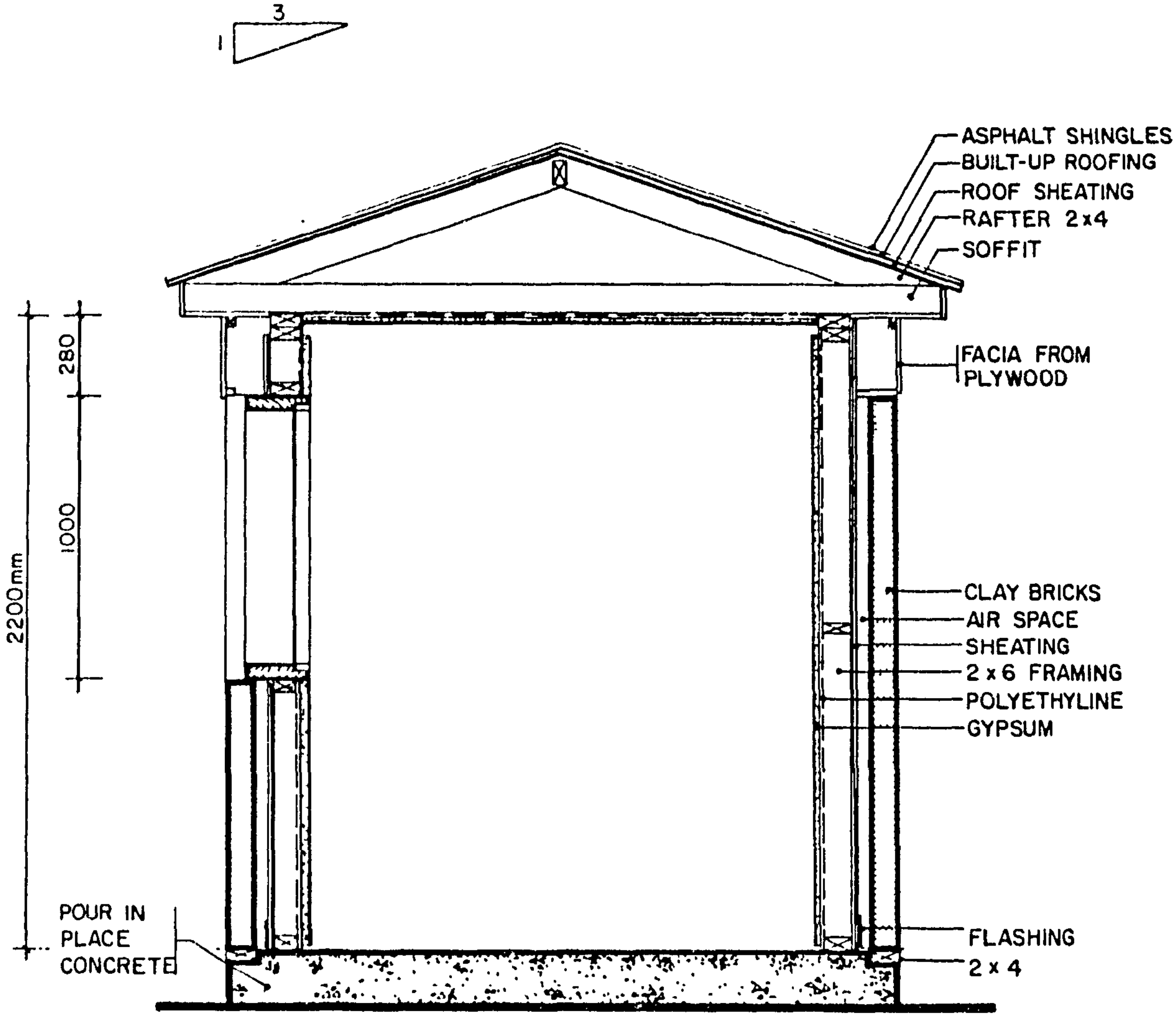


Figure 4.13 Section AA

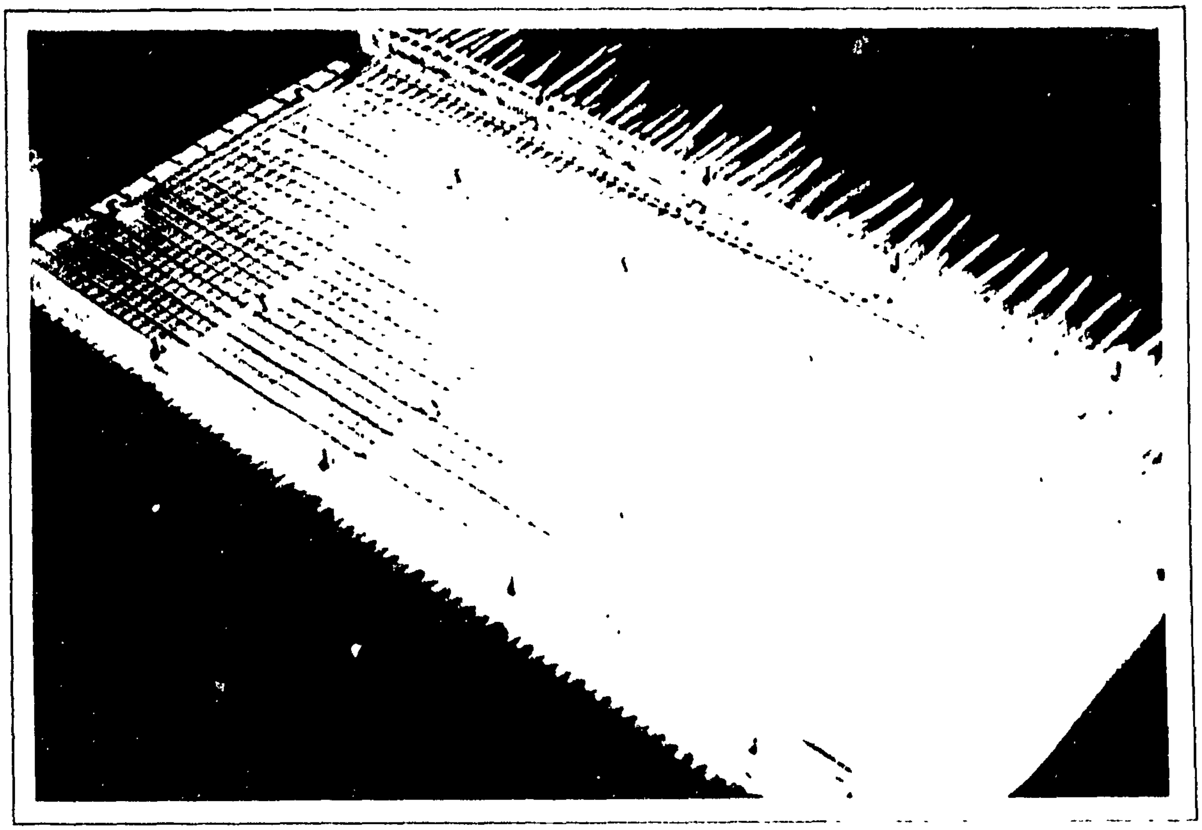


Figure 4.14   Fluid multimanometer

systems but still the number of transducers and channels is limited to about twelve.

Low pressure transducers which can be installed inside of the building are cheap (about $600), but they have a slow response time (more than 1 second). If a scanivalve was used in connection with one cheap and slow response transducer, then it would require more than 65 seconds to scan the sixty-five pressure taps of the experimental station and at the same time all the measurements can not be recorded simultaneously. In this research work simultaneous recording from all pressure taps appears to be more appropriate.

One low pressure transducer was purchased and it was used in a preliminary experiment. Its wind pressure measurements were compared with ones from the fluid manometer in Figure 4.15. Pressure transducer recordings were taken every second, whereas, fluid manometer recordings were taken every ten seconds. The mean wind pressure of the pressure transducer recordings was 35.3Pa and that of the fluid manometer readings was 35.7Pa. Therefore, wind pressures taken instantaneously from the fluid manometer are mean wind pressures for a short period of time.

Since this research work is concerned with differential pressures across the wythes of rain screen walls which may drive rain into the cavity, the instantaneous recordings of a fluid manometer for every 5-10 seconds --which are the mean wind pressure for a short period of time-- can be used instead of instantaneous recordings of a pressure transducer. In addition, since the experimental station is

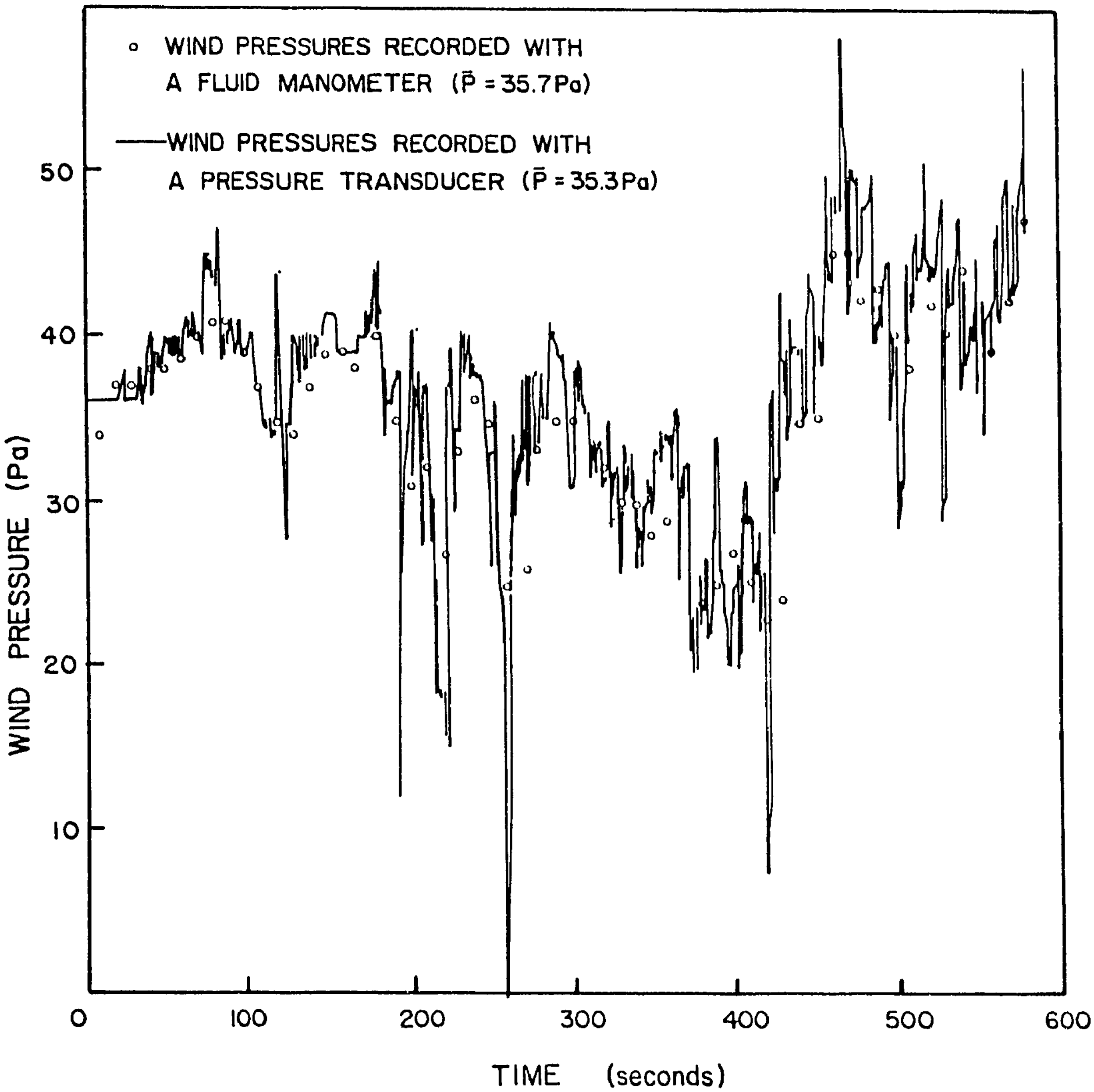


Figure 4.15 Wind pressure fluctuations

a low building, it is exposed to low wind pressure fluctuations and a fluid manometer gives a good approximation of wind pressures.

For the above reasons, a fluid multimanometer was selected. A camera was used every 5-10 seconds to record simultaneously the readings from all channels. The 65 channels of the fluid multimanometer were connected with taps of the experimental station which are located as following:

- 15 taps on the outer wythe of A wall, to measure wind pressure
- 16 taps on outer wythe of B wall
- 15 taps on outer wythe of C wall
- 14 taps on outer wythe of D wall
- 4 taps on the inner wythe (one tap in each wall) to measure the cavity pressure
- 1 tap in the interior space
- the reference pressure was taken from a proper tap 50m away from the station.

Before each case (set) of experiments the fluid multimanometer was calibrated to a fluid micromanometer at proper temperature.

The inner wythe had been installed with 75 taps to record the cavity pressure. In preliminary tests, cavity pressure was uniform in all locations of taps, except in cases where big vent holes were left open, but still the cavity pressure variation was only 3Pa. Therefore, only 4 taps (one on each wall) of the cavity were used during the experiments.

4.2.3 Experimental Procedure

Many cases were tested with/without vent holes or with valves under different wind pressures. In this research work 328 experiments are included (the total number was more than 500); for each experiment a picture was taken to show the 65 readings from the fluid multimanometer; thus, 21320 readings (wind and cavity pressures) were recorded and are included here.

Table 4.1 summarizes the different cases which were tested. In cases 1-4 there were no vent holes on the outer wythe of the experimental station. The wind direction in all the cases is different except in cases 2 and 4 in which the direction of wind is the same. Sometimes, the same experimental case was tested twice, as in cases 5 and 6, and in cases 10 and 11.

4.3 RESULTS AND ANALYSIS

4.3.1 Introductory Analysis

All the data (readings) of experiments, as they have been copied from films, are presented on Appendix A. Only integer numbers were used for pressures, since 0.5Pa or smaller pressure data could not be read properly from the

Table 4.1: EXPERIMENTS

CASE No	EXPERIMENTAL CASE	SIZE OF EACH HOLE in (cm)	NUMBER OF EXPERIMENTS
1	no vent holes	0	30
2 and 3	no vent holes	0	15
4	no vent holes	0	38
5	many vent holes*	5x1	18
6	many vent holes*	5x1	27
7	one vent hole: A10	5x1.6	11
8	one vent hole: A10	5x3.2	13
9	one vent hole: A10	5X6.5	12
10	one vent hole: A10	5x13	7
11	one vent hole: A10	5x13	5
12	one vent hole: B12	5x13	14
13	two vent holes: A10,C6	5x13	6
14	two vent holes: A6,A10	5x13	14
15	three vent holes:A6,A10,A13	5x13	32
16	one valve:** B12	r=2.8	35
17	two valves: B12,B15***	r=2.8	38
18	three valves: B5,B12,B15	r=2.8	13
		TOTAL	328

Note:
*The vent holes were as follows: three vent holes 5cmx1cm on each wall A and C, and four vent holes of the same size on B and D.
**Each valve consists of two contiguous holes with a round opening of 2.8cm radius.
***There was another valve D12, but it was closed all the time.

fluid multimanometer. These readings were then transferred to the zero reference pressure for each channel and the results are presented on Appendix B.

For each experiment mean wind pressure and cavity pressure were calculated. A few photographs of each case are presented in Appendix C. Statistical analysis was then performed for the calculated values and regression analysis for the observed values of coefficients.

4.3.2 Various cases without vent holes

a) Experimental Data

Four cases (1-4) were tested under different wind conditions. In all four cases there were no vent holes on the outer wythe of the experimental station. In total 83 experiments were performed for cases 1-4 and the corresponding pictures were taken to record the data from the fluid multimanometer. Figure 4.16 shows a typical picture of the multimanometer with respect to case 1. Some of the remaining pictures for the cases 1 to 4 are included in Appendix C. Then, the data of pictures were transfered to the tables in Appendix A. It is observed that cavity pressures were negative in all experiments.

Mean wind pressure $\bar{P}$ and cavity pressure P_c were calculated for all the 4 cases by using the recorded data from Appendix B and shown in Tables 4.2 - 4.4. Then, the pressure differences $\bar{P}-P_c$ were calculated in the same tables. The mean wind pressures $\bar{P}$ were calculated from equation 3.10

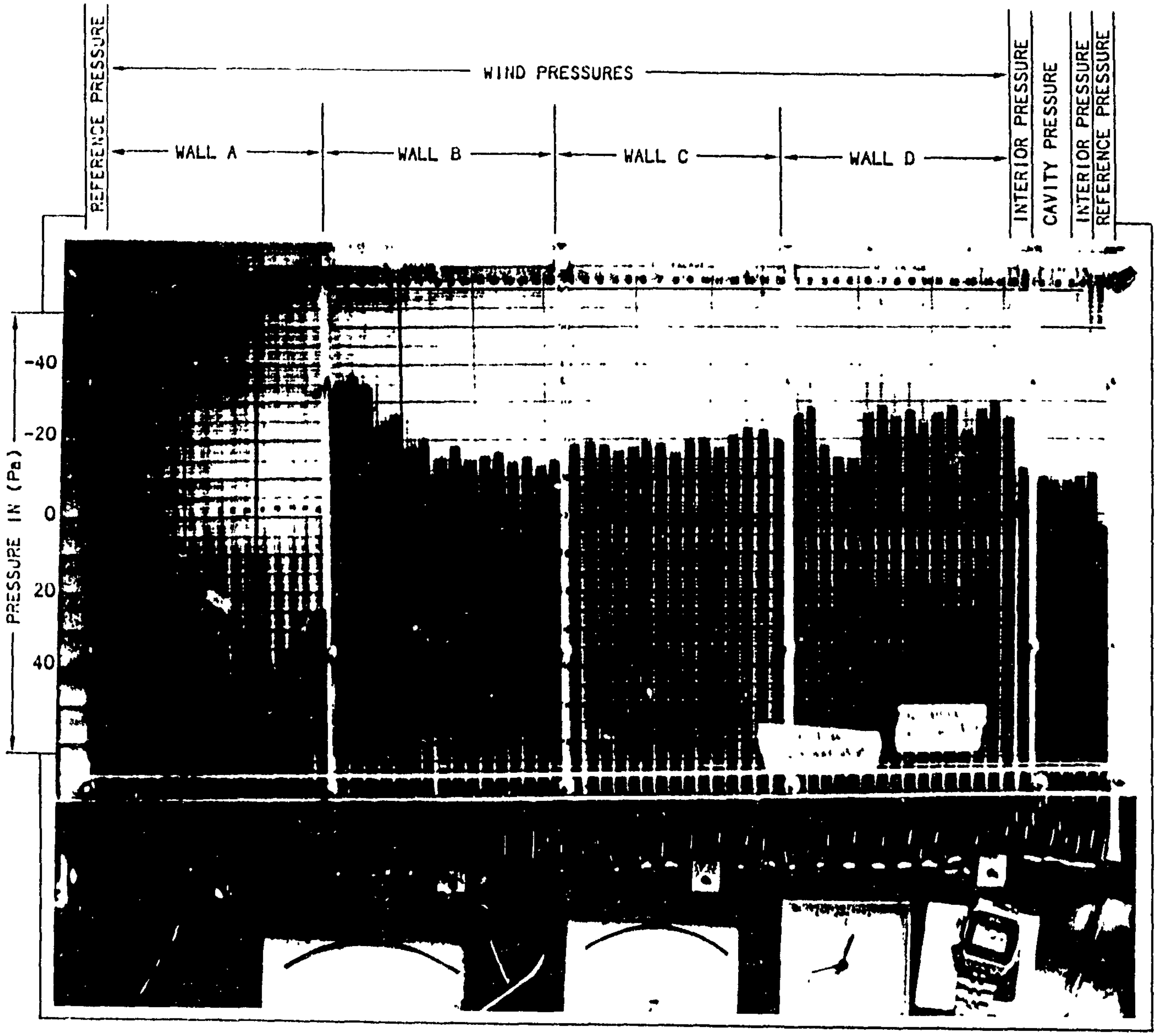


Figure 4.16 Wind and cavity pressure profile around building with vent holes closed (Table 4.1, case 1, experiment 3)

Table 4.2 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c and $\bar{P}-P_c$ for the experiments of case 1 (with no vent holes)

EXPERIMENT No	FILM No	POSE No	WALL A $\sum P_j S_j$ Pa m²	WALL B $\sum P_j S_j$ Pa m²	WALL C $\sum P_j S_j$ Pa m²	WALL D $\sum P_j S_j$ Pa m²	$\bar{P}$ Pa	P_c Pa	$\bar{P}-P_c$ Pa
1	13	38	140	-29	-82	-144	-5.7	-6.3	0.6
2	13	39	167	-66	-63	-121	-4.1	-7.3	3.1
3	13	42	148	-137	-90	-141	-11.0	-13.0	2.0
4	13	43	147	-163	-94	-165	-13.7	-16.0	2.3
5	13	44	102	-128	-85	-154	-13.2	-15.0	1.8
6	13	45	69	-79	-64	-117	-9.5	-10.0	0.5
7	13	46	56	-29	-57	-93	-6.2	-6.0	-0.2
8	13	2	73	71	-83	-119	-2.9	-2.5	-0.4
9	13	3	93	72	-88	-129	-2.5	-2.0	-0.5
10	13	4	98	73	-92	-130	-2.5	-2.0	-0.5
11	13	5	92	57	-81	-117	-2.5	-1.5	-1.0
12	13	6	88	26	-83	-116	-4.2	-3.0	-1.2
13	13	7	65	57	-89	-117	-4.1	-3.0	-1.1
14	13	8	75	29	-77	-118	-4.5	-3.0	-1.5
15	13	9	79	13	-65	-87	-3.0	-2.0	-1.0
16	13	10	61	34	-66	-97	-3.4	-2.0	-1.4
17	13	11	63	35	-67	-89	-2.9	-1.5	-1.4
18	13	12	39	46	-66	-82	-3.2	-2.0	-1.2
19	13	13	41	40	-58	-68	-2.2	-1.0	-1.2
20	13	14	40	15	-43	-61	-2.4	-1.5	-0.9
21	13	15	41	-6	-34	-52	-2.6	-2.0	-0.6
22	13	16	28	1	-29	-42	-2.1	-1.0	-1.1
23	13	17	19	16	-27	-32	-1.2	0.0	-1.2
24	13	18	23	18	-21	-29	-0.5	1.0	-1.5
25	13	19	40	-11	-17	-28	-0.8	0.0	-0.8
26	13	20	41	-31	-15	-45	-2.5	-2.0	-0.5
27	13	21	29	-34	-21	-40	-3.3	-3.0	-0.3
28	13	22	37	-46	-22	-43	-3.7	-4.0	0.3
29	13	23	57	-57	-25	-57	-4.2	-5.0	0.8
30	13	24	122	-84	-28	-82	-3.6	-5.0	1.4

Table 4.3 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c and $\bar{P}-P_c$ for the experiments of cases 2-3 (with no vent holes)

EXPERIMENT No	FILM No	POSE No	WALL A $\Sigma P_j S_j$ Pa m²	WALL B $\Sigma P_j S_j$ Pa m²	WALL C $\Sigma P_j S_j$ Pa m²	WALL D $\Sigma P_j S_j$ Pa m²	$\bar{P}$ Pa	P_C Pa	$\bar{P}-P_C$ Pa
1	18	6	86	-57	-42	-86	-5.0	-6.0	1.0
2	18	7	84	-62	-4[illegible]	-88	-5.8	-6.0	0.2
3	18	8	70	-60	-47	-88	-6.2	-6.5	0.3
4	18	9	93	-71	-38	-88	-5.2	-7.0	1.8
5	12	22	156	-39	-62	-124	-3.5	-6.0	2.5
6	12	23	126	-43	-69	-126	-5.7	-7.0	1.3
7	12	24	62	-3	-67	-107	-5.7	-6.0	0.3
8	12	25	133	-56	-63	-115	-5.1	-9.0	3.9
9	12	26	111	-61	-64	-112	-6.3	-9.0	2.7
10	12	27	85	-51	-59	-104	-6.4	-7.0	0.6
11	12	28	67	-30	-52	-88	-5.2	-5.0	-0.2
12	12	30	77	-36	-39	-75	-3.6	-5.0	1.4
13	12	32	69	-10	-33	-63	-1.8	-2.0	0.2
14	12	35	44	43	-54	-77	-2.2	-1.0	-1.2
15	12	37	45	41	-59	-76	-2.5	-1.0	-1.5

Table 4.4 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c and $\bar{P}-P_c$ for the experiments of case 4 (with no vent holes)

EXPERIMENT No	FILM No	POSE No	WALL A $\Sigma P_j S_j$ Pa m²	WALL B $\Sigma P_j S_j$ Pa m²	WALL C $\Sigma P_j S_j$ Pa m²	WALL D $\Sigma P_j S_j$ Pa m²	$\bar{P}$ Pa	P_c Pa	$\bar{P}-P_c$ Pa
1	2	14	-43	46	-15	-55	-3.3	-4.0	0.7
2	2	15	-40	27	-5	-52	-3.5	-4.0	0.5
3	2	16	-32	19	1	-42	-2.6	-3.7	1.0
4	2	17	-29	13	2	-40	-2.7	-3.7	1.0
5	2	18	-29	13	-	-40	-2.8	-3.7	0.9
6	2	19	-29	16	-8	-37	-2.9	-3.7	0.7
7	2	20	-32	16	-25	-38	-4.0	-4.7	0.7
8	2	21	-37	31	-31	-41	-3.9	-4.0	0.1
9	2	22	-37	31	-22	-45	-3.7	-4.0	0.3
10	2	23	-40	30	-5	-55	-3.5	-4.0	0.5
11	2	24	-35	26	11	-50	-2.4	-3.0	0.6
12	2	25	-34	25	11	-50	-2.4	-3.0	0.6
13	2	26	-32	20	5	-44	-2.6	-3.0	0.4
14	2	27	-30	19	-3	-41	-2.8	-3.0	0.2
15	2	28	-33	33	-9	-44	-2.6	-3.0	0.4
16	2	29	-39	37	-21	-47	-3.5	-4.0	0.5
17	2	30	-39	37	-26	-45	-3.7	-4.0	0.3
18	2	31	-44	37	-42	-46	-4.8	-5.0	0.2
19	2	32	-41	43	-43	-48	-4.5	-5.0	0.5
20	2	33	-42	46	-46	-49	-4.6	-5.0	0.4
21	2	34	-45	48	-43	-48	-4.4	-5.0	0.6
22	2	35	-42	49	-32	-46	-3.6	-4.0	0.4
23	2	36	-37	32	-30	-44	-4.0	-4.0	.0
24	2	37	-38	38	-27	-45	-3.6	-4.0	0.4
25	2	38	-38	38	-19	-50	-3.4	-4.0	0.6
26	2	39	-38	31	-14	-53	-3.7	-4.0	0.3
27	2	40	-31	32	-1	-48	-2.4	-3.0	0.6
28	2	41	-30	15	8	-45	-2.6	-3.7	1.0
29	2	42	-29	10	10	-44	-2.6	-3.7	1.1
30	2	43	-28	2	12	-42	-2.8	-3.7	0.9
31	2	44	-27		17	-42	-2.5	-3.7	1.1
32	2	1	-30	2	16	-42	-2.7	-3.7	1.0
33	2	2	-30	5	12	-42	-2.7	-3.7	0.9
34	2	3	-32	14	7	-42	-2.6	-3.7	1.1
35	2	4	-31	18	-	-40	-2.7	-3.0	0.3
36	2	5	-29	17	-7	-37	-2.8	-3.0	0.2
37	2	6	-28	12	-9	-34	-3.0	-3.7	0.7
38	2	7	-23	14	-5	-27	-2.1	-2.7	0.6

$$\bar{P} = \frac{\sum S_j P_j}{S} = \frac{1}{S}(\sum S_{a15}P_{a15} + \sum S_{b16}P_{b16} + \sum S_{c15}P_{c15} + \sum S_{d14}P_{d14})$$

where:

$\sum S_{a15} P_{a15} = S_{a1}P_{a1} + S_{a2}P_{a2} + \ldots + S_{a15}P_{a15}$

$S_{a1}, \ldots S_{a15}$ is the wall area which corresponds to tap 1, ... 15 of wall A

$P_{a}, \ldots P_{a15}$ is the wind pressure on tap A1,...A15 respectively and so on for the walls B, C and D.

The cavity pressures of Tables 4.2-4.4 are mean cavity pressures calculated from the cavity pressures of Appendix B.

b) The Analytical Model

The analytical model for rain screen walls without vent holes (such walls are called cavity walls) was presented previously, equation 3.12:

$$\bar{P} - P_c = 0 \qquad (4.1)$$

This equation (4.1) can be validated with the data of these experimental cases 1-4.

c) Analysis of Data

The values $\bar{P}-P_c$ for the cases 1-4 were calculated in Tables 4.2-4.4. Then, statistical analysis was done for these values. Some statistical measures are presented in

Table 4.5. Average values are -0.2, 0.8 and 0.5 for the three cases; these are close to 0Pa. The median values, which show the measure of central tendency, are -0.5, 0.6, and 0.6Pa. The minimum and maximum pressure ranges are -1.5Pa and 3.9Pa respectively. The standard deviations, which are the most important statistical variable measure of variability, are 1.2, 1.4, 0.3. The mode values, which are the most frequently occurring values, are -1.2, 0.3, and 0.6Pa.

Moreover, Figures 4.17-4.19 show the relative frequency histograms which are drafted for $\bar{P}-P_c$ values of all cases (1-4). It is observed that generally a high percentage of values are in the range of -1 to 1Pa. About 80% of observed values are within -2Pa to 1Pa for the case 1; 60% of observed values are within 0Pa to 2Pa for the cases 2/3, and 95% of the observed values are within 0Pa to 1Pa. Taking into account that the accuracy of data (pressure readings from the multimanometer) was ± 0.5Pa, it can be concluded that most of the values of $\bar{P}-P_c$ are equal to zero and therefore the equation 4.1 is valid for the case of a rain screen wall without vent holes.

4.3.3 Various Cases With Many Vent Holes of the Same Size

a) Experimental Readings

Cases 5 and 6 were performed under different wind conditions. 45 pictures were taken to record the data from the fluid multimanometer. In these cases, there were small

Table 4.5 Statistical measures for the cases 1-4

VARIABLE	CASE 1	CASES 2-3	CASE 4
Sample size	30	15	38
Average	-0.2	0.8	0.5
Median	-0.5	0.6	0.6
Mode	-1.2	0.3	0.6
Variance	1.5	2.0	0.1
Standard deviation	1.2	1.4	0.3
Standard error	0.2	0.3	0.1
Minimum	-1.5	-1.5	0
Maximum	3.1	3.9	1.1
Range	4.6	5.4	1.1

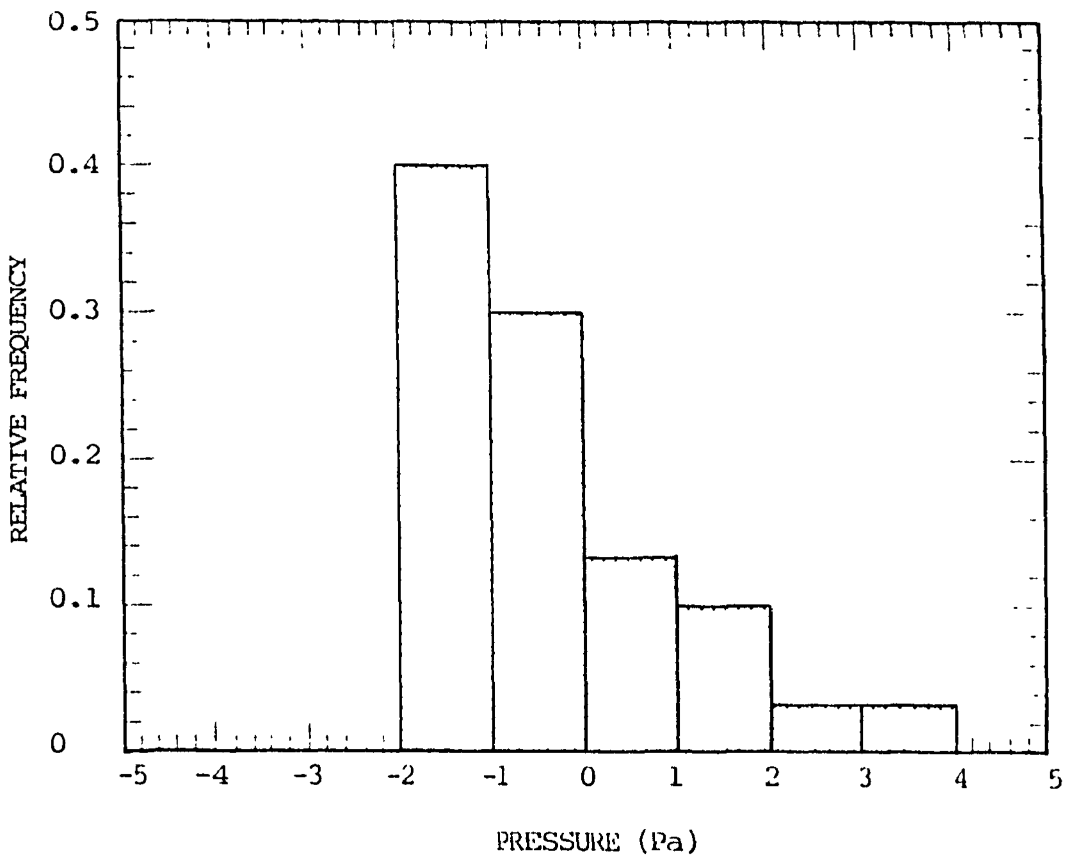


Figure 4.17 **Case 1 with no vent holes; relative frequency histogram for pressure difference ($\bar{P}$-P_c)**

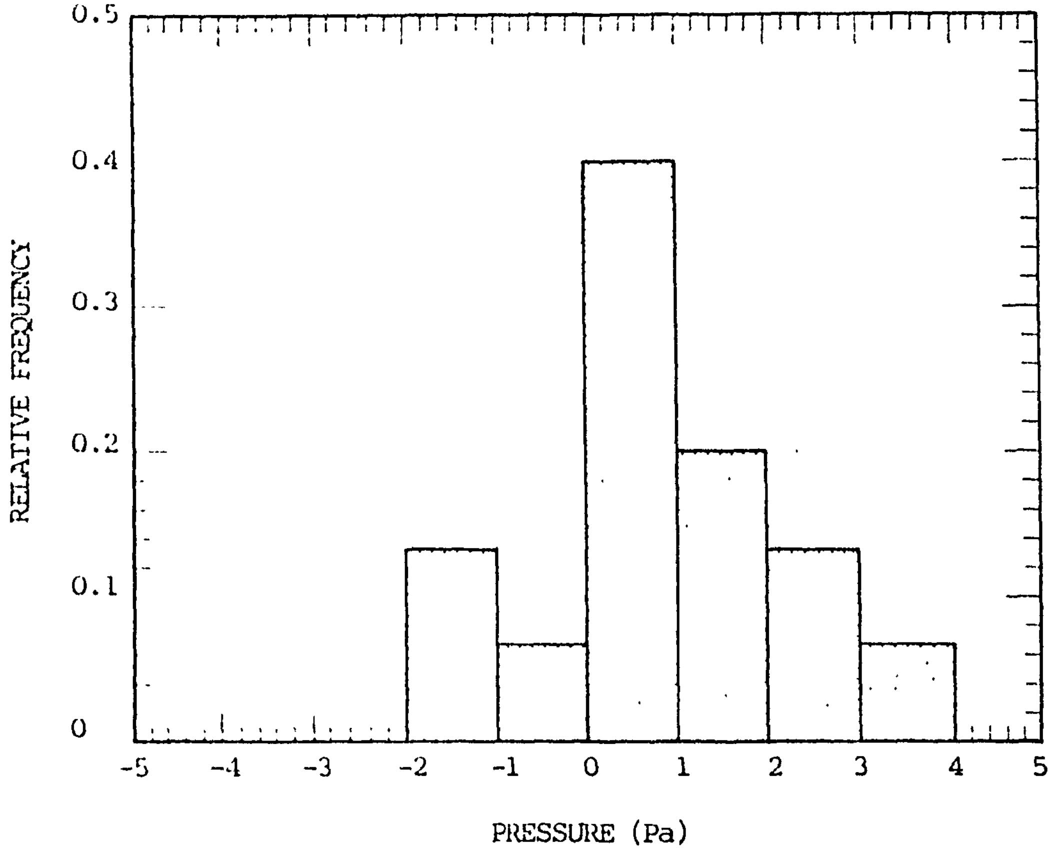


Figure 4.18 Case 2 and 3 with no vent holes; relative frequency histogram for pressure difference ($\bar{P}-P_c$)

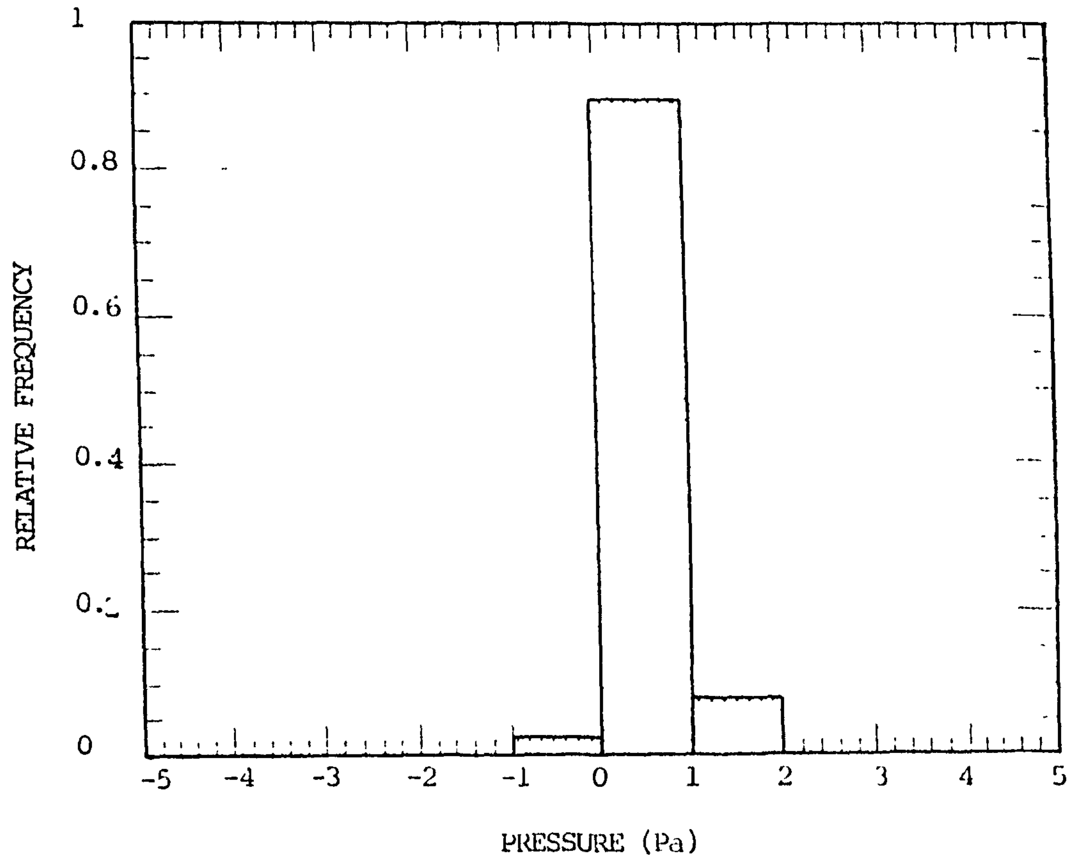


Figure 4.19 **Case 4 with no vent holes; relative frequency histogram for pressure difference ($\bar{P}-P_c$)**

vent holes, 1cm x 5cm, at the bottom of the walls of the experimental station placed as follows: three on each wall A and C, and four on each wall B and D. There were no cracks or holes on the inner wythe.

Figure 4.20 shows a typical picture of the multimanometer with respect to case 5. Some of the pictures for the cases 5 and 6 are included in Appendix C. As explained previously, all the data (from the 45 pictures) were transferred to tables in Appendix A. Again, it is observed that cavity pressures were negatives in all the experiments.

Mean wind pr ssure $\bar{P}$ and cavity pressure P_c were calculated for the cases 5 and 6 by using the recorded data from Appendix B and are shown in Tables 4.6 and 4.7.

b) The Analytical Model

In the case of a rain screen wall with many small vent holes, the analytical model 3.17 can be applied. Since the vent holes were small, 10mm wide, they could be treated like cracks, and equation 3.12 or 4.1, as before, could be applied.

c) Analysis of Data

The pressure differences $\bar{P}-P_c$ for the cases 5 and 6 was shown in Tables 4.6 and 4.7. Then, statistical analysis was done for these values. Some statistical variables are presented in Table 4.8; these variables were calculated by using the computer program Statgraphics [125]. Average

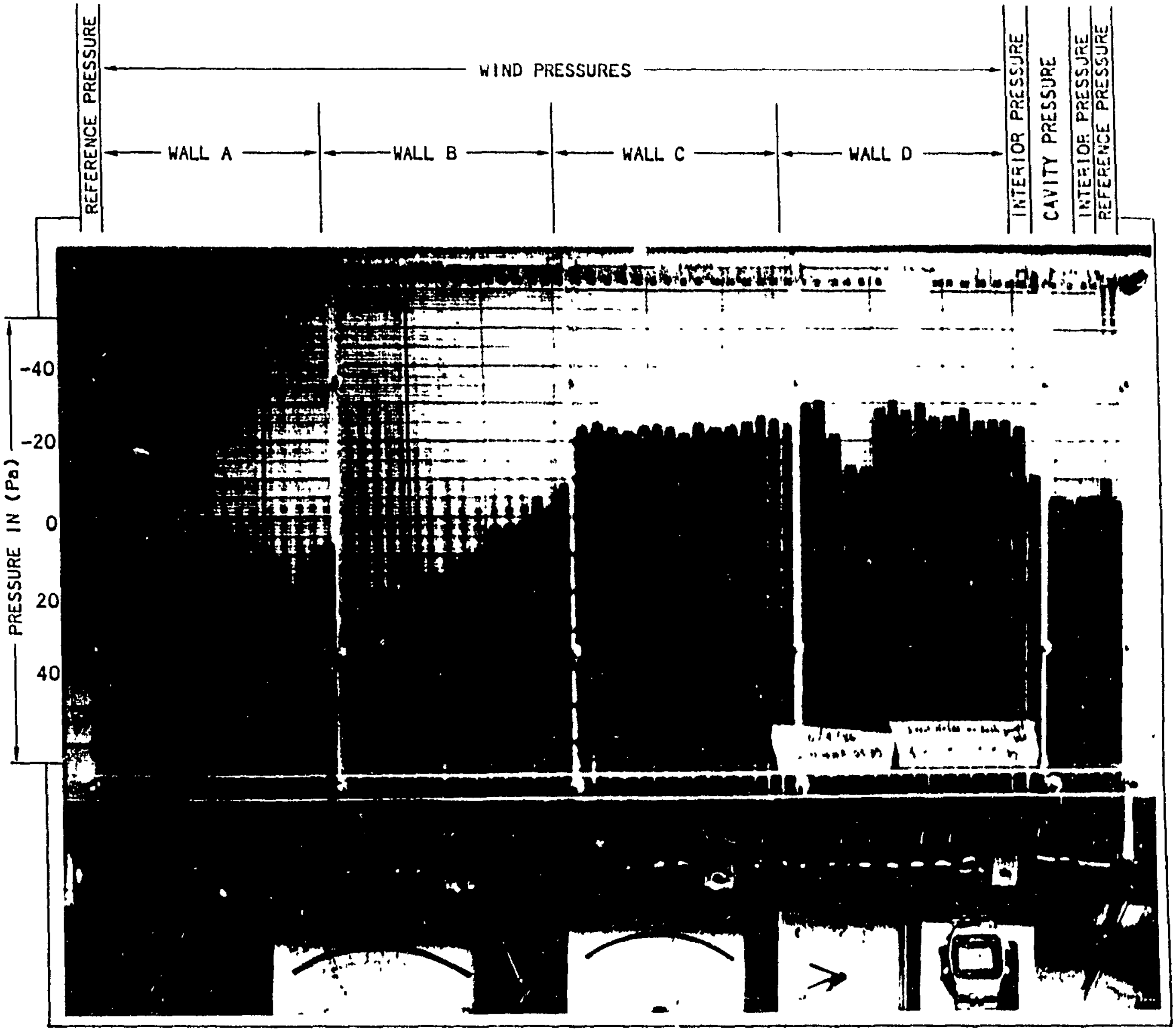


Figure 4.20 Wind and cavity pressure profile around building with many small vent holes (Table 4.1, case 5, experiment 1)

Table 4.6 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c and $\bar{P}-P_c$ for the experiments of case 5 (with many vent holes 5cm x 1cm)

EXPERIMENT No	FILM No	POSE No	WALL A $\Sigma P_j S_j$ Pa m²	WALL B $\Sigma P_j S_j$ Pa m²	WALL C $\Sigma P_j S_j$ Pa m²	WALL D $\Sigma P_j S_j$ Pa m²	$\bar{P}$ Pa	P_C Pa	$\bar{P}-P_C$ Pa
1	10	12	53	103	-81	-111	-1.8	-1.3	-0.5
2	10	13	88	26	-53	-83	-1.1	-1.0	-0.1
3	10	14	65	-2	-40	-60	-1.9	-1.0	-0.9
4	10	15	50	-22	-34	-51	-2.9	-2.0	-0.9
5	10	16	52	-38	-26	-42	-2.8	-3.0	0.2
6	10	18	101	-50	-44	-87	-4.0	-4.5	0.5
7	10	19	68	-42	-46	-85	-5.2	-5.0	-0.2
8	10	20	76	-47	-42	-85	-4.9	-5.0	0.1
9	10	21	87	-72	-46	-85	-5.8	-3.0	-2.8
10	10	22	89	20	-71	-114	-3.8	-3.3	-0.5
11	10	23	106	10	-88	-133	-5.2	-5.0	-0.2
12	10	24	111	-16	-77	-121	-5.2	-5.0	-0.2
13	10	25	110	-22	-73	-121	-5.4	-5.0	-0.4
14	10	26	111	-22	-76	-122	-5.4	-5.0	-0.4
15	10	27	90	-22	-66	-110	-5.4	-5.0	-0.4
16	10	28	94	-31	-54	-99	-4.6	-4.5	-0.1
17	10	29	83	-19	-50	-90	-3.8	-3.5	-0.3
18	10	30	81	-12	-45	-81	-2.9	-2.5	-0.4

Table 4.7 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c and $\bar{P}-P_c$ for the experiments of case 6 (with many vent holes 5cm x 1cm)

EXPERIMENT NO	FILM NO	POSE NO	WALL A $\Sigma P_j S_j$ Pa m²	WALL B $\Sigma P_j S_j$ Pa m²	WALL C $\Sigma P_j S_j$ Pa m²	WALL D $\Sigma P_j S_j$ Pa m²	$\bar{P}$ Pa	P_c Pa	$\bar{P}-P_c$ Pa
1	11	1	102	-28	-41	-76	-2.2	-3.0	0.8
2	11	2	100	-51	-35	-60	-2.3	-5.0	2.7
3	11	3	114	-75	-37	-92	-4.5	-7.0	2.5
4	11	4	83	-99	-47	-87	-7.5	-9.0	1.5
5	11	5	62	-94	-43	-77	-7.6	-8.0	0.4
6	11	6	64	-104	-45	-71	-7.8	-8.0	0.2
7	11	7	67	-90	-42	-78	-7.2	-8.0	0.8
8	11	8	75	-68	-30	-70	-4.7	-5.0	0.3
9	11	9	91	-64	-39	-79	-4.6	-5.0	0.4
10	11	10	72	-43	-60	-97	-6.4	-6.0	-0.4
11	11	11	72	-47	-65	-105	-7.2	-7.0	-0.2
12	11	12	66	-67	-55	-92	-7.4	-7.0	-0.4
13	11	13	75	-60	-47	-89	-6.0	-6.0	.0
14	11	14	73	-67	-38	-77	-5.5	-6.0	0.5
15	11	15	77	-71	-33	-74	-5.1	-6.0	0.9
16	11	16	73	-65	-25	-68	-4.3	-5.3	1.0
17	11	17	79	-51	-21	-60	-2.7	-4.3	1.6
18	11	18	94	-82	-30	-86	-5.2	-7.0	1.8
19	11	19	71	-51	-28	-56	-3.2	-4.0	0.8
20	11	20	64	-30	-30	-71	-3.3	-3.0	-0.3
21	11	21	126	-60	-17	-70	-1.1	-2.0	0.9
22	11	22	138	-64	-55	-114	-4.7	-6.0	1.3
23	11	23	115	-69	-52	-110	-5.9	-7.0	1.1
24	11	24	97	-22	-63	-118	-5.3	-5.0	-0.3
25	11	25	115	-17	-73	-121	-4.8	-5.5	0.7
26	11	26	119	-15	-52	-93	-2.1	-3.0	0.9
27	11	27	87	40	-66	-106	-2.2	-1.8	-0.5

Table 4.8 Outcome from the previous tables cases 5 and 6

VARIABLE	CASE 5	CASES 6
Sample size	18	27
Average	-0.4	0.7
Median	-0.3	0.8
Mode	-0.4	0.9
Variance	0.4	0.7
Standard deviation	0.7	0.8
Standard error	0.1	0.1
Minimum	-2.8	-0.5
Maximum	0.5	2.7
Range	3.3	3.2

values are -0.4Pa and 0.7Pa for the cases 5 and 6 respectively; these values are close to 0Pa. The mode values are -0.4 and 0.9Pa. The standard deviations are 0.6 and 0.8. The minimum and maximum pressure ranges are -2.8 and 2.7Pa respectively. According to Chebyshev's theorem [126], 75% is the minimum percentage of observations of pressure difference $\bar{P}-P_c$ within (0 ± 1.2)Pa and (0 ± 1.6)Pa for the cases 5 and 6.

Moreover, Figures 4.21 and 4.22 show relative frequency histograms. In the first one, almost 80% of values are within (-1 to 0)Pa and in the second one, almost 92% of the values are within (-1 to 2)Pa. Taking into account that, in the laboratory experiments, the value of equation 3.22 was not constant, and also that the reading accuracy from the multimanometer was ±0.5Pa, it can be concluded that most of the observed values of $\bar{P}-P_c$ are equal to zero, and equations 3.12 or 4.1 is valid. Small vent holes uniformly distributed on a rain screen wall with size not bigger than 5cmx1cm, have the same effect upon cavity pressure as cracks have. In both cases, small vent holes or cracks, the mean wind pressure $\bar{P}$ is equal to cavity pressure P_c, always $\bar{P}=P_c$. If the cracks (or small vent holes) are not uniformly spread upon the outer wythe of a rain screen wall, then the mean wind pressure will not be equal to the cavity pressure ($\bar{P}\neq P_c$). Therefore, a rain screen wall with many small vent holes performs like the one without vent holes.

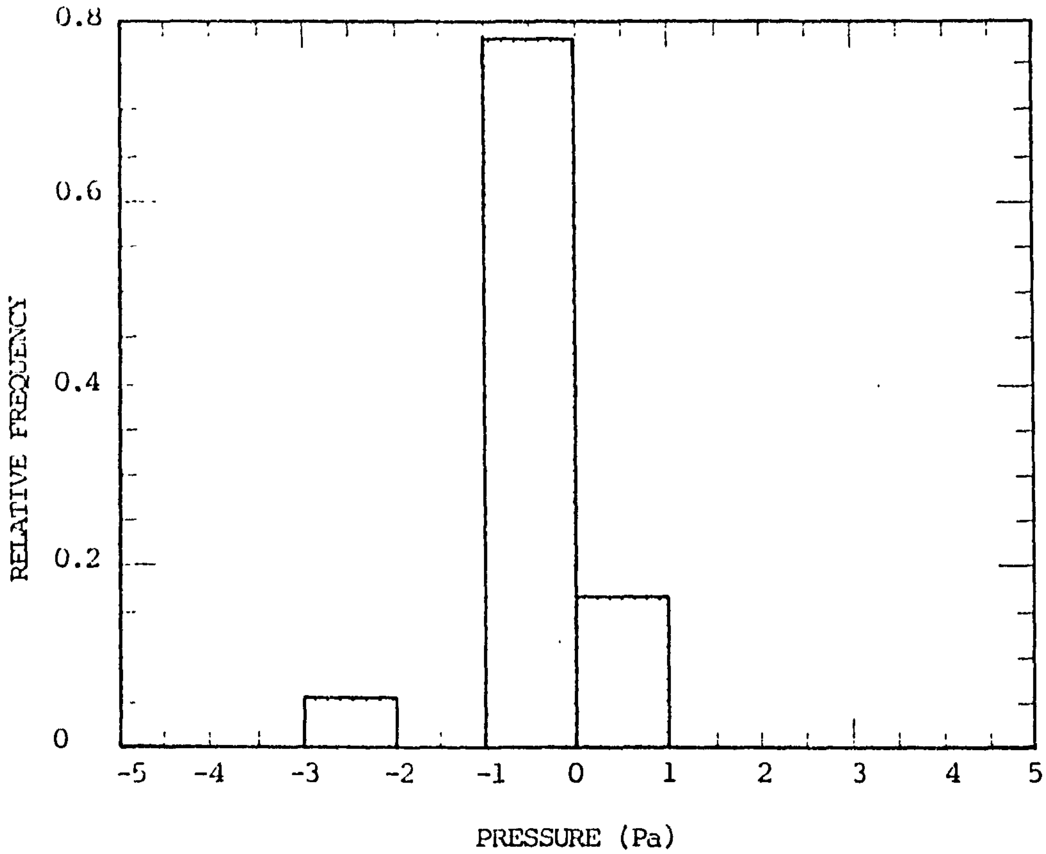


Figure 4.21 Case 5 with many small vent holes; relative frequency histogram for pressure difference ($\bar{P}-P_c$)

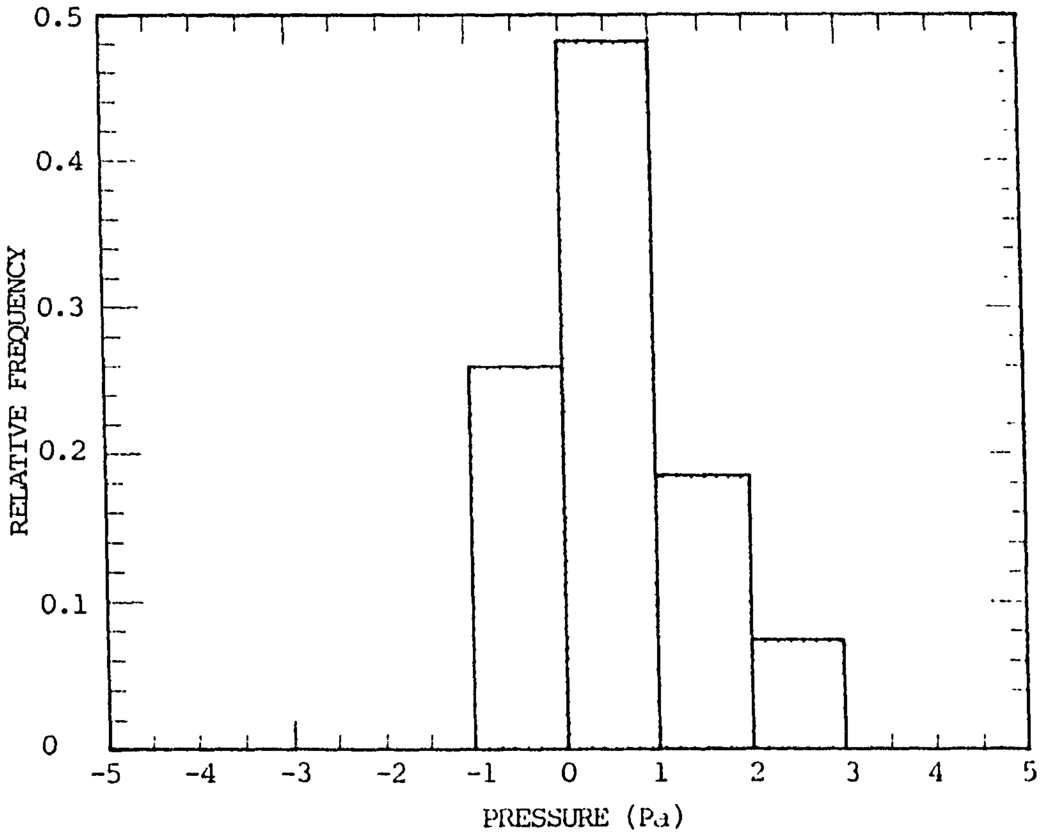


Figure 4.22 Case 6 with many small vent holes; relative frequency histogram for pressure difference ($\bar{P}-P_c$)

4.3.4 Various Cases With One or More Vent Holes of Different Sizes

a) Experimental Data

Nine cases (7-15) were tested under different wind conditions and with different hole sizes. Also, there were no holes or cracks on the inner wythe. In each case 114 experiments were performed and all the data are presented in Appendix A. Figures 4.23-4.25 show typical pictures of multimanometer with respect to cases 7, 10 and 15 respectively. Some of the pictures for the cases 7-15 are included in Appendix C. The size of the vent hole in case 7 experiment 1, was small, but in next cases it became bigger and bigger. Table 4.1 shows the cases and the hole(s) size and location. In the beginning cavity pressures were negative, but when the vent hole became big they were positive.

In Tables 4.9-4.17 the values of the mean wind pressure $\bar{P}$ and cavity pressures P_c were calculated for the cases 7-15; the wind pressures on the vent holes A10, A6, A13 and C6 as well as the wind and cavity pressures were extracted from Appendix B.

b) The Analytical Model

The analytical model for the case of vent holes and cracks in the outer wythe was presented previously, equation 3.17:

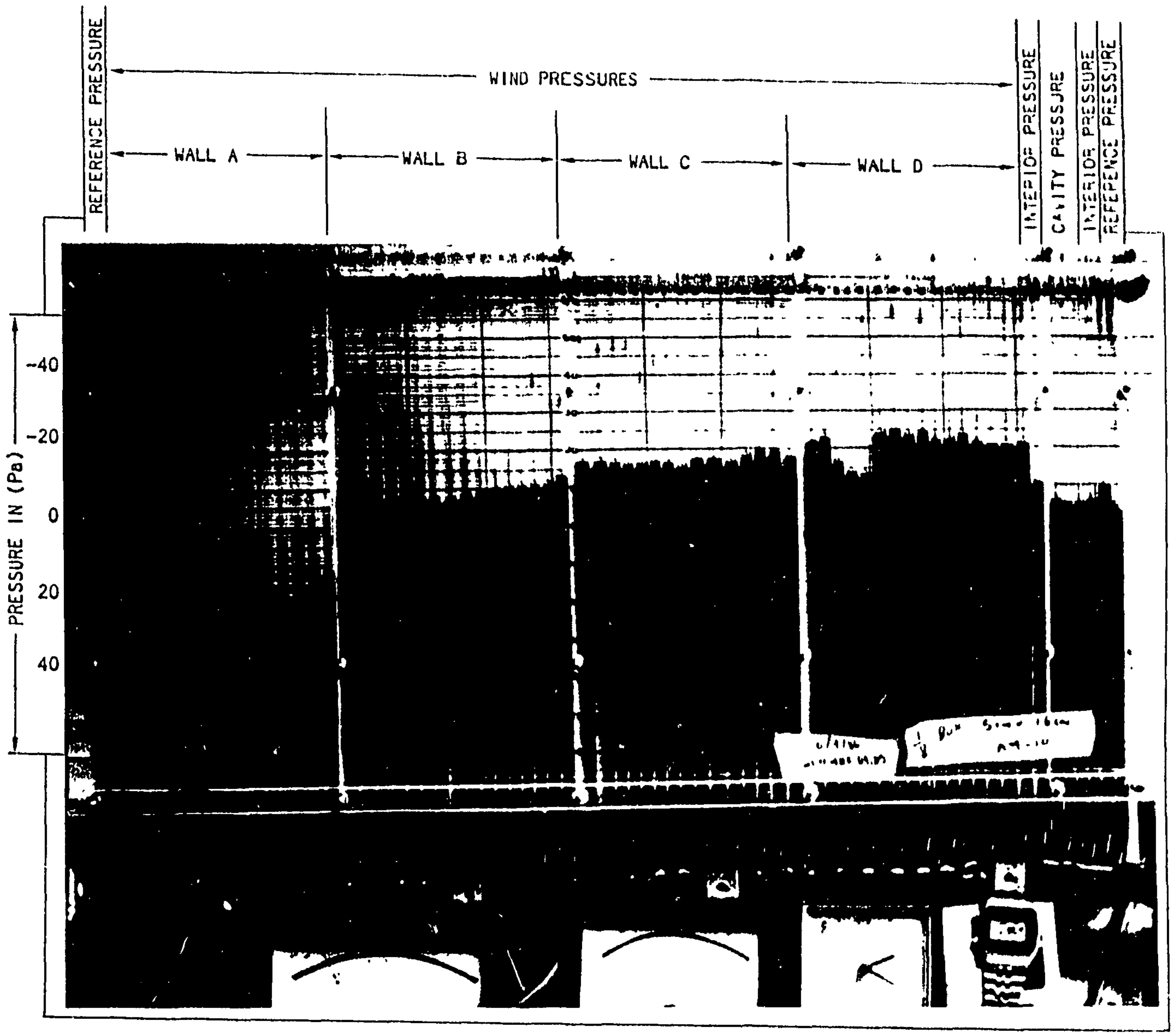


Figure 4.23 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 1.6cm (Table 4.1, case 7, experiment 1)

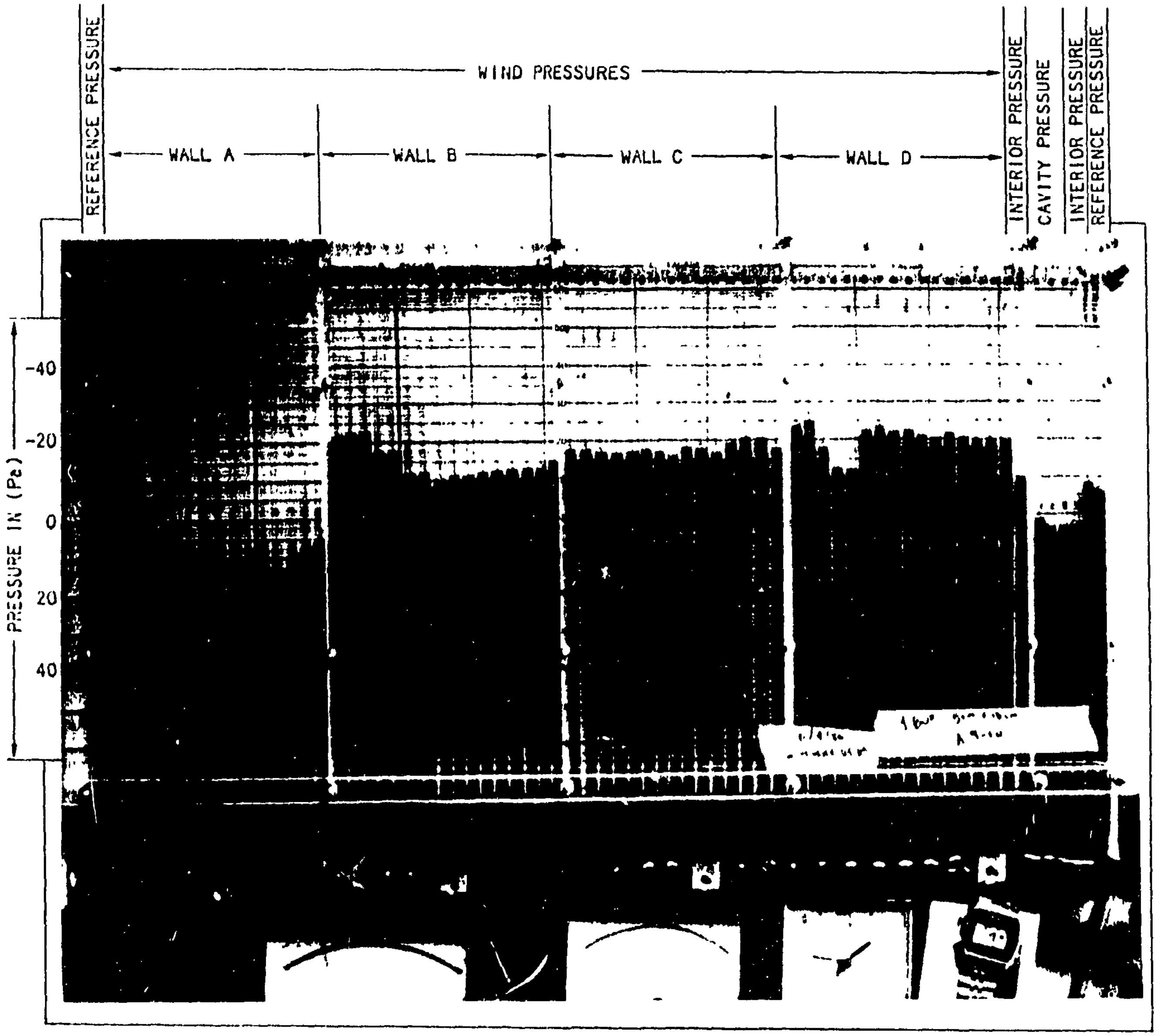


Figure 4.24 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 13cm (Table 4.1, case 10, experiment 4)

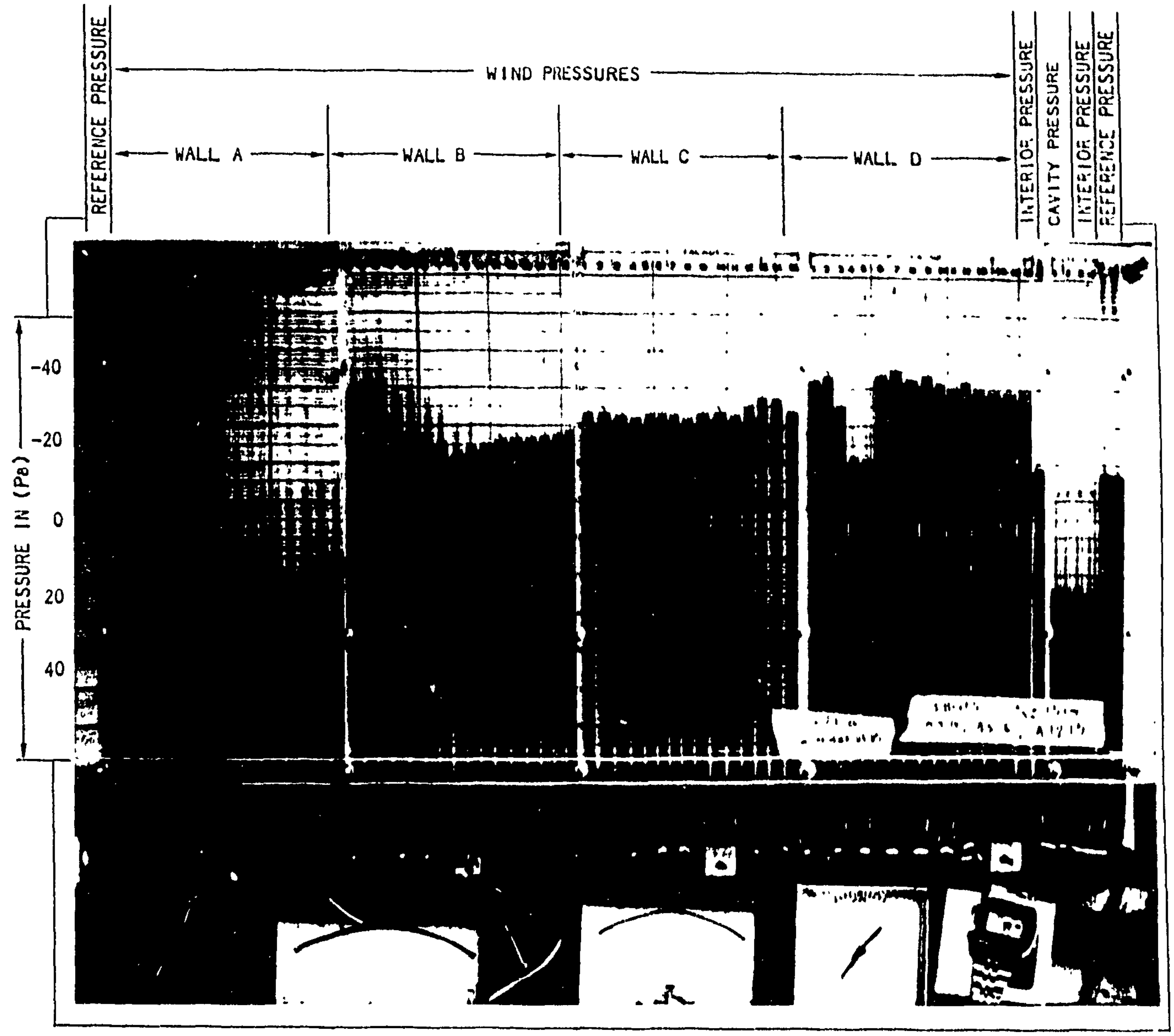


Figure 4.25 Wind and cavity pressure profile around building with three vent holes A6, A10 and A13: 5cm x 13cm each (Table 4.1, case 15, experiment 3)

Table 4.9 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c, Y, X and k for the experiments of case 7 (with one vent hole A10: 5cm x 1.6cm)

EXPERIMENT No	FILM No	POSE No	$\bar{P}$ Pa	P_C Pa	Y $\bar{P}-P_C$ Pa	P A10 Pa	$(P - P_C)^{½}$ A10 $Pa^{½}$	Ah cm^2	X $Pa^{½}$	k $Pa^{½}$
1	18	1	-5.6	-2.5	-3.1	21	4.8	8.1	0.0001949	15970
2	18	2	-4.4	-2.0	-2.4	17	4.4	8.1	0.0001753	13829
3	18	3	-2.9	-1.0	-1.9	9	3.2	8.1	0.0001272	14733
4	18	4	-3.2	-2.0	-1.2	16	4.2	8.1	0.0001706	7180
5	18	5	-3.6	-2.0	-1.6	12	3.7	8.1	0.0001505	10622

Table 4.10 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c, Y, X and k for the experiments of case 8 (with one vent hole A10: 5cm x 3.2cm)

EXPERIMENT No	FILM No	POSE No	$\bar{P}$ Pa	P_C Pa	Y $\bar{P}-P_C$ Pa	P A10 Pa	$(P - P_C)^{½}$ A10 $Pa^{½}$	Ah cm^2	X $Pa^{½}$	k $Pa^{½}$
1	17	26	-9.1	-6.0	-3.1	23	5.4	16.2	0.0004331	7246
2	17	27	-8.9	-6.0	-2.9	26	5.7	16.2	0.0004549	6475
3	17	28	-9.4	-7.0	-2.4	22	5.4	16.2	0.0004331	5582
4	17	29	-4.6	-3.0	-1.6	12	3.9	16.2	0.0003115	5243
5	17	30	-1.8	0.0	-1.8	9	3.0	16.2	0.0002413	7442
6	17	31	-3.3	-1.0	-2.3	21	4.7	16.2	0.0003772	6008
7	17	32	-4.1	-2.0	-2.1	30	5.7	16.2	0.0004549	4688

Table 4.11 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c, Y, X and k for the experiments of case 9 (with one vent hole A10: 5cm x 6.5cm)

EXPERIMENT NO	FILM NO	POSE NO	$\bar{P}$ Pa	P_C Pa	Y $P-P_C$ Pa	P A10 Pa	$(P-P_C)^{1/2}$ A10 $Pa^{1/2}$	Ah cm^2	X $Pa^{1/2}$	k $Pa^{1/2}$
1	17	14	-9.0	-3.0	-6.0	33	6.0	32.5	0.0009680	6208
2	17	15	-5.6	-0.8	-4.8	21	4.7	32.5	0.0007524	6406
3	17	16	-6.4	-2.0	-4.4	16	4.2	32.5	0.0006845	6361
4	17	17	-3.5	1.0	-4.5	14	3.6	32.5	0.0005817	7665
5	17	18	-3.8	0.8	-4.6	20	4.4	32.5	0.0007079	6455
6	17	19	-4.6	-0.8	-3.8	7	2.8	32.5	0.0004491	8568
7	17	20	-5.6	-1.0	-4.6	21	4.7	32.5	0.0007567	6025
8	17	21	-7.9	-3.8	-4.2	18	4.7	32.5	0.0007524	5531
9	17	22	-5.5	-0.3	-5.2	33	5.8	32.5	0.0009303	5620
10	17	23	-6.4	0.0	-6.4	36	6.0	32.5	0.0009680	6619
11	17	24	-4.4	1.3	-5.6	30	5.4	32.5	0.0008651	6519
12	17	25	-2.2	3.0	-5.2	18	3.9	32.5	0.0006248	8339

Table 4.12 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c, Y, X and k for the experiments of case 10 (with one vent hole A10: 5cm x 13cm)

EXPERIMENT NO	FILM NO	POSE NO	$\bar{P}$ Pa	P_C Pa	Y $P-P_C$ Pa	P A10 Pa	$(P-P_C)^{1/2}$ A10 $Pa^{1/2}$	Ah cm^2	X $Pa^{1/2}$	k $Pa^{1/2}$
1	17	1	-3.4	6.0	-9.4	12	2.4	65.0	0.0007904	11855
2	17	2	-1.8	8.0	-9.8	14	2.4	65.0	0.0007904	12374
3	17	3	-3.4	10.0	-13.4	27	4.1	65.0	0.0013304	10039
4	17	4	-4.3	8.0	-12.3	20	3.5	65.0	0.0011178	10963
5	17	5	-5.3	8.0	-13.3	21	3.6	65.0	0.0011634	11464
6	17	6	-4.5	5.3	-9.8	13	2.8	65.0	0.0008983	10887
7	17	7	-3.3	6.3	-9.6	13	2.6	65.0	0.0008383	11419
8	17	8	-4.1	4.3	-8.3	9	2.2	65.0	0.0007032	11823
9	17	9	-3.3	7.8	-11.1	18	3.2	65.0	0.0010330	10719
10	17	10	-3.4	8.0	-11.4	18	3.2	65.0	0.0010204	11205
11	17	11	-4.1	7.8	-11.9	20	3.5	65.0	0.0011293	10497
12	17	12	-4.5	7.0	-11.5	16	3.0	65.0	0.0009680	11849
13	17	13	-4.5	5.3	-9.8	13	2.8	65.0	0.0008983	10862

Table 4.13 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c, Y, X and k for the experiments of case 11 (with one vent hole A10: 5cm x 13cm)

EXPERIMENT No	FILM No	POSE No	$\bar{P}$ Pa	P_c Pa	Y $\bar{P}-P_c$ Pa	P_{A10} Pa	$(P_{A10}-P_c)^{1/2}$ $Pa^{1/2}$	Ah cm^2	X $Pa^{1/2}$	k $Pa^{1/2}$
1	15	26	-4.2	6.0	-10.2	14	2.8	65.0	0.0009126	11197
2	15	27	-2.0	6.3	-8.2	13	2.6	65.0	0.0008383	9798
3	15	28	-4.0	4.8	-8.8	11	2.5	65.0	0.0008067	10853
4	15	29	-3.5	9.8	-13.3	24	3.8	65.0	0.0012180	10884
5	15	30	-4.2	10.0	-14.2	24	3.7	65.0	0.0012073	11741
6	15	31	-5.9	7.5	-13.4	22	3.8	65.0	0.0012287	10920
7	15	32	-3.2	6.3	-9.4	15	3.0	65.0	0.0009545	9900
8	15	33	-4.9	9.8	-14.7	30	4.5	65.0	0.0014520	10123
9	15	34	-9.9	7.5	-17.4	33	5.0	65.0	0.0016294	10690
10	15	35	-9.5	5.0	-14.5	20	3.9	65.0	0.0012497	11624
11	15	36	-6.9	3.8	-10.7	15	3.4	65.0	0.0010823	9873

Table 4.14 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c, Y, X and k for the experiments of case 12 (with one vent hole B12: 5cm x 13cm)

EXPERIMENT NO	FILM NO	POSE NO	$\bar{P}$ Pa	P_C Pa	Y $\bar{P}-P_C$ Pa	P B12 Pa	$(P-P_C)^{1/2}$ B12 $Pa^{1/2}$	Ah cm^2	X $Pa^{1/2}$	k $Pa^{1/2}$
1	8	9	-6.2	10.0	-16.2	16	2.4	65	0.0007904	20537
2	8	10	-6.0	6.0	-12.0	11	2.2	65	0.0007215	16601
3	8	11	-2.9	5.0	-7.9	9	2.0	65	0.0006453	12286
4	8	12	-4.5	5.0	-9.5	8	1.7	65	0.0005589	16947
5	8	13	-4.9	7.0	-11.9	11	2.0	65	0.0006453	18390
6	8	14	-4.0	6.0	-10.0	16	3.2	65	0.0010204	9833
7	8	15	-2.5	5.0	-7.5	8	1.7	65	0.0005589	13391
8	8	16	-5.4	9.0	-14.4	14	2.2	65	0.0007215	19965
9	8	17	-6.5	8.0	-14.5	14	2.4	65	0.0007904	18337
10	8	18	-7.3	11.0	-18.3	17	2.4	65	0.0007904	23186
11	8	19	-2.3	8.0	-10.3	14	2.4	65	0.0007904	12977
12	8	20	-4.2	4.0	-8.2	8	2.0	65	0.0006453	12710
13	8	21	-3.5	4.0	-7.5	7	1.7	65	0.0005589	13385
14	8	22	-4.0	3.0	-7.0	6	1.7	65	0.0005589	12531

Table 4.15 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c, Y, X and k for the experiments of case 13 (with two vent holes A10, C6: 5cm x 13cm)

EXPERIMENT NO	FILM NO	POSE NO	$\bar{P}$ Pa	P_C Pa	Y $\bar{P}-P_C$ Pa	P A10 Pa	$(P-P_C)^{1/2}$ A10	P C6 Pa	$(P-P_C)^{1/2}$ C6 $Pa^{1/2}$	A_h cm^2	X $Pa^{1/2}$	k $Pa^{1/2}$
1	18	34	-7.8	-0.8	-7.0	23	4.9	-10	3.0	65	0.0005911	11850
2	18	35	-5.8	0.3	-6.0	19	4.3	-11	3.4	65	0.0003149	19202
3	18	36	-4.3	2.3	-6.5	25	4.8	-9	3.4	65	0.0004568	14251
4	18	37	-3.8	3.3	-7.1	57	7.3	-12	3.9	65	0.0011056	6383
5	18	38	-5.7	2.5	-8.2	47	6.7	-11	3.7	65	0.0009669	8461
6	18	39	-6.2	2.8	-8.9	39	6.0	-11	3.7	65	0.0007462	11966

Table 4.16 **Calculated mean wind pressures $\bar{P}$, cavity pressures P_c, Y, X and k for the experiments of case 14 (with two vent holes A6, A10: 5cm x 13cm)**

EXPERIMENT NO	FILM No	POSE NO	$\bar{P}$ Pa	P_C Pa	Y $\bar{P}-P_C$ Pa	P A6 Pa	$(P-P_C)^{1/2}$ A6	P A10 Pa	$(P-P_C)^{1/2}$ A10 $Pa^{1/2}$	Ah cm^2	X $Pa^{1/2}$	k $Pa^{1/2}$
1	15	37	-3.9	18.3	-12.2	24	2.4	23	2.2	65	0.0014770	8240
2	15	38	-4.5	19.3	-23.8	27	2.8	27	2.8	65	0.0017965	13223
3	15	39	-5.4	19.8	-25.1	27	2.7	30	3.2	65	0.0019019	13221
4	15	40	-5.4	19.8	-25.2	28	2.9	29	3.0	65	0.0019082	13202
5	15	41	-6.1	26.5	-32.6	41	3.8	40	3.7	65	0.0024142	13498
6	15	42	-6.3	27.5	-33.8	30	1.6	42	3.8	65	0.0017389	19430
7	15	43	-6.9	27.5	-34.4	39	3.4	39	3.4	65	0.0021884	15727
8	15	44	-6.9	14.5	-21.4	20	2.3	21	2.5	65	0.0015794	13568
9	15	1	-7.4	22.5	-29.9	34	3.4	33	3.2	65	0.0021398	13964
10	15	2	-6.0	21.5	-27.5	28	2.5	32	3.2	65	0.0018682	14731
11	15	3	-5.7	15.8	-21.5	21	2.3	23	2.7	65	0.0016081	13344
12	15	4	-5.6	19.5	-25.1	27	2.7	28	2.9	65	0.0018244	13770
13	15	5	-5.5	15.3	-20.7	21	2.4	22	2.6	65	0.0016121	12858
14	15	6	-3.7	15.3	-18.9	19	1.9	23	2.8	65	0.0015231	12416

Table 4.17 **Calculated mean wind pressures $\bar{P}$, cavity pressures P_c, Y, X and k for the experiments of case 15 (with three vent holes A6, A10, A13: 5cm x 13cm)**

EXPERIMENT No	FILM No	POSE No	$\bar{P}$	P_C	Y $(\bar{P}-P_C)$	P_{A6}	$(P-P_C)^{1/2}$	P_{A10}	$(P-P_C)^{1/2}$	P_{A13}	$(P-P_C)^{1/2}$	A_h	X $Pa^{1/2}$	k $Pa^{1/2}$
1	16	43	-5.6	22.0	-27.6	28	2.4	29	2.6	24	1.4	65	0.0021004	13154
2	16	44	-5.4	25.8	-31.1	29	1.8	30	2.1	31	2.3	65	0.0019862	15659
3	16	1	-5.4	30.8	-36.1	34	1.8	38	2.7	38	2.7	65	0.0023193	15566
4	16	2	-5.2	21.5	-26.7	23	1.2	25	1.9	26	2.1	65	0.0016833	15870
5	16	3	-5.2	21.8	-27.0	26	2.1	27	2.3	25	1.8	65	0.0019862	13586
6	16	4	-6.3	16.8	-23.0	20	1.8	22	2.3	20	1.8	65	0.0019027	12089
7	16	5	-7.7	23.0	-30.7	33	3.2	30	2.6	20	-1.7	65	0.0013152	23333
8	16	6	-7.2	28.8	-35.9	37	2.9	37	2.9	30	1.1	65	0.0022143	16231
9	16	7	-5.4	20.8	-26.2	22	1.1	23	1.5	27	2.5	65	0.0016514	15838
10	16	8	-4.5	16.3	-20.8	18	1.3	20	1.9	22	2.4	65	0.0018254	11389
11	16	9	-4.3	19.3	-23.5	20	0.9	23	1.9	26	2.6	65	0.0017426	13496
12	16	10	-2.7	17.3	-20.0	19	1.3	20	1.7	21	1.9	65	0.0015868	12574
13	16	11	-2.1	13.5	-15.6	14	0.7	16	1.6	19	2.3	65	0.0014951	10408
14	16	12	-2.2	11.0	-13.2	11	0.0	13	1.4	14	1.7	65	0.0010152	13012
15	16	13	-3.1	13.3	-16.3	14	0.9	16	1.7	18	2.2	65	0.0015178	10747
16	16	14	-4.4	13.3	-17.7	15	1.3	17	1.9	16	1.7	65	0.0015868	11133
17	16	15	-5.3	11.3	-16.6	12	0.9	14	1.7	14	1.7	65	0.0013496	12269
18	16	16	-3.5	6.0	-9.5	5	-1.0	5	-1.0	7	1.0	65	0.0003226	29455
19	16	17	-2.3	12.5	-14.8	13	0.7	14	1.2	16	1.9	65	0.0012270	12097
20	16	18	-2.6	20.5	-23.1	21	0.7	24	1.9	26	2.3	65	0.0015885	14543
21	16	19	-1.6	25.5	-27.1	26	0.7	30	2.1	34	2.9	65	0.0018534	14632
22	16	20	-3.8	22.3	-26.1	23	0.9	26	1.9	28	2.4	65	0.0016780	15538
23	16	21	-5.2	21.8	-26.9	25	1.8	27	2.3	27	2.3	65	0.0020604	13062
24	16	22	-5.9	35.0	-40.9	44	3.0	45	3.2	39	2.0	65	0.0026337	15511
25	16	23	-7.2	29.8	-36.9	35	2.3	36	2.5	33	1.8	65	0.0021277	17364
26	16	24	-7.4	24.8	-32.2	31	2.5	31	2.5	27	1.5	65	0.0020973	15339
27	16	25	-5.7	23.8	-29.5	27	1.8	29	2.3	27	1.8	65	0.0019027	15487
28	16	26	-5.1	23.8	-28.9	27	1.8	29	2.3	27	1.8	65	0.0019027	15177
29	16	27	-6.9	22.8	-29.6	29	2.5	29	2.5	25	1.5	65	0.0020973	14120
30	16	28	-5.7	26.8	-32.4	34	2.7	33	2.5	27	0.5	65	0.0018368	17662
31	16	29	-4.7	18.8	-23.4	21	1.5	22	1.8	21	1.5	65	0.0015497	15120
32	16	30	-3.3	19.3	-22.6	21	1.3	22	1.7	22	1.7	65	0.0014970	15093
33	16	31	-3.9	17.5	-21.4	21	1.9	21	1.9	23	2.3	65	0.0019640	10908

$$\bar{P} - P_c + \frac{c}{a}(2/\rho)^{1/2}\frac{A}{S}\sum(P_j - P_c)^{1/2} = 0 \tag{4.2}$$

For the case of one vent hole equation 3.17 becomes:

$$\bar{P} - P_c + \frac{c}{a}(2/\rho)^{1/2}\frac{A}{S}(P_j - P_c)^{1/2} = 0 \tag{4.3}$$

where

$\bar{P}$ is the mean wind pressure from the equation 3.10

P_c is the cavity pressure

A is the area of the vent hole

S is the gross wall area of outer wythe

c is the discharge coefficient of vent hole (j)

a is the equivalent orifice area of outer wythe

P_j is the wind pressure on the vent hole (j)

Equation 4.3 can be applied for the cases 7-12, whereas equation 4.2 can be applied forthe cases 13-15.

c) Analysis of Data

Using the notation:

$$Y = \bar{P} - P_c \tag{4.4}$$

$$X = \frac{A}{S}\sum(P_j - P_c)^{1/2} \tag{4.5}$$

$$k = \frac{c}{a}\left(\frac{2}{\rho}\right)^{1/2} \tag{4.6}$$

If there is only one vent hole, then

$$X = \frac{A}{S}(P-P_c)^{1/2} \qquad (4.7)$$

and equation 4.2 becomes

$$Y + k X = 0 \qquad (4.8)$$

Using regression analysis, predictions of one variable can be obtained by using known values of the another. These predictions are made by means of the equation 4.8, which provides the estimate of the unknown variable Y when the value of another variable X is known $Y=-kX$ for which the regression line passes through zero.

Figures 4.26-4.34 show the observed data and a fitted regression line to these data. The line of fit has been accomplished by using the computer program Statgraphics [125]. It should be emphasized that a straight line seems to be the appropriate function relating Y and X. Data tend to follow the predicted line.

Table 4.18 presents the predicted coefficient k for the cases 7-15, as well as the standard error and the coefficient of correlation (R-squared). The predicted value of k was $15000>k>6000$. This variation of k is due to the level of accuracy of the pressure readings from the multimanometer ($\pm$0.5Pa), and also due to the fact that k is a function of c and a, equation 4.6. The c is usually referred to as the discharge coefficient which is not constant, see equation 2.8. The c is a function of Reynolds number and the geometry of opening which may be regarded as

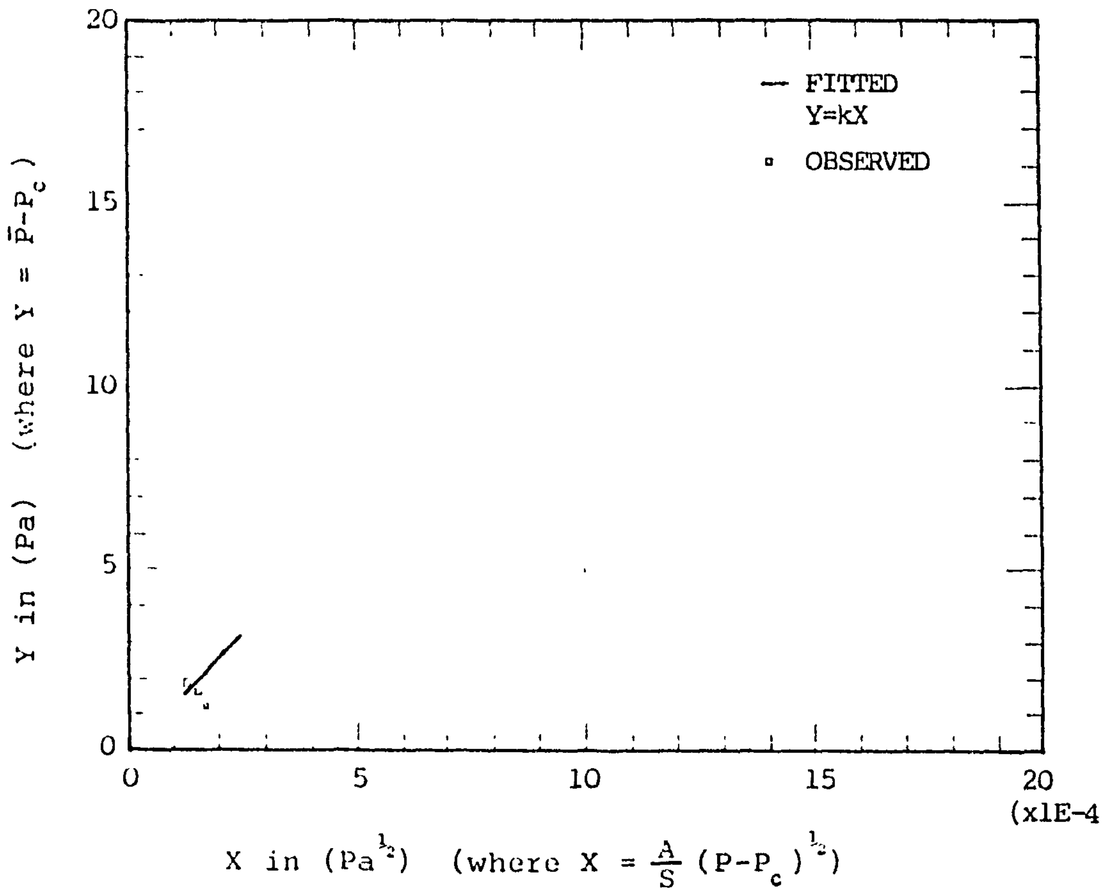


Figure 4.26 Regression line to the observed pressures Y for case 7 (one vent hole A10: 5cm x 1.6cm) The regression equation of the line is Y = 12583 X

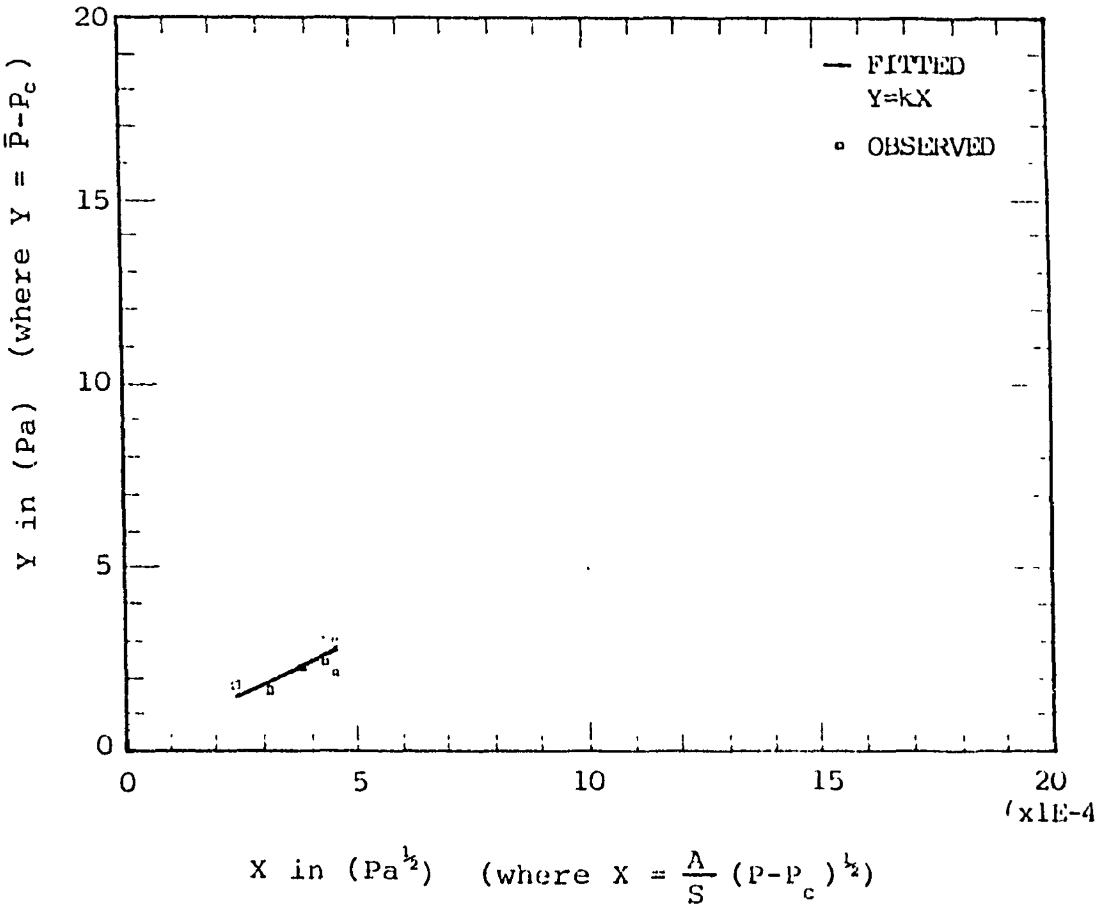


Figure 4.27 **Regression line to the observed pressures Y for case 8 (one vent hole A10: 5cm x 3.2cm) The regression equation of the line is Y = 5994 X**

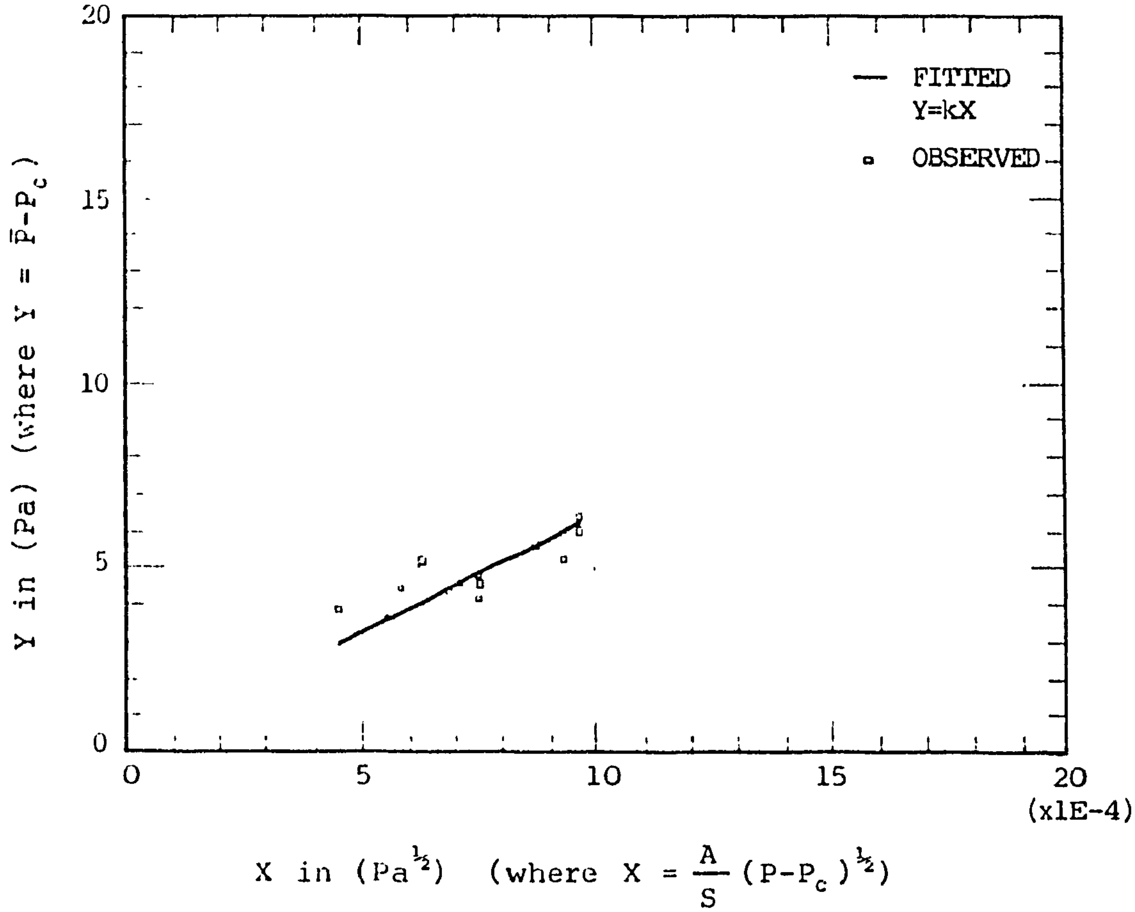


Figure 4.28 Regression line to the observed pressures Y for case 9 (one vent hole A10: 5cm x 6.5cm) The regression equation of the line is Y = 6451 X

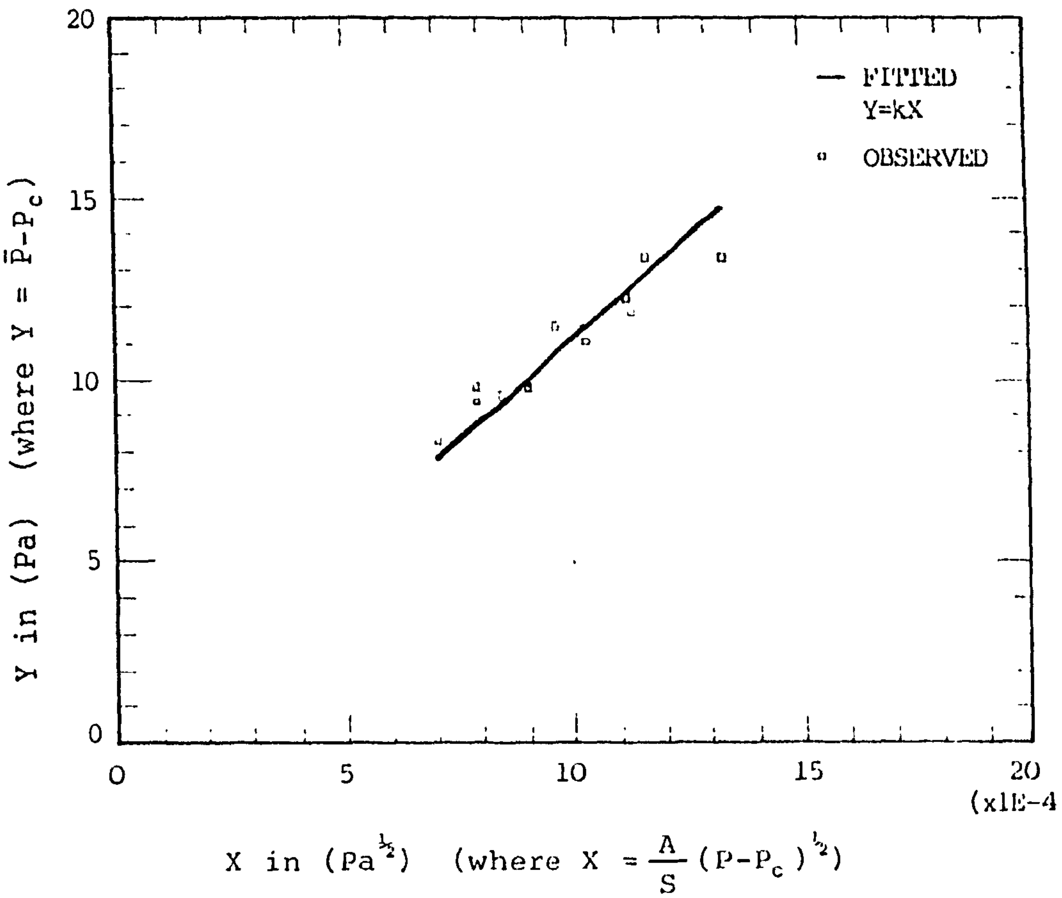


Figure 4.29 Regression line to the observed pressures Y for case 10 (one vent hole A10: 5cm x 13cm)
The regression equation of the line is Y = 11065 X

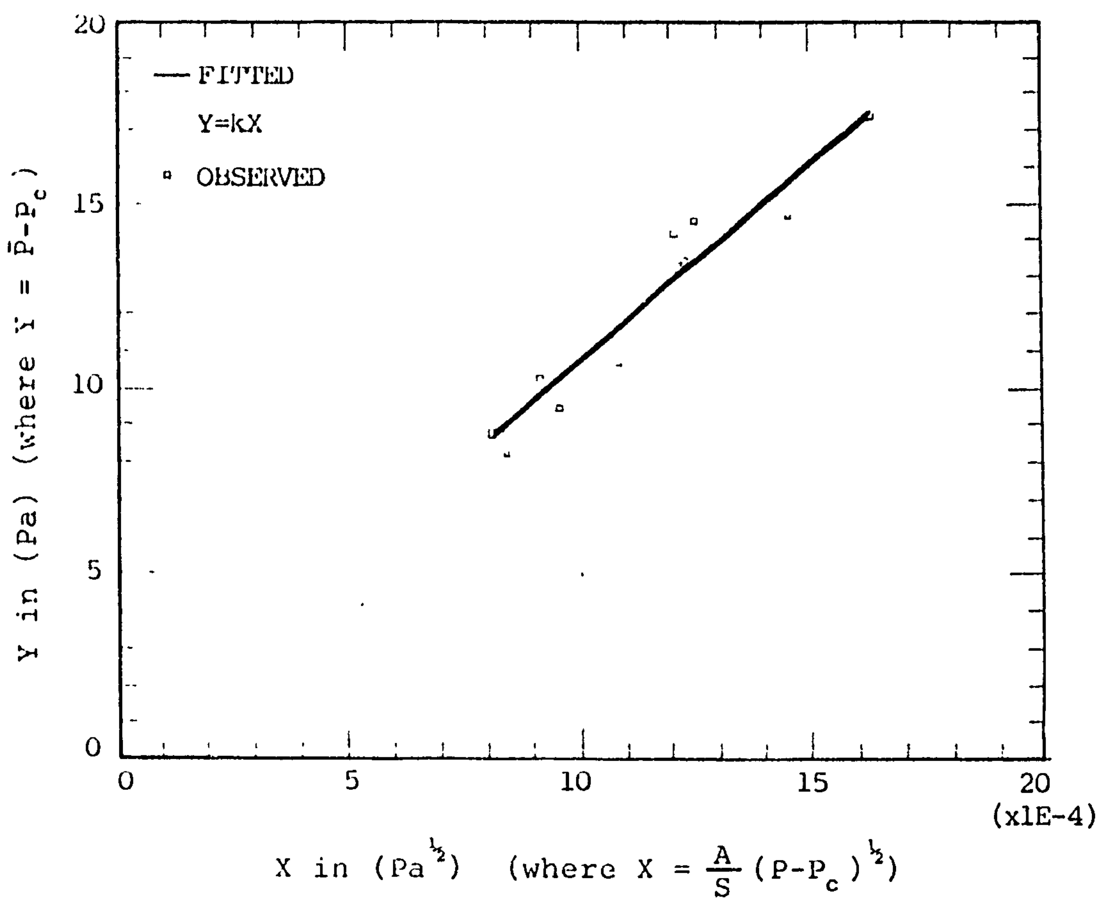


Figure 4.30 **Regression line to the observed pressures Y for case 11 (one vent hole A10: 5cm x 13cm) The regression equation of the line is Y = 10733 X**

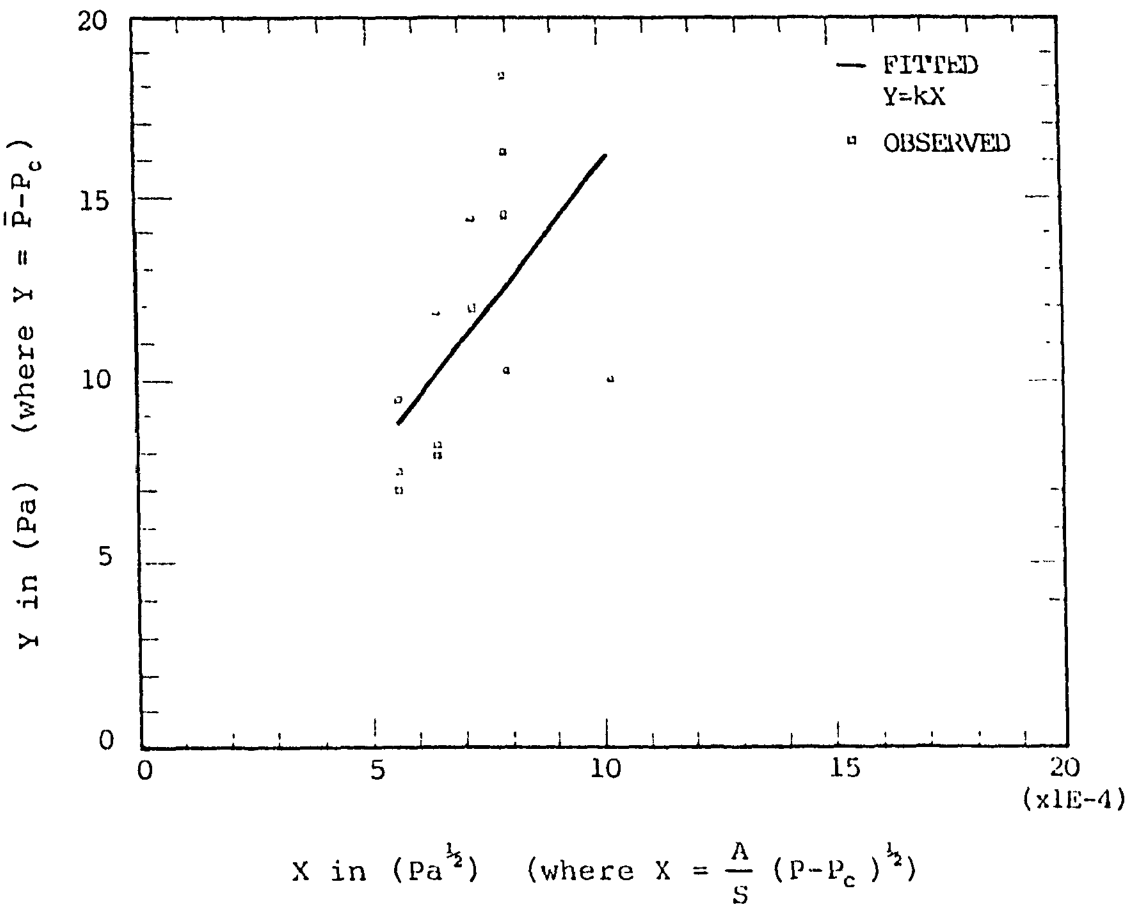


Figure 4.31 Regression line to the observed pressures Y for case 12 (one vent hole B12: 5cm x 13cm)
The regression equation of the line is Y = 15789 X

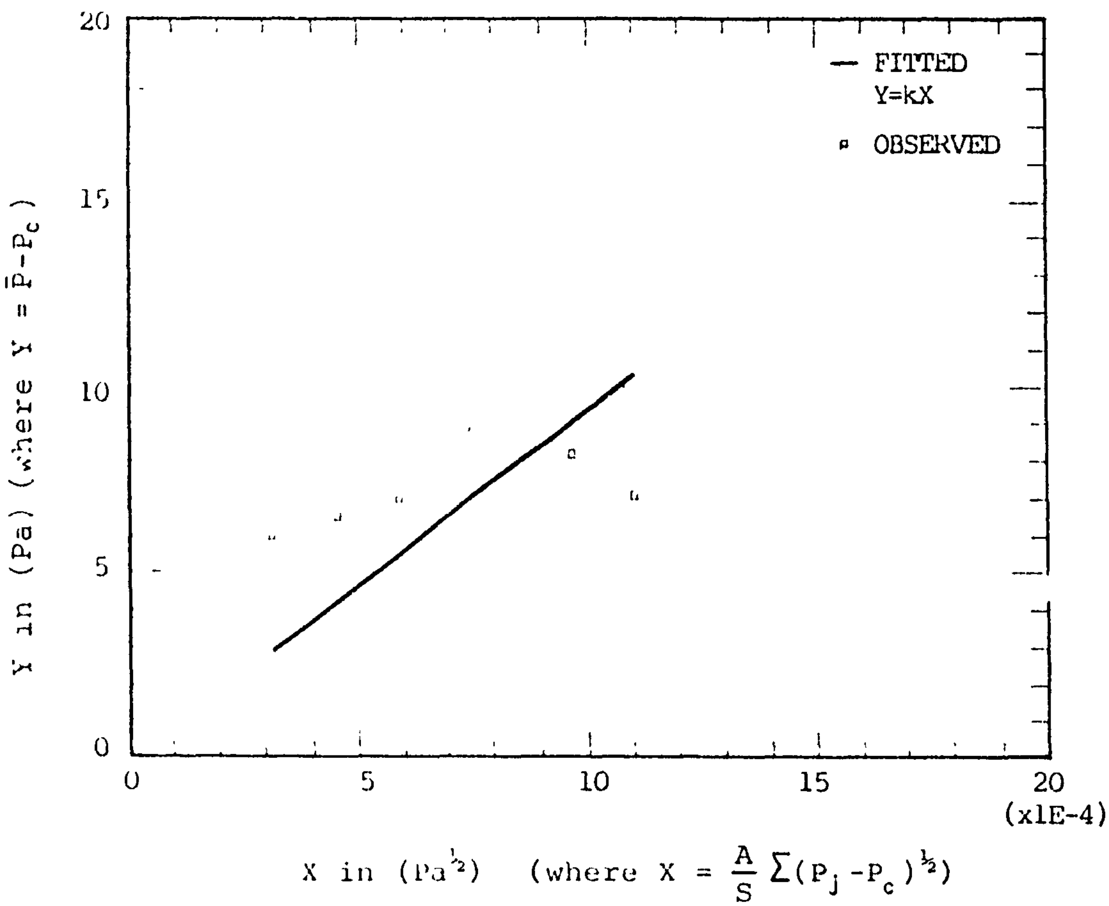


Figure 4.32 Regression line to the observed pressures Y for case 13 (two vent holes A10 and C6: 5cm x 13cm each) The regression equation of the line is Y = 9318 X

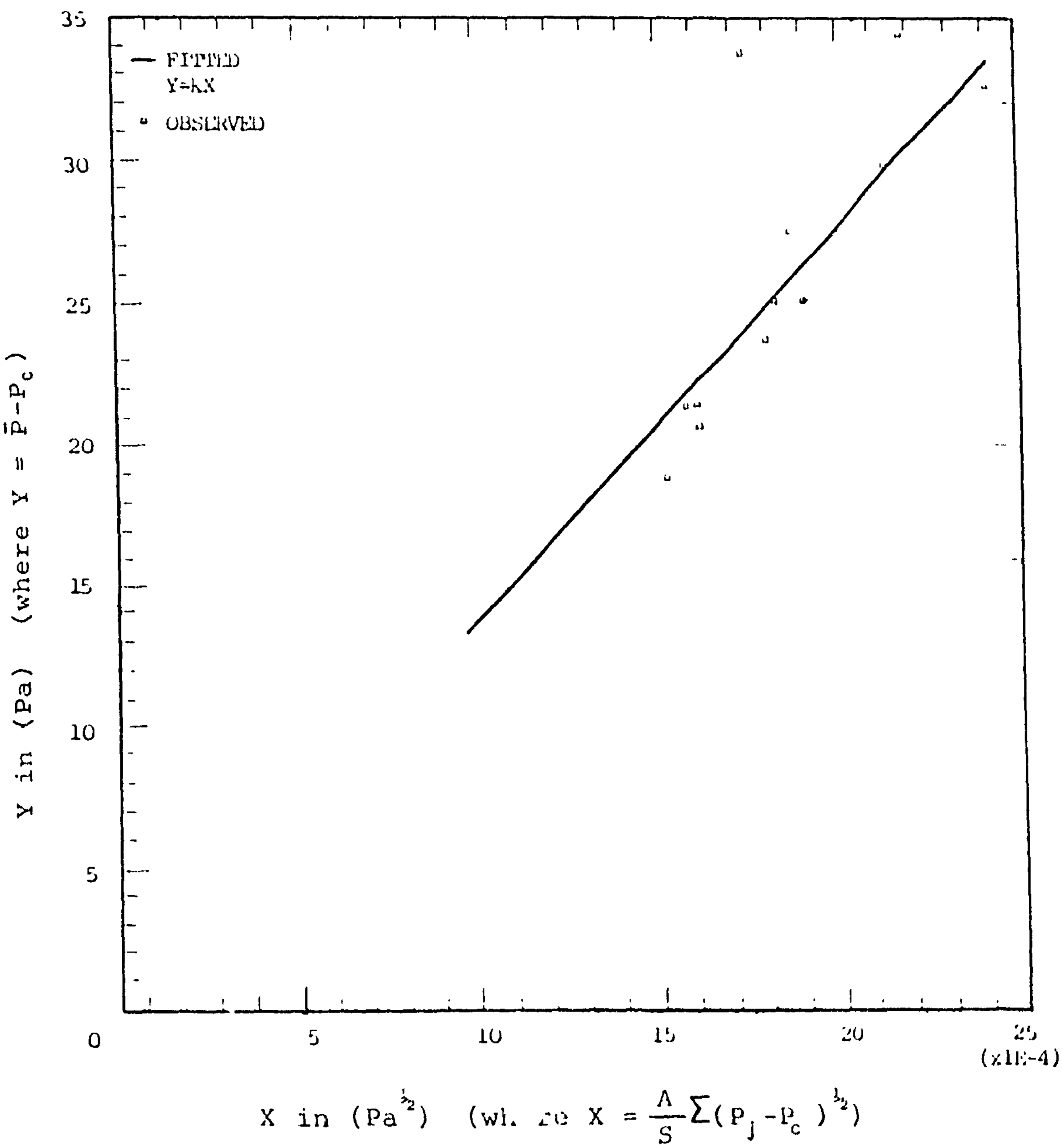


Figure 4.33 Regression line to the observed pressures Y for case 14 (two vent holes A6 and A10: 5cm x 13cm each) The regression equation of the line is Y = 13856 X

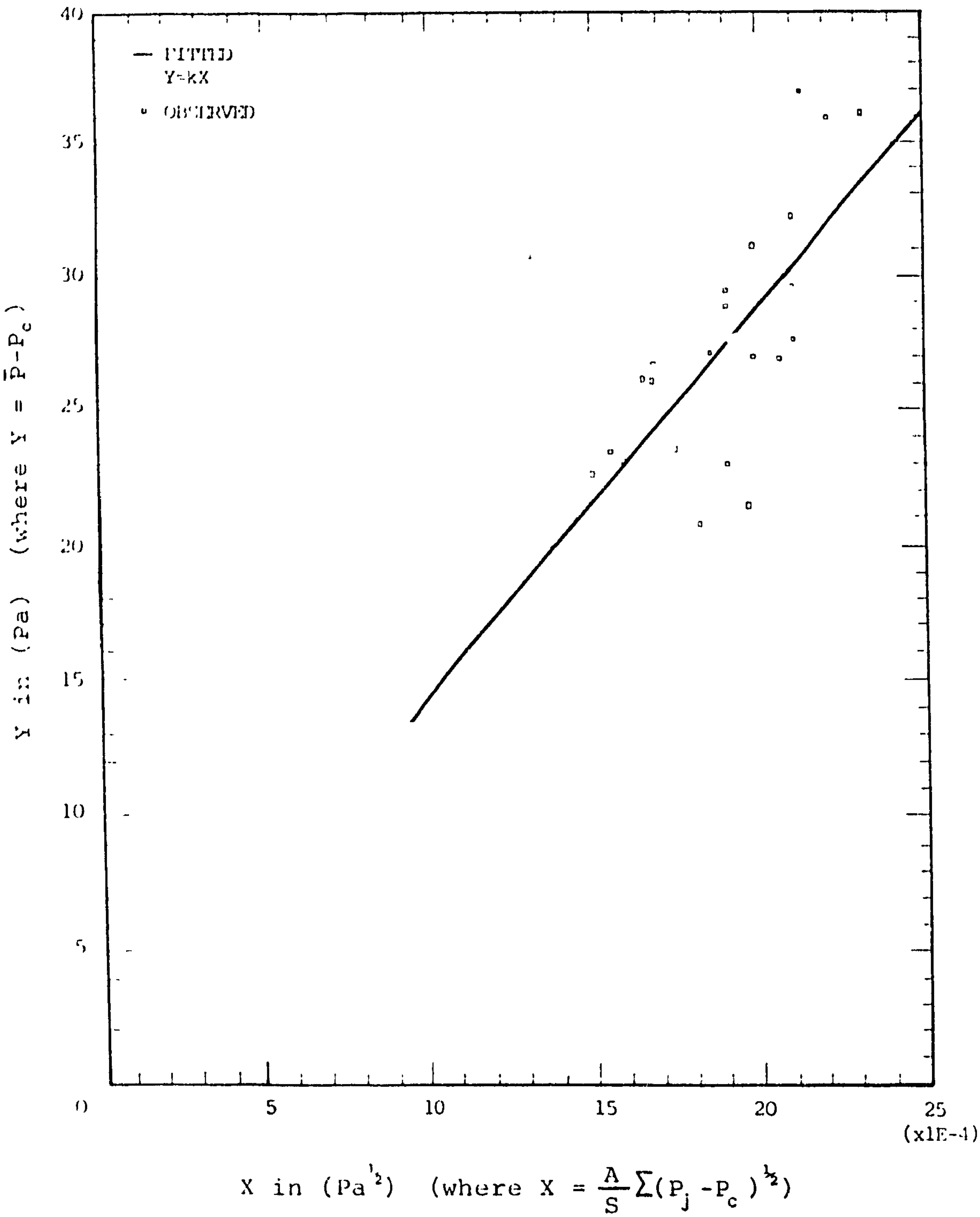


Figure 4.34 Regression line to the observed pressures Y for case 15 (three vent holes A6, A10, A13: 5cm x 13cm each) The regression equation of the line is Y = 14449 X

Table 4.18: Predicted coefficient k for the cases 7-15

CASE	EXPERIMENT No. (OBSERVATIONS)	COEFFICIENT (PREDICTED) k	TOTAL VENT AREA cm^2	STANDARD ERROR	CORREL. COEF. R^2
7	5	12583	9	1653	0.93
8	7	5994	16	372	0.97
9	12	6451	32.5	228	0.98
10	13	11065	65	182	0.99
11	11	10733	65	198	0.99
12	14	15789	65	1155	0.93
13	6	9318	130	1363	0.90
14	14	13856	130	561	0.98
15	32	14449	195	396	0.97

a constant for openings with a typical dimension greater than about 10mm. Table 4.18 shows the predicted coefficient k for cases 7-15. The variation of k in cases 7-9 may also be due to the change of the vent hole size which affects the discharge coefficient. A small variation of k in cases 10-11 is due to the vent hole size and location which remained unchanged. In case 12 the location of the vent hole was changed. In cases 13-14 the location and size of the vent hole have been changed. The variation in the discharge coefficient of vent holes was also observed in laboratory experiments and was mentioned in equation 3.24. Since the value of k is a function of discharge coefficient of vent holes and coefficient of cracks a variation of k is unavoidable.

4.3.5 Various Cases With Valves

a) Experimental data

To validate the new wall system of pressurized cavity wall, a few valves were installed in the vent holes and tested. During the winter there were no problems with valves and the valves were vibrating all the time.

Cases 16-18 were tested under different wind conditions; 86 experiments were performed. Figure 4.35 shows a typical picture of the multimanometer with respect to case 18. Some of the pictures for the cases 16-18 are included in Appendix C. In the case 16, one valve was installed close to the tap B12. Each valve consists of two contiguous holes of

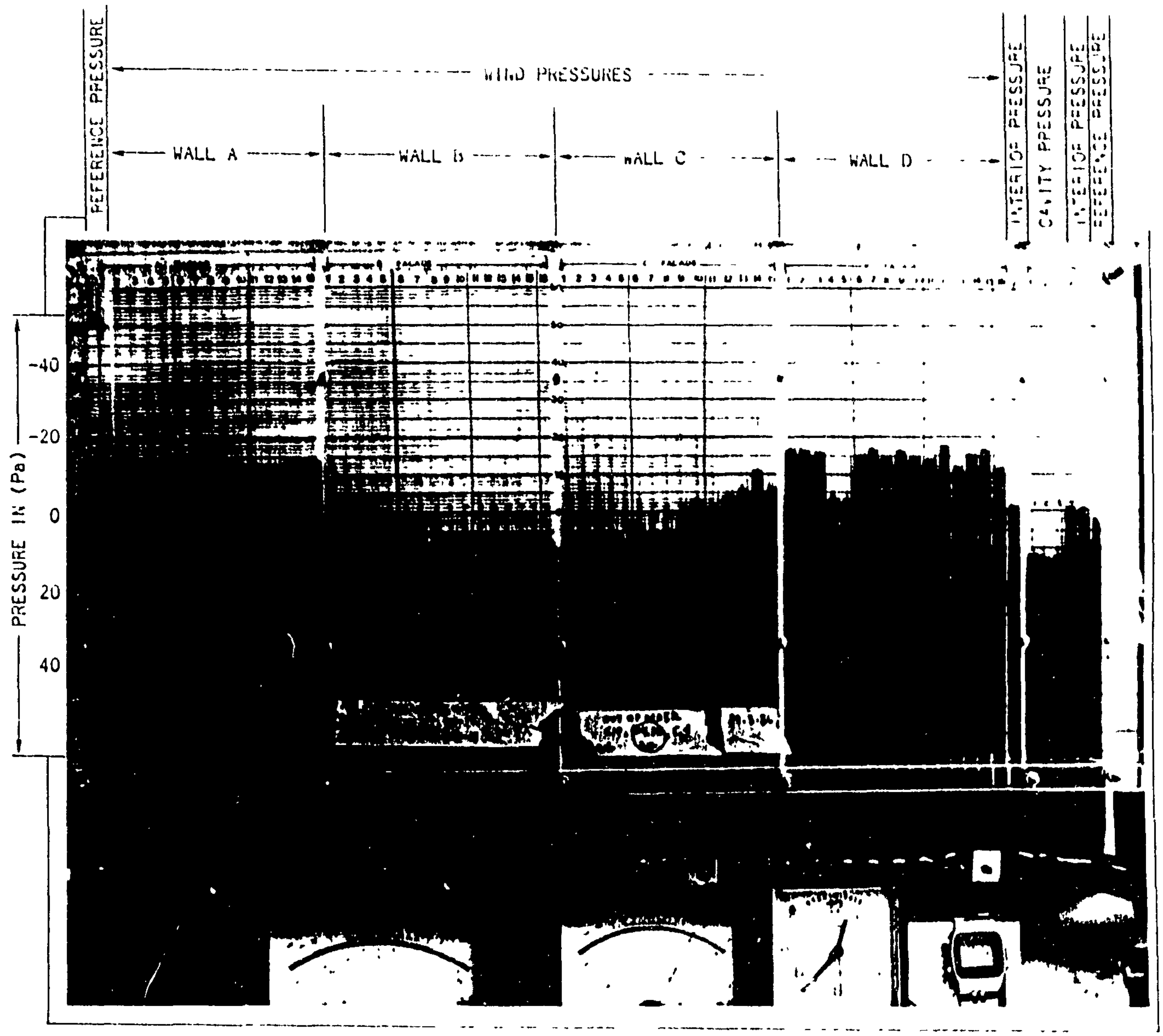


Figure 4.35 Wind and cavity pressure profile around building with three valves B5, B12 and B15 (Table 4.1, case 18, experiment 11)

round opening of 2.8cm radius. In the case 17, two valves were installed. In the case 18, three valves were installed close to taps B5, B12 and B15 respectively.

In Tables 4.19-4.21 the values of mean wind pressure $\bar{P}$ and cavity pressures P_c were calculated for the cases 16-18; the wind pressures on the valves as well as the wind and cavity pressures were extracted from Appendix B. Cavity pressure was increased in cases 17 and 18.

b) Analytical Model

An open valve behaves like a vent hole. Since the valves were vibrating, their hole area is unknown. But the previous equation 4.7 can be used, where A is the area of valve hole and a different k value will be obtained (k').

c) Analysis of Data

Since a valve was not open all the time it may be assumed that a percentage of valve area is working like a vent hole. It can also be shown that a valve works like a smaller vent hole than its size.

The coefficient k of the experiment cases 7-15 with vent holes is:

$$k = \frac{c}{d}\left(\frac{2}{\rho}\right)^{1/2} \qquad (4.9)$$

The coefficient k'of the experiment cases 16-18 with valves is:

Table 4.19 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c, Y, X and k for the experiments of case 16 (with one valve B12)

EXPERIMENT NO	FILM NO	POSE NO	$\bar{P}$ Pa	P_c Pa	Y $\bar{P}-P_c$ Pa	P_{B12} Pa	$(P_{B12}-P_c)^{1/2}$ $Pa^{1/2}$	A_h cm^2	X $Pa^{1/2}$	k $Pa^{1/2}$
1	4	41	-3.1	1.0	-4.1	11	3.2	28	0.0008791	4660
2	4	42	-4.0	-1.0	-3.0	8	3.0	28	0.0008340	3560
3	4	43	-4.0	-1.0	-3.0	8	3.0	28	0.0008340	3649
4	4	44	-4.2	-1.0	-3.2	8	3.0	28	0.0008340	3836
5	4	1	-4.1	-1.0	-3.1	8	3.0	28	0.0008340	3759
6	4	2	-4.2	-1.0	-3.2	7	2.8	28	0.0007863	4075
7	4	3	-4.1	-1.0	-3.1	6	2.6	28	0.0007355	4154
8	4	4	-3.0	0.0	-3.0	8	2.8	28	0.0007863	3807
9	4	5	-3.3	-1.0	-2.3	7	2.8	28	0.0007863	2929
10	4	6	-3.4	-1.0	-2.4	6	2.6	28	0.0007355	3203
11	4	7	-3.4	-1.0	-2.4	5	2.4	28	0.0006809	3525
12	4	8	-3.5	-1.0	-2.5	7	2.8	28	0.0007863	3226
13	4	9	-3.6	0.0	-3.6	9	3.0	28	0.0008340	4297
14	4	10	-4.6	-1.0	-3.6	8	3.0	28	0.0008340	4349
15	4	11	-4.2	-1.0	-3.2	9	3.2	28	0.0008791	3685
16	4	12	-4.2	0.0	-4.2	12	3.5	28	0.0009630	4341
17	4	13	-4.1	1.0	-5.1	14	3.6	28	0.0010023	5059
18	4	14	-3.9	0.0	-3.9	11	3.3	28	0.0009220	4197
19	4	15	-3.4	0.0	-3.4	9	3.0	28	0.0008340	4024
20	4	16	-4.4	-1.0	-3.4	7	2.8	28	0.0007863	4310
21	4	17	-3.5	-1.0	-2.5	7	2.8	28	0.0007863	3129
22	4	18	-2.4	1.0	-3.4	10	3.0	28	0.0008340	4136
23	4	19	-2.4	1.0	-3.4	12	3.3	28	0.0009220	3712
24	4	20	-3.3	0.0	-3.3	11	3.3	28	0.0009220	3534
25	4	21	-3.3	0.0	-3.3	9	3.0	28	0.0008340	3906
26	4	22	-3.3	0.0	-3.3	8	2.8	28	0.0007863	4198
27	4	23	-3.3	0.0	-3.3	8	2.8	28	0.0007863	4167
28	4	24	-3.2	-1.0	-2.2	7	2.8	28	0.0007863	2759
29	4	25	-4.1	-2.0	-2.1	6	2.8	28	0.0007863	2628
30	4	26	-4.1	-2.0	-2.1	6	2.8	28	0.0007863	2722
31	4	27	-3.2	-1.0	-2.2	7	2.8	28	0.0007863	2787
32	4	28	-2.2	0.0	-2.2	8	2.8	28	0.0007863	2839
33	4	29	-2.2	0.0	-2.2	8	2.8	28	0.0007863	2834
34	4	30	-2.3	0.0	-2.3	8	2.8	28	0.0007863	2883
35	4	31	-2.5	0.0	-2.5	6	2.4	28	0.0006809	3739

Table 4.20 Calculated mean wind pressures $\bar{P}$, cavity pressures P_c, Y, X and k for the experiments of case 17 (with two valves B12, B15)

EXPERIMENT NO	FILM NO	POSE NO	$\bar{P}$ Pa	P_c Pa	Y $(\bar{P}-P_c)$ Pa	P B12 Pa	$(P-P_c)^{1/2}$ B12 $Pa^{1/2}$	P B15 Pa	$(P-P_c)^{1/2}$ B15 $Pa^{1/2}$	P D12 Pa	$(P-P_c)^{1/2}$ D12 $Pa^{1/2}$	cm^2	X $Pa^{1/2}$	k $Pa^{1/2}$
1	6	9	-2.8	3.0	-5.8	10	2.6	11	2.8	-10	0.0	28	0.0015218	3789
2	6	10	-2.5	2.0	-4.5	6	2.0	7	2.2	-9		28	0.0011776	3797
3	6	11	-4.4	-3.0	-1.4	0	1.7	-4	0.0	-14		28	0.0004815	2943
4	6	12	-5.8	-4.0	-1.8	1	2.2	-5	0.0	-20		28	0.0006216	2825
5	6	13	-4.8	-1.0	-3.8	4	2.2	1	1.4	-16		28	0.0010147	3704
6	6	14	-5.3	-2.0	-3.3	2	2.0	0	1.4	-12		28	0.0009491	3426
7	6	15	-5.5	-1.0	-4.5	5	2.4	3	2.0	-12		28	0.0012369	3670
8	6	16	-4.4	1.0	-5.4	7	2.4	8	2.6	-14		28	0.0014164	3845
9	6	17	-3.9	1.0	-4.9	7	2.4	8	2.6	-15		28	0.0014164	3435
10	6	18	-4.1	3.0	-7.1	8	2.2	12	3.0	-17		28	0.0014556	4909
11	6	19	-2.4	5.0	-7.4	10	2.2	14	3.0	-14		28	0.0014556	5087
12	6	20	-2.5	4.0	-6.5	9	2.2	12	2.8	-14		28	0.0014079	4616
13	6	21	-2.4	3.0	-5.4	7	2.0	10	2.6	-13		28	0.0012915	4181
14	6	22	-2.5	2.3	-4.8	7	2.2	9	2.6	-13		28	0.0013183	3635
15	6	23	-2.2	7.0	-9.2	13	2.4	16	3.0	-16		28	0.0015149	6096
16	6	24	-6.3	7.0	-13.3	17	3.2	20	3.6	-20		28	0.0018814	7060
17	6	25	-7.4	10.0	-17.4	21	3.3	26	4.0	-24		28	0.0020340	8534
18	6	26	-8.0	7.0	-15.0	19	3.5	20	3.6	-23		28	0.0019653	7614
19	6	27	-5.2	8.0	-13.2	17	3.0	20	3.5	-19		28	0.0017970	7336
20	6	28	-4.1	8.0	-12.1	17	3.0	21	3.6	-18		28	0.0018363	6599
21	6	29	-4.1	6.3	-10.4	14	2.8	17	3.3	-17		28	0.0016776	6201
22	6	30	-2.9	5.7	-8.6	12	2.5	15	3.1	-15		28	0.0015489	5549
23	6	31	-3.7	4.0	-7.7	11	2.6	13	3.0	-15		28	0.0015695	4915
24	6	32	-3.4	2.0	-5.4	7	2.2	9	2.6	-14		28	0.0013571	4006
25	6	33	-2.3	2.0	-4.3	7	2.2	9	2.6	-12		28	0.0013571	3190
26	6	34	-4.2	0.0	-4.2	4	2.0	6	2.4	-15		28	0.0012369	3364
27	6	35	-4.7	6.0	-10.7	14	2.8	17	3.3	-18		28	0.0017083	6276
28	6	36	-4.1	6.3	-10.4	14	2.8	17	3.3	-16		28	0.0016776	6194
29	6	37	-4.0	4.0	-8.0	12	2.8	13	3.0	-13		28	0.0016203	4911
30	6	38	-4.2	1.0	-5.2	7	2.4	8	2.6	-15		28	0.0014164	3686
31	6	39	-5.6	4.7	-10.3	13	2.9	16	3.4	-20		28	0.0017384	5915
32	6	40	-3.7	6.0	-9.7	14	2.8	17	3.3	-18		28	0.0017083	5664
33	6	41	-3.2	3.0	-6.2	9	2.4	11	2.8	-16		28	0.0014672	4216
34	6	42	-3.7	-1.0	-2.7	5	2.4	0	1.0	-21		28	0.0009589	2830
35	6	43	-5.2	1.0	-6.2	8	2.6	6	2.2	-24		28	0.0013571	4560
36	6	44	-4.8	2.0	-6.8	9	2.6	10	2.8	-22		28	0.0015218	4438
37	6	45	-5.3	4.3	-9.6	12	2.8	15	3.3	-22		28	0.0016776	5731
38	6	1	-3.5	2.0	-5.5	8	2.4	8	2.4	-19		28	0.0013619	4040

Table 4.21 **Calculated mean wind pressures $\bar{P}$, cavity pressures P_c, Y, X and k for the experiments of case 18 (with three valves B5, B12, B15)**

EXPERIMENT No.	FILM No.	POSE No.	$\bar{P}$ Pa	P_C Pa	Y $(\bar{P}-P_C)$ Pa	P B5 Pa	$(P-P_C)^{1/2}$ B5	P B12 Pa	$(P-P_C)^{1/2}$ B12 $Pa^{1/2}$	P B15 Pa	$(P-P_C)^{1/2}$ B15 $Pa^{1/2}$	cm	X $Pa^{1/2}$	k $Pa^{1/2}$
1	8	40	-2.5	3.0	-5.5	3	0.0	9	2.4	9	2.4	28	0.0013619	4013
2	8	41	-5.3	13.0	-18.3	17	2.0	26	3.6	24	3.3	28	0.0024803	7379
3	8	42	-6.3	10.0	-16.3	14	2.0	22	3.5	21	3.3	28	0.0024410	6676
4	8	43	-7.0	5.0	-12.0	8	1.7	13	2.8	12	2.6	28	0.0020033	5983
5	8	44	-4.8	5.0	-9.8	3		12	2.6	13	2.8	28	0.0015218	6459
6	8	1	-3.6	0.0	-3.6	0	0.0	5	2.2	6	2.4	28	0.0013025	2783
7	8	2	-5.0	1.0	-6.0	-1		7	2.4	10	3.0	28	0.0015149	3939
8	8	3	-3.5	0.0	-3.5	0	0.0	4	2.0	4	2.0	28	0.0011120	3123
9	8	4	-4.3	7.0	-11.3	7	0.0	15	2.8	16	3.0	28	0.0016203	6949
10	8	5	-5.1	6.0	-11.1	5		15	3.0	18	3.5	28	0.0017970	6195
11	8	6	-3.2	10.0	-13.2	7		18	2.8	23	3.6	28	0.0017886	7402
12	8	7	-4.6	1.0	-5.6	-1		8	2.6	7	2.4	28	0.0014164	3918
13	8	8	-4.2	2.0	-6.2	0		8	2.4	10	2.8	28	0.0014672	4256

$$k' = \frac{c'}{a}\left(\frac{2}{\rho}\right)^{1/2} \tag{4.10}$$

The discharge coefficient c of a vent hole is different from the discharge coefficient c′ of a valve, while the coefficient (a) of cracks of bricks is the same in both cases. By dividing (4.1) by (4.2) then:

$$\frac{k'}{k} = \frac{c'}{c}$$

or

$$c' = \frac{k'}{k}c \tag{4.11}$$

Therefore, the range of c′ can be calculated. Since $15000<k<6000$ and $6000<k'<4000$, for k = 15000 and k′ = 6000 then c′ = 0.37 c and for k = 6000 and k′ = 4000 then c′= 0.62.

Using regression analysis, predictions are made by means of equation 4.8. In Figures 4.36-4.38 the observed data and a fitted regression line are plotted for the cases 16-18 respectively. However it appears that this model is not giving the best fit to the observed values due to fact that the vent hole area is not constant (in case of valves).

Table 4.22 presents the predicted coefficient k′ for these cases as well as the standard error. As expected, k′ value is lower than the k value because a valve behaves like a vent hole of smaller area. The predicted value of k′ was $4000<k<6000$.

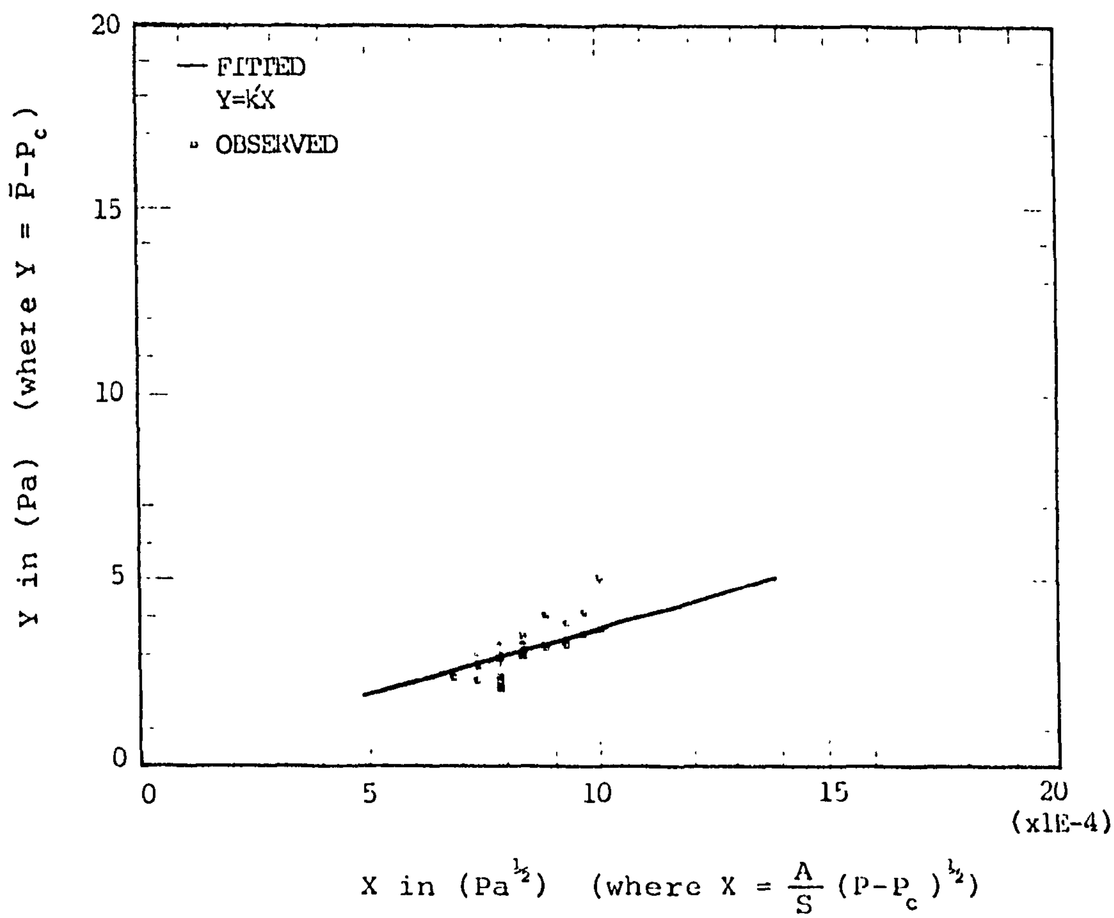


Figure 4.36 Regression line to the observed pressures Y for case 16 (one valve B12)
The regression equation of the line is Y = 3725 X

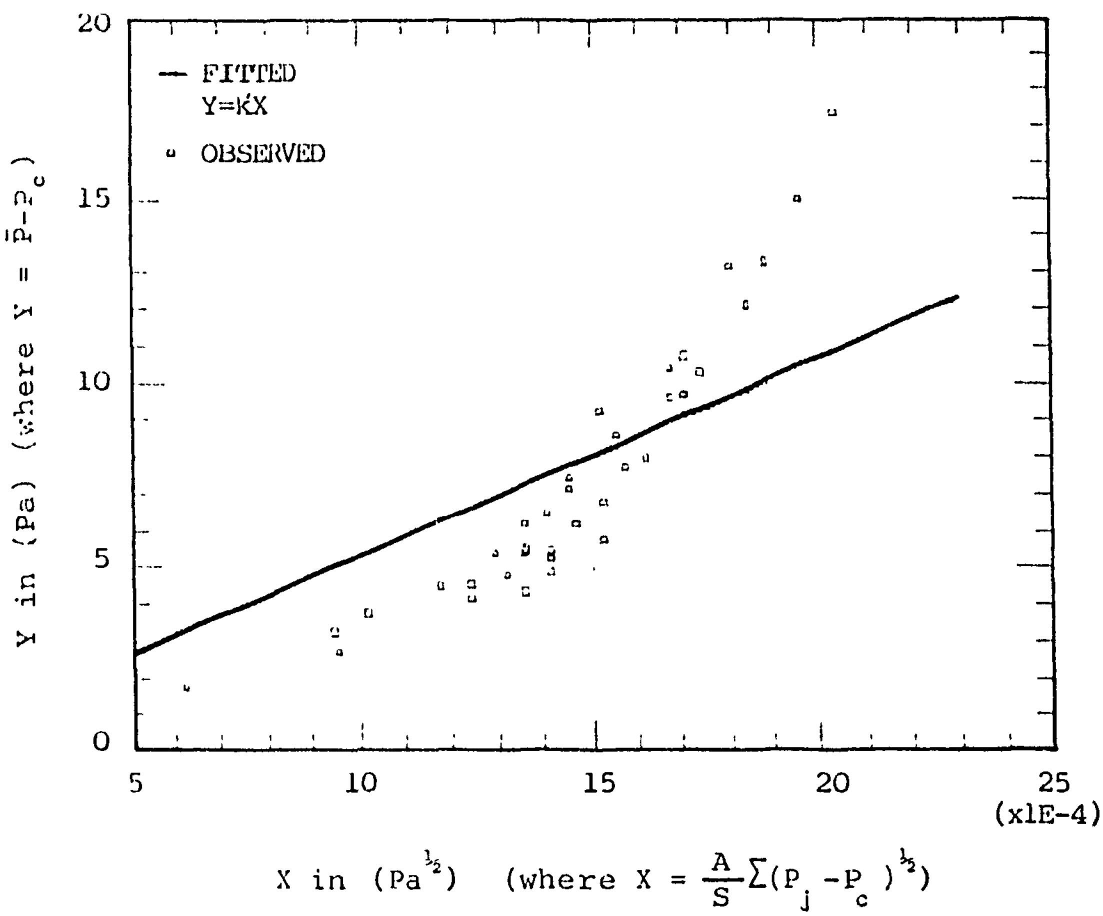


Figure 4.37 Regression line to the observed pressures Y for case 17 (two valves B12 and B15)
The regression equation of the line is Y = 5327 X

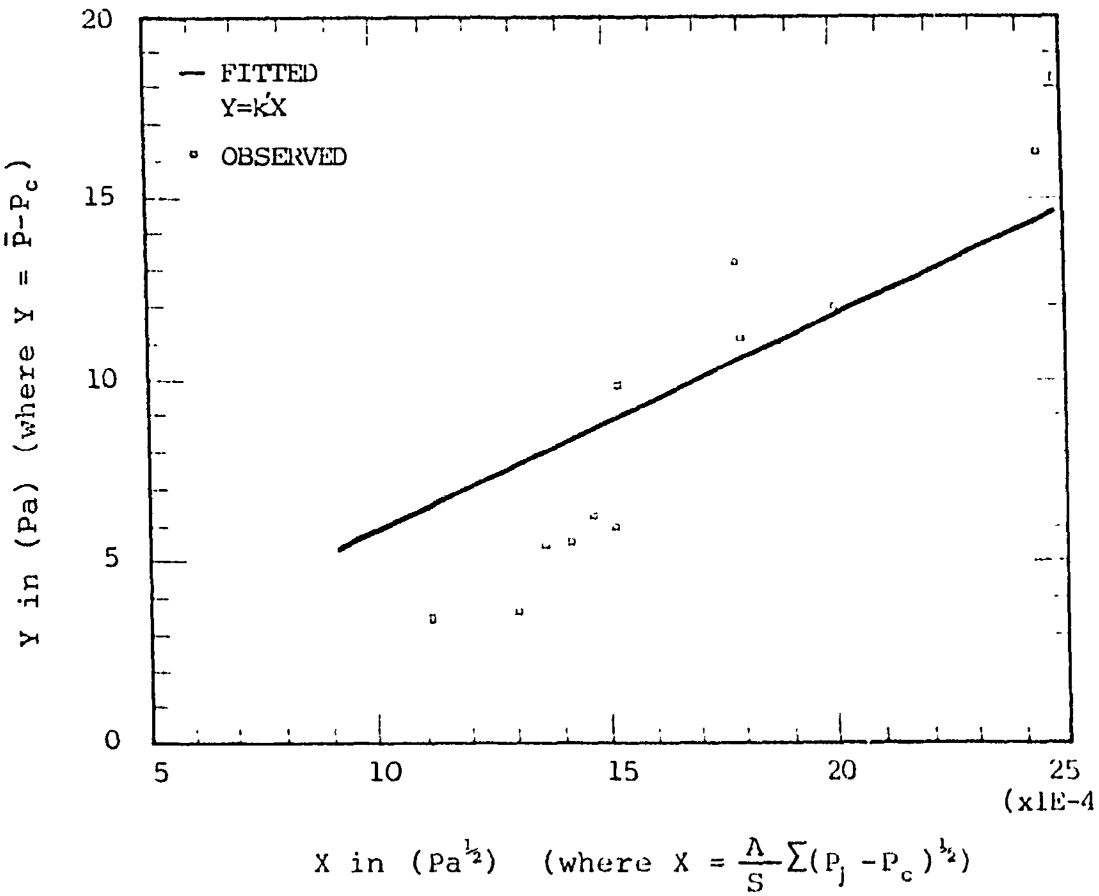


Figure 4.38 Regression line to the observed pressures Y for case 18 (three valves B5, B12 and B15)
The regression equation of the line is Y = 5890 X

Table 4.22 Predicted coefficient k′ for the cases 16-18

CASE	EXPERIMENT No. (OBSERVATIONS)	COEFFICIENT (PREDICTED) k′	TOTAL AREA OF VALVES (cm^2)	STANDARD ERROR	CORREL. COEF. R^2
16	35	3725	56	107	0.97
17	38	5327	112	244	0.93
18	13	5890	168	423	0.94

CHAPTER 5

5 ANALYSIS AND DISCUSSION

5.1. ANALYSIS AND DISCUSSION OF CASES 1-6

In cases 1-4 there were cracks on the outer wythe of the experimental station, while in cases 5 and 6 there were many small vent holes on the outer wythe. With the experimental work it was proven that mean wind pressure $\bar{P}$ was almost equal to cavity pressure P_c under different wind conditions. Numerical analysis of pressures has already been presented.

Figures 5.1-5.4 present graphs of instantaneous wind pressures on the four walls of the experimental station for cases 1, 2-3, 5 and 6 of experiments 8, 5, 1 and 20 respectively. In each figure there are three curves of wind pressures taken at different level heights such as 0.3m, 1.5m and 2.1m. The graphs show that the mean wind pressure $\bar{P}$ is almost equal to cavity pressure P_c.

Furthermore, Figures 5.1 and 5.3 show that the outer wythe of walls A and B is exposed to a positive pressure difference (wind pressures are greater than the cavity pressure). In Figure 5.2, the wind direction has changed and

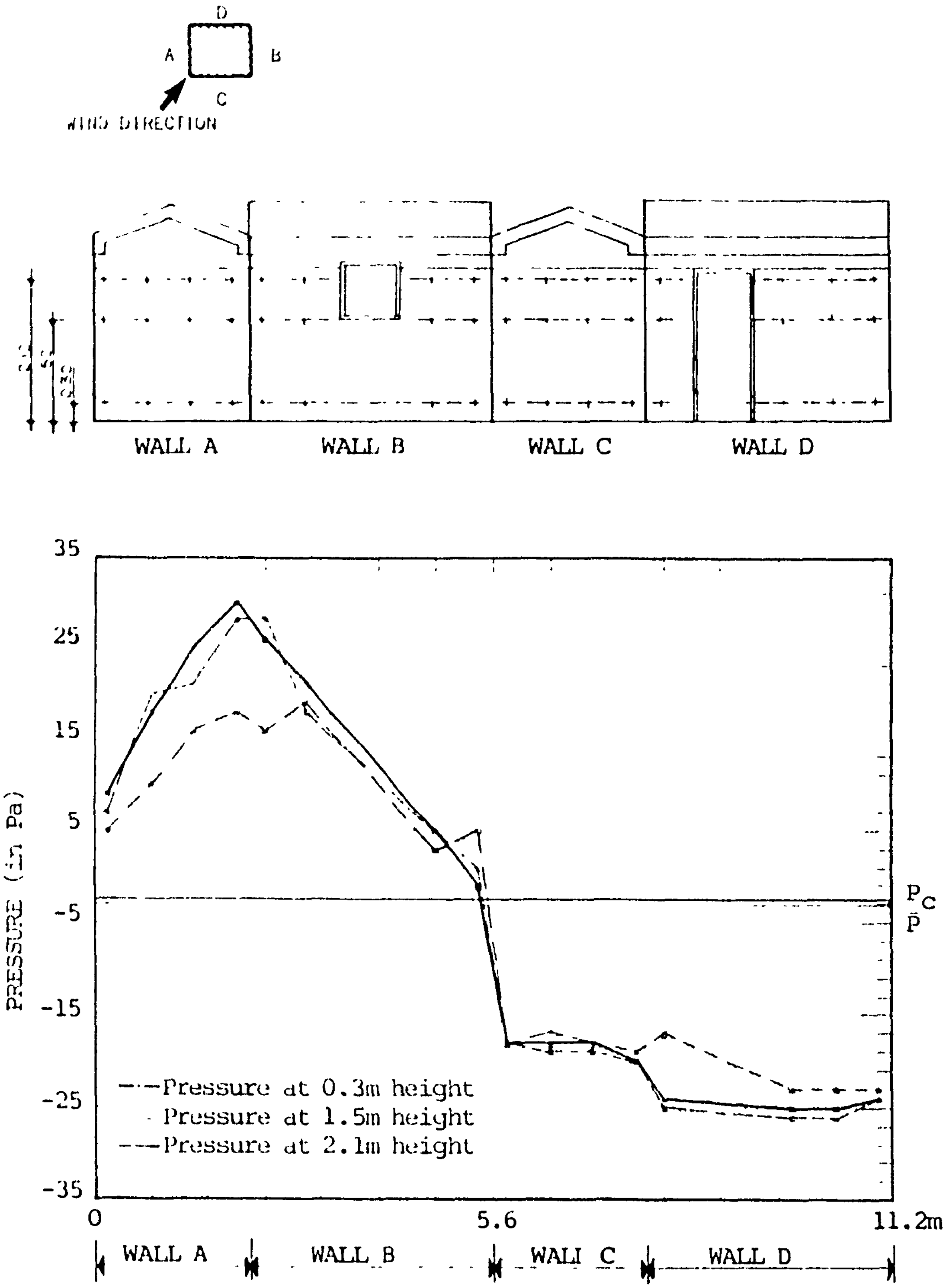


Figure 5.1 Distribution of wind pressures for the four walls of the experimental station; case 1, experiment 8 without vent holes

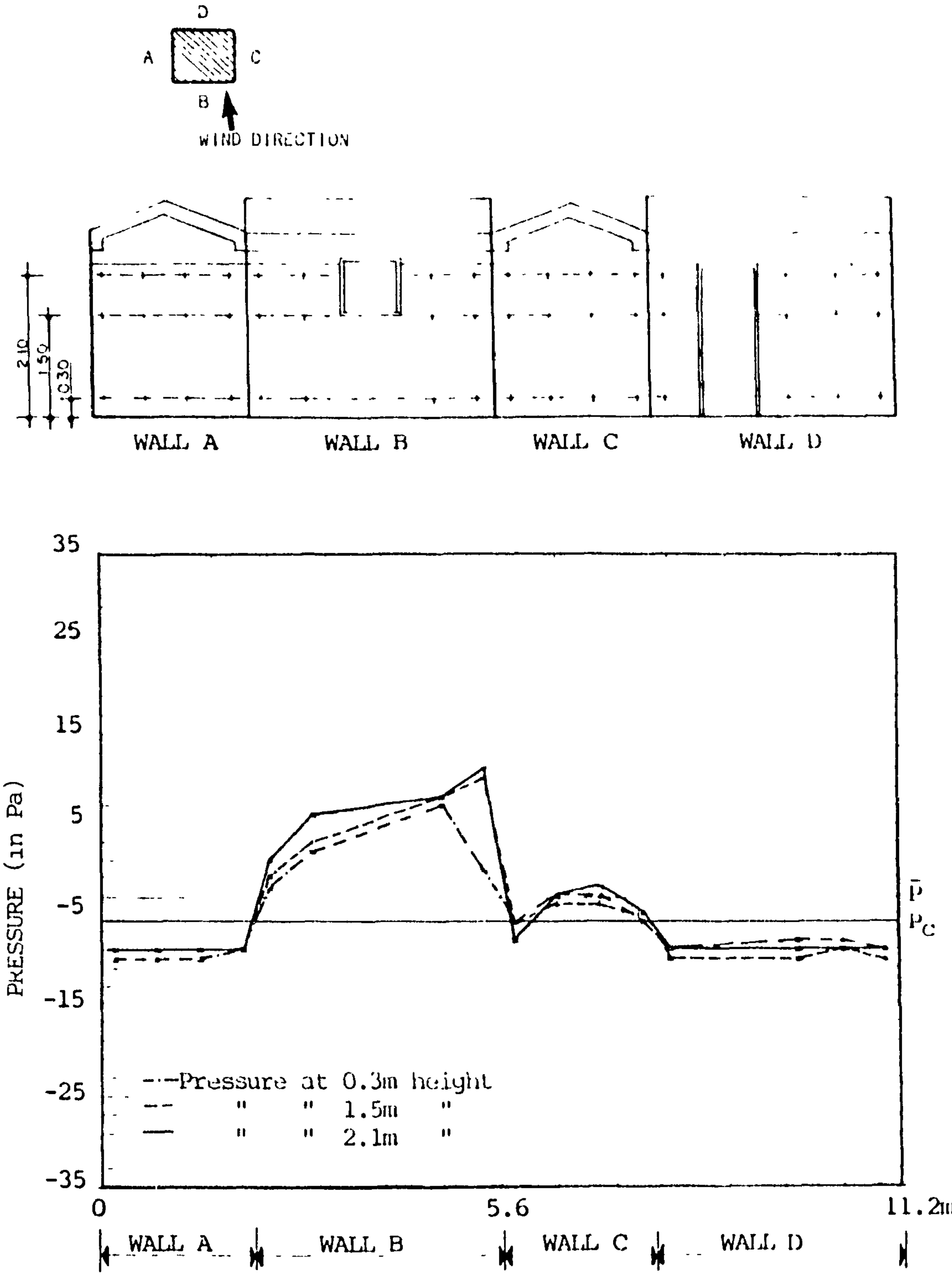


Figure 5.2 Distribution of wind pressures for the four walls of the experimental station; case 2-3, experiment 5 without vent holes

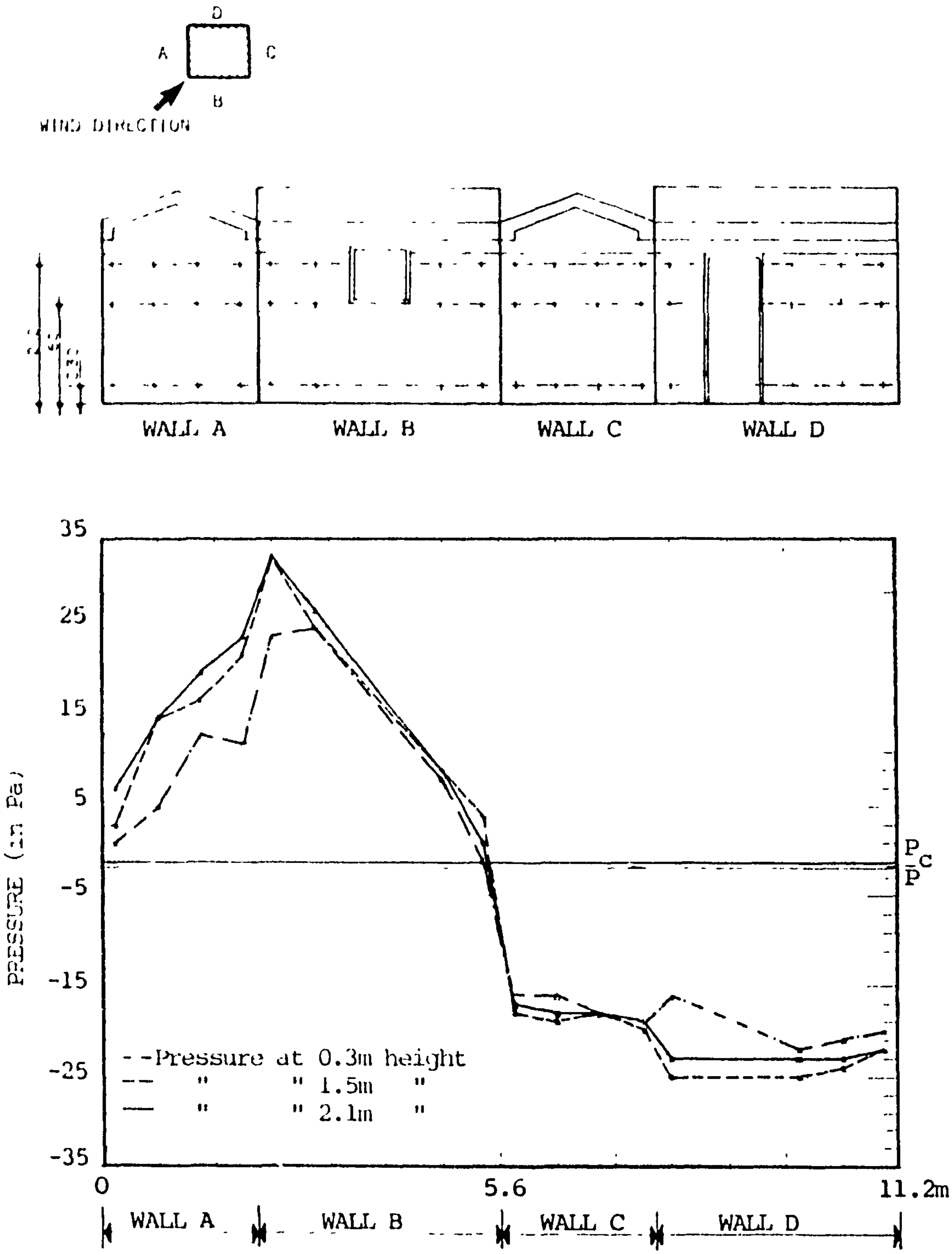


Figure 5.3 Distribution of wind pressures for the four walls of the experimental station; case 5, experiment 1 with many small vent holes

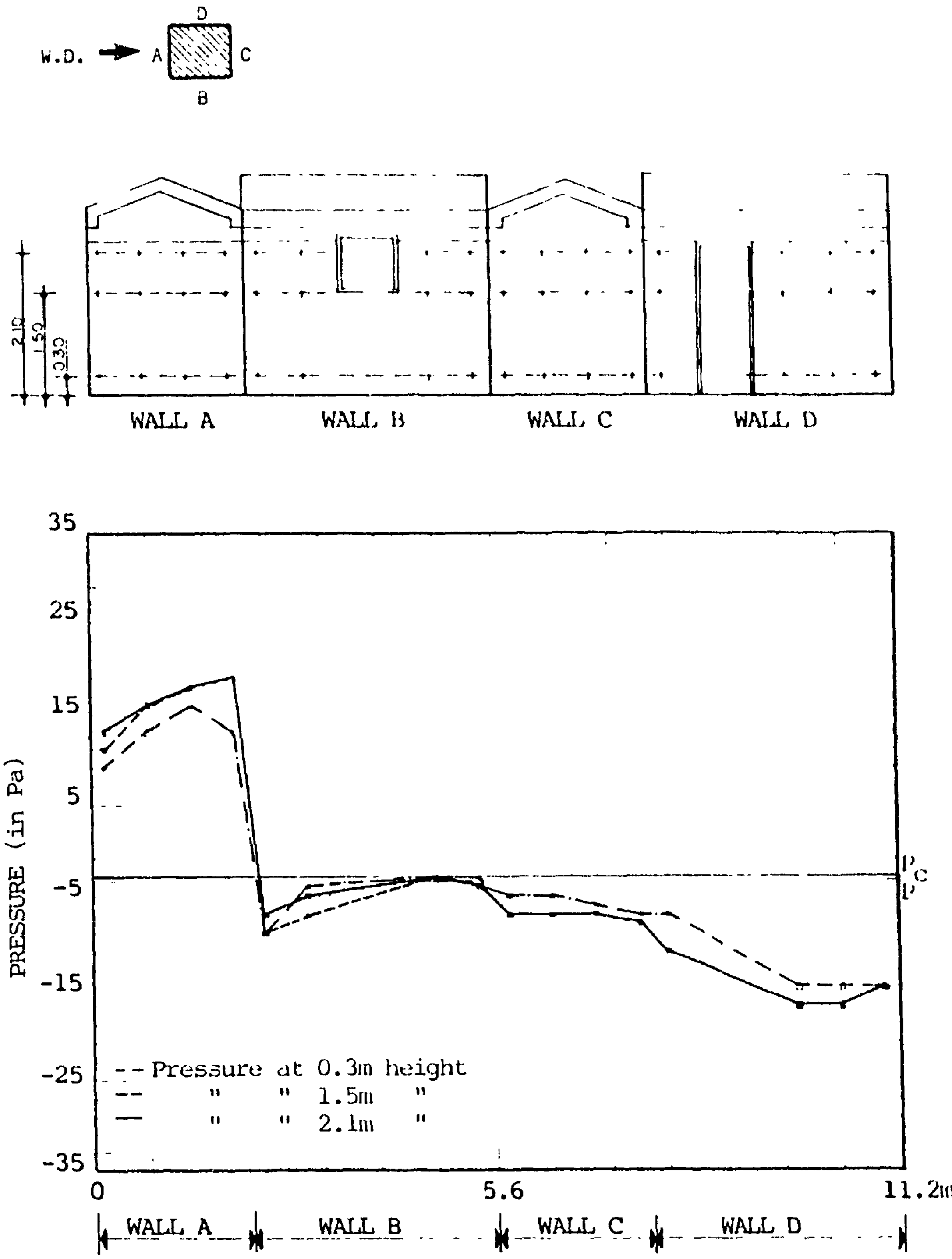


Figure 5.4 Distribution of wind pressures for the four walls of the experimental station case 6, experiment 20 with many small vent holes

the outer wythe of walls B and C is exposed to a positive pressure difference. Approximately, in all experiments, half of the total wall area of the outer wythe was exposed to a positive pressure difference which increases the risk of rain penetration.

5.2. ANALYSIS AND DISCUSSION OF CASES 7-18

In chapter 4 it was shown numerically that cavity pressure P_c increases when the vent holes on the windward wall are increased; while this chapter shows it graphically.

Figures 5.5-5.13 present graphs of instantaneous wind pressures on the four walls of the experimental station. The vent holes or valves are marked on the facades of the experimental station of these figures. The wind pressure at the vent hole or valve is also marked. In Figure 5.5 the vent hole was small (5cm x 1.6cm), see Table 4.1, but it was increased in the next cases. For example, in Figure 5.9 the vent hole was (5cm x 13cm) and in Figure 5.13 there were three vent holes (5cmx13cm) each. In Figure 5.5 the cavity pressure P_c was close to the mean wind pressure $\bar{P}$, but it was increased in the next cases (Figures 5.6-5.13) while the mean wind pressure remained the same. The cavity pressure reached a maximum value in case 15, experiment 3, Figure 5.13 (it increased from -4Pa to 30Pa). In the same figure, the outer wythe of wall A is exposed to a minimum pressure difference; only a small part of the facades of the

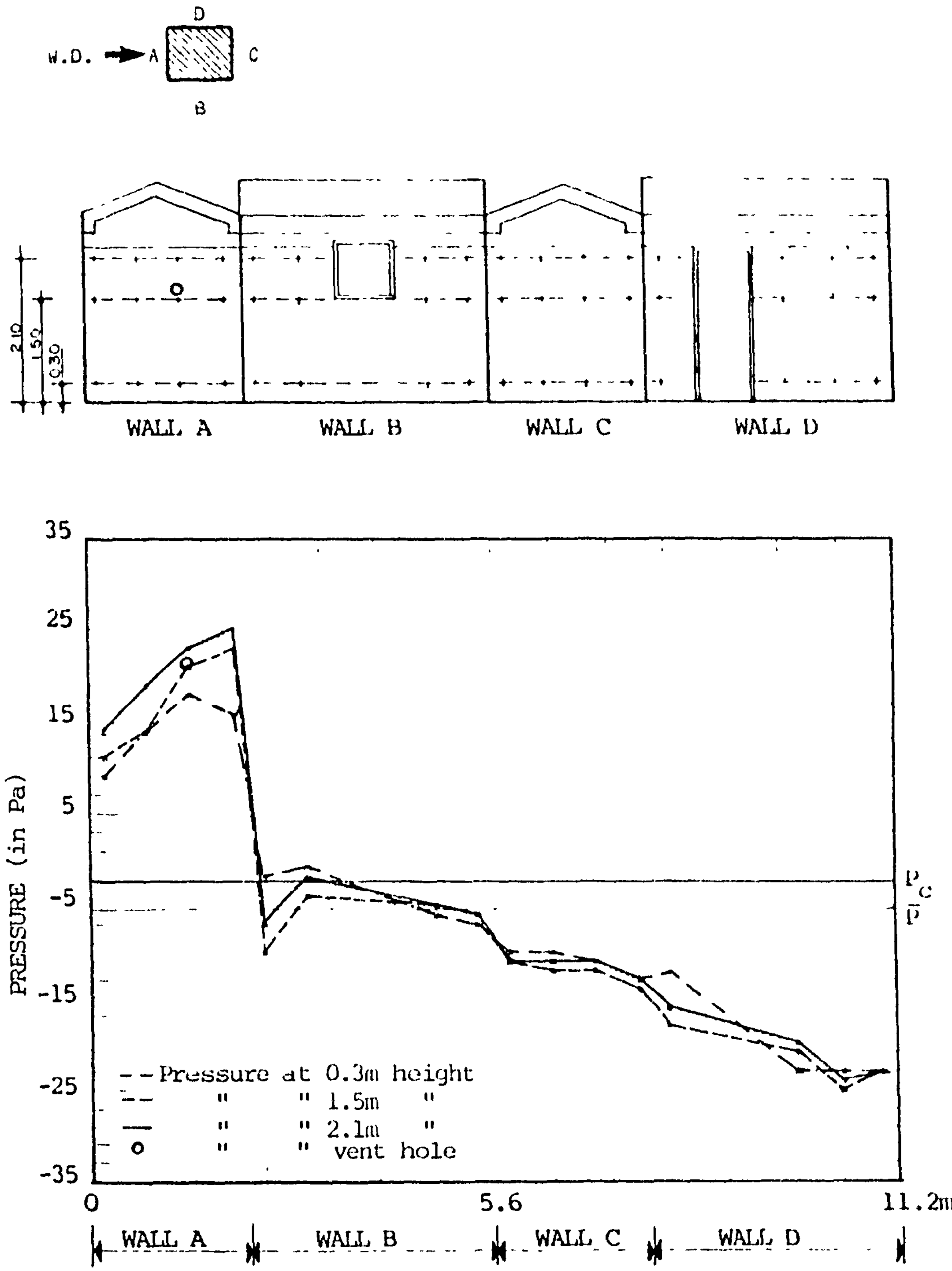
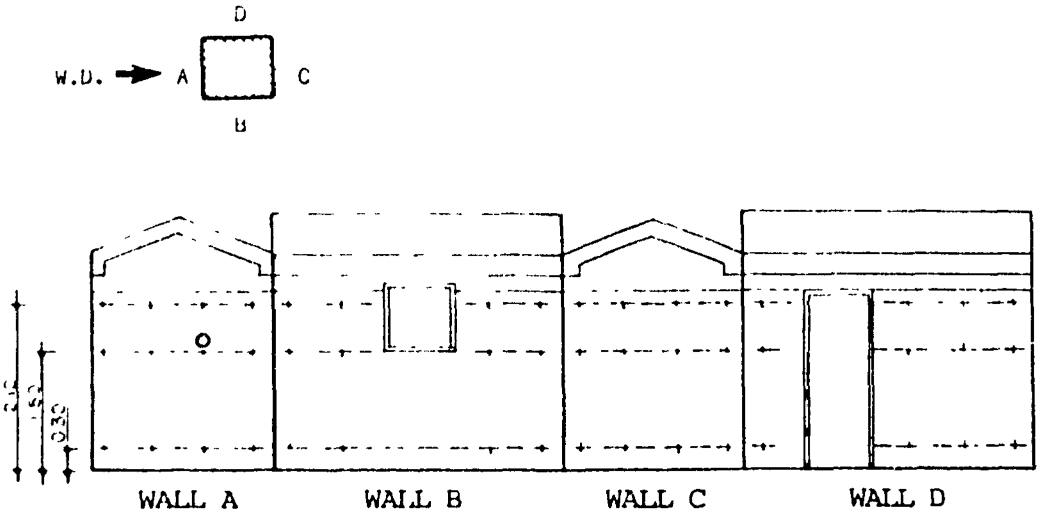


Figure 5.5 Distribution of wind pressures for the four walls of the experimental station; case 7, experiment 1 with one vent hole A10 (5cm x 1.6cm)



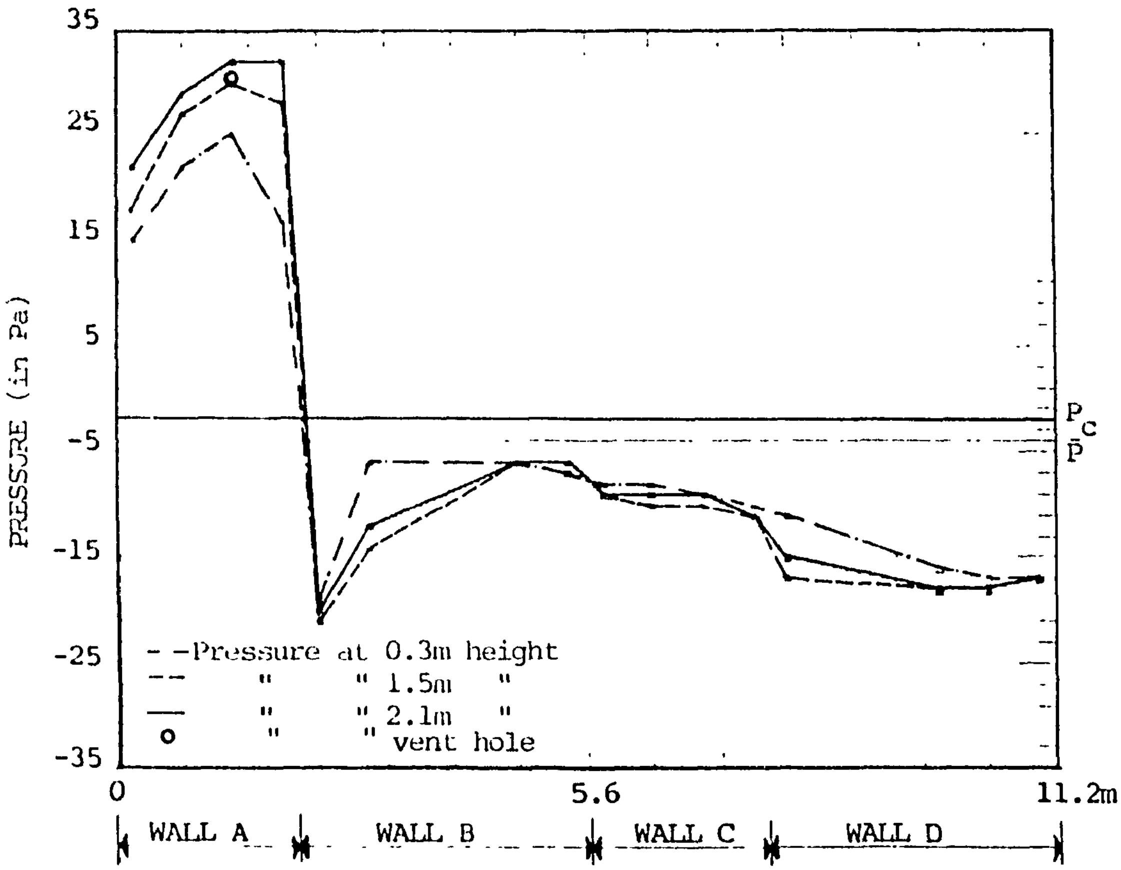


Figure 5.6 Distribution of wind pressures for the four walls of the experimental station; case 8, experiment 7 with one vent hole A10 (5cm x 3.2cm)

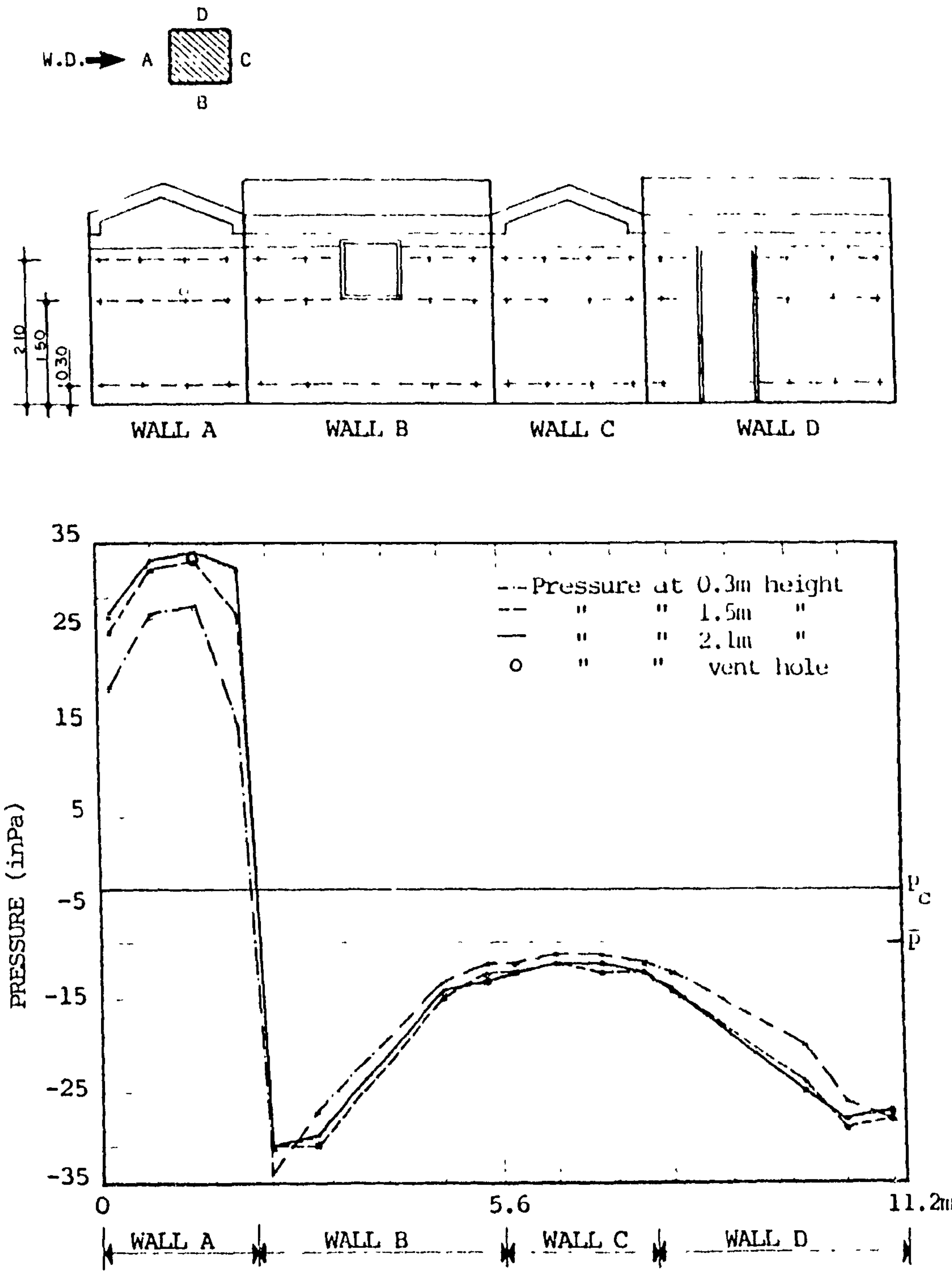


Figure 5.7 Distribution of wind pressures for the four walls of the experimental station; case 9, experiment 7 with one vent hole A10 (5cm x 6.5cm)

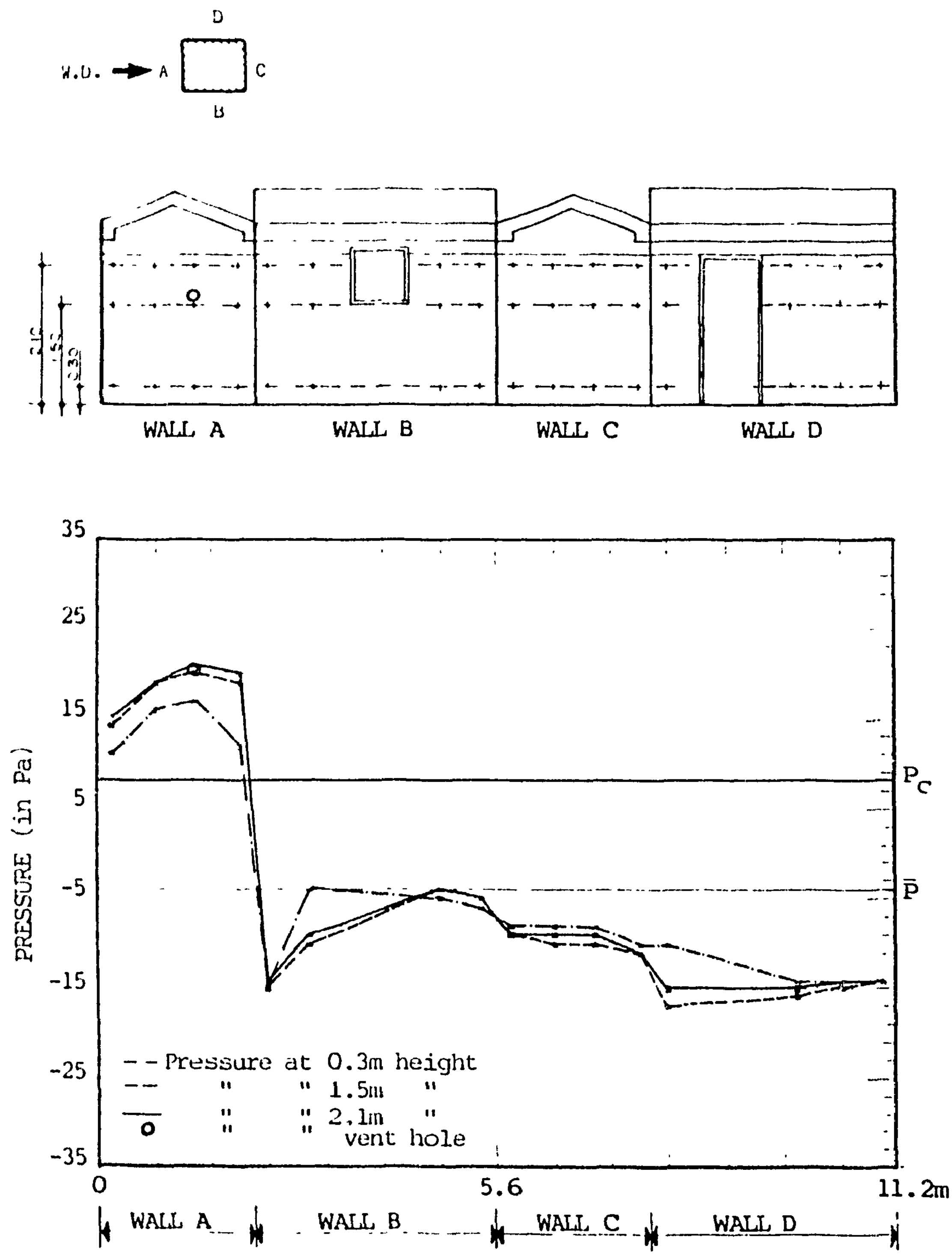


Figure 5.8 Distribution of wind pressures for the four walls of the experimental station; case 10, experiment 4 with one vent hole A10 (5cm x 13cm)

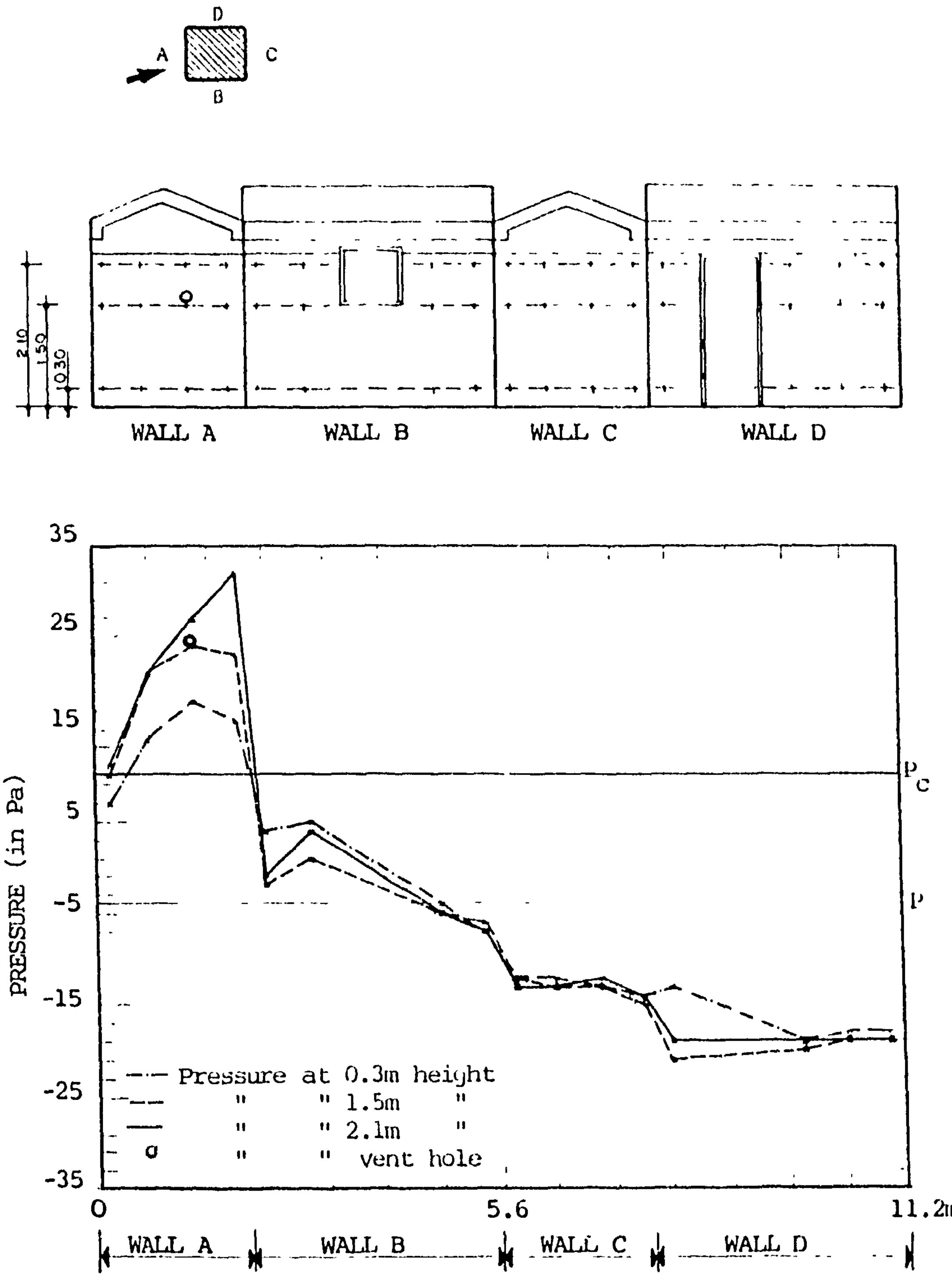


Figure 5.9 Distribution of wind pressures for the four walls of the experimental station; case 11, experiment 5 with one vent hole A10 (5cm x 13cm)

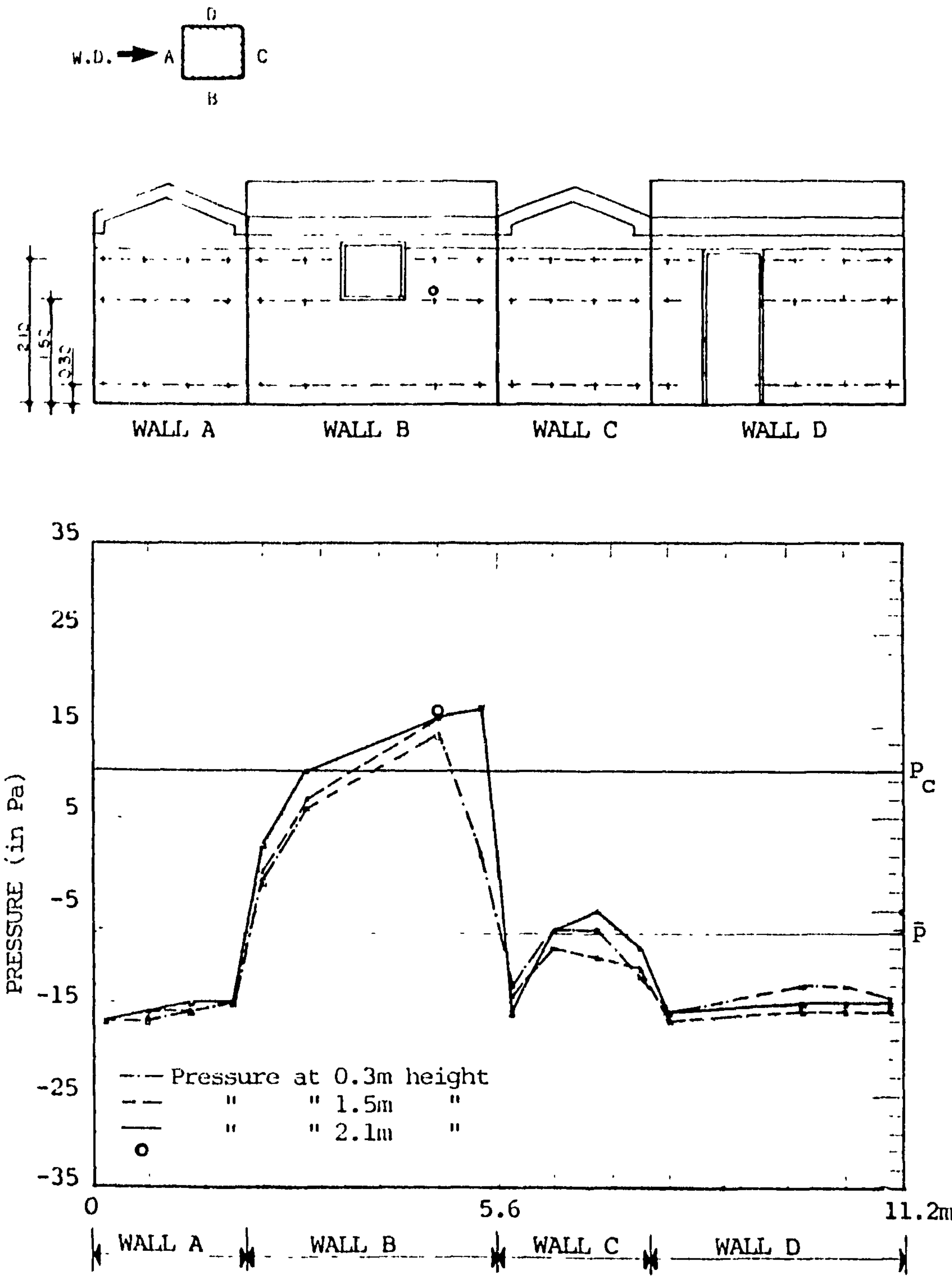


Figure 5.10 Distribution of wind pressures for the four walls of the experimental station; case 12, experiment 1 with one vent hole B12 (5cm x 13cm)

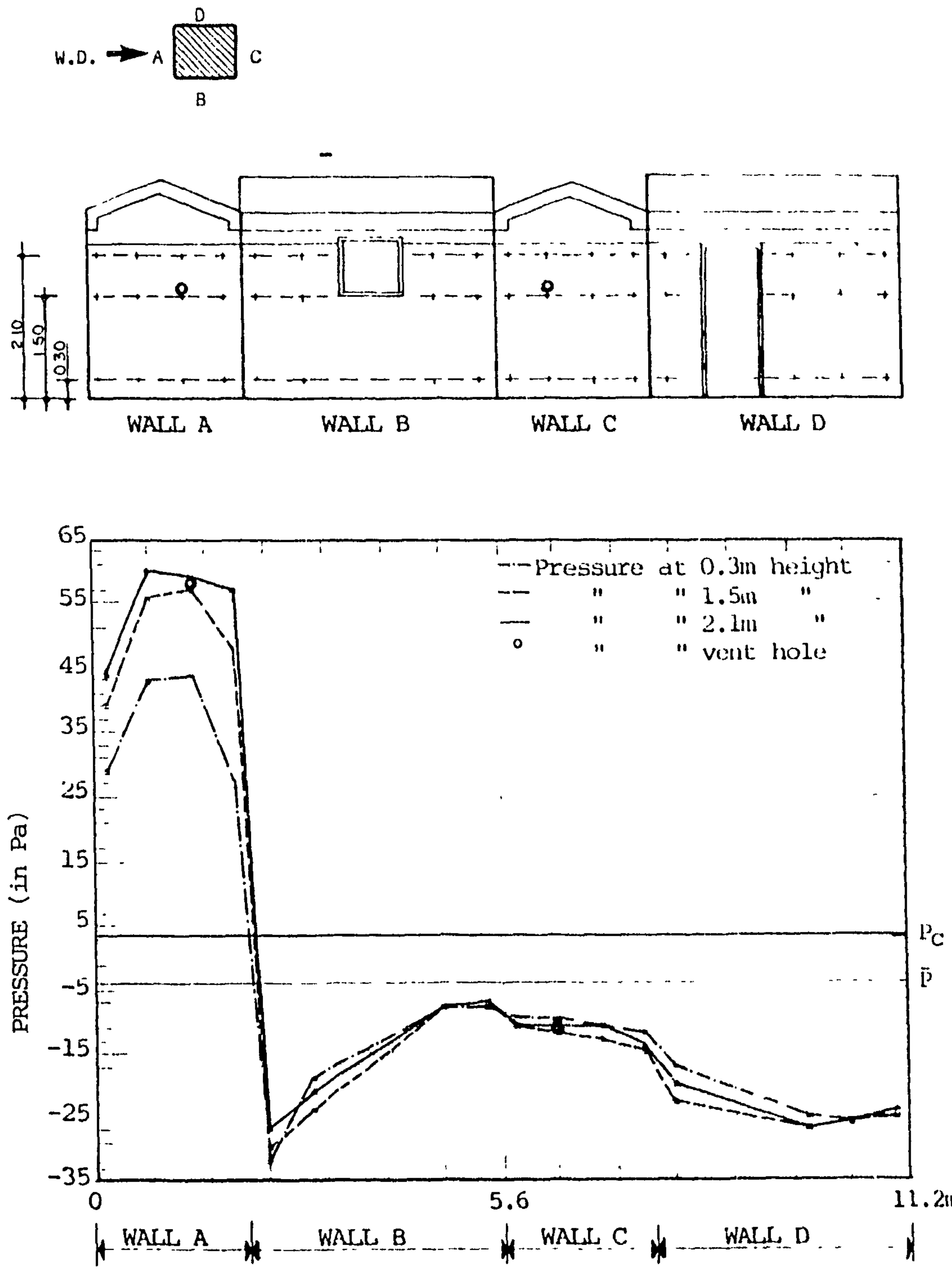


Figure 5.11 Distribution of wind pressures for the four walls of the experimental station; case 13, experiment 4 with two vent holes A10, C6 (5cm x 13cm each)

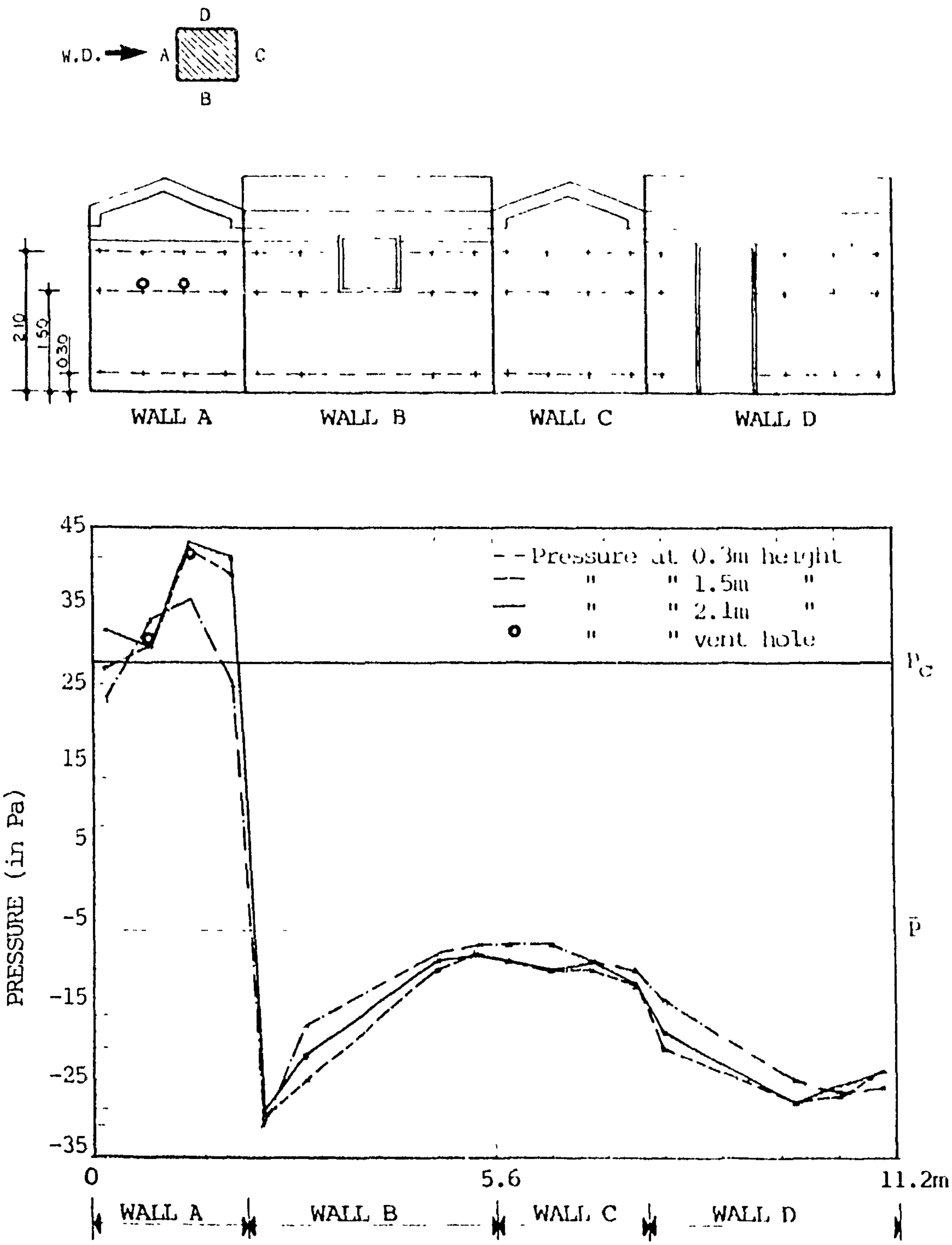


Figure 5.12 **Distribution of wind pressures for the four walls of the experimental station; case 14, experiment 6 with two vent holes A6, A10 (5cm x 13cm each)**

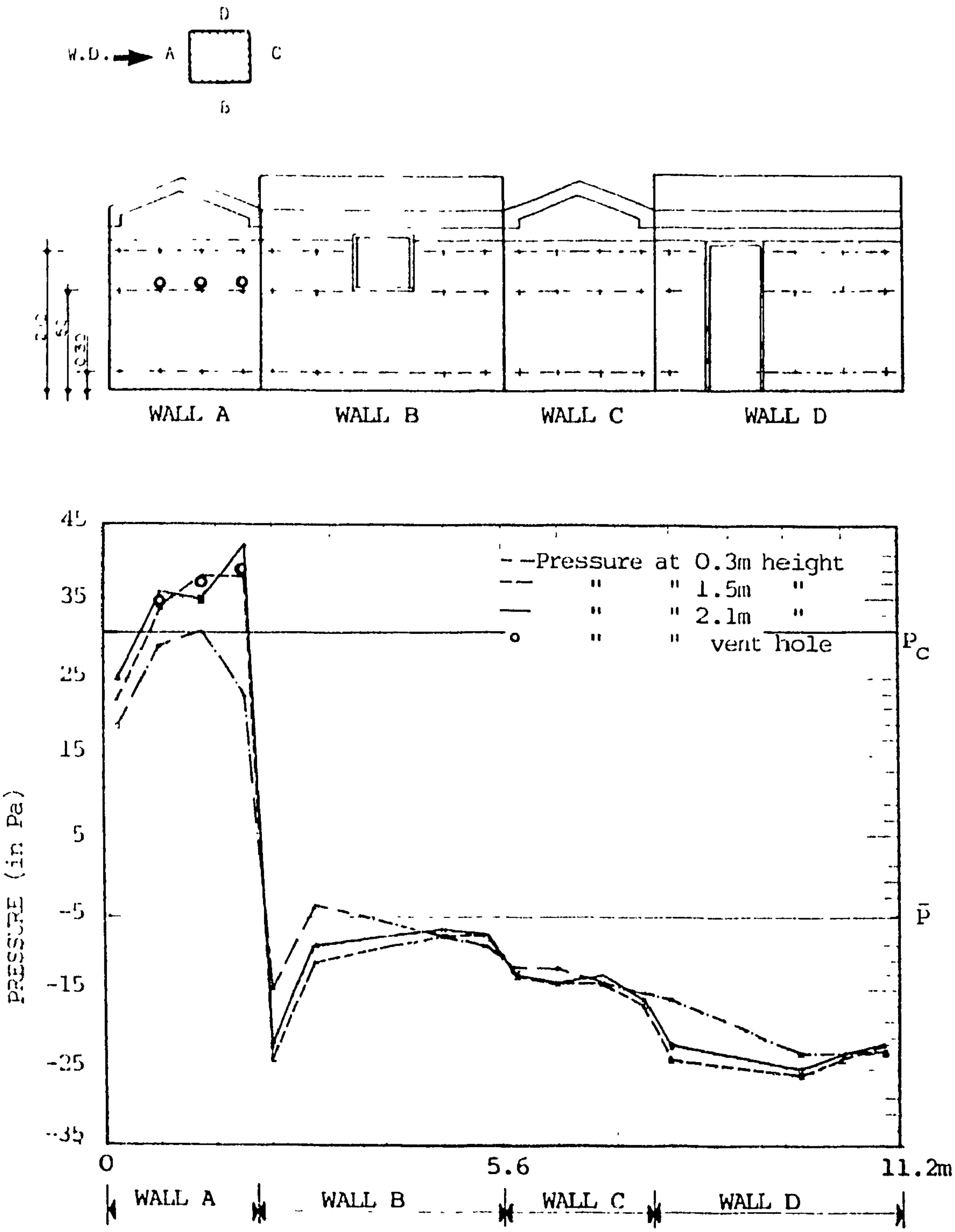


Figure 5.13 Distribution of wind pressures for the four walls of the experimental station; case 15, experiment 3 with three vent holes A6, A10, A13 (5cm x 13cm each)

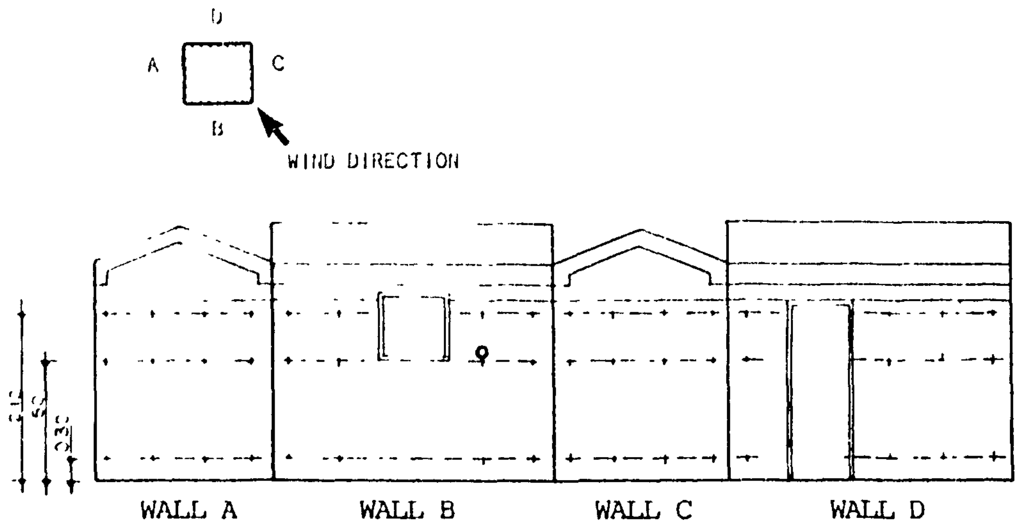
experimental station were exposed to a positive pressure difference and therefore the risk of rain penetration was low.

Figures 5.14-5.16 show cases with valves instead of vent holes. There is an increase in cavity pressure even with a few number of valves.

Figures 5.5-5.16 (which represent a pressurized cavity wall) show that pressurized cavity wall will have higher cavity pressures than those observed from a cavity wall or non-compartmentalized wall (Figures 5.1-5.4). Therefore the risk of rain penetration is less in pressurized cavity walls compared to cavity walls.

In conclusion, in case 8 the cavity pressure P_c is almost equal to $\bar{P}$, Figure 5.6 and Table 4.10. It may be assumed that the area of all cracks of the outer wythe of the experimental station is equivalent to the area of a vent hole, since a vent hole balances the air losses through cracks. The area of a vent hole 5cm x 3.2cm = $16cm^2$ had balanced the air losses through cracks ($\bar{P}$ was almost equal to P_c). The brick wall area of the experimental station was $20.1445m^2$. Therefore, the total area of cracks of brick walls is equivalent with a hole (16/20.1445)= $0.8cm^2$ per square meter of outer wythe. More experiments on different types of bricks and quality of workmanship may give different crack equivalent areas.

To achieve a high positive pressure in a cavity, it is required at least four times the area of vent hole (5 x 3.2cm) of case 8. Such a hole (5cm x 13cm = $65cm^2$) creates



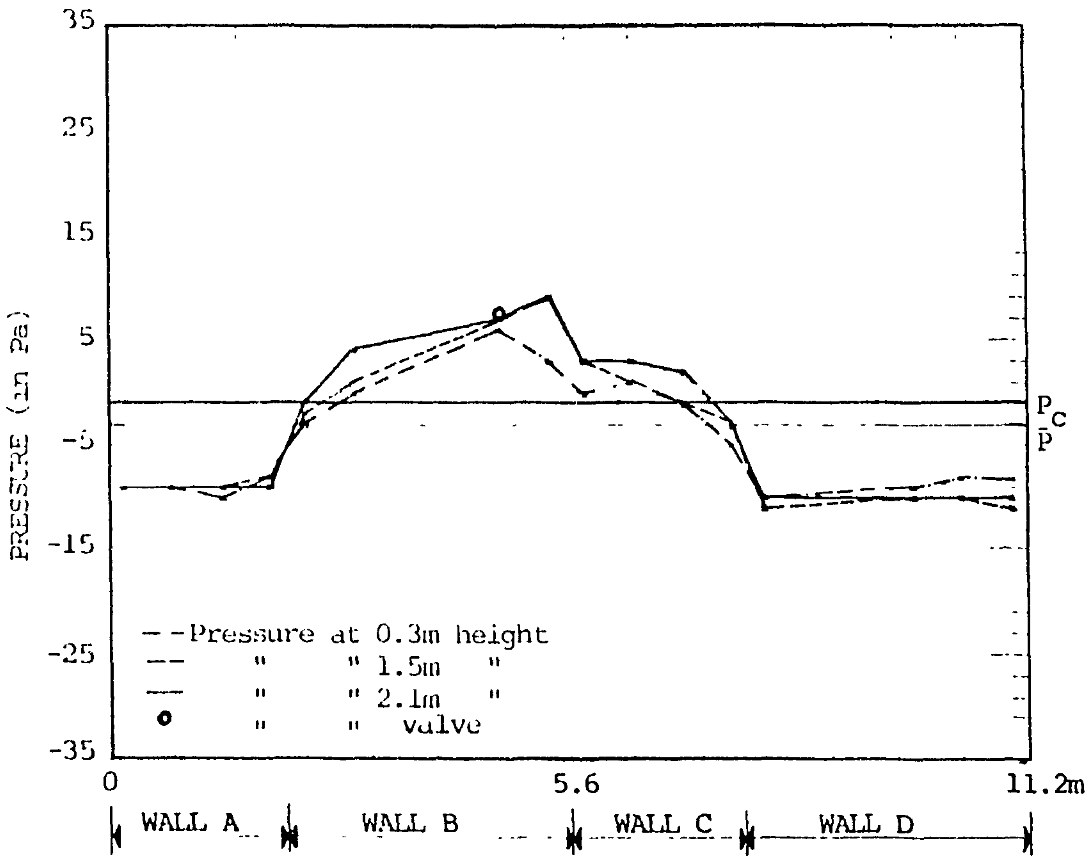


Figure 5.14 Distribution of wind pressures for the four walls of the experimental station; case 16, experiment 28 with one valve B12

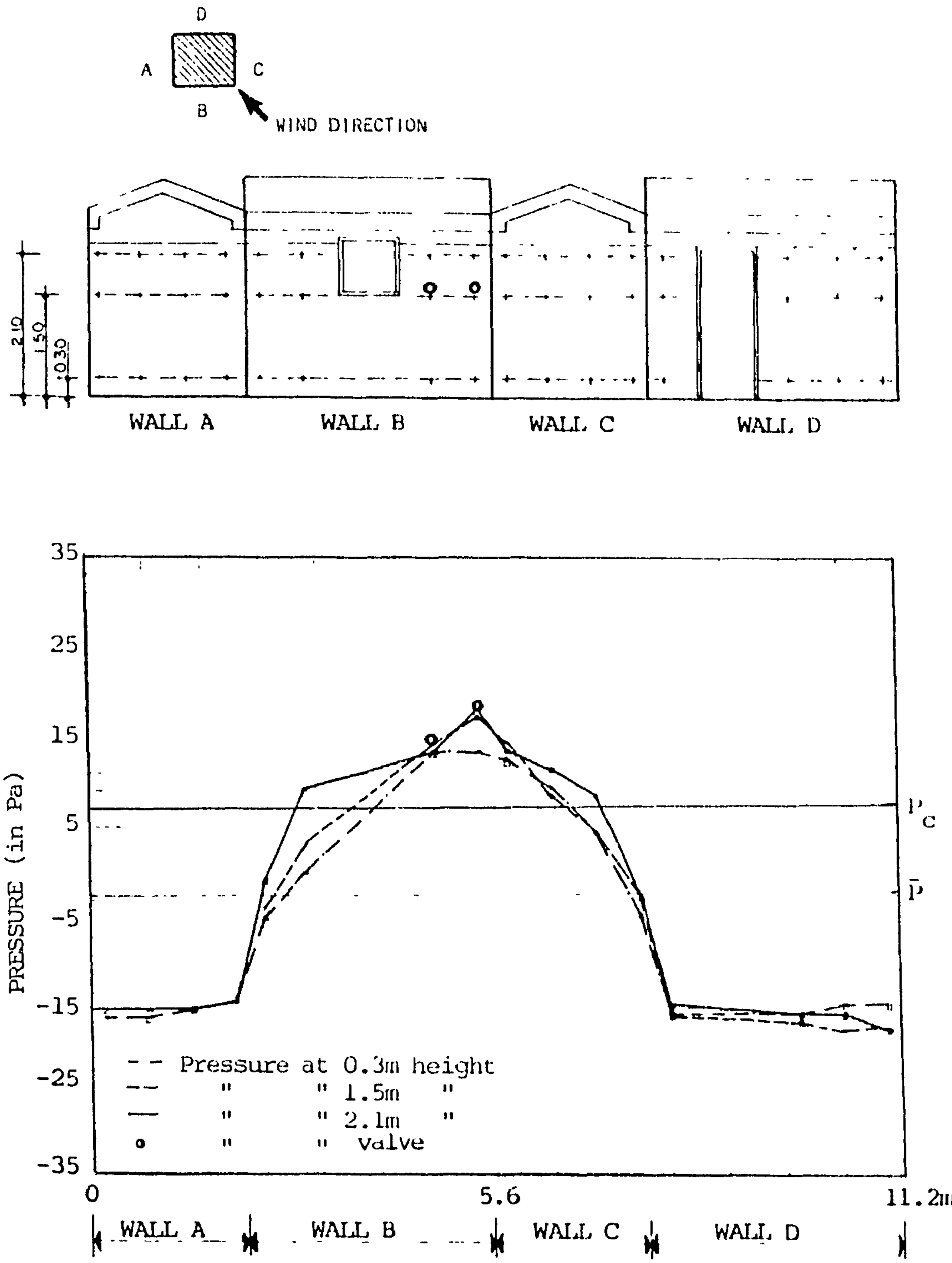


Figure 5.15 Distribution of wind pressures for the four walls of the experimental station; case 17, experiment 32 with two valves B12, B15

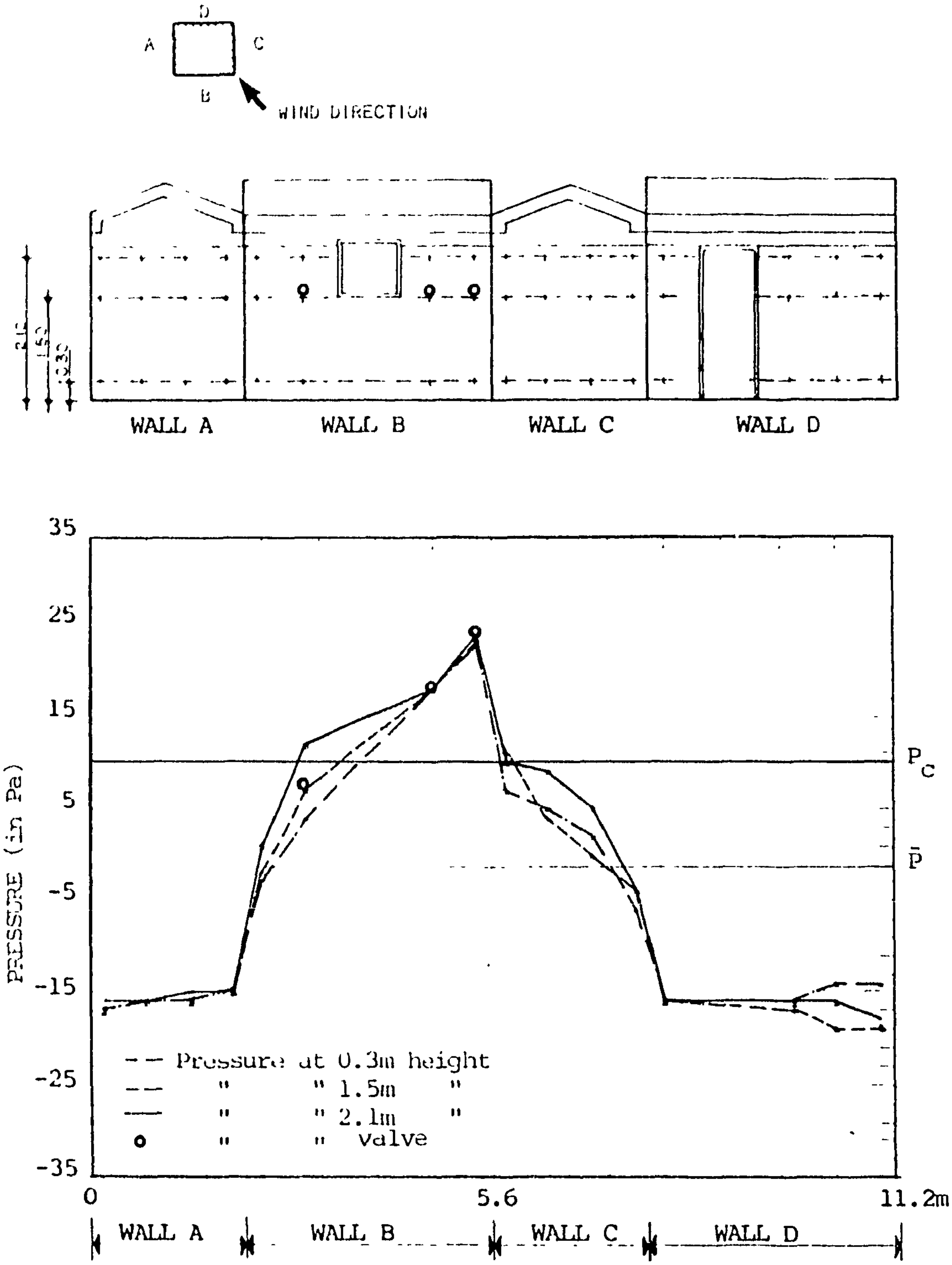


Figure 5.16 Distribution of wind pressures for the four walls of the experimental station; case 18, experiment 11 with three valves B5, B12, B15

high positive cavity pressure and is shown in Figure 5.10. A high positive cavity pressure was created for cases 13-15 where the area of the vent hole was greater than or equal to $65cm^2$.

5.3 THE USE OF k COEFFICIENT FOR WALL DESIGN

The coefficient k was calculated for each case 7-15, Table 4.18. Figure 5.17 presents all the regression lines of Figures 4.63-4.71; it is the result of all experiments with vent holes. The predicted range of k was $5994<k<15789$. For the case of valves the predicted range of k' was $3725<k'<5890$.

If the outer wythe of a building consists of brick units, the following variables should be estimated to calculate the area of the valves to increase the cavity pressure:

a) Mean wind pressure ($\bar{P}$, as defined in equation 3.10). The mean wind pressure on a building can be estimated for any wind direction and wind speed from wind studies on models or on buildings. If the two facades of a building are exposed to wind the mean wind pressure will be different from another building with four facades. Also, the shape of the building, squared, rectangular, or other, will affect the mean wind pressure.

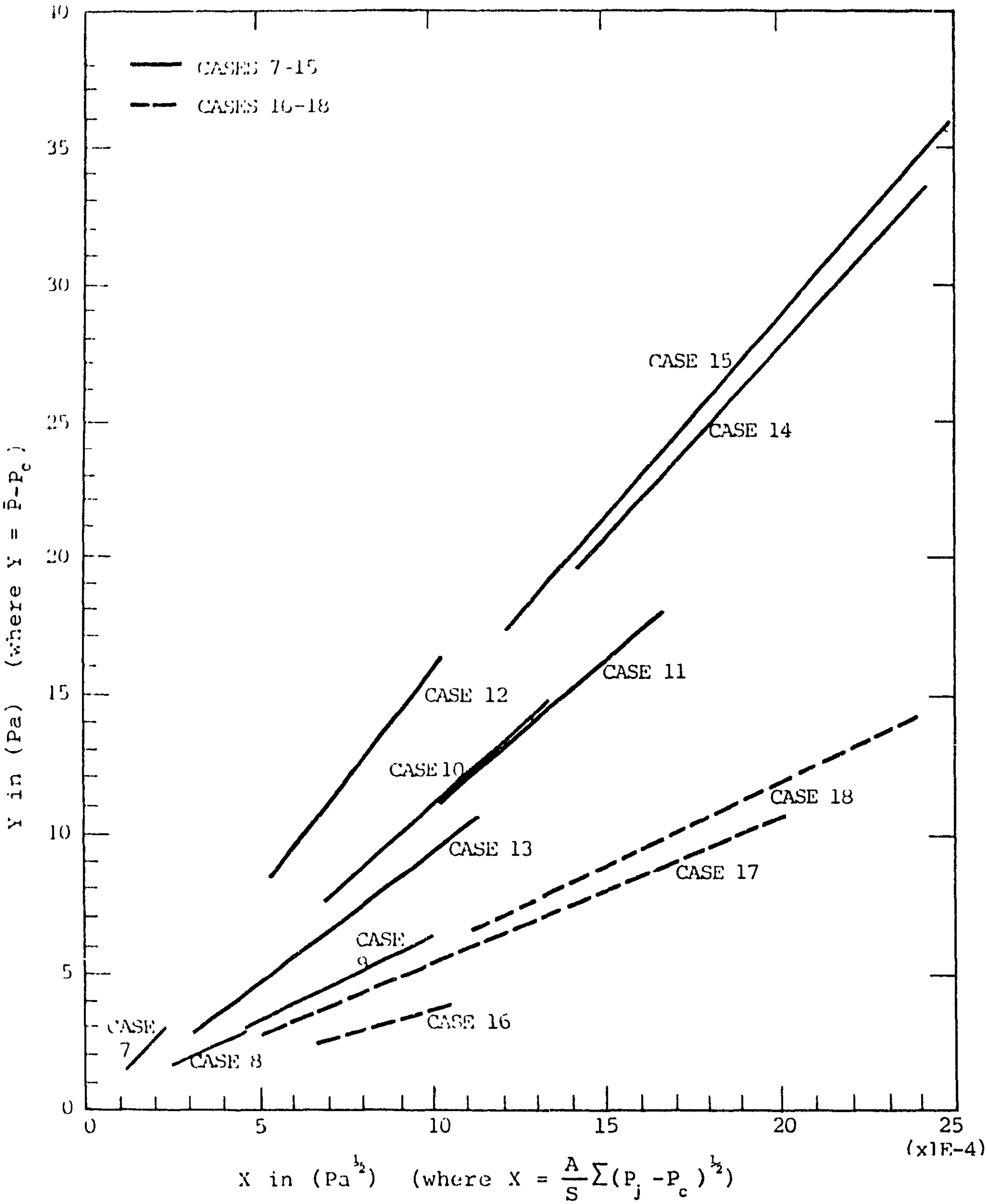


Figure 5.17 Regression lines of cases 7-18

b) Mean high positive pressure on the windward wall (P_h).

The mean high pressure can be also estimated from wind studies on models or on buildings.

c) Cavity pressure (P_c).

The cavity pressure should always be taken as less than the mean high pressure (P_h); for example P_c may be taken as 1/2 or 2/3 or 3/4 of P_h.

To estimate the area of valves required to increase the cavity pressure, equation 4.7 should be used together with $3725<k<5890$. To estimate the area of vent holes instead of valves, k should be taken as $6000<k<15000$.

For example: to estimate the area of valves required to increase the cavity pressure equation 4.7 becomes:

$$\bar{P} - P_c = k \frac{A}{S} (P_h - P_c)^{1/2}$$

Assuming that:

$2.7m \times 15m = 40.5m^2$ is the total wall area

$\bar{P} = 0Pa$ (depends from building shape)

$P_c = 100Pa$

$P_h = 150Pa$

$k = 11000$

then:

$$A = \frac{(100-0) \times 40.5}{5000(150-100)} = 0.11m^2$$

Therefore one valve or several valves of total area $0.11 m^2$ can be used to increase the cavity pressure. The area of $0.11 m^2$ is equivalent to about 22 valves when each valve has two contiguous round holes of 2.8cm radius each.

CHAPTER 6

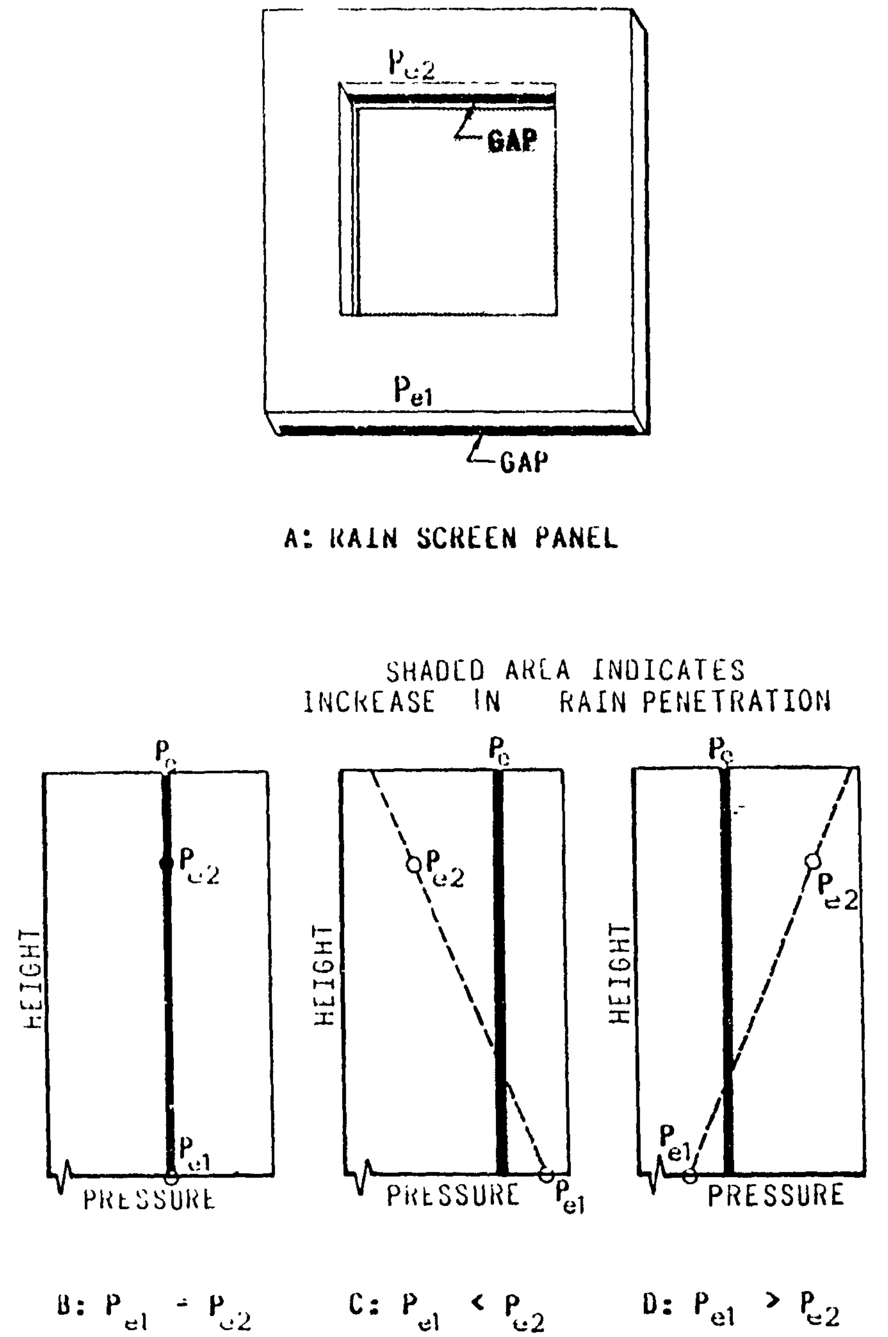
6 APPLICATIONS

The pressurized cavity principle can be applied to buildings in different ways; it can be applied on a wall panel or on the facades of a building by placing valves on the outer wythe. The resulting increase in cavity pressure with decrease the risk of rain penetration.

6.1 APPLICATION OF PRESSURIZED CAVITY PRINCIPLE TO A WALL PANEL

The Place Air Canada building, Figures 2.8-2.9, consists of rain screen panels. Each panel has two gaps for pressure equalization. Usually, the wind pressures on the two gaps of each panel are almost equal, except at the corners where there may be a significant pressure difference between the two gaps of the same panel. In such a case, pressure equalization has not been achieved and the application of the pressurized cavity principle is more beneficial.

Figure 6.1 shows the wind pressure (P_w) and the cavity pressure (P_c) of a rain screen panel. The wind pressure on



POSSIBLE CASES OF WIND AND CAVITY PRESSURE

P_e = WIND PRESSURE, P_c = CAVITY PRESSURE

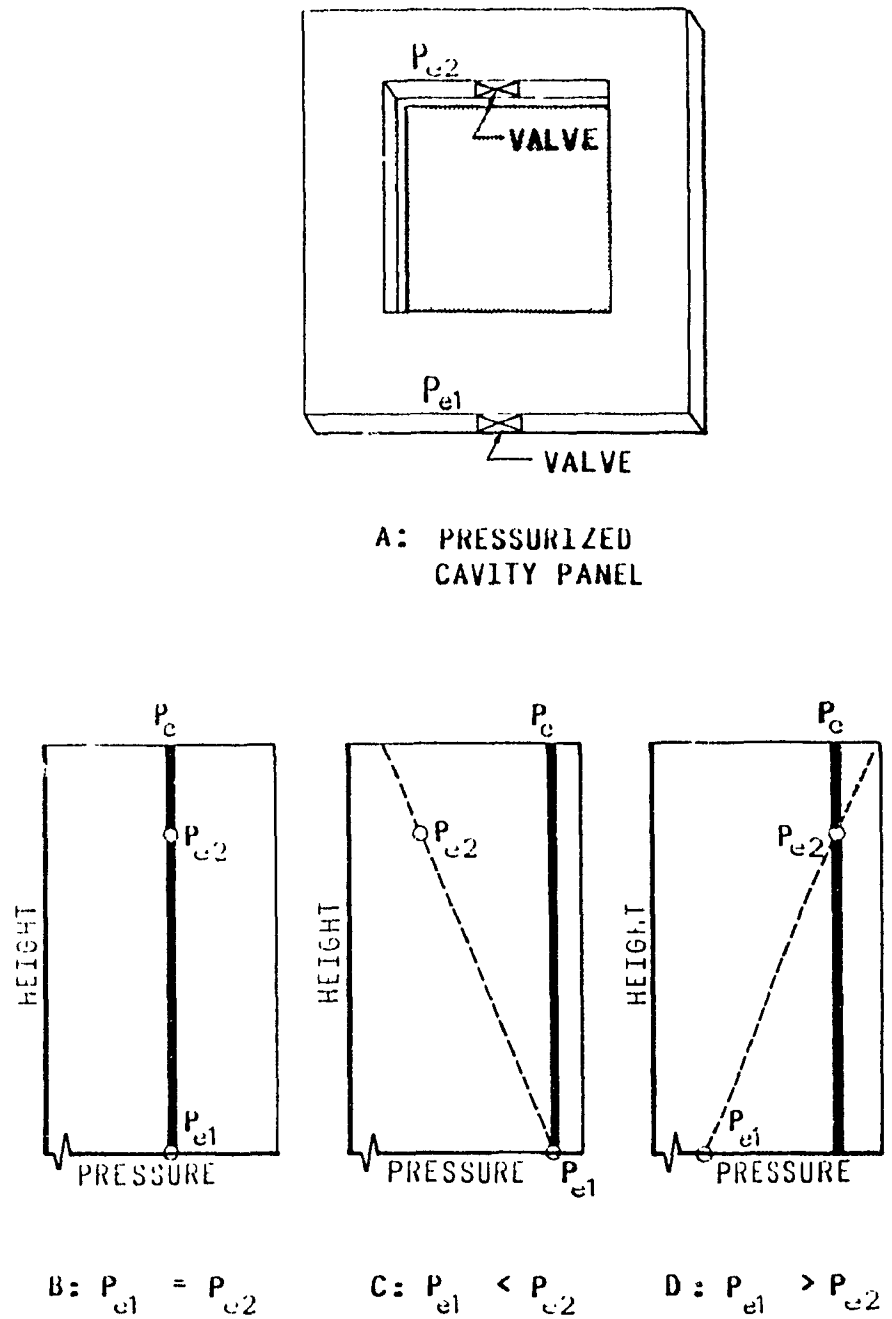
Figure 6.1 Wind and cavity pressures on a rain screen panel

the first gap can be equal (B), less (C) or greater (D) than the wind pressure on the second gap. Pressure equalization has been achieved only in case B. Figure 6.2 shows the wind and cavity pressure of a panel in which the gaps have been replaced with valves. For the same wind pressure, the cavity pressure is higher than before (less shaded area), thus this case prevents rain penetration better than the case without valves.

6.2 APPLICATION OF PRESSURIZED CAVITY PRINCIPLE TO WALLS

Figure 6.3 shows a corner of a building with rain screen walls. It is recognized that if the corner is the windward one, the wind pressure profiles will be one of Figure 6.3c. These figures show that there is a positive pressure difference across the wall (shaded areas); such a pressure difference increases the risk of rain penetration.

Figure 6.4 shows the same corner, but the vent holes have been replaced with valves. Then, for the same wind pressure profiles, the cavity pressure will be increased, Figure 6.4c. There is no positive pressure difference across the wall (no shaded areas), therefore, the risk of rain penetration has been decreased.



POSSIBLE CASES OF WIND AND CAVITY PRESSURE

P_e = WIND PRESSURE, P_c = CAVITY PRESSURE

Figure 6.2 Wind and cavity pressures on a pressurized cavity panel

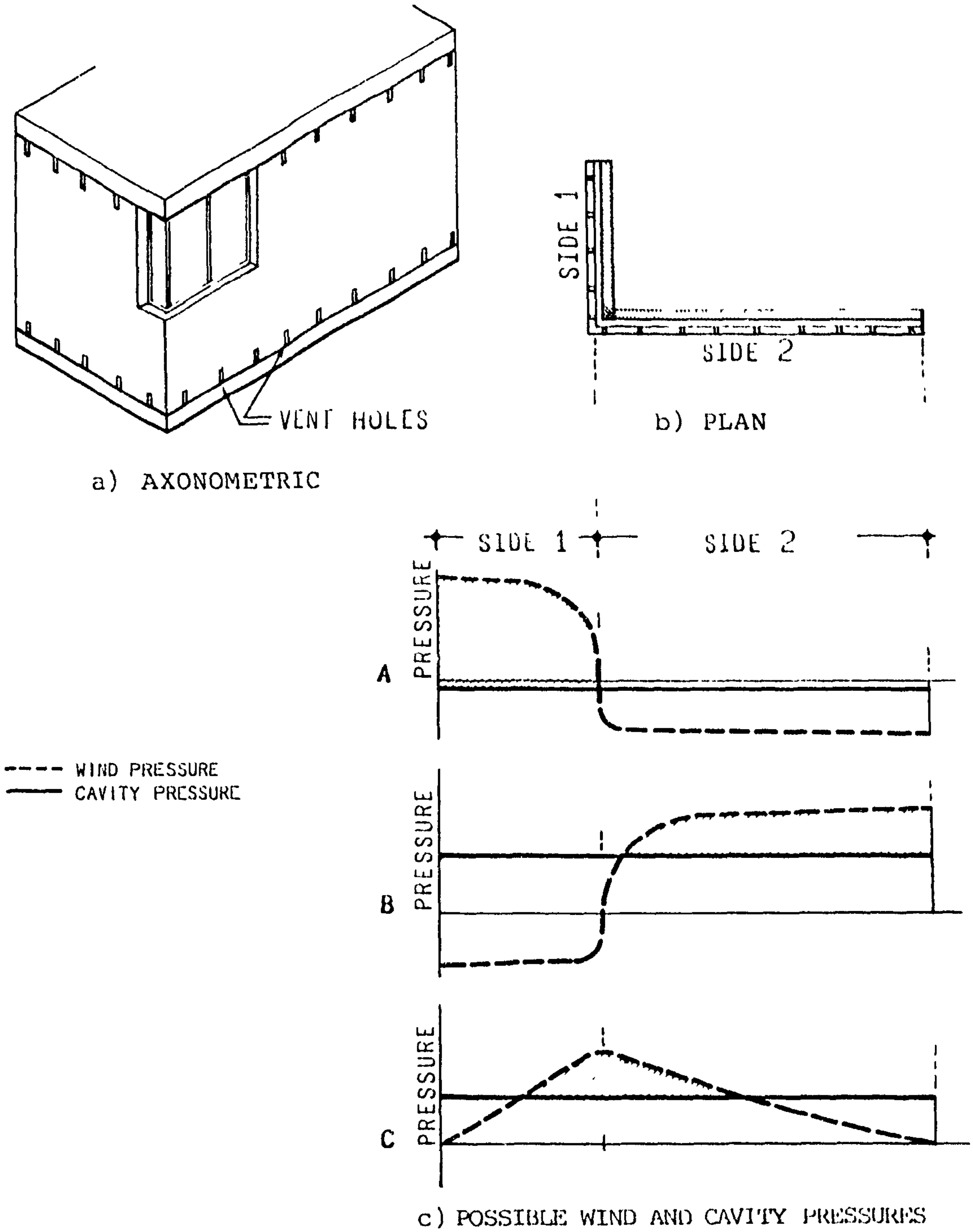


Figure 6.3 Rain screen wall

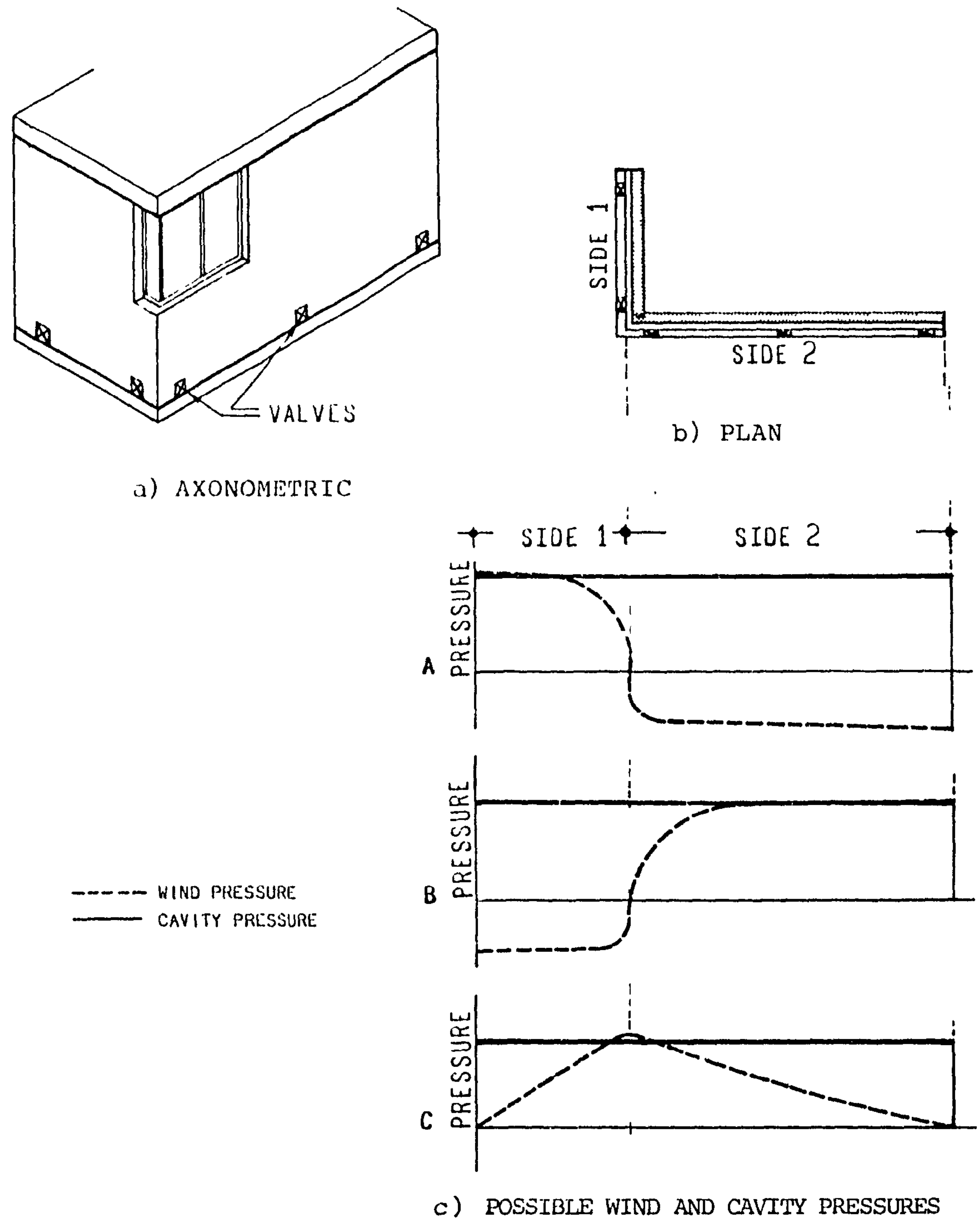


Figure 6.4 Pressurized cavity wall

6.3 APPLICATION OF PRESSURIZED CAVITY PRINCIPLE TO BUILDINGS

Figure 6.5a gives the pressure coefficients of walls for a tall building as determined by the National Building Code of Canada. If all four walls are uniformly permeable, then the interior pressure coefficient is -0.3.

Figure 6.5b shows the same building with cavity walls exposed to the same wind conditions. Since the cavity is continuous around the building, it may be treated like the interior space. It may be assumed that the pressure coefficient inside the cavity wall will be the same as the interior pressure coefficient of -0.3. If this is the case, there is a high positive pressure difference across the windward wall, since the difference between wind and cavity pressure coefficients is 0.8-(-0.3) = 1.1. This high positive pressure coefficient increases the risk of rain penetration.

Figure 6.5c shows the same building where the exterior rain screen walls are compartmentalized and contain vent holes. The pressure coefficient inside each compartment is equal to the corresponding wind pressure coefficient. In this case, pressure equalization is achieved and less rain penetration than in the previous case of cavity walls occurs.

Figure 6.5d shows the same building where the exterior walls are pressurized cavity walls. The pressure coefficient inside the cavity is equal to the highest exterior pressure

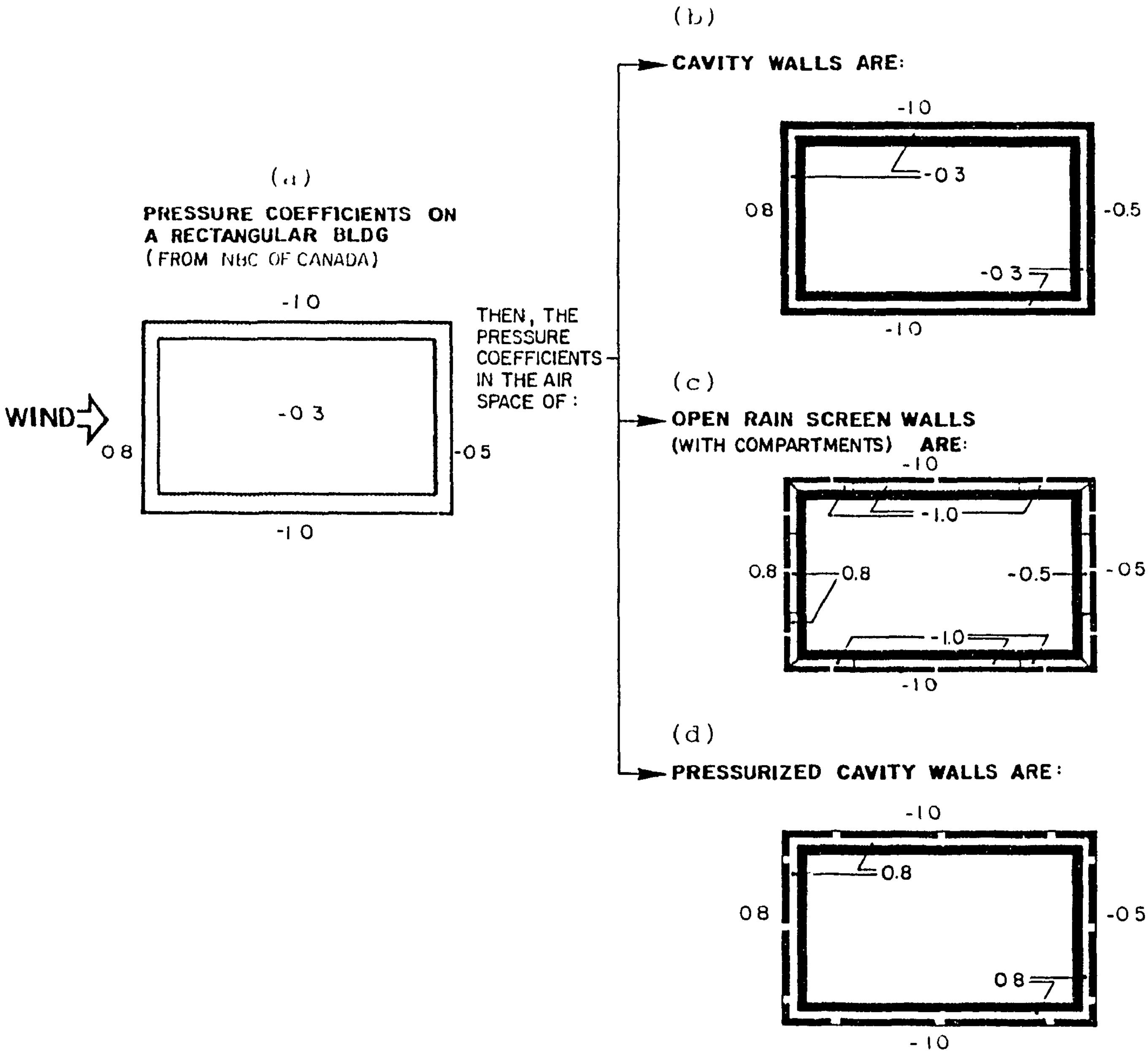


Figure 6.5 Cavity pressures in cavity walls, rain screen walls and pressurized cavity walls

coefficient which is 0.8 (in the case without air losses through cavities). In a building with airtight cavities the pressure coefficient inside the cavity will be also close to 0.8. In these cases there is a negative pressure difference across the outer wythes of four walls since the difference between wind and cavity pressure coefficients for side walls is (-1.0)-0.8 = -1.8. The negative pressure difference decreases the rain penetration through walls. In this case, there is also a negative pressure difference on the corners of the building which are the most vulnerable to rain penetration.

Another way of applying valves on the exterior walls of a building is the following:
Since the corners of buildings are vulnerable to rain penetration, the pressurized cavity principle can be applied on a building as in Figure 6.6. The walls are cavity walls with vent holes, the corners have been isolated from the rest of the cavity and one valve has been installed in each divider. The pressure coefficients, in Figure 6.6, show that the cavity pressure in the corners A and D is higher than the wind pressure, thus risk of rain penetration is low.

6.4 PRESSURIZED CAVITY PRINCIPLE - REDUCTION OF INFILTRATION/EXFILTRATION

Pressurized cavities may reduce infiltration/ exfiltration air losses. Pressures on the exterior facades

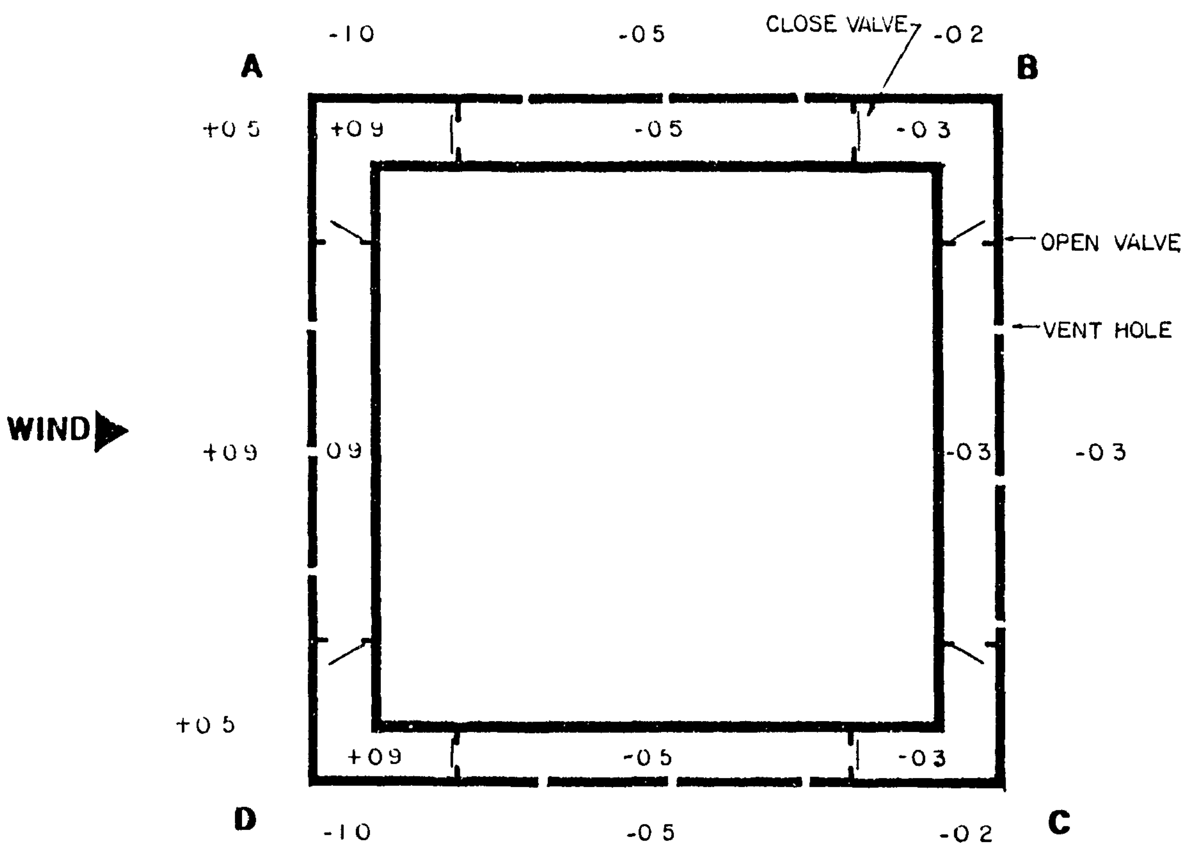


Figure 6.6 Wind pressure coefficients on a structure with pressurized cavity corners; valves have been installed in corners

of a building caused by wind and by temperature simply add. However, since flows are not proportional to pressure differences, the flows due to each source are not additive.

Figure 6.7 shows qualitatively pressure forces (on the inner wythe) for a typical building with rain screen walls, with uniform openings above and below midheight and without significant internal resistance to flow. Figure 6.8 shows qualitatively pressure forces for the same typical building but with pressurized cavity walls; the inner wythe is exposed to less pressure differences than in the case of Figure 6.7, therefore, infiltration/exfiltration air losses has been reduced.

Figures 6.9 and 6.10 show the air leakage paths between rain screen walls and pressurized cavity walls.

6.5 WIND PRESSURES ON THE OUTER WYTHE OF PRESSURIZED CAVITY WALLS

The outer wythe of pressurized cavity walls is exposed to higher wind loads than in cases of rain screen walls. A rain screen wall attempts to equalize cavity and wind pressures. A pressurized cavity wall attempts to equalize cavitv and high positive wind pressures; therefore, the cavity pressure is higher than the wind pressure on leeward walls. The design load for a typical building may be:

- 100Pa pressure difference lasting for several months
- 1000Pa pressure difference lasting 60 seconds once in

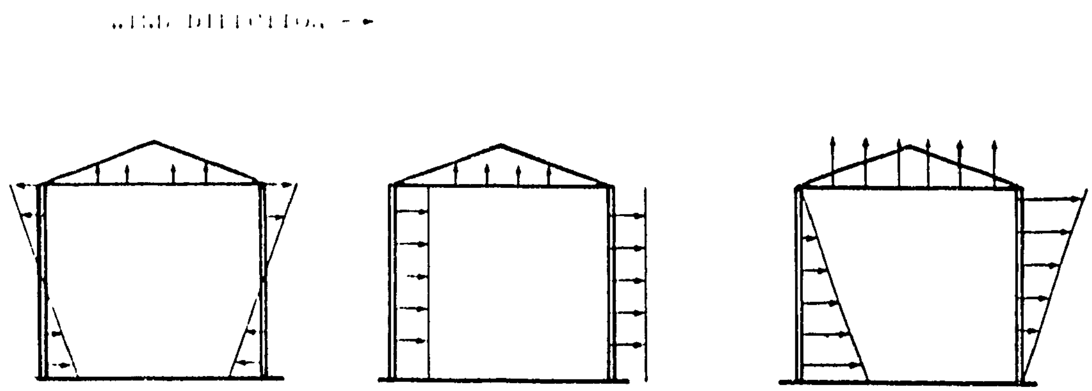


Figure 6.7 Pressure differences for a structure with cavity walls; arrows point from higher to lower pressure and indicate direction of air flow

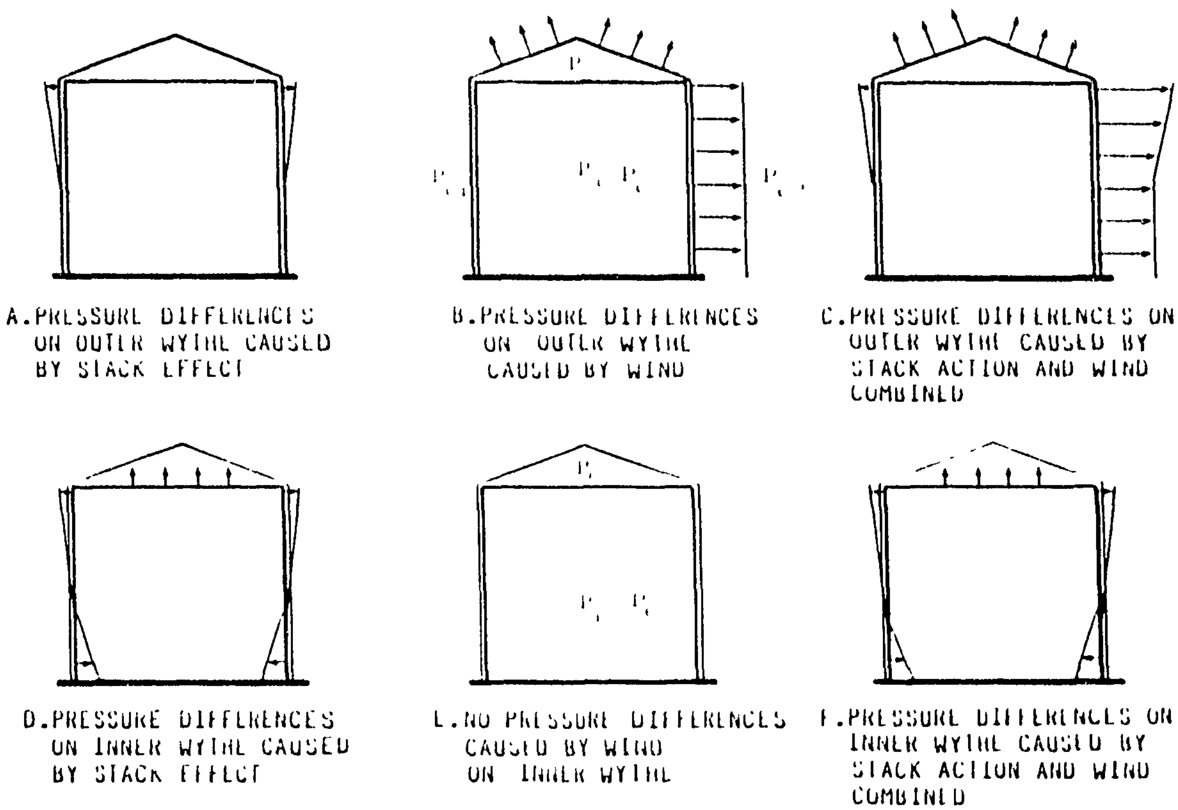


Figure 6.8 Pressure differences for a structure with pressurized cavity walls integrated with the attic space; arrows point from higher to lower pressure and indicate direction of air flow

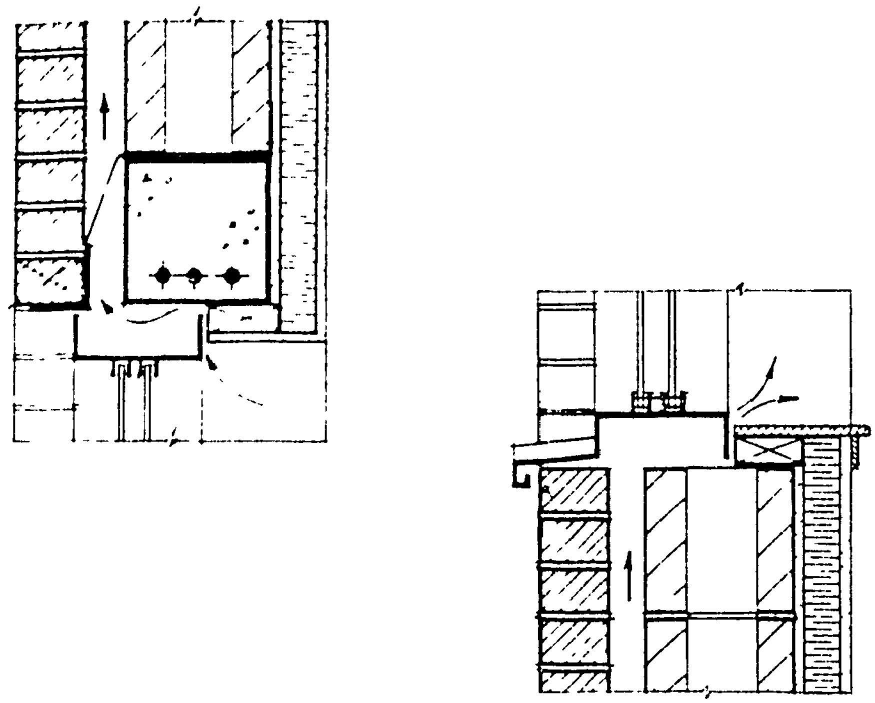


Figure 6.9 Air leakage paths of a typical rain screen wall

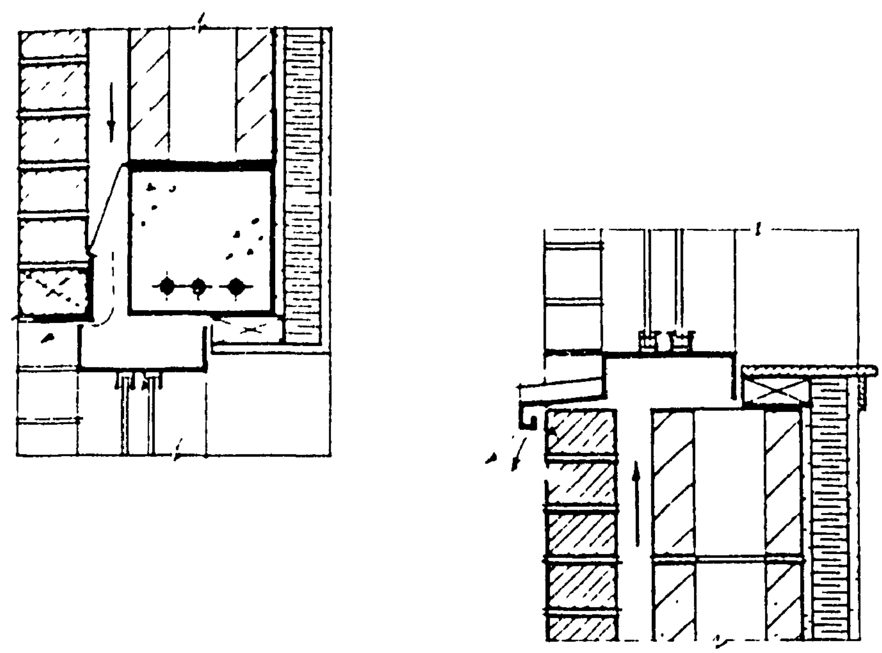


Figure 6.10 Air leakage paths of a pressurized cavity wall

30 years and

- 2500Pa pressure difference during gust winds of 3 to 5 seconds.

Always, both wythes (inner and outer) are designed to carry the above loads. A pressurized cavity wall increases the forces acting on the outer wythe. To avoid such an increase of forces on the outer wythe pressure relief valves should be installed on it. The pressure relief valves (which work when the cavity pressure is above 500 Pa) release the unecessary high cavity pressure.

CHAPTER 7

7 CONCLUSIONS

7.1 ACCOMPLISHMENTS

Rain screen walls with different sizes of vent holes have been tested. Wind pressures and cavity pressures were recorded and their relationships were determined. Analytical model of cavity pressures was validated by using experimental data.

Furthermore, a new system, the pressurized cavity wall, is proposed which increases the cavity pressure and therefore reduces the risk of rain penetration. The performance of the new system was also tested at the Experimental Station; the cavity pressure in all experiments was positive.

7.2 CONTRIBUTION

The present research work, entitled ´Control of Rain Penetration Through Pressurized Cavity Walls´ does not test wall specimens in a rain test chamber or measure the quantity of water passing through a wall. It demonstrates that the cavity pressure is a significant parameter and limited research work exists on it. The increase in cavity pressure reduces the rain penetration.

Moreover, this research work questions the effectiveness of rain screen walls. It proves that rain screen walls, and of course cavity walls as well, may leak under wind-driven rain conditions. Leakage is due to the bad implementation of the pressure equalization principle and not the principle itself. Non-compartmentalization of the cavity is the typical weakness of rain screen walls, and pressure equalization does not occur.

The present study proposes and develops an analytical model relating the cavity pressures, wind pressures and openings of a rain screen wall. The coefficient k of the analytical model was determined experimentally. It is a function of the coefficient of cracks of a brick wall. It can be used to determine the area of vent holes required to balance the air losses through cracks in brickwork.

Moreover, the present study proposes and develops a new principle, the pressurized cavity, which prevents leakage better than non-compartmentalized rain screen or cavity wall systems. This new method comprises a protective envelope of uniform high pressure around the building. The high pressure in cavity walls is created by replacing the vent holes with valves. Tests of the new principle demonstrate its good performance.

7.3 FURTHER RESEARCH REQUIRED

The present research work focused on cracks and holes of outer wythe. The experimental field work was performed on the Experimental Station. The outer wythe of its rain screen was built with clay bricks units and its coefficient k was determined. Further experimental work such as:

- cavity wall with varying cavity width
- cavity wall with different back-up systems
- cavity wall of different dimensions

is required to determine the range of the coefficient k for various cases.

Further refinement in the mathematical model with respect to vibration of the valves is required in order to explain the variations in the observed values.

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APPENDIX A

WIND AND CAVITY PRESSURES AROUND EXPERIMENTAL STATION AS RECORDED FROM FLUID MULTIMANOMETER

CASE	FILE No.	POSE	TIME	REFER.P	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
					WIND PRESSURES ON THE WALL A (in Pa)														
				0	4	4	4	3	4	3	4	3	3	2	2	1	0	-1	-1
CASE 1	13	38	10.27.20	0	32	27	19	22	42	39	32	33	45	42	35	45	40	32	28
	13	39	10.28.03	-1	36	32	24	28	48	45	38	40	52	43	42	52	45	32	28
	13	42	12.42.15	3	45	40	34	35	50	46	41	42	48	43	39	40	35	25	25
	13	43	12.42.20	6	48	39	35	35	54	51	44	44	54	48	42	46	39	27	25
	13	44	12.42.25	5	31	29	25	25	35	35	32	32	38	35	31	37	32	23	19
	13	45	12.42.30	0	18	17	14	13	22	20	18	18	24	21	18	22	19	14	12
	13	46	12.42.35	-3	10	10	8	7	15	14	12	10	17	15	12	17	15	10	8
	13	2	12.42.45	-3	10	8	4	5	19	20	15	10	25	20	15	28	25	19	14
	13	3	12.42.50	-3	13	9	4	6	24	21	18	14	30	26	20	37	33	27	19
	13	4	12.42.55	-3	14	10	5	7	26	25	19	15	33	30	22	29	27	30	22
	13	5	12.43.00	-4	12	10	5	6	22	22	17	12	27	25	19	30	30	25	19
	13	6	12.43.05	-3	12	10	6	8	22	22	18	15	28	25	20	32	28	23	18
	13	7	12.43.10	-3	10	7	3	4	17	17	13	10	22	18	15	24	20	17	13
	13	8	12.43.15	-4	10	9	6	6	13	18	15	13	21	20	16	22	20	18	13
	13	9	12.43.20	-5	10	10	6	6	18	18	15	13	22	20	15	23	20	16	12
	13	10	12.43.26	-5	6	5	2	3	15	14	10	8	18	15	12	20	18	13	8
	13	11	12.43.36	-5	6	5	2	3	15	14	10	8	18	16	12	21	19	14	9
	13	12	12.43.50	-5	3	1	-1	-1	8	8	5	3	11	9	6	13	11	9	5
	13	13	12.44.00	-6	3	2	-1	-1	8	8	5	2	10	8	5	11	10	8	5
	13	14	12.44.11	-6	3	2	0	0	8	8	5	3	10	8	5	10	10	6	3
	13	15	12.44.20	-6	5	4	2	2	9	8	6	5	10	8	5	9	8	4	1
	13	16	12.44.31	-7	1	0	-1	-1	4	4	2	1	5	4	2	4	3	0	-1
	13	17	12.44.42	-8	-1	-2	-3	-3	1	0	-1	-2	1	0	-1	0	-1	-3	-4
	13	18	12.44.50	-9	0	-1	-2	-3	2	0	-1	-2	1	-1	-2	-1	-2	-4	-5
	13	19	12.45.09	-8	5	4	2	1	8	6	4	3	7	5	3	5	3	0	-3
	13	20	12.45.20	-6	9	7	3	3	12	10	6	6	10	8	5	7	4	0	-1
	13	21	12.45.44	-6	5	4	2	1	6	5	4	3	6	5	2	4	2	-1	-2
	13	22	12.46.01	-5	8	7	5	4	10	9	8	6	9	8	5	6	4	0	-2
	13	23	12.47.16	-4	13	12	9	8	16	15	13	12	15	14	11	13	10	5	2
	13	24	12.47.31	-3	32	30	21	20	37	35	28	28	35	33	27	30	25	15	12
	13	25	12.47.36	1	42	40	32	30	53	52	44	43	52	52	44	47	41	30	24
CASE 2-3	18	6	14.22.47	-2	20	17	13	13	25	24	20	20	27	25	20	25	22	15	12
	18	7	14.23.00	-2	22	18	10	13	27	24	19	20	27	24	20	24	20	14	11
	18	8	14.23.17	-2	16	15	10	10	22	20	17	17	23	20	17	22	18	10	9
	18	9	14.23.31	-2	23	22	18	16	28	27	23	22	27	25	21	24	20	14	11
	12	22	10.20.49	-1	34	30	22	22	45	44	35	34	47	45	38	48	43	34	26
	12	23	10.20.55	0	25	25	19	19	35	35	30	29	39	37	32	40	37	31	24
	12	24	10.21.01	-2	12	10	7	7	17	16	15	3	20	18	15	18	17	15	12
	12	25	10.21.05	0	30	29	23	23	41	40	34	32	41	40	33	35	35	25	22
	12	26	10.21.10	0	24	22	19	18	30	32	28	26	33	33	29	32	30	25	26
	12	27	10.21.15	-1	17	16	13	13	25	24	20	19	27	25	22	25	25	20	16
	12	28	10.21.20	-3	12	11	9	9	17	16	15	14	20	18	15	19	17	14	11
	12	30	10.21.30	-4	15	12	9	10	20	19	15	15	20	19	25	19	25	10	7
	12	32	10.21.40	-6	12	10	7	6	16	15	12	11	18	16	12	16	15	9	6
	12	35	10.22.00	-5	5	4	1	1	10	10	7	5	13	10	9	13	10	7	4
	12	37	10.22.12	-5	4	2	0	0	10	10	7	4	13	10	8	14	13	10	6

KEY

WIND PRESSURES ON THE WALL B (in Pa)

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16
-1	-1	-1	-2	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2	-3
-19	-22	-10	-1	-2	4	-1	1	0	-3	-7	-7	-8	-9	-7	-12
-27	-28	-22	-15	-18	-10	-12	-7	-11	-7	-8	-10	-9	-10	-8	-12
-35	-36	-34	-24	-27	-18	-20	-15	-18	-15	-16	-17	-14	-16	-13	-15
-33	-35	-33	-26	-28	-23	-23	-19	-20	-16	-16	-18	-15	-16	-14	-15
-22	-24	-23	-21	-23	-19	-19	-15	-17	-14	-14	-15	-12	-13	-12	-13
-20	-21	-20	-15	-16	-13	-14	-12	-13	-11	-12	-13	-12	-13	-12	-13
-9	-10	-11	-7	-9	-7	-8	-7	-10	-8	-9	-10	-10	-11	-10	-13
22	24	12	16	14	15	10	10	6	5	0	0	-2	-6	-4	-11
25	24	15	18	14	17	10	10	7	5	-1	-1	-3	-7	-5	-11
24	25	18	17	14	17	10	11	8	5	-2	-2	-3	-8	-5	-12
16	15	13	12	10	13	7	7	5	2	-3	-4	-5	-8	-6	-12
9	5	6	8	5	8	2	3	0	-1	-5	-6	-6	-10	-8	-13
19	15	10	15	11	12	8	8	3	3	-1	-1	-3	-7	-5	-11
6	2	2	7	5	6	2	2	0	-1	-4	-5	-6	-9	-7	-12
-2	-6	-3	1	0	2	-1	-1	-3	-4	-7	-7	-8	-10	-9	-13
7	4	2	5	4	5	2	2	-1	-1	-5	-5	-6	-9	-8	-12
9	8	5	5	4	5	2	1	-1	-2	-6	-6	-7	-10	-8	-13
12	12	8	7	6	7	3	3	1	-1	-4	-4	-6	-9	-8	-13
8	8	7	5	4	5	1	1	0	-3	-6	-6	-7	-10	-10	-13
0	-1	-1	-2	-2	0	-3	-3	-4	-6	-8	-8	-9	-10	-10	-13
-10	-11	-7	-7	-7	-5	-6	-6	-6	-8	-10	-10	-10	-11	-11	-13
-7	-7	-6	-6	-6	-5	-7	-7	-7	-9	-10	-10	-10	-11	-11	-13
-3	-4	-5	-4	-4	-4	-5	-5	-6	-7	-8	-9	-10	-11	-11	-13
-5	-6	-6	-5	-5	-5	-6	-6	-7	-8	-9	-9	-10	-11	-11	-13
-14	-15	-15	-12	-12	-8	-10	-9	-10	-10	-10	-11	-11	-11	-11	-13
-16	-16	-18	-15	-15	-12	-12	-10	-11	-10	-10	-11	-11	-11	-11	-12
-17	-17	-16	-15	-15	-12	-12	-11	-11	-11	-11	-12	-12	-12	-12	-13
-18	-18	-19	-16	-17	-16	-15	-12	-12	-11	-11	-12	-11	-11	-12	-13
-19	-19	-21	-17	-18	-16	-15	-13	-13	-12	-12	-13	-12	-12	-12	-13
-25	-26	-27	-22	-24	-20	-19	-16	-17	-15	-14	-14	-13	-12	-12	-13
-30	-31	-35	-28	-30	-22	-22	-16	-19	-14	-11	-13	-12	-10	-9	-11
-22	-24	-21	-15	-17	-10	-10	-8	-8	-9	-10	-10	-10	-10	-9	-12
-23	-25	-22	-16	-17	-10	-11	-8	-10	-10	-10	-11	-11	-11	-10	-13
-20	-21	-19	-15	-15	-12	-13	-11	-11	-10	-11	-11	-11	-11	-11	-13
-20	-21	-23	-19	-20	-16	-16	-13	-14	-12	-12	-12	-11	-10	-10	-12
-18	-20	-15	-9	-10	-3	-5	-3	-5	-5	-7	-8	-8	-8	-7	-11
-15	-16	-14	-9	-10	-2	-5	-3	-4	-5	-8	-8	-9	-10	-8	-12
-7	-6	-5	-2	-3	1	-1	0	-1	-2	-5	-5	-6	-7	-6	-11
-16	-18	-20	-15	-15	-11	-10	-8	-9	-5	-6	-7	-7	-8	-6	-10
-20	-20	-20	-13	-15	-10	-10	-7	-8	-6	-9	-9	-9	-10	-8	-11
-20	-20	-17	-10	-11	-8	-9	-6	-7	-7	-9	-10	-10	-10	-9	-11
-15	-17	-13	-7	-9	-6	-7	-6	-6	-7	-9	-9	-10	-10	-10	-12
-19	-20	-16	-12	-13	-9	-9	-7	-8	-8	-9	-10	-10	-10	-10	-12
-14	-15	-10	-9	-10	-5	-6	-6	-6	-7	-8	-9	-10	-10	-10	-12
5	5	2	6	5	7	4	4	1	0	-3	-3	-5	-7	-5	-10
8	8	5	5	5	6	2	2	2	-1	-4	-4	-6	-8	-7	-11

WIND PRESSURES ON THE WALL C (in Pa)

C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
-3	-3	-3	-3	-2	-2	-2	-2	-3	-2	-2	-2	-3	-2	-2
-19	-20	-19	-18	-19	-20	-20	-18	-21	-20	-20	-23	-26	-25	-21
-17	-17	-16	-16	-16	-17	-17	-15	-18	-18	-16	-19	-21	-20	-18
-19	-19	-19	-17	-18	-20	-19	-16	-20	-20	-18	-21	-23	-22	-20
-18	-18	-18	-16	-16	-18	-17	-15	-18	-18	-15	-18	-20	-19	-16
-17	-17	-16	-15	-15	-17	-16	-14	-16	-17	-15	-17	-19	-18	-16
-17	-17	-16	-15	-16	-17	-17	-15	-17	-17	-15	-18	-19	-18	-16
-19	-19	-18	-17	-18	-18	-18	-16	-19	-18	-17	-19	-20	-20	-18
-24	-24	-24	-22	-23	-24	-24	-22	-24	-24	-23	-25	-26	-26	-24
-25	-25	-24	-23	-24	-25	-25	-23	-25	-25	-24	-26	-28	-28	-25
-25	-26	-25	-24	-25	-26	-25	-24	-26	-25	-25	-27	-30	-29	-26
-24	-24	-24	-23	-24	-25	-24	-23	-25	-24	-24	-25	-28	-27	-25
-23	-23	-23	-22	-23	-24	-23	-22	-24	-24	-23	-25	-28	-28	-24
-25	-25	-24	-23	-25	-25	-25	-23	-25	-25	-25	-26	-28	-28	-26
-23	-23	-22	-22	-23	-24	-23	-21	-24	-23	-23	-25	-27	-27	-25
-21	-22	-21	-20	-21	-22	-21	-20	-23	-22	-21	-23	-25	-24	-22
-22	-22	-21	-21	-22	-22	-22	-20	-23	-22	-21	-23	-25	-24	-23
-22	-22	-21	-21	-22	-22	-22	-21	-23	-22	-22	-23	-25	-24	-23
-23	-22	-22	-21	-22	-22	-22	-21	-23	-22	-22	-22	-23	-23	-22
-22	-22	-21	-20	-21	-22	-21	-20	-22	-21	-21	-22	-23	-22	-21
-19	-18	-18	-17	-18	-18	-18	-17	-19	-18	-17	-18	-20	-19	-18
-17	-16	-16	-15	-16	-16	-15	-15	-17	-16	-15	-17	-18	-17	-16
-17	-16	-16	-15	-16	-16	-15	-15	-17	-16	-15	-16	-17	-17	-16
-18	-17	-16	-16	-16	-16	-16	-15	-17	-16	-16	-17	-18	-18	-17
-17	-16	-16	-15	-16	-16	-16	-15	-17	-16	-15	-16	-17	-17	-17
-15	-15	-14	-14	-14	-14	-14	-13	-15	-14	-13	-15	-15	-15	-14
-14	-14	-13	13	-13	-13	-13	-12	-14	-13	-12	-13	-14	-13	-13
-14	-14	-13	-13	-13	-13	-13	-12	-14	-13	-12	-13	-14	-13	-13
-14	-13	-13	-12	-12	-12	-12	-11	-13	-12	-12	-13	-13	-13	-12
-14	-13	-13	-12	-12	-12	-12	-11	-13	-12	-11	-12	-13	-12	-11
-13	-13	-12	-11	-12	-12	-11	-10	-12	-12	-11	-12	-13	-12	-11
-12	-12	-11	-10	-10	-11	-10	-9	-11	-11	-10	-12	-13	-12	-11
-14	-14	-13	-13	-13	-14	-13	-12	-14	-14	-13	-15	-16	-16	-14
-15	-15	-15	-14	-15	-15	-15	-14	-16	-15	-15	-17	-19	-17	-15
-15	-15	-14	-14	-14	-15	-14	-13	-15	-15	-14	-16	-17	-17	-15
-14	-13	-13	-12	-12	-13	-12	-11	-13	-13	-12	-14	-15	-15	-13
-16	-16	-16	-15	-16	-17	-16	-15	-18	-18	-15	-19	-21	-21	-18
-17	-17	-17	-16	-16	-17	-17	-15	-18	-18	-16	-20	-23	-22	-19
-19	-19	-18	-17	-18	-19	-18	-17	-20	-20	-18	-21	-23	-23	-20
-12	-15	-16	-15	-16	-17	-15	-14	-18	-18	-15	-19	-20	-19	-17
-16	-16	-16	-15	-16	-17	-16	-14	-17	-17	-15	-18	-20	-19	-17
-16	-16	-15	-15	-16	-16	-16	-15	-17	-17	-15	-18	-20	-20	-18
-16	-16	-15	-15	-16	-17	-16	-15	-18	-18	-16	-18	-20	-20	-18
-15	-15	-15	-14	-15	-15	-15	-13	-15	-15	-14	-16	-18	-17	-15
-16	-16	-15	-15	-15	-15	-15	-14	-17	-16	-15	-17	-18	-17	-16
-20	-20	-19	-18	-19	-19	-19	-17	-20	-20	-19	-20	-21	-21	-20
-21	-21	-20	-19	-20	-20	-20	-19	-21	-20	-20	-22	-23	-23	-20

WIND PRESSURES ON THE WALL D (in Pa) — CAVITY PRES.

D1	D2	D3	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	P_1	A	B	C	D
-3	-2	-2	-1	-1	-1	-1	-1	0	-1	0	0	0	0	0	0	1	1	0
-32	-36	-24	-32	-35	-30	-33	-29	-28	-30	-28	-27	-27	-27	-13	-6	-5	-6	-6
-28	-28	-20	-29	-31	-28	-29	-27	-26	-27	-25	-25	-24	-25	-12	-8	-8	-8	-8
-27	-29	-18	-27	-29	-26	-28	-24	-27	-29	-22	-28	-30	-26	-11	-10	-9	-9	-10
-22	-24	-16	-27	-30	-29	-30	-25	-33	-34	-27	-33	-35	-32	-11	-10	-9	-9	-10
-23	-23	-17	-27	-30	-29	-29	-25	-30	-31	-26	-30	-31	-30	-11	-10	-9	-9	-10
-23	-23	-18	-25	-27	-26	-26	-24	-27	-27	-23	-26	-26	-25	-11	-10	-9	-9	-10
-23	-23	-18	-18	-15	-15	-25	-26	-25	-25	-23	-24	-24	-23	-11	-9	-8	-8	-9
-30	-30	-22	-29	-32	-29	-30	-27	-28	-30	-26	-27	-27	-26	-10	-5	-5	-5	-5
-32	-33	-23	-31	-34	-31	-33	-29	-29	-32	-28	-28	-29	-27	-10	-5	-4	-4	-5
-32	-35	-24	-32	-35	-31	-33	-29	-29	-31	-28	-28	-28	-27	-10	-5	-4	-4	-5
-30	-33	-23	-30	-33	-29	-31	-28	-27	-29	-27	-27	-27	-26	-10	-5	-5	-5	-5
-29	-32	-22	-29	-31	-32	-30	-27	-26	-28	-25	-25	-25	-25	-10	-6	-5	-5	-6
-30	-32	-22	-29	-31	-28	-30	-27	-27	-29	-25	-25	-25	-25	-10	-6	-5	-5	-6
-28	-58	-21	-27	-29	-26	-28	-25	-24	-26	-23	-23	-23	-23	-10	-7	-6	-6	-7
-26	-27	-19	-25	-27	-24	-26	-23	-23	-24	-22	-22	-22	-21	-10	-7	-6	-6	-7
-27	-28	-20	-25	-27	-25	-26	-23	-23	-25	-27	-27	-27	-26	-10	-7	-6	-6	-7
-26	-27	-21	-25	-27	-24	-26	-23	-23	-25	-22	-22	-22	-21	-10	-6	-6	-6	-6
-25	-26	-20	-23	-25	-23	-24	-22	-21	-23	-21	-21	-21	-20	-10	-7	-6	-6	-7
-24	-24	-21	-21	-22	-20	-21	-20	-19	-21	-19	-19	-19	-18	-10	-7	-6	-6	-7
-22	-22	-19	-20	-21	-19	-20	-18	-18	-19	-18	-18	-18	-18	-10	-7	-7	-7	-7
-20	-20	-17	-18	-19	-18	-18	-17	-17	-18	-16	-16	-16	-16	-10	-8	-7	-7	-8
-19	-19	-15	-18	-18	-17	-17	-16	-16	-17	-15	-15	-15	-15	-10	-8	-7	-7	-8
-18	-18	-15	-16	-17	-16	-16	-15	-15	-16	-14	-14	-14	-14	-9	-8	-7	-7	-8
-17	-17	-14	-16	-16	-15	-15	-14	-14	-15	-14	-14	-14	-27	-9	-8	-7	-7	-8
-17	-17	-13	-16	-16	-15	-15	-15	-14	-15	-14	-13	-13	-13	-9	-8	-7	-7	-8
-16	-15	-13	-18	-18	-18	-17	-15	-17	-18	-17	-15	-16	-17	-9	-8	-7	-7	-8
-16	-16	-13	-16	-16	-16	-16	-15	-15	-16	-15	-14	-14	-15	-9	-9	-8	-8	-9
-16	-15	-13	-17	-17	-17	-16	-15	-15	-15	-14	-14	-13	-14	-9	-9	-8	-8	-9
-15	-15	-12	-18	-18	-18	-18	-16	-17	-19	-17	-16	-17	-18	-9	-9	-8	-8	-9
-14	-14	-11	-23	-23	-24	-24	-19	-24	-26	-23	-20	-22	-26	-9	-8	-7	-7	-8
-18	-18	-17	-26	-27	-26	-26	-22	-25	-27	-24	-22	-23	-26	-10	-9	-8	-8	-9
-23	-24	-18	-22	-23	-21	-21	-20	-19	-20	-19	-18	-18	-19	-10	-8	-7	-7	-8
-22	-24	-18	-21	-22	-20	-21	-20	-20	-21	-19	-20	-20	-20	-10	-8	-7	-7	-8
-20	-20	-15	-22	-24	-22	-23	-21	-21	-22	-21	-20	-20	-21	-10	-8	-8	-8	-8
-18	-17	-14	-23	-25	-24	-24	-22	-22	-23	-22	-20	-20	-22	-10	-9	-8	[illegible]	-9
-27	-29	-19	-29	-31	-28	-30	-26	-26	-29	-26	-25	-26	-28	-10	-7	-6	-6	-7
-28	-30	-19	-29	-30	-28	-29	-26	-26	-28	-24	-24	-25	-26	-10	-7	-6	-6	-7
-26	-28	-18	-26	-27	-26	-27	-24	-24	-26	-23	-23	-23	-23	-10	-8	-7	-7	-8
-25	-27	-18	-26	-27	-26	-27	-24	-24	-25	-23	-22	-23	-23	-11	-9	-8	-8	-9
-26	-27	-18	-25	-27	-25	-25	-24	-23	-24	-22	-22	-22	-22	-11	-9	-8	-8	-9
-25	-25	-18	-25	-26	-24	-25	-23	-23	-24	-21	-21	-21	-21	-11	-8	-7	-7	-8
-24	-24	-16	-24	-25	-23	-24	-22	-22	-23	-20	-21	-20	-20	-10	-8	-7	-7	-8
-22	-22	-17	-22	-22	-21	-21	-20	-20	-20	-19	-19	-19	-19	-10	-9	-8	-8	-9
-22	-22	-17	-21	-22	-20	-21	-20	-19	-20	-18	-18	-18	-18	-10	-8	-7	-7	-8
-24	-25	-18	-23	-24	-22	-23	-21	-21	-22	-20	-20	-20	-19	-9	-6	-5	-5	-6
-24	-25	-18	-22	-24	-22	-23	-21	-20	-22	-20	-19	-20	-19	-9	-6	-5	-5	-6

CASE	FILM No.	POSE	TIME	0	A1 4	A2 4	A3 4	A4 3	A5 4	A6 3	A7 4	A8 3	A9 3	A10 2	A11 2	A12 1	A13 0	A14 -1	A15 -1
					WIND PRESSURE ON THE WALL A (in Pa)														
CASE 12	8	9	12.42.33	4	-9	-9	-9	-10	-8	-9	-9	-10	-8	-10	-10	-10	-11	-12	-12
	8	10	12.42.45	4	-5	-6	-6	-7	-5	-6	-6	-6	-6	-7	-8	-8	-9	-10	-10
	8	11	12.43.05	2	-5	-5	-5	-6	-5	-6	-5	-5	-5	-6	-6	-6	-7	-9	-9
	8	12	12.43.24	3	-4	-4	-4	-5	-4	-5	-5	-5	-5	-6	-6	-6	-7	-8	-9
	8	13	12.43.32	3	-5	-5	-5	-6	-5	-5	-5	-6	-5	-6	-7	-7	-8	-9	-10
	8	14	12.43.48	1	-8	-10	-9	-8	-8	-10	-9	-9	-8	-10	-11	-10	-10	-12	-13
	8	15	12.44.18	1	-4	-4	-3	-4	-4	-5	-4	-5	-5	-6	-6	-6	-7	-8	-8
	8	16	12.44.36	3	-6	-7	-7	-8	-5	-7	-6	-7	-5	-7	-8	-7	-8	-10	-10
	8	17	12.44.47	4	-6	-7	-7	-9	-6	-7	-6	-7	-6	-8	-9	-9	-10	-11	[illegible]
	8	18	12.45.01	4	-11	-11	-11	-12	-10	-11	-10	-11	-10	-11	-13	-11	-12	-14	[illegible]
	8	19	12.45.30	1	-7	-8	-7	-8	-7	-8	-7	-8	-7	-9	-9	-9	-10	-11	-11
	8	20	12.46.04	3	-5	-6	-6	-7	-5	-6	-5	-6	-5	-7	-7	-7	-8	-10	-10
	8	21	12.46.26	2	-3	-3	-3	-4	-2	-3	-3	-4	-3	-5	-5	-5	-6	-7	-7
	8	22	12.46.58	2	-2	-2	-2	-3	-3	-5	-4	-4	-5	-6	-6	-6	-6	-8	-9
CASE 4	2	14	11.05.35	4	-2	-3	-3	-4	-3	-4	-3	-4	-4	-5	-5	-5	-6	-7	-7
	2	15	11.05.40	4	-2	-2	-2	-3	-2	-3	-3	-3	-3	-4	-5	-5	-5	-6	-6
	2	16	11.05.45	3	-1	-1	-1	-2	-1	-2	-2	-2	-2	-3	-3	-4	-5	-5	-6
	2	17	11.05.50	3	-1	0	0	-1	0	-1	-1	-2	-2	-2	-3	-3	-4	-5	-5
	2	18	11.05.55	3	0	0	0	-1	0	-1	-1	-2	-2	-2	-3	-3	-4	-5	-5
	2	19	11.06.00	3	0	0	0	-1	0	-1	-1	-2	-2	-2	-2	-3	-4	-5	-5
	2	20	11.06.05	4	0	0	0	-2	0	-1	0	-2	-1	-2	-3	-3	-3	-5	-5
	2	21	11.06.10	4	-1	-1	-2	-3	-1	-2	-2	-2	-2	-3	-4	-4	-5	-6	-6
	2	22	11.06.15	4	-1	-1	-2	-3	-1	-2	-2	-3	-2	-3	-4	-4	-5	-6	-6
	2	23	11.06.20	4	-2	-2	-2	-3	-2	-3	-2	-3	-2	-4	-5	-5	-5	-7	-7
	2	24	11.06.25	3	-2	-2	-2	-3	-2	-3	-2	-3	-3	-4	-4	-4	-5	-6	-6
	2	25	11.06.30	3	-2	-2	-2	-3	-2	-3	-2	-3	-2	-4	-4	-4	-5	-6	-6
	2	26	11.06.35	3	-1	-2	-2	-3	-2	-2	-2	-2	-2	-3	-3	-3	-4	-5	-6
	2	27	11.06.40	3	-1	-1	-1	-2	-1	-2	-1	-2	-2	-2	-3	-3	-4	-5	-5
	2	28	11.06.45	3	-1	-1	-2	-3	-2	-2	-2	-2	-2	-3	-4	-4	-5	-6	-6
	2	29	11.06.50	4	-2	-2	-2	-3	-2	-3	-2	-3	-3	-3	-4	-4	-5	-6	-6
	2	30	11.06.55	4	-2	-2	-2	-3	-2	-3	-2	-3	-3	-4	-5	-5	-5	-6	-7
	2	31	11.06.59	5	-2	-2	-3	-4	-2	-3	-2	-3	-3	-4	-5	-5	-5	-6	-7
	2	32	11.07.05	5	-1	-2	-2	-4	-1	-2	-2	-2	-2	-3	-4	-4	-4	-6	-6
	2	33	11.07.10	5	-1	-2	-2	-4	-2	-2	-2	-3	-2	-3	-5	-4	-5	-6	-7
	2	34	11.07.15	5	-2	-3	-3	-5	-2	-3	-3	-4	-3	-4	-5	-5	-5	-6	-7
	2	35	11.07.20	4	-3	-3	-3	-4	-2	-4	-3	-4	-3	-5	-5	-5	-5	-6	-7
	2	36	11.07.25	4	-2	-2	-1	-2	-1	-2	-2	-2	-2	-3	-3	-4	-5	-6	-6
	2	37	11.07.30	4	-2	-2	-2	-3	-2	-2	-2	-2	-2	-3	-4	-4	-5	-6	-6
	2	38	11.07.35	4	-1	-2	-2	-3	-2	-2	-2	-3	-2	-3	-4	-4	-5	-6	-6
	2	39	11.07.40	4	-2	-1	-1	-3	-2	-2	-2	-3	-2	-4	-4	-4	-5	-6	-6
	2	40	11.07.45	3	-1	-1	-1	-2	-1	-2	-1	-2	-2	-3	-3	-3	-4	-5	-6
	2	41	11.07.53	3	0	-1	-1	-2	-1	-2	-1	-2	-1	-2	-3	-3	-4	-5	-5
	2	42	11.07.56	3	0	0	-1	-2	0	-2	-1	-2	-1	-2	-2	-3	-4	-5	-5
	2	43	11.08.00	3	0	0	-1	-2	0	-1	-1	-1	-1	-2	-2	-3	-3	-5	-5
	2	44	11.08.05	3	0	0	0	-1	0	-1	-1	-1	-1	-2	-2	-2	-3	-4	-5
	2	1	11.08.10	3	-1	-1	-1	-2	-1	-2	-1	-2	-1	-2	-2	-3	-4	-5	-5
	2	2	11.08.15	3	-1	-1	-1	-2	-1	-2	-1	-2	-1	-2	-3	-3	-4	-5	-5
	2	3	11.08.20	3	-1	-1	-1	-2	-1	-2	-2	-2	-2	-3	-3	-3	-5	-6	-6
	2	4	11.08.25	3	-1	-1	-1	-2	-1	-2	-2	-2	-2	-3	-3	-3	-4	-5	-5
	2	5	11.08.30	3	0	0	0	-2	0	-1	-1	-2	-2	-2	-3	-3	-4	-5	-5
	2	6	11.08.35	3	0	0	0	-1	0	-1	0	-2	-2	-2	-3	-3	-4	-5	-5
	2	7	11.08.40	2	0	0	0	-1	0	-1	0	-1	-1	-2	-2	-2	-3	-5	-5

WIND PRESSURE ON THE WALL B (in Pa)

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15
-1	-1	-1	-2	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2
5	2	1	12	10	9	14	13	17	16	18	18	16	19	19
5	3	0	10	9	7	11	10	13	12	13	13	12	13	13
0	-1	-2	5	3	1	3	3	9	7	9	9	8	12	12
2	0	-1	6	5	4	7	6	10	8	10	9	8	10	10
5	2	0	9	8	6	8	9	11	10	12	12	10	12	11
10	8	3	14	14	11	15	14	16	14	15	15	13	10	11
0	-1	-1	4	3	2	5	4	7	6	7	7	6	8	8
6	4	2	12	11	9	14	12	15	14	15	15	14	14	14
6	4	2	12	10	8	13	12	15	14	16	16	14	15	15
10	8	3	17	15	12	15	15	19	17	19	19	16	17	18
0	-2	-3	7	4	2	9	5	12	10	12	13	12	16	16
0	-2	-3	5	3	1	5	3	9	7	9	9	8	12	12
1	0	-1	4	3	2	4	3	7	5	7	7	5	8	8
3	2	0	5	5	4	5	5	7	5	6	6	4	5	5
4	2	1	10	8	6	10	9	14	13	14	14	13	15	15
3	1	0	7	5	5	8	6	10	9	10	10	9	10	10
1	0	0	5	4	3	5	4	7	6	6	6	6	8	8
0	0	-1	4	3	2	4	3	6	5	5	5	5	6	6
1	0	-1	4	3	2	4	3	6	5	5	5	5	6	6
1	0	0	4	3	2	5	4	6	5	6	6	6	6	6
4	2	1	6	5	4	6	5	7	6	6	6	6	6	6
5	3	1	8	7	5	6	7	10	9	10	10	9	12	11
4	2	1	8	6	5	7	7	10	9	10	10	9	13	12
3	1	0	8	5	4	7	5	10	9	11	11	10	14	13
2	0	-1	6	4	2	5	3	9	8	9	9	8	11	11
1	0	-1	6	4	2	5	3	9	7	8	9	8	11	11
1	0	-1	5	3	2	4	3	8	6	7	7	7	9	9
1	0	-1	5	3	2	4	3	8	6	7	7	6	9	9
2	1	0	7	5	4	5	5	10	9	10	10	9	12	13
4	2	1	9	7	5	7	8	12	10	12	12	10	14	13
5	4	2	10	9	7	8	9	11	10	10	11	10	10	10
7	5	3	10	10	9	10	10	12	11	12	12	10	10	10
7	5	3	12	10	9	10	10	13	12	13	13	12	12	13
8	5	3	12	10	9	10	10	14	13	14	14	13	13	14
7	5	3	12	10	9	12	11	15	13	15	15	13	14	15
5	3	2	10	9	8	10	10	14	13	14	14	13	14	14
4	2	1	8	6	5	7	7	10	10	10	10	10	12	12
5	3	1	9	8	6	8	8	12	10	12	12	10	13	13
4	2	1	9	7	5	8	8	12	10	12	12	11	14	14
3	1	0	8	5	4	6	7	10	9	11	11	10	14	13
2	1	0	6	5	4	6	5	10	9	10	10	9	12	11
1	0	-1	4	2	2	4	3	6	5	6	6	5	8	8
0	1	-1	3	2	1	3	2	5	4	5	5	5	6	6
0	-1	-2	2	1	0	2	1	5	3	3	3	3	4	4
0	-1	-2	2	1	0	2	0	4	3	3	3	3	3	3
0	-1	-1	2	1	0	2	0	4	3	3	4	3	4	4
0	-1	-2	2	1	0	2	1	5	4	4	5	4	5	5
0	-1	-1	4	3	1	4	2	6	5	6	6	6	8	8
1	0	-1	4	3	2	5	3	7	6	7	7	6	8	8
1	0	0	4	4	3	5	4	6	5	6	6	5	7	7
1	0	0	4	3	2	4	3	6	5	5	5	4	5	5
0	0	1	2	2	2	3	3	5	4	4	4	3	5	5

WIND PRESSURE ON THE WALL C (in Pa)

C1	C2	C3	C4	C5	C6	C7	C8	C9	C11	C12	C13	C14	C15
-3	-3	-3	-3	-2	-2	-2	-2	-3	-2	-2	-3	-2	-2
-15	-13	-13	-12	-5	-7	-6	-5	-4	-5	-7	-10	-12	-10
-16	-14	-14	-12	-6	-7	-7	-5	-4	-5	-6	-8	-10	-8
8	9	8	6	8	5	6	6	4	3	-2	-3	-6	-4
-7	-5	-5	-4	0	-1	-1	-1	-2	-2	-5	-6	-8	-6
-14	-12	-13	-11	-6	-6	-6	-5	-4	-5	-6	-7	-10	-7
-21	-20	-20	-20	-19	-18	-18	-16	-15	-14	-10	-12	-13	-11
0	0	0	-2	1	-1	0	0	-1	-2	-3	-5	-7	-5
-20	-18	-19	-20	-15	-16	-16	-13	-10	-9	-8	-9	-10	-8
-21	-18	-18	-19	-12	-14	-14	-11	-7	-7	-8	-9	-11	-9
-26	-25	-27	-26	-19	-19	-19	-14	-12	-10	-9	-11	-12	-10
7	9	7	6	7	4	5	5	3	2	-3	-5	-9	-5
7	8	7	6	6	4	5	5	3	2	-3	-4	-7	-5
-7	-6	-6	-5	-2	-3	-2	-2	-3	-3	-4	-6	-7	-6
-12	-11	-11	-11	-8	-8	-9	-7	-6	-5	-5	-6	-7	-6
-5	-1	-1	-1	2	0	1	2	0	0	-3	-5	-8	-5
0	2	2	1	4	2	3	3	2	1	-2	-3	-5	-3
2	3	3	2	4	3	3	3	2	1	-1	-2	-4	-3
3	4	3	3	4	3	3	3	2	1	-1	-2	-4	-2
2	3	2	2	3	2	2	2	1	0	-1	-2	-4	-3
-1	0	-1	-1	0	0	0	-1	0	0	-2	-3	-5	-3
-6	-5	-5	-6	-4	-4	-4	-2	-3	-2	-3	-4	-5	-4
-10	-9	-9	-9	-4	-5	-5	-3	-3	-2	-3	-5	-6	-4
-7	-5	-5	-5	-1	-2	-2	-1	-1	-1	-3	-4	-6	-4
2	3	2	2	4	2	3	3	2	1	-2	-3	-6	-3
6	7	7	6	6	5	6	6	4	4	-1	-2	-4	-2
7	8	7	7	6	5	6	6	4	3	-1	-2	-4	-2
4	5	5	5	4	3	4	4	2	2	-1	-2	-4	-2
0	2	2	2	2	1	2	2	0	0	-2	-3	-5	-3
-3	-2	-1	0	1	0	1	2	0	0	-3	-4	-6	-4
-7	-6	-5	-4	0	-1	-1	0	-1	-1	-3	-5	-6	-5
-10	-7	-7	-7	-2	-3	-3	-1	-2	-2	-3	-5	-6	-5
-12	-10	-10	-10	-7	-7	-7	-5	-5	-4	-4	-5	-6	-5
-13	-12	-12	-11	-7	-7	-7	-5	-4	-4	-4	-5	-6	-5
-15	-13	-12	-12	-7	-8	-9	-6	-4	-4	-4	-5	-6	-5
-16	-14	-14	-14	-7	-9	-10	-7	-4	-5	-4	-6	7	-5
-11	-9	-8	-9	-4	-5	-5	-4	-2	-3	-4	-5	-7	-5
-14	-11	-10	-10	-2	-4	-3	-2	-2	2	-4	-5	-6	-5
-10	-8	-7	-7	-2	-3	-3	-2	-2	-2	-4	-5	-6	-5
-4	-3	-3	-3	1	-1	-1	0	0	-1	-3	-5	-7	-5
0	0	0	-1	2	0	0	1	0	0	-3	-5	-7	-5
3	3	2	1	4	2	2	2	2	1	-2	-3	-5	-3
6	6	5	4	5	4	5	5	3	2	-1	-2	-3	-2
7	7	5	4	6	5	5	5	4	3	0	-1	-3	-2
7	7	6	5	7	6	5	5	5	4	0	-1	-2	-1
7	8	7	6	8	7	7	7	6	5	-1	0	-1	0
7	8	8	6	7	6	7	6	5	4	1	0	-1	0
6	7	7	6	5	5	6	5	3	3	0	-1	-2	-1
6	5	5	5	4	4	5	5	2	3	-1	-2	-3	-2
0	2	3	2	3	2	3	3	1	1	-2	-3	-4	-3
-2	-1	0	-1	1	0	0	1	0	0	-2	-3	-4	-3
-3	-2	-2	-2	0	0	0	0	-1	-1	-2	-3	-4	-3
-3	-2	-1	-2	0	0	0	0	-1	-1	-2	-3	-4	-3

WIND PRESSURE ON THE WALL D (in Pa)

D1	D2	D3	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	P_1	CAVITY PRES. A	B	C
-3	-2	-2	-1	-1	-1	-1	-1	0	-1	0	0	0	0	0	0	1	1
-15	-15	-14	-12	-14	-12	-13	-10	-11	-13	-9	-11	-12	-10	0	14	15	15
-12	-12	-11	-10	-11	-10	-11	-9	-9	-11	-7	-10	-10	-7	0	10	11	11
-13	-13	-12	-12	-12	-11	-12	-11	-10	-12	-9	-11	-12	-8	-1	7	8	8
-11	-11	-10	-9	-10	-9	-10	-8	-8	-10	-7	-9	-9	-7	0	8	9	9
-11	-11	-10	-10	-10	-9	-10	-8	-8	-10	-7	-8	-9	-8	0	10	11	11
-11	-11	-11	-8	-8	-8	-8	-7	-7	-8	-6	-7	-8	-7	1	7	8	8
-10	-10	-10	-8	-9	-8	-8	-8	-7	-9	-7	-8	-9	-7	0	6	7	7
-11	-11	-10	-10	-10	-10	-10	-9	-8	-10	-7	-8	-9	-7	1	12	13	13
-12	-12	-11	-10	-11	-10	-11	-10	-9	-11	-7	-9	-10	-8	1	12	13	13
-12	-12	-12	-10	-11	-10	-11	-10	-10	-11	-8	-11	-11	-9	1	15	16	16
-14	-14	-13	-12	-13	-12	-13	-12	-11	-14	-10	-12	-13	-10	0	9	10	10
-13	-13	-12	-11	-12	-10	-12	-10	-10	-12	-8	-11	-11	-8	0	7	8	8
-9	-9	-8	-7	-8	-7	-7	-7	-6	-7	-5	-6	-7	-6	0	6	7	7
-8	-8	-7	-6	-6	-6	-6	-5	-5	-6	-4	-5	-5	-5	0	5	6	6
-10	-10	-10	-8	-10	-7	-9	-6	-6	-9	-5	-7	-8	-5	-1	0	1	1
-10	-10	-9	-7	-9	-7	-8	-6	-6	-8	-4	-6	-7	-5	-1	0	1	1
-9	-8	-8	-6	-7	-6	-7	-6	-5	-7	-4	-6	-6	-4	-1	0	0	0
-8	-8	-7	-6	-7	-6	-6	-5	-5	-7	-4	-5	-6	-4	-1	0	0	0
-8	-8	-7	-6	-7	-6	-6	-5	-5	-6	-4	-5	-6	-4	-1	0	0	0
-7	-7	-6	-5	-6	-5	-6	-5	-5	-6	-3	-5	-5	-4	-1	0	0	0
-7	-6	-6	-5	-5	-5	-5	-3	-4	-5	-2	-4	-5	-3	-1	0	0	0
-7	-7	-6	-5	-6	-5	-6	-4	-4	-6	-3	-4	-5	-3	-1	0	1	1
-8	-8	-7	-6	-7	-6	-7	-5	-5	-6	-4	-5	-6	-5	-1	0	1	1
-10	-10	-9	-8	-9	-8	-8	-7	-7	-9	-6	-7	-8	-5	-1	0	1	1
-10	-10	-9	-8	-9	-8	-9	-7	-7	-9	-5	-7	-8	-5	-1	0	1	1
-10	-10	-9	-8	-9	-8	-9	-7	-6	-10	-5	-7	-8	-5	-1	0	1	1
-9	-8	-8	-7	-8	-7	-7	-6	-6	-8	-5	-6	-7	-4	-1	0	1	1
-8	-8	-7	-6	-7	-6	-7	-5	-5	-7	-4	-5	-6	-4	-1	0	1	1
-9	-9	-8	-7	-7	-6	-7	-6	-5	-7	-5	-6	-7	-5	-1	0	1	1
-8	-8	-7	-7	-7	-6	-7	-6	-5	-7	-5	-6	-6	-5	-1	0	1	1
-8	-8	-7	-6	-6	-6	-6	-5	-5	-6	-4	-5	-6	-5	-1	0	1	1
-7	-7	-6	-5	-6	-5	-5	-5	-4	-6	-3	-5	-5	-4	-1	0	1	1
-8	-8	-7	-6	-7	-6	-6	-5	-5	-6	-3	-5	-5	-3	-1	0	1	1
-8	-8	-7	-6	-7	-6	-6	-5	-5	-6	-3	-5	-5	-4	-1	0	1	1
-8	-8	-7	-6	-7	-5	-6	-5	-5	-6	-3	-5	-5	-3	-1	0	1	1
-8	-8	-7	-6	-7	-6	-7	-6	-5	-7	-4	-5	-6	-4	-1	0	1	1
-8	-8	-7	-6	-7	-6	-6	-6	-4	-6	-4	-5	-6	-3	-1	0	1	1
-8	-8	-7	-6	-7	-6	-6	-5	-5	-7	-4	-5	-6	-3	-1	0	1	1
-10	-9	-9	-7	-8	-7	-7	-6	-5	-8	-5	-6	-6	-5	-1	0	1	1
-10	-10	-9	-7	-8	-7	-8	-7	-6	-8	-5	-7	-7	-5	-1	0	1	1
-10	-10	-9	-8	-8	-7	-8	-7	-6	-8	-5	-7	-7	-5	-1	0	1	1
-10	-9	-9	-7	-8	-7	-8	-6	-5	-8	-4	-6	-7	-4	-1	0	0	0
-9	-9	-8	-7	-8	-7	-7	-6	-5	-7	-4	-6	-7	-4	-1	0	0	0
-8	-8	-8	-7	-7	-6	-7	-6	-5	-7	-4	-5	-6	-4	-1	0	0	0
-8	-8	-8	-6	-7	-6	-7	-6	-5	-7	-4	-6	-7	-3	-1	0	0	0
-8	-8	-7	-6	-7	-6	-7	-6	-5	-7	-4	-6	-7	-4	-1	0	0	0
-8	-8	-7	-6	-7	-6	-7	-6	-5	-8	-4	-6	-7	-4	-1	0	0	0
-8	-8	-7	-6	-7	-6	-7	-6	-5	-8	-4	-6	-7	-4	-1	0	0	0
-8	-8	-7	-6	-7	-6	-6	-5	-5	-7	-4	-5	-6	-4	-1	0	1	1
-7	-7	-6	-6	-6	-5	-6	-5	-5	-6	-3	-5	-5	-3	-1	0	1	1
-7	-6	-6	-5	-5	-5	-5	-4	-4	-5	-3	-4	-5	-3	-1	0	0	0
-6	-6	-5	-5	-5	-5	-5	-4	-3	-5	-3	-4	-4	-3	-1	0	0	0

WIND PRESSURES ON THE WALL A (in Pa)

CASE	FILM No.	POSE	TIME	REFER. P	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
				0	4	4	4	3	4	3	4	3	3	2	2	1	0	-1	-1
CASE 5	10	12	9.40.52	-4	7	3	-1	0	15	14	9	4	19	15	11	21	18	12	7
	10	13	9.41.00	-6	15	13	8	9	21	20	16	14	24	21	17	23	20	14	9
	10	14	9.41.05	-7	12	10	7	6	15	13	10	10	15	13	10	13	10	5	3
	10	15	9.41.10	-7	10	10	7	5	12	10	9	7	10	7	5	7	4	0	-1
	10	16	9.41.20	-7	10	10	8	5	13	10	9	8	10	8	6	8	5	0	-1
	10	18	9.41.30	-3	22	20	14	15	30	27	22	22	30	28	23	30	25	15	12
	10	19	9.41.35	-3	17	15	10	10	20	19	15	15	20	19	14	18	15	9	6
	10	20	9.41.41	-3	17	15	13	12	21	20	18	17	22	20	17	19	17	12	8
	10	21	9.41.45	-4	15	13	10	10	21	20	18	17	24	23	18	25	24	17	12
	10	22	9.41.50	-2	15	10	5	8	24	24	18	14	30	26	20	36	32	25	18
	10	23	9.41.55	0	18	15	10	10	28	30	24	19	35	33	28	42	40	33	25
	10	24	9.42.01	-1	20	18	14	14	30	30	25	23	35	34	28	39	35	28	22
	10	25	9.42.05	-1	20	17	13	14	30	30	25	23	34	33	28	37	35	28	22
	10	26	9.42.10	-1	20	17	13	14	30	30	25	23	35	33	28	37	35	30	23
	10	27	9.42.15	-2	20	17	13	12	25	24	19	19	27	25	21	28	25	20	15
	10	28	9.42.20	-3	20	17	13	13	25	24	20	20	26	25	22	25	24	20	14
	10	29	9.42.25	-4	15	14	10	10	20	20	17	16	22	22	18	22	20	16	12
	10	30	9.42.30	-5	13	11	9	8	18	18	15	14	20	20	16	22	20	16	12
CASE 6	11	1	9.47.25	-5	20	18	12	13	27	25	20	20	28	25	21	26	23	17	13
	11	2	9.47.30	-4	23	20	15	15	28	26	22	22	27	26	22	25	20	15	11
	11	3	9.47.35	-2	27	25	20	20	35	34	29	28	34	32	27	30	24	16	13
	11	4	9.47.40	-1	23	22	18	17	26	25	24	22	25	24	20	20	17	10	9
	11	5	9.47.45	-2	17	15	12	11	20	18	16	16	20	18	15	15	13	7	5
	11	6	9.47.50	-2	25	20	15	13	24	20	17	17	20	16	13	14	9	3	3
	11	7	9.47.55	-2	21	19	13	12	23	20	17	17	21	18	15	17	13	6	5
	11	8	9.48.00	-4	19	16	12	12	22	20	16	16	21	19	15	18	15	8	6
	11	9	9.48.05	-3	21	18	12	13	27	25	19	20	28	25	20	26	24	15	10
	11	10	9.48.10	-1	17	13	8	10	22	21	16	15	25	23	17	26	24	16	12
	11	11	9.48.15	0	19	16	12	12	25	23	18	17	25	23	18	25	22	15	11
	11	12	9.48.20	-1	19	16	13	12	23	20	18	16	22	20	15	20	15	10	7
	11	13	9.48.25	-2	17	15	12	12	22	21	18	17	24	22	18	22	18	13	9
	11	14	9.48.30	-3	17	15	13	12	20	20	17	16	21	20	16	18	15	10	8
	11	15	9.48.35	-3	19	18	15	14	22	22	20	18	21	20	16	17	14	9	6
	11	16	9.48.40	-4	17	15	14	12	20	19	17	16	19	18	15	15	13	8	5
	11	17	9.48.45	-5	17	14	12	12	20	19	16	16	20	19	16	17	14	10	6
	11	18	9.48.50	-2	25	23	18	17	30	27	24	24	28	25	22	24	19	12	9
	11	19	9.48.56	-4	15	13	10	10	19	18	15	15	19	18	15	18	15	10	7
	11	20	9.49.00	-5	12	10	7	7	15	14	12	11	16	15	13	15	14	10	7
	11	21	9.49.15	-6	27	25	20	20	34	32	27	27	32	29	25	27	22	15	12
	11	22	9.49.30	-1	30	25	17	19	42	38	29	29	46	41	32	49	42	30	22
	11	23	9.49.35	-1	30	25	17	18	35	32	27	27	36	33	28	35	30	22	17
	11	24	9.49.40	-1	22	17	11	13	30	27	21	20	33	29	23	35	30	23	18
	11	25	9.49.49	-1	25	20	14	15	34	32	25	24	37	35	28	38	35	27	22
	11	26	9.50.20	-4	22	18	12	14	30	29	22	22	35	33	25	38	35	25	18
	11	27	9.50.34	-4	13	9	4	6	20	20	16	12	25	23	19	30	27	24	19

WIND PRESSURES ON THE WALL B (in Pa)

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16
-1	-1	-1	-2	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2	-3
28	28	19	21	20	20	15	15	10	9	3	3	2	-5	-2	-8
-3	-5	-5	-2	-2	2	0	2	0	-1	-5	-5	-5	-8	-6	-10
-10	-12	-13	-10	-10	-8	-8	-5	-6	-5	-8	-8	-8	-10	-10	-12
-14	-14	-15	-14	-14	-12	-12	-10	-10	-10	-11	-11	-11	-12	-12	-13
-15	-15	-16	-16	-16	-14	-15	-13	-14	-14	-14	-15	-14	-15	-15	-15
-20	-20	-20	-14	-16	-11	-11	-8	-10	-9	-10	-11	-10	-11	-10	-12
-17	-17	-16	-12	-14	-10	-10	-7	-9	-8	-10	-10	-10	-11	-10	-12
-19	-18	-20	-14	-15	-11	-11	-8	-10	-9	-10	-10	-10	-11	-10	-12
-10	-11	-10	-18	-20	-15	-17	-15	-17	-17	-19	-20	-20	-21	-20	-22
10	10	5	5	3	6	2	2	-1	-1	-5	-5	-6	-10	-7	-12
10	7	7	8	5	10	3	3	0	-1	-6	-6	-6	-10	-8	-13
-8	-10	-6	1	-1	3	-1	-1	-2	-4	-8	-8	-8	-10	-9	-13
-10	-13	-7	-1	-3	2	-2	-1	-2	-4	-9	-9	-9	-10	-9	-13
-10	-13	-6	0	-2	2	-2	-1	-2	-5	-9	-9	-9	-11	-9	-13
-13	-16	-6	-3	-4	0	-3	-3	-3	-5	-9	-9	-9	-11	-10	-13
-18	-19	-13	-9	-10	-2	-6	-5	-5	-6	-10	-10	-10	-11	-10	-12
-15	-16	-10	-6	-7	-2	-6	-5	-5	-5	-10	-10	-10	-11	-10	-13
-13	-15	-8	-5	-7	-2	-6	-5	-5	-8	-10	-10	-10	-11	-10	-13
-20	-21	-17	-13	-13	-5	-9	-5	-6	-7	-10	-10	-10	-11	-10	-13
-21	-22	-21	-18	-18	-13	-14	-10	-12	-10	-10	-11	-10	-10	-10	-12
-22	-23	-24	-20	-22	-17	-17	-14	-15	-11	-11	-12	-11	-10	-10	-11
-25	-26	-27	-24	-25	-21	-20	-17	-17	-14	-13	-15	-13	-13	-13	-13
-25	-26	-28	-25	-25	-22	-20	-16	-17	-14	-13	-15	-13	-13	-13	-14
-26	-26	-27	-26	-26	-24	-22	-19	-20	-17	-16	-17	-15	-15	-15	-15
-25	-25	-26	-23	-23	-20	-19	-16	-17	-14	-14	-15	-13	-14	-13	-14
-24	-24	-25	-21	-22	-17	-17	-14	-14	-13	-12	-13	-12	-12	-12	-13
-25	-25	-23	-18	-19	-13	-14	-11	-12	-11	-12	-12	-11	-12	-11	-12
-12	-12	-12	-7	-10	-6	-8	-6	-9	-8	-10	-10	-10	-11	-10	-13
-13	-14	-13	-8	-10	-6	-7	-5	-8	-7	-8	-9	-9	-10	-10	-9
-19	-20	-18	-15	-16	-12	-13	-11	-12	-11	-11	-11	-12	-12	-10	-13
-21	-21	-19	-16	-16	-11	-12	-10	-11	-10	-11	-11	-11	-11	-10	-13
-22	-22	-22	-19	-20	-16	-16	-13	-14	-12	-13	-12	-12	-12	-11	-12
-23	-23	-23	-21	-22	-19	-18	-15	-15	-12	-12	-12	-11	-11	-10	-12
-22	-22	-23	-21	-22	-19	-19	-15	-16	-13	-12	-12	-11	-11	-10	-11
-23	-23	-26	-22	-23	-18	-18	-15	-15	-13	-12	-12	12	-11	-10	-12
-23	-23	-27	-23	-24	-20	-20	-16	-17	-12	-11	-12	-11	-10	-10	-11
18	-19	-20	-17	-18	-15	-15	-12	-14	-10	-11	-11	-10	-10	-10	-11
-13	-15	-15	-12	-13	-10	-12	-10	-11	-9	-10	-10	-10	-11	-10	-12
-22	-22	-23	-21	-21	-21	-20	-18	-18	-14	-15	-15	-12	-13	-11	-12
-23	-23	-15	-13	-14	-9	-12	-10	-10	-10	-12	-12	-11	-12	-10	-13
-25	-26	-21	-16	-17	-12	-12	-10	-9	-10	-11	-11	-10	-11	-9	-12
-8	-9	-6	-4	-5	-2	-4	-3	-4	-5	-7	-7	-8	-10	-7	-12
-8	-10	-6	-3	-4	2	-2	-1	-2	-3	-7	-7	-7	-10	-7	-12
-16	-17	-8	-4	-5	0	-4	-3	-5	-6	-10	-10	-10	-11	-10	-13
7	6	10	9	7	12	3	5	1	0	-5	-5	-6	-10	-7	-12

WIND PRESSURES ON THE WALL C (in Pa)

C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
-3	-3	-3	-3	-2	-2	-2	-2	-3	-2	-2	-2	-3	-2	-2
-24	-25	-24	-23	-24	-25	-24	-22	-25	-24	-24	-25	-27	-26	-25
-20	-20	-20	-18	-20	-20	-20	-18	-21	-20	-19	-22	-23	-22	-20
-18	-18	-18	-17	-18	-19	-18	-16	-19	-18	-18	-19	-21	-20	-18
-18	-17	-17	-16	-17	-17	-17	-15	-18	-17	-16	-18	-18	-18	-16
-17	-16	-16	-15	-16	-16	-15	-14	-17	-15	-14	-15	-16	-15	-15
-16	-15	-15	-14	-15	-15	-15	-13	-16	-15	-14	-16	-17	-17	-15
-16	-16	-15	-15	-15	-15	-15	-14	-16	-16	-15	-17	-17	-17	-16
-16	-15	-15	-14	-15	-15	-14	-13	-15	-15	-13	-15	-16	-16	-15
-17	-17	-16	-15	-17	-17	-16	-15	-18	-17	-15	-18	-19	-18	-16
-21	-20	-20	-19	-20	-20	-20	-18	-21	-20	-19	-21	-23	-22	-20
-22	-22	-21	-21	-22	-22	-21	-20	-23	-22	-21	-24	-25	-24	-22
-20	-20	-20	-19	-20	-20	-20	-18	-21	-21	-20	-23	-25	-23	-21
-20	-19	-19	-18	-19	-20	-19	-18	-20	-20	-18	-22	-24	-22	-20
-20	-20	-19	-18	-19	-20	-19	-18	-21	-21	-19	-23	-25	-24	-20
-19	-19	-18	-17	-18	-19	-18	-17	-20	-20	-18	-21	-23	-22	-18
-18	-17	-16	-16	-17	-17	-17	-16	-18	-18	-16	-19	-21	-20	-17
-18	-17	-16	-16	-17	-17	-17	-15	-18	-18	-17	-19	-21	-20	-17
-18	-17	-16	-16	-17	-17	-17	-15	-18	-18	-17	-19	-21	-20	-17
-17	-17	-16	-15	-16	-16	-16	-15	-17	-17	-15	-18	-19	-18	-16
-15	-15	-14	-13	-14	-14	-13	-12	-15	-14	-13	-15	-17	-16	-14
-14	-13	-12	-12	-12	-12	-12	-11	-14	-12	-12	-14	-15	-14	-13
-15	-15	-14	-13	-13	-13	-13	-12	-15	-14	-13	-15	-15	-15	-14
-15	-15	-14	-14	-14	-14	-13	-12	-15	-14	-13	-15	-15	-15	-14
-17	-16	-15	-14	-15	-15	-14	-13	-15	-15	-13	-15	-15	-14	-14
-15	-15	-14	-13	-14	-14	-13	-12	-15	-14	-13	-14	-15	-14	-14
-15	-15	-13	-12	-13	-13	-12	-11	-15	-13	-12	-14	-15	-14	-13
-15	-15	-14	-13	-14	-14	-13	-12	-15	-15	-13	-15	-16	-15	-14
-18	-17	-16	-15	-17	-17	-16	-15	-18	-17	-16	-18	-19	-18	-17
-17	-17	-16	-15	-17	-17	-16	-14	-18	-17	-16	-19	-20	-19	-17
-16	-16	-15	-15	-15	-16	-15	-13	-17	-16	-15	-17	-17	-17	-15
-16	-15	-14	-14	-15	-15	-14	-13	-16	-15	-14	-16	-17	-16	-15
-15	-14	-13	-13	-13	-14	-13	-12	-15	-14	-13	-15	-16	-15	-14
-14	-13	-12	-12	-12	-12	-12	-11	-14	-13	-12	-14	-14	-14	-13
-13	-13	-12	-11	-12	-12	-11	-10	-13	-12	-11	-13	-14	-13	-12
-14	-13	-12	-11	-12	-12	-11	-10	-13	-12	-11	-13	-14	-13	-12
-13	-12	-11	-11	-11	-11	-10	-9	-12	-11	-10	-12	-13	-12	-11
-14	-13	-12	-12	-12	-12	-12	-11	-13	-12	-11	-14	-15	-14	-13
-15	-15	-14	-13	-14	-14	-13	-12	-15	-14	-13	-15	-16	-16	-14
-14	-13	-12	-11	-12	-13	-11	-9	-14	-13	-10	-13	-14	-13	-12
-16	-16	-15	-15	-15	-16	-15	-13	-16	-16	-15	-17	-18	-17	-15
-16	-15	-15	-14	-15	-15	-14	-13	-15	-15	-14	-17	-17	-17	-14
-18	-18	-18	-17	-17	-17	-17	-15	-18	-18	-16	-19	-20	-19	-17
-20	-20	-19	-18	-19	-19	-19	-18	-20	-20	-18	-21	-23	-22	-20
-18	-18	-17	-16	-18	-18	-17	-16	-19	-18	-16	-20	-21	-20	-18
-21	-21	-20	-20	-21	-21	-20	-19	-22	-21	-20	-23	-25	-24	-22

WIND PRESSURES ON THE WALL D (in Pa) / CAVITY PRES.

D1	D2	D3	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	P_1	A	B	C	D
-3	-2	-2	-1	-1	-1	-1	-1	0	-1	0	0	0	0	0	0	1	1	0
-30	-31	-22	-29	-31	-28	-30	-27	-27	-29	-25	-26	-26	-24	-10	-5	-4	-5	-5
-26	-27	-19	-25	-27	-25	-26	-23	-23	-25	-22	-22	-22	-21	-10	-7	-6	-6	-7
-22	-23	-17	-21	-22	-21	-22	-19	-20	-21	-18	-20	-19	-18	-10	-8	-7	-7	-8
-20	-20	-16	-18	-18	-18	-18	-16	-18	-19	-16	-21	-21	-18	-10	-9	-8	-8	-9
-16	-16	-14	-15	-15	-16	-16	-13	-17	-18	-15	-20	-21	-18	-9	-10	-9	-9	-10
-21	-21	-16	-24	-24	-23	-23	-21	-22	-23	-21	-22	-22	-22	-10	-7	-6	-7	-8
-21	-21	-16	-23	-23	-22	-22	-20	-21	-23	-21	-21	-21	-22	-10	-8	-7	-7	-8
-20	-21	-15	[illegible]	-24	-23	-23	-21	-22	-23	-21	-21	-21	-22	-10	-8	-7	-7	-8
-22	-23	-17	[illegible]	-25	-24	-24	-22	-22	-24	-21	-21	-21	-22	-10	-7	-6	-6	-7
-26	-27	-20	-28	-30	-28	-29	-26	-26	-27	-25	-25	-25	-25	-10	-5	-4	-5	-5
-29	-30	-22	-30	-32	-29	-30	-28	-27	-29	-27	-26	-26	-26	-10	-5	-4	-4	-5
-28	-29	-21	-28	-30	-28	-29	-26	-26	-27	-25	-25	-25	-24	-10	-6	-5	-5	-6
-28	-29	-21	-29	-30	-28	-29	-26	-26	-27	-25	-25	-24	-24	-11	-6	-5	-5	-6
-29	-30	-20	-29	-31	-28	-29	-26	-26	-27	-25	-25	-25	-24	-10	-6	-5	-5	-6
-27	-28	-20	-27	-29	-27	-27	-25	-25	-26	-24	-23	-23	-23	-11	-7	-6	-6	-7
-25	-26	-19	-27	-28	-25	-26	-25	-24	-25	-23	-22	-22	-22	-11	-7	-6	-7	-8
-25	-27	-18	-25	-26	-25	-25	-23	-23	-24	-22	-21	-21	-21	-11	-7	-6	-7	-8
-25	-26	-17	-24	-25	-24	-24	-22	-22	-23	-21	-21	-20	-20	-11	-7	-6	-7	-8
-23	-24	-18	-22	-23	-22	-22	-21	-21	-22	-20	-20	-20	-20	-11	-8	-7	-7	-8
-20	-21	-16	-19	-19	-18	-18	-16	-16	-17	-16	-15	-15	-15	-11	-9	-8	-8	-9
-20	-19	-15	-25	-25	-25	-24	-22	-23	-24	-22	-21	-21	-21	-11	-9	-8	-8	-9
-17	-17	-14	-20	-21	-21	-20	-19	-20	-21	-21	-22	-22	-21	-11	-10	-9	-9	-10
-15	-15	-14	-18	-18	-18	-18	-16	-18	-21	-21	-22	-23	-22	-10	-10	-9	-9	-10
-14	-15	-14	-15	-15	-15	-16	-13	-16	-19	-18	-25	-25	-20	-10	-10	-9	-9	-10
-15	-15	-13	-18	-18	-19	-19	-16	-19	-21	-21	-24	-24	-22	-10	-10	-9	-9	-10
-16	-16	-14	-19	-19	-21	-21	-18	-20	-21	-20	-22	-22	-21	-10	-9	-8	-8	-9
-19	-20	-15	-21	-21	-21	-21	-19	-20	-21	-20	-22	-22	-20	-10	-8	-7	-7	-8
-21	-23	-16	-23	-24	-23	-23	-21	-21	-23	-21	-22	-22	-20	-10	-7	-6	-6	-7
-22	-23	-17	-23	-25	-23	-24	-22	-22	-23	-22	-22	-22	-21	-10	-7	-6	-6	-7
-18	-18	-14	-21	-22	-22	-22	-19	-23	-24	-22	-22	-22	-22	-10	-8	-7	-7	-8
-19	-19	-14	-21	-23	-23	-23	-20	-23	-24	-21	-22	-22	-21	-10	-8	-7	-7	-8
-18	-18	-13	-21	-22	-21	-21	-19	-21	-22	-21	-20	-20	-20	-10	-9	-8	-8	-9
-16	-16	-13	-21	-22	-21	-21	-19	-21	-22	-20	-20	-19	-20	-11	-9	-8	-8	-9
-16	-15	-13	-20	-21	-21	-21	-19	-21	-22	-19	-20	-20	-19	-11	-9	-8	-8	-10
-16	-15	-13	-19	-20	-20	-20	-18	-21	-21	-18	-19	-19	-18	-11	-9	-8	-8	-10
-16	-13	-12	-23	-24	-24	-24	-20	-23	-25	-22	-21	-22	-23	-11	-9	-8	-8	-9
-18	-16	-13	-18	-18	-18	-18	-15	-17	-18	-16	-15	-16	-16	-10	-8	-7	-7	-8
-19	-18	-14	-23	-23	-23	-23	-21	-22	-23	-20	-20	-20	-20	-10	-8	-7	-7	-8
-18	-14	-10	-22	-23	-24	-24	-21	-25	-27	-23	-24	-24	-24	-10	-8	-7	-7	-8
-23	-23	-16	-26	-27	-27	-27	-24	-27	-29	-25	-26	-26	-26	-10	-7	-6	-6	-7
-23	-23	-17	-26	-27	-26	-27	-24	-25	-27	-24	-25	-24	-25	-11	-8	-7	-7	-8
-26	-26	-19	-28	-29	-28	-28	-25	-27	-28	-25	-26	-25	-25	-11	-6	-5	-5	-6
-27	-28	-20	-29	-30	-28	-29	-26	-27	-28	-25	-26	-25	-25	-11	-6	-5	-6	-7
-26	-27	-20	-26	-27	-25	-25	-24	-23	-24	-22	-22	-22	-22	-11	-7	-6	-6	-7
-29	-30	-19	-28	-31	-28	-29	-26	-26	-27	-25	-25	-25	-24	-11	-5	-5	-5	-6

WIND PRESSURES ON THE WALL A (in Pa)

CASE	FILM No.	POSE	TIME	REFER. P	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
				0	4	4	4	3	4	3	4	3	3	2	2	1	0	-1	-1
CASE 8	17	26	14.12.39	-1	24	21	17	16	27	25	21	21	27	24	19	22	16	9	8
	17	27	14.12.47	-1	28	25	19	18	32	28	24	24	30	27	22	25	18	10	9
	17	28	14.13.01	0	23	21	17	16	25	25	22	22	26	24	20	21	17	10	9
	17	29	14.13.21	-5	9	8	5	4	10	10	8	8	10	9	7	8	5	2	0
	17	30	14.13.38	-8	6	5	2	1	6	4	3	3	5	3	1	2	0	4	5
	17	31	14.14.04	-5	13	12	9	8	17	17	14	13	18	18	14	17	15	10	7
	17	32	14.14.34	-3	23	19	13	15	30	27	21	22	32	29	24	30	25	16	13
CASE 7	18	1	14.20.11	-3	15	12	8	9	20	14	15	14	23	20	17	23	20	15	12
	18	2	14.20.18	-4	10	9	5	5	15	14	11	10	17	15	12	16	14	10	7
	18	3	14.20.33	-6	5	4	2	1	8	5	4	4	8	5	4	7	5	1	0
	18	4	14.20.55	-5	10	10	7	6	15	14	10	10	15	13	10	13	10	5	2
	18	5	14.21.16	-5	7	6	3	3	10	10	6	6	11	9	6	10	9	4	1
CASE 15	16	43	13.35.35	-6	20	19	14	14	27	25	22	22	27	25	22	23	18	13	10
	16	44	13.35.45	-7	20	15	10	11	27	25	19	19	30	25	20	30	24	15	12
	16	1	13.35.55	-7	22	19	12	15	33	30	24	25	31	33	26	36	31	20	15
	16	2	13.36.05	-7	14	12	8	9	20	19	25	25	22	20	16	22	19	13	10
	16	3	13.36.15	-7	19	17	12	12	25	22	19	19	25	22	19	23	18	10	8
	16	4	13.36.25	-6	13	12	9	9	18	17	15	14	19	18	14	17	14	8	4
	16	5	13.36.35	-7	30	27	20	19	33	29	23	23	30	25	18	21	13	3	3
	16	6	13.36.45	-7	30	27	19	19	37	33	27	26	35	32	25	30	23	12	9
	16	7	13.36.55	-7	12	10	5	5	18	18	13	10	22	18	13	22	20	13	9
	16	8	13.37.05	-7	9	7	3	3	15	14	10	9	16	15	10	17	15	10	7
	16	9	13.37.15	-7	10	9	5	5	18	16	13	10	20	18	14	20	19	13	7
	16	10	13.37.25	-9	9	7	4	4	13	13	10	8	15	13	10	13	12	7	3
	16	11	13.37.35	-9	4	2	0	0	8	8	5	3	10	9	5	10	10	6	2
	16	12	13.37.45	-9	5	3	0	0	7	5	4	3	8	6	3	6	5	1	-1
	16	13	13.37.55	-8	5	5	2	1	10	9	7	5	10	10	6	10	10	6	2
	16	14	13.38.05	-7	10	7	3	3	13	11	7	7	14	12	7	12	9	3	0
	16	15	13.38.15	-6	6	5	2	2	10	9	6	6	10	10	6	10	8	3	0
	16	16	13.38.25	-7	0	0	-2	-2	2	1	0	0	2	0	-1	0	0	-3	-4
	16	17	13.38.35	-8	5	2	0	1	10	8	5	5	10	8	6	11	8	3	0
	16	18	13.38.45	-8	10	8	4	5	18	16	12	12	20	18	14	21	18	12	7
	16	19	13.38.55	-9	15	10	5	6	24	20	15	13	27	23	17	30	25	28	23
	16	20	13.39.05	-8	12	10	6	7	20	18	14	14	24	20	16	24	20	15	10
	16	21	13.39.15	-7	16	13	9	10	24	21	17	16	26	22	18	25	20	13	10
	16	22	13.39.21	-7	34	28	17	19	45	40	29	30	45	40	32	41	32	20	15
	16	23	13.39.26	-6	26	22	15	16	35	32	25	26	35	32	27	32	27	19	14
	16	24	13.39.35	-6	25	20	12	14	33	28	21	22	32	27	22	28	21	12	10
	16	25	13.39.45	-7	19	15	10	10	25	23	18	18	27	24	18	25	20	14	10
	16	26	13.39.55	-7	18	15	9	10	25	23	17	16	27	24	17	25	20	13	9
	16	27	13.40.00	-6	24	20	15	15	30	26	22	22	29	25	20	24	19	12	8
	16	28	13.40.15	-7	25	23	15	15	31	30	24	23	31	28	22	25	20	12	9
	16	29	13.40.25	-8	15	12	8	7	18	16	13	13	19	16	13	16	13	7	4
	16	30	13.40.35	-9	12	10	8	7	16	15	14	13	18	15	14	15	13	9	6
	16	31	13.40.45	-8	13	12	8	8	17	16	13	13	17	15	12	14	15	5	4

WIND PRESSURES ON THE WALL B (in Pa)

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16
-1	-1	-1	-2	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2	-3
-27	-27	-29	-27	-27	-26	-25	-22	-22	-20	-20	-20	-18	-19	-19	-18
-28	-28	-31	-29	-30	-30	-27	-25	-25	-21	-19	-21	-17	-17	-17	-17
-25	-25	-27	-26	-26	-25	-24	-21	-21	-18	-16	-18	-15	-15	-15	-15
-19	-19	-20	-19	-19	-17	-17	-15	-15	-13	-13	-13	-13	-12	-13	-14
-18	-18	-20	-18	-19	-17	-16	-14	-16	-13	-13	-13	-13	-13	-13	-14
-20	-20	-17	-14	-15	-10	-11	-9	-9	-10	-11	-11	-11	-11	-11	-13
-24	-25	-23	-17	-18	-10	-13	-9	-10	-10	-11	-11	-11	-11	-11	-13
-11	-14	-6	-7	-8	-5	-8	-7	-8	-8	-10	-10	-11	-11	-11	-13
-13	-15	-8	-8	-8	-6	-8	-8	-9	-9	-10	-10	-11	-11	-11	-13
-9	-9	-7	-5	-5	-5	-5	-6	-6	-7	-8	-9	-10	-10	-10	-13
-17	-17	-17	-12	-12	-10	-10	-9	-10	-10	-10	-10	-11	-11	-11	-13
-14	-15	-10	-10	-10	-6	-8	-8	-8	-10	-10	-10	-11	-11	-11	-13
-29	-30	-30	-26	-27	-23	-23	-20	-20	-17	-16	-17	-16	-16	-17	-17
-29	-30	-25	-20	-21	-18	-18	-15	-16	-15	-16	-16	-16	-16	-17	-18
-30	-32	-23	-18	-19	-12	-15	-12	-14	-14	-16	-17	-17	-17	-17	-19
-27	-27	-20	-15	-15	-10	-12	-11	-12	-13	-15	-15	-16	-16	-17	-18
-30	-30	-28	-24	-25	-21	-20	-18	-18	-16	-16	-16	-16	-16	-17	-17
-27	-28	-24	-20	-20	-18	-17	-15	-15	-15	-15	-16	-15	-15	-16	-17
-35	-35	-33	-32	-32	-30	-30	-29	-28	-27	-25	-28	-25	-27	-27	-25
-36	-36	-36	-32	-33	-32	-30	-28	-26	-25	-23	-25	-22	-23	-23	-21
-8	-8	-10	-9	-10	-10	-11	-11	-12	-12	-14	-15	-14	-16	-16	-17
-2	-5	-5	-4	-5	-5	-6	-7	-8	-9	-11	-12	-12	-14	-14	-16
-13	-14	-10	-6	-7	-5	-8	-8	-8	-10	-13	-13	-13	-15	-15	-16
-17	-18	-16	-13	-14	-11	-12	-11	-11	-11	-13	-14	-14	-15	-15	-16
-6	-6	-6	-6	-7	-5	-7	-7	-7	-9	-11	-12	-12	-13	-13	-15
-14	-14	-13	-11	-12	-9	-10	-10	-10	-11	-12	-12	-13	-14	-14	-15
-16	-17	-12	-10	-11	-8	-10	-10	-10	-11	-13	-13	-13	-14	-15	-15
-20	-21	-20	-18	-18	-15	-15	-13	-13	-13	-13	-14	-14	-14	-15	-15
-18	-18	-18	-15	-16	-12	-13	-11	-12	-12	-13	-14	-14	-14	-15	-15
-9	-9	-10	-9	-9	-8	-9	-8	-8	-9	-10	-10	-11	-12	-12	-13
-10	-11	-10	-6	-8	-5	-8	-6	-9	-9	-11	-11	-11	-12	-13	-15
-15	-17	-11	-8	-9	-5	-8	-7	-10	-10	-12	-12	-13	-14	-14	-16
-19	-20	-10	-9	-10	-5	-8	-8	-9	-11	-13	-14	-14	-15	-15	-17
-22	-24	-16	-12	-13	-10	-11	-10	-10	-12	-15	-15	-15	-15	-15	-17
-27	-29	-27	-20	-23	-16	-16	-13	-15	-14	-14	-15	-15	-15	-16	-17
-35	-36	-39	-31	-33	-26	-26	-20	-21	-18	-18	-19	-18	-17	-18	-18
-32	-33	-37	-28	-30	-22	-22	-17	-18	-16	-15	-17	-17	-16	-17	-17
-34	-34	-39	-30	-32	-23	-23	-18	-20	-16	-16	-17	-17	-15	-16	-17
-27	-28	-30	-22	-25	-18	-18	-14	-16	-14	-15	-15	-15	-15	-15	-16
-25	-28	-27	-20	-21	-13	-15	-12	-14	13	-14	-15	-15	-15	-15	-17
-32	-33	-36	-28	-29	-22	-21	-18	-19	-16	-15	-15	-16	-15	-15	-17
-32	-32	-34	-27	-28	-22	-22	-18	-19	-16	-15	-16	-16	-16	-16	-17
-25	-26	-27	-21	-22	-18	-18	-15	-16	-14	-15	-15	-15	-15	-15	-16
-25	-26	-26	-18	-20	-16	-16	-13	-15	-14	-14	-15	-15	-15	-15	-17
-24	-25	-25	-20	-21	-18	-17	-15	-16	-14	-14	-15	-15	-15	-15	-16

WIND PRESSURES ON THE WALL C (in Pa)

C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
-3	-3	-3	-3	-2	-2	-2	-2	-3	-2	-2	-2	-3	-2	-2
-16	-16	-15	-15	-14	-15	-14	-12	-15	-14	-13	-14	-15	-15	-14
-15	-15	-15	-14	-13	-14	-13	-11	-14	-13	-12	-13	-14	-13	-13
-14	-14	-13	-13	-12	-12	-12	-10	-13	-12	-12	-13	-14	-14	-13
-14	-14	-13	-13	-13	-13	-12	-11	-13	-13	-12	-12	-14	-13	-13
-15	-14	-13	-13	-13	-13	-13	-12	-14	-13	-12	-13	-13	-13	-13
-15	-15	-15	-14	-15	-15	-15	-13	-16	-15	-15	-17	-18	-17	-15
-15	-15	-15	-14	-14	-15	-14	-13	-15	-15	-14	-16	-17	-16	-15
-17	-17	-16	-16	-16	-17	-16	-15	-17	-17	-16	-18	-20	-19	-18
-16	-16	-16	-15	-16	-16	-16	-15	-17	-17	-15	-17	-19	-18	-16
-16	-16	-16	-15	-16	-16	-16	-15	-17	-16	-15	-17	-18	-18	-16
-15	-15	-14	-13	-14	-14	-14	-13	-15	-15	-14	-15	-16	-15	-15
-15	-15	-15	-14	-15	-15	-15	-14	-16	-15	-15	-16	-17	-16	-15
-19	-19	-18	-18	-18	-19	-18	-17	-19	-19	-18	-20	21	-20	-19
-20	-20	-20	-19	-20	-20	-20	-18	-21	-21	-20	-22	-23	-23	-20
-23	-23	-23	-22	-23	-23	-23	-21	-23	-23	-23	-25	-27	-27	-24
-22	-22	-21	-21	-22	-22	-22	-20	-23	-23	-22	-24	-27	-25	-22
-20	-20	-19	-18	-19	-19	-18	-18	-20	-20	-18	-21	-23	-22	-19
-19	-19	-19	-18	-19	-19	-18	-17	-20	-19	-18	-20	-22	-21	-19
-24	-24	-24	-23	-22	-22	-22	-21	-23	-22	-21	-22	-23	-22	-21
-22	-22	-21	-20	-20	-20	-20	-18	-20	-20	-18	-20	-21	-20	-19
-24	-24	-23	-22	-23	-23	-23	-21	-24	-24	-22	-24	-26	-26	-24
-24	-24	-23	-22	-23	-24	-23	-22	-24	-23	-23	-24	-25	-25	-23
-23	-23	-22	-21	-22	-22	-22	-21	-23	-22	-22	-24	-25	-25	-23
-20	-20	-19	-18	-19	-19	· 19	-18	-20	-20	-19	-21	-22	-21	-20
-20	-20	-20	-19	-20	-20	-20	-18	-21	-21	-20	-22	-23	-23	-21
-18	-18	-18	-17	-18	-18	-18	-16	-18	-18	-17	-18	-20	-19	-18
-19	-19	-18	-17	-19	-19	-18	-17	-20	-19	-18	-20	-21	-20	-19
-17	-17	-16	-16	-17	-17	-16	-15	-18	-17	-16	-18	-19	-18	-17
-18	-18	-17	-17	-17	-17	-17	-16	-18	-17	-16	-18	-20	-19	-17
-18	-17	-17	-16	-17	-17	-16	-16	-18	-17	-16	-17	-18	-18	-17
-20	-19	-19	-18	-19	-19	-18	-17	-20	-19	-18	-20	-21	-20	-19
-20	-20	-20	-19	-20	-20	-20	-19	-21	-20	-20	-22	-23	-22	-21
-22	-22	-21	-20	-22	-22	-21	-20	-23	-23	-21	-24	-26	-25	-23
-21	-21	-21	-20	-21	-22	-21	-20	-22	-22	-21	-24	-26	-25	-23
-20	-19	-19	-18	-19	-20	-20	-18	-20	-20	-19	-22	-23	-22	-20
-21	-21	-20	-19	-20	-21	-20	-19	-21	-21	-20	-22	-23	-23	-21
-21	-22	-20	-19	-21	-22	-21	-19	-22	-22	-20	-23	-24	-24	-21
-19	-19	-18	-17	-19	-20	-19	-17	-20	-20	-18	-20	-22	-21	-19
-19	-19	-19	-18	-19	-20	-19	-17	-20	-20	-19	-21	-22	-21	-20
-20	-21	-20	-19	-20	-21	-20	-19	-21	-21	-20	-22	-24	-23	-21
-20	-20	-19	-18	-19	-19	-19	-17	-20	-20	-18	-21	-22	-21	-20
-20	-20	-19	-19	-20	-20	-19	-17	-20	-19	-18	-20	-21	-21	-20
-19	-19	-18	-18	-19	-19	-18	-17	-19	-19	-18	-20	-20	-20	-19
-19	-19	-19	-18	-19	-19	-19	-17	-20	-20	-18	-20	-21	-21	-20
-18	-18	-18	-17	-18	-18	-18	-16	-19	-18	-17	-19	-20	-20	-18

WIND PRESSURES ON THE WALL D (in Pa) CAVITY PRES.

D1	D2	D3	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	P_1	A	B	C	D
-3	-2	-2	-1	-1	-1	-1	-1	0	-1	0	0	0	0	0	0	1	1	0
-14	-14	-13	-16	-17	-20	-19	-16	-25	-25	-20	-25	-27	-26	-9	-7	-6	-6	-7
-12	-13	-11	-18	-19	-22	-21	-16	-27	-29	-25	-25	-27	-30	-9	-7	-6	-6	-7
-15	-14	-12	-21	-22	-24	-23	-19	-26	-27	-25	-24	-24	-27	-10	-7	-6	-6	-7
-16	-15	-14	-18	-18	-18	-18	-16	-18	-19	-17	-17	-17	-18	-9	-8	-7	-7	-8
-14	-14	-12	-14	-14	-15	-14	-13	-15	-16	-14	-17	-16	-15	-8	-8	-7	-7	-8
-21	-21	-16	-20	-21	-20	-20	-18	-18	-19	-18	-18	-17	-18	-9	-6	-5	-5	-6
-21	-22	-16	-22	-23	-22	-22	-20	-21	-22	-20	-20	-20	-20	-9	-5	-4	-4	-5
-22	-23	-17	-24	-25	-24	-25	-27	-27	-29	-26	-26	-26	-26	-10	-5	-5	-5	-5
-21	-22	-16	-22	-23	-21	-22	-20	-20	-21	-19	-19	-19	-19	-10	-6	-5	-5	-6
-20	-20	-15	-20	-20	-19	-19	-18	-18	-19	-17	-17	-17	-17	-10	-7	-6	-6	-7
-19	-19	-15	-19	-19	-18	-18	-18	-17	-18	-16	-16	-16	-16	-10	-7	-6	-6	-7
-20	-20	-15	-19	-19	-18	-18	-17	-16	-17	-16	-15	-15	-16	-9	-7	-6	-6	-7
-25	-25	-20	-30	-30	-30	-30	-26	-28	-29	-27	-26	-26	-28	-8	16	16	16	18
-29	-30	-22	-31	-32	-30	-30	-28	-28	-30	-28	-27	-27	-28	-8	19	19	19	20
-32	-33	-25	-34	-35	-33	-34	-31	-30	-32	-30	-29	-29	-30	-8	24	24	24	25
-30	-32	-23	-29	-30	-29	-29	-27	-27	-27	-26	-26	-25	-26	-8	15	15	15	15
-27	-28	-22	27	-28	-26	-27	-25	-24	-25	-24	-23	-23	-24	-8	15	15	15	16
-25	-26	-20	-27	-28	-26	-27	-25	-24	-25	-23	-23	-23	-23	-8	11	11	11	12
-21	-23	-20	-21	-22	-23	-22	-19	-25	-27	-23	-30	-30	-28	-6	16	16	16	18
-21	-21	-19	-30	-32	-33	-32	-29	-34	-35	-32	-34	-34	-35	-6	21	22	22	24
-27	-28	-21	-31	-33	-31	-32	-28	-30	-32	-29	-30	-30	-30	-7	14	14	14	15
-27	-28	-22	-29	-30	-29	-30	-27	-27	-29	-26	-27	-27	-27	-8	10	10	10	9
-28	-29	-23	-28	-29	-27	-28	-26	-26	-27	-25	-25	-25	-25	-8	12	13	13	13
-25	-25	-20	-25	-26	-25	-25	-24	-24	-25	-23	-22	-22	-23	-8	8	9	9	9
-25	-26	-18	-24	-26	-24	-25	-23	-23	-24	-21	-21	-21	-21	-8	5	5	5	5
-21	-22	-17	-21	-21	-21	-21	-19	-20	-21	-19	-20	-20	-20	-8	2	3	3	2
-23	-24	-18	-22	-23	-22	-22	-21	-21	-22	-20	-20	-20	-20	-8	5	6	6	6
-21	-21	-17	-23	-23	-23	-23	-20	-21	-23	-20	-20	-21	-22	-8	6	7	7	7
-22	-23	-18	-21	-22	-21	-21	-20	-20	-21	-19	-19	-19	-20	-8	5	6	6	6
-20	-20	-16	-18	-19	-18	-18	-17	-17	-18	-16	-16	-16	-17	-8	-1	0	0	-1
-22	-23	-18	-21	-22	-21	-21	-20	-20	-21	-19	-19	-19	-19	-7	5	5	5	5
-26	-27	-21	-27	-28	-26	-27	-25	-24	-26	-24	-23	-23	-24	-8	13	13	13	13
-29	-30	-22	-29	-31	-28	-30	-28	-27	-28	-26	-25	-25	-25	-7	16	17	17	18
-29	-31	-22	-28	-30	-27	-28	-26	-25	-27	-25	-25	-24	-24	-8	14	15	15	15
-27	-27	-20	-29	-30	-29	-29	-27	-27	-28	-27	-25	-25	-26	-8	15	15	15	16
-28	-28	-22	-35	-36	-36	-36	-31	-36	-38	-32	-33	-36	-37	-7	28	28	28	30
-29	-30	-23	-34	-35	-35	-35	-31	-34	-35	-31	-32	-33	-34	-7	24	24	24	25
-25	-25	-20	-34	-35	-34	-34	-29	-33	-35	-32	-30	-31	-34	-7	19	19	19	20
-27	-27	-22	-33	-34	-32	-32	-29	-31	-32	-30	-29	-29	-31	-8	17	17	17	18
-27	-27	-21	-33	-33	-32	-33	-29	-30	-33	-30	-29	-29	-31	-7	17	17	17	18
-27	-27	-22	-30	-31	-31	-31	-27	-30	-32	-29	-29	-29	-30	-8	17	17	17	18
-27	-27	-22	-32	-32	-32	-32	-29	-31	-33	-30	-29	-30	-31	-8	20	20	20	21
-24	-24	-20	-27	-28	-27	-27	-25	-27	-29	-26	-25	-26	-27	-8	11	11	11	12
-25	-25	-19	-27	-27	-26	-27	-25	-25	-27	-24	-24	-24	-24	-8	10	11	11	11
-23	-23	-18	-25	-26	-25	-25	-24	-24	-25	-23	-22	-23	-23	-8	10	10	10	10

Case	FILM No.	POSE	TIME	REFER. P	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
					WIND PRESSURES ON THE WALL A (in Pa)														
				0	4	4	4	3	4	3	4	3	3	2	2	1	0	-1	-1
CASE 11	15	26	13.22.19	-6	5	4	2	1	9	9	7	5	10	10	7	10	10	8	5
	15	27	13.22.39	-9	10	8	4	3	10	9	6	5	8	6	4	5	2	-2	-3
	15	28	13.23.00	-7	6	5	2	2	9	7	5	5	8	6	3	6	3	-2	-3
	15	29	13.23.12	-6	13	10	6	7	20	19	14	14	24	20	15	25	19	10	7
	15	30	13.23.18	-5	10	9	4	5	20	19	13	12	25	21	15	28	18	15	10
	15	31	13.23.51	-4	17	14	9	9	22	20	15	15	23	20	15	20	17	12	7
	15	32	13.24.17	-7	10	8	5	3	12	10	7	7	11	10	6	9	6	2	0
	15	33	13.24.34	-5	28	25	19	18	32	30	25	25	29	27	22	22	18	9	8
	15	34	13.24.40	0	34	32	25	24	38	37	33	31	36	35	29	30	25	14	12
	15	35	13.24.53	-2	20	19	15	14	24	22	19	19	22	20	17	18	14	10	8
	15	36	13.25.13	-4	15	13	10	9	16	15	13	13	14	13	10	10	8	3	2
CASE 14	15	37	13.26.43	-8	18	14	8	8	22	19	13	13	20	17	12	15	12	4	2
	15	38	13.26.51	-7	20	15	10	10	25	23	18	17	25	22	17	22	17	10	7
	15	39	13.27.02	-6	18	14	10	12	25	24	20	19	29	26	22	30	25	18	13
	15	40	13.27.11	-6	21	17	12	13	27	25	20	20	28	25	20	25	20	15	12
	15	41	13.27.22	-6	32	30	23	22	39	38	32	32	38	36	31	32	27	18	15
	15	42	13.27.32	-6	30	25	20	20	28	27	31	30	40	38	32	36	33	25	18
	15	43	13.27.40	-7	33	27	19	20	40	35	27	29	39	34	27	32	25	13	11
	15	44	13.27.52	-6	15	13	9	9	18	17	14	14	19	17	13	16	13	8	4
	15	1	13.28.08	-5	28	25	19	18	33	32	26	26	33	30	25	29	24	14	10
	15	2	13.28.19	-6	20	17	13	13	27	25	21	20	29	28	22	28	25	18	13
	15	3	13.28.25	-6	14	11	7	7	19	18	14	13	21	19	14	20	18	13	9
	15	4	13.28.35	-6	20	16	10	11	25	24	18	18	26	24	18	24	20	14	9
	15	5	13.28.50	-6	13	12	8	8	19	18	13	13	20	18	13	18	15	7	4
	15	6	13.29.00	-7	10	9	5	5	18	15	13	12	20	18	13	22	18	10	7
CASE 10	17	1	13.45.30	-7	4	3	2	2	8	7	5	5	8	7	5	7	5	3	1
	17	2	13.45.45	-8	3	2	-1	0	8	7	4	3	10	8	4	12	9	4	2
	17	3	13.45.55	-6	16	15	10	10	23	22	18	17	25	23	19	24	20	15	10
	17	4	13.46.06	-6	13	12	8	8	17	16	13	13	18	16	13	15	13	9	5
	17	5	13.46.15	-5	15	13	10	10	20	18	15	15	20	18	14	18	14	8	5
	17	6	13.46.25	-6	7	6	4	3	10	9	7	7	10	9	6	9	7	3	0
	17	7	13.46.36	-7	9	7	4	3	12	9	6	6	10	8	5	7	4	0	-1
	17	8	13.46.51	-6	3	2	1	1	6	5	4	3	6	5	3	5	4	1	-1
	17	9	13.47.01	-6	8	7	3	4	15	13	10	9	16	14	10	17	14	10	5
	17	10	13.47.10	-6	9	5	2	3	15	13	9	8	17	14	10	18	14	10	6
	17	11	13.47.25	-6	16	14	9	8	20	17	13	13	19	16	12	15	11	4	3
	17	12	13.47.45	-6	10	8	4	4	14	13	9	9	15	12	8	13	10	4	2
	17	13	13.48.03	-6	8	6	4	3	10	10	7	6	10	9	5	8	5	2	0
CASE 9	17	14	14.04.49	0	31	29	23	22	37	35	30	30	37	35	30	33	27	18	14
	17	15	14.05.10	-4	20	17	14	12	23	20	18	17	20	19	15	17	13	7	5
	17	16	14.05.22	-3	15	14	10	9	18	16	15	13	17	15	13	14	10	6	4
	17	17	14.05.35	-6	9	8	5	4	11	10	8	8	11	10	7	10	8	4	1
	17	18	14.06.12	-5	16	15	10	10	20	18	15	14	19	17	13	15	12	5	4
	17	19	14.06.45	-5	4	3	1	0	5	5	3	3	5	4	2	4	2	0	-2
	17	20	14.07.35	-3	18	16	12	12	22	20	17	17	23	20	16	19	15	9	6
	17	21	14.09.26	-1	21	20	15	13	24	22	18	18	22	19	15	17	13	4	4
	17	22	14.10.00	-2	27	24	16	17	35	32	25	25	37	33	27	35	28	18	14
	17	23	14.10.14	-1	28	27	20	21	37	36	30	30	40	37	30	39	33	22	17
	17	24	14.10.37	-4	23	22	17	17	29	28	24	24	30	28	24	28	24	17	13
	17	25	14.11.16	-7	10	8	4	5	15	13	10	10	16	13	10	15	12	8	4

WIND PRESSURES ON THE WALL B (in Pa)

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16
-1	-1	-1	-2	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2	-3
-8	-10	-5	-5	-5	-4	-7	-7	-7	-9	-12	-11	-12	-13	-13	-15
-18	-18	-17	-17	-17	-16	-16	-16	-15	-15	-15	-16	-15	-16	-15	-16
-19	-20	-17	-17	-16	-15	-17	-15	-16	-15	-15	-16	-15	-15	-15	-16
-18	-21	-15	-11	-12	-10	-12	-10	-12	-12	-14	-14	-14	-14	-14	-16
-7	-8	-2	-3	-5	-1	-6	-5	-6	-8	-12	-12	-11	-14	-13	-15
-16	-19	-18	-15	-17	-12	-14	-12	-12	-12	-14	-14	-14	-14	-13	-15
-15	-16	-17	-15	-16	-12	-13	-11	-13	-11	-12	-12	-12	-13	-13	-14
-22	-23	-23	-22	-23	-22	-22	-20	-21	-20	-20	-19	-17	-19	-19	-19
-30	-31	-30	-29	-30	-28	-27	-25	-25	-22	-21	-21	-18	-19	-17	-18
-28	-29	-32	-28	-29	-25	-25	-21	-22	-18	-16	-18	-16	-15	-15	-16
-22	-22	-24	-22	-23	-21	-20	-19	-19	-16	-15	-16	-15	-15	-15	-16
-22	-24	-23	-20	-20	-17	-17	-15	-15	-14	-14	-15	-15	-14	-15	-16
-25	-27	-27	-20	-22	-16	-16	-14	-15	-14	-14	-15	-15	-14	-15	-16
-29	-30	-23	-18	-20	-15	-16	-14	-15	-14	-15	-15	-15	-15	-15	-16
-30	-32	-28	-24	-25	-20	-20	-18	-18	-16	-16	-16	-15	-15	15	-16
-35	-35	-35	-30	-31	-28	-27	-23	-25	-21	-19	-21	-18	-18	-17	-17
-36	-37	-38	-30	-32	-25	-25	-19	-22	-18	-18	-19	-17	-17	-17	-17
-35	-37	-38	-32	-34	-30	-29	-24	-26	-22	-21	-22	-20	-20	-20	-20
-29	-31	-30	-23	-24	-19	-19	-17	-18	-16	-16	-17	-16	-16	-16	-17
-37	-37	-39	-32	-34	-29	-26	-21	-23	-18	-16	-17	-16	-15	-16	-17
-30	-32	-30	-22	-24	-18	-18	-15	-18	-15	-15	-16	-15	-15	-15	-17
-22	-24	-19	-15	-16	-12	-13	-11	-13	-12	-14	-14	-14	-15	-15	-16
-27	-28	-26	-20	-21	-13	-15	-11	-13	-13	-14	-15	-15	-15	-15	-16
-25	-27	-23	-18	-18	-13	-13	-11	-12	-12	-13	-14	-14	-14	-15	-16
-18	-19	-15	-10	-12	-8	-10	-9	-11	-11	-13	-14	-14	-15	-15	-16
-13	-13	-12	-10	-10	-8	-9	-8	-9	-10	-11	-11	-12	-12	-12	-14
-3	-4	-3	-3	-4	-2	-5	-5	-6	-7	-10	-10	-10	-12	-11	-14
-18	-18	-20	-15	-15	-10	-11	-8	-10	-10	-11	-12	-12	-13	-13	-15
-21	-22	-22	-17	-17	-11	-12	-10	-11	-11	-12	-12	-13	-13	-13	-15
-26	-26	-26	-20	-22	-17	-17	-13	-15	-12	-12	-13	-13	-13	-13	-14
-19	-20	-19	-15	-16	-12	-13	-11	-12	-11	-12	-13	-13	-13	-13	-15
-18	-20	-21	-17	-18	-14	-14	-12	-13	-11	-12	-12	-12	-12	-12	-14
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-13	-14	-8	-6	-7	-4	-7	-7	-8	-9	-11	-11	-12	-12	-12	-14
-20	-21	-21	-17	-18	-15	-16	-14	-15	-13	-13	-14	-13	-13	-13	-14
-16	-17	-18	-15	-17	-13	-14	-12	-14	-12	-12	-13	-13	-13	-13	-15
-16	-17	-17	-15	-16	-13	-14	-12	-13	-12	-13	-14	-14	-14	-14	-15
-32	-32	-35	-32	-32	-28	-27	-23	-22	-19	-16	-17	-15	-15	-14	-14
-25	-25	-27	-23	-25	-20	-20	-16	-17	-15	-13	-15	-14	-12	-12	-13
-20	-21	-22	-20	-20	-17	-17	-15	-15	-13	-12	-13	-12	-11	-12	-13
-18	-19	-17	-14	-14	-12	-12	-11	-11	-11	-11	-12	-12	-12	-12	-14
-19	-20	-22	-19	-20	-16	-16	-14	-14	-12	-12	-13	-13	-12	-13	-14
-15	-15	-14	-12	-12	-11	-12	-11	-11	-11	-12	-12	-12	-12	-12	-13
-22	-23	-25	-22	-22	-23	-23	-13	-15	-12	-11	-12	-12	-11	-11	-12
-21	-21	-23	-22	-22	-22	-21	-20	-19	-18	-17	-17	-15	-15	-15	-15
-27	-27	-29	-22	-24	-20	-18	-14	-14	-12	-11	-12	-12	-11	-11	-12
-29	-29	-28	-19	-22	-16	-15	-10	-12	-10	-10	-11	-11	-10	-10	-12
-26	-27	-25	-19	-20	-15	-15	-11	-11	-10	-10	-12	-12	-11	-11	-13
-15	-16	-13	-10	-11	-6	-9	-8	-9	-10	-11	-11	-12	-12	-12	-14

WIND PRESSURES ON THE WALL C (in Pa)

C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
-3	-3	-3	-3	-2	-2	-2	-2	-3	-2	-2	-2	-3	-2	-2
-20	-20	-19	-18	-19	-20	-19	-18	-20	-20	-19	-21	-22	-22	-20
-17	-16	-16	-16	-16	-16	-16	-15	-16	-15	-15	-16	-17	-17	-16
-17	-16	-16	-16	-15	-15	-15	-15	-16	-15	-15	-16	-17	-16	-15
-18	-18	-18	-17	-17	-17	-17	-16	-18	-18	-17	-19	-20	-19	-18
-21	-20	-20	-20	-20	-20	-20	-19	-20	-20	-20	-21	-23	-23	-21
-19	-18	-18	-18	-18	-18	-18	-17	-19	-19	-17	-20	-21	-20	-19
-16	-16	-15	-15	-15	-15	-15	-14	-16	-15	-14	-16	-17	-16	-15
-18	-17	-16	-16	-16	-16	-15	-14	-16	-16	-15	-16	-17	-16	-15
-17	-17	-16	-15	-15	-15	-15	-14	-15	-15	-15	-15	-16	-15	-15
-17	-17	-16	-15	-16	-16	-15	-14	-16	-16	-15	-16	-17	-17	-16
-16	-16	-15	-15	-15	-15	-15	-13	-15	-14	-14	-15	-15	-15	-14
-18	-18	-17	-16	-17	-18	-17	-16	-18	-17	-17	-19	-19	-19	-18
-18	-18	-18	-17	-18	-18	-18	-16	-18	-18	-17	-19	-20	-20	-18
-19	-19	-19	-18	-19	-19	-19	-17	-20	-20	-18	-21	-23	-22	-20
-19	-19	-18	-17	-18	-19	-18	-17	-20	-20	-18	-21	-23	-21	-19
-19	-19	-18	-16	-18	-18	-17	-15	-18	-18	-17	-19	-20	-20	-18
-19	-19	-18	-17	-19	-19	-18	-16	-19	-19	-18	-21	-22	-21	-19
-21	-21	-20	-19	-20	-20	-20	-18	-20	-20	-19	-21	-22	-21	-20
-18	-19	-18	-17	-18	-18	-18	-16	-18	-18	-17	-19	-20	-20	-18
-18	-18	-18	-17	-18	-18	-17	-16	-18	-18	-16	-19	-20	-19	-18
-20	-20	-19	-19	-19	-20	-19	-18	-20	-20	-18	-21	-22	-22	-20
-20	-20	-19	-18	-20	-20	-19	-18	-20	-20	-19	-21	-22	-22	-20
-20	-20	-19	-18	-19	-20	-20	-18	-20	-20	-19	-21	-22	-22	-20
-19	-19	-18	-18	-18	-19	-18	-17	-19	-18	-18	-20	-21	-20	-19
-20	-20	-20	-19	-20	-20	-20	-18	-20	-20	-19	-21	-22	-21	-20
-18	-18	-17	-17	-17	-17	-17	-16	-18	-18	-17	-18	-20	-20	-18
-20	-19	-19	-18	-19	-19	-19	-18	-20	-19	-19	-20	-22	-21	-20
-19	-19	-18	-18	-18	-18	-18	-17	-19	-19	-18	-20	-21	-21	-19
-18	-18	-17	-17	-17	-18	-17	-16	-18	-18	-16	-19	-20	-20	-18
-16	-16	-16	-15	-16	-16	-16	-15	-17	-17	-16	-18	-19	-18	-17
-16	-16	-15	-15	-16	-16	-16	-15	-17	-16	-15	-17	-18	-17	-16
-15	-15	-15	-14	-15	-15	-14	-13	-15	-15	-14	-15	-16	-15	-15
-17	-16	-16	-15	-16	-16	-15	-14	-17	-16	-15	-17	-17	-17	-16
-17	-17	-16	-15	-17	-17	-17	-15	-18	-17	-16	-18	-19	-18	-17
-18	-18	-17	-17	-17	-18	-17	-16	-19	-18	-17	-19	-20	-20	-18
-16	-16	-16	-15	-15	-16	-16	-14	-17	-16	-15	-17	-18	-17	-16
-16	-16	-16	-15	-16	-16	-15	-14	-16	-15	-15	-16	-17	-16	-16
-16	-16	-16	-15	-15	-15	-15	-15	-16	-15	-15	-16	-17	-17	-16
-15	-15	-14	-14	-13	-13	-13	-12	-14	-14	-12	-14	-15	-14	-13
-15	-14	-14	-13	-13	-13	-13	-12	-14	-13	-12	-14	-15	-14	-13
-15	-15	-14	-13	-14	-15	-14	-12	-15	-15	-14	-15	-16	-15	-15
-15	-15	-15	-14	-15	-15	-15	-13	-16	-15	[illegible]	-16	-16	-16	-15
-14	-14	-14	-13	-13	-13	-13	-12	-14	-13	-13	-14	-15	-15	-14
-15	-15	-14	-14	-14	-14	-14	-13	-15	-14	-13	-15	-15	-15	-14
-14	-14	-13	-13	-13	-13	-13	-12	-14	-13	-13	-14	-15	-14	-14
-15	-15	-14	-14	-13	-13	-13	-12	-13	-12	-11	-12	-13	-12	-12
-14	-14	-14	-12	-13	-14	-14	-12	-15	-15	-13	-15	-16	-15	-14
-16	-16	-15	-14	-15	-15	-15	-13	-16	-16	-15	-17	-18	-18	-16
-16	-16	-16	-15	-16	-16	-16	-14	-17	-16	-15	-17	-19	-18	-16
-17	-17	-17	-16	-17	-17	-17	-16	-18	-17	-17	-18	-19	-19	-18

WIND PRESSURES ON THE WALL D (in Pa) / CAVITY PRES.

D1	D2	D3	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	P_1	A	B	C	D
-3	-2	-2	-1	-1	-1	-1	-1	0	-1	0	0	0	0	0	0	1	1	0
-24	-24	-19	-23	-24	-22	-23	-21	-21	-22	-20	-20	-20	-20	-9	0	1	1	0
-17	-17	-15	-16	-16	-16	-16	-15	-16	-18	-16	-20	-20	-19	-8	-3	-2	-2	-2
-17	-16	-14	-17	-17	-17	-17	-15	-17	-18	-16	-19	-19	-18	-7	-3	-1	-1	-2
-23	-24	-18	-22	-23	-22	-22	-21	-21	-22	-20	-21	-21	-20	-7	2	5	5	5
-27	-28	-20	-26	-27	-25	-26	-25	-24	-25	-23	-24	-24	-23	-7	4	6	6	6
-24	-24	-19	-23	-24	-23	-23	-22	-22	-23	-21	-21	-20	-21	-8	2	5	5	4
-19	-19	-16	-21	-21	-21	-21	-19	-21	-22	-20	-19	-20	-20	-8	-1	0	0	0
-17	-16	-13	-23	-24	-26	-26	-22	-28	-29	-24	-24	-26	-28	-7	3	6	6	6
-18	-16	-13	-26	-28	-28	-28	-25	-29	-30	-27	-27	-28	-29	-8	5	9	9	9
-13	-18	-16	-22	-24	-24	-24	-21	-26	-27	-25	-27	-27	-27	-8	2	4	4	4
-16	-16	-15	-19	-20	-20	-20	-18	-22	-24	-21	-23	-24	-24	-8	-1	1	1	0
-22	-22	-18	-25	-26	-25	-26	-23	-27	-29	-25	-29	-29	-28	-7	0	1	1	1
-25	-24	-19	-28	-29	-27	-28	-25	-27	-29	-26	-27	-27	-27	-7	12	13	13	13
-28	-29	-21	-29	-31	-28	-29	-27	-27	-29	-26	-27	-27	-27	-7	13	15	14	15
-26	-27	-20	-29	-30	-29	-29	-26	-28	-30	-28	-27	-27	-29	-7	13	15	14	15
-24	-24	-18	-34	-36	-35	-35	-32	-33	-36	-35	-31	-32	-35	-7	20	21	21	22
-28	-29	-23	-35	-36	-35	-35	-32	-32	-34	-33	-30	-30	-32	-8	21	22	22	23
-24	-25	-21	-32	-33	-35	-34	-29	-36	-37	-34	-33	-36	-36	-7	20	21	21	22
-23	-22	-18	-27	-28	-28	-27	-25	-28	-29	-26	-26	-27	-27	-8	8	9	9	10
-24	-23	-19	-32	-32	-32	-31	-29	-30	-32	-31	-28	-29	-31	-7	17	18	18	19
-28	-28	-22	-31	-31	-30	-30	-29	-29	-30	-28	-27	-27	-28	-7	15	16	16	17
-27	-27	-21	-29	-30	-28	-29	-27	-27	-27	-25	-25	-25	-25	-8	10	10	10	11
-28	-29	-22	-29	-30	-28	-29	-27	-27	-27	-26	-25	-25	-25	-8	13	14	14	15
-26	-27	-22	-26	-26	-25	-25	-24	-23	-24	-23	-22	-22	-23	-8	9	10	10	10
-27	-28	-22	-26	-26	-25	-25	-24	-23	-24	-23	-22	-22	-23	-8	8	9	9	9
-22	-22	-17	-21	-22	-20	-21	-20	-19	-20	-18	-18	-18	-18	-9	-1	0	0	-1
-23	-24	-18	-22	-23	-22	-22	-20	-20	-22	-19	-19	-19	-19	-8	0	1	1	0
-26	-27	-20	-25	-26	-24	-25	-23	-22	-24	-22	-21	-21	-21	-8	3	5	5	5
-24	-25	-18	-23	-24	-22	-23	-21	-20	-22	-20	-20	-20	-20	-8	1	3	3	3
-23	-23	-18	-23	-24	-23	-22	-21	-21	-22	-20	-20	-20	-20	-8	2	4	4	4
-21	-21	-17	-21	-21	-20	-20	-19	-18	-19	-18	-18	-18	-18	-8	-1	0	0	0
-18	-18	-15	-20	-20	-20	-19	-18	-19	-20	-19	-17	-18	-19	-8	-1	0	0	0
-20	-19	-15	-19	-20	-19	-19	-18	-18	-19	-17	-17	-17	-17	-8	-2	-1	-1	-1
-22	-22	-16	-23	-23	-22	-22	-21	-20	-21	-20	-19	-19	-19	-8	1	3	3	2
-24	-24	-18	-24	-25	-23	-24	-22	-21	-23	-21	-20	-20	-20	-8	1	3	3	3
-19	-19	-16	-23	-23	-23	-23	-20	-22	-23	-22	-21	-21	-22	-8	1	3	3	2
-18	-18	-15	-23	-23	-24	-23	-21	-23	-25	-23	-22	-22	-23	-8	0	2	2	2
-18	-18	-15	-20	-20	-20	-20	-18	-20	-21	-19	-19	-19	-20	-8	-1	0	0	0
-17	-16	-14	-24	-25	-26	-25	-21	-28	-30	-26	-27	-28	-28	-9	-4	-2	-2	-2
-17	-17	-14	-22	-22	-23	-22	-19	-23	-25	-21	-22	-23	-23	-9	-5	-4	-4	-4
-18	-18	-15	-21	-22	-21	-21	-19	-20	-21	-19	-19	-19	-19	-9	-5	-4	-4	-5
-19	-18	-15	-20	-20	-19	-19	-18	-18	-19	-17	-17	-17	-17	-9	-5	-4	-4	-5
-18	-18	-14	-20	-20	-20	-20	-18	-20	-21	-18	-19	-20	-19	-8	-5	-3	-3	-4
-17	-16	-14	-18	-18	-17	-17	-16	-16	-17	-15	-15	-15	-15	-8	-6	-5	-5	-5
-20	-19	-15	-21	-21	-20	-20	-19	-19	-20	-19	-18	-18	-18	-9	-5	-3	-3	-3
-14	-14	-12	-19	-19	-20	-20	-16	-20	-22	-19	-19	-20	-22	-8	-5	-4	-4	-4
-20	-20	-15	-25	-26	-25	-25	-23	-23	-25	-23	-21	-21	-22	-9	-3	-1	-1	-2
-25	-25	-18	-29	-30	-28	-29	-26	-26	-27	-26	-24	-24	-25	-9	-2	0	0	0
-25	-26	-19	-26	-27	-25	-26	-24	-23	-24	-23	-21	-21	-22	-10	-3	-2	-2	-2
-22	-23	-17	-21	-22	-20	-21	-19	-19	-20	-18	-18	-18	-18	-9	-4	-3	-3	-4

	FILM No.	POSE	TIME	REF. P	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
				0	4	4	4	3	4	3	4	3	3	2	2	1	0	-1	-1
CASE 13	18	34	14.35.55	-3	24	20	15	14	27	24	20	20	25	22	18	19	15	7	6
	18	35	14.36.05	-4	13	10	7	7	18	16	13	12	19	17	13	18	15	10	7
	18	36	14.36.13	-5	17	16	12	11	24	22	18	17	25	22	17	22	18	12	9
	18	37	14.36.20	-2	46	41	28	30	62	57	44	44	60	57	44	56	46	30	24
	18	38	14.36.25	-2	40	38	30	30	48	48	40	40	50	47	39	45	37	25	21
	18	39	14.36.33	-3	31	30	25	24	37	38	34	34	39	38	33	35	30	22	18

WIND PRESSURES ON THE WALL A (in Pa)

WIND PRESSURES ON THE WALL B (in Pa)

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16
-1	-1	-1	-2	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2	-3
-26	-26	-27	-26	-26	-25	-24	-22	-22	-19	-18	-19	-17	-18	-17	-17
-15	-16	-14	-13	-14	-12	-13	-12	-12	-12	-13	-13	-13	-14	-14	-15
-20	-22	-19	-15	-16	-14	-14	-12	-12	-12	-12	-13	-13	-13	-13	-15
-30	-33	-35	-25	-27	-22	-21	-14	-17	-12	-12	-12	-12	-11	-11	-13
-32	-34	-36	-29	-30	-26	-24	-19	-20	-15	-14	-15	-13	-12	-12	-13
-33	-35	-36	-27	-28	-25	-21	-17	-16	-14	-14	-14	-13	-12	-12	-14

WIND PRESSURES ON THE WALL C (in Pa)

C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
-3	-3	-3	-3	-2	-2	-2	-2	-3	-2	-2	-2	-3	-2	-2
-16	-16	-16	-15	-15	-15	-15	-13	-15	-15	-13	-15	-16	-15	-14
-18	-18	-17	-16	-16	-17	-16	-15	-17	-17	-16	-17	-18	-18	-16
-17	-17	-16	-16	-16	-16	-16	-15	-17	-17	-15	-17	-18	-18	-16
-16	-16	-15	-15	-15	-16	-15	-14	-16	-17	-15	-18	-20	-19	-16
-16	-16	-15	-15	-15	-15	-15	-13	-15	-16	-13	-17	-18	-18	-16
-16	-16	-15	-15	-15	-16	-16	-13	-16	-17	-15	-17	-18	-18	-16

WIND PRESSURES ON THE WALL D (in Pa)															CAVITY PRES.			
D1	D2	D3	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	P_1	A	B	C	D
-3	-2	-2	-1	-1	-1	-1	-1	0	-1	0	0	0	0	0	0	1	1	0
-17	-16	-15	-21	-21	-23	-22	-20	-26	-27	-23	-26	-26	-27	-8	-5	-3	-3	-2
-21	-21	-16	-23	-24	-24	-24	-21	-24	-25	-22	-23	-23	-23	-9	-5	-3	-3	-2
-21	-21	-17	-24	-25	-25	-25	-22	-24	-25	-23	-23	-23	-24	-9	-4	-2	-2	-1
-25	-27	-21	-30	-31	-30	-30	-28	-28	-29	-28	-26	-26	-27	-9	-1	2	2	4
-25	-24	-20	-30	-32	-30	-30	-28	-29	-30	-29	-27	-26	-29	-10	-2	2	1	3
-23	-23	-17	-30	-31	-30	-31	-27	-31	-32	-31	-28	-29	-31	-9	-2	1	0	2

CASE 16

FILM No.	POSE	TIME	REFER. P	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
				WIND PRESSURE ON THE WALL A (in Pa)														
			0	4	4	4	3	4	3	4	3	3	2	2	1	0	-1	-1
4	41	11.30.15	3	-3	-3	-3	-4	-3	-4	-3	-4	-4	-5	-5	-5	-6	-7	-7
4	42	11.30.20	4	-3	-3	-3	-4	-2	-4	-3	-4	-3	-5	-5	-5	-5	-6	-7
4	43	11.30.25	4	-3	-3	-3	-4	-3	-4	-3	-4	-3	-5	-5	-5	-5	-6	-7
4	44	11.30.30	4	-3	-3	-3	-4	-3	-4	-3	-4	-4	-5	-5	-5	-6	-7	-7
4	1	11.30.35	4	-3	-3	-3	-4	-3	-5	-3	-4	-4	-5	-5	-5	-6	-7	-7
4	2	11.30.40	4	-3	-3	-3	-4	-3	-4	-3	-4	-3	-5	-5	-5	-6	-7	-7
4	3	11.30.45	4	-3	-3	-3	-4	-2	-3	-3	-4	-3	-4	-5	-5	-5	-6	-7
4	4	11.30.50	3	-2	-2	-2	-3	-2	-3	-3	-3	-3	-4	-4	-5	-5	-6	-7
4	5	11.30.55	3	-2	-2	-2	-3	-2	-2	-2	-3	-2	-3	-4	-4	-5	-6	-6
4	6	11.31.00	3	-1	-1	-1	-2	0	-1	-1	-2	-1	-2	-3	-3	-4	-5	-5
4	7	11.31.05	3	0	0	0	-2	0	-1	-1	-2	-1	-2	-3	-3	-4	-5	-5
4	8	11.31.10	3	-2	-2	-2	-3	-2	-2	-2	-3	-2	-3	-4	-4	-4	-5	-6
4	9	11.31.15	3	-2	-2	-2	-3	-1	-2	-2	-2	-2	-3	-3	-3	-4	-5	-6
4	10	11.31.20	4	-2	-2	-2	-3	-1	-2	-2	-2	-2	-3	-4	-4	-5	-6	-6
4	11	11.31.26	4	-3	-3	-3	-4	-3	-4	-3	-4	-4	-5	-5	-5	-6	-7	-7
4	12	11.31.30	4	-4	-4	-4	-5	-4	-5	-5	-6	-5	-6	-7	-7	-7	-9	-9
4	13	11.31.35	4	-5	-5	-5	-6	-5	-6	-6	-6	-6	-7	-7	-7	-8	-10	-10
4	14	11.31.40	4	-3	-3	-3	-5	-3	-4	-4	-5	-4	-5	-6	-6	-7	0	-8
4	15	11.31.45	3	-3	-3	-3	-4	-2	-3	-3	-4	-4	-5	-5	-5	-6	-7	-7
4	16	11.31.50	4	-2	-2	-2	-3	-2	-3	-2	-3	-3	-4	-4	-5	-5	-6	-7
4	17	11.31.55	3	-3	-3	-3	-5	-2	-4	-3	-5	-4	-5	-5	-5	-6	-7	-7
4	18	11.32.01	2	-3	-4	-4	-5	-3	-4	-3	-5	-4	-5	-6	-6	-6	-7	-8
4	19	11.32.05	2	-4	-5	-5	-6	-3	-5	-4	-5	-4	-6	-6	-6	-7	-8	-8
4	20	11.32.10	3	-3	-3	-3	-5	-3	-4	-3	-4	-4	-5	-5	-5	-6	-7	-7
4	21	11.32.15	3	-3	-3	-3	-4	-3	-4	-3	-4	-3	-4	-5	-5	-6	-7	-7
4	22	11.32.20	3	-2	-2	-2	-4	-2	-3	-3	-4	-4	-5	-5	-5	-6	-7	-7
4	23	11.32.25	3	-2	-2	-2	-3	-2	-3	-2	-3	-3	-4	-4	-5	-5	-6	-6
4	24	11.32.30	3	-2	-2	-2	-3	-2	-3	-2	-3	-3	-4	-5	-5	-5	-6	-6
4	25	11.32.35	4	-3	-3	-2	-3	-2	-4	-3	-4	3	-5	-5	-5	-6	-7	-7
4	26	11.32.40	4	-3	-3	-2	-3	-3	-4	-3	-4	-4	-5	-5	-5	-6	-7	-7
4	27	11.32.45	3	-2	-3	-2	-3	-2	-4	-3	-4	-3	-5	-5	-5	-6	-7	-7
4	28	11.32.50	2	-2	-2	-2	-3	-2	-3	-3	-4	-4	-5	-5	-5	-6	-7	-7
4	29	11.32.55	2	-2	-2	-2	-4	-2	-3	-3	-3	-3	-4	-4	-5	-5	-6	-7
4	30	11.33.00	2	-2	-2	-2	-3	-2	-2	-2	-3	-2	-4	-4	-4	-5	-6	-6
4	31	11.33.05	2	-1	-1	-1	-2	-1	-2	-2	-2	-2	-2	-3	-3	-4	-5	-6

WIND PRESSURE ON THE WALL B (in Pa)

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15
-1	-1	-1	-2	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2
3	1	0	8	6	5	8	7	11	10	12	12	11	14	13
2	1	0	7	5	4	8	5	10	9	10	10	10	12	12
2	0	0	6	5	3	6	5	10	9	10	10	9	12	12
2	1	0	7	5	4	7	6	10	9	10	10	9	12	12
2	0	0	7	5	3	7	5	10	8	10	10	9	12	12
2	0	-1	5	4	3	7	5	9	8	9	9	8	10	10
1	0	-1	5	4	2	6	4	9	7	8	8	7	10	10
2	1	0	7	5	3	7	5	9	8	9	9	8	10	10
3	2	0	6	5	4	7	5	9	7	8	8	7	8	8
2	1	0	5	4	4	5	4	7	6	7	7	5	6	6
2	1	0	4	4	3	5	4	7	5	6	6	5	5	5
4	3	2	7	6	5	7	7	9	8	8	8	7	7	7
5	4	3	8	8	7	9	9	11	9	10	10	8	9	9
4	3	2	8	7	6	8	8	10	9	10	10	9	10	9
2	1	0	8	5	4	8	6	11	10	11	11	11	13	13
4	1	0	10	8	5	10	8	14	12	14	14	13	17	17
3	1	0	11	8	5	9	9	15	14	17	16	15	20	19
4	2	1	10	8	6	9	9	13	12	13	13	13	14	14
3	2	1	8	6	5	8	8	10	10	10	10	10	11	10
3	2	1	7	6	5	8	7	10	9	10	9	8	9	9
4	3	1	8	8	5	8	7	10	8	8	8	7	8	8
4	2	0	8	7	5	8	7	10	8	10	10	8	10	10
5	3	1	9	8	7	10	9	13	10	12	12	10	12	12
5	3	2	10	9	7	10	9	13	12	12	12	11	12	12
3	2	0	8	6	5	8	7	10	9	10	10	10	11	11
2	0	0	6	5	3	7	5	9	8	9	9	9	11	10
2	0	-1	5	4	3	6	5	9	8	9	9	8	10	10
1	0	-1	5	3	2	5	4	8	7	8	8	7	10	10
1	0	-1	5	4	2	6	4	8	7	8	8	8	10	10
0	-1	-1	4	3	2	5	3	8	7	8	8	8	10	10
1	-1	-1	5	3	2	6	4	8	7	8	8	8	10	10
1	-1	-1	5	3	2	5	4	8	7	8	8	8	10	10
1	0	-1	5	4	2	6	4	8	7	8	8	8	9	9
1	0	-1	5	4	3	6	4	8	7	8	8	7	8	8
1	0	-1	4	3	2	4	3	6	5	6	6	5	7	7

WIND PRESSURE ON THE WALL C (in Pa)

C1	C2	C3	C4	C5	C6	C7	C8	C9	C11	C12	C13	C14	C15
-3	-3	-3	-3	-2	-2	-2	-2	-3	-2	-2	-3	-2	-2
-2	-1	-1	-2	1	-1	0	0	0	-1	-3	-5	-7	-5
2	3	2	1	3	1	2	2	1	0	-2	-4	-6	-4
2	3	2	1	3	1	2	2	1	0	-3	-4	-6	-4
1	2	2	1	3	0	1	2	0	0	-3	-5	-7	-5
1	3	2	1	2	0	2	2	0	0	-3	-5	-7	-5
2	3	2	2	3	1	2	2	0	0	-3	-4	-7	-4
4	5	4	3	4	3	3	3	2	0	-2	-3	-6	-4
1	2	1	0	2	1	2	2	1	0	-2	-3	-6	-4
-5	-4	-4	-5	-3	-3	-3	-3	-2	-2	-3	-4	-5	-4
-6	-5	-5	-5	-3	-3	-4	-3	-2	-2	-3	-4	-5	-4
-7	-6	-6	-6	-3	-3	-3	-3	-3	-3	-3	-4	-5	-4
-11	-10	-11	-11	-7	-7	-8	-6	-5	-4	-4	-5	-5	-5
-15	-13	-13	-13	-10	-11	-11	-9	-6	-7	-4	-6	-6	-6
-14	-13	-13	-12	-8	-9	-9	-7	-5	-6	-4	-6	-6	-5
-1	0	-2	-2	1	-1	-1	0	0	-1	-3	-5	-7	-5
-1	1	0	0	2	0	-1	-1	-1	-1	[illegible]	-5	-8	-5
-1	2	1	0	3	0	1	1	1	-1	-4	-6	-9	-6
-5	-3	-4	-4	0	-1	-1	0	0	-1	-4	-5	-8	-5
-7	-5	-6	-6	-1	-3	-3	-2	-1	-2	-3	-5	-6	-5
-8	-7	-7	-7	-2	-3	-4	-3	-2	-2	-3	-5	-6	-5
-9	-7	-7	-7	-3	-3	-3	-2	-2	-2	-3	-5	-6	-5
-9	-7	-6	-6	-2	-2	-2	-1	-2	-2	-4	-5	-6	-5
-11	-10	-10	-9	-4	-4	-4	-3	-2	-3	-4	-5	-6	-5
-12	-11	-11	-10	-4	-5	-6	-5	-2	-3	-4	-5	-6	-5
-5	-4	-4	-4	0	-1	-1	-1	0	-1	-3	-5	-6	-5
-1	0	-1	-1	1	0	0	0	0	-1	-3	-4	-6	-4
0	0	-1	-1	1	0	0	0	0	-1	-3	-4	-6	-5
3	3	2	0	4	2	2	2	2	0	-2	-3	-6	-4
5	5	4	3	5	3	3	3	2	1	-2	-3	-6	-4
5	5	5	4	5	3	4	4	2	2	-2	-3	-5	-3
4	5	4	4	4	2	3	3	1	1	-2	-3	-6	-4
2	4	3	3	3	1	2	2	1	0	-3	-4	-6	-4
0	1	1	2	2	0	1	2	0	0	-3	-4	-6	-4
-4	-3	-3	-3	-1	-1	-1	0	-1	-1	-3	-4	-5	-4
-6	-5	-5	-5	-2	-2	-2	-1	-2	-2	-3	-4	-5	-4

WIND PRESSURE ON THE WALL D (in Pa)

D1	D2	D3	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	P_1	CAVITY PRES. A	B	C
-3	-2	-2	-1	-1	-1	-1	-1	0	-1	0	0	0	0	0	0	1	1
-11	-10	-10	-9	-9	-8	-9	-8	-7	-9	-6	-7	-8	-6	-1	4	5	5
-11	-10	-10	-9	-10	-8	-9	-8	-7	-10	-6	-7	-8	-6	-1	3	4	4
-10	-10	-10	-8	-10	-8	-9	-7	-7	-9	-6	-7	-8	-6	-1	3	4	4
-10	-10	-10	-8	-10	-8	-9	-7	-7	-10	-6	-7	-9	-6	-1	3	4	4
-10	-10	-9	-8	-9	-8	-9	-7	-6	-9	-5	-7	-8	-5	-1	3	4	4
-10	-10	-9	-7	-9	-7	-8	-6	-6	-9	-5	-7	-8	-5	-1	3	4	4
-10	-10	-9	-8	-9	-8	-8	-7	-6	-9	-5	-7	-8	-5	-1	3	4	4
-10	-10	-9	-7	-8	-7	-8	-7	-6	-8	-6	-7	-8	-6	-1	3	4	4
-8	-8	-7	-6	-6	-6	-6	-5	-5	-6	-4	-6	-6	-5	0	2	3	3
-7	-7	-6	-6	-6	-5	-6	-5	-4	-6	-3	-5	-5	-4	0	2	3	3
-7	-6	-6	-5	-5	-5	-5	-4	-4	-5	-3	-4	-5	-3	0	1	2	2
-7	-6	-6	-5	-5	-5	-5	-4	-4	-5	-3	-4	-5	-3	0	2	3	3
-7	-7	-6	-5	-6	-5	-5	-5	-4	-5	-3	-4	-5	-3	0	3	4	4
-8	-8	-7	-6	-6	-5	-6	-5	-4	-6	-3	-4	-5	-3	0	3	4	4
-11	-10	-10	-8	-9	-8	-9	-8	-7	-9	-6	-7	-8	-6	-1	3	4	4
-12	-11	-11	-10	-11	-10	-10	-10	-8	-10	-8	-9	-10	-8	-1	4	5	5
-12	-12	-12	-10	-11	-10	-11	-10	-9	-11	-8	-10	-10	-8	-1	5	6	6
-11	-10	-10	-9	-10	-8	-10	-8	-7	-10	-6	-8	-9	-7	-1	4	5	5
-10	-9	-8	-7	-8	-7	-7	-6	-6	-8	-5	-7	-7	-5	-1	3	4	4
-9	-8	-8	-7	-7	-6	-7	-6	-5	-7	-4	-6	-7	-5	-1	3	4	4
-8	-8	-7	-6	-7	-6	-6	-5	-5	-6	-4	-5	-6	-4	-1	2	3	3
-9	-8	-8	-6	-7	-6	-6	-6	-5	-7	-5	-6	-6	-5	-1	3	4	4
-9	-8	-8	-6	-7	-6	-7	-6	-5	-7	-4	-6	-7	-5	0	3	4	4
-9	-9	-8	-7	-8	-7	-7	-6	-5	-7	-4	-6	-7	-5	0	3	4	4
-10	-10	-9	-7	-9	-7	-8	-7	-6	-8	-5	-7	-7	-5	-1	3	4	4
-10	-10	-9	-7	-8	-7	-8	-7	-6	-8	-5	-7	-8	-5	-1	3	4	4
-10	-10	-9	-7	-8	-7	-8	-7	-6	-8	-5	-7	-7	-5	-1	3	4	4
-10	-10	-9	-8	-8	-8	-8	-7	-7	-8	-5	-7	-8	-5	-1	2	3	3
-10	-10	-9	-8	-9	-8	-8	-8	-7	-9	-6	-8	-8	-6	-1	2	3	3
-10	-10	-9	-8	-8	-8	-8	-8	-7	-9	-6	-8	-8	-6	-1	2	3	3
-10	-10	-9	-8	-8	-8	-8	-7	-7	-9	-6	-7	-8	-6	-1	2	3	3
-9	-9	-8	-7	-8	-7	-8	-7	-7	-8	-5	-7	-8	-5	-1	2	3	3
-9	-9	-8	-7	-8	-7	-7	-6	-6	-8	-5	-7	-7	-5	-1	2	3	3
-8	-8	-7	-6	-7	-6	-6	-5	-5	-7	-3	-5	-6	-4	-1	2	3	3
-7	-7	-6	-5	-6	-5	-6	-5	-4	-6	-3	-5	-5	-4	-1	2	3	3

	FILM NO.	POSE	TIME	O REFER. P	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
					WIND PRESSURE ON THE WALL A (in Pa)														
				0	4	4	4	3	4	3	4	3	3	2	2	1	0	-1	-1
CASE 17	6	9	11.56.30	2	-3	-3	-3	-5	-3	-5	-4	-5	-4	-5	-6	-6	-6	-7	-8
	6	10	11.56.36	2	-2	-2	-1	-2	-1	-3	-2	-3	-2	-3	-4	-4	-5	-6	-6
	6	11	11.56.40	5	-1	-1	0	-1	0	-1	-1	-1	-1	-2	-2	-2	-3	-5	-5
	6	12	11.56.45	7	-2	-3	-3	-3	-2	-3	-2	-3	-3	-4	-5	-5	-5	-6	-7
	6	13	11.56.50	5	-4	-5	-5	-5	-3	-5	-4	-5	-4	-5	-5	-5	-6	-7	-7
	6	14	11.56.56	5	-2	-2	-2	-3	-1	-2	-2	-3	-2	-3	-4	-4	-5	-6	-6
	6	15	11.57.00	5	-3	-3	-3	-4	-2	-3	-3	-4	-3	-4	-5	-5	-5	-6	-7
	6	16	11.57.10	4	-4	-4	-5	-5	-3	-5	-4	-5	-4	-5	-6	-6	-6	-7	-7
	6	17	11.57.15	4	-4	-4	-4	-5	-3	-5	-4	-5	-4	-5	-5	-5	-6	-7	-8
	6	18	11.57.20	4	-6	-6	-6	-6	-5	-6	-5	-6	-6	-7	-7	-7	-8	-9	-10
	6	19	11.57.25	2	-6	-6	-6	-6	-5	-6	-6	-6	-6	-7	-7	-7	-8	-9	-10
	6	20	11.57.30	2	-5	-5	-5	-6	-5	-6	-5	-6	-5	-7	-7	-7	-8	-9	-10
	6	21	11.57.35	2	-4	-5	-5	-5	-4	-5	-5	-5	-5	-6	-6	-6	-7	-8	-8
	6	22	11.57.41	2	-4	-5	-5	-5	-3	-5	-5	-5	-4	-5	-6	-5	-6	-7	-8
	6	23	11.57.46	2	-7	-7	-8	-8	-7	-8	-8	-8	-8	-9	-9	-9	-10	-11	-11
	6	24	11.57.52	5	-10	-10	-10	-12	-10	-10	-10	-11	-10	-11	-11	-11	-12	-13	-13
	6	25	11.58.01	6	-12	-13	-14	-15	-12	-13	-13	-13	-12	-14	-14	-14	-15	-15	-15
	6	26	11.58.10	7	-11	-11	-11	-13	-10	-11	-11	-12	-11	-12	-12	-12	-13	-14	-14
	6	27	11.58.16	4	-9	-10	-10	-11	-9	-10	-10	-10	-9	-10	-10	-10	-12	-12	-12
	6	28	11.58.21	3	-8	-9	-9	-10	-8	-10	-9	-10	-9	-10	-10	-10	-12	-12	-12
	6	29	11.58.25	3	-7	-8	-8	-10	-8	-9	-8	-9	-8	-10	-10	-10	-11	-11	-11
	6	30	11.58.30	2	-6	-6	-6	8	-6	-7	-7	-7	-6	-8	-8	-8	-9	-10	-10
	6	31	11.58.35	3	-5	-5	-6	-7	-5	-6	-6	-7	-5	-7	-7	-7	-8	-10	-10
	6	32	11.58.41	3	-4	-4	-4	-5	-3	-5	-5	-5	-4	-5	-6	-6	-6	-7	-8
	6	33	11.58.45	2	-3	-3	-3	-5	-3	-5	-4	-5	-4	-5	-5	-5	-6	-7	-8
	6	34	11.58.51	4	-3	-3	-3	-5	-2	-4	-3	-4	-3	-5	-5	-5	-6	-7	-7
	6	35	11.59.00	4	-7	-8	-7	-8	-7	-8	-8	-8	-8	-9	-10	-9	-10	-11	-11
	6	36	11.59.08	3	-7	-8	-8	-9	-7	-8	-8	-8	-8	-9	-10	-10	-10	-11	-11
	6	37	11.59.20	3	-5	-5	-5	-6	-5	-6	-5	-6	-6	-7	-7	-8	-8	-10	-10
	6	38	11.59.30	4	-5	-5	-5	-5	-4	-5	-5	-6	-5	-6	-7	-6	-7	-8	-9
	6	39	11.59.40	5	-8	-8	-8	-9	-8	-8	-8	-9	-8	-9	-10	-10	-10	-11	-12
	6	40	11.59.50	3	-8	-8	-8	-10	-8	-9	-9	-10	-9	-10	-10	-10	-11	-12	-12
	6	41	12.00.00	3	-5	-5	-5	-6	-5	-6	-5	-6	-5	-7	-7	-7	-8	-10	-10
	6	42	12.00.06	5	-5	-6	-5	-5	-4	-5	-5	-5	-5	-6	-6	-6	-7	-8	-8
	6	43	12.00.13	6	-8	-10	-9	-9	-8	-10	-8	-8	-7	-10	-9	-8	-10	-10	-10
	6	44	12.00.20	5	-8	-9	-9	-10	-8	-9	-8	-8	-7	-9	-9	-8	-10	-10	-10
	6	45	12.00.30	5	-10	-10	-10	-10	-9	-10	-10	-10	-10	-11	-10	-10	-12	-12	-12
	6	1	12.00.40	4	-6	-6	-6	-7	-5	-6	-5	-7	-6	-7	-7	-7	-8	-10	-10
CASE 18	8	40	12.27.27	2	-2	-2	-2	-4	-2	-3	-2	-3	-3	-4	-4	-5	-5	-6	-6
	8	41	12.28.43	4	-8	-10	-10	-11	-8	-10	-9	-10	-9	-10	-11	-10	-11	-12	-12
	8	42	12.28.45	5	-8	-9	-9	-10	-8	-9	-8	-9	-8	-10	-10	-10	-10	-11	-12
	8	43	12.31.06	6	-6	-6	-6	-6	-5	-6	-6	-6	-5	-7	-7	-7	-7	-9	-9
	8	44	12.35.23	4	-7	-7	-7	-9	-7	-8	-7	-8	-7	-9	-9	-8	-10	-10	-11
	8	1	12.35.36	4	-4	-4	-4	-5	-3	-5	-4	-5	-5	-5	-5	-5	-6	-7	-7
	8	2	12.35.47	5	-6	-7	-6	-7	-6	-7	-6	-7	-6	-8	-8	-8	-9	-10	-10
	8	3	12.36.05	3	-3	-3	-3	-3	-2	-4	-3	-4	-3	-5	-5	-5	-6	-6	-7
	8	4	12.36.17	4	-3	-3	-3	-5	-3	-4	-3	-3	-3	-5	-5	-5	-5	-6	-6
	8	5	12.36.24	4	-8	-8	-9	-10	-8	-9	-8	-10	-9	-10	-10	-10	-11	-12	-12
	8	6	12.36.31	2	-10	-11	-11	-12	-10	-11	-10	-11	-10	-12	-12	-12	-13	-13	-13
	8	7	12.36.52	5	-8	-10	-9	-10	-7	-8	-8	-9	-7	-9	-10	-8	-10	-10	-11
	8	8	12.37.24	4	-5	-5	-5	-6	-5	-6	-5	-6	-6	-7	-7	-7	-8	-10	-10

WIND PRESSURE ON THE WALL B (in Pa)

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15
-1	-1	-1	-2	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2
2	0	-1	6	4	3	6	5	9	8	10	10	9	12	11
0	-1	-1	4	3	2	4	3	6	5	6	6	6	6	7
0	-1	-1	3	2	0	3	1	5	4	3	3	5	-2	-1
2	0	-1	7	4	1	5	3	8	6	5	6	7	2	0
2	0	-1	6	4	2	5	4	8	7	7	7	7	4	4
2	0	0	5	4	3	5	4	7	5	5	5	5	3	3
2	1	0	5	4	3	6	5	8	7	7	8	7	6	6
1	0	-1	6	4	2	6	4	9	8	9	9	9	10	10
0	-1	-2	5	3	1	5	3	9	8	8	9	9	10	10
1	2	2	7	4	1	5	3	10	9	10	10	10	14	14
0	-2	-2	7	3	1	5	3	10	9	10	10	10	14	14
0	-2	-3	6	2	0	3	3	9	7	9	9	9	13	12
0	-2	-3	5	2	0	3	2	7	6	7	7	7	10	10
0	-2	-3	4	2	0	3	2	7	6	7	7	7	9	9
0	-2	-3	8	4	1	4	4	12	10	13	13	12	18	16
4	0	-1	14	9	6	10	10	19	17	20	20	19	25	23
5	1	0	17	12	8	12	14	23	21	25	25	23	32	30
7	4	3	18	15	12	18	17	23	22	24	24	23	25	25
5	2	1	14	11	8	14	12	18	17	19	19	18	22	22
4	0	0	12	9	6	13	10	17	15	18	18	17	23	22
4	1	0	11	8	5	11	9	15	14	15	15	15	19	18
2	0	-1	8	5	3	8	6	12	10	12	12	12	15	15
2	0	-1	8	5	3	8	6	12	10	12	12	11	14	14
1	-1	-1	5	3	2	5	4	9	7	8	8	8	10	10
0	-1	-2	5	2	1	4	2	7	6	7	7	7	8	9
0	-2	-2	4	2	0	3	2	7	5	6	6	6	8	8
3	0	-1	10	8	4	10	8	15	13	16	16	15	19	19
3	1	-1	10	8	5	10	9	15	14	15	15	15	19	18
2	0	-1	8	5	4	7	6	12	10	13	13	12	15	14
1	-1	-2	6	4	2	5	3	9	8	9	9	9	10	10
2	0	-2	10	6	3	8	7	15	13	15	16	15	19	19
1	-2	-3	10	5	2	9	5	14	12	14	15	14	19	18
0	-2	-3	7	3	0	4	3	10	8	9	10	9	12	12
0	-2	-3	8	2	0	4	1	9	8	8	8	9	3	3
0	-2	-3	9	3	0	7	3	12	10	10	12	12	11	10
0	-2	-3	8	3	0	7	3	10	10	10	12	12	14	13
0	-2	-3	10	5	2	8	5	14	12	14	15	15	18	18
0	-2	-3	8	3	0	6	2	10	9	9	10	10	9	10
1	0	-1	5	4	3	5	5	8	7	9	9	8	10	9
13	10	5	22	20	16	25	21	27	25	28	28	25	23	26
12	9	5	20	18	14	21	19	24	23	25	25	23	24	24
8	6	4	14	13	12	15	14	17	16	18	17	16	16	16
2	0	-1	10	6	4	10	7	14	13	14	14	14	15	15
0	-1	-2	5	3	1	5	2	8	6	6	7	7	8	8
0	-2	-3	7	3	0	6	2	10	9	10	10	10	13	13
0	-1	-2	4	2	0	3	2	5	4	4	5	5	5	5
4	2	0	12	10	7	12	11	16	15	17	17	15	18	18
3	0	0	11	8	6	12	10	15	14	16	17	15	20	20
2	-1	-2	12	8	5	12	9	17	15	18	18	18	24	23
0	-2	-3	9	3	0	7	3	11	10	10	11	12	10	10
0	-2	-3	5	3	0	5	3	9	8	9	10	10	12	12

WIND PRESSURE ON THE WALL C (in Pa)

C1	C2	C3	C4	C5	C6	C7	C8	C9	C11	C12	C13	C14	C15
-3	-3	-3	-3	-2	-2	-2	-2	-3	-2	-2	-3	-2	-2
-2	-1	-1	-2	0	-1	0	0	-1	-2	-4	-5	-7	-5
3	4	3	2	4	2	3	3	2	1	-2	-3	-6	-4
13	14	12	9	14	12	11	10	10	8	3	1	-2	0
20	20	18	14	19	18	18	16	14	13	5	5	2	3
8	9	9	7	12	11	10	10	9	8	3	3	0	0
0	1	1	0	3	3	2	2	2	2	0	-1	-2	-2
-5	-4	-4	-4	0	-1	-1	-1	0	-1	-2	-3	-4	-3
4	5	5	4	5	4	5	5	3	3	-1	-3	-5	-3
12	12	12	10	11	9	10	10	8	7	0	-1	-4	-1
12	13	12	10	10	9	10	9	7	5	-1	-2	-5	-2
12	13	11	10	10	8	9	9	7	5	-1	-2	-6	-3
13	13	10	10	10	8	9	9	7	5	-1	-2	-5	-2
13	12	10	10	10	9	9	9	7	5	0	-1	-4	-2
10	10	10	9	9	8	8	8	5	5	0	-1	-4	-2
12	12	10	9	9	6	8	8	5	4	2	3	7	4
-4	-3	-3	-2	3	0	0	2	2	0	-5	-6	-10	-6
0	2	0	-1	5	0	2	2	2	-1	-7	-9	-13	-9
-9	-6	-8	-8	2	-2	-2	-1	0	-2	-7	-8	-12	-9
-3	-1	-3	-3	4	0	0	1	1	-1	-5	-7	-12	-8
2	4	2	1	5	2	3	3	2	0	-5	-7	-12	-7
3	5	4	3	5	2	3	3	2	0	-4	-6	-10	-7
4	6	5	4	5	3	4	4	2	1	-3	-5	-8	-5
5	6	5	4	5	3	4	4	3	1	-3	-5	-8	-5
8	9	8	6	7	5	6	6	4	3	-1	-2	-5	-3
10	10	8	7	8	7	7	7	5	4	0	-1	-4	-2
11	12	10	9	10	9	9	9	6	6	0	-1	-3	-1
4	5	5	4	7	4	5	5	4	2	-3	-5	-9	-5
-1	0	0	0	4	2	3	3	1	0	-4	-6	-10	-6
-3	0	0	0	2	0	1	1	0	-1	-4	-6	-9	-6
8	10	10	8	10	9	10	9	7	5	-1	-2	-5	-2
7	9	9	9	9	6	8	8	5	4	-2	-4	-8	-4
13	14	13	12	12	9	10	10	8	5	-2	-3	-8	-4
15	15	13	12	13	10	11	10	9	7	0	-1	-4	-1
29	29	25	22	25	24	23	22	20	18	8	7	2	5
26	27	25	22	23	22	22	21	18	16	6	6	1	4
22	22	20	19	19	17	17	17	14	12	4	3	-2	1
18	19	17	16	15	12	14	13	10	8	0	-1	-6	-2
23	22	20	18	19	17	17	17	15	12	4	2	-2	1
-5	-2	-2	-2	0	-1	0	0	-1	-1	-3	-5	-6	-5
-27	-25	-25	-27	-20	-21	-22	-17	-11	-10	-8	-11	-11	-10
-25	-23	-23	-25	-16	-17	-18	-14	-9	-9	-8	-10	-11	-10
-18	-15	-15	-15	-11	-12	-12	-10	-8	-9	-6	-8	-10	-8
2	3	2	2	5	4	5	6	3	3	-3	-4	-7	-4
12	13	11	9	12	11	11	10	9	8	2	1	-1	0
18	19	18	17	15	14	15	15	11	10	1	0	-3	0
6	6	6	5	6	5	5	5	4	3	0	-1	-3	-2
-8	-6	-6	-5	0	-2	-2	-1	0	-2	-5	-6	-9	-6
3	4	2	1	5	2	3	3	3	1	-3	-5	-10	-6
9	10	8	6	9	4	5	5	4	2	-4	-5	-11	-6
25	25	23	21	23	20	20	20	18	15	5	4	-1	3
12	13	12	11	10	9	10	10	7	6	0	-1	-4	-2

WIND PRESSURE ON THE WALL D (in Pa)

D1	D2	D3	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	P_1	CAVITY PRES. A	B	C
-3	-2	-2	-1	-1	-1	-1	-1	0	-1	0	0	0	0	0	0	1	1
-10	-10	-10	-8	-9	-8	-9	-7	-7	-9	-6	-7	-8	-6	-1	5	6	6
-10	-10	-9	-8	-9	-8	-8	-8	-7	-8	-6	-7	-8	-6	-1	4	5	5
-11	-10	-10	-9	-10	-9	-10	-9	-8	-10	-6	-8	-9	-6	-2	2	3	3
-14	-13	-13	-12	-13	-12	-13	-12	-10	-14	-8	-12	-13	-7	-2	3	4	4
-11	-11	-11	-10	-11	-10	-11	-10	-9	-12	-7	-10	-12	-7	-1	4	5	5
-9	-8	-9	-7	-8	-7	-8	-7	-6	-8	-5	-7	-8	-5	-1	3	4	4
-9	-8	-8	-7	-7	-6	-7	-6	-5	-8	-5	-6	-7	-4	0	4	5	5
-12	-12	-11	-10	-11	-10	-11	-10	-9	-11	-7	-10	-10	-7	-1	5	6	6
-13	-12	-12	-11	-12	-11	-12	-11	-10	-12	-9	-10	-11	-8	-1	5	6	6
-14	-13	-13	-12	-13	-12	-13	-12	-11	-14	-10	-12	-12	-10	-1	7	8	8
-14	-13	-13	-12	-13	-11	-12	-11	-11	-13	-10	-11	-12	-9	-1	7	8	8
-13	-13	-12	-11	-12	-11	-12	-10	-10	-13	-9	-11	-12	-9	-1	6	7	7
-12	-12	-11	-10	-11	-10	-11	-10	-10	-12	-8	-10	-11	-8	-1	5	6	6
-12	-12	-11	-10	-11	-10	-11	-10	-9	-12	-7	-10	-11	-6	-1	5	5	5
-14	-14	-14	-12	-14	-12	-14	-12	-11	-15	-10	-12	-13	-8	-1	9	10	10
-15	-15	-15	-13	-16	-13	-15	-12	-12	-16	-10	-13	-15	-10	0	12	13	13
-19	-18	-18	-16	-18	-15	-18	-15	-15	-19	-12	-16	-17	-12	0	16	17	17
-17	-17	-16	-15	-17	-14	-16	-13	-13	-17	-11	-14	-16	-11	0	14	15	15
-16	-16	-15	-14	-16	-13	-15	-12	-12	-16	-10	-13	-15	-10	0	12	13	13
-16	-16	-15	-14	-16	-13	-15	-12	-13	-16	-11	-14	-15	-11	0	11	12	12
-15	-15	-14	-13	-15	-12	-14	-12	-12	-15	-10	-13	-14	-10	0	10	10	10
-13	-13	-12	-11	-13	-11	-13	-10	-10	-14	-8	-11	-13	-8	-1	8	9	8
-13	-13	-12	-11	-13	-11	-12	-10	-10	-13	-7	-11	-12	-7	-1	7	8	8
-12	-12	-11	-10	-11	-10	-11	-10	-9	-12	-7	-10	-11	-7	-1	5	6	6
-12	-11	-11	-10	-11	-10	-11	-9	-8	-11	-7	-10	-10	-7	-1	4	5	5
-12	-11	-11	-10	-11	-10	-11	-10	-9	-12	-7	-10	-11	-6	-1	4	5	5
-15	-15	-15	-13	-14	-12	-14	-13	-12	-15	-10	-13	-14	-10	-1	10	11	11
-14	-14	-13	-12	-14	-12	-13	-11	-11	-14	-10	-12	-13	-10	0	10	10	10
-12	-12	-11	-10	-11	-10	-11	-9	-9	-11	-8	-10	-10	-7	0	7	8	8
-13	-12	-12	-11	-12	-11	-12	-10	-10	-12	-8	-12	-12	-9	-1	5	6	6
-15	-15	-15	-14	-15	-13	-15	-13	-13	-16	-11	-14	-15	-11	-1	10	11	10
-15	-15	-15	-14	-15	-14	-15	-14	-13	-16	-12	-15	-15	-12	-1	9	10	10
-14	-13	-13	-12	-13	-12	-13	-12	-10	-14	-9	-11	-13	-9	-1	6	7	7
-16	-15	-16	-15	-16	-14	-15	-15	-13	-17	-11	-14	-16	-10	-2	4	5	5
-16	-16	-17	-15	-17	-15	-17	-15	-14	-19	-11	-16	-18	-10	-2	7	8	8
-16	-16	-16	-15	-17	-14	-16	-14	-13	-18	-9	-15	-17	-8	-2	7	8	8
-16	-16	-15	-15	-16	-14	-16	-15	-13	-18	-11	-15	-17	-10	-1	10	10	10
-15	-15	-15	-14	-16	-13	-15	-14	-12	-16	-10	-13	-15	-9	-2	6	7	7
-9	-9	-8	-7	-8	-7	-8	-6	-6	-8	-5	-7	-7	-5	-1	5	6	6
-13	-13	-12	-11	-11	-11	-11	-11	-10	-12	-10	-10	-11	-9	0	17	18	18
-13	-13	-13	-11	-12	-11	-12	-11	-10	-12	-8	-10	-11	-8	0	15	16	16
-11	-11	-11	-10	-11	-9	-10	-8	-7	-10	-6	-7	-9	-6	0	11	12	12
-14	-14	-13	-12	-14	-12	-14	-11	-10	-15	-9	-12	-14	-8	-1	9	10	10
-12	-12	-12	-11	-12	-11	-12	-10	-9	-13	-7	-10	-12	6	-1	4	5	5
-15	-15	-14	-13	-15	-13	-15	-14	-12	-16	-10	- 3	-15	-9	-2	6	7	7
-10	-10	-9	-8	-10	-8	-9	-7	-6	-10	-5	-7	-8	-5	-1	3	4	4
-11	-14	-13	-12	-13	-12	-13	-11	-10	-14	-9	-11	-12	-9	0	11	12	12
16	-16	-15	-14	-15	-13	-15	-12	-12	-16	-10	-13	-15	-10	-1	10	11	11
-17	-16	-16	-15	-17	-15	-16	-15	-14	-18	-12	-16	-17	-12	-1	12	13	13
16	-16	-16	-15	-18	-15	-17	-15	-14	-19	-11	-16	-18	-10	-2	6	7	7
-13	-12	-12	-11	-12	-11	-12	-12	-10	-13	-9	-12	-13	-8	-1	6	7	7

APPENDIX B

WIND AND CAVITY PRESSURES AROUND EXPERIMENTAL STATION TRANSFERRED TO ZERO REFERENCE PRESSURE

Case	FILM NO.	POSE	TIME	REF.	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CASE 1	13	38	10.27.20	0	28	23	15	19	38	36	28	30	42	40	33	44	40	33	29
	13	39	10.28.03	0	33	29	21	26	45	43	35	38	50	47	41	52	46	34	30
	13	42	12.42.15	0	38	33	27	29	43	40	34	36	42	38	34	36	32	23	23
	13	43	12.42.20	0	38	29	25	26	44	42	34	35	45	40	34	39	33	22	20
	13	44	12.42.25	0	22	20	16	17	26	27	23	24	30	28	24	31	27	19	15
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Table header: WIND PRESSURES in Pa

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-16	-18	-11	-16	-18	-16	-17	-15	-15	-16	-15	-14	-15	-14	-4	-1	-1	-1	-1

CASE	FILM No.	POSE	TIME	REF. P	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
					WIND PRESSURES in Pa														
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CASE 12	8	9	12.42.33	0	-17	-17	-17	-17	-16	-16	-17	-17	-15	-16	-16	-15	-15	-15	-15
	8	10	12.42.45	0	-13	-14	-14	-14	-13	-13	-14	-13	-13	-13	-14	-13	-13	-13	-13
	8	11	12.43.05	0	-11	-11	-11	-11	-11	-11	-11	-10	-10	-10	-10	-9	-9	-10	-10
	8	12	12.43.24	0	-11	-11	-11	-11	-11	-11	-12	-11	-11	-11	-11	-10	-10	-10	-11
	8	13	12.43.32	0	-12	-12	-12	-12	-12	-11	-12	-12	-11	-11	-12	-11	-11	-11	-12
	8	14	12.43.48	0	-13	-15	-14	-12	-13	-14	-14	-13	-12	-13	-14	-12	-11	-12	-13
	8	15	12.44.18	0	-9	-9	-8	-8	-9	-9	-9	-9	-9	-9	-9	-8	-8	-8	-8
	8	16	12.44.36	0	-13	-14	-14	-14	-12	-13	-13	-13	-11	-12	-13	-11	-11	-12	-12
	8	17	12.44.47	0	-14	-15	-15	-16	-14	-14	-14	-14	-13	-14	-15	-14	-14	-13	-14
	8	18	12.45.01	0	-19	-19	-19	-19	-18	-18	-18	-18	-17	-17	-19	-16	-16	-17	-18
	8	19	12.45.30	0	-12	-13	-12	-12	-12	-12	-12	-12	-11	-12	-12	-11	-11	-11	-11
	8	20	12.46.04	0	-12	-13	-13	-13	-12	-12	-12	-12	-11	-12	-12	-11	-11	-12	-12
	8	21	12.46.26	0	-9	-9	-9	-9	-8	-8	-9	-9	-8	-9	-9	-8	-8	-8	-8
	8	22	12.46.58	0	-8	-8	-8	-8	-9	-10	-10	-9	-10	-10	-10	-9	-8	-9	-10
CASE 4	2	14	11.05.35	0	-10	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-10	-10	-10	-10
	2	15	11.05.40	0	-10	-10	-10	-10	-10	-10	-11	-10	-10	-10	-11	-10	-9	-9	-9
	2	16	11.05.45	0	-8	-8	-8	-8	-8	-8	-9	-8	-8	-8	-8	-8	-8	-7	-8
	2	17	11.05.50	0	-8	-7	-7	-7	-7	-7	-8	-8	-8	-7	-8	-7	-7	-7	-7
	2	18	11.05.55	0	-7	-7	-7	-7	-7	-7	-8	-8	-8	-7	-8	-7	-7	-7	-7
	2	19	11.06.00	0	-7	-7	-7	-7	-7	-7	-8	-8	-8	-7	-7	-7	-7	-7	-7
	2	20	11.06.05	0	-8	-8	-8	-9	-8	-8	-8	-9	-8	-8	-9	-8	-7	-8	-8
	2	21	11.06.10	0	-9	-9	-10	-10	-9	-9	-10	-9	-9	-9	-10	-9	-9	-9	-9
	2	22	11.06.15	0	-9	-9	-10	-10	-9	-9	-10	-10	-9	-9	-10	-9	-9	-9	-9
	2	23	11.06.20	0	-10	-10	-10	-10	-10	-10	-10	-10	-9	-10	-11	-10	-9	-10	-10
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	2	25	11.06.30	0	-9	-9	-9	-9	-9	-9	-9	-9	-8	-9	-9	-8	-8	-8	-8
	2	26	11.06.35	0	-8	-9	-9	-9	-9	-8	-9	-8	-8	-8	-8	-7	-7	-7	-8
	2	27	11.06.40	0	-8	-8	-8	-8	-8	-8	-8	-8	-8	-7	-8	-7	-7	-7	-7
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	2	30	11.06.55	0	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-11	-10	-9	-9	-10
	2	31	11.06.59	0	-11	-11	-12	-12	-11	-11	-11	-11	-11	-11	-12	-11	-10	-10	-11
	2	32	11.07.05	0	-10	-11	-11	-12	-10	-10	-11	-10	-10	-10	-11	-10	-9	-10	-10
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	2	34	11.07.15	0	-11	-12	-12	-13	-11	-11	-12	-12	-11	-11	-12	-11	-10	-10	-11
	2	35	11.07.20	0	-11	-11	-11	-11	-10	-11	-11	-11	-10	-11	-11	-10	-9	-9	-10
	2	36	11.07.25	0	-10	-10	-9	-9	-9	-9	-10	-9	-9	-9	-9	-9	-9	-9	-9
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	2	40	11.07.45	0	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-7	-7	-7	-8
	2	41	11.07.53	0	-7	-8	-8	-8	-8	-8	-8	-8	-7	-7	-8	-7	-7	-7	-7
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	2	44	11.08.05	0	-7	-7	-7	-7	-7	-7	-8	-7	-7	-7	-7	-6	-6	-6	-7
	2	1	11.08.10	0	-8	-8	-8	-8	-8	-8	-8	-8	-7	-7	-7	-7	-7	-7	-7
	2	2	11.08.15	0	-8	-8	-8	-8	-8	-8	-8	-8	-7	-7	-8	-7	-7	-7	-7
	2	3	11.08.20	0	-8	-8	-8	-8	-8	-8	-9	-8	-8	-8	-8	-7	-8	-8	-8
	2	4	11.08.25	0	-8	-8	-8	-8	-8	-8	-9	-8	-8	-8	-8	-7	-7	-7	-7
	2	5	11.08.30	0	-7	-7	-7	-8	-7	-7	-8	-8	-8	-7	-8	-7	-7	-7	-7
	2	6	11.08.35	0	-7	-7	-7	-7	-7	-7	-7	-8	-8	-7	-8	-7	-7	-7	-7
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C1	C2	C3	C4	C5	C6	C7	C8	C9	C11	C12	C13	C14	C15
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D1	D2	D3	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	P_1	CAVITY PRES. A	B	C
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	FILM No.	POSE	TIME	REF. P	WIND PRESSURES in Pa														
					A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CASE 5	10	12	9.40.52	0	7	3	-1	1	15	15	9	5	20	17	13	24	22	17	12
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	10	14	9.41.05	0	15	13	10	10	18	17	13	14	19	18	15	19	17	13	11
	10	15	9.41.10	0	13	13	10	9	15	14	12	11	14	12	10	13	11	8	7
	10	16	9.41.20	0	13	13	11	9	16	14	12	12	14	13	11	14	12	8	7
	10	18	9.41.30	0	21	19	13	15	29	27	21	22	30	29	24	32	28	19	16
	10	19	9.41.35	0	16	14	9	10	19	19	14	15	20	20	15	20	18	13	10
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	10	21	9.41.45	0	15	13	10	11	21	21	18	18	25	25	20	28	28	22	17
	10	22	9.41.50	0	13	8	3	7	22	23	16	13	29	26	20	37	34	28	21
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	10	24	9.42.01	0	17	15	11	12	27	28	22	21	33	33	27	39	36	30	24
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CASE 6	11	1	9.47.25	0	21	19	13	15	28	27	21	22	30	28	24	30	28	23	19
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C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
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Case	FILE NO.	PASS	TIME	REF. P	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
					WIND PRESSURES in Pa														
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CASE 8	17	27	14.12.47	0	25	22	16	16	29	26	21	22	28	26	21	25	19	12	11
CASE 8	17	28	14.13.01	0	19	17	13	13	21	22	18	19	23	22	18	20	17	11	10
CASE 8	17	29	14.13.21	0	10	9	6	6	11	12	9	10	12	12	10	12	10	8	6
CASE 8	17	30	14.13.38	0	10	9	6	6	10	9	7	8	10	9	7	9	8	13	14
CASE 8	17	31	14.14.04	0	14	13	10	10	18	19	15	15	20	21	17	21	20	16	13
CASE 8	17	32	14.14.34	0	22	18	12	15	29	27	20	22	32	30	25	32	28	20	17
CASE 7	18	1	14.20.11	0	14	11	7	9	19	14	14	14	23	21	18	25	23	19	16
CASE 7	18	2	14.20.18	0	10	9	5	6	15	15	11	11	18	17	14	19	18	15	12
CASE 7	18	3	14.20.33	0	7	6	4	4	10	8	6	7	11	9	8	12	11	8	7
CASE 7	18	4	14.20.55	0	11	11	8	8	16	16	11	12	17	16	13	17	15	11	8
CASE 7	18	5	14.21.16	0	8	7	4	5	11	12	7	8	13	12	9	14	14	10	7
CASE 15	16	43	13.35.35	0	22	21	16	17	29	28	24	25	30	29	26	28	24	20	17
CASE 15	16	44	13.35.45	0	23	18	13	15	30	29	22	23	34	30	25	36	31	23	20
CASE 15	16	1	13.35.55	0	25	22	15	19	36	34	27	29	35	38	31	42	38	28	23
CASE 15	16	2	13.36.05	0	17	15	11	13	23	23	28	29	26	25	21	28	26	21	18
CASE 15	16	3	13.36.15	0	22	20	15	16	28	26	22	23	29	27	24	29	25	18	16
CASE 15	16	4	13.36.25	0	15	14	11	12	20	20	17	17	22	22	18	22	20	15	11
CASE 15	16	5	13.36.35	0	33	30	23	23	36	33	26	27	34	30	23	27	20	11	11
CASE 15	16	6	13.36.45	0	33	30	22	23	40	37	30	30	39	37	30	36	30	20	17
CASE 15	16	7	13.36.55	0	15	13	8	9	21	22	16	14	26	23	18	28	27	21	17
CASE 15	16	8	13.37.05	0	12	10	6	7	18	18	13	13	20	20	15	23	22	18	15
CASE 15	16	9	13.37.15	0	13	12	8	9	21	20	16	14	24	23	19	26	26	21	15
CASE 15	16	10	13.37.25	0	14	12	9	10	18	19	15	14	21	20	17	21	21	17	13
CASE 15	16	11	13.37.35	0	9	7	5	6	13	14	10	9	16	16	12	18	19	16	12
CASE 15	16	12	13.37.45	0	10	8	5	6	12	11	9	9	14	13	10	14	14	11	9
CASE 15	16	13	13.37.55	0	9	9	6	6	14	14	11	10	15	16	12	17	18	15	11
CASE 15	16	14	13.38.05	0	13	10	6	7	16	15	10	11	18	17	12	18	16	11	8
CASE 15	16	15	13.38.15	0	8	7	4	5	12	12	8	9	13	14	10	15	14	10	7
CASE 15	16	16	13.38.25	0	3	3	1	2	5	5	3	4	6	5	4	6	7	5	4
CASE 15	16	17	13.38.35	0	9	6	4	6	14	13	9	10	15	14	12	18	16	12	9
CASE 15	16	18	13.38.45	0	14	12	8	10	22	21	16	17	25	24	20	28	26	21	16
CASE 15	16	19	13.38.55	0	20	15	10	12	29	26	20	19	33	30	24	38	34	38	33
CASE 15	16	20	13.39.05	0	16	14	10	12	24	23	18	19	29	26	22	31	28	24	19
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CASE 15	16	22	13.39.21	0	37	31	20	23	48	44	32	34	49	45	37	47	39	28	23
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CASE 15	16	24	13.39.35	0	27	22	14	17	35	31	23	25	35	31	26	33	27	19	17
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CASE 15	16	27	13.40.00	0	26	22	17	18	32	29	24	25	32	29	24	29	25	19	15
CASE 15	16	28	13.40.15	0	28	26	18	19	34	34	27	27	35	33	27	31	27	20	17
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CASE 15	16	30	13.40.35	0	17	15	13	13	21	21	19	19	24	22	21	23	22	19	16
CASE 15	16	31	13.40.45	0	17	16	12	13	21	21	17	18	22	21	18	21	23	14	13

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Case	FILE NO.	POSE	TIME	REF. P	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CASE 11	15	26	13.22.19	0	7	6	4	4	11	12	9	8	13	14	11	15	16	15	12
	15	27	13.22.39	0	15	13	9	9	15	15	11	11	14	13	11	13	11	8	7
	15	28	13.23.00	0	9	8	5	6	12	11	8	9	12	11	8	12	10	6	5
	15	29	13.23.12	0	15	12	8	10	22	22	16	17	27	24	19	30	25	17	14
	15	30	13.23.18	0	11	10	5	7	21	21	14	14	27	24	18	32	23	21	16
	15	31	13.23.51	0	17	14	9	10	22	21	15	16	24	22	17	23	21	17	12
	15	32	13.24.17	0	13	11	8	7	15	14	10	11	15	15	11	15	13	10	8
	15	33	13.24.34	0	29	26	20	20	33	32	26	27	31	30	25	26	23	15	14
	15	34	13.24.40	0	30	28	21	21	34	34	29	28	33	33	27	29	25	15	13
	15	35	13.24.53	0	18	17	13	13	22	21	17	18	21	20	17	19	16	13	11
	15	36	13.25.13	0	15	13	10	10	16	16	13	14	15	15	12	13	12	8	7
CASE 14	15	37	13.26.43	0	22	18	12	13	26	24	17	18	25	23	18	22	20	13	11
	15	38	13.26.51	0	23	18	13	14	28	27	21	21	29	27	22	28	24	18	15
	15	39	13.27.02	0	20	16	12	15	27	27	22	22	32	30	26	35	31	25	20
	15	40	13.27.11	0	23	19	14	16	29	28	22	23	31	29	24	30	26	22	19
	15	41	13.27.22	0	34	32	25	25	41	41	34	35	41	40	35	37	33	25	22
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	15	43	13.27.40	0	36	30	22	24	43	39	30	33	43	39	32	38	32	21	19
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	15	2	13.28.19	0	22	19	15	16	29	28	23	23	32	32	26	33	31	25	20
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	15	4	13.28.35	0	22	18	12	14	27	27	20	21	29	28	22	29	26	21	16
	15	5	13.28.50	0	15	14	10	11	21	21	15	16	23	22	17	23	21	14	11
	15	6	13.29.00	0	13	12	8	9	21	19	16	16	24	23	18	28	25	18	15
CASE 15	17	1	13.45.30	0	7	6	5	6	11	11	8	9	12	12	10	13	12	11	9
	17	2	13.45.45	0	7	6	3	5	12	12	8	8	15	14	10	19	17	13	11
	17	3	13.45.55	0	18	17	12	13	25	25	20	20	28	27	23	29	26	22	17
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	17	6	13.46.25	0	9	8	6	6	12	12	9	10	13	13	10	14	13	10	7
	17	7	13.46.36	0	12	10	7	7	15	13	9	10	14	13	10	13	11	8	7
	17	8	13.46.51	0	5	4	3	4	8	8	6	6	9	9	7	10	10	8	6
	17	9	13.47.01	0	10	9	5	7	17	16	12	12	19	18	14	22	20	17	12
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	17	13	13.48.03	0	10	8	6	6	12	13	9	9	13	13	9	13	11	9	7
CASE 9	17	14	14.04.49	0	27	25	19	19	33	32	26	27	34	33	28	32	27	19	15
	17	15	14.05.10	0	20	17	14	13	23	21	18	18	21	21	17	20	17	12	10
	17	16	14.05.22	0	14	13	9	9	17	16	14	13	17	16	14	16	13	10	8
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	17	18	14.06.12	0	17	16	11	12	21	20	16	16	21	20	16	19	17	11	10
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	17	20	14.07.35	0	17	15	11	12	21	20	16	17	23	21	17	21	18	13	10
	17	21	14.09.26	0	18	17	12	11	21	20	15	16	20	18	14	17	14	6	6
	17	22	14.10.00	0	25	22	14	16	33	31	23	24	36	33	27	36	30	21	17
	17	23	14.10.14	0	25	24	17	19	34	34	27	28	38	36	29	39	34	24	19
	17	24	14.10.37	0	23	22	17	18	29	29	24	25	31	30	26	31	28	22	18
	17	25	14.11.16	0	13	11	7	9	18	17	13	14	20	18	15	21	19	16	12

WIND PRESSURES in Pa

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16
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															CAVITY PRES.			
D1	D2	D3	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	P_1	A	B	C	D
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-12	-14	-8	-13	-14	-12	-13	-11	-12	-12	-11	-11	-11	-11	-2	3	3	3	3

	FILM No.	POSE	TIME	REF. P	PRESSURES in Pa														
					A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CASE 13	18	34	14.35.55	0	23	19	14	14	26	24	19	20	25	23	19	21	18	11	10
	18	35	14.36.05	0	13	10	7	8	18	17	13	13	20	19	15	21	19	15	12
	18	36	14.36.13	0	18	17	13	13	25	24	19	19	27	25	20	26	23	18	15
	18	37	14.36.20	0	44	39	26	29	60	56	42	43	59	57	44	57	48	33	27
	18	38	14.36.25	0	38	36	28	29	46	47	38	39	49	47	39	46	39	28	24
	18	39	14.36.33	0	30	29	24	24	36	38	33	34	39	39	34	37	33	26	22

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16
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-10	-11	-9	-7	-9	-7	-8	-7	-7	-6	-7	-7	-7	-8	-8	-8
-14	-16	-13	-8	-10	-8	-8	-6	-6	-5	-5	-6	-6	6	-6	-7
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C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
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-10	-10	-9	-9	-10	-11	-11	-8	-10	-12	-10	-12	-12	-13	-11

D1	D2	D3	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	P_1	CAVITY PRES. A	B	C	D
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-11	-11	-10	-17	-17	-19	-18	-16	-23	-23	-20	-23	-23	-24	-5	-2	-1	-1	1
-14	-15	-10	-18	-19	-19	-19	-16	-20	-20	-18	-19	-19	-19	-5	-1	0	0	2
-13	-14	-10	-18	-19	-19	-19	-16	-19	-19	-18	-18	-18	-19	-4	1	2	2	4
-20	-23	-17	-27	-28	-27	-27	-25	-26	-26	-26	-24	-24	-25	-7	1	3	3	6
-20	-20	-16	-27	-29	-27	-27	-25	-27	-27	-27	-25	-24	-27	-8	0	3	2	5
-17	-18	-12	-26	-27	-26	-27	-23	-28	-28	-28	-25	-26	-28	-6	1	3	2	5

CASE 16

WIND PRESSURES in Pa

FILM No.	POSE	TIME	REF. P	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	41	11.30.15	0	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-9	-9	-9	-9
4	42	11.30.20	0	-11	-11	-11	-11	-10	-11	-11	-11	-10	-11	-11	-10	-9	-9	-10
4	43	11.30.25	0	-11	-11	-11	-11	-11	-11	-11	-11	-10	-11	-11	-10	-9	-9	-10
4	44	11.30.30	0	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-9	-10	-10	-10
4	1	11.30.35	0	-11	-11	-11	-11	-11	-12	-11	-11	-11	-11	-11	-10	-10	-10	-10
4	2	11.30.40	0	-11	-11	-11	-11	-11	-11	-11	-11	-10	-11	-11	-10	-10	-10	-10
4	3	11.30.45	0	-11	-11	-11	-11	-10	-10	-11	-11	-10	-10	-11	-10	-10	-10	-10
4	4	11.30.50	0	-9	-9	-9	-9	-9	-9	-10	-9	-9	-9	-9	-10	-9	-9	-10
4	5	11.30.55	0	-9	-9	-9	-9	-9	-8	-9	-9	-8	-8	-9	-9	-8	-8	-9
4	6	11.31.00	0	-8	-8	-8	-8	-7	-7	-8	-8	-7	-7	-8	-8	-8	-8	-8
4	7	11.31.05	0	-7	-7	-7	-8	-7	-7	-8	-8	-7	-7	-8	-7	-7	-7	-7
4	8	11.31.10	0	-9	-9	-9	-9	-9	-8	-9	-9	-8	-8	-9	-7	-7	-7	-7
4	9	11.31.15	0	-9	-9	-9	-9	-8	-8	-9	-8	-8	-8	-8	-8	-7	-7	-8
4	10	11.31.20	0	-10	-10	-10	-10	-9	-9	-10	-9	-9	-9	-10	-7	-7	-7	-8
4	11	11.31.26	0	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-10	-10	-10	-10
4	12	11.31.30	0	-12	-12	-12	-12	-12	-12	-13	-13	-12	-12	-13	-12	-11	-12	-12
4	13	11.31.35	0	-13	-13	-13	-13	-13	-13	-14	-13	-13	-13	-13	-12	-12	-13	-13
4	14	11.31.40	0	-11	-11	-11	-12	-11	-11	-12	-12	-11	-11	-12	-11	-11	-3	-11
4	15	11.31.45	0	-10	-10	-10	-10	-9	-9	-10	-10	-10	-10	-10	-9	-9	-9	-9
4	16	11.31.50	0	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-9	-9	-10
4	17	11.31.55	0	-10	-10	-10	-11	-9	-10	-10	-11	-10	-10	-10	-9	-9	-9	-9
4	18	11.32.01	0	-9	-10	-10	-10	-9	-9	-9	-10	-9	-9	-10	-9	-8	-8	-9
4	19	11.32.05	0	-10	-11	-11	-11	-9	-10	-10	-10	-9	-10	-10	-9	-9	-9	-9
4	20	11.32.10	0	-10	-10	-10	-11	-10	-10	-10	-10	-10	-10	-10	-9	-9	-9	-9
4	21	11.32.15	0	-10	-10	-10	-10	-10	-10	-10	-10	-9	-9	-10	-9	-9	-9	-9
4	22	11.32.20	0	-9	-9	-9	-10	-9	-9	-10	-10	-10	-10	-10	-9	-9	-9	-9
4	23	11.32.25	0	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-8	-8	-8
4	24	11.32.30	0	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-10	-9	-8	-8	-8
4	25	11.32.35	0	-11	-11	-10	-10	-10	-11	-11	-11	-4	-11	-11	-10	-10	-10	-10
4	26	11.32.40	0	-11	-11	-10	-10	-11	-11	-11	-11	-11	-11	-11	-10	-10	-10	-10
4	27	11.32.45	0	-9	-10	-9	-9	-9	-10	-10	-10	-9	-10	-10	-9	-9	-9	-9
4	28	11.32.50	0	-8	-8	-8	-8	-8	-8	-9	-9	-9	-9	-9	-8	-8	-8	-8
4	29	11.32.55	0	-8	-8	-8	-9	-8	-8	-9	-8	-8	-8	-8	-8	-7	-7	-8
4	30	11.33.00	0	-8	-8	-8	-8	-8	-7	-8	-8	-7	-8	-8	-7	-7	-7	-7
4	31	11.33.05	0	-7	-7	-7	-7	-7	-7	-8	-7	-7	-6	-7	-6	-6	-6	-7

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B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	-1	-2	7	4	3	6	5	9	9	11	11	10	13	12
-1	-2	-3	5	2	1	5	2	7	7	8	8	8	10	10
-1	-3	-3	4	2	0	3	2	7	7	8	8	7	10	10
-1	-2	-3	5	2	1	4	3	7	7	8	8	7	10	10
-1	-3	-3	5	2	0	4	2	7	6	8	8	7	10	10
-1	-3	-4	3	1	0	4	2	6	6	7	7	6	8	8
-2	-3	-4	3	1	-1	3	1	6	5	6	6	5	8	8
0	-1	-2	6	3	1	5	3	7	7	8	8	7	9	9
1	0	-2	5	3	2	5	3	7	6	7	7	6	7	7
0	-1	-2	4	2	2	3	2	5	5	6	6	4	5	5
0	-1	-2	3	2	1	3	2	5	4	5	5	4	4	4
2	1	0	6	4	3	5	5	7	7	7	7	6	6	6
3	2	1	7	6	5	7	7	9	8	9	9	7	8	8
1	0	-1	6	4	3	5	5	7	7	8	8	7	8	7
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-3	-4	-4	2	0	-1	2	0	5	5	6	6	6	8	8
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0	-2	-2	5	2	1	4	3	7	7	8	8	8	10	10
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0	-1	-2	5	3	2	5	3	7	7	8	8	7	8	8
0	-1	-2	4	2	1	3	2	5	5	6	6	5	7	7

C1	C2	C3	C4	C5	C6	C7	C8	C9	C11	C12	C13	C14	C15
0	0	0	0	0	0	0	0	0	0	0	0	0	0
-2	-1	-1	-2	0	-2	-1	-1	0	-2	-4	-5	-8	-6
1	2	1	0	1	-1	0	0	0	-2	-4	-5	8	-6
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0	1	1	0	1	-2	-1	0	-1	-2	-5	-6	-9	-7
0	2	1	0	0	-2	0	0	-1	-2	-5	-6	-9	-7
1	2	1	1	1	-1	0	0	-1	-2	-5	-5	-9	-6
3	4	3	2	2	1	1	1	1	-2	-4	-4	-8	-6
1	2	1	0	1	0	1	1	1	-1	-3	-3	-7	-5
-5	-4	-4	-5	-4	-4	-4	-4	-2	-3	-4	-4	-6	-5
-6	-5	-5	-5	-4	-4	-5	-4	-2	-3	-4	-4	-6	-5
-7	-6	-6	-6	-4	-4	-4	-4	-3	-4	-4	-4	-6	-5
-11	-10	-11	-11	-8	-8	-9	-7	-5	-5	-5	-5	-6	-6
-15	-13	-13	-13	-11	-12	-12	-10	-6	-8	-5	-6	-7	-7
-15	-14	-14	-13	-10	-11	-11	-9	-6	-8	-6	-7	-8	-7
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-6	-4	-5	-5	-2	-3	-3	-2	-1	-3	-6	-6	-10	-7
-7	-5	-6	-6	-2	-4	-4	-3	-1	-3	-4	-5	-7	-6
-9	-8	-8	-8	-4	-5	-6	-5	-3	-4	-5	-6	-8	-7
-9	-7	-7	-7	-4	-4	-4	-3	-2	-3	-4	-5	-7	-6
-8	-6	-5	-5	-2	-2	-2	-1	-1	-2	-4	-4	-6	-5
-10	-9	-9	-8	-4	-4	-4	-3	-1	-3	-4	-4	-6	-5
-12	-11	-11	-10	-5	-6	-7	-6	-2	-4	-5	-5	-7	-6
-5	-4	-4	-4	-1	-2	-2	-2	0	-2	-4	-5	-7	-6
-1	0	-1	-1	0	-1	-1	-1	0	-2	-4	-4	-7	-5
0	0	-1	-1	0	-1	-1	-1	0	-2	-4	-4	-7	-6
3	3	2	0	3	1	1	1	2	-1	-3	-3	-7	-5
4	4	3	2	3	1	1	1	1	-1	-4	-4	-8	-6
4	4	4	3	3	1	2	2	1	0	-4	-4	-7	-5
4	5	4	4	3	1	2	2	1	0	-3	-3	-7	-5
3	5	4	4	3	1	2	2	2	0	-3	-3	-6	-4
1	2	2	3	2	0	1	2	1	0	-3	-3	-6	-4
-3	-2	-2	-2	-1	-1	-1	0	0	-1	-3	-3	-5	-4
-5	-4	-4	-4	-2	-2	-2	-1	-1	-2	-3	-3	-5	-4

D1	D2	D3	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	P_1	CAVITY PRES. A	B	C
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-11	-11	-11	-11	-11	-10	-11	-10	-10	-11	-9	-10	-11	-9	-4	1	1	1
-12	-12	-12	-12	-13	-11	-12	-11	-11	-13	-10	-11	-12	-10	-5	-1	-1	-1
-11	-12	-12	-11	-13	-11	-12	-10	-11	-12	-10	-11	-12	-10	-5	-1	-1	-1
-11	-12	-12	-11	-13	-11	-12	-10	-11	-13	-10	-11	-13	-10	-5	-1	-1	-1
-11	-12	-11	-11	-12	-11	-12	-10	-10	-12	-9	-11	-12	-9	-5	-1	-1	-1
-11	-12	-11	-10	-12	-10	-11	-9	-10	-12	-9	-11	-12	-9	-5	-1	-1	-1
-11	-12	-11	-11	-12	-11	-11	-10	-10	-12	-9	-11	-12	-9	-5	-1	-1	-1
-10	-11	-10	-9	-10	-9	-10	-9	-9	-10	-9	-10	-11	-9	-4	0	0	0
-8	-9	-8	-8	-8	-8	-8	-7	-8	-8	-7	-9	-9	-8	-3	-1	-1	-1
-7	-8	-7	-8	-8	-7	-8	-7	-7	-8	-6	-8	-8	-7	-3	-1	-1	-1
-7	-7	-7	-7	-7	-7	-7	-6	-7	-7	-6	-7	-8	-6	-3	-2	-2	-2
-7	-7	-7	-7	-7	-7	-7	-6	-7	-7	-6	-7	-8	-6	-3	-1	-1	-1
-7	-8	-7	-7	-8	-7	-7	-7	-7	-7	-6	-7	-8	-6	-3	0	0	0
-9	-10	-9	-9	-9	-8	-9	-8	-8	-9	-7	-8	-9	-7	-4	-1	-1	-1
-12	-12	-12	-11	-12	-11	-12	-11	-11	-12	-10	-11	-12	-10	-5	-1	-1	-1
-13	-13	-13	-13	-14	-13	-13	-13	-12	-13	-12	-13	-14	-12	-5	0	0	0
-13	-14	-14	-13	-14	-13	-14	-13	-13	-14	-12	-14	-14	-12	-5	1	1	1
-12	-12	-12	-12	-13	-11	-13	-11	-11	-13	-10	-12	-13	-11	-5	0	0	0
-10	-10	-9	-9	-10	-9	-9	-8	-9	-10	-8	-10	-10	-8	-4	0	0	0
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-8	-9	-8	-8	-9	-8	-8	-7	-8	-8	-7	-8	-9	-7	-4	-1	-1	-1
-8	-8	-8	-7	-8	-7	-7	-7	-7	-8	-7	-8	-8	-7	-3	1	1	1
-8	-8	-8	-7	-8	-7	-6	-7	-7	-8	-6	-8	-9	-7	-2	1	1	1
-9	-10	-9	-9	-10	-9	-9	-8	-8	-9	-7	-9	-10	-8	-3	0	0	0
-10	-11	-10	-9	-11	-9	-10	-9	-9	-10	-8	-10	-10	-8	-4	0	0	0
-10	-11	-10	-9	-10	-9	-10	-9	-9	-10	-8	-10	-11	-8	-4	0	0	0
-10	-11	-10	-9	-10	-9	-10	-9	-9	-10	-8	-10	-10	-8	-4	0	0	0
-10	-11	-10	-10	-10	-10	-10	-9	-10	-10	-8	-10	-11	-8	-4	-1	-1	-1
-11	-12	-11	-11	-12	-11	-11	-11	-11	-12	-10	-12	-12	-10	-5	-2	-2	-2
-11	-12	-11	-11	-11	-11	-11	-11	-11	-12	-10	-12	-12	-10	-5	-2	-2	-2
-10	-11	-10	-10	-10	-10	-10	-9	-10	-11	-9	-10	-11	-9	-4	-1	-1	-1
-8	-9	-8	-8	-9	-8	-9	-8	-9	-9	-7	-9	-10	-7	-3	0	0	0
-8	-9	-8	-8	-9	-8	-8	-7	-8	-9	-7	-9	-9	-7	-3	0	0	0
-7	-8	-7	-7	-8	-7	-7	-6	-7	-8	-5	-7	-8	-6	-3	0	0	0
-6	-7	-6	-6	-7	-6	-7	-6	-6	-7	-5	-7	-7	-6	-3	0	0	0

WIND PRESSURES in Pa

CASE	FILM No.	POSE	TIME	RET. P	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CASE 17	6	9	11.56.30	0	-9	-9	-9	-10	-9	-10	-10	-10	-9	-9	-10	-9	-8	-8	-9
	6	10	11.56.36	0	-8	-8	-7	-7	-7	-8	-8	-8	-7	-7	-8	-7	-7	-7	-7
	6	11	11.56.40	0	-10	-10	-9	-9	-9	-9	-10	-9	-9	-9	-9	-8	-8	-9	-9
	6	12	11.56.45	0	-13	-14	-14	-13	-13	-13	-13	-13	-13	-13	-14	-13	-12	-12	-13
	6	13	11.56.50	0	-13	-14	-14	-13	-12	-13	-13	-13	-12	-12	-12	-11	-11	-11	-11
	6	14	11.56.56	0	-11	-11	-11	-11	-10	-10	-11	-11	-10	-10	-11	-10	-10	-10	-10
	6	15	11.57.00	0	-12	-12	-12	-12	-11	-11	-12	-12	-11	-11	-12	-11	-10	-10	-11
	6	16	11.57.10	0	-12	-12	-13	-12	-11	-12	-12	-12	-11	-11	-12	-11	-10	-10	-10
	6	17	11.57.15	0	-12	-12	-12	-12	-11	-12	-12	-12	-11	-11	-11	-10	-10	-10	-11
	6	18	11.57.20	0	-14	-14	-14	-13	-13	-13	-13	-13	-13	-13	-13	-12	-12	-12	-13
	6	19	11.57.25	0	-12	-12	-12	-11	-11	-11	-12	-11	-11	-11	-11	-10	-10	-10	-11
	6	20	11.57.30	0	-11	-11	-11	-11	-11	-11	-11	-11	-10	-11	-11	-10	-10	-10	-11
	6	21	11.57.35	0	-10	-11	-11	-10	-10	-10	-11	-10	-10	-10	-10	-9	-9	-9	-9
	6	22	11.57.41	0	-10	-11	-11	-10	-9	-10	-11	-10	-9	-9	-10	-8	-8	-8	-9
	6	23	11.57.46	0	-13	-13	-14	-13	-13	-13	-14	-13	-13	-13	-13	-12	-12	-12	-12
	6	24	11.57.52	0	-19	-19	-19	-20	-19	-18	-19	-19	-18	-18	-18	-17	-17	-17	-17
	6	25	11.58.01	0	-22	-23	-24	-24	-22	-22	-23	-22	-21	-22	-22	-21	-21	-20	-20
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-15	-16	-15	-15	-17	-15	-17	-14	-14	-18	-13	-16	-18	-12	-5	5	5	5
-13	-14	-14	-14	-15	-14	-15	-13	-13	-16	-11	-14	-16	2	-5	0	0	0
-17	-18	-17	-17	-19	-17	-19	-18	-17	-20	-15	-18	-20	-14	-7	1	1	1
-10	-11	-10	-10	-12	-10	-11	-9	-9	-12	-8	-10	-11	-8	-4	0	0	0
-15	-16	-15	-15	-16	-15	-16	-14	-14	-17	-13	-15	-16	-13	-4	7	7	7
-17	-18	-17	-17	-18	-16	-18	-15	-16	-19	-14	-17	-19	-14	-5	6	6	6
-16	-16	-16	-16	-18	-16	-17	-16	-16	-19	-14	-18	-19	-14	-3	10	10	10
-18	-19	-19	-19	-22	-19	-21	-19	-19	-23	-16	-21	-23	-15	-7	1	1	1
-14	-14	-14	-14	-15	-14	-15	-15	-14	-16	-13	-16	-17	-12	-5	2	2	2

APPENDIX C

WIND AND CAVITY PRESSURE PROFILES RECORDED BY MULTIMANOMETER AROUND EXPERIMENTAL STATION

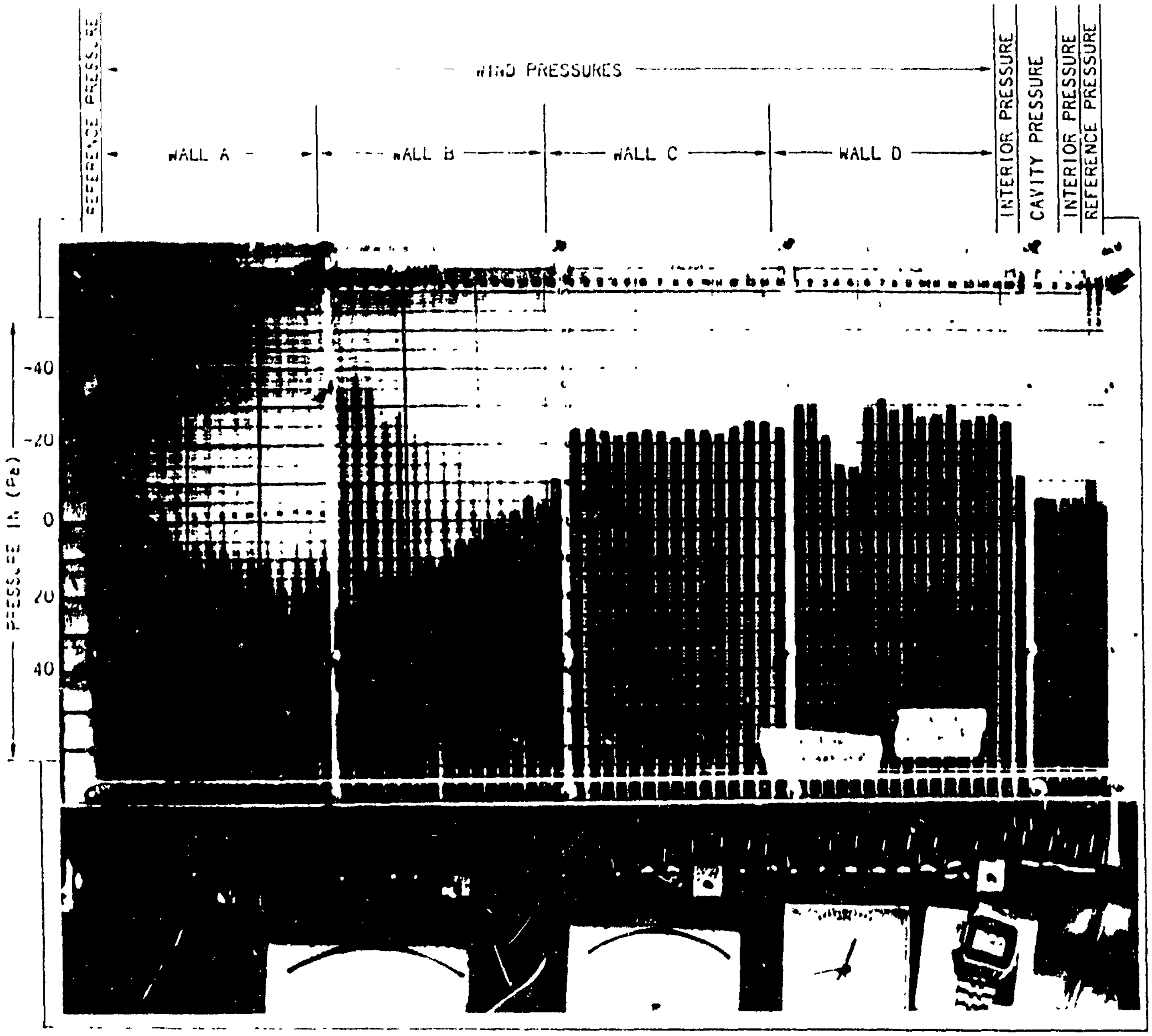

Figure A.1 Wind and cavity pressure profile around building with vent holes closed (Table 4.1, case 1, experiment 8)

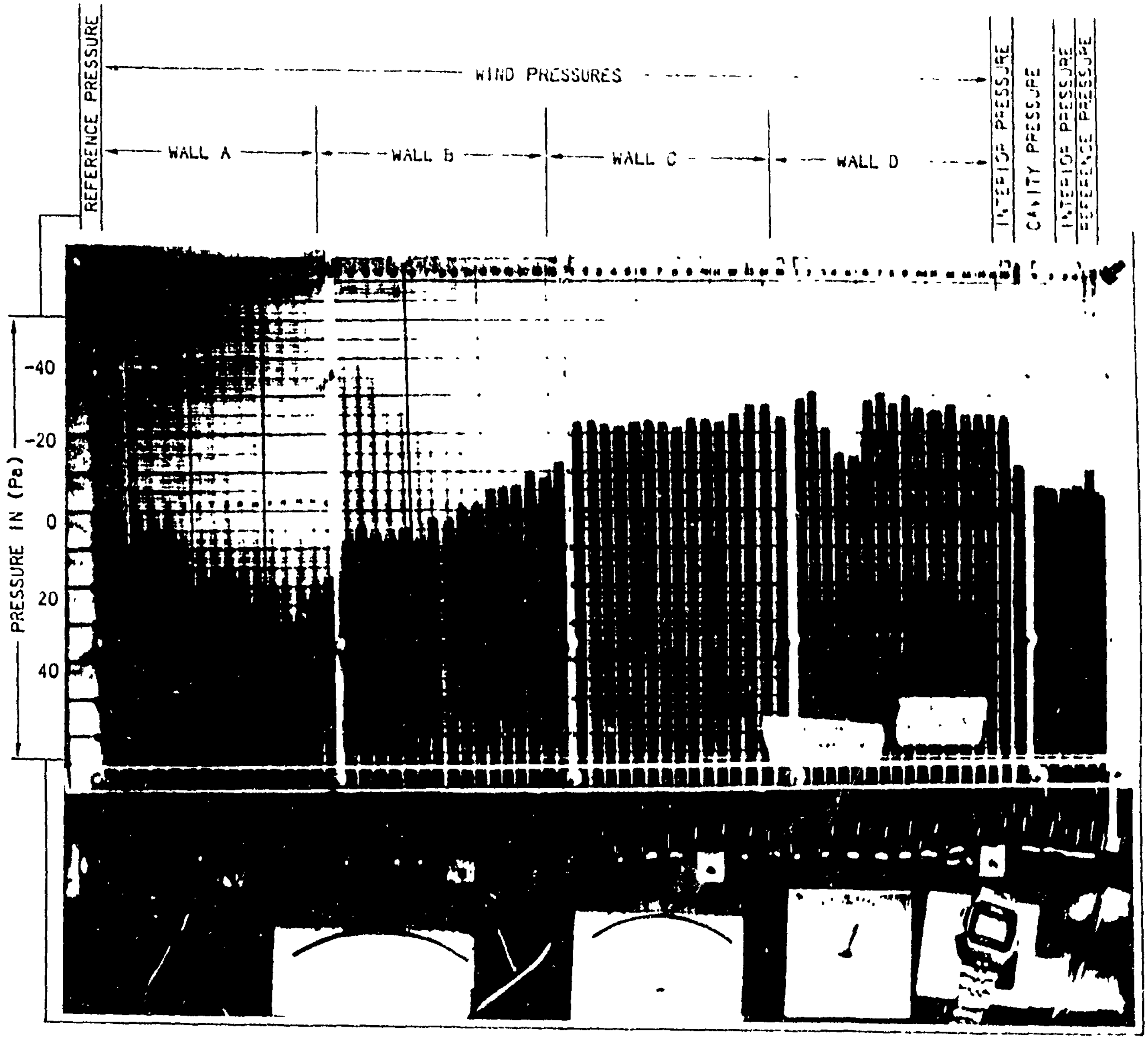

Figure A.2 Wind and cavity pressure profile around building with vent holes closed (Table 4.1, case 1, experiment 12)

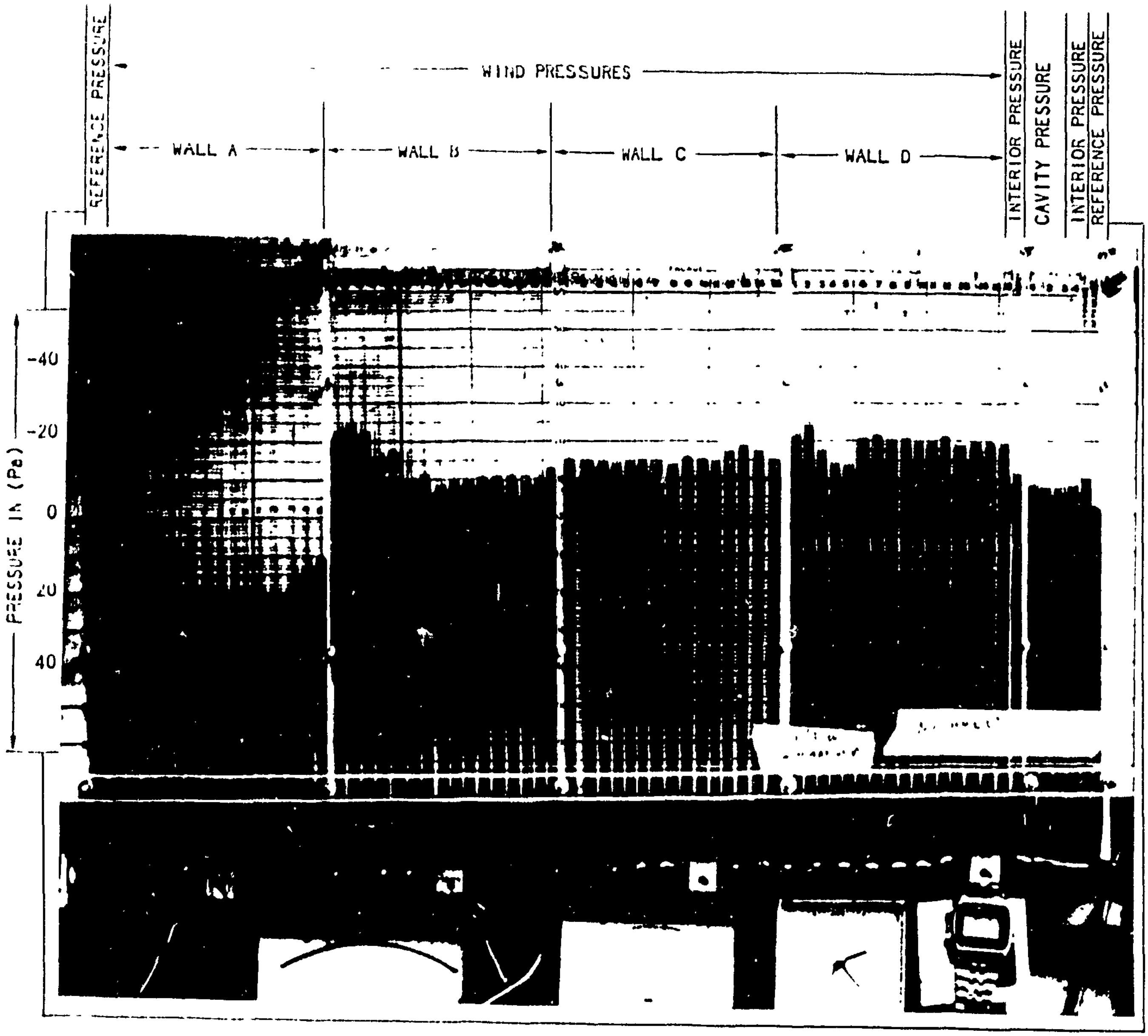

Figure A.3 Wind and cavity pressure profile around building with vent holes closed (Table 4.1, case 2-3, experiment 2)

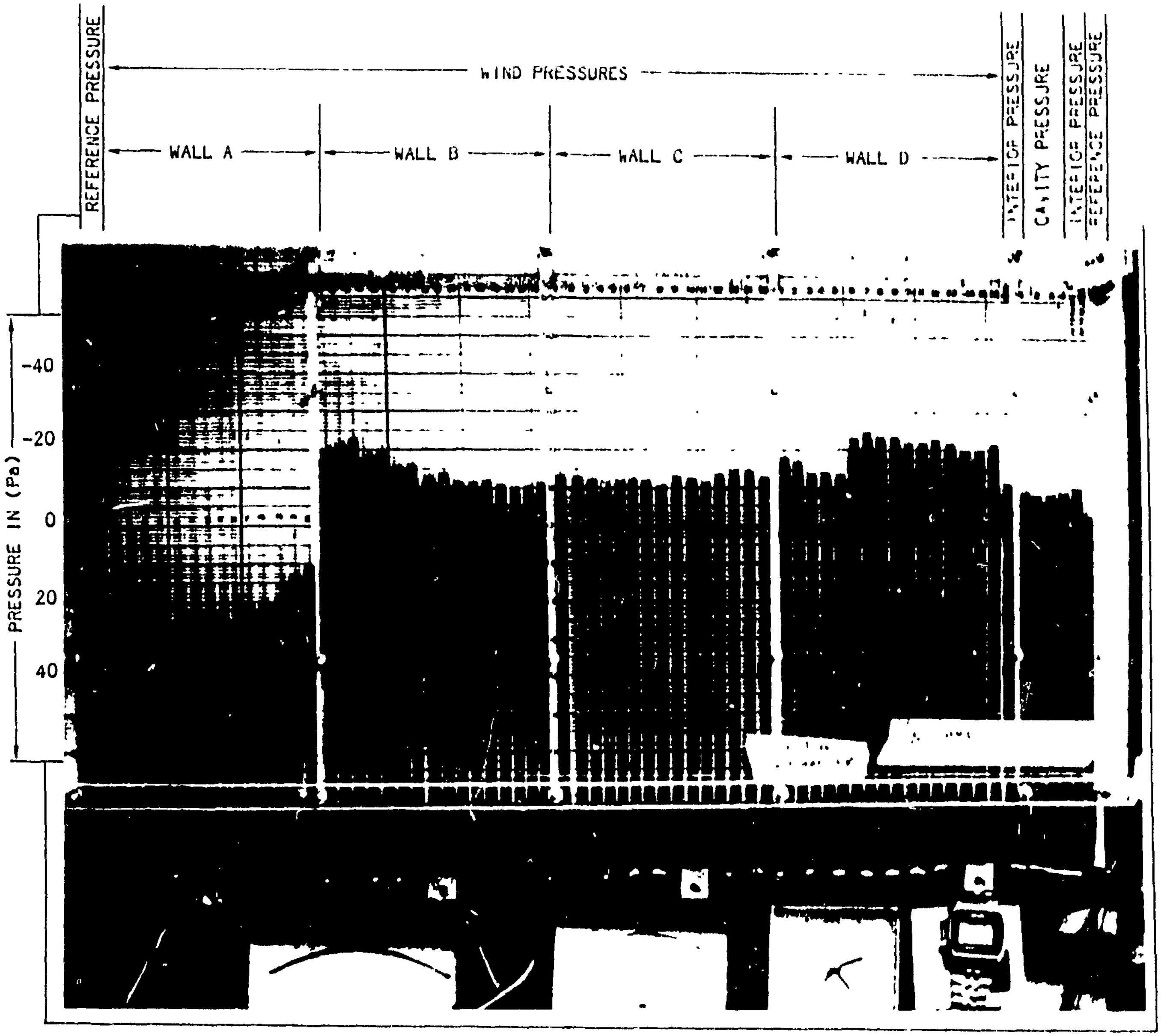

Figure A.4 Wind and cavity pressure profile around building with vent holes closed (Table 4.1, case 2-3, experiment 4)

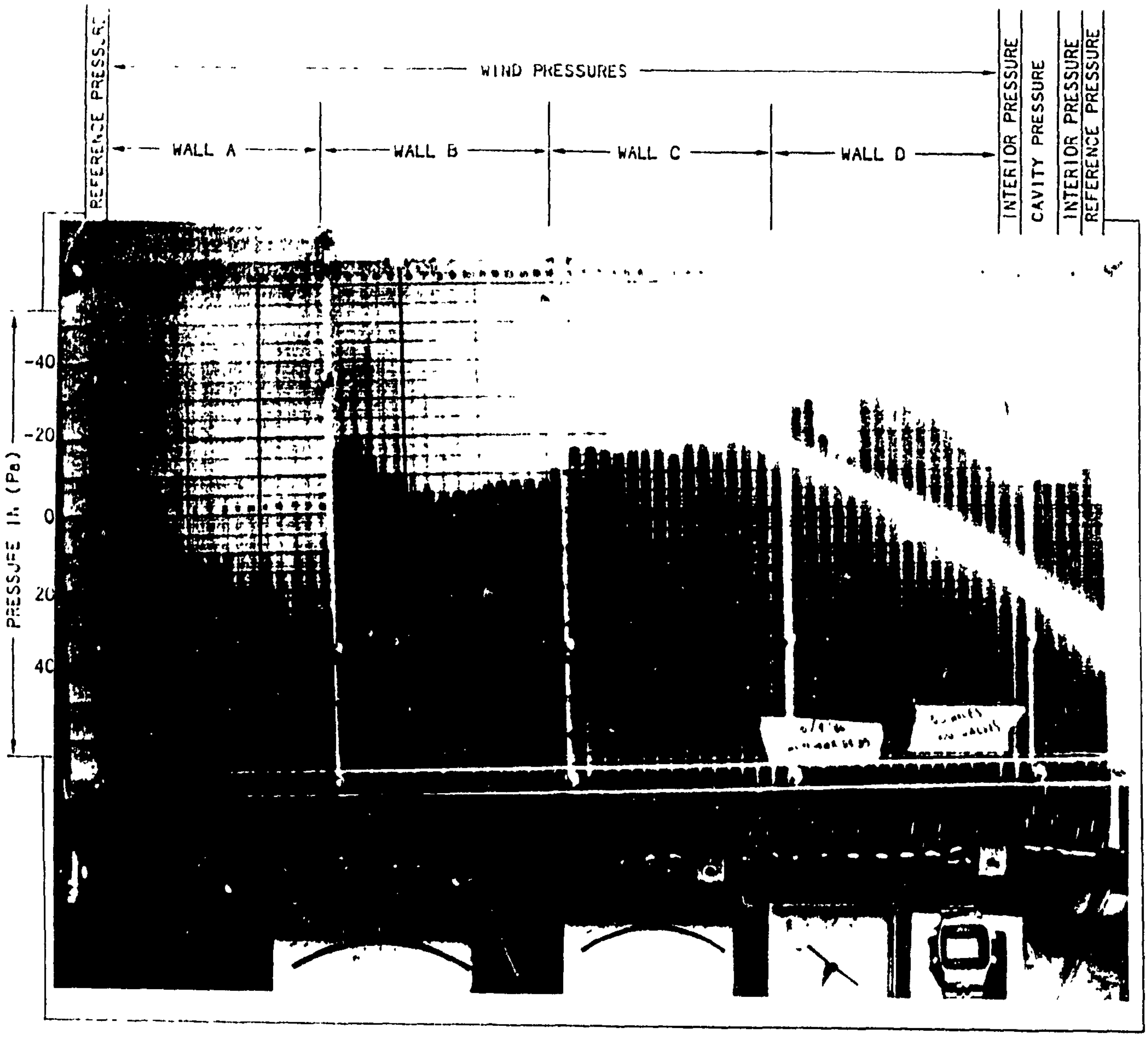

Figure A.5 Wind and cavity pressure profile around building with vent holes closed (Table 4.1, case 2-3, experiment 5)

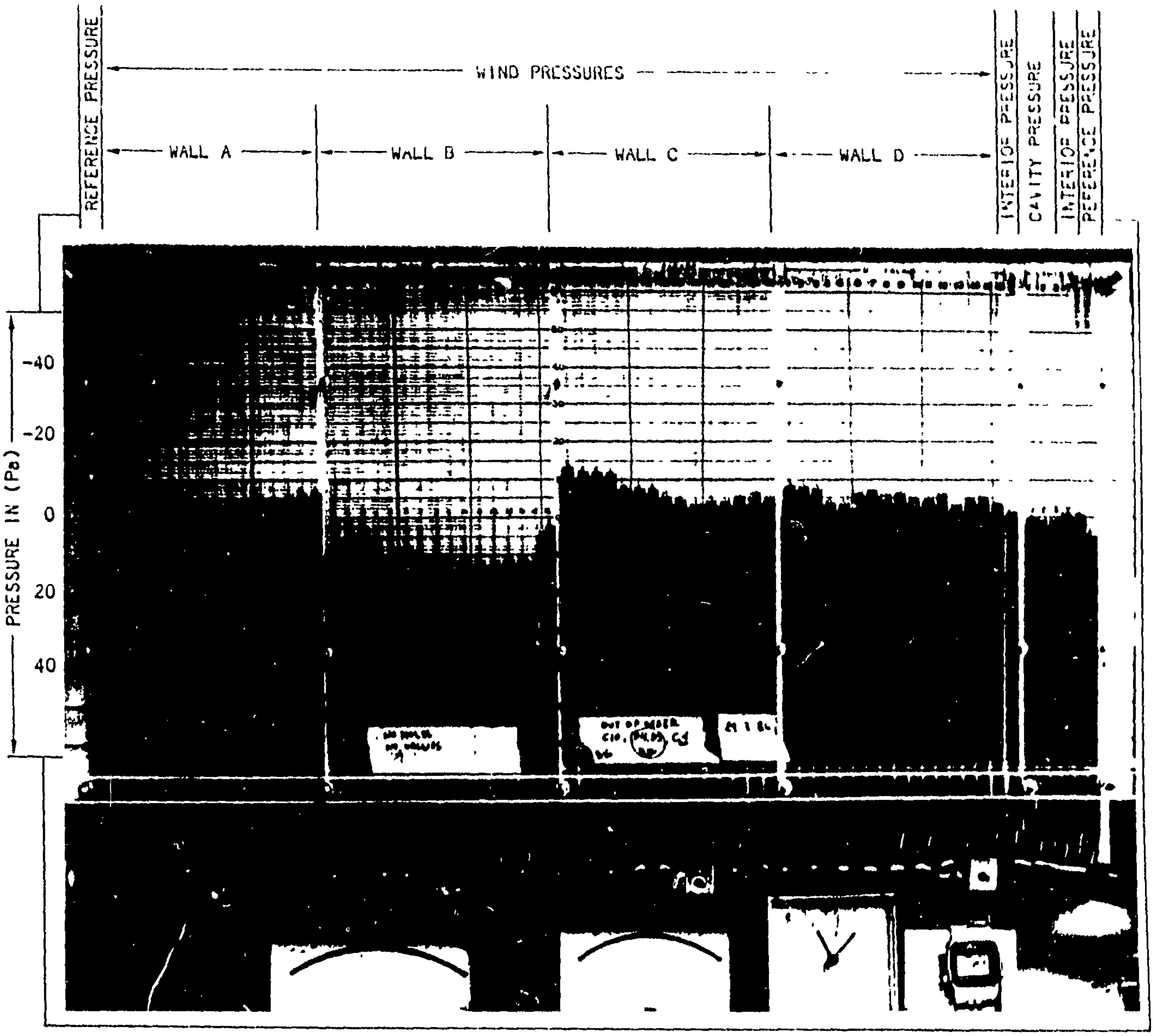

Figure A.6 Wind and cavity pressure profile around building with vent holes closed (Table 4.1, case 4, experiment 19)

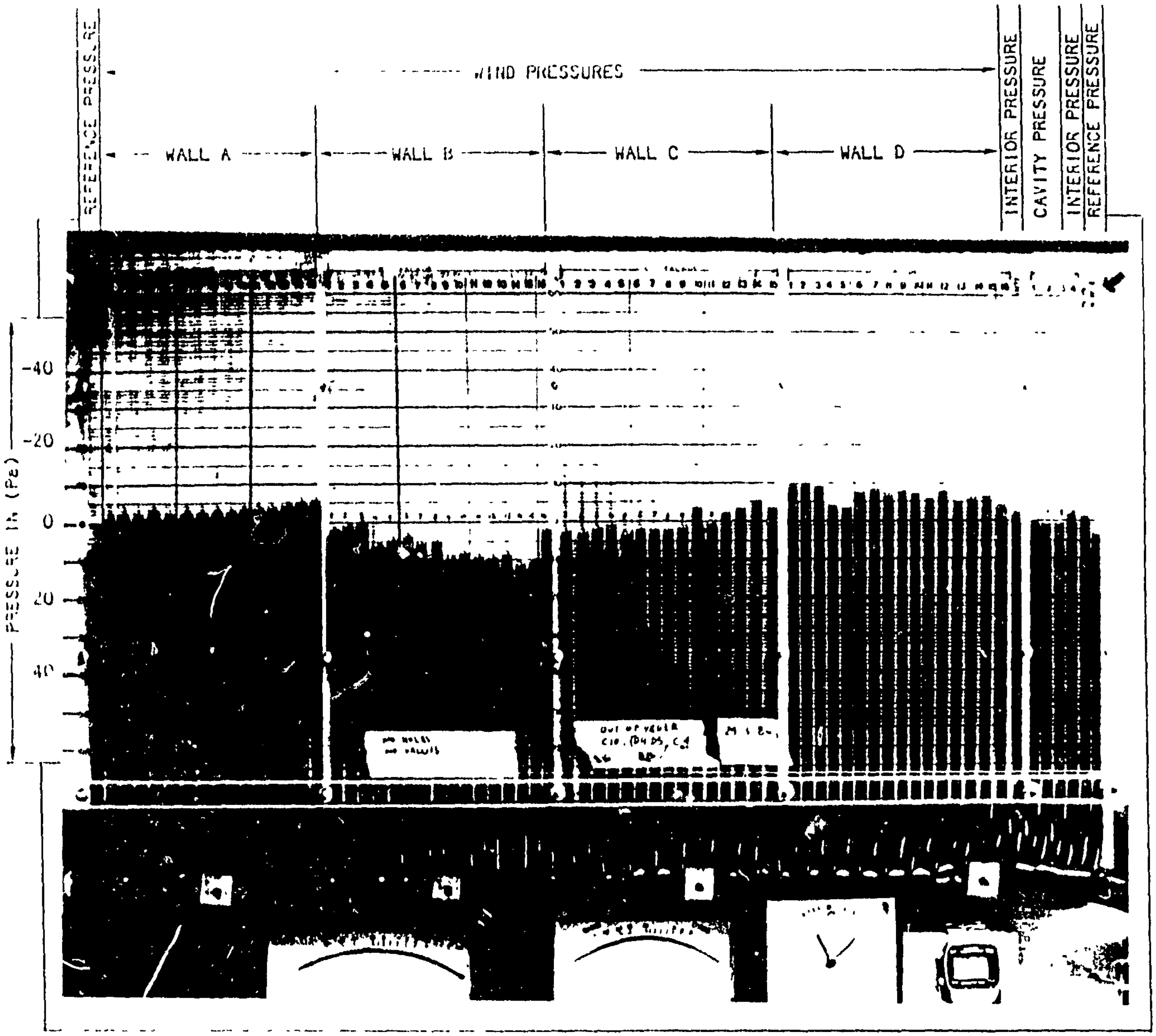

Figure A.7 Wind and cavity pressure profile around building with vent holes closed (Table 4.1, case 4, experiment 27)

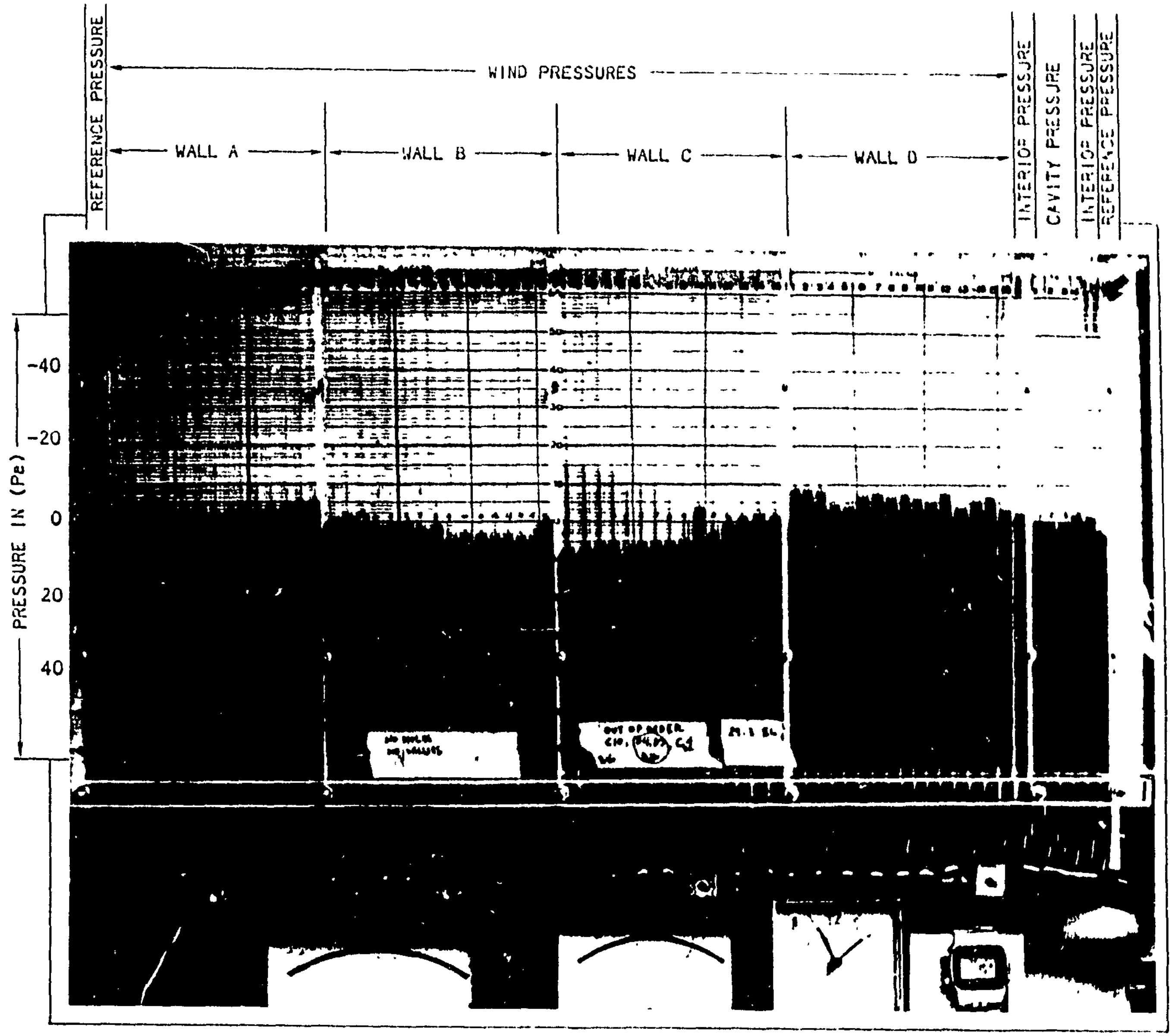

Figure A.8 Wind and cavity pressure profile around building with vent holes closed (Table 4.1, case 4, experiment 30)

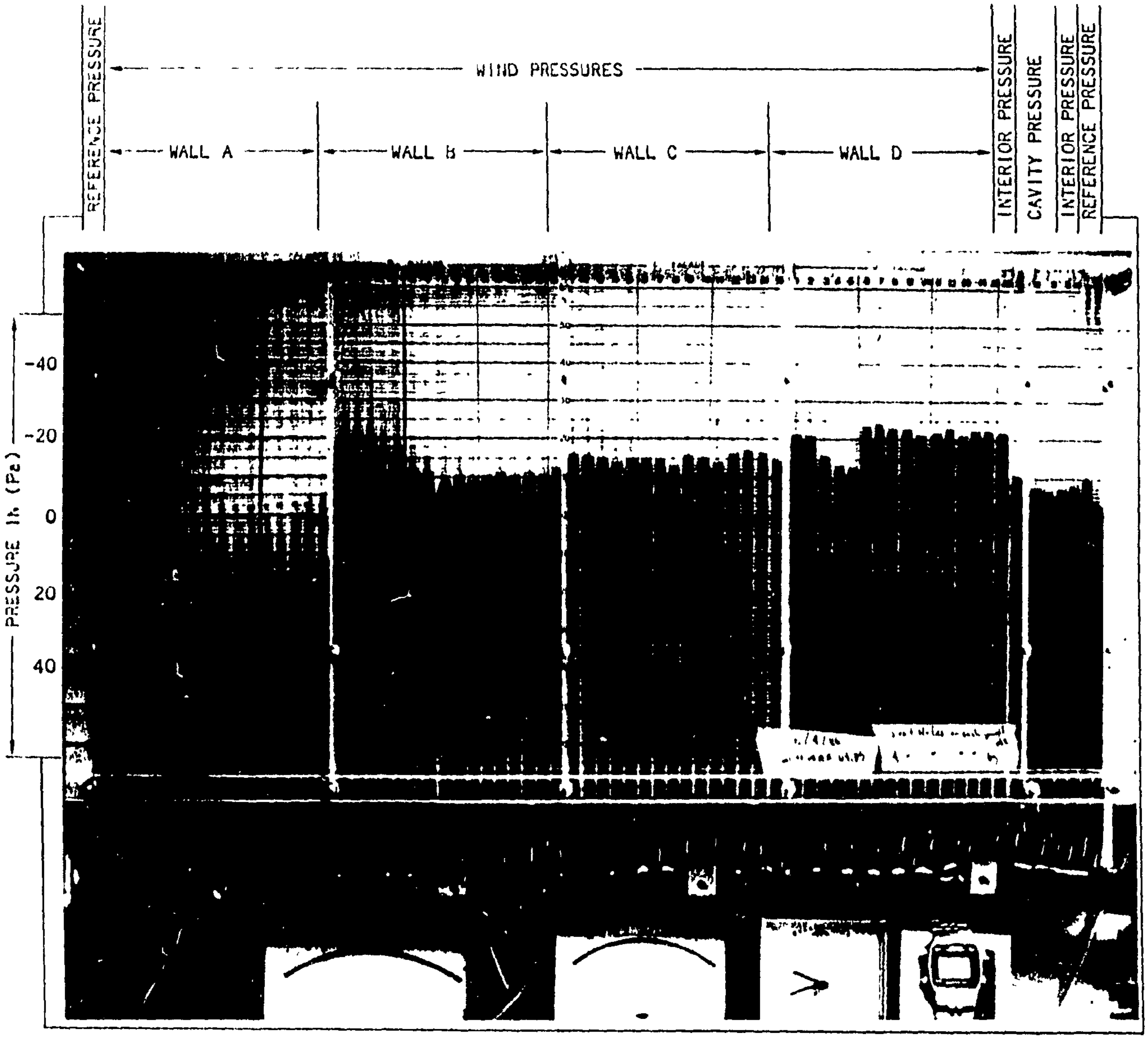

Figure A.9 Wind and cavity pressure profile around building with many small vent holes (Table 4.1, case 5, experiment 5)

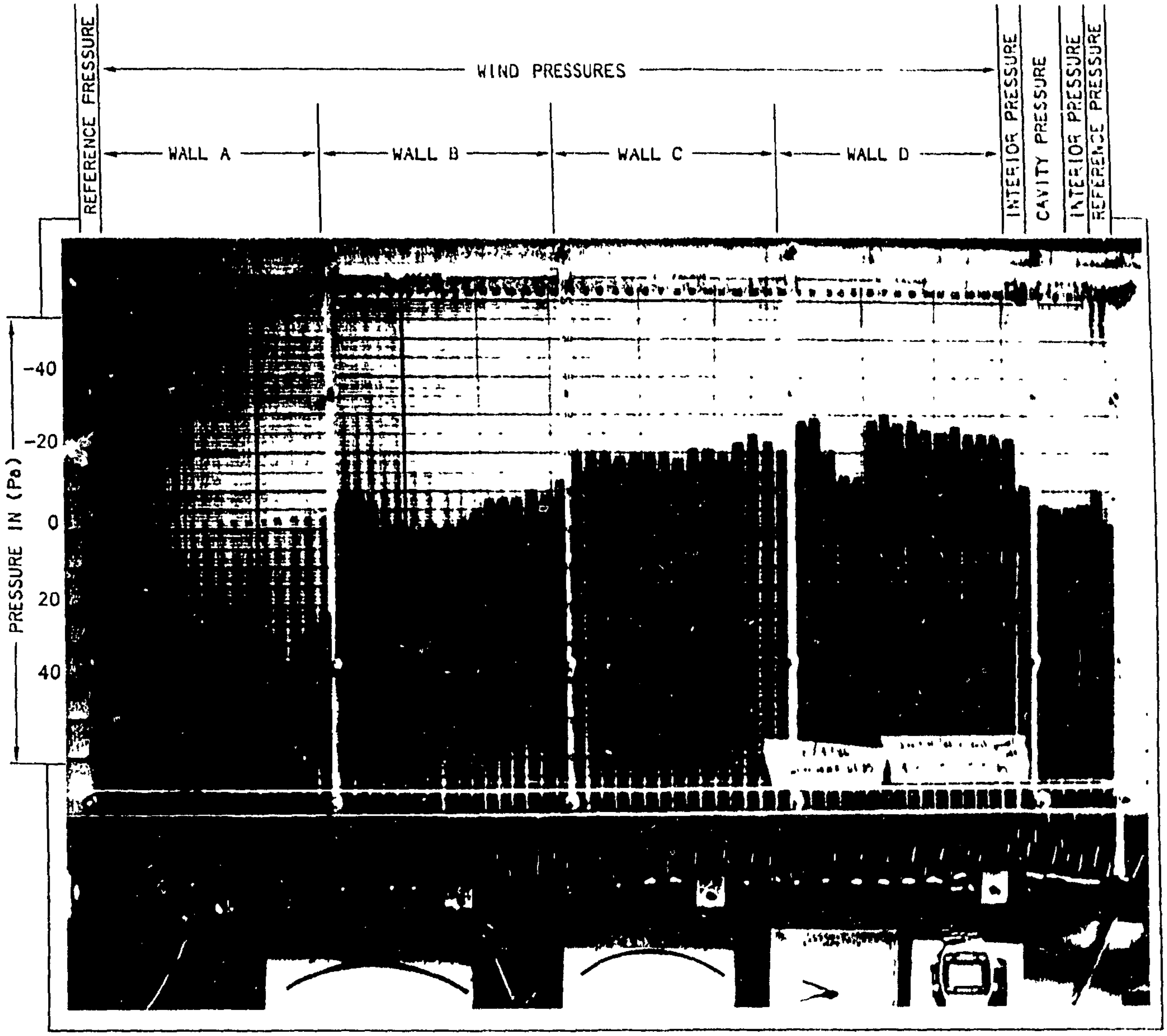

Figure A.10 Wind and cavity pressure profile around building with many small vent holes (Table 4.1, case 5, experiment 12)

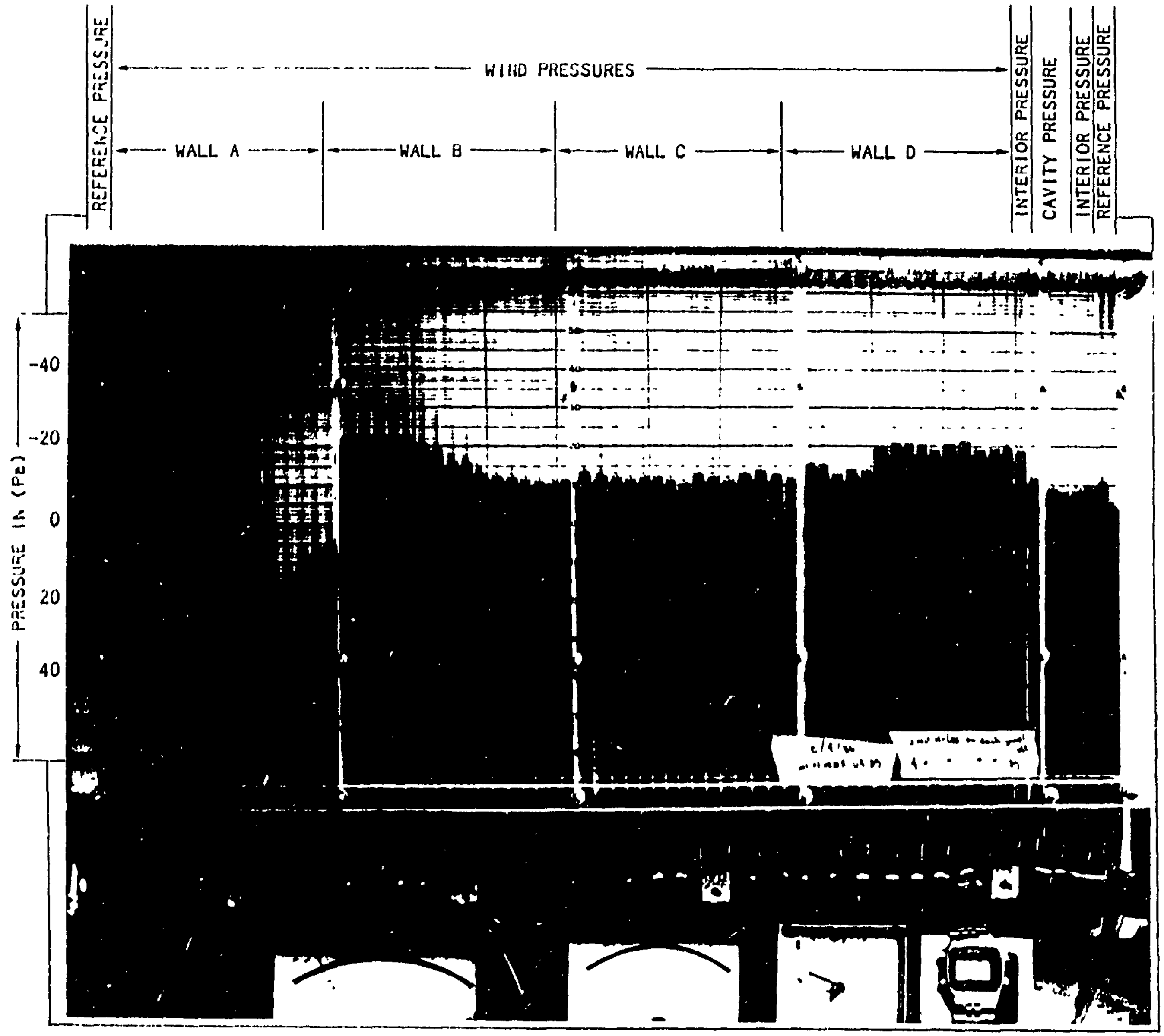

Figure A.11 Wind and cavity pressure profile around building with many small vent holes (Table 4.1, case 6, experiment 16)

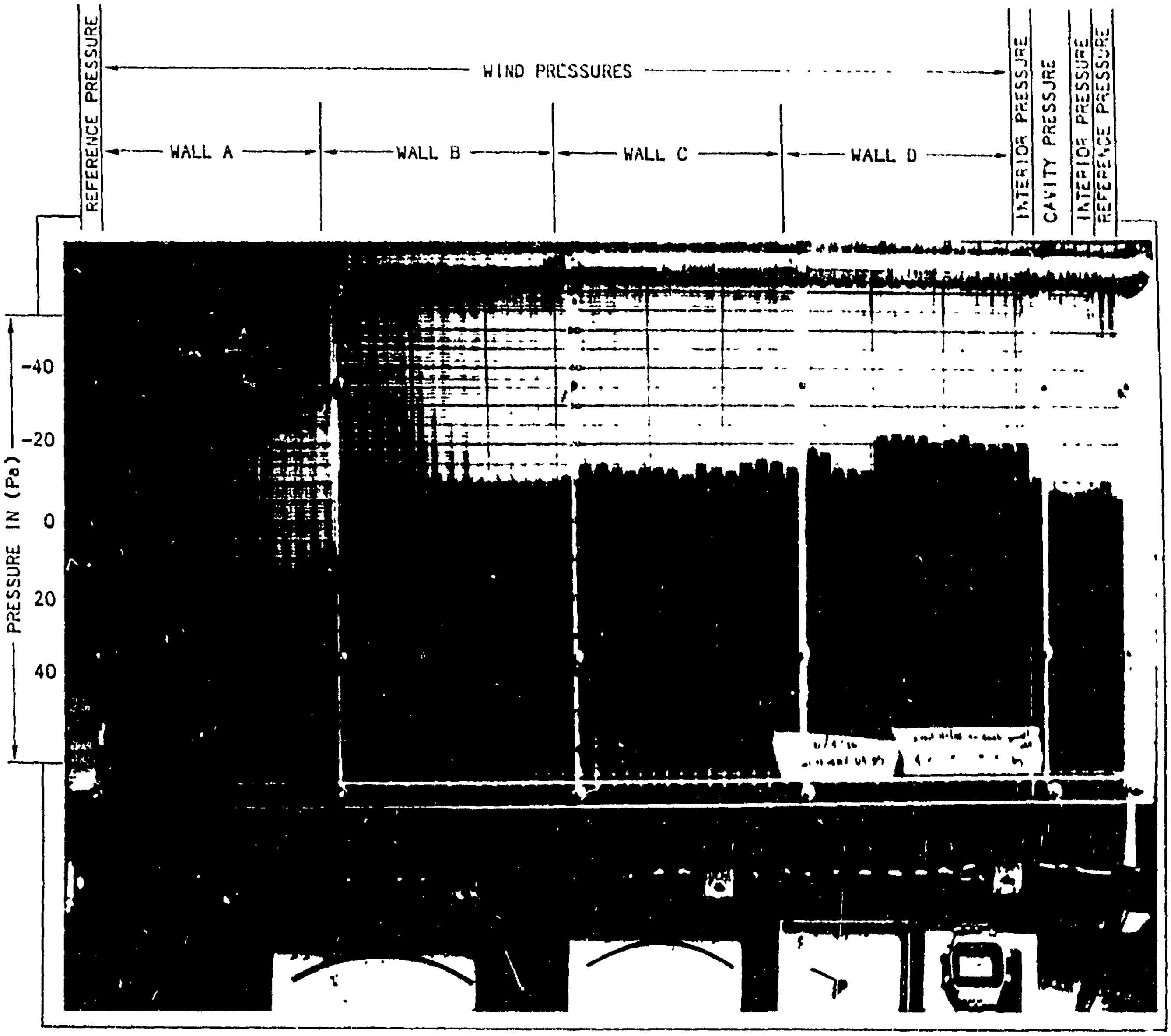

Figure A.12 Wind and cavity pressure profile around building with many small vent holes (Table 4.1, case 6, experiment 20)

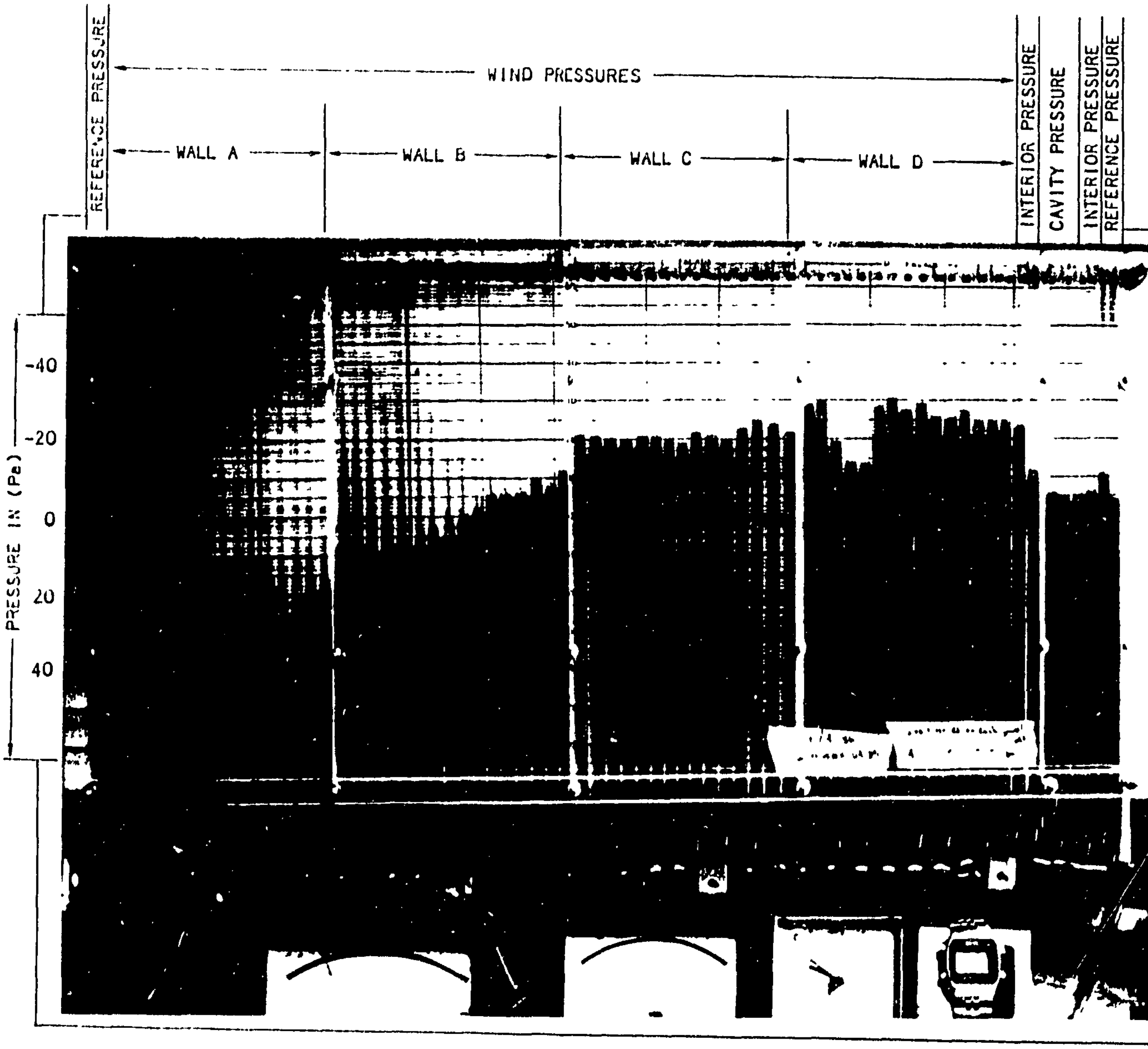

Figure A.13 Wind and cavity pressure profile around building with many small vent holes (Table 4.1, case 6, experiment 27)

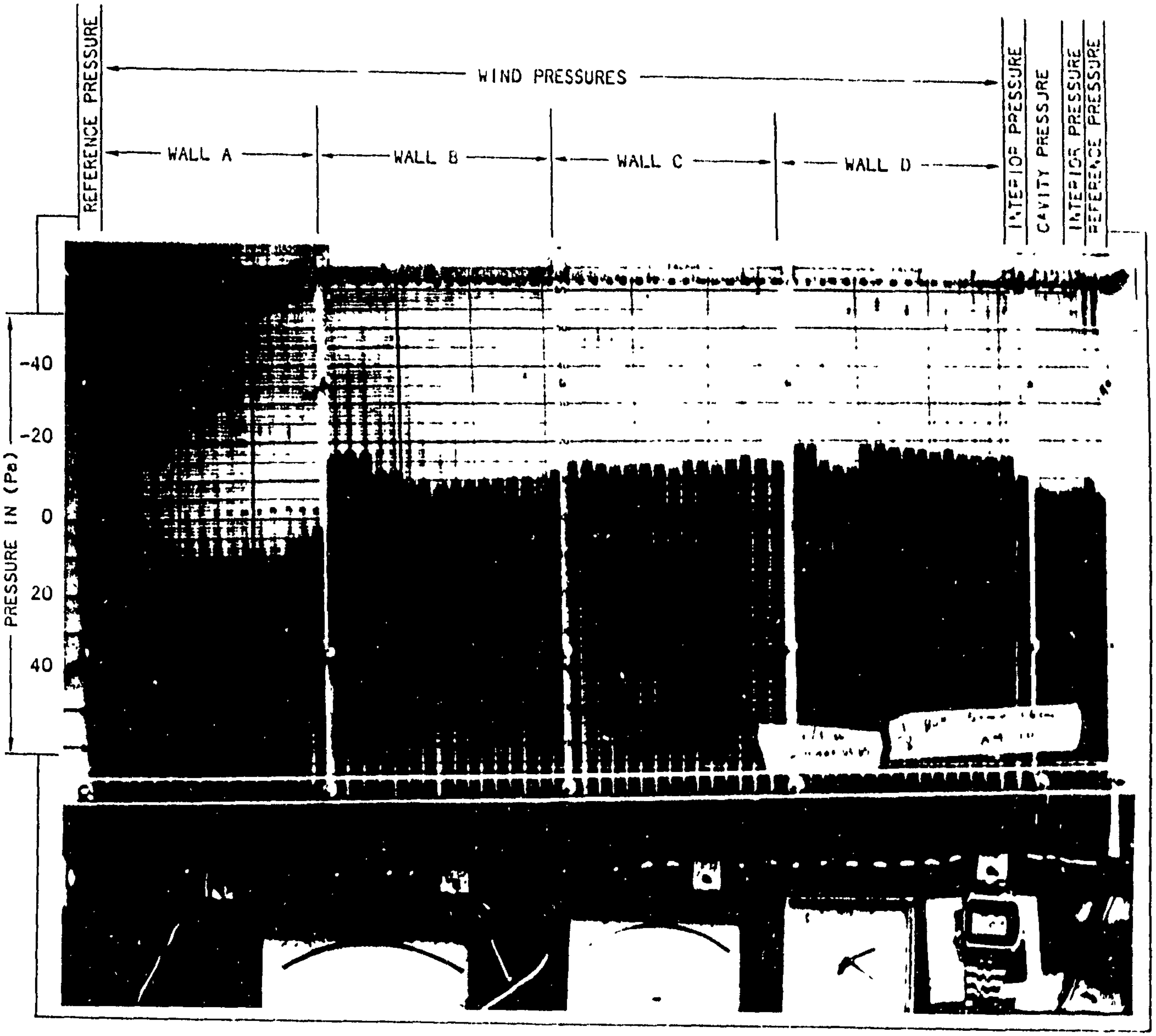

Figure A.14 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 1.6cm (Table 4.1, case 7, experiment 4)

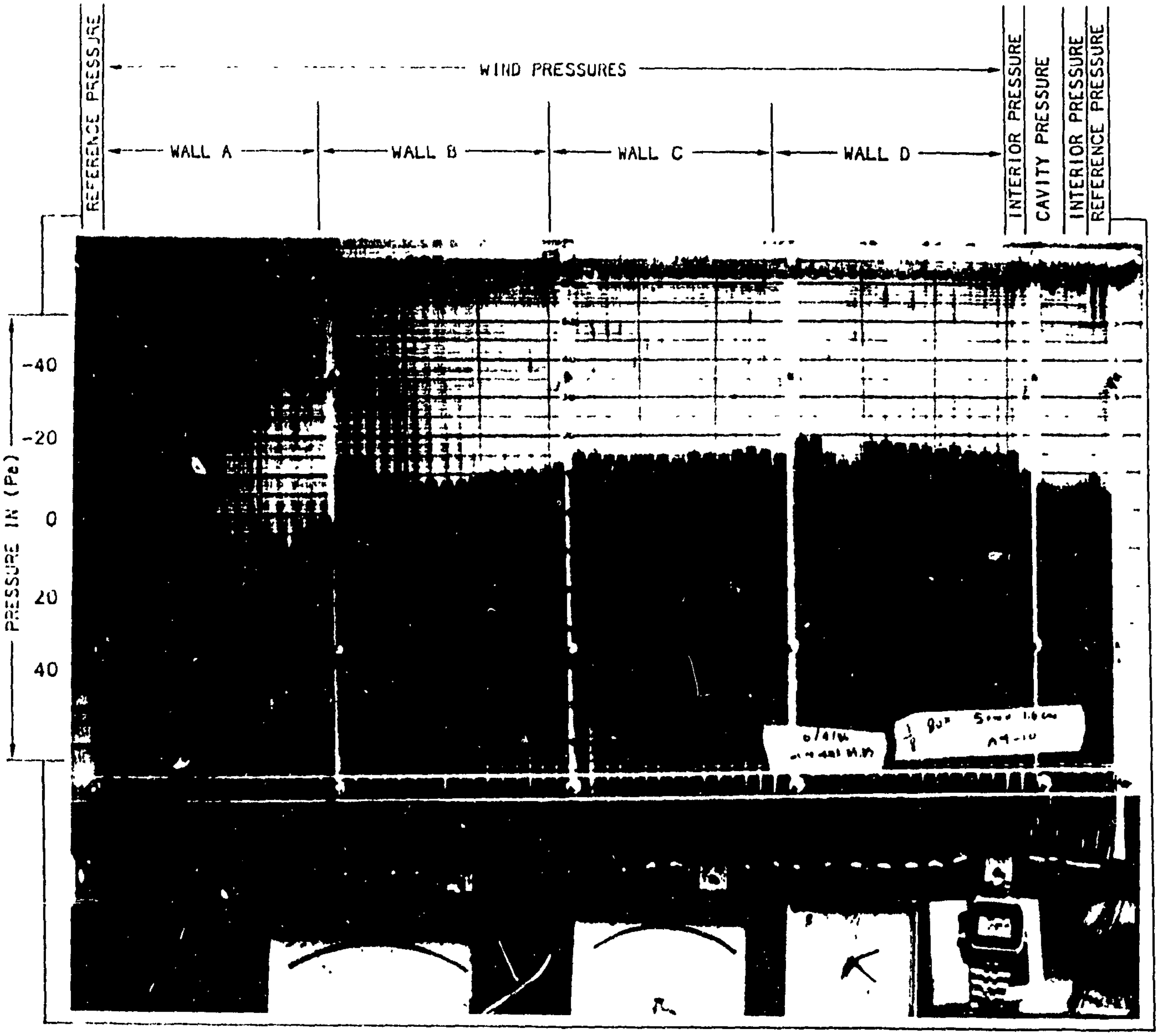

Figure A.15 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 1.6cm (Table 4.1, case 7, experiment 5)

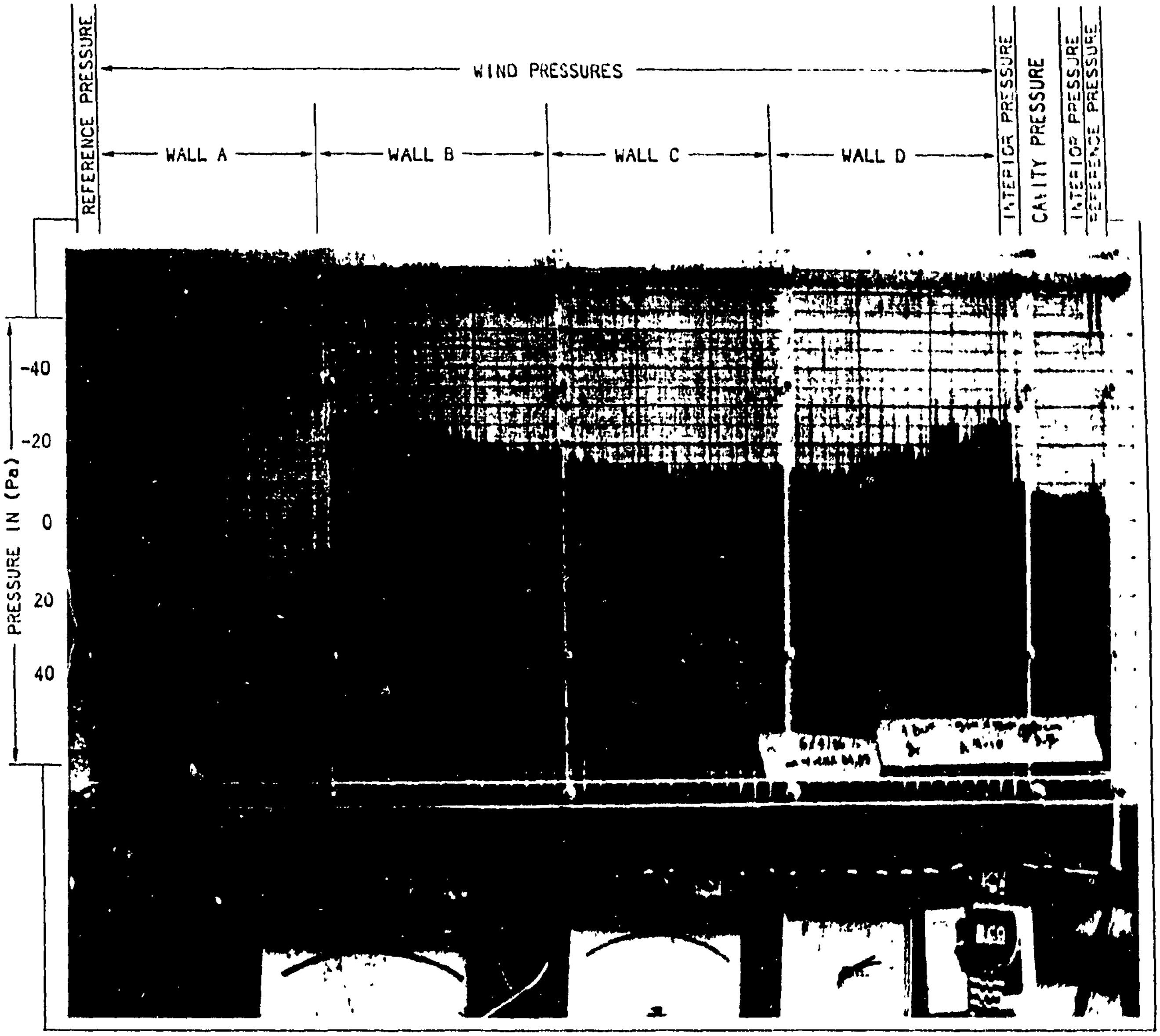

Figure A.16 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 3.2cm (Table 4.1, case 8, experiment 1)

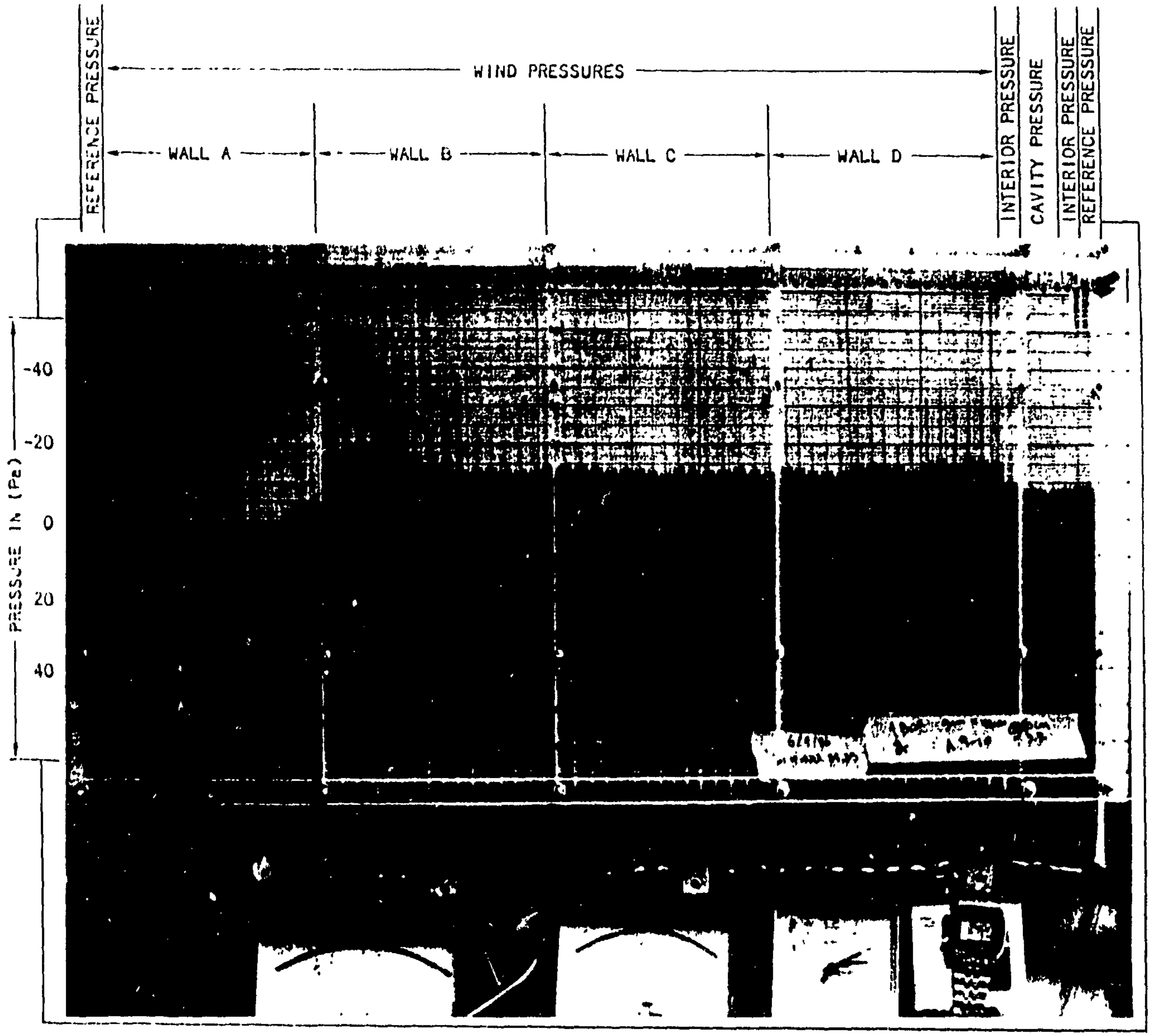

Figure A.17 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 3.2cm (Table 4.1, case 8, experiment 5)

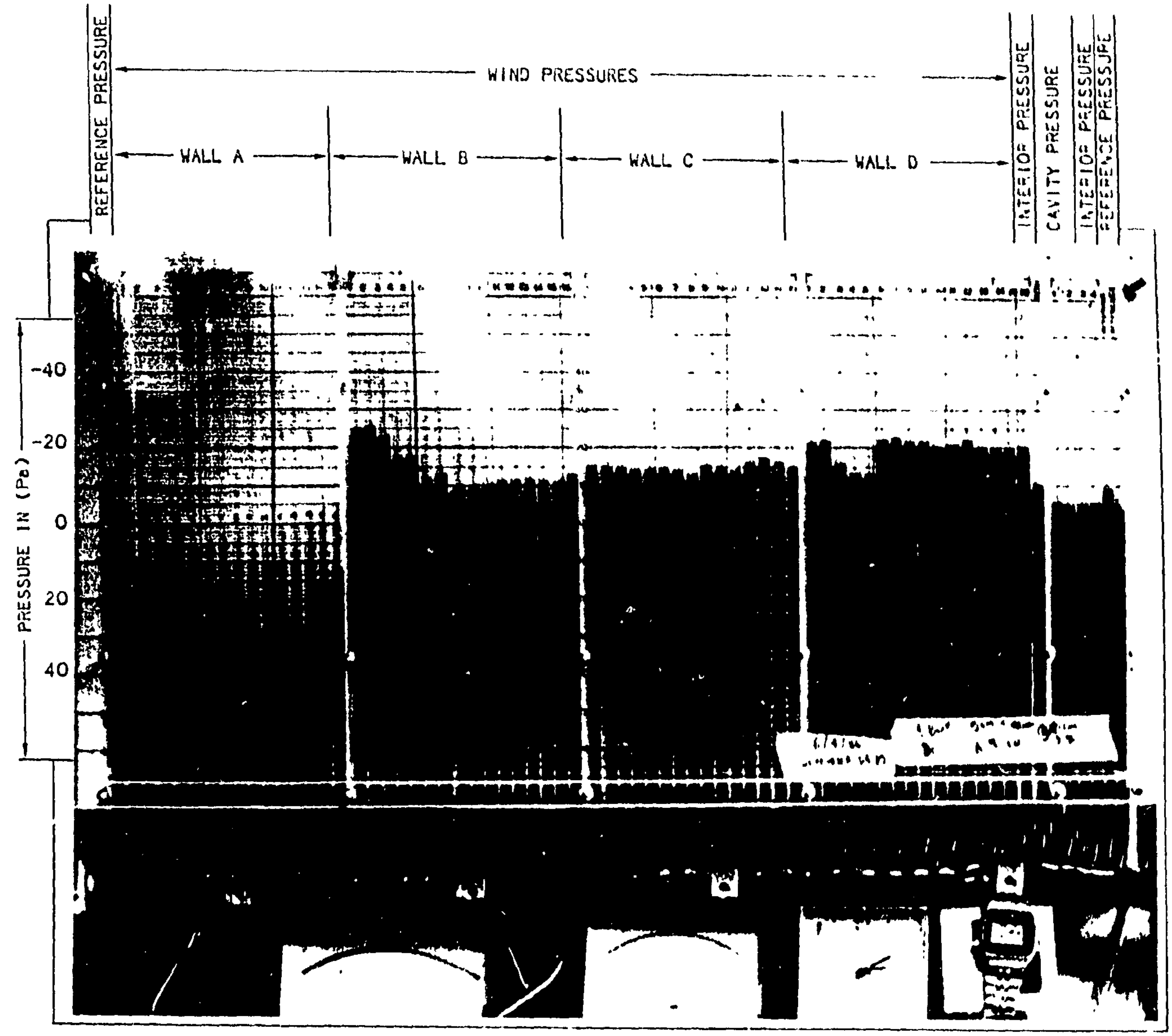

Figure A.18 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 3.2cm (Table 4.1, case 8, experiment 7)

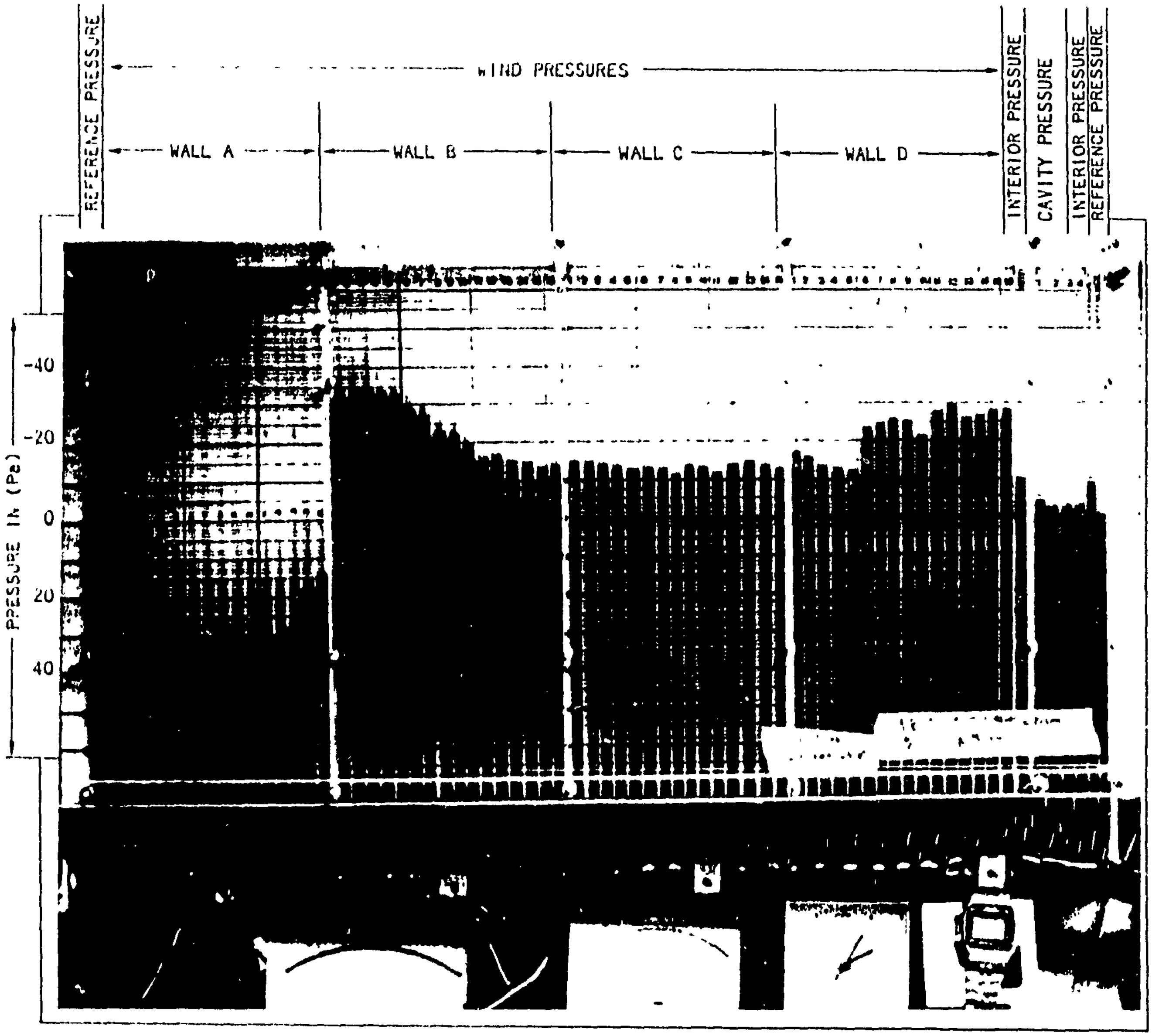

Figure A.19 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 6.5cm (Table 4.1, case 9, experiment 1)

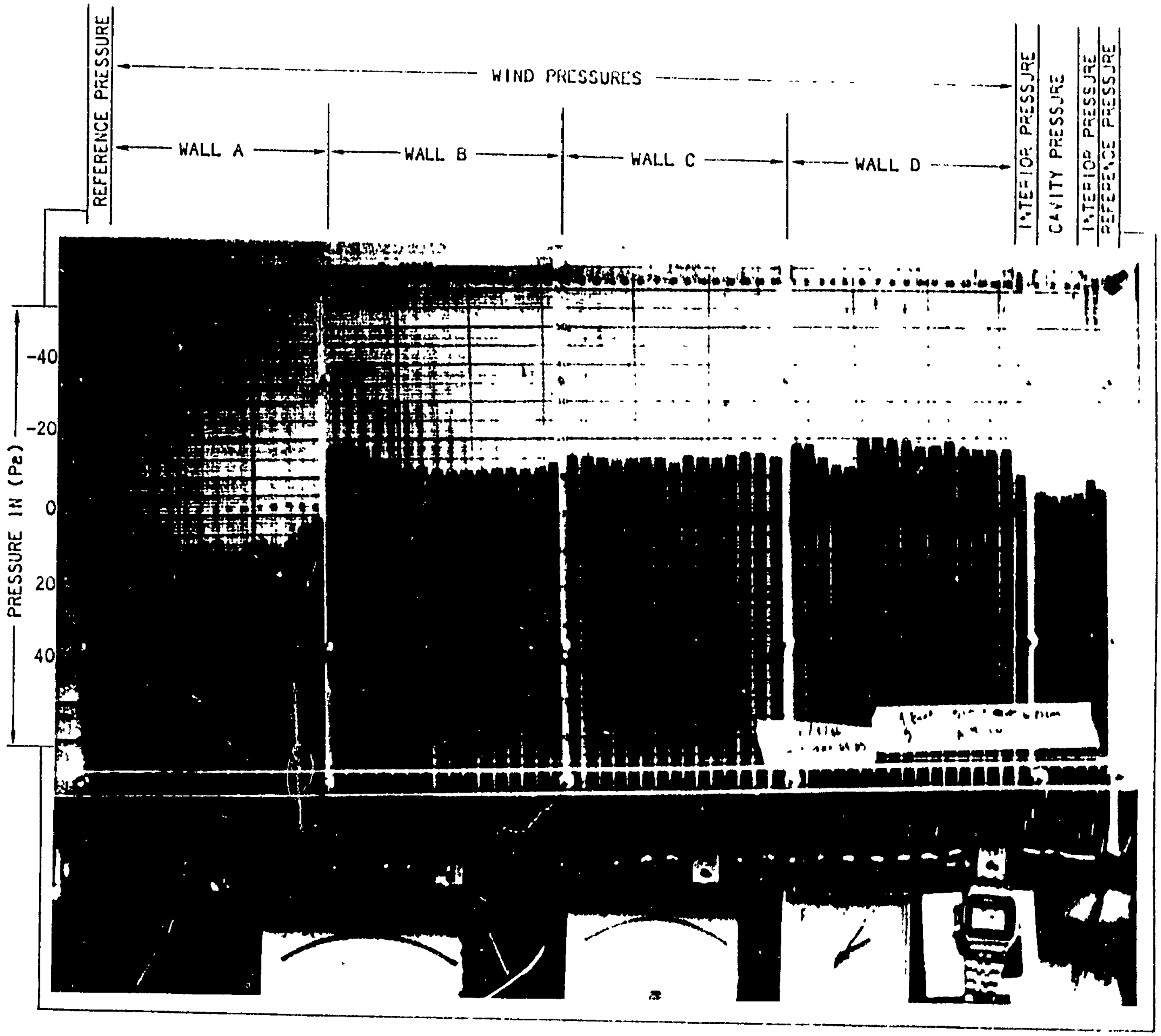

Figure A.20 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 6.5cm (Table 4.1, case 9, experiment 4)

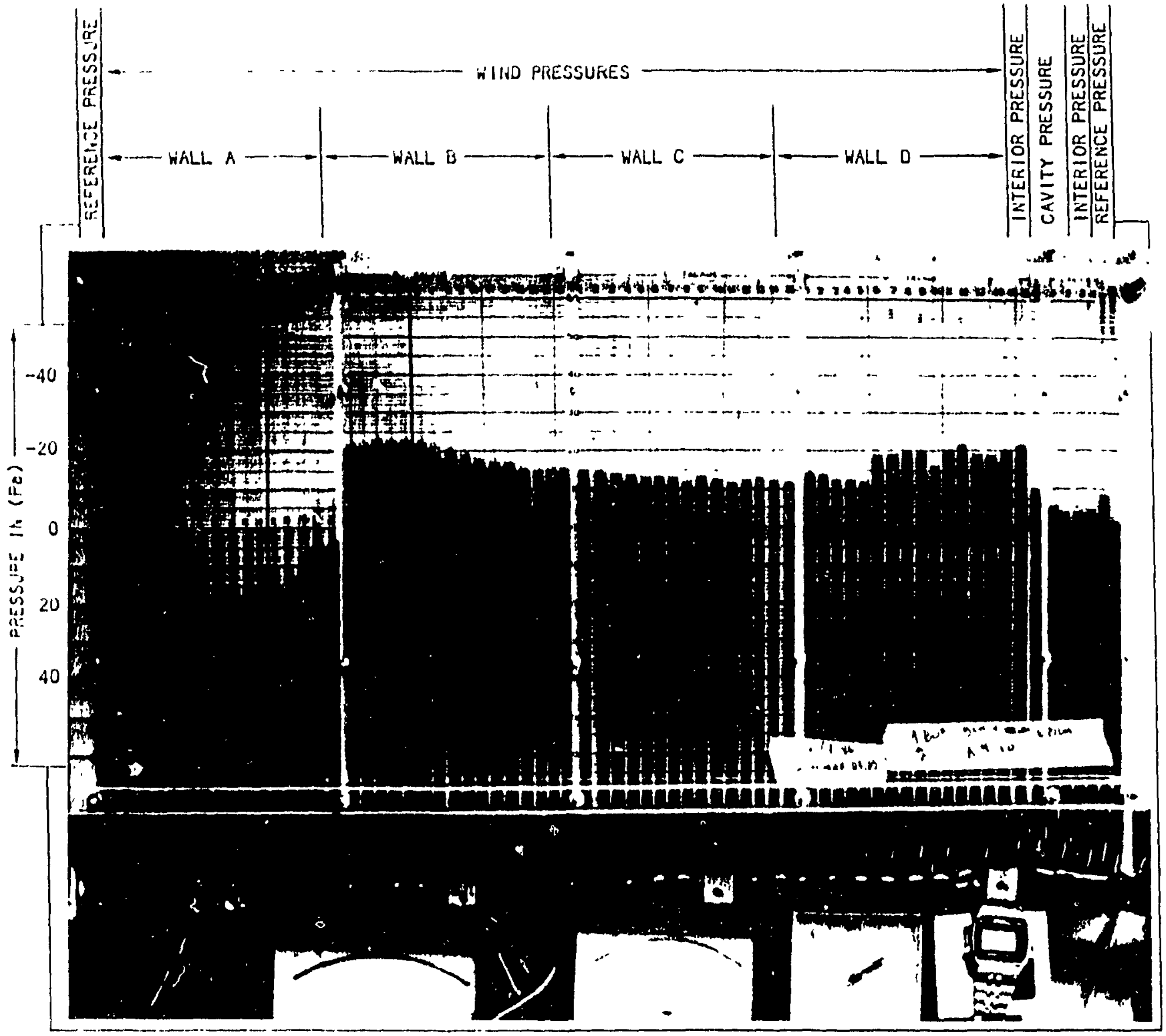

Figure A.21 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 6.5cm (Table 4.1, case 9, experiment 8)

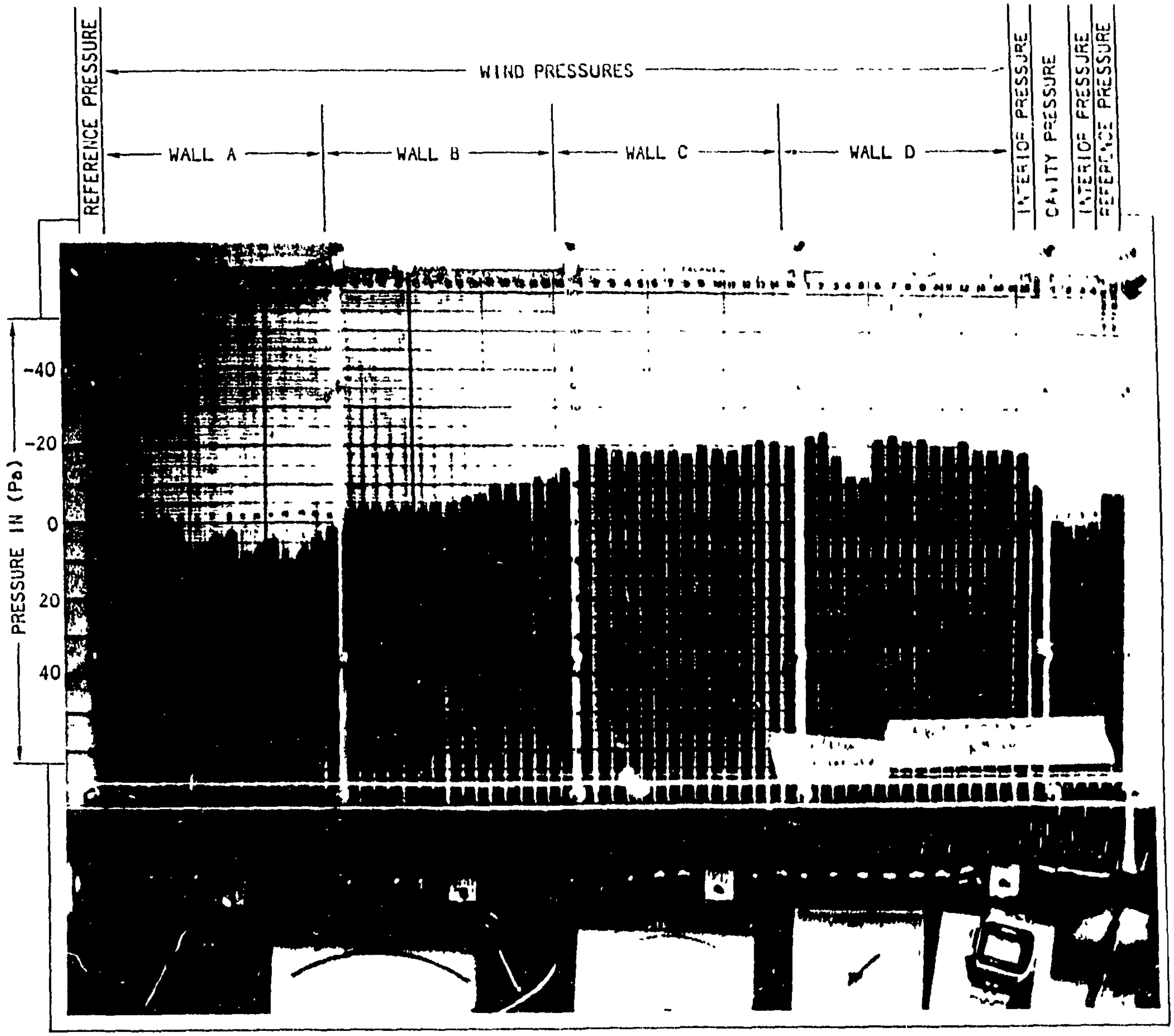

Figure A.22 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 13cm (Table 4.1, case 10, experiment 2)

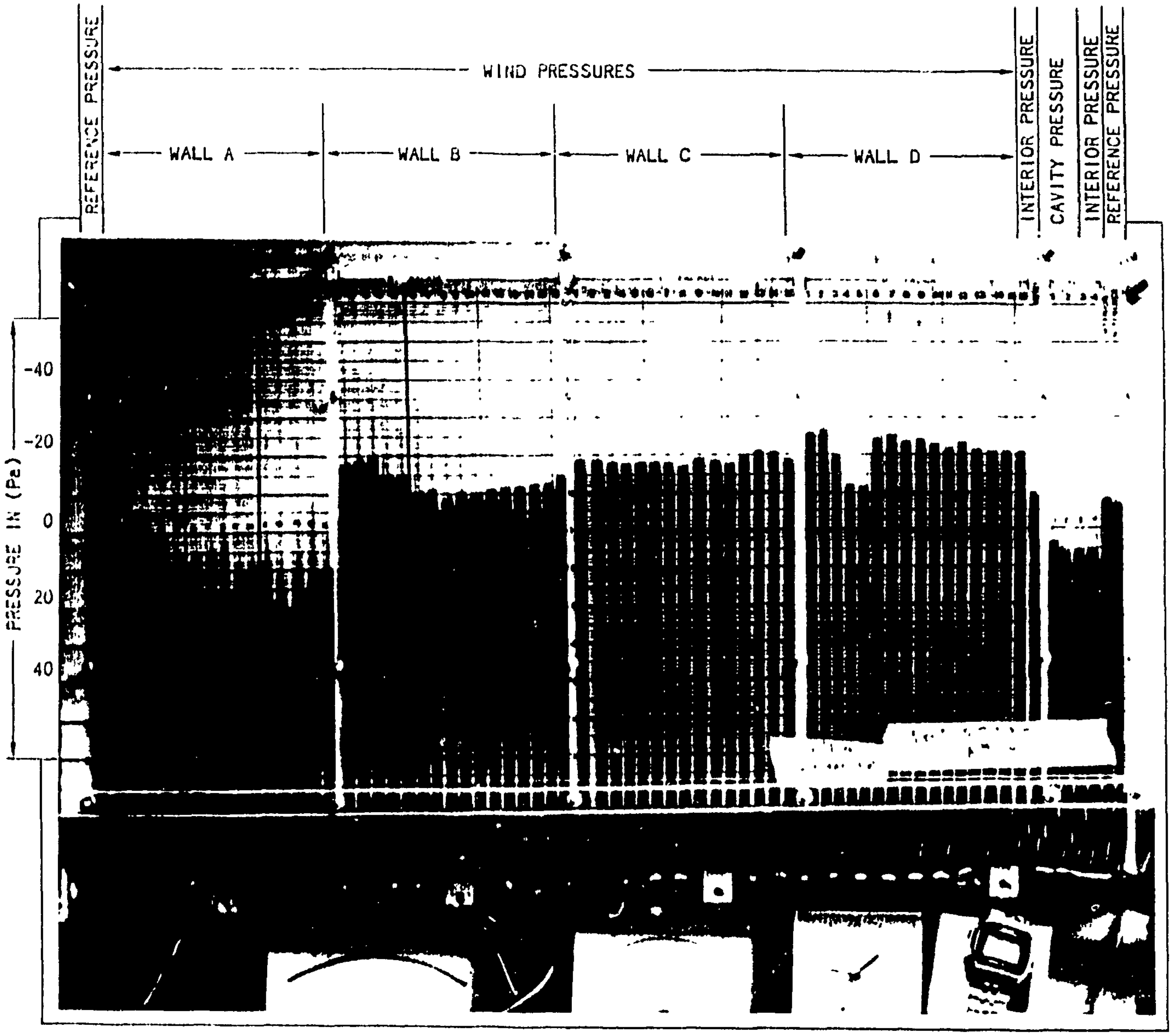

Figure A.23 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 13cm (Table 4.1, case 10, experiment 3)

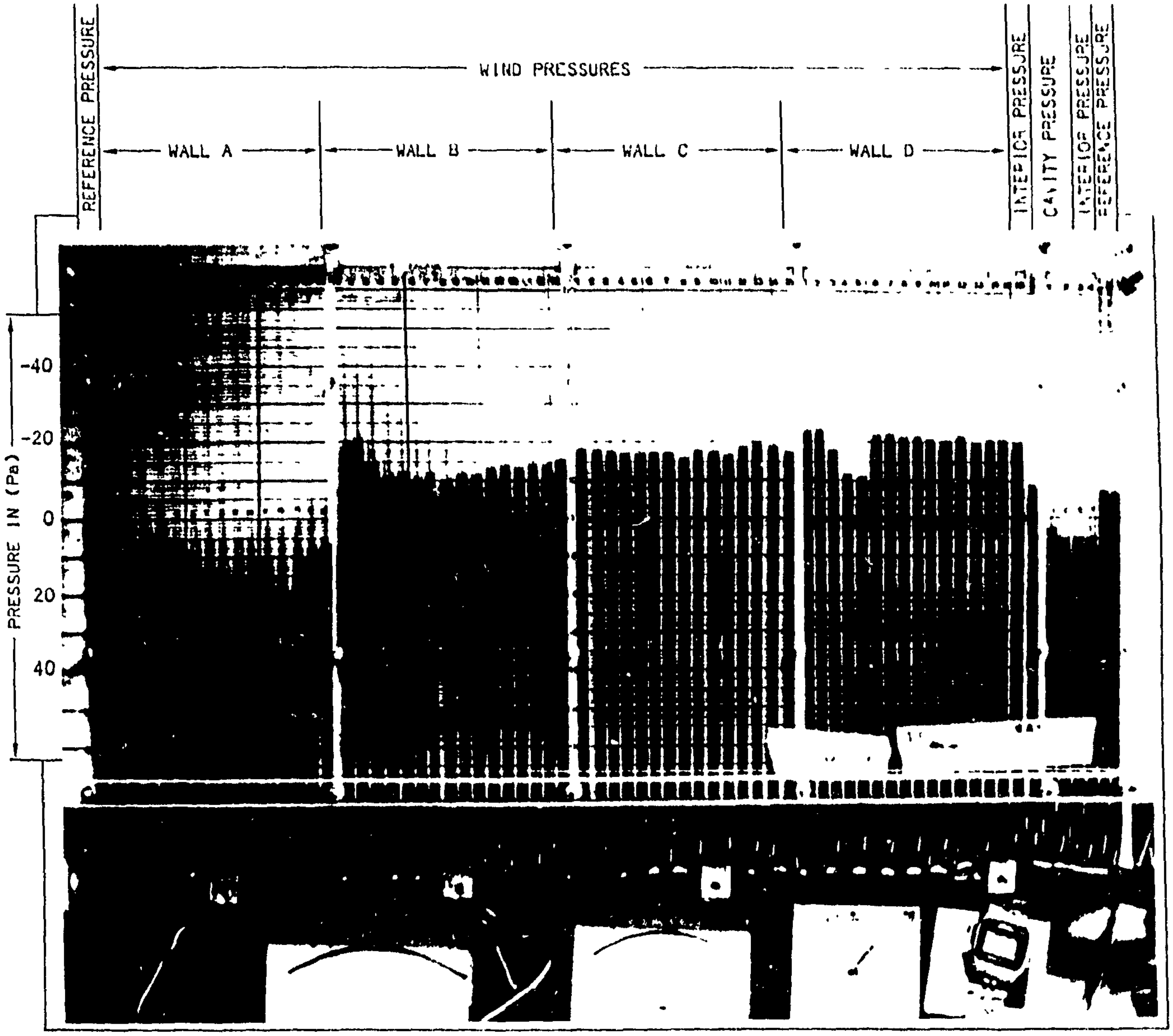

Figure A.24 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 13cm (Table 4.1, case 11, experiment 4)

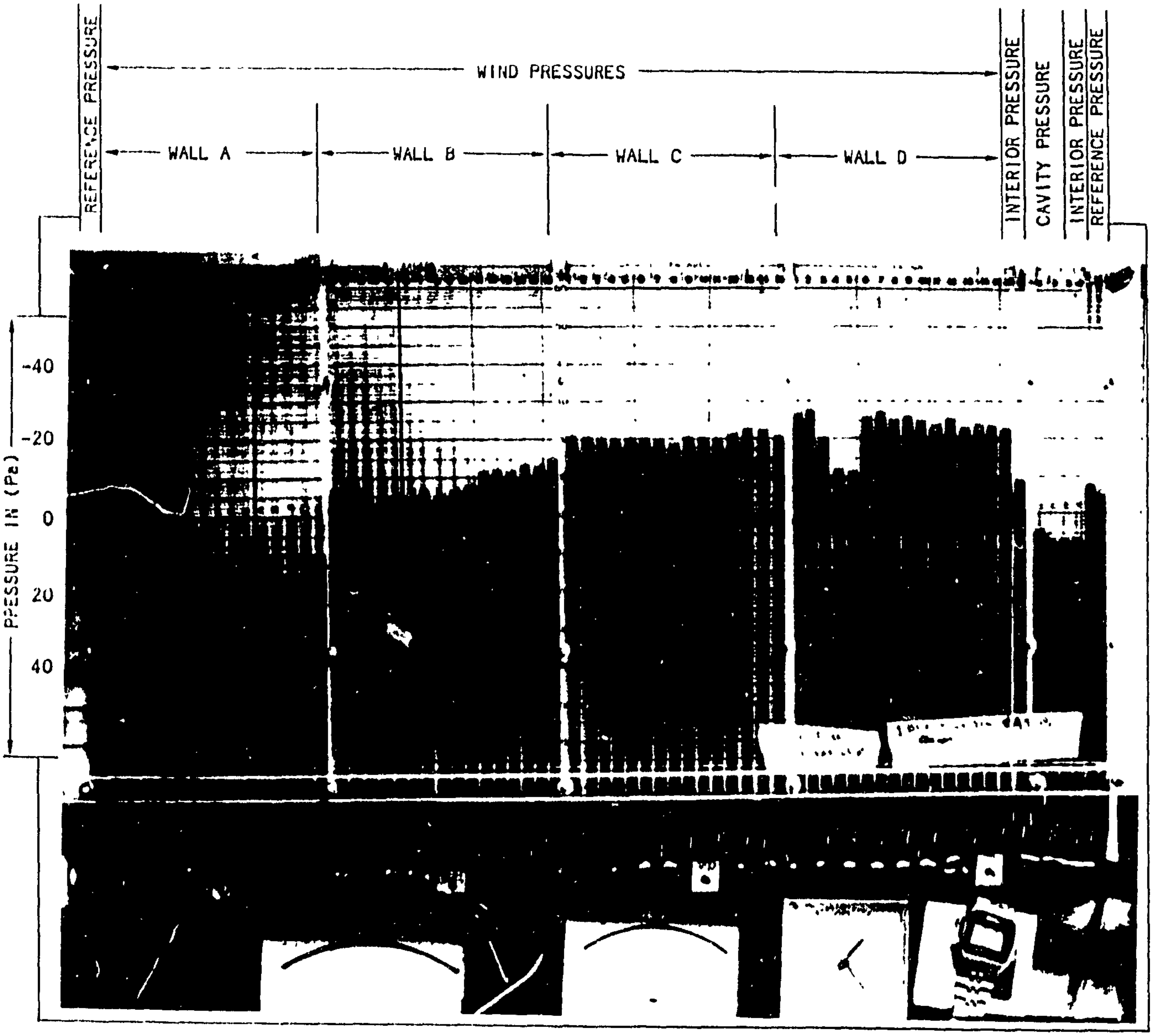

Figure A.25 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 13cm (Table 4.1, case 11, experiment 5)

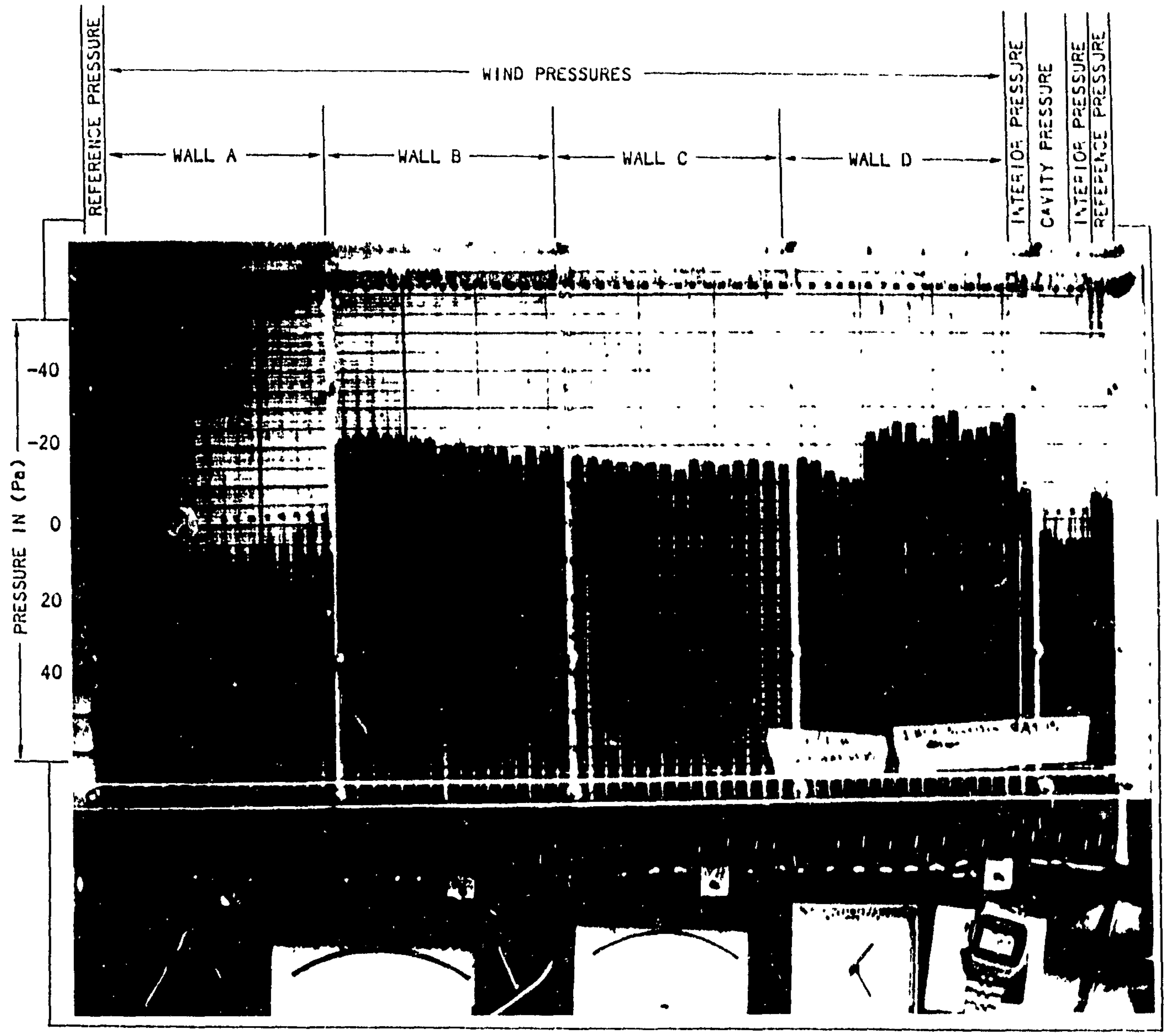

Figure A.26 Wind and cavity pressure profile around building with one vent hole A10: 5cm x 13cm (Table 4.1, case 11, experiment 8)

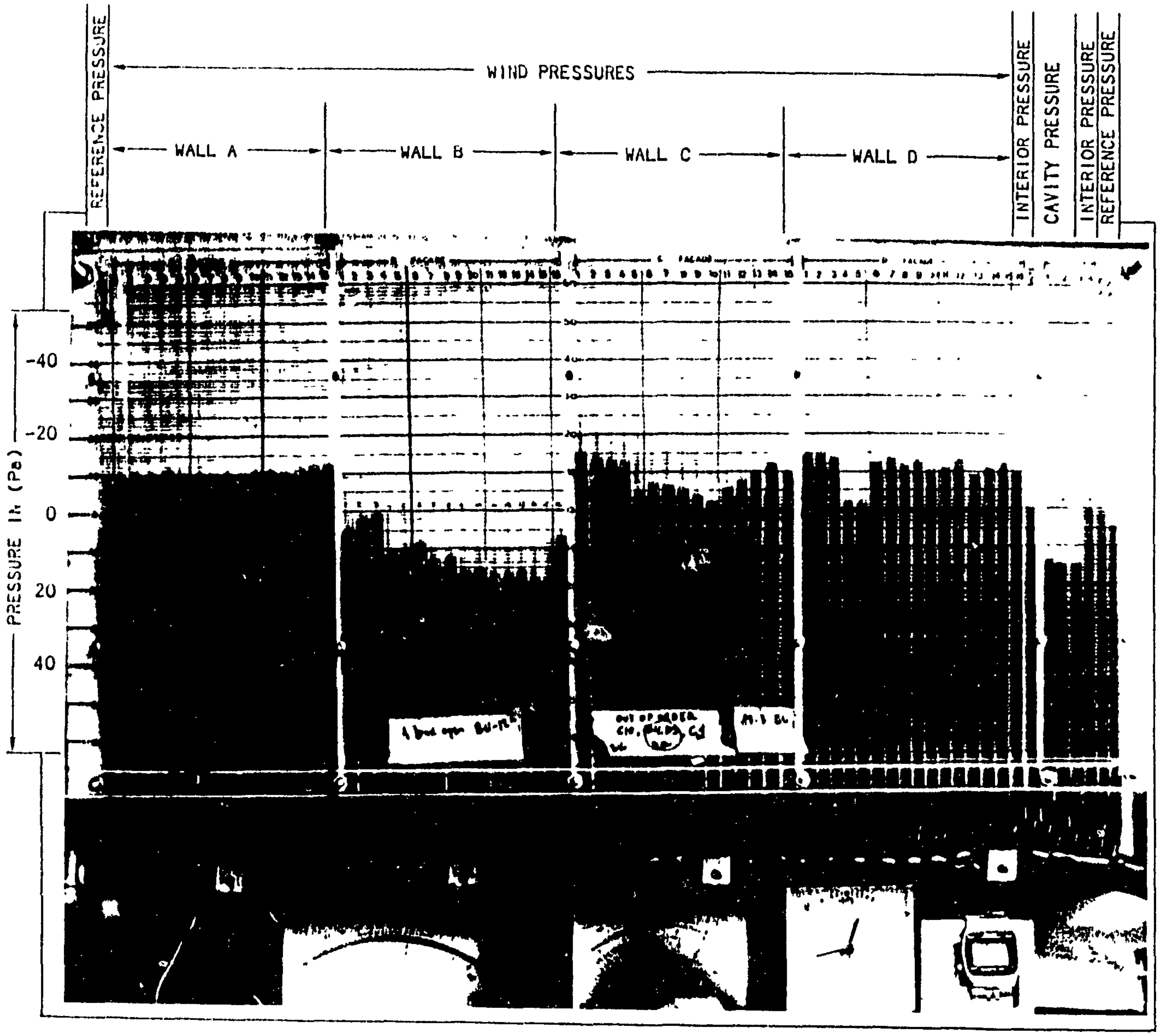

Figure A.27 Wind and cavity pressure profile around building with one vent hole B12: 5cm x 13cm (Table 4.1, case 12, experiment 1)

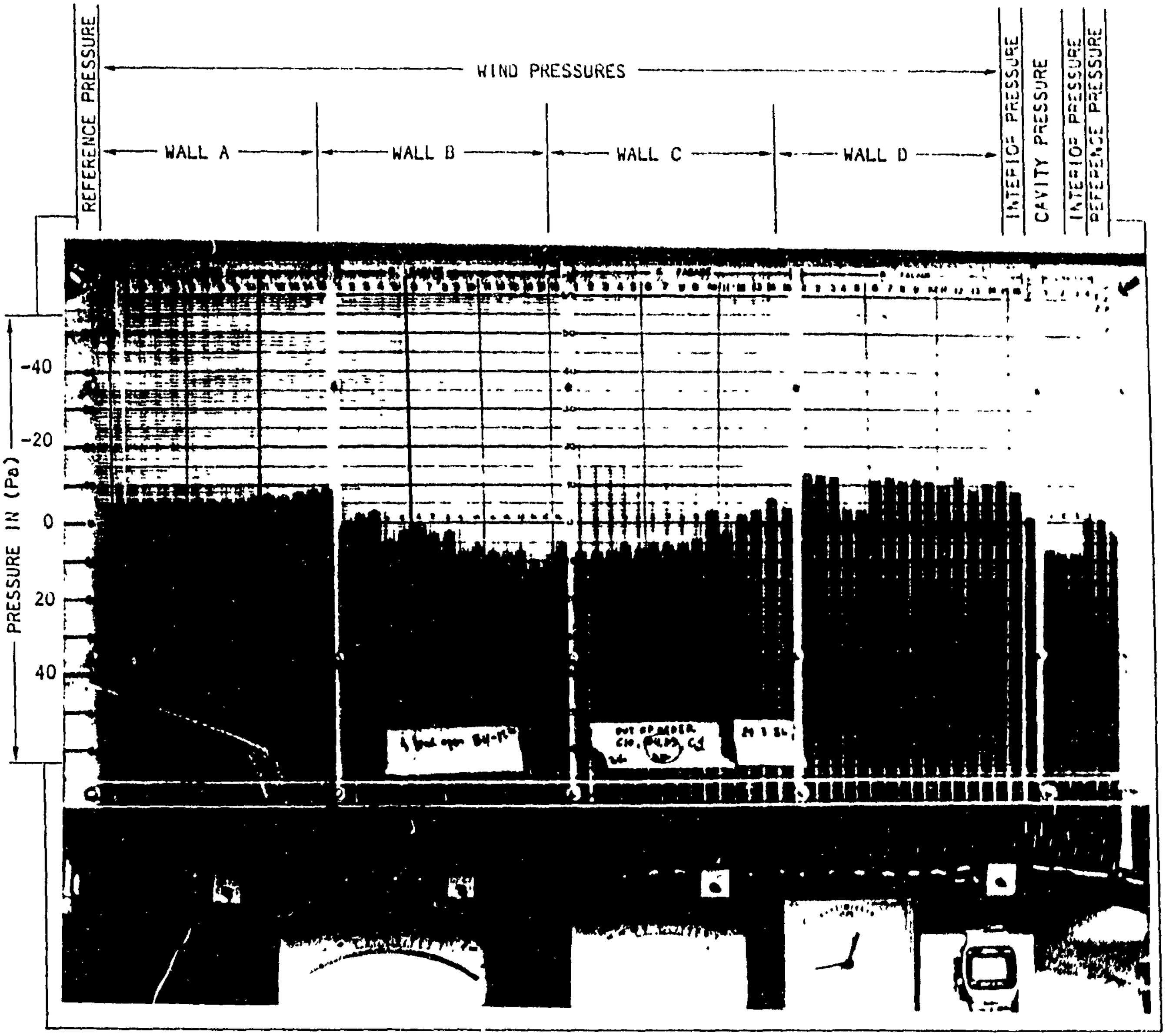

Figure A.28 Wind and cavity pressure profile around building with one vent hole B12: 5cm x 13cm (Table 4.1, case 12, experiment 3)

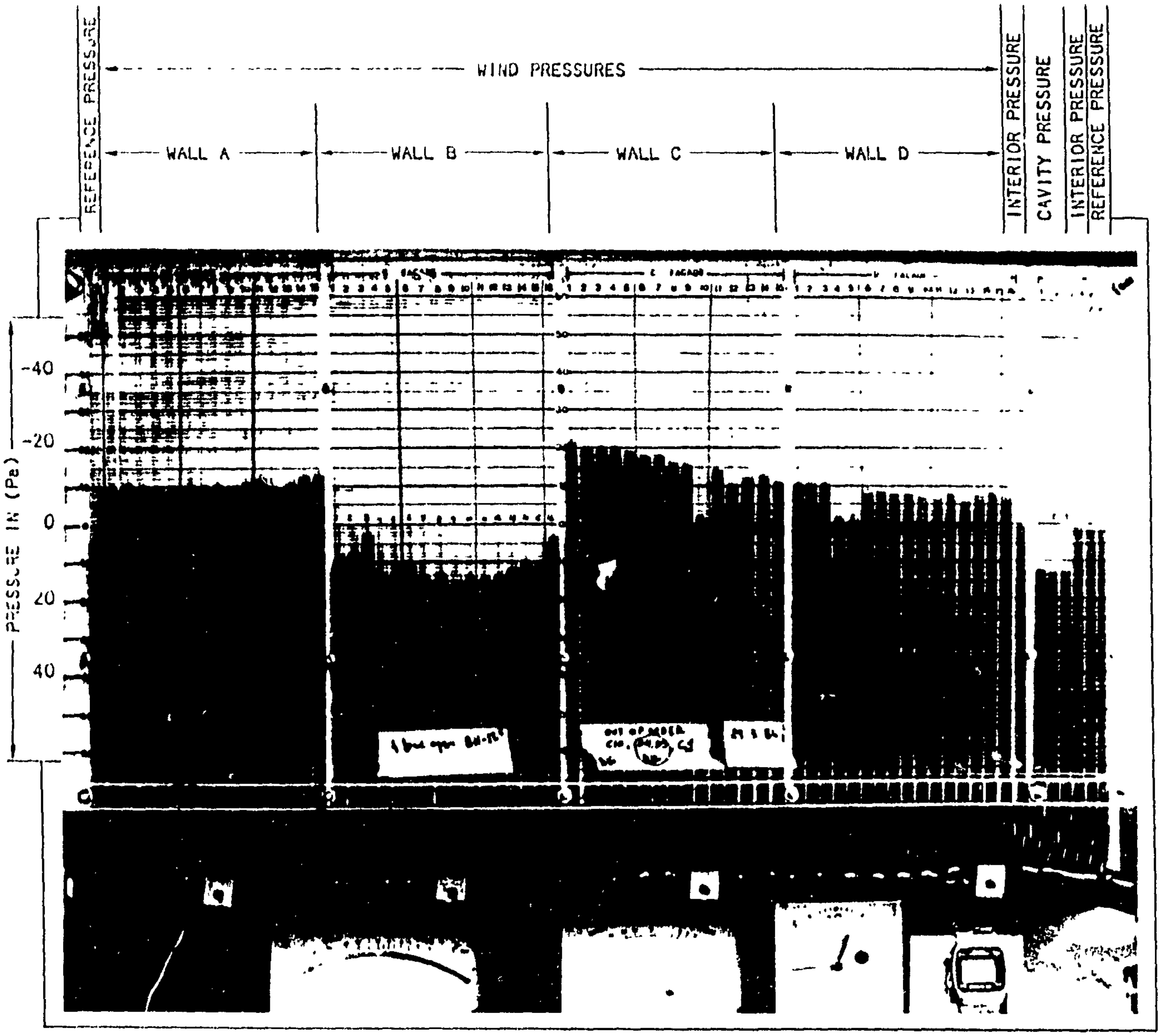

Figure A.29 Wind and cavity pressure profile around building with one vent hole B12: 5cm x 13cm (Table 4.1, case 12, experiment 6)

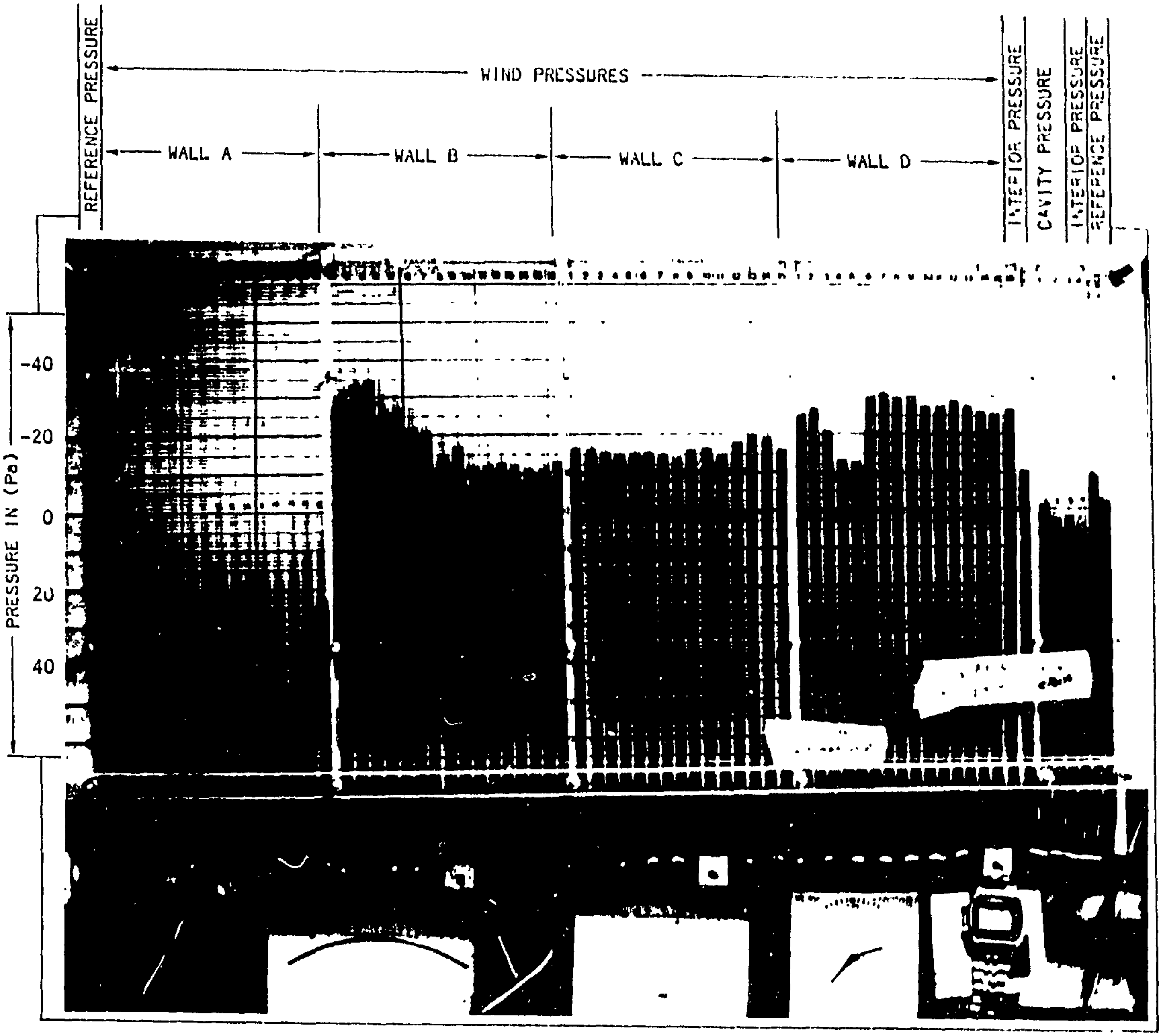

Figure A.30 Wind and cavity pressure profile around building with two vent holes A10, C6: 5cm x 13cm each (Table 4.1, case 13, experiment 4)

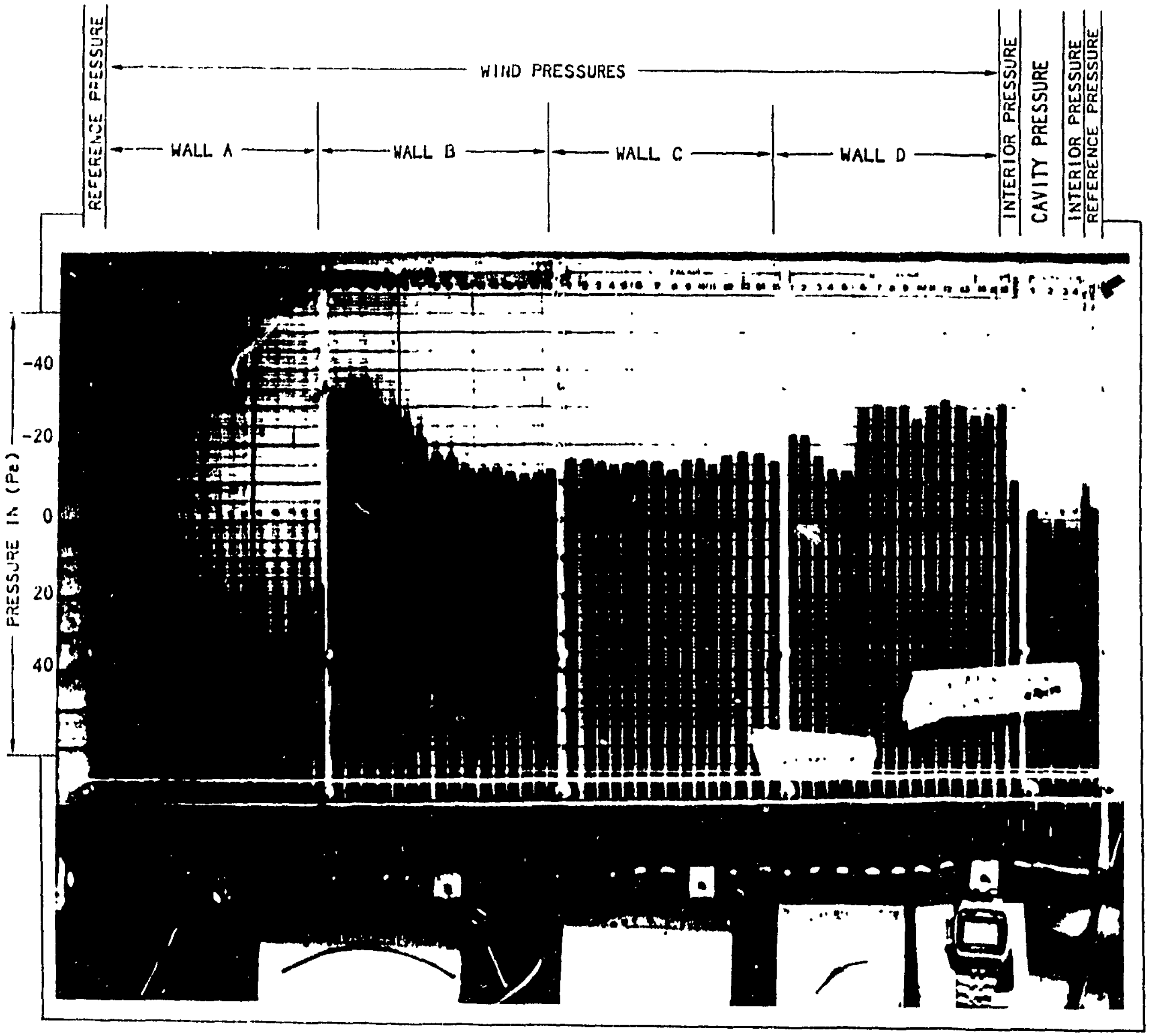

Figure A.31 Wind and cavity pressure profile around building with two vent holes A10, C6: 5cm x 13cm each (Table 4.1, case 13, experiment 5)

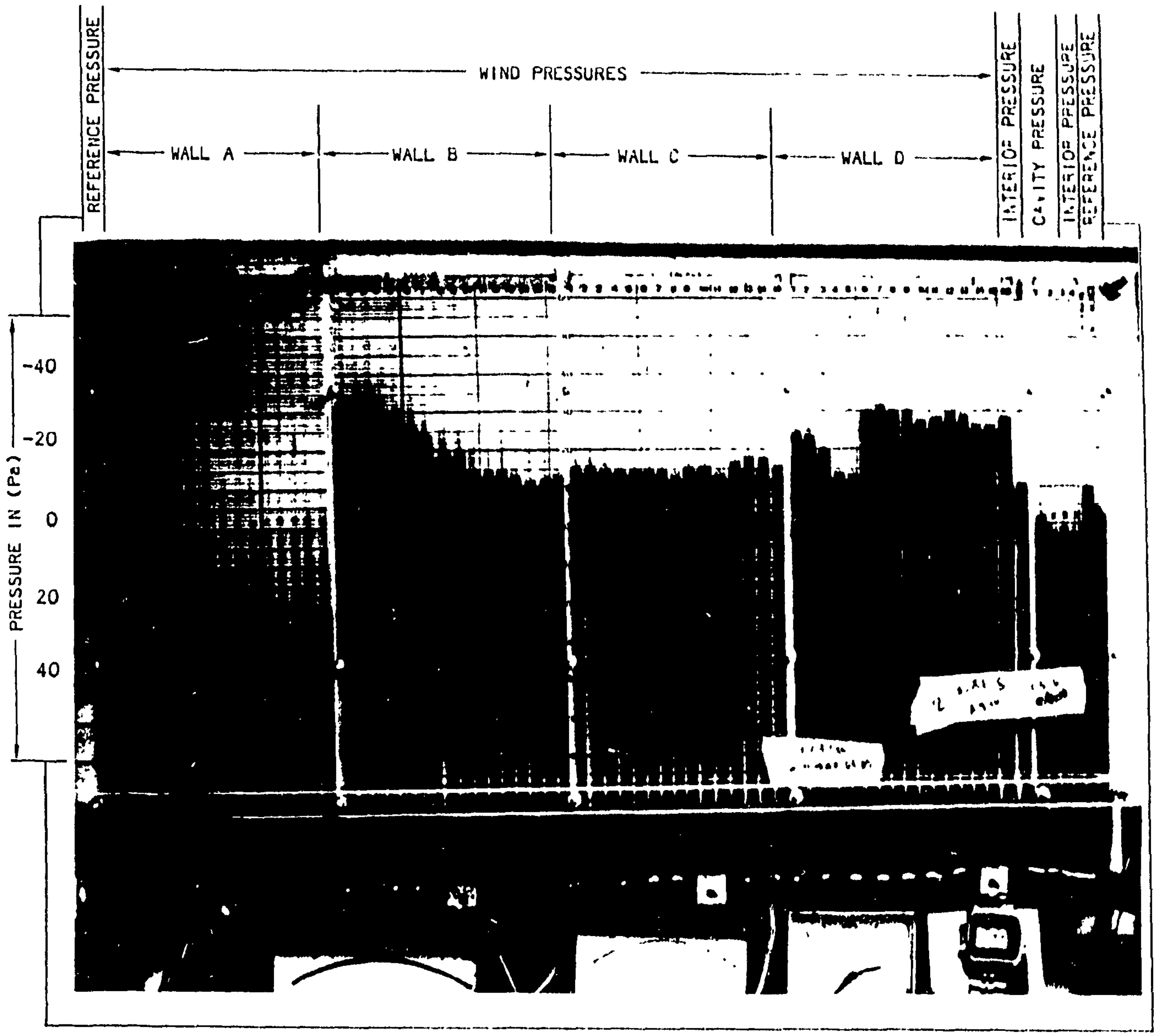

Figure A.32 Wind and cavity pressure profile around building with two vent holes A10, C6: 5cm x 13cm each (Table 4.1, case 13, experiment 6)

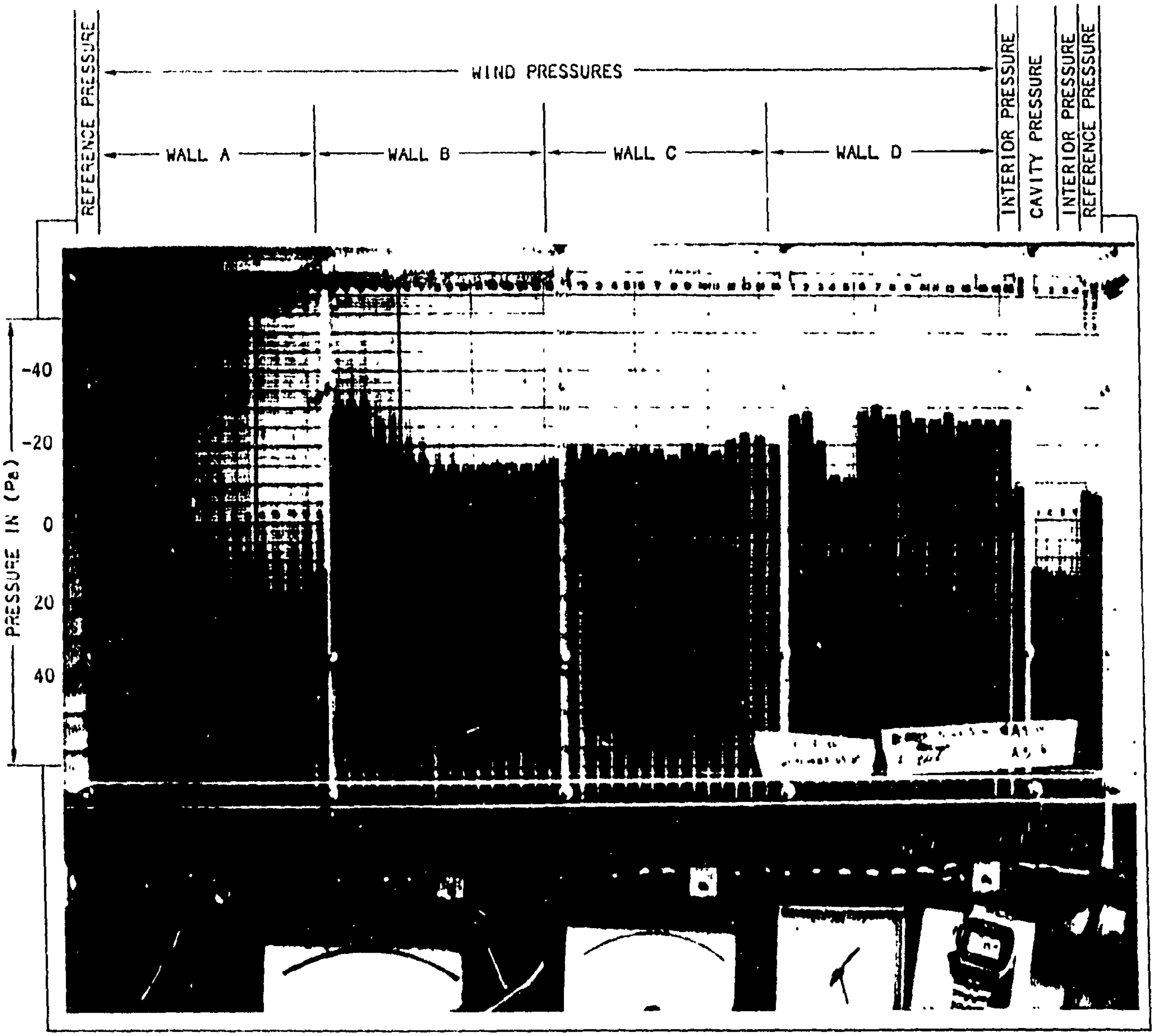

Figure A.33 Wind and cavity pressure profile around building with two vent holes A6, A10: 5cm x 13cm each (Table 4.1, case 14, experiment 3)

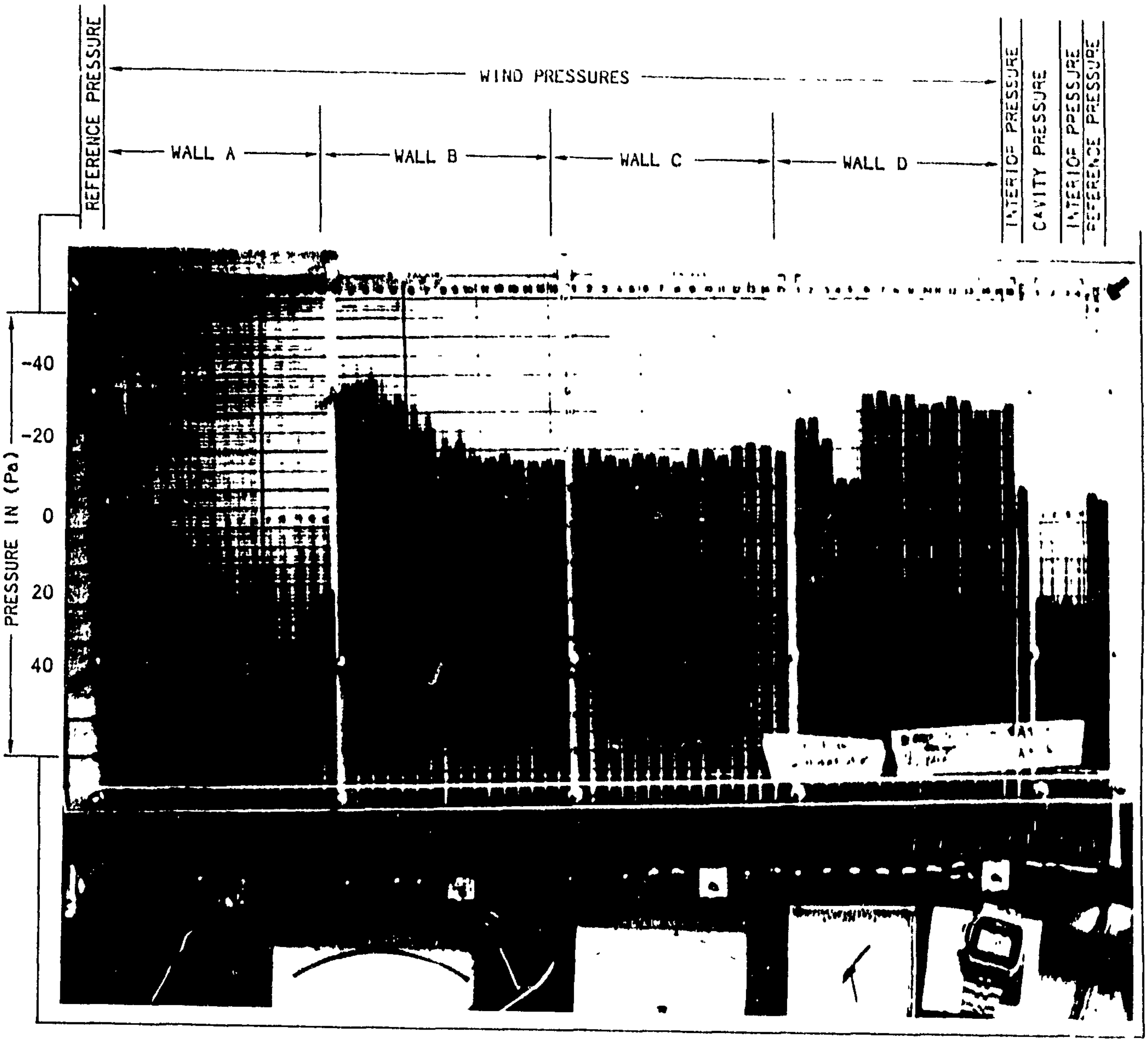

Figure A.34 Wind and cavity pressure profile around building with two vent holes A6, A10: 5cm x 13cm each (Table 4.1, case 14, experiment 6)

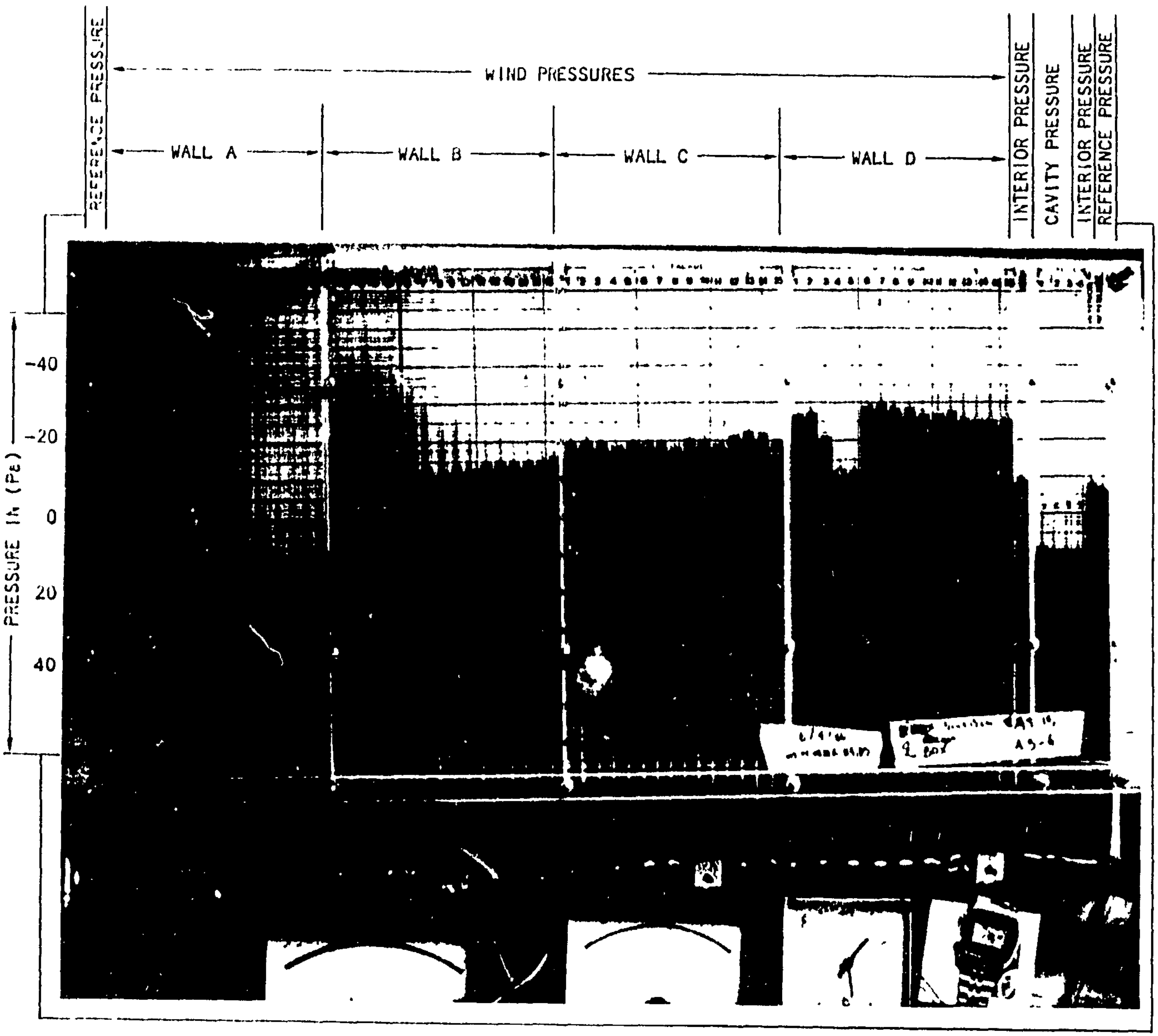

Figure A.35 Wind and cavity pressure profile around building with two vent holes A6, A10: 5cm x 13cm each (Table 4.1, case 14, experiment 11)

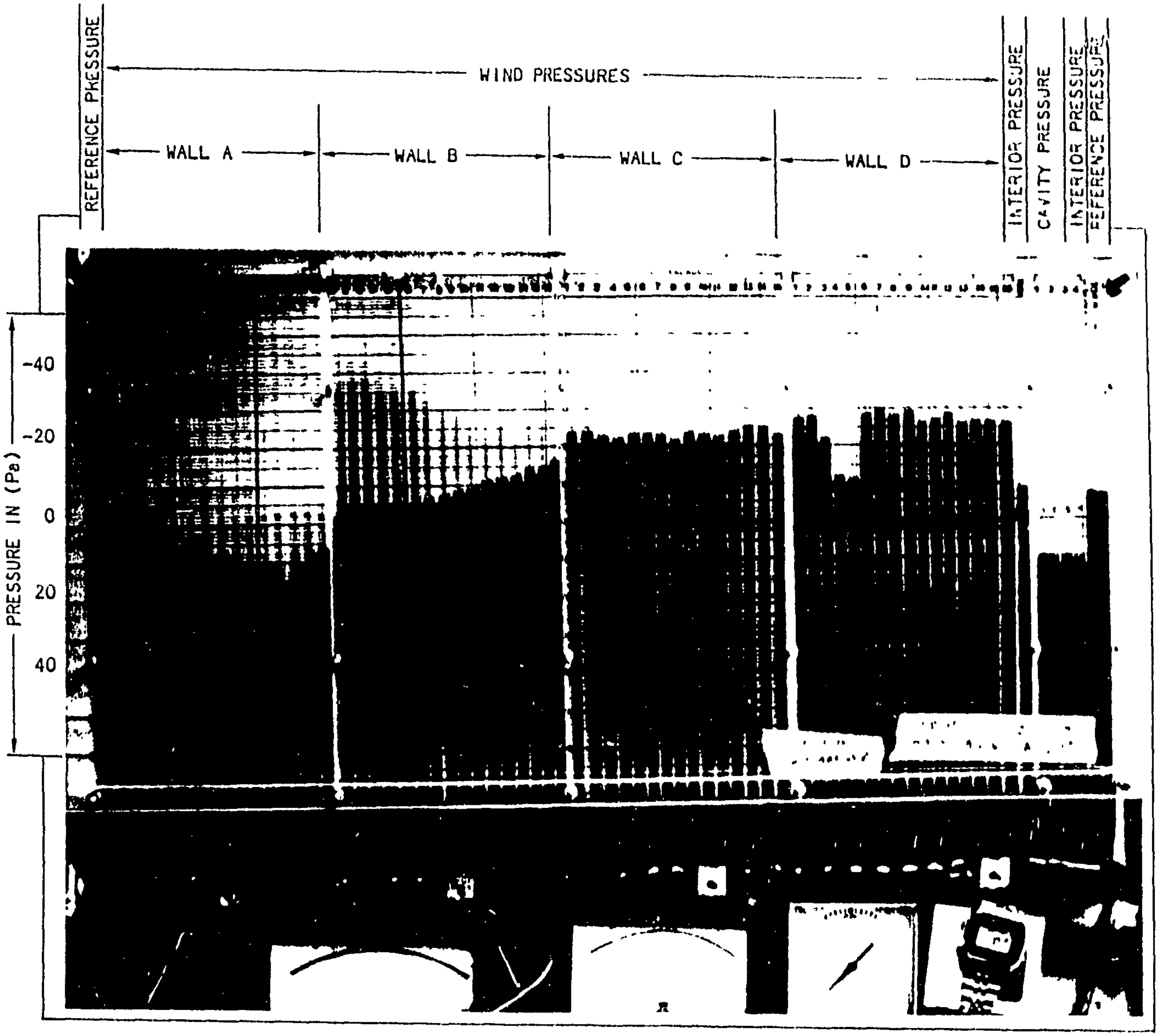

Figure A.36 Wind and cavity pressure profile around building with three vent holes A6, A10 and A13: 5cm x 13cm each (Table 4.1, case 15, experiment 10)

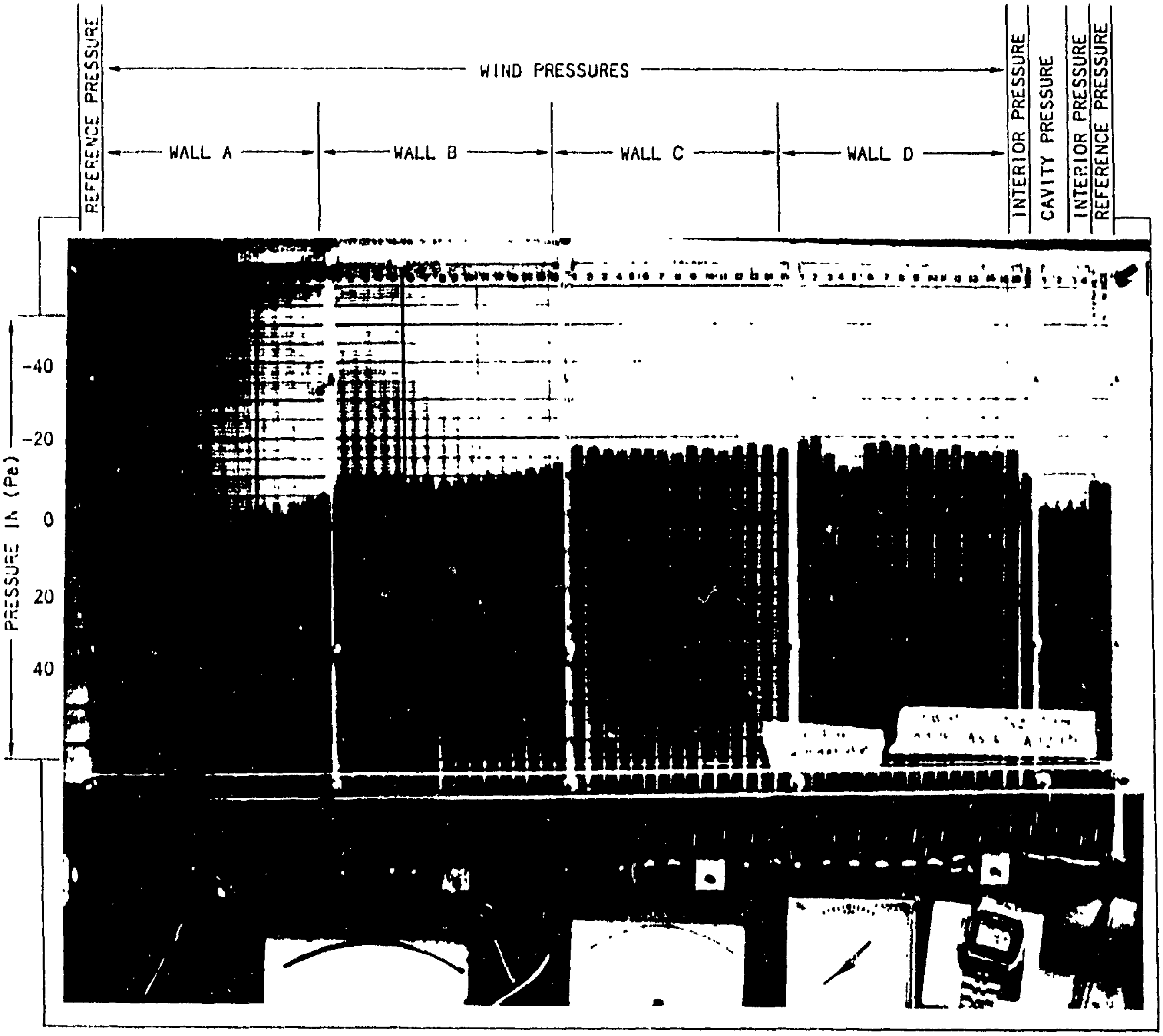

Figure A.37 Wind and cavity pressure profile around building with three vent holes A6, A10 and A13: 5cm x 13cm each (Table 4.1, case 15, experiment 18)

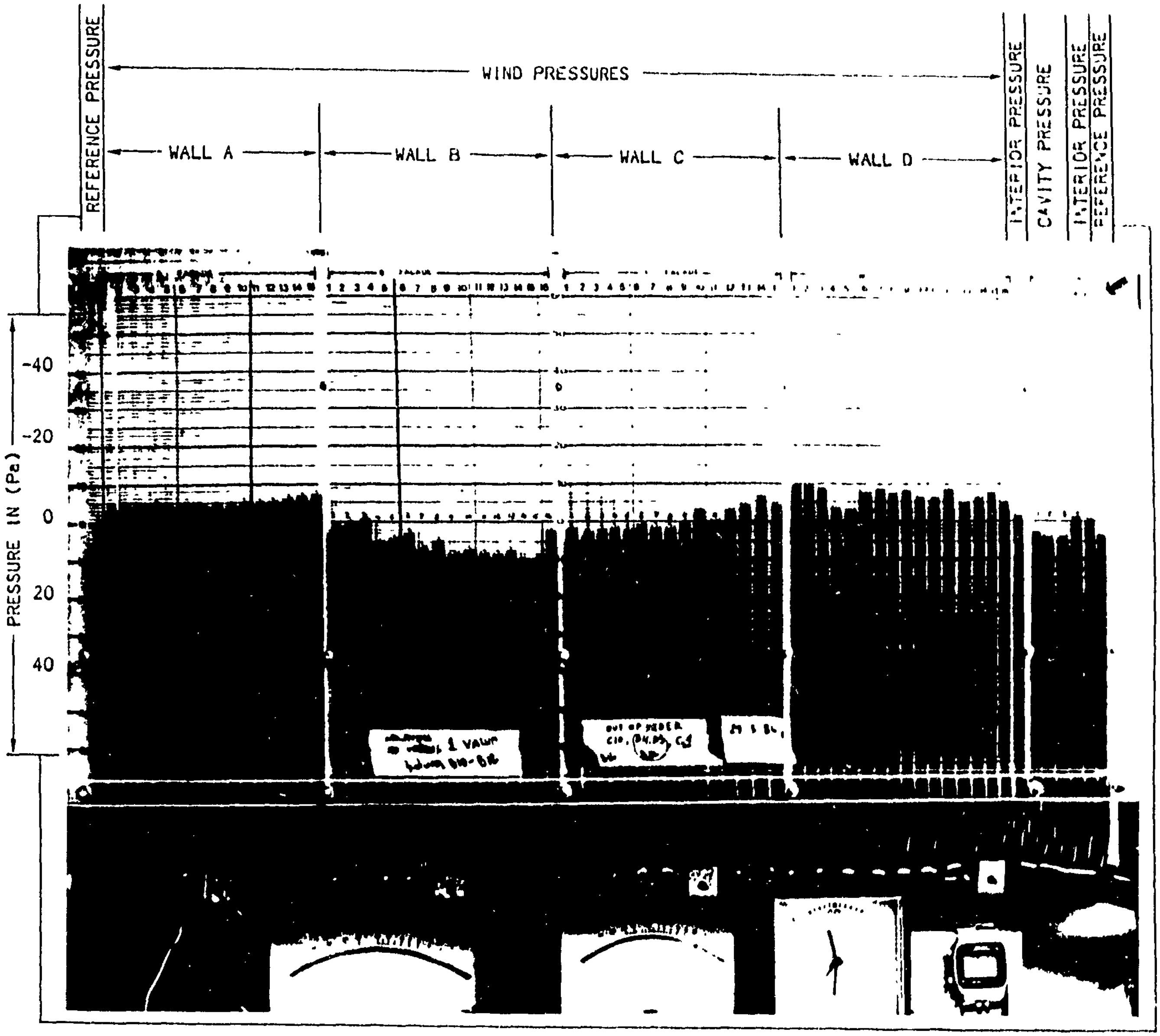

Figure A.38 Wind and cavity pressure profile around building with one valve B12 (Table 4.1, case 16, experiment 6)

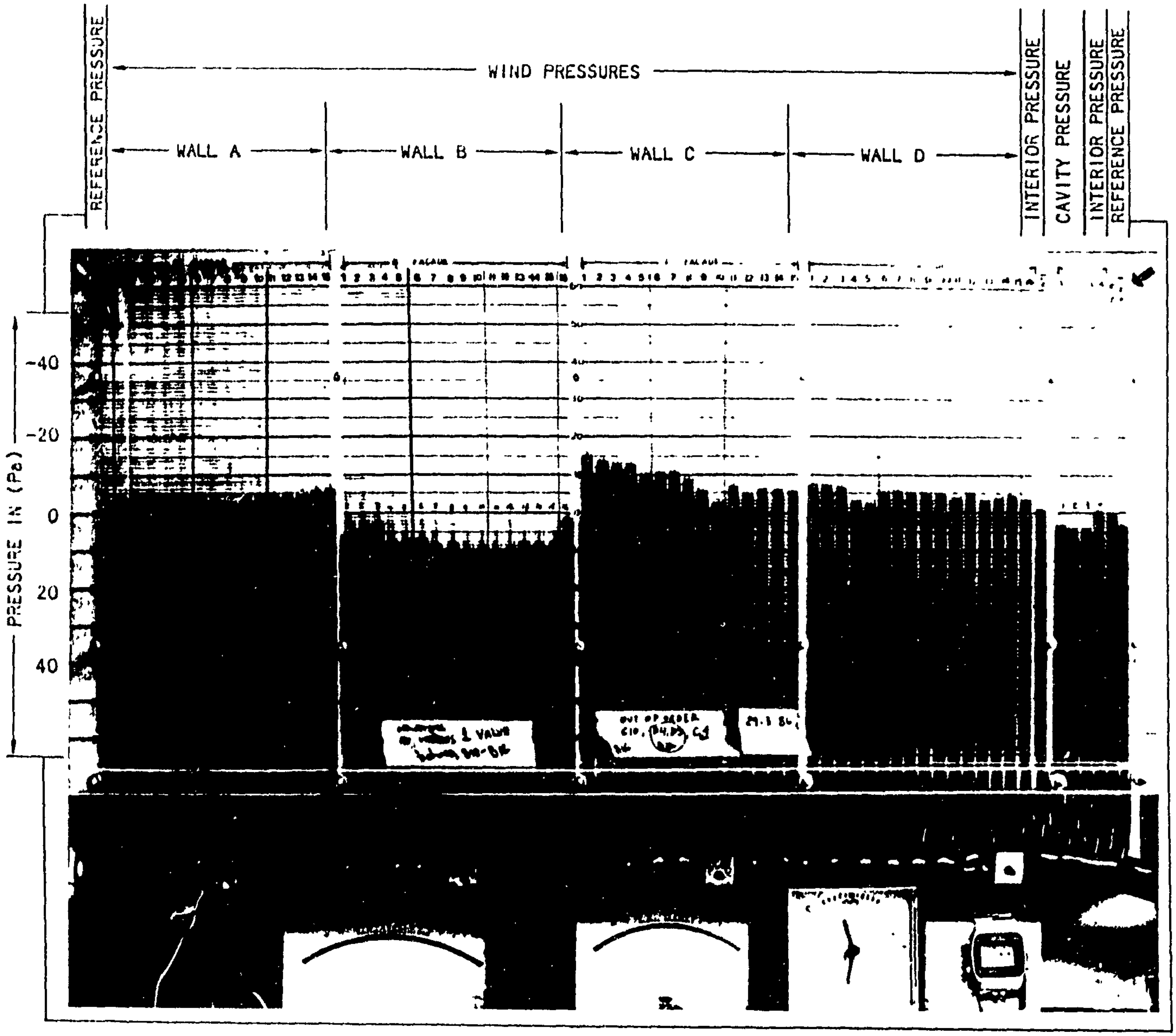

Figure A.39 Wind and cavity pressure profile around building with one valve B12 (Table 4.1, case 16, experiment 13)

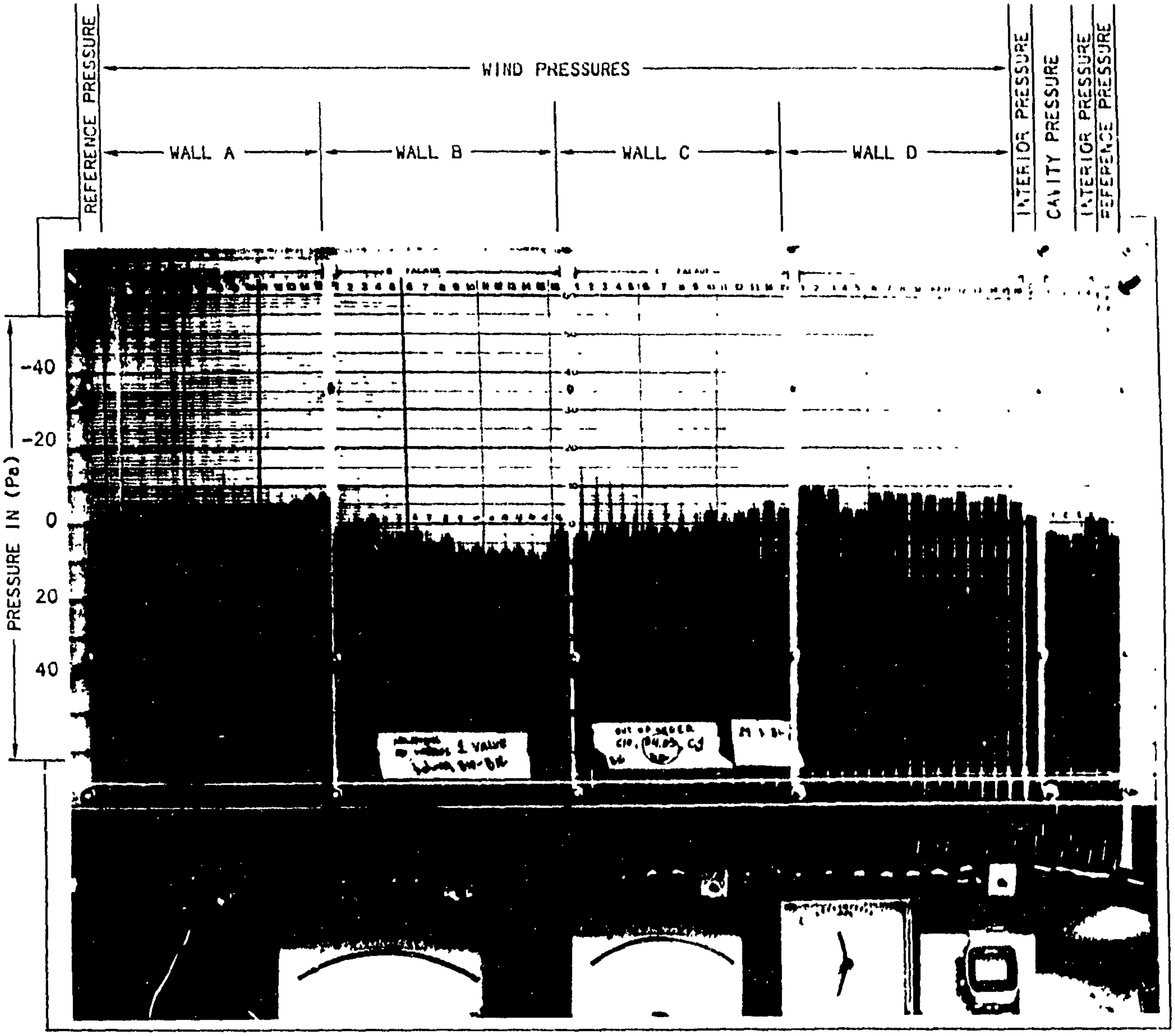

Figure A.40 Wind and cavity pressure profile around building with one valve B12 (Table 4.1, case 16, experiment 28)

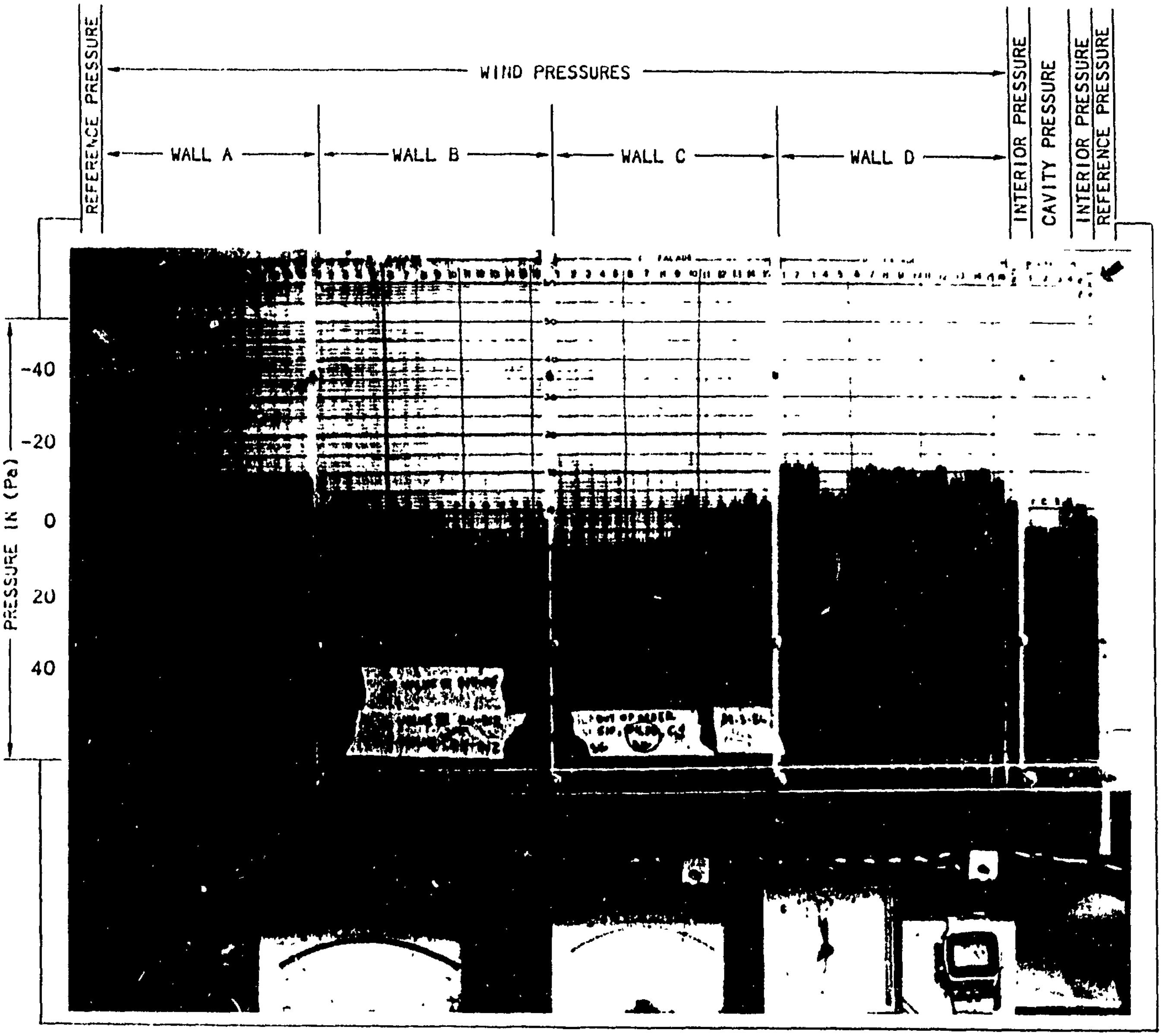

Figure A.41 Wind and cavity pressure profile around building with two valves B12 and B15 (Table 4.1, case 17, experiment 13)

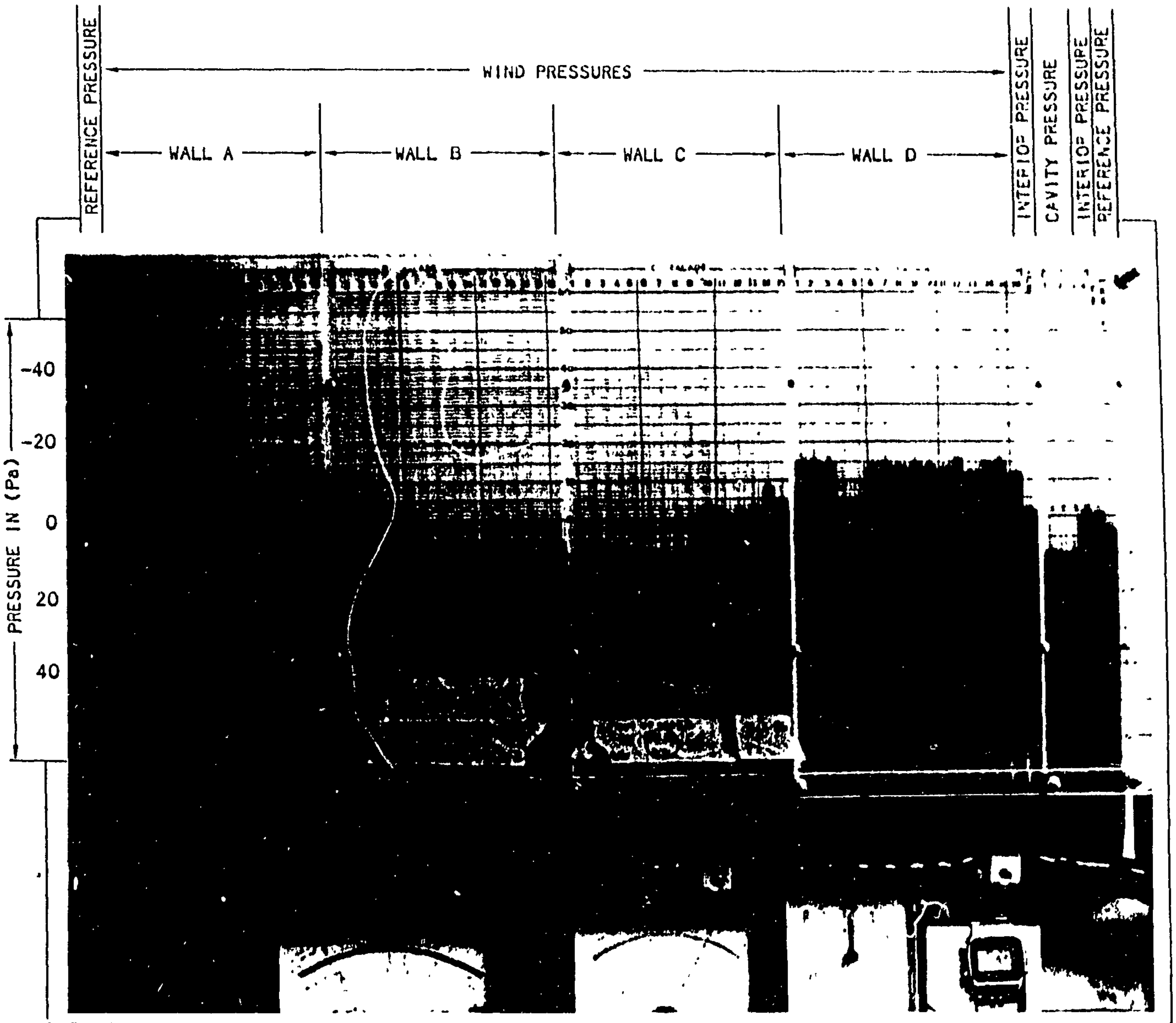

Figure A.42 Wind and cavity pressure profile around building with two valves B12 and B15 (Table 4.1, case 17, experiment 32)

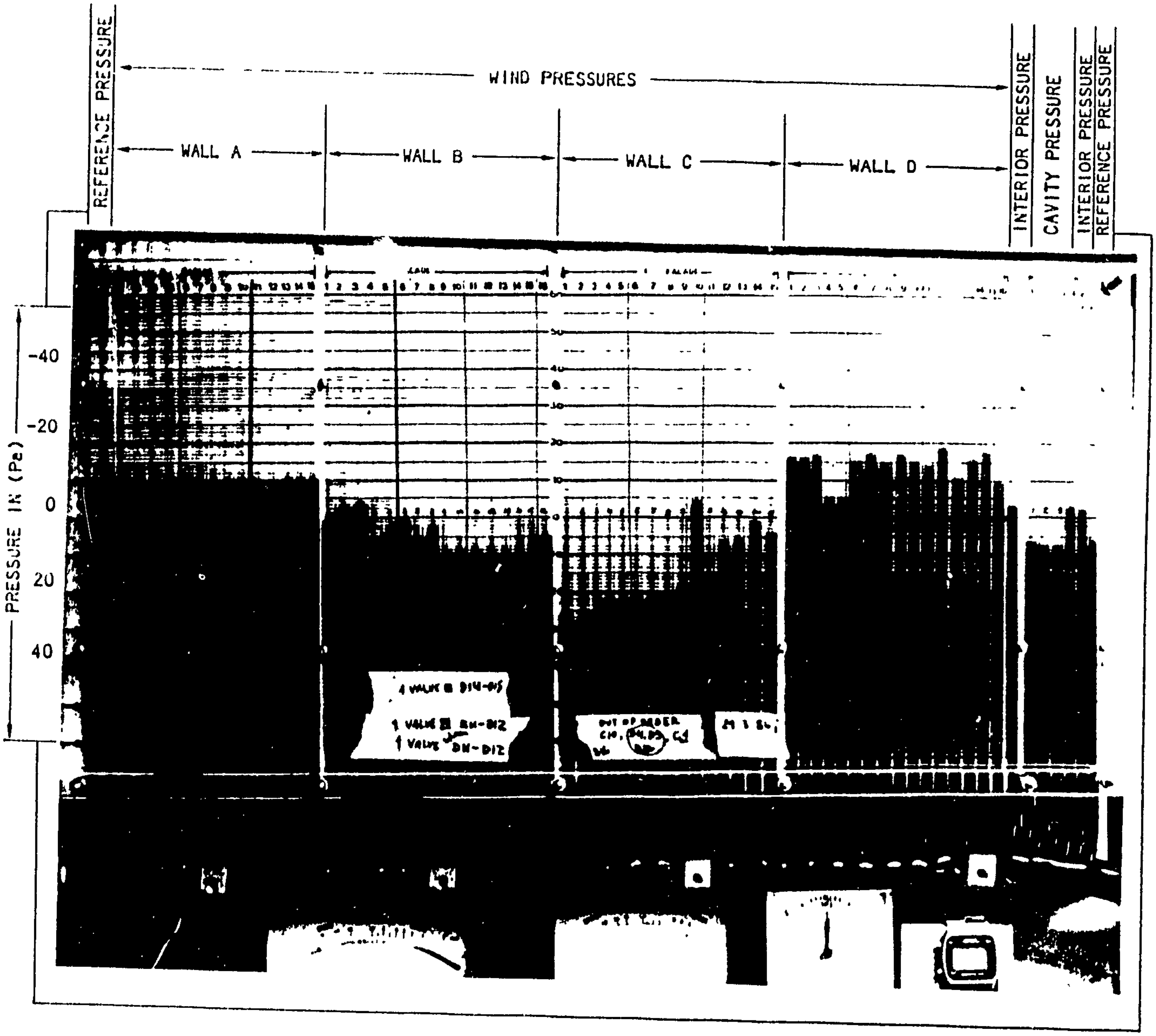

Figure A.43 Wind and cavity pressure profile around building with two valves B12 and B15 (Table 4.1, case 17, experiment 35)

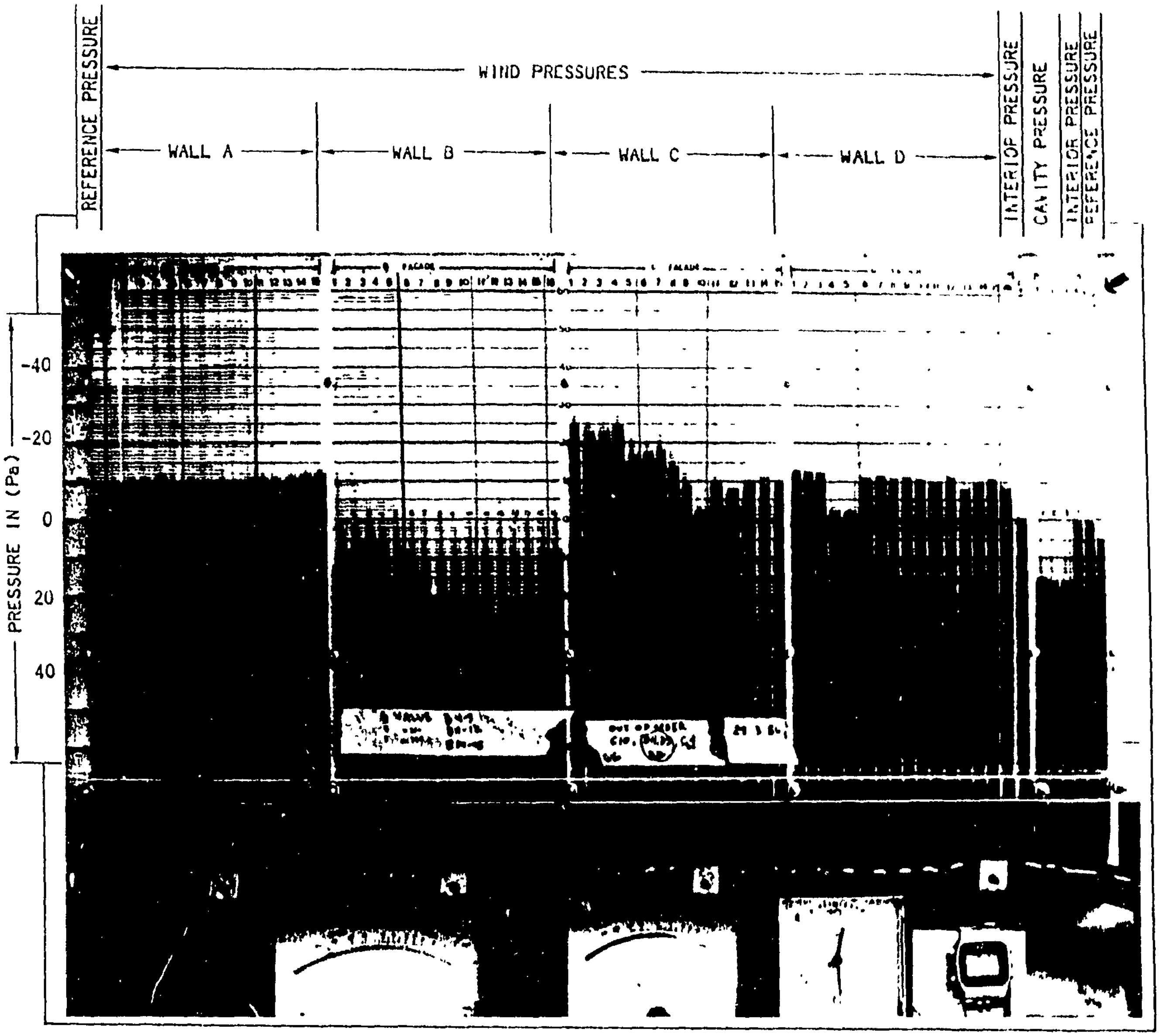

Figure A.44 Wind and cavity pressure profile around building with three valves B5, B12 and B15 (Table 4.1, case 18, experiment 3)

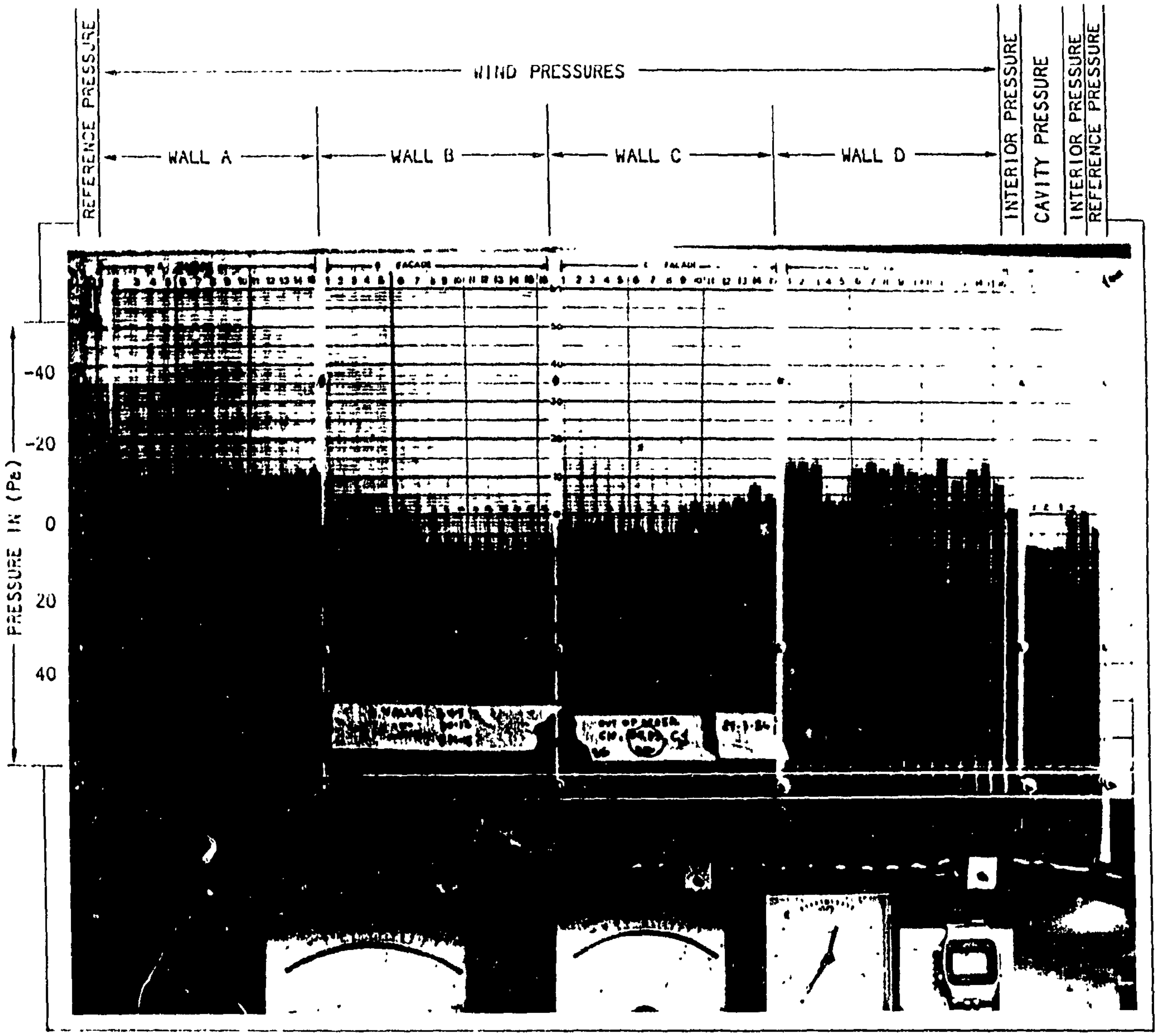

Figure A.45 Wind and cavity pressure profile around building with three valves B5, B12 and B15 (Table 4.1, case 18, experiment 5)