REDUCTION OF NOISE FROM MULTI-HEAD WOODWORKING PLANERS

A TECHNICAL GUIDE

OSH
OCCUPATIONAL SAFETY & HEALTH SERVICE

DEPARTMENT OF LABOUR
TE TARI MAHI

Addendum: Health and Safety in Employment Act 1992

Since this hooklet was first published, the Health and Safety in Employment Act 1992 has come into force. While the technical and general information in this booklet remains current, it contains references to legislation which has been superseded by the new Act. You are advised to read this booklet in conjunction with the Act and any regulations made under it. Your local Occupational Safety and Health Service office can provide further information.

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1. Introduction

For some years the high levels of noise associated with the operation of multi-head planing and moulding woodworking machines have been of concern to the manufacturers and informed owners of machinery, and to agencies concerned with the health of employees.

2. Noise criteria

The Department of Health estimates that a noise level of 85 dB(A) for a period of 8 hours, or an equivalent to this, is a low risk for noise-induced hearing loss. In the operator's position, the noise level generated during the operation of a 4-sider, depending on the type of wood being planed etc, would be in the region of 100 dB(A). Thus, an operation of less than 15 minutes per day (1 1/4 hours per week) would exceed the Health Department's recommendations.

3. New Zealand legislation

The noise provision of the Factories and Commercial Premises Act 1981 requires the occupier of an undertaking to take all practicable steps to reduce the noise from a process by controlling the noise at source or by isolating or insulating the process. The long-term use of personal hearing protection is acceptable only where no practicable solution is available or as an interim measure pending the installation of control measures. Many occupiers successfully operate acoustically enclosed multi-head planers and the practicability of insulating this machinery, in terms of the Act, has now been demonstrated.

When designing an acoustic enclosure, both the cost effectiveness and technical feasibility should be considered. If the criteria of 85 dB(A) cannot be met by the installation of an enclosure, because of unreasonable limitations of operation or cost, then the requirements of the Act would still be met if it can be shown that further reductions are impracticable. Hearing protection may still be required to be worn by the operators, subsequent to the installation of the enclosure.

4. Reduction of noise at design stage

Most manufacturers of planers have attempted, with some success, to reduce noise by experimentation with the factors governing the generation of noise, such as speed of rotation and the distance between the tool and the table edges. Because of the requirements of safety and precision, these modifications are limited and cannot, at present, effectively reduce the noise. Certain manufacturers have, therefore, opted for custom-built enclosures, and these are available on many of the newest machines.

However, the idea of acoustically enclosing planing machines is not a new one. For many years numerous operators of this type of equipment have experimented with different designs with varying degrees of success. Several companies in New Zealand have now designed, manufactured and installed acoustic enclosures for multi-head planers which reduce the noise exposure of the operators to acceptable levels. Correctly designed, these enclosures provide a greatly improved noise climate, not only for the operator but throughout the factory, with additional benefits such as better dust and chip control and lighting.

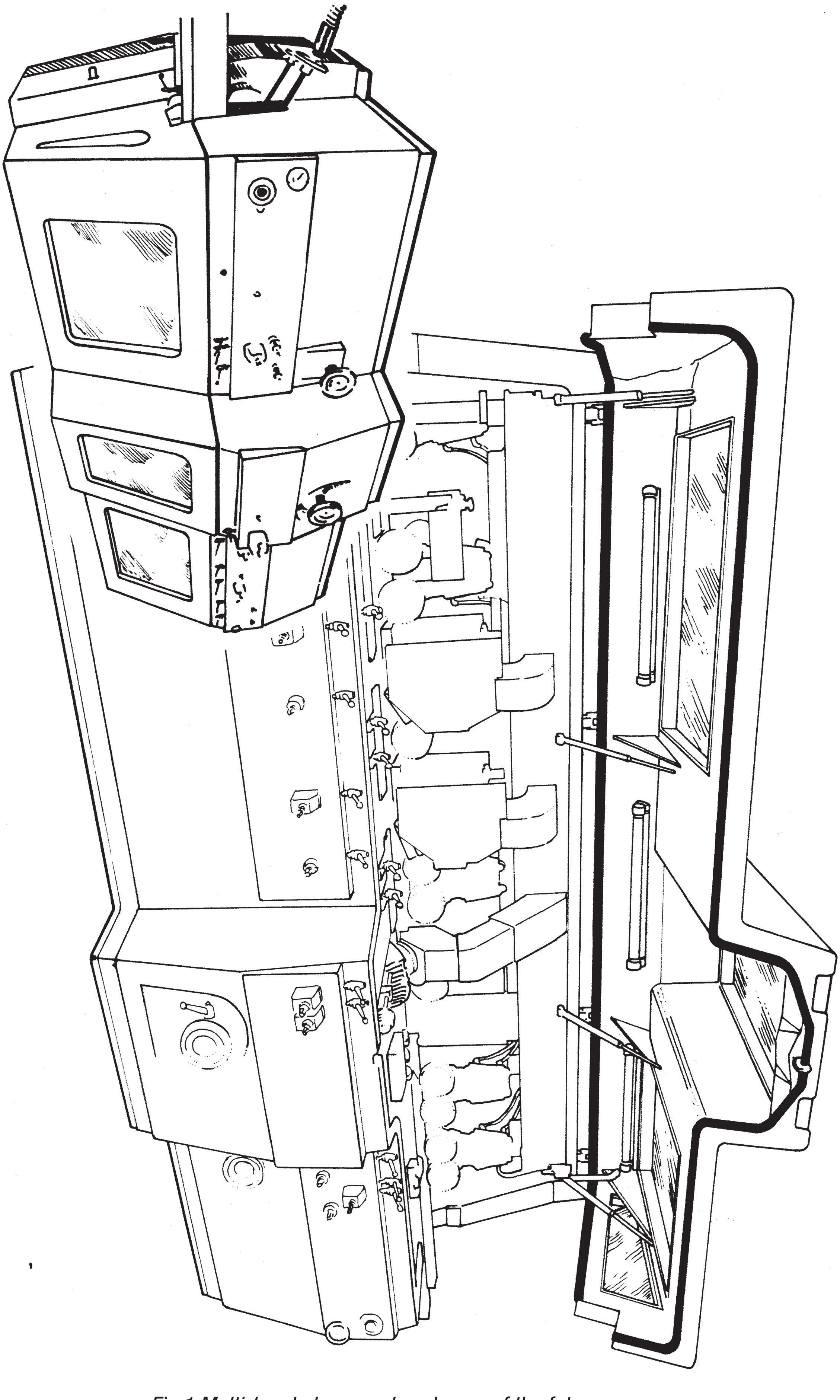

Fig.1 Multi-head planer and enclosure of the future

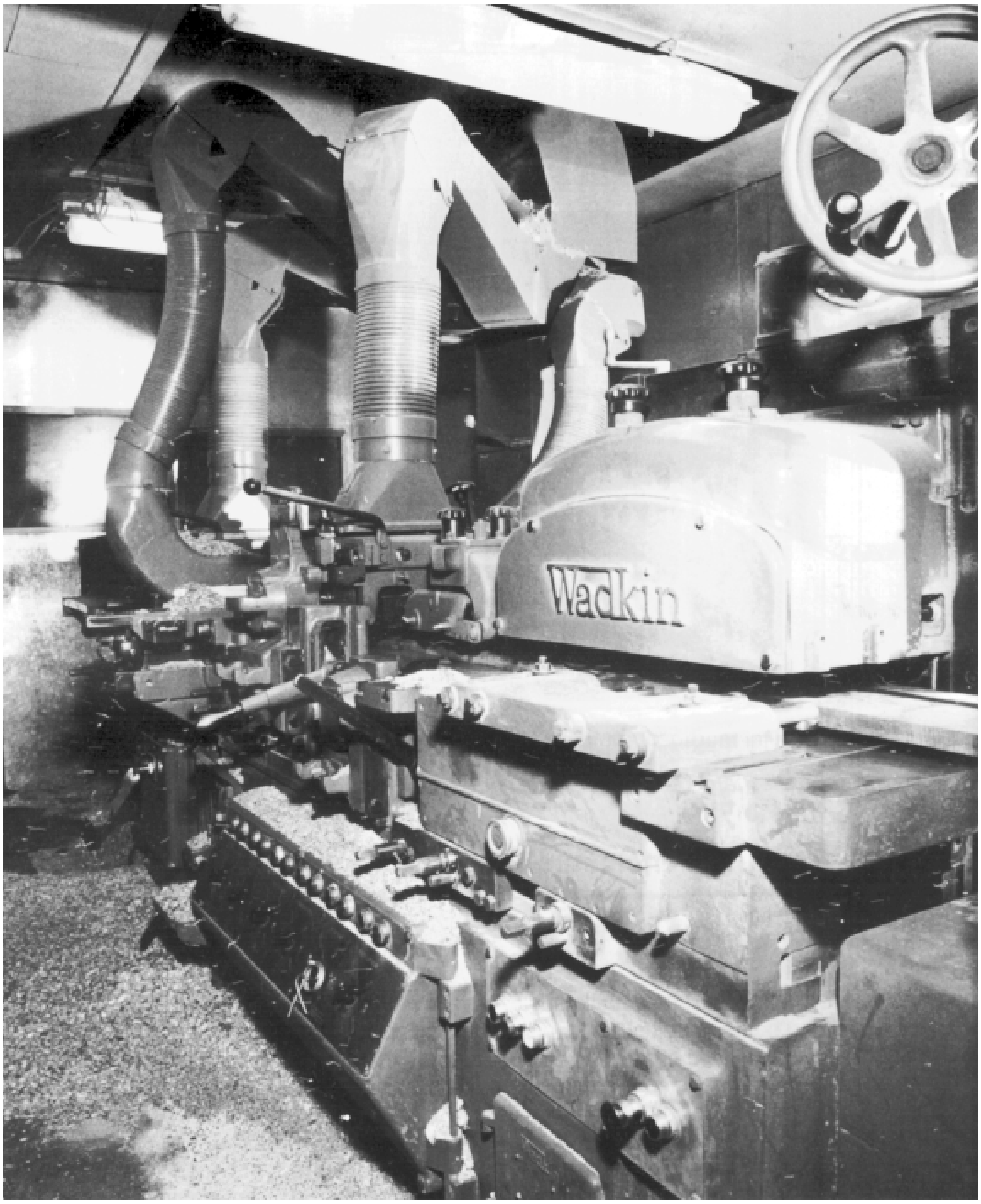

Fig.2 Inside enclosure at Carter Holt (Central) Limited, Napier

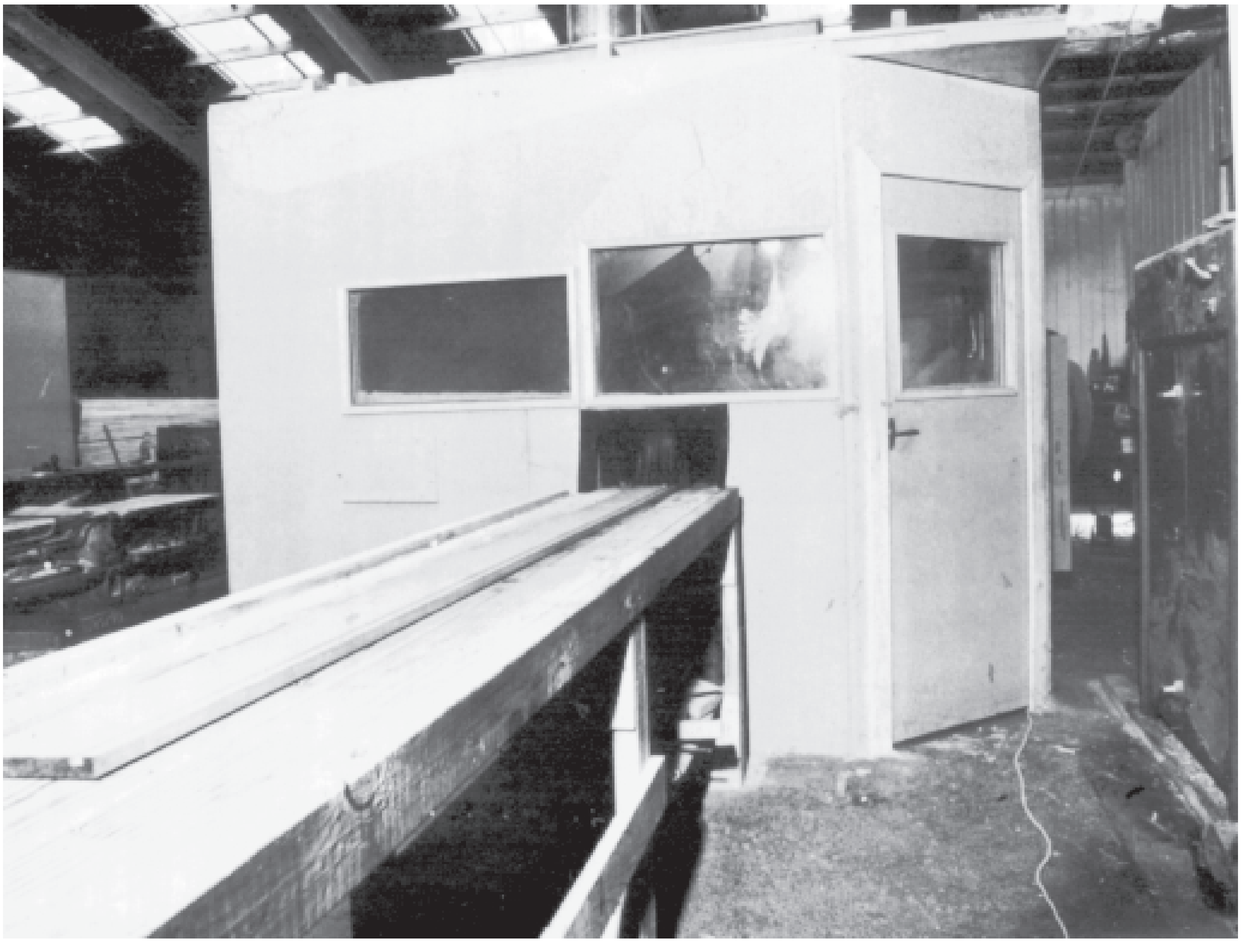

Fig. 3 Discharge end of enclosure at Carter Holt (Central) Limited, Napier

5. Design of acoustic enclosure

(a) General

The most popular design for an acoustic enclosure allows the operator to enter the enclosure through close fitting doors to adjust and maintain the machine. The simple construction and availability of materials would enable the enclosure to be manufactured locally, possibly by the company operating the machine. The majority of enclosures are based on a particle board or plywood outer skin on 100 mm x 50 mm studs with the enclosure lined with sound-absorbent material (details are discussed later in this booklet). The construction can be varied within limits to suit the materials available at the time. The solid wooden skin provides the attenuation and the sound-absorbent lining reduces the reverberation within the room, which, in turn, assists in the reduction of the noise transmitted to the surroundings.

Any air gaps in the enclosure or reductions in the density of its surface skin will reduce the effectiveness of the noise attenuation. Particular attention must therefore be paid to openings in the enclosure and windows must be sealed to prevent air leaks.

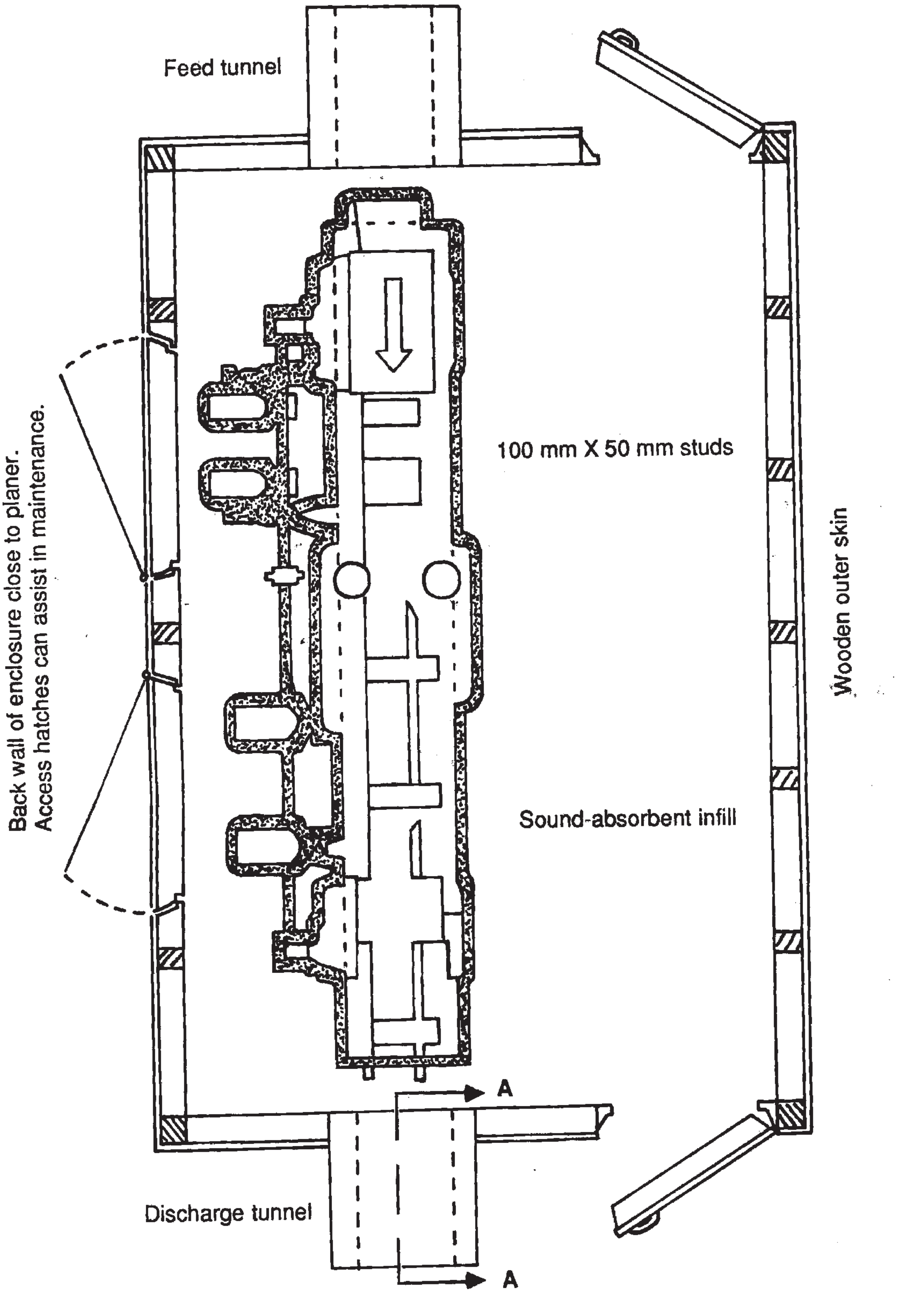

Fig.4 Typical layout of an acoustic enclosure for a multi-head planer

The positioning of windows and doors, and the overall design and finish of the enclosure, will also influence operator acceptance. By giving careful consideration to detail, hindrance to the machine's operation can be reduced to a minimum, thus overcoming operator resistance and maintaining an efficient level of production.

Good lighting, in either tungsten or fluorescent lamps, should be installed to improve visual conditions for the operators of the machine. Care should be taken that fluorescent lamps are phased or coated to prevent the generation of a stroboscopic effect leading to misjudgment of the speed of rotating machinery.

(b) Isolation

The enclosure should be free-standing and not rigidly attached to the planer at any point. Direct contact will transmit vibration, thus reducing the effectiveness of the enclosure. Sponge rubber can be used for the dust extractor or duct penetrations to provide some isolation between the duct and enclosure and prevent noise leaking through the air gaps.

As low-frequency noise is not generally a problem with multi-head planers, mounting on antivibration devices should not be required but the machines should be positioned on firm, structurally sound foundations. Enclosure walls can be placed on rubber stripping to provide good acoustic sealing and isolation (see Fig. 5).

(c) Construction materials

The degree of attenuation required will depend upon the level of noise generated by the machine. Fig. 5 indicates a type of wall and roof construction that will attenuate the noise from a multi-head planer with a level of between 95 dB(A) and 105 dB(A) to approximately 85 dB.(A) at the operator position. The 20 mm particle board would need to be upgraded should the noise level at the operator position exceed 105 dB(A). One method of achieving this would be by bonding, say, 12 mm gypsum board to all internal surfaces of the wooden outer skin prior to installation of the sound-absorbent material. The bonding agent should be applied to the whole contact surface.

Glass fibre or mineral wool batts are commonly used as a sound-absorbent infill. The sound absorbent material should be installed comprehensively over the walls and ceiling, and fitted snugly between the studs. It should be compressed slightly and held in place by a suitable mesh or fabric. Over-compression or packing will result in a deterioration of the acoustic properties. Retaining the batts with chicken wire alone can look unsightly and a professional-looking finish with a hemp hessian material or woven glass fabric will prove more acceptable. Peg board with 25 - 30% perforation is also a commonly used finish. This has the disadvantage of being easily damaged, although a suitably situated wooden rail within the enclosure can often provide some protection.

All the materials mentioned have proved effective when incorporated in an acoustic enclosure. The list is by no means complete and there are examples of metal framed rooms or mild steel panelwork system enclosures that have proven equally, if not more, effective. When choosing materials the variables of acoustic requirements, cost and availability must all be considered but it is hoped the above will serve as useful guidelines.

(d) Doors

All doors should be constructed of a similar material or a material of equivalent sound attenuating properties to that used for the walls and roof. The door should fit as tightly as possible. Resilient (rubber or neoprene) seals can be incorporated all round the top and sides

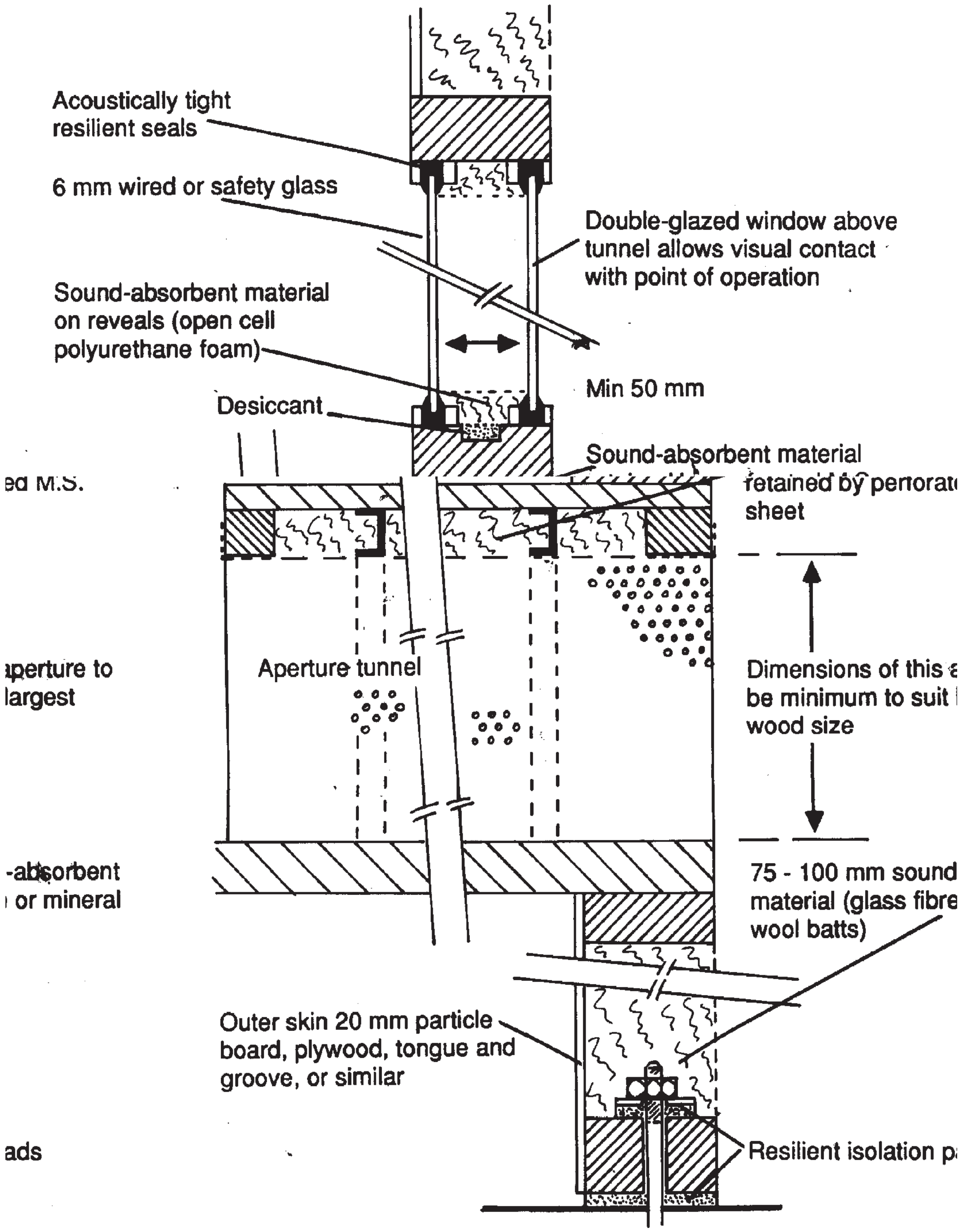

Fig.5 Section through A-A (refer to Fig.4) indicating an acoustic wall tunnel and window design

to accomplish a seal. If a raised threshold can be tolerated, the seal can be continued around the base of the door. Cam lift (rising butt) hinges can also be used to effect a seal at the base of the door.

Doors can be fitted with a compression latch and door closure springs, particularly if ventilation (discussed later) is incorporated in the design. Ventilation will reduce negative pressure in the enclosure produced by the dust extraction system and thus the doors will not be effectively sealed by suction.

(e) Windows

As windows can reduce the effectiveness of the enclosure, they should be installed only where necessary. A window can be installed between the operator on the feed side of the enclosure and the point of operation of the machine. A window can also be installed in a similar position on the discharge side. These windows should be positioned above and close to the feed and discharge aperture so that the operator can easily view the operation. Further windows will only be required for the safety supervision of any operator who has to enter the enclosure, and should be kept as small as possible.

Windows should preferably be double-glazed, with a minimum of 50 mm air gap between the panes. The glass should be mounted in acoustically tight, possibly resiliently lined frames. The use of 6 mm safety glass or wired glass is recommended. Wired glass has the drawback of impeding observation in certain circumstances, and to overcome this a spotlight can be mounted inside the enclosure to highlight the operation points. A sound-absorbent material can be used to line the reveals between the two panes as a final touch.

(f) Feed and discharge apertures

Particular attention must be paid to the workpiece feed and discharge openings. These openings dictate the level to which noise can be reduced at the operator positions. Several methods have been used to attenuate noise through the openings, but the first step should be to ensure that the aperture size is as small as possible to suit the maximum possible size of wood to be planed. If a table is used for feed or discharge, then a tunnel can be utilised.

Lining the tunnels with sound-absorbent material (25 mm - 50 mm of fibreglass or open cell polyurethane foam) will greatly increase the effectiveness. This absorbent material should be retained with a rigid but open material, e.g. perforated mild steel sheet, to prevent damage to the infill. The total length of the tunnel will depend on the open area of the aperture but between 600 mm and 900 mm is generally sufficient. If it is impracticable to use a tunnel then heavy resilient curtaining, possibly in strips, can be used but this tends not to be nearly as effective.

A common fault is to make the aperture large enough to see the machine, which seriously diminishes the noise climate at the operator position. The window should be built in low enough to provide this visual contact, thus allowing the aperture dimension to be reduced.

(g) Ventilation

A dust extraction system generally provides sufficient ventilation for the enclosure. If no additional provision is made for supply air to be drawn into the enclosure, the air can only enter through the feed and discharge openings and around the door seals etc. This added resistance may impair the efficiency of the system, and outward opening doors will prove difficult to open against the negative pressure. The provision of a ventilation panel or panels will overcome these deficiencies. Fig. 8 demonstrates one type of ventilation panel that will allow the passage

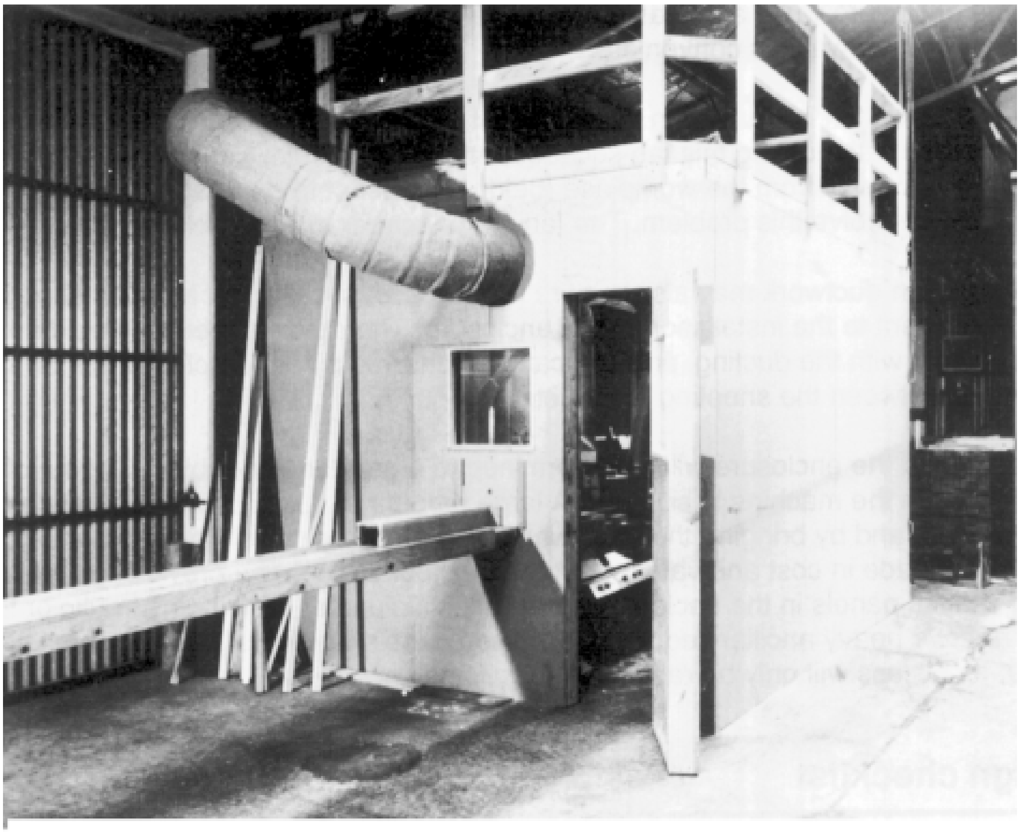

Fig. 6 4-sider at J B Mouldings Limited, Napier

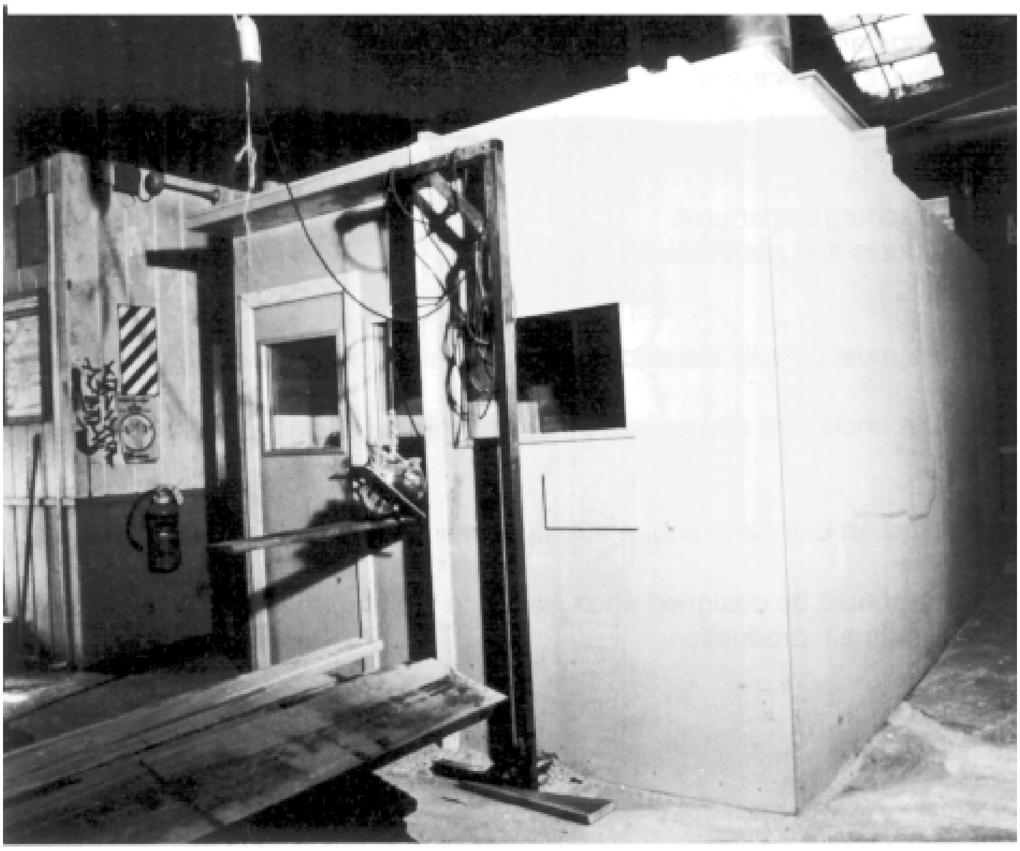

Fig.7 Feed end of enclosure at Carter Holt (Central) Limited, Napier

of air into the enclosure while attenuating the noise transmitted outwards. These panels can be installed in the roof or wall, as convenient.

If the dust extraction fan is situated in the vicinity of the multi-head planer, some attention may have to be given to attenuating this fan subsequent to the remedial work being undertaken. Repositioning the fan away from the workplace (being careful not to generate a neighbourhood noise problem) can solve this problem. The fan manufacturer may be able to assist.

The dust extraction ductwork may also require lagging acoustically with a dense sheeting material subsequent to the installation of the enclosure. The dense sheeting should not come into direct contact with the ducting, and this can be achieved by sandwiching, say, 50 mm of glass fibre mat between the sheeting and duct.

The dimensions of the enclosure will be determined to a greater extent by the layout of the workshop in which the machine is situated. A large amount of space behind the machine is generally wasted, and by bringing the back wall of the enclosure close to the planer, good savings can be made in cost and valuable workshop floor space. The provision of intelligently positioned access panels in the enclosure can prove invaluable, allowing hydraulic or forklift access to remove heavy ancillary equipment. These panels would not need to be easily demountable, as access will only be required intermittently.

6. Design checklist

(a) Ensure that the material of construction is sufficient to attenuate the noise to the recommended level at the operator position within the limitations of cost effectiveness and availability.

(b) Areas requiring particular attention to detail to maintain acoustic integrity production and overcome operator resistance are:

- Doors
- Windows
- Feed and discharge apertures
- Ventilation ducts and penetrations
- Good lighting

(c) The enclosure must be fully isolated from the vibration of the machine.

(d) The size of the enclosure and access panels should be designed to suit on-site requirements.

(e) The dust extraction unit may require attenuation subsequent to the work on the planer.

(f) The enclosure should be designed and finished to a standard that will enhance operator acceptance and maintain production.

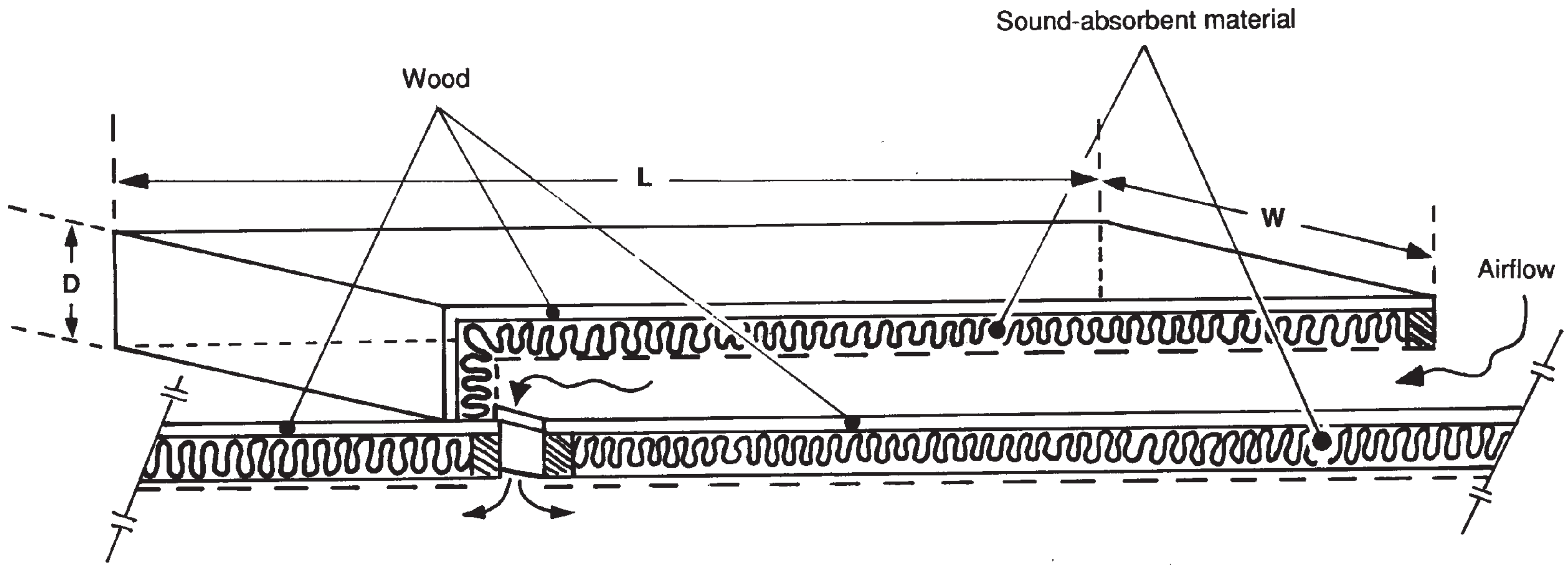

Fig 8 Section showing root ventilatlon panel

L = 1500 -1800 mm
W = 1200 -1 500 mm (The greater dimension reduces the resistance to airflow).
D = 125 - 175 mm (Consisting of 20 mm wood, 50 - 100 mm sound-absorbent material and approximately 60 mm air gap).
The construction of the panel would be of similar material to the enclosure for compatibility.