

Installation of flues and ventilation for gas appliances of rated input not exceeding 60 kW (1st, 2nd and 3rd family gases) —

**Part 1: Specification for installation of
flues**

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Gas Standards Policy Committee (GSE/-) to Technical Committee GSE/30, upon which the following bodies were represented:

- British Flue and Chimney Manufacturers' Association
- British Gas plc
- Confederation for the Registration of Gas Installers
- Consumer Standards Advisory Committee of BSI
- Department of the Environment
- Department of Trade and Industry (Consumer Safety Unit, CA Division)
- Health and Safety Executive
- Institute of Domestic Heating and Environmental Engineers
- Institution of Gas Engineers
- Liquefied Petroleum Gas Industry Technical Association (UK)
- Society of British Gas Industries
- Trades Union Congress
- Coopted members

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Foreword

This Part of BS 5440 has been prepared under the direction of the Gas Standards Policy Committee. It is a revision of BS 5440-1:1978 which is withdrawn.

This revision has been undertaken because of the need to:

- a) cover recent developments in appliance design, flue material and practical experience in the disposal of products of combustion by means of flues;
- b) refine and improve the method of sizing an individual open flue according to its route and height;
- c) expand on the recommendations for siting terminals and to prohibit the use of wall terminals with open flue natural draught systems;
- d) describe in further detail means of safeguarding against blockage of appliance flue connections in brick chimneys;
- e) continue to emphasize the use of room-sealed systems where practicable.

The various flue systems are grouped in either open, closed or room-sealed forms and classified by whether they are natural or fanned draught types.

NOTE This standard has been written in the form of a practice specification (see clause 6 of PD 6501-1:1982). To comply with this specification, the user has to comply with all its requirements. He may depart from recommendations, but this would be his own responsibility and he would be expected to have good reasons for doing so.

It is essential that the appropriate specifications/codes of practice are consulted on all aspects of appliance and flue installation.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

In particular, attention is drawn to the following.

- a) Statutory Instrument 1358:1984: The Gas Safety (Installation and Use) Regulations 1984.
- b) Statutory Instrument 1065:1985 (as amended): Building Regulations 1985.
- c) Statutory Instrument 1596:1981 (as amended): The Building Standards (Scotland) Regulations 1981.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 40, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 5440 specifies the design and installation requirements for flue systems which form part of a new or replacement appliance installation for domestic or commercial purposes. It specifies natural and fanned draught flues for appliances which comply with the appropriate British Standard specification, utilize 1st, 2nd or 3rd family gases and have rated heat inputs not exceeding 60 kW.

This standard deals with the complete flue equipment from the appliance connection to the discharge to outside air. It also covers flues that were intended originally for appliances burning other fuels but which are subsequently used for gas appliances.

NOTE 1 For information on flues for appliances having rated inputs exceeding 60 kW, reference should be made to BS 6644.

NOTE 2 The installation of additional efficiency-enhancing equipment into the flue system is excluded from this standard.

NOTE 3 For specific information on incinerators see BS 3813-1.

NOTE 4 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 5440 the definitions given in BS 1179:1967 and BS 1179-6 apply, together with the following.

2.1

balanced-flued appliance

a room-sealed appliance which draws its combustion air from a point adjacent to the point at which the combustion products are discharged, the inlet and outlet being so disposed that wind effects are substantially balanced

2.2

branched flue system

a shared open flue system serving appliances situated on two or more floors

2.3

builder's opening

a space formed in a wall or chimney breast into which an appliance may be placed and from which a flue leads

NOTE This is sometimes called a fireplace recess.

2.4

chimney

a structure enclosing a flue or flues

2.5

chimney liner

a rigid or flexible pipe inserted in a chimney to form a flue

2.6

closed flue system

a flue system that is closed to a room or internal space due to the absence of a draught diverter, flue break and any draught break on the appliance

2.7

common flue system

a shared open flue system serving two or more appliances installed in the same room or space

2.8

condensate drain

a fixture in a flue or appliance (resistant to corrosion from condensate formed from the products of combustion), where condensate can be drained

2.9

condensate pipe

a pipe, which may also be part of the flue pipe (resistant to corrosion from condensate formed from the products of combustion), which is leak free, and along which condensate may flow

2.10

condensing appliance

an appliance designed to make use of the latent heat from the water vapour in the combustion products by condensing the water vapour within the appliance

2.11

core

a device to be inserted into, and drawn through, a flue for the purpose of clearing surplus jointing material and any other debris and ascertaining whether the flue is clear

2.12

decorative fuel effect gas appliance

an open-flued appliance designed to simulate a solid fuel open fire primarily for decorative purposes and intended to be installed so that the products of combustion pass unrestricted from the firebed to the flue

2.13

draught break

an opening into any part of an open flue system, including that part integral with the appliance

2.14

draught diverter

a device for preventing conditions in a secondary flue from interfering with the combustion performance of an appliance

2.15**drip collar**

a device fitted on or around a sloping pipe or duct, designed to direct the flow of moisture to a particular course

2.16**fan-diluted flue system**

a fanned draught open flue system in which the products of combustion are diluted with air to an agreed low concentration

2.17**fanned draught flue system**

a flue system in which the removal of flue products is dependent on the fan

2.18**fire stop**

a barrier or seal of non-combustible material which is designed to prevent or retard the passage of smoke or flames

2.19**flue**

a passage for conveying combustion products to the outside air

2.20**flue break**

an opening into a secondary flue in the same room as, and in addition to, the opening at the draught diverter

2.21**flue pipe**

a pipe enclosing a flue; for a double-walled type it is the inner pipe

2.22**flue system**

a complete assembly of flue components from one or more appliances to a single terminal including primary flue(s) and draught diverter(s), if any

2.23**independent flue system**

a flue system that is not built into the structure of a building but may be supported by attachment thereto

2.24**individual flue system**

a flue system serving one appliance only

2.25**main flue**

that part of a shared open flue system carrying products of combustion from two or more appliances

2.26**natural draught flue system**

a flue system in which the draught is provided by the thermal force arising from the heat of the products of combustion

2.27**open flue system**

a flue system that is open to a room or internal space at each appliance position

2.28**open-flued appliance**

an appliance designed to be connected to an open flue system, its combustion air being drawn from the room or internal space in which it is installed

2.29**pluming**

a visible cloud formed when products of combustion exit from a flue and are cooled below the dew point by mixing with external air

2.30**precast chimney block**

a factory-made block chimney system which can be either free standing or built into a wall

2.31**precast flue block**

a block, incorporating a preformed section of flue, that can be built into a wall with other flue blocks to form a chimney

2.32**room-sealed appliance**

an appliance that, when in operation, has the combustion system including the air inlet and the products outlet, isolated from the room or space in which the appliance is installed

2.33**secondary flue**

that part of an open flue system connecting a draught diverter or draught break to the terminal

2.34**secondary flue height**

the vertical distance between two horizontal planes passing respectively through the top of the draught diverter, or in the case of a gas fire the spigot, and the base of the terminal

2.35**secondary flue length**

the distance along the central line of the flue between two horizontal planes passing respectively through the top of the draught diverter, or in the case of a gas fire the spigot, and the base of the terminal

2.36**Se-duct**

a duct rising vertically through a building, open at its extremities, and serving to bring combustion air to, and to take products to the outside air from, room-sealed appliances

2.37**shared flue or duct system**

a flue or duct system serving two or more appliances

2.38**subsidiary flue**

that part of a shared open flue system which connects the appliance outlet to the main flue

2.39**terminal**

a device fitted at the flue outlet to allow or assist products of combustion to escape, minimize downdraught and prevent entry of material which might block the flue

2.40**terminal guard**

a device fitted over a terminal in order to protect persons from contact with, prevent interference with and prevent damage to, the terminal

2.41**termination**

the outlet of the flue system from which products of combustion discharge into external air

2.42**U-duct**

a duct in the form of a vertical U, the ends being open and adjacent, one limb of which provides combustion air whilst room-sealed appliances are fitted to the other limb

3 Preliminary design considerations**3.1 Types of flue system**

Flue systems shall be one of the types shown in Figure 1 according to the form of the appliance (room-sealed, open or closed).

COMMENTARY AND RECOMMENDATIONS ON 3.1. *The need to discharge the products of combustion to the outside air through a flue is dependent on the thermal input of the appliance, the period of continuous use and the size of the room. Reference should be made to the appropriate appliance and installation specifications, codes of practice and manufacturers' instructions for specific requirements including those for flueless appliances.*

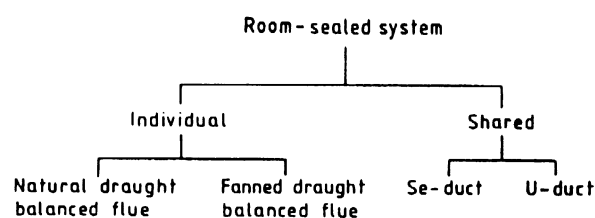
Of the three major forms of flue system, shown diagrammatically in Figure 1(a), Figure 1(b) and Figure 1(c) the room-sealed form neither contributes to, nor places any requirement on the ventilation of the room containing the appliance. Open flue systems operate with appliances receiving air for combustion from the installation space which thus requires a source of air supply. Such flue systems participate in the ventilation of the room. Closed flue systems operate with appliances which take air for combustion from either inside or outside the appliance space. See BS 5440-2 for specific ventilation requirements.

For all these forms of flue system, the motive power to discharge the products of combustion to the outside may be produced either thermally (derived from the temperature excess of the flue gases over ambient temperature) or by means of a fan. Where a fan is included in a room-sealed or closed flue system, it will be an integral part of the appliance. For open flue systems, the fan may be integral with the appliance or comprise an independent unit with appropriate safety controls (see clause 5).

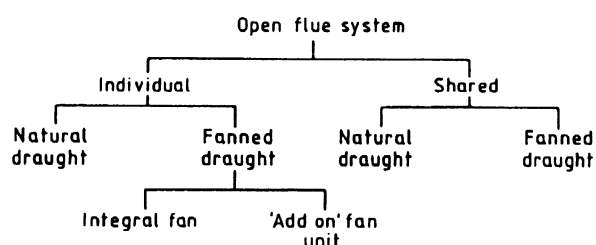
Certain appliances are designed to extract latent heat from the water vapour in the products of combustion and require provision for the draining of the condensate so formed. The temperature of the products at the appliance outlet may be low enough to permit the application of materials and constructions of novel form (see clause 10).

The choice of flue system for a specific situation will be dependent on the types of appliance available to provide the service required and the proposed location of the appliance. As the motive power generated by a fan is considerably greater than that generated thermally, fanned systems may prove advantageous in view of their greater flexibility in flue run, reduced flue size and less critical termination and siting for single or multiple appliance installations.

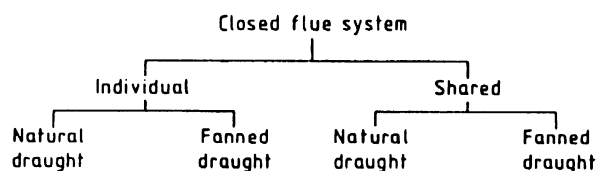
In general, the room-sealed method of flueing has advantages over an open flue system and should be chosen whenever practicable.



(a) Room-sealed system



(b) Open flue system



(c) Closed flue system

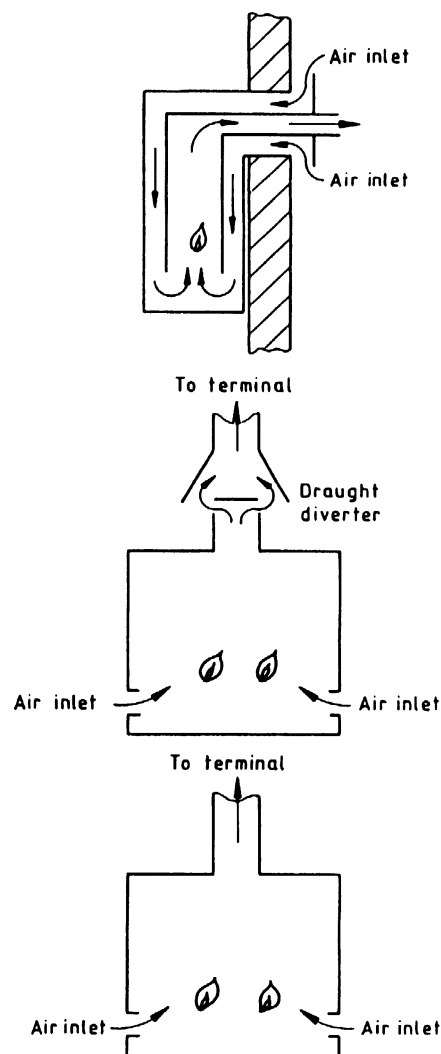


Figure 1 — Flue systems

3.2 Flue termination

The various forms of termination and their acceptable locations are dependent on the type of flue system and shall comply with the requirements given in the relevant clauses.

COMMENTARY AND RECOMMENDATIONS ON 3.2. *The main function of the termination of a flue system is to effectively discharge the products of combustion to the outside air under all weather conditions. This is achieved by the design of the terminal and its siting. Openings in the terminal are sized to prevent the ingress of foreign matter which would seriously impair the performance of the flue system. Under certain conditions, pluming can occur at the termination and, where possible, terminal positions where this could cause a nuisance should be avoided.*

3.3 Fire precautions

All the systems shall be so installed as to prevent ignition of any part of the building structure.

COMMENTARY AND RECOMMENDATIONS ON 3.3.

Precautions to be taken are detailed in the various clauses.

Particular precautions should be taken with incinerators where the flue gas temperature is likely to be higher than for other appliances.

For buildings of timber framed construction, adequate safeguards are achieved by, for example, the introduction of suitable sleeves or ducts where the flue system passes adjacent to combustible material, or other simple shielding arrangements. For such buildings, precautions are also necessary to preserve the integrity of any vapour barrier and to minimize any effects on the thermal and acoustic insulation properties of the structure. Detailed arrangements are to be found in the current editions of British Gas plc Publications DM2 and DM3.

4 Individual open flue: natural draught

4.1 Design

4.1.1 General. Any new flue system shall be constructed from the materials specified in 4.1.2, 4.1.3, routed and sized as specified in 4.1.5 and terminated as specified in 4.1.6 and 4.1.7.

Any existing flue systems shall comply with 4.1.9. Each flue shall only communicate with the room or space in which the appliance is installed.

4.1.2 Flue pipes. Metallic flue pipes shall comply with BS 715. Flue pipe defined by BS 715 as being for internal use shall not be used externally. Different types of double-wall flue pipe shall be mixed in the construction of a flue system only if the flue pipe manufacturer's recommended adaptors are used.

For incinerators, the installer of the flue shall consult the appliance manufacturer and the flue manufacturer in order to determine the suitability of flue pipe for use with incinerators.

COMMENTARY AND RECOMMENDATIONS ON 4.1.2. *BS 567 and BS 835 cover asbestos¹⁾ materials, and existing flue systems constructed of these materials may be re-used (see 4.1.9).*

No standards currently exist for non-metallic flue pipes constructed of materials other than asbestos.

NOTE Proprietary prefabricated flue boxes complying with BS 715 may be used in conjunction with flue pipe also complying with BS 715. Further details concerning their application are given in the appropriate appliance specifications.

4.1.3 Chimneys. Chimneys shall be either:

- a) of brick or other masonry construction and lined with one of the following:
 - 1) clay flue linings complying with BS 1181; or
 - 2) rebated and socketed clay pipes and fittings complying with BS 65; or
 - 3) rebated or socketed flue linings made from kiln-burnt aggregate and high alumina cement; or
 - 4) metallic flue liners complying with BS 715;
- b) flue blocks complying with BS 1289;
- c) factory-made insulated chimneys complying with BS 4543;

4.1.4 Existing flue systems. If an existing chimney or flue is to be used for a gas appliance, it shall comply with 4.1.9.

4.1.5 Route and sizing. The flue shall be routed and sized to ensure full clearance of combustion products.

The minimum cross-sectional area of flues for appliances other than gas fires shall be not less than the area of the flue spigot. Flues for new or replacement gas fires shall have a minimum cross-sectional area of 12 000 mm² unless the appliance manufacturer's instructions specifically permit otherwise.

The following appliances shall not be connected to flue blocks having a cross-sectional area between 12 000 mm² and 13 000 mm² or having a minor dimension of 63 mm or less:

- a) incinerators and drying cabinets;
- b) appliances having a flue outlet area greater than 13 000 mm².

Gas fires and combined appliances incorporating a gas fire shall be connected to flue blocks only if the appliance manufacturer's instructions specifically state that this is acceptable.

Flues for decorative fuel effect gas appliances (which fall within the scope of BS 6714²⁾) shall be so sized that they will contain a circle not less than 175 mm in diameter.

¹⁾ Stringent precautions are needed when working with asbestos. (See "Work with asbestos insulation and asbestos coating" [Health and Safety Executive] and "Asbestos materials in Buildings" [Department of the Environment: HMSO].) New (or alterations to existing) flue systems should not be constructed from materials containing asbestos. Existing asbestos flue systems may be re-used. When working with asbestos materials the "Asbestos: Licensing Regulations (1984)" have to be complied with.

²⁾ In course of revision.

COMMENTARY AND RECOMMENDATIONS ON 4.1.5.

Chimneys constructed of flue blocks are intended either for bonding into and forming an integral part of the building structure (in which case they are mainly in new premises) or for adding-on to either a new or existing building. It should be noted that flue blocks are generally more resistive to flow than are flue pipes of the same cross-sectional area. Not all appliances are suitable for connection to this type of chimney.

The flue should take the most direct practicable route consistent with structural stability, appearance and termination (see 4.1.7). Horizontal or slightly inclined runs of flue should be avoided. An essentially vertical route from the draught diverter is especially desirable. A minimum of 600 mm of vertical flue directly above the draught diverter should be provided.

Any new or existing chimney or two-storey circular flue pipe system can normally be expected to give satisfactory performance provided that it contains no long horizontal sections, excessive restrictions or numerous bends.

Single storey flue systems, systems containing precast concrete flue blocks and those containing long horizontal elements or numerous bends require more careful consideration during the design stage (or prior to connecting an appliance to an existing flue). Particular care should be taken with single storey flue systems in dwellings with more than one storey.

The required cross-sectional area of an individual open flue depends on a number of factors, including the heat input to the appliance, the length of the flue and the additional resistance caused by offsets and bends. Sufficient vertical flue should be provided to compensate for this additional resistance.

Changes in appliance design mean that a flue that has performed adequately with an existing appliance cannot be assumed to be satisfactory for a replacement appliance of the same type.

An existing gas fire and flue combination should have a minimum flue cross-sectional area of 12 000 mm². Exceptions are permitted where it can be demonstrated that there is clearance of combustion products, when checked in accordance with 4.3.2.

Appendix A describes a method of assessing whether a flue system is likely to give a satisfactory performance and is based on the concept of the equivalent vertical height of the flue.

Long external flue runs should be avoided, particularly from appliances fitted in cellars and basements. Whenever possible, flues should be run inside the premises to ensure that the internal length exceeds the exposed external length of flue. Where external flue runs are unavoidable double-wall flue pipes complying with BS 715 or factory insulated flues complying with BS 4543-2 and BS 4543-3 should be used.

4.1.6 Terminal design. Proprietary terminals shall comply with BS 715 and BS 1289.

Where a proprietary terminal is not used, the free area of outlet openings on the termination shall be at least twice the cross-sectional area of the flue. Outlet openings shall be such that they will admit a 6 mm diameter ball but not a 16 mm diameter ball except for openings in a terminal serving an incinerator which shall admit a ball of at least 25 mm diameter. The openings shall either be uniformly distributed around the termination or arranged at two opposite faces.

4.1.7 Termination

4.1.7.1 Any terminal or termination shall be positioned so that combustion products can safely disperse at all times. Except in those circumstances specified in 4.1.7.2 the terminal shall be sited in accordance with Table 1 and Appendix B.

The terminal for an open-flued natural draught flue system shall not be positioned within 1.5 m of a wall surface.

Whenever an existing appliance is replaced the terminal location shall comply with 4.1.7.

COMMENTARY AND RECOMMENDATIONS ON 4.1.7.1.
Additional precautions may be needed in siting a terminal in certain circumstances, such as on a sloping site or near to a very large structure.

4.1.7.2 Where there are adjacent vertical structures which may affect the performance of the flue, the height of the terminal shall not be less than 600 mm measured above a line joining the neighbouring high points where it crosses the central axis of the flue (see Figure 3) instead of from the point of intersection of the flue with a flat roof or the highest point of intersection with a pitched roof. If more than two separate structures are sited on the roof the condition resulting in the highest flue shall be employed.

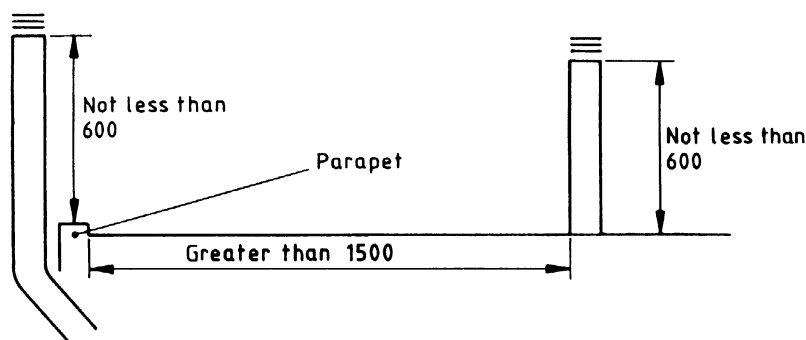
COMMENTARY AND RECOMMENDATIONS ON 4.1.7.2.
Where the horizontal distance between the flue and a structure exceeds 1.5 m and is greater than 10 times the height of that structure above the point where the flue passes through the roof, then that structure may be discounted as having any effect on the performance of that flue (see Figure 4).

Table 1 — Location of roof mounted terminals for individual natural draught open flue systems (minimum height of base of terminal)

Type of roof		Location not within 1.5 m of a vertical surface ^a of a structure on the roof		Location within 1.5 m of a vertical surface ^a of a structure on the roof	
		Internal route		External route	Internal route + external route
		On ridge	Not on ridge		
Pitched	Pitch exceeding 45°	At or above ridge level (see Figure 11)	1 m above flue/roof intersection (see Figure 10)	See Figure 10	The base of the terminal to be 600 mm above the level of the top of the structure (see Figure 5, Figure 7, Figure 9 and Figure 12)
	Pitch not exceeding 45°		600 mm above flue/roof intersection (see Figure 11)	The base of the terminal to be 600 mm above the level of the adjacent roof edge (see Figure 2, Figure 6 and Figure 8)	
Flat	With parapet		Not applicable		
	Without parapet	250 mm above flue/roof intersection (see Figure 6)			

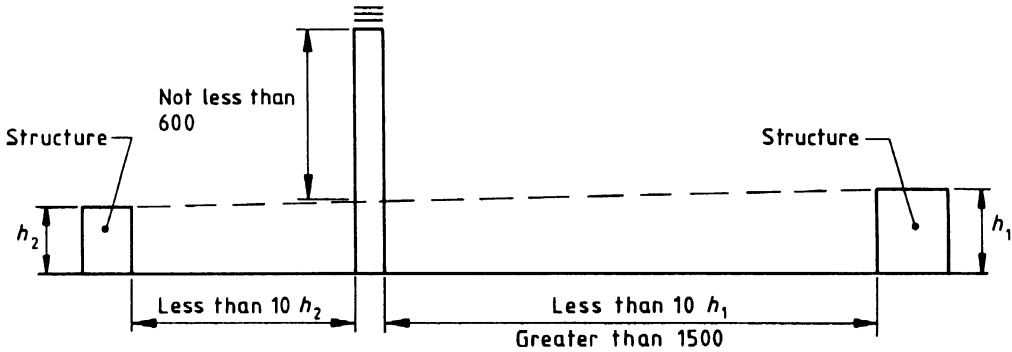
^a For example, a chimney stack, dormer window, tank room, parapet, etc.

^b When the flue outlet is a horizontal distance greater than 10 times the height h of the parapet or structure, the terminal outlet height need be only 250 mm above the roof.



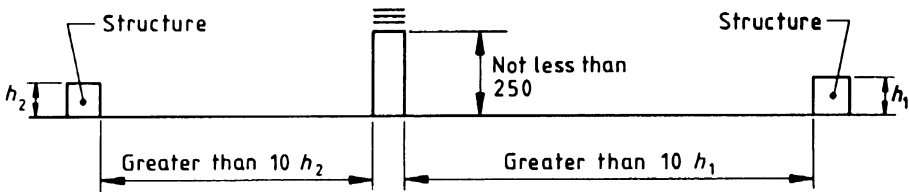
All dimensions are in millimetres.

Figure 2 — Flat roof, with parapet



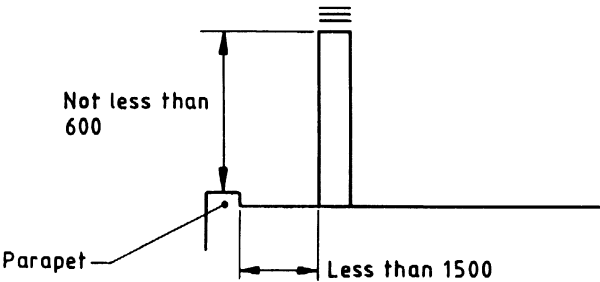
All dimensions are in millimetres.

Figure 3 — Flat roof, envelope method



All dimensions are in millimetres.

Figure 4 — Flat roof, where the flue outlet is more than 10 heights (*h*) away from all structures



All dimensions are in millimetres.

Figure 5 — Flat roof, with flue close to parapet

