

Structural design of low-rise buildings —

**Part 1: Code of practice for stability, site
investigation, foundations and ground
floor slabs for housing**

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee B/204, Structural design of low-rise buildings, upon which the following bodies were represented:

- Building Employers' Confederation
- Chartered Institute of Building
- Consumer Policy Committee of BSI
- Department of the Environment (Building Research Establishment)
- Department of the Environment (Construction Directorate)
- Federation of Master Builders
- House Builders' Federation
- Institute of Building Control
- Institution of Civil Engineers
- Institution of Structural Engineers
- National Council of Building Material Producers
- National House-Building Council
- Royal Institute of British Architects
- Scottish Office (Building Directorate)

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- Association of Lightweight Aggregate Manufacturers
- Brick Development Association
- Council of the Forest Industries of British Columbia

This British Standard, having been prepared under the direction of the Sector Board for Building and Civil Engineering, was published under the authority of the Standards Board and comes into effect on 15 September 1995

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First published March 1986
Second edition September 1995

The following BSI references relate to the work on this standard:
Committee reference B/204
Draft for comment 88/11563 DC

ISBN 0 580 23340 5

Amendments issued since publication

Amd. No.	Date	Comments
8980	November 1995	Indicated by a sideline in the margin

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Foreword

This Part of BS 8103 has been prepared under the direction of Technical Committee B/204, Structural design of low-rise buildings.

BS 8103 will be published in four Parts:

- *Part 1: Code of practice for stability, site investigation, foundations and ground floor slabs for housing;*
- *Part 2: Code of practice for masonry walls for housing;*
- *Part 3: Code of practice for timber floors and roofs for housing (in preparation);*
- *Part 4: Code of practice for suspended concrete floors for housing.*

to allow detailed consultation with other BSI Technical Committees responsible for the structural use of materials. However, it is the intention to combine these Parts into a single document in due course.

This standard is a revision of BS 8103-1:1986 which is withdrawn. It modifies the scope and limitations so that they are similar to Section 1 of the Approved Document A1/2. In particular, maximum clear spans for roofs and floors have been raised from 9 m and 4.5 m to 12 m and 6 m respectively.

A large proportion of the national building programme is concerned with new housing and alterations in both the public and private sectors where traditional methods of construction are used for the majority of houses and it is to these that this Part of BS 8103 is applicable.

However, when such dwellings are certified by organizations such as the National House Building Council, reference should in addition be made to the appropriate documents published by these bodies.

It is assumed that this standard will be used by those with expertise in building construction but not necessarily in structural engineering design. Houses constructed within the limitations stated in the relevant clauses will not require additional specialist advice. For any conditions outside the limitations of this standard appropriate specialist advice has to be obtained.

Where foundations other than those given in item h) of clause 1 have been designed by suitably qualified persons, the remainder of the building may be constructed in accordance with the relevant clauses of this standard.

When using this standard, it is important to ensure that the overall stability of the house is achieved, and that the work of any specialist engaged is properly coordinated. The situations included in this standard which require the consultation of suitably qualified persons are identified in the clauses to which they relate.

All drawings in this document only show structural details. Other details, e.g. damp proof courses (d.p.cs), are not included.

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.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 26, 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 8103 gives recommendations for the structural design of low-rise housing and covers the stability of the structure, site investigation and foundations and ground floor slabs used in the construction. Foundations comprising strip footings or trench fill founded in normal ground are the only type described.

Low-rise housing comprises detached, semi-detached and terraced houses and flats (with not more than four self-contained dwelling units per floor accessible from one staircase), of not more than three storeys above ground intended for domestic occupation and of traditional masonry construction with timber roofs and floors of timber or concrete. For the purposes of this standard additional habitable accommodation in the roof space constitutes a storey of the house. The recommendations also apply to certain single storey, non-residential buildings, e.g. domestic garages and annexes to residential buildings with a floor area not exceeding 36 m². This standard does not include the design of basements, but providing the basement is of one level only and is designed to provide a firm platform at ground level the provisions of this standard may apply to the superstructure.

Proprietary housing systems, and houses of timber, steel or concrete framed construction are not covered by this standard.

The structural design recommendations described in this standard are not specifically intended to cover other considerations such as fire resistance, thermal and sound insulation, resistance to damp penetration and durability. Reference should be made to other appropriate British Standards and statutory regulations and their supporting technical documents (e.g. BS 5628-3:1985 and the appropriate Approved Documents to the Building Regulations) for these and other matters.

In using this standard the following limitations apply:

- a) roof: maximum clear span 12.0 m;
- b) floor: maximum clear span 6.0 m;
- c) design wind speed: not exceeding 44 m/s (see 5.3);
- d) no part of wall or roof higher than 15 m above lowest adjacent ground level;
- e) storey height: maximum 2.7 m;
- f) maximum clear length of a loadbearing wall between vertical lateral supports of 9.0 m;
- g) maximum length of any opening in loadbearing walls: 3.0 m;

h) only strip footings or trench fill foundations in normal ground conditions (see 7.1).

Where foundations other than those given in item h) have been designed by suitably qualified persons, the remainder of the building may be constructed in accordance with the relevant clauses of this standard.

2 References

2.1 Normative references

This Part of BS 8103 incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to, or revisions of, the cited publication apply to this Part of BS 8103 only when incorporated in it by updating or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This Part of BS 8103 refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

3 Definitions

For the purposes of this Part of BS 8103, the following definitions apply.

3.1

buttress

section of wall or pier bonded or securely tied to an adjacent wall providing support against lateral forces acting on the wall

3.2

cavity

space between two leaves of a cavity wall

3.3

cavity wall

two parallel single-leaf walls spaced at least 50 mm apart and effectively tied together with wall ties

3.4

foundation

that part of a structure in direct contact with and transmitting loads to the ground

3.5

foundation depth

distance between the finished external ground level and the underside of the concrete in strip footings or trench fill construction

3.6**ground-supported slab**

concrete slab constructed directly on and supported by the ground to receive material forming or supporting the wearing surface

3.7**hoggin**

inert natural mixture usually consisting of gravel, sand and clay

3.8**loadbearing wall**

wall that carries vertical and/or lateral loads in addition to its self weight

3.9**masonry**

assemblage of structural units that are bonded or solidly put together with mortar

3.10**nogging**

solid piece of timber between timber members to provide support for an attachment point

3.11**pier**

integral thickened section located in a wall

3.12**separating wall**

wall between two buildings that is common to both

3.13**storey height**

the underside to underside distance between floors or between a floor and roof or in the case of a ground storey the distance between the top of the ground floor and the underside of the floor above

3.14**strip footing**

bed of concrete laid in the bottom of a trench, its thickness being less than its width, that forms a strip foundation to carry a masonry wall

3.15**trench fill**

deep bed of concrete filling a trench that forms a strip foundations to carry a masonry wall

4 Symbols

For the purposes of this Part of BS 8103, the following symbols apply:

a	retained height of ground;
d	depth of fill material;
h_1	height of main building measured to the highest part of the wall or roof;
h_2	height of wing or annexe measured to the highest part of the wall or roof;
l	length of wall to wing or annexe;
p_1	projection of wing extending for more than one storey;
p_2	projection of single storey wing or annexe;
p_{sf}	projection of strip footing beyond face of supported wall;
s	step height in foundations;
t	overall thickness of wall;
t_1	thickness of leaf 1 of cavity wall;
t_2	thickness of leaf 2 of cavity wall;
t_{sf}	thickness of strip footing;
t_{tf}	thickness of trench fill;
w_1	width of wall to main building;
w_2	width of wall to single storey wing or annexe;
w_3	width of wall to a wing extending for more than one storey.

5 Stability and connections between elements**5.1 Stability considerations**

This Part of BS 8103 together with BS 8103-2, BS 8103-3¹⁾ and BS 8103-4 gives recommendations on the sizing of individual elements of a house: foundations, walls, floors and roof in relation to the forces acting on them due to dead and imposed loading. In order to provide overall stability of the structure in relation to any likely loading condition it is essential for these elements to be properly joined together. When considering the plan form of the building it is essential that the external walls interact to form the sides of a rigid box completed by the floors and roof as shown in Figure 1 for the ground floor. In these forms of construction bracing in the planes of the roof is a necessary contribution to the overall stability.

¹⁾ In preparation

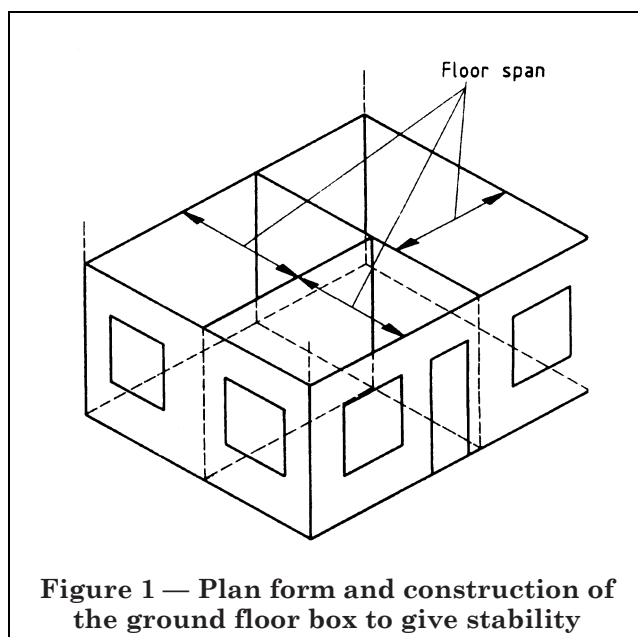


Figure 1 — Plan form and construction of the ground floor box to give stability

Internal masonry walls should be connected so as to interact with external walls and brace the structure. Internal lightweight partitions should also be connected so that they contribute to the overall stability but they should be discounted in the design of the masonry. The connections between structural elements described in 5.4 should be used as necessary to ensure that the elements of the box interact fully so as to transfer and share loads placed on one element with other elements.

It is particularly important to ensure that wind loads are transferred to buttress walls, piers and chimneys.

In the situations shown in Figure 2 with the force derived from wind action at right angles to the gable, the gable in isolation is extremely vulnerable. The front and rear walls in combination with the floor offer substantial lateral support provided that the wind forces from the top of the gable can be transferred to them. A braced roof, if adequately connected, laterally restrains the top of the gable and transfers the loads to the front and rear walls.

Likewise the front and rear walls depend upon the lateral support provided by the floors and roof connected to the gable walls.

A house should not be expected to be totally resistant to the excessive forces that may arise due to extreme causes such as earth tremors, explosion or impact by vehicles. Provided that the design procedures recommended in this standard are correctly followed, particularly the recommendations for connections between elements, then the effects of the excessive forces should be minimized if they occur.

5.2 Dimensional limits to ensure stability

5.2.1 Ground levels either side of walls

Where a wall is subjected to a lateral load from retained material due to a difference in levels on opposite sides, the difference in level above fully compacted backfill should not exceed the dimensions shown in Figure 3. The recommendations given in Figure 3b do not apply where there is an adjacent roadway on the upper level, used other than by private cars, and where the roadway for such vehicles is closer than a distance equivalent to 1.25 times the retained height. Such situations are outside the scope of this standard.

Figure 3 does not apply to free-standing walls.

5.2.2 Building shape

For residential buildings of not more than three storeys, adequate stability against wind forces is achieved if the building dimensions, as shown in Figure 4, do not exceed the following values.

- a) The height of the main building (h_1) should not be greater than twice the width of the building. The width should be taken as w_1 if p_1 is equal to or less than w_3 , **or** as w_3 if p_1 is greater than w_3 .
- b) The width of the annexe (w_2) should not be less than half the height of the annexe (h_2) if its length (p_2) is greater than twice its width (w_2).

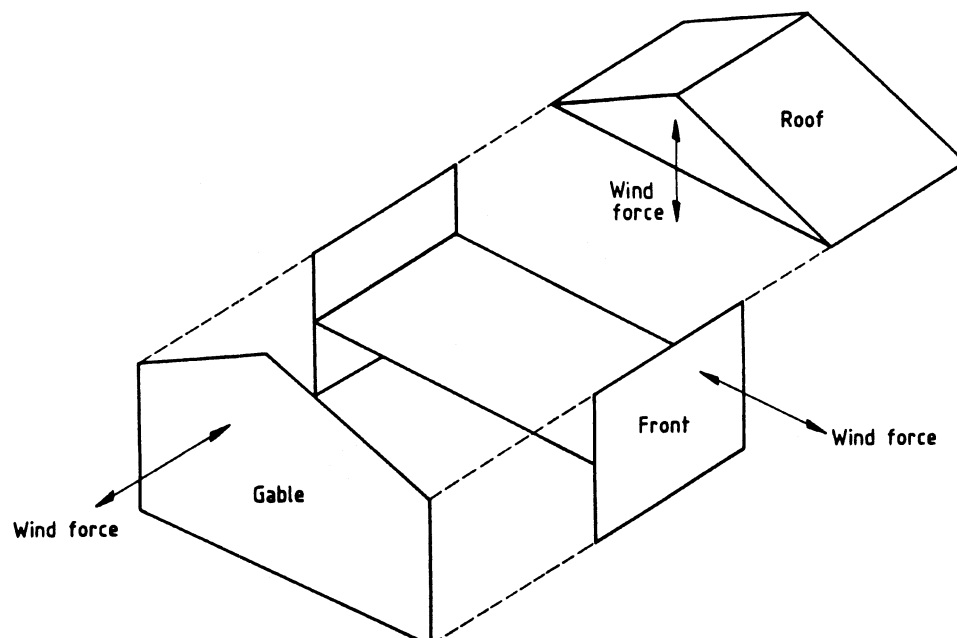
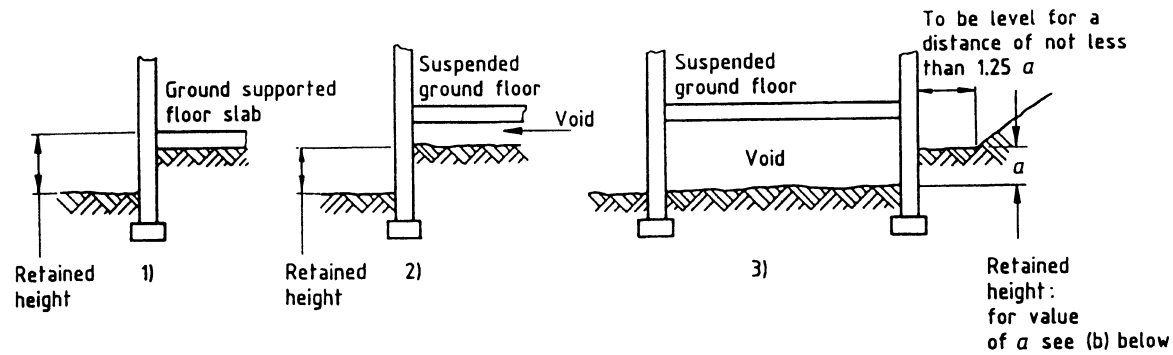
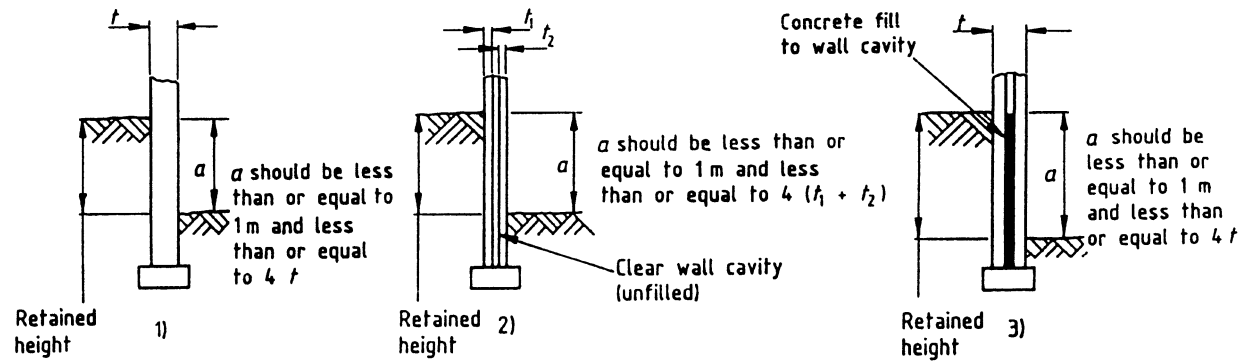


Figure 2 — Diagram illustrating the action of wind forces



a) Situations where differences in level may occur



b) Maximum difference in permitted level

NOTE. Floor slabs in figure 3b have been omitted for clarity, and may be on either side of the walls shown.

Figure 3 — Walls with a difference in level on opposite sides

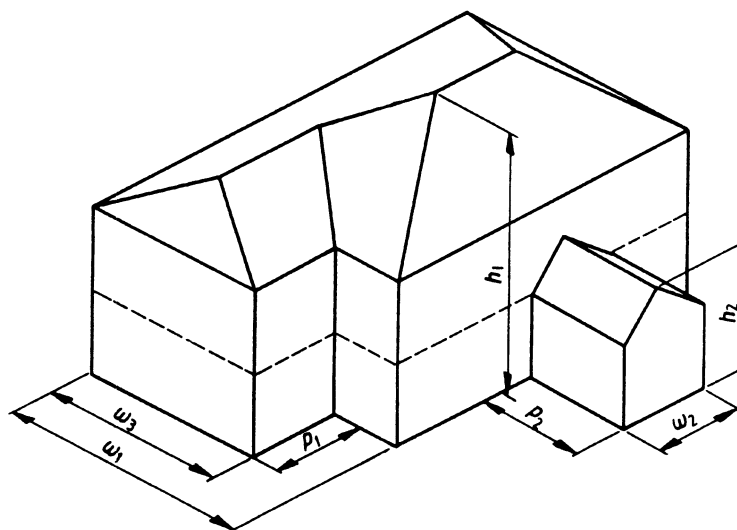


Figure 4 — Building shape

5.2.3 Height of building

The maximum height above the lowest finished ground level adjoining the building should not exceed 15 m as shown in Figure 5.

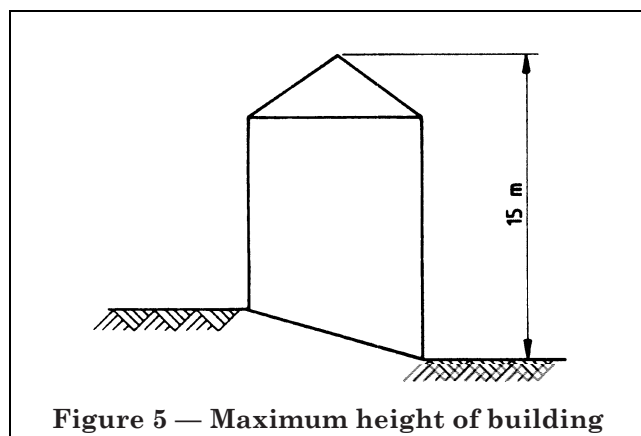


Figure 5 — Maximum height of building

5.2.4 Storey height

The maximum height of any storey should not exceed 2.7 m measured as shown in Figure 6. The height of substructure walls measured between the top of the foundation and the top of the ground floor slabs should also not exceed 2.7 m.

5.3 Wind loading

The magnitude of wind pressure to which a house is exposed to is dependent on its height, geographical location and degree of exposure.

The scope of this standard is limited to buildings subjected to design wind speeds (as defined in CP 3:Chapter V-2) not exceeding 44 m/s. A simplified method of ensuring conformity to this limitation is as follows.

- Determine the basic wind speed at the site of the building from Figure 7.
- Determine the maximum permissible height of the building from either Table 1 or Table 2 depending on the basic wind speed and ground roughness category. (Table 1 and Table 2 are respectively applicable to normal, level sites and sloping sites.)

5.4 Connections between structural elements

5.4.1 General

The details of floor or roof to wall connections given in 5.4.2 provide for the tying together of elements recommended by this standard to ensure overall house stability and lateral restraint for walls. All rafters/roof joists should be fixed to the wall plate, e.g. by framing anchors, and other connections should be made at the positions shown in Figure 8 with the exception of the cases listed in items a) to f). Connections, where provided, should be inserted throughout the length of the wall at that level. Depending on the roof or floor construction and the location of the connection, the relevant detail indicated in Figure 8 should be chosen from Figure 9 to Figure 16.