

Buildings and structures for agriculture —

Part 22: Code of practice for design, construction and loading

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Foreword

This Part of BS 5502 has been prepared under the direction of the Technical Sector Board for Building and Civil Engineering. It is a revision of BS 5502-22:1987, which is withdrawn.

BS 5502 has been restructured into the following broad subject areas:

- *Part 0: Introduction;*
- *Parts 10 to 19: Reference information and legislation;*
- *Parts 20 to 39: General design;*
- *Parts 40 to 59: Livestock buildings;*
- *Parts 60 to 79: Crop buildings;*
- *Parts 80 to 99: Ancillary buildings.*

More specifically, the general design series will comprise:

- *Part 20: Code of practice for general design considerations;*
- *Part 21: Code of practice for selection and use of construction materials;*
- *Part 22: Code of practice for design, construction and loading;*
- *Part 23: Code of practice for fire precautions;*
- *Part 25: Code of practice for services and facilities;*
- *Part 30: Code of practice for control of infestation;*
- *Part 31: Code of practice for the management of waste (storage and handling);*
- *Part 32: Guide to noise attenuation;*
- *Part 33: Guide to control of odour pollution.*

A more detailed description of the new structure of BS 5502 is given in Part 0.

The object of introducing the structure is to allow subject areas to be broadly characterized, and related subject matter, whether in the form of recommendations, guidance or supporting data, to be rationalized and brought together. It will also allow sufficient flexibility to enable BS 5502 to be expanded and developed in a logical way in the future.

For design and construction of, and the loadings for, agricultural buildings and structures to be carried out in accordance with this standard, reference has to be made to the relevant material codes of practice, some recommendations of which have been modified by this Part of BS 5502 for classified agricultural buildings and structures. This Part of BS 5502 also contains special considerations peculiar to agricultural buildings and structures that should be taken into account during their design and construction.

It has been assumed in the drafting of this Part of BS 5502 that the execution of its provisions is entrusted to appropriately qualified and experienced people, for whose guidance it has been prepared.

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 to iv, pages 1 to 24, 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 5502 gives recommendations for the design and construction of, and the loading for, agricultural buildings and structures.

2 References

2.1 Normative references

This Part of BS 5502 incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed on page 28. Subsequent amendments to, or revisions of, any of these publications apply to this British Standard only when incorporated in it by updating or revision.

2.2 Informative references

This Part of BS 5502 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 5502, the definitions given in BS 5268-2:1991, BS 5328-1:1991, BS 5628-1:1992, BS 5628-2:1985, BS 5628-3:1985, BS 5950-1:1990, BS 5950-5:1987, BS 6100, BS 7543:1992 and BS 8110-1:1985 apply, together with the following.

zone of effect

the area around a retaining structure extending a distance 1.5 times its height (h) above ground or its depth (d) below ground, whichever is greater, beyond the retaining structure's real or projected ground perimeter

4 Symbols

For the purposes of this Part of BS 5502, the following symbols apply:

A	altitude of site in metres above mean sea level;	d_a	depth below ground for zone of effect for structure's alternative face;
b_c	breadth of compression face of a concrete beam (T and inverted L purlins and sheeting rails) measured midway between restraints (see BS 8110-1:1985);	E1, E2, E3, E4	classification of exposure situations in accordance with BS 5628-2:1985;
b_t	breadth of tension face of a concrete beam (T and inverted L purlins and sheeting rails) measured midway between restraints (see BS 8110-1:1985);	GL	ground level;
d	depth below ground for zone of effect;	h	height above ground for zone of effect;
		h_a	height above ground for zone of effect for structure's alternative face;
		H_s	point load applied horizontally at the surface of a single slat from livestock (in kN);
		l_e	effective length of section;
		l_p	span of a purlin, centre to centre of support (in mm);
		l_s	effective span of a multi-slat unit;
		n	number of slats in a multi-slat unit;
		N	return period for loading (in years);
		P_B	characteristic load from bedding (including allowance for livestock) acting horizontally to a wall (in kN/m ²);
		P_G	concentrated tractor load on a wall for grass silage (part load) (in kN);
		P_L	vertical load on a floor from livestock applied on any square with a 300 mm side (in kN);
		P_s	vertical load from livestock applied on a single slat (in kN/m);
		P_v	vertical load on a floor from a vehicle applied on any square with a 300 mm side (in kN);
		r	least radius of gyration of a section;
		s_{alt}	coefficient used in correcting the basic snow load on the ground for altitude;
		s_b	basic snow load (on the ground);
		s_d	snow load on a roof;
		$s_{d(N)}$	snow load on a roof with a return period of N years;
		s_o	site snow load (on the ground);
		SC2, SC3, SC4, SC6	strength class of timber as given in BS 5268-2:1991;
		T_G	horizontal load on a wall from grass silage (part load) which increases uniformly with depth z (in kN/m ²);
		v_c	design concrete shear stress as given in BS 8110-1:1985;

V_s	design wind speed as given in CP 3: Chapter V-2:1972 (in m/s);
W_G	uniform horizontal load from grass silage (part load) (in kN/m ²);
W_L	uniformly distributed vertical load over the gross floor area from livestock (in kN/m ²);
W_p	classified load on a puffin (in kN);
W_s	vertical load on the gross floor area to be used in the design of slat supports (in kN/m ²);
W_v	uniformly distributed vertical load over the gross floor area from vehicles (in kN/m ²);
Y_s	specified minimum yield strength of steel as given in BS 5950-1:1990;
z	depth below rolled surface of grass silage or the compacted surface of bedding (in m);
γ_c	classification factor for agricultural buildings and structures;
γ_f	partial safety factor for load as given in BS 5628-2:1985, BS 5950-1:1990 and BS 8110-1:1985;
μ	snow load shape coefficient;
ω	conversion factor for return periods for snow loads based on 50 years return as unity.

5 Preparation of site

5.1 For site preparation reference should be made to BS 5930:1981.

5.2 If any drains are severed during the excavations in connection with the building or structure, its drains or services, effective steps should be taken to secure the continued passage of the below-ground water through or around the site and to deal with any surface water which may run on to the site.

6 Service life

6.1 As service life may be different from design life (see BS 7543:1992), where required, guidance should be sought on durability limits of materials.

NOTE Information on predicted service life should be available from the manufacturer or supplier.

6.2 Unless otherwise stated, the structural components and the external envelope should be such that, with reasonable maintenance, they remain effective for the design life.

7 Foundations

7.1 For the design and construction of foundations of a building or structure, reference should be made to BS 8110-1:1985 and BS 8004:1986.

Attention should be paid to the possibility of attack by sulfates or any other deleterious matter which may be present in the soil.

7.2 The foundations of a building or structure should:

- a) safely sustain and transmit to the ground the worst combination of dead load, imposed load and wind load so that it does not cause any settlement or other movement which would impair the stability or serviceability of, or cause damage to, the building or structure or any adjoining building or structure or works;
- b) be taken down to such a depth, or be so constructed, as to safeguard the building or structure against damage by swelling, shrinkage or freezing of the subsoil;
- c) be designed to resist overturning moments or sliding forces, especially where lateral imposed loads, induced by the storage of agricultural or other products against walls, are transferred to the foundations.

8 Works below ground

8.1 Ducts, tanks, hoppers and other works below ground should be so designed and built as to resist external ground pressures including, if relevant, the pressure due to the presence of ground water, nearby foundations and other loadings.

Where ducts, tanks, etc. are to retain liquids, they should be so constructed as to prevent any contamination by the escape of the liquids into the subsoil and the entry of ground water into the duct, tank or other receptacle.

Where tanks are constructed in ground which has a high water table, adequate means of preventing flotation should be provided.

8.2 Covers to ducts, tanks, pits and similar constructions should be provided as necessary. These covers should conform to one of the following:

- a) be constructed to withstand all loads from livestock, stored materials, the transporting of materials over them, and all vehicles used in the building or structure or its environs;
- b) be provided with suitable barriers to prevent such access.

8.3 The construction of any duct, tank, receptacle or other underground works should be capable of resisting attack by sulfates, acids (such as are produced by the fermentation of silage), manure, washings, and any other deleterious matter present in the stored material or in the subsoil.

9 Works above foundations

The structural components of an agricultural building or structure above the foundations should safely sustain and transmit to the foundations or base the combined loads without such deflection or deformation as would impair the stability or serviceability of the whole or any part of the building or structure, or any other building or structure.

NOTE Attention is drawn to the Reservoirs Act 1975 [1] which applies to above-ground storage in reservoirs, lagoons and tanks and which requires all structures in excess of 25 000 m³ capacity above the lowest adjoining natural ground level to be designed and the construction to be supervised by a panel engineer. Lists of panel engineers are held by the Department of the Environment and by the Scottish Office Environment Department.

10 Protection of floors

10.1 Where floors of buildings or structures in contact with the ground are used for the storage of grain, seeds, concentrated feed stuffs, fertilizer or for the housing of livestock on insulated floors, they should be so constructed as to prevent the passage of moisture from the ground to the upper surface of the floor or the underside of the insulation.

10.2 Although moisture barriers are not usually required for the following:

- a) floors for crop production;
- b) livestock on a bedding of straw, wood shavings or other absorbent material;
- c) storage of fodder crops;
- d) storage of farm wastes;
- e) the housing of implements;

nevertheless, attention should be paid to the need to prevent the passage of slurries and wastes, especially silage effluent, to ground water. In addition, it should be taken into account that these buildings or structures may be used in the future for alternative uses.

10.3 Hardcore laid and compacted under any floor should contain no water-soluble sulfates or other deleterious matter in such quantities that it can cause damage to any part of the floor.

10.4 Concrete floors subject to attack by organic acids (see BS 5502-21:1990 for the chemical composition of waste products) should be designed and constructed to resist very severe exposure conditions as given in Table 3.2 of BS 8110-1:1985 (see also **16.4.4** and **16.4.5**). Such floors should be well compacted, cured and, where necessary, should be provided with a surface coating.

10.5 Where suspended timber floors are constructed, damp-proof courses should be provided to prevent moisture from the ground adversely affecting the timber or other materials in the floor.

10.6 In class 1 and class 2 buildings (see clause **14**) where a timber floor is constructed as a suspended floor, other than above a pit or cellar for the storage of dung, the ground surface should be suitably sealed. The space between such a seal and any timber should be not less than 125 mm and this space should be clear of debris and should have adequate through ventilation.

10.7 Where a suspended floor constructed from timber is placed over a cellar or pit specially designed for the storage of dung, reference should be made to BS 5502-21:1990 for the appropriate protective treatment against decay.

11 Protection of walls, piers and columns

11.1 Any wall, pier, or column of a building or structure should be designed and constructed so that it does not transmit moisture to any material which may be adversely affected by it.

11.2 Where the walls are regularly subjected to the application of water, e.g. for hygiene purposes, or where the walls may be subjected to moisture from stored products and where moisture may adversely affect the materials, a surface treatment should be applied to the walls to protect them from becoming damp.

12 Protection of roofs

12.1 Except as stated in **12.2**, the roof of any building or structure should be weatherproof and so constructed that it does not transmit moisture due to rain or snow to any part of the structure or its contents which would be adversely affected by such moisture.

12.2 The recommendation in **12.1** should not be applied to those buildings and structures where, because of internal environmental requirements, it is necessary to provide openings in the roof for the entry of fresh air or the exhaust of foul air. Where air from such vents may cause corrosion of the surrounding materials, precautions should be taken to protect them (see BS 5502-21:1990).

13 Balustrades and safety rails

Balustrades and/or safety rails should be provided for any workplace or walkway which is situated more than 1.5 m above floor or ground level. They should conform to BS 6180:1982 as modified by **15.9** (see also BS 5502-80:1990).

14 Design classification

14.1 Agricultural buildings and structures should be designed in accordance with one of the four classes given in Table 1. All drawings and written reference should include information on the class upon which the design is based.

14.2 Buildings and structures should be designated according to the density of human occupancy, the location of the building and the return period of loadings (design life) on all structural members (including purlins and sheeting rails).

NOTE The design life does not necessarily relate to the durability limits of materials of construction (see **6.1**).

14.3 For retaining structures or buildings containing a retaining element, the density of occupancy should apply within the structure's zone of effect (see **3.1** and Figure 1).

14.4 The design classification of a building should be determined so that it satisfies both the occupancy and distance recommendations stated for the class.

14.5 Care should be taken when siting buildings and structures to ensure that the classification of existing buildings and structures is not infringed.

Table 1 — Design classifications

Class (see note 1)	Maximum normal human occupancy within a building or structure or its zone of effect where applicable (see note 2) person h/year	Minimum allowable distance to a classified highway or human habitation (see note 3) m	Minimum design life years
1	Unrestricted	Unrestricted	50
2	Not exceeding 6 h/day at a maximum density of 2 persons/50 m ² (4 380/50 m ²)	Either 10 or limit of zone of effect if greater than 10	20
3	Not exceeding 2 h/day at a maximum density of 1 person/50 m ² (730/50 m ²)	Either 20 or limit of zone of effect if greater than 20	10
4	Not exceeding 1 h/day at a maximum density of 1 person/50 m ² (365/50 m ²)	Either 30 or limit of zone of effect if greater than 30	2

NOTE 1 The risk of collapse is greater in buildings or structures of larger classification number.

NOTE 2 If it is known that the occupancy may for short periods (i.e. less than 70 days) be of higher density or a larger number of hours per day, then the cumulative effect over a year of all occupancy within a 50 m² area, should be aggregated. If the cumulative effect exceeds the person hours per year figure then the next higher classification should be used.

NOTE 3 Distance from a structure to a classified highway or human habitation means the distance to the edge of highway (including footway) or nearest point of human habitation.