

Buildings and structures for agriculture —

**Part 50: Code of practice for design,
construction and use of storage tanks
and reception pits for livestock slurry**

ICS 65.040.10

Committees responsible for this British Standard

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 Health and Safety Executive
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Contents

	Page
Committees responsible	Inside front cover
Foreword	iii
1 Scope	1
2 Definitions and symbols	1
2.1 Definitions	1
2.2 Symbols	1
3 Siting of slurry storage tanks and reception pits	3
3.1 General	3
3.2 Emissions to air	3
3.3 Pollution control	3
3.4 Other considerations	4
4 Sizing of slurry storage tanks and reception pits	4
4.1 General	4
4.2 Amounts of waste produced by livestock	4
4.3 Amounts of dirty water produced	4
4.4 Slurry storage tank size	4
4.5 Reception pit size	4
5 Loads	5
5.1 General	5
5.2 Slurry loads	5
5.3 Wind loads	5
5.4 Pressures on reception pits and below ground tanks	5
5.5 Reception pit cover/grid loadings	8
5.6 Machinery loading	8
6 Structural design	8
6.1 General	8
6.2 Walls and floors	8
6.3 Cylindrical steel plate tanks	9
6.4 Concrete stave tanks	10
6.5 Earth bank lagoons	10
6.6 Covers for stores	10
7 Materials	11
7.1 General	11
7.2 Corrosion protection	11
7.3 Joints, sealing and waterproofing	12
8 Safety	12
8.1 General	12
8.2 Guarding of slurry storage tanks and reception pits	12
8.3 Access to slurry storage tanks	12
8.4 Access to covered reception pits	12
8.5 Valves	13
8.6 Extension to height	13
8.7 Notices	14
9 Operation and maintenance manual	14

	Page
Appendix A Bibliography	15
Appendix B Design methodology for slurry storage tanks constructed with concrete staves	16
Appendix C Checklist for the operators of slurry storage tanks and reception pits	23
<i>Text deleted</i>	
Figure 1 — Symbols	2
Figure 2 — Soil/backfill and slurry loading example for reception pits	6
Figure 3 — Surcharge from point load	7
Figure 4 — Surcharge from uniform load	7
Figure 5 — Surcharge from isolated foundation	8
Table 1 — Soil/backfill data	6
Table 2 — Effective second moment of area for wind stiffeners	9
List of references	24

Foreword

This Part of BS 5502 has been prepared under the direction of the Technical Sector Board for Building and Civil Engineering. BS 5502-50:1993+A2:2010 supersedes BS 5502-50:1993+A1:2003, which is withdrawn.

The start and finish of text introduced or altered by Amendment No. 1 and Amendment No. 2 is indicated in the text by tags **[A1]** **[A1]** and **[A2]** **[A2]**. Minor editorial changes are not tagged.

Amendment A2 introduces the following principal changes:

- all references have been updated;
- e) to g) have been added to **8.5.4**;
- an additional source of guidance has been given in Clause **9**; and
- the index has been removed.

BS 5502 is structured into the following broad subject areas:

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

More specifically, the livestock building series comprises:

- *Part 40: Code of practice for design and construction of cattle buildings;*
- *Part 41: Code of practice for design and construction of sheep buildings and pens;*
- *Part 42: Code of practice for design and construction of pig buildings;*
- *Part 43: Code of practice for design and construction of poultry buildings;*
- *Part 49: Code of practice for design and construction of milking premises;*
- *Part 50: Code of practice for design, construction and use of storage tanks and reception pits for livestock slurry;*
- *Part 51: Code of practice for design and construction of slatted, perforated and mesh floors for livestock;*
- *Part 52: Code of practice for design of alarm systems, emergency ventilation and smoke ventilation for livestock housing.*

The object of 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 also allows sufficient flexibility to enable BS 5502 to be expanded and developed in a logical way in the future.

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.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot 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 25 and a back cover.

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1 Scope

This Part of BS 5502 gives recommendations for the design, construction and use of agricultural storage tanks and reception pits for livestock slurry.

NOTE Further sources of information are given in Appendix A. The titles of the publications referred to in this standard are listed on page 24.

2 Definitions and symbols

2.1 Definitions

For the purposes of this Part of BS 5502, the following definitions apply.

2.1.1

slurry

a mixture of animal excreta, urine and water of a consistency that allows it to be pumped or discharged by gravity

NOTE Slurry may also contain quantities of bedding, feed wastes, disinfectants, medication residues, silage and dairy washing water. The principal determinants of slurry density are the type of animal producing it, the housing and feeding regime, and the amount of surface runoff water or washing-down water mixed with it. If left undisturbed in a tank, slurry will separate into three components: a bottom layer of sediment; a middle region of liquid relatively free from suspended solids; and a surface crust made up of fibrous material. Over time these crusts can grow to considerable depths, particularly over cow slurry.

For operational reasons it is recommended that stored slurry is agitated frequently to avoid this separation occurring. However, due regard should be given to the risk of nuisance from odours.

2.1.2

slurry storage tank

a container for storing agricultural slurry including lagoons

NOTE Tanks may be provided with access ladders and equipment for filling, discharging and agitating contents.

2.1.3

reception pit

a storage pit usually built below ground and generally adjacent to the slurry storage tank

NOTE Slurry is normally collected in the reception pit and thoroughly mixed prior to pumping into the tank. On emptying the tank, slurry may be discharged by gravity to the reception pit before pumping into a spreader, tanker or elsewhere.

2.2 Symbols

2.2.1

General

The symbols used in this Part of BS 5502 are as given in 2.2.2 and 2.2.3 (see also Figure 1).

NOTE Additional symbols are used in Appendix B.

2.2.2

Slurry storage tank

D	diameter of tank (in m)
H	height of tank (in m)
h	height of slurry in tank (in m)
p_h	wall pressure from stored slurry (in kN/m ²)
p_c	hoop stress from stored slurry (in kN/m ²)
p_v	floor pressure from stored slurry (in kN/m ²)
t	wall thickness (in mm)
z	depth below slurry surface for calculating p_h (in m)

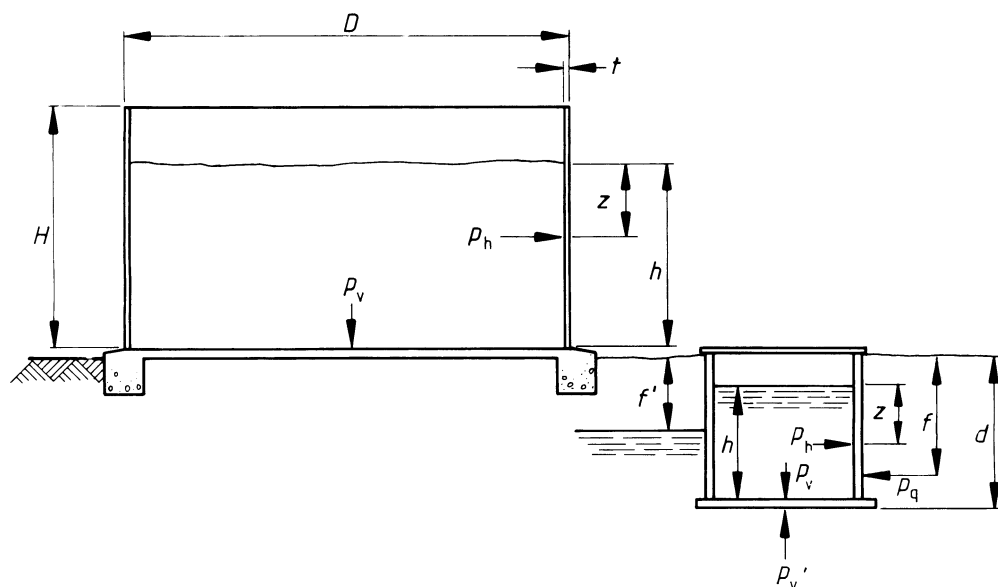


Figure 1 — Symbols

2.2.3

Reception pit

- a average dimension of adjacent foundation base parallel to reception pit (in m)
- d depth of pit below ground level (in m)
- d_2 distance from point of application of concentrated point load to wall face measured horizontally (in m)
- f depth below ground level for calculating p_q (in m)
- f_1 depth below point of application of load (in m)
- f' depth of groundwater level below ground level (in m)
- f_A, f_B specific values of f (in m)
- g acceleration due to gravity, (in m/s^2)
- h depth of slurry in pit (in m)
- K constant dependent on soil surface
- K_L K in relation to soil level
- p_h wall pressure from stored slurry (in kN/m^2)
- p_q horizontal pressure from backfill (in kN/m^2)
- p_{s1} horizontal pressure from concentrated point load (in kN/m^2)
- p_{s2} horizontal pressure from wall (in kN/m^2)
- p_v floor pressure from stored slurry (in kN/m^2)
- p_v' floor pressure from groundwater (in kN/m^2)
- T concentrated load (or wheel load from Table 6 of BS 5502-22:1987) (in kN)
- T' uniformly distributed load acting vertically at the point of application (in kN/m^2)
- T_s shear force from foundation base load (in kN)
- W specific weight $\times g \times 10^{-3}$ of dry backfill (in kN/m^3)
- W_1 buoyant weight $\times g \times 10^{-3}$ of backfill (in kN/m^3)
- W_w specific weight $\times g \times 10^{-3}$ of water (9.81 kN/m^3)
- W_z specific weight $\times g \times 10^{-3}$ of backfill to resist floatation (in kN/m^3)
- z depth below slurry surface for calculating p_h (in m)

3 Siting of slurry storage tanks and reception pits

3.1 General

When siting a slurry storage tank or reception pit, due regard should be made to the classification of the structure, the classification of adjacent buildings and the retaining structure's zone of effect (see BS 5502-22).

In addition, the possible nuisance from odour (see 3.2), the dangers of water pollution (see 3.3) and operational factors (see 3.4) should be taken into consideration in siting slurry storage tanks.

Consideration should be given to the regulations listed in BS 5502-11, in particular when siting slurry tanks or reception pits within 400 m of a protected building.

Where siting is such that accidental impact from vehicles is possible, consideration should be given to the provision of suitable barriers (see also clause 9).

The site ground conditions should be such as to avoid excessive or differential settlement (see also 6.5).

3.2 ^{A1} Emissions to air

It is impossible to eliminate all emissions to air (including odours) associated with slurry storage but it is possible to reduce its offensiveness and strength. To lessen nuisance the storage facilities should be sited as far away from human habitation as possible and due account should be taken of prevailing winds. Shelter belts and windbreaks may assist in mixing emissions to air with fresh air.

NOTE Reducing emissions to air from stored slurry depends on careful management of the storage system and possibly some form of biological treatment such as aeration or anaerobic digestion. Best results are obtained when the collection, storage and field spreading system are designed with odour control in mind.

Covers will reduce direct emissions escape from slurry stores. Rainwater collection from use of a cover results in less spreading which further reduces emissions. Ammonia losses from a store can be reduced by over 80 % when covers are used. ^{A1}

The Public Health Act 1936, the Public Health (Recurring Nuisances) Act 1969, the Environmental Protection Act 1990 and the Public Health (Scotland) Act 1897 give local authorities, acting through their environmental health officers, limited powers to control odours that amount to a statutory nuisance. BS 5502-33 gives guidance on controlling odour pollution.

3.3 Pollution control

Slurries have a very high biochemical oxygen demand (BOD) compared with domestic sewage and should not be allowed to enter a watercourse.

Adequate sizing of slurry storage tanks and careful management of the waste system are needed to prevent accidental overflow.

Slurry storage tanks and reception pits should be constructed so that polluting material is safely contained during storage or transfer and that unintended dilution with surface water or groundwater is prevented. It is also important that storage containers are built and maintained in a condition that will prevent any leakage. Slurry tanks and reception pits should not be sited within 10 m of open watercourses or sites liable to flooding. Underdrains should be removed from sites to be used for storage of slurry and manure.

^{A2} Minimum requirements for the siting, sizing and constructional requirements for slurry stores are detailed in the Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010, Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (Wales) Regulations 2010, and the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) (Scotland) Regulations 2003 (SSAFO). Also this legislation requires that the Environment Agency and, in Scotland, the Scottish Environment Protection Agency (SEPA) be informed of any new or substantially enlarged or substantially reconstructed installation. Their environmental control officers should be consulted about any new activity where there might be a risk of water pollution and where guidance is required.

NOTE The agricultural fuel oil aspect of the 2003 regulations were revoked in 2006 and are now covered by the Water Environment (Oil Storage) (Scotland) Regulations 2006. ^{A2}

3.4 Other considerations

If other constraints allow, it is preferable to site reception pits and slurry storage tanks close to livestock buildings so that slurry can easily be scraped, conveyed or sluiced in channels into the reception pit. There may be several tractor/tanker/spreader combinations that will need to be accommodated in terms of width, turning circle and traffic flow.

Management of slurry storage containers can vary but often there is a requirement to keep longer fibrous material out of the slurry storage tank to avoid blockages and surface crusting. Fibres can be held up on a suitably designed reception pit grid cover whilst slurry drops through. A separate short-term storage container for these fibres and thick solids can be sited adjacent to the slurry storage tank such that any drain-back will run into the reception pit. Sometimes it is also useful to have a slight rise to the reception grid to prevent inundation by runoff water.

4 Sizing of slurry storage tanks and reception pits

4.1 General

The frequency at which the contents of a slurry storage tank can be disposed of safely should be taken into account when determining the size of the tank. Where safe disposal is not possible during winter months, provision for a least 4 months' storage in England and Wales and six months' storage in Scotland should be provided. Slurry output can be estimated from established figures with appropriate amounts of dirty water added.

4.2 Amounts of waste produced by livestock

The characteristics and volume of neat slurry or excreta produced by a particular species depends on a number of factors: the size, age and breed; the diet and type of food and whether this is mainly roughage, liquid feed or a high energy ration; the availability of drinking water; and the environmental conditions in which the animals are kept. Standard slurry output figures are only a guide and should be modified for individual circumstances. For livestock with body weights outside the range quoted an estimate of the daily output of excreta may be obtained from the ratio of body weight to the amount of excreta.

4.3 Amounts of dirty water produced

There are three main sources of dirty water production: cleaning and disinfection; rainwater falling on to soiled yard areas; and drainage from farmyard manure stores. Other sources of dirty water may need to be identified and allowed for in a disposal system. Since the sizing of a slurry store depends on the total daily waste production and the storage period it is important to decide whether dirty water enters the store or whether it enters a separate disposal system. It is common for some dirty water to enter the slurry store and for some to be disposed of separately. Estimates of cleaning water used can be made from standard figures but each individual installation should be checked.

NOTE Detailed rainfall estimates for a particular farm can be obtained by contacting the Rainfall Enquiry Bureau at the Meteorological Office Headquarters, Bracknell, Berks RG12 2SZ. ^[A2] Return periods for rainfall and likely volumes of cleaning water are given in BS 5502-31, 8.3.2. ^[A2]

4.4 Slurry storage tank size

Tank size should be based on the total daily estimate of slurry and dirty water production in conjunction with the desired storage period. In addition, ^[A1] for stores open to rainfall ^[A1] an allowance should be made for incidental rainfall directly on to the store during the design storage period. A freeboard of at least 300 mm should be provided. This should be increased to 750 mm for earth banked lagoons.

^[A2] **NOTE** Attention is drawn to the Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010, Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (Wales) Regulations 2010 which require that freeboards provided for earthbank structures are maintained during use. In Scotland this applies to all types of slurry store. ^[A2]

The physical size of the tank or tanks will depend on the space available, height of other buildings and operational management. For example, it will be easier to mix the contents of a tank if a relatively small diameter, tall tank is chosen rather than a large diameter, low tank. A larger diameter tank will collect more direct rainfall due to its greater surface area. Aesthetically, a lower, larger diameter tank may fit more harmoniously with the landscape and other buildings. ^[A1] Where a cover is permanently fitted, rain falling directly onto the tank can be ignored. ^[A1]

4.5 Reception pit size

Only one reception pit is normally needed to serve one or more slurry storage tanks. The pit and associated pipes/channels should be capable of storing a minimum of two days' production of waste. Where sluiced channel systems lead to a reception pit, the reception pit should be capable of holding the contents of the sluiced channel.