

EARTH-BANKED SLURRY STORES

Prepared by ADAS National Building Design Team.
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The soil used to construct an earth-banked store must have special properties to ensure stability and low permeability, usually a high clay content.

The site conditions must also be suitable. It is advisable to consult the Environment Agency and the local planning authority about the site at the initial planning stage.

Stores can be built below, above or part below/above ground level.

Dimensions of the store will depend upon the quantity and type of slurry to be stored and operational requirements.

When calculating the capacity at least 750mm must be added to the depth for freeboard (See References 6&7).



Earth-banked slurry store with access ramp

Site Suitability

- Avoid sites in a flood plain or sites with a high water table.
- Check proximity of water table and fluctuations in depth over a period of time.
- Avoid improperly filled ground or other unsuitable ground conditions.
- Investigate geology of the site:- sub-strata types, presence of faults or irregularities in substrata, evidence of mining.
- Use trial holes to sample soil properties and obtain soil profiles at various depths over the site.
- The outside edge of the embankment must be at least 10 metres from a water-course (See References 6 & 7).

An investigation to assess the suitability of the soils on site should be undertaken. The two most important factors to consider are:-

- **Permeability** – A maximum permeability of 10^{-9} metres per second extending to a depth of at least one metre over the whole of the site must be achievable.
- **Stability** – The soil must be suitable to form stable embankments while maintaining the required permeability under all conditions

The selection of a soil to meet the above requirements should only be entrusted to suitably qualified experts e.g. chartered civil engineers. It may be necessary to obtain samples over the whole site area at various depths and to carry out laboratory tests to determine the suitability of soils.

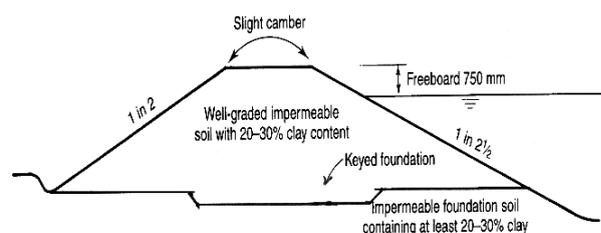
Design and Specification

The sketch shows a typical cross-section of an earth embankment built using an impermeable clay soil with uniform properties. It is keyed into, and built directly off, the impermeable subsoil base. This is the cheapest and simplest form of construction.

The slopes and width of the embankment shown may need to be varied for different site conditions and soil properties.

Non-uniform soils require more complex arrangements. Artificial impermeable liners can be used on certain sites but these require specialist design and construction.

CIRIA Report No 126 provides more detailed information on embankment design including the use of liners (See



Earth embankment cross-section

Reference 1) .

- Slope the floor slightly towards the filling point. This allows slurry to float and spread over the whole area.
- If machines used to empty the store will operate from the top of the embankment, the banks must be designed to take their size and weight.
- Obtain the characteristics of the soils and substrata of the site in sufficient detail to enable designs to be prepared to BS 6031. Note that BS 6031 is not specific on design for impermeable construction. Soil specifications must conform to the required impermeable standards. (See Reference 3).
- Determine the correct geometry of the embankment cross-section and the particulars of its foundation.
- If necessary carry out tests to BS 1377 to determine soil strengths and permeability (See Reference 4).
- Determine by tests: relationship between compaction requirement according to soil density and moisture content for impermeable construction (See References 1 & 2).

Construction

- Ensure that the relevant Health and Safety Regulations including CDM Regulations are observed (See Reference 5).
- Prepare site by removing all trees, scrub, roots, other vegetation and unsuitable material.
- Remove topsoil from the site including the area of the embankments and set aside for re-use later.
- Relocate any drains to at least 10 metres away from the outside of the embankment, properly backfilling the old drain trench with impermeable material.
- Level and compact the sub-soil to impermeable standards.
- Level embankment areas and prepare the formation layer to provide a proper key for embankment construction.
- Using suitable impermeable soil-fill, place and compact in uniform layers using mechanical plant – all as described in Table 21 of CIRIA Report No 126.
- Ensure that the construction is fully in accordance with the detailed drawings and specification. A suitably qualified supervisor should carry out this duty.
- A permanent safety fence with lockable access gates should surround the site. This must conform to HSE requirements. It is recommended that the fence be at least 1.3 metres high and of un-climbable construction such as close spaced barbed wire, corrosion protected steel chain-link or mesh properly fixed to strainer wires and attached to hardwood or concrete posts with strainer posts and corner posts as required. More substantial fencing may be necessary in certain locations e.g. adjacent to a public footpath.
- Conform to requirements of the Control of Pollution Regulations and the Water Code (See References 6 & 7).

Repair and Maintenance

- Ask the designer and installer for operation and maintenance instructions.
- Do not fill above the 750mm freeboard level – periodically check levels to assess any leakage.
- Properly repair: any subsidence damage or damage caused by mechanical action or wind and waves, and other erosion damage.
- Repair rodent damage - a layer of wire mesh may give protection.
- Do not allow tree or shrub growth on embankments – roots may cause damage.
- Provide warning notices and rescue equipment.
- Maintain safety fences and rescue equipment.
- Vulnerable areas requiring special attention include: the foot of the embankment, joints with other forms of construction, integral pipework.

Further advice is provided in CIRIA Report No 126 – Farm Waste Storage and CIRIA Report No 164 – Design of Containment Systems (See References 1 & 2).

References

- 1 CIRIA Report No 126: Farm waste storage - guidelines for construction.
- 2 CIRIA Report No 164: Design of containment systems.
- 3 British Standard BS 6031 Code of Practice for earthworks.
- 4 British Standard BS 1377 Methods of tests for soils for civil engineering purposes.
- 5 Health and Safety Executive: Construction (Design and Management) Regulations.
- 6 The Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991 (as amended).
- 7 The Code of Good Agricultural Practice for Water; MAFF Free publication.

