DEPARTMENT OF AGRICULTURE AND FOOD

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MINIMUM SPECIFICATION FOR BOVINE LIVESTOCK UNITS AND REINFORCED TANKS

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DEPARTMENT OF AGRICULTURE AND FOOD

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The receiving of this specification does not imply approval of a grant application. However, if written approval is issued, then this specification becomes part of the contract between the applicant and the Department of Agriculture and Food.

This is a minimum specification. Where the word "SHALL" is used, then that standard (at least) **must** be followed in grant-aided buildings. Where a procedure is "RECOMMENDED", this is advice only on good practice.

Note that all references to other Department Specifications are to the current edition of that specification [available on the Department of Agriculture and Food Website (www.agriculture.gov.ie) under Farm buildings]. Similarly, references to Standards are to the current edition of the Irish, British or European Standard, as appropriate.

This specification covers only the design and internal layout of bovine livestock units, and the design and construction of slurry / effluent storage tanks. **For the design and construction of a building's superstructure, Department Specification 'S101: Minimum Specification for the Structure of Agricultural Buildings' shall be read and followed alongside this specification.**

Note: This edition of S123 incorporates S130 (Reinforced Concrete Tanks), S122 (Cubicle Houses; Loose Houses), and S125 (Suckler housing). This specification has ten sections, as follows:-

1 Safety

1.1 Responsibility for Safety

Applicants are reminded that they have a duty under the Safety, Health, and Welfare at Work Act 2005 to provide a safe working environment on the farm, including farm buildings, for all people who may work on that farm. There is a further duty to ensure that any contractor, or person hired to do building work, provides and/or works in a safe environment during construction.

1.2 Safety during Construction

Farmer/Applicant Responsibility: Please note that neither the Minister nor any official of the Department shall be in any way liable for any damage, loss or injury to persons, animals or property in the event of any occurrence related to the development and the applicant shall fully indemnify the Minister or any official of the Minister in relation to any such damage, loss or injury howsoever occurring during the development works. It is the applicant's responsibility to provide a construction stage project supervisor.

Dangers: Where the applicant/farmer is undertaking any part of the above work, it is his/her responsibility to seek competent advice and to undertake all temporary work required to ensure the stability of excavations, superstructure, stanchion foundations, wall foundations, to guard against possible wind damage and to avoid any other foreseeable risk. It is also his/her responsibility to ensure that any drains, springs or surface water are diverted away from the works.

Power lines: Farm buildings shall not be constructed under or nearer than 10m to an overhead power supply. If advice is required, or if power lines need to be diverted, it is the applicant's responsibility to contact, in writing, the local ESB supervisor before construction commences and then to follow the ESB conditions.

Danger to children: It is the applicants responsibility to prevent children from playing or spending time in the vicinity of any construction work.

1.3 Safety Notices

It is recommended that at least one safety notice should be put on the side of a building next to which a slurry agitation point is situated. The notice should be as close to the agitation point as possible. [Notices are available from most farm supply outlets and Teagasc].

1.4 Toxic Gases and Agitation

Harmful gases are generated in slurry stores and these have been responsible for both human and animal deaths. Good ventilation in slatted buildings is always important, and is vital during agitation or emptying of the tanks. Where silage effluent has been added to the slurry there can be a danger of more concentrated gases. Therefore:

1. Tanks shall always be agitated and/or emptied from the external agitation points, and never from openings within the house.
2. All doors, and any feed-flaps, shall be fully opened before agitation/emptying begins and kept open until completion of tank emptying.
3. No person shall enter the house during agitation or emptying. It is strongly recommended that animals be removed from the house before agitation. It is also recommended that animal holding pens are installed close to the house to facilitate this removal.
4. Some poisonous slurry gases are heavier than air. No person should climb down into an emptied or part-emptied tank without breathing apparatus. Such apparatus requires full training before it can be used.

1.5 Safety Tank Fencing

A stock proof and child proof fence, 1.8m high, shall be provided around all external tanks not already protected by safety covers as specified in Clause 4.5.

Posts shall be 2.3m long minimum of either:-

a) Reinforced concrete 125mm x 125mm at butt end (to IS 177: 1980)

b) Galvanised angle iron 60mm x 60mm x 6mm thick

c) Galvanised tubular steel, 75mm outside diameter, and 3.2mm thick

Uprights and strainers shall be embedded 400mm into the tank wall or in 0.5m square concrete base, not more than 3.0m apart. Alternatively they may be fixed to the outside of the tank with proprietary bolts to manufacturer's instructions. Four strands of 3.2 mm plain wire shall be strained, and stapled or tied to the uprights with tying wire. Chain link fencing, 2.5mm, (to IS 130:1980), 1.8m high, shall be secured to the outside of the line wires over entire fence. One strand of 2.5mm barbed wire shall be placed along the top of the fence.

A 3.5m wide gate, 1.8m high, of galvanised steel, or preservative treated timber, with closing bolts and locks, shall be fitted at each agitation or emptying point. The only horizontal bars shall be at the top and bottom of the gate. Chain-link fencing shall be fitted to the outside of the gate. The gate shall be designed such that neither people or stock can get through or under when closed. A safety concrete kerb, minimum 300mm x 600mm wide, shall be installed near the edge of the tank, across the width of the gate.

Other proprietary fence systems will be acceptable if the above criteria are met.

1.6 Backfilling of tanks

All tanks shall be backfilled prior to the installation of any cover, e.g. Slats or slabs. This is to prevent the possibility of the bank beside the tank collapsing under the weight of vehicles delivering and unloading slats or slabs. When slats, slabs or beams are being unloaded, care should be taken to ensure that the vehicle delivering them does not park on the recently backfilled area.

1.7 Maintenance

All farm buildings require regular maintenance to ensure the health and safety of personnel and animals. After each winter-season buildings should be thoroughly washed and cleaned out. Fittings such as slats, electrical fittings, drinking arrangements, etc., should be periodically checked, and all defective items replaced.

2 Design of Buildings

2.1 General Design

Proper design of tanks and buildings depends on stocking density; feed-face length; storage period; the management plan for landspreading of slurry and effluents; the chosen systems of agitation and emptying; and the economics of construction. All these decisions should be taken before construction starts.

The general superstructure of the building shall be constructed to the current edition of **Specification S101: Minimum Specification for the Structure of Agricultural Buildings.**

The use of a **Simple Steel Frame Structure** as specified in S101, is the strongly recommended option for cattle housing. Houses may also be built to the other designs given in S101. If trusses are being installed, they require a high standard of protection and ongoing maintenance in the aggressive livestock environment. If other structural designs not specified in S101 are used, then a full set of design drawings and full structural calculations shall be prepared by a chartered engineer, and given to this Department for prior approval before the start of construction.

2.2 Tank Gases

To maximise ventilation during agitation of slurry, and to reduce gas build-up in the house, sliding doors, unsheeted gates, or unobstructed openings shall be provided to both ends of the passageway in houses which exceed l5m in length. The minimum opening size at each end shall be 3 metres wide by 3 metres high.

2.3 Ventilation of Structure

Permanent open ventilation shall be provided, as **specified in Specification S101**, as a strict condition of grant-aid, in order to protect animal health and the working life of the structure. Full ventilation shall also be provided in any conversion or extension of existing buildings.

Spaced sheeting for the roof is strongly recommended, and shall be installed as per S101.

2.4 Design of Slatted Houses

To maximise the capacity of slurry storage directly under the house, tanks should be installed under the entire animal area. [Extending the tanks under the central passage is also recommended]. A maximum width of 1.0m solid concrete floor will be grant-aided. It is recommended that no more than 500mm is provided at either the front or back of the pen. Larger areas of solid concrete flooring may make it difficult to achieve the required minimum slurry storage capacity. The solid concrete floor shall have a slope of at least 1:36, towards the tank, However, it is recommended that this be sloped at 1:14 to ensure self-cleaning. Where an existing house is being converted to a slatted cattle unit, up to 3m width of concrete at the back of the slatted animal area will be grant–aided. It is strongly recommended that the feed passage is at least 50mm above the level of the slats.

2.5 Design of slatted Suckler houses

When the slatted area is part of a suckler house it is recommended that slats with gaps between 35-38mm are used as these are best suited for young calves to avoid injury. The floor area per cow in slatted suckler housing depends on cow size and calving date. Autumn, winter and, early spring calving cows require more space than cows calving, post the housing period. A floor area of 2.5m^2 to 3.5m^2 per cow, depending on circumstances, is recommended.

Where feeding is rationed it is recommended that feeding space should be 0.6m per cow. The minimum space shall be 0.4m.

2.6 Layout of Cubicle houses

In order to ensure a stress-free environment for dairy cows in houses with double or multiple rows of cubicles, the following shall be incorporated in the layout design of any new buildings:-

- At least two routes to the feedface.
- No dead end passages.
- Cross-over points between rows shall be a minimum of 2.3m (2 cubicles) wide, or 3.5m (3 cubicles) wide if a drinker is positioned at the point.

In all cubicle houses there shall be a minimum 3.5m standing area at the feedface, and at least 2 drinkers, and preferably four, per 50 cubicle unit. It is recommended that where the heel of the cubicle bed faces the feed face that the standing area be at least 4m wide.

Solid-floor cubicle houses shall normally incorporate an easy-feed passage with barriers. If a self-feed design is chosen it is strongly recommended that all feeding areas be covered to minimise requirements for soiled water storage.

Scraped passages behind cubicle beds shall be at least 1.8m wide, and normally 2.0m or more. Channels to which slurry is scraped shall have slatted or gridded covers with max. 40mm slots, or alternatively be positioned to prevent any animal access. Mechanical scrapers shall be installed to manufacturer's specifications.

For smaller cubicle units (no more than 8 cubicles on any side of each passage) where the cubicle beds run perpendicular to the feed passage the requirement for crossover points and no dead end passages is relaxed to a strong recommendation.

Cubicles are a less favoured option for suckler herds. Existing cubicle housing may be adapted by the provision of creep area and an easy feed arrangement. Where calves are present with cows, provision shall be made to ensure easy escape for calves from cubicles to avoid risk of injury.

Where calves are with cows, a suitable creep area must be provided either at the end of the house, at the head of the cubicles, or in an adjoining house.

Where a slatted feed area is being added on to an existing cubicle house the general requirements become strongly recommended.

2.7 Design of Loose Houses

Loose houses shall normally incorporate an easy-feed passage with barriers. If a self-feed design is chosen it is strongly recommended that all feeding areas be covered to minimise requirements for soiled water storage.

Loose houses with full bedding shall be designed with floors sloped at least 1 in 40 (it is recommended that the floor be sloped at 1 in 30) so that all liquid seepage is drained at source to an appropriate store. Where bedded floors are installed beside slatted tanks, a barrier (timber or concrete kerb) may be placed to prevent ingress of bedding material into tanks. A system of removal of the liquid effluent shall be provided in every loose house. A channel 75mm x 75mm shall be provided across every opening and the effluent collected and diverted to a suitable holding tank. The channel shall be provided 600mm outside of the opening so as to collect any effluent seepage. The channel shall be constructed as specified in clause 2.8.

A floor area of 3.5m^2 to 4m^2 per cow is required. If calves are running with cows an additional area of at least 1m^2 is required per cow.

[The type of loose house which incorporates sloped floors with minimal or no bedding is not recommended, but if such pens are installed the floor shall have a slope of between 1 in 16 and 1 in 12. The length of sloped sections to channels in these specialised sloped-floor houses shall be 1.6m max. with no bedding, and 2.4m max. with limited bedding].

2.8 Walls around bovine housing.

Walls are not mandatory for slatted, cubicle or loose housing. Walls, where installed, shall be constructed to the requirements of Specification S101. [It is recommended that walls be not more than 1.5m in height, or 2.0m for loose houses with 4m eave height.] Where walls are not provided appropriate barriers, constructed to the requirements of clauses 3.4, 3.5 or 3.6, shall be installed to ensure the proper control of animals. Houses without external walls shall not be used for accommodation of young calves, and are not recommended for dairy cows.

Where walls have been omitted in solid-floor cubicle houses and loose houses, channels shall be constructed around the house as per Fig. 3 and Fig. 4. The channel shall be not more than 1m outside the barrier. The channels shall be connected to a suitable tank.

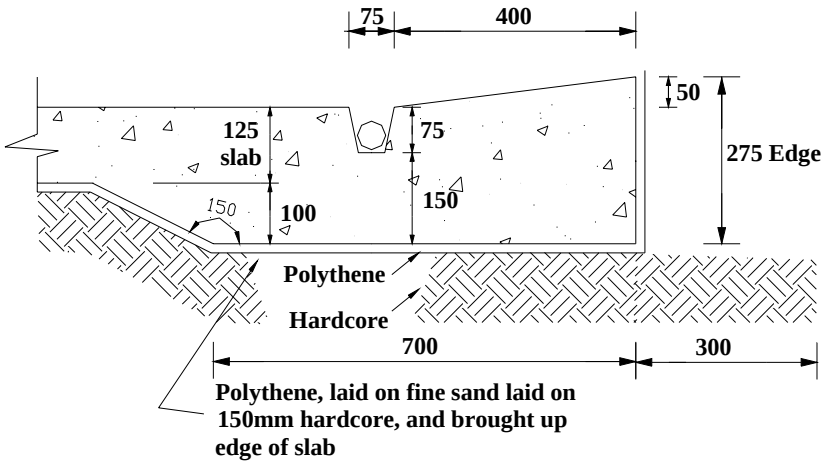

Figure 3: Channel design for use at edge of concrete.

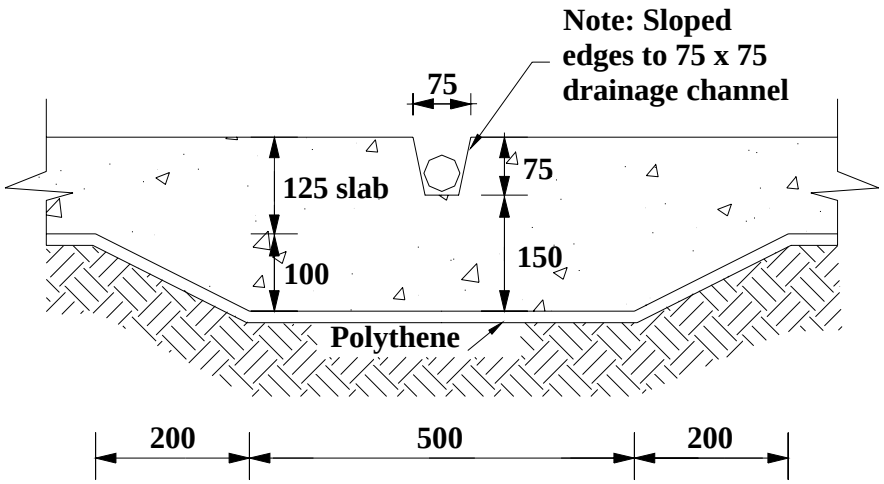

Figure 4: Channel design for use when concrete extends as working yard area.

2.9 Walls over tanks

Walls shall not be built directly onto slats under any circumstances. As walls are not mandatory in most houses (Clause 2.8), steel barriers may instead be installed across the gable end of a building, with or without steel cladding. Prefabricated concrete wall panels may also be installed (Clause B9.2 in S.101), positioned at least 10mm above the top of the slats. If it is decided to install a blockwork or mass-concrete gable wall, then it shall be positioned on a supporting beam. This beam may either be prefabricated, or constructed on site (Clause 8.12 or 8.13), and shall have at least 150 mm support at each end. If it is decided to extend the slats under the beam, there shall be a gap of at least 10mm between the beam and the top of the slats. In all circumstances there shall be sufficient space outside the house to install a 1.2m wide slab or manhole slat on the walls of the extended tank.

Where a wall is erected on a tank wall, the tank wall shall be wide enough to carry the full width of wall **and** provide a full slat bearing of 150mm (see clause 3.1). Where walls are 200mm, 350mm (min.) tank walls are necessary.

2.10 General Suckler housing design

Suckler housing shall provide clean, comfortable, well ventilated, draught free accommodation for calves with suitable accommodation for cows. Housing should permit the accommodation of cows and calves in small groups according to calf age, to minimise the spread of disease from older to younger calves. A strawbedded creep should always be provided for Autumn/Winter/early Spring calves.

There are three types of housing for cows with suckling calves:

1. Slatted housing with creep area
2. Cubicle housing with creep area
3. Loose housing with creep area

The above systems can be combined. The most usual combination is slatted and loose housing, where cows are easy-fed along slatted passages. A kerb 200mm to 250mm high and 200mm wide to retain bedding material shall be provided between slats and bedded area. The floor area required per cow and calves is the same as for loose housing.

Calving boxes shall be provided if calving is indoors. In slatted units where the creep area is at the back of slats, part of the creep area may be partitioned to provide a suitable calving box. In larger herds a further box may be provided to keep cows with calves for a few days after calving; floor area shall not be less than 14.5m^2. Calving box may be provided in an adjoining building. Calving boxes shall be as specified in S147.

It is recommended that a crush gate, set out 600mm from the wall to facilitate handling, is provided in the calving box for suckler cows.

Outline drawings, Figures 5, 6, and 7 show some suggested lay-outs for suckler housing.

2.11 Design of Creep area

A creep area of at least 1m^2 per calf shall be provided for spring born calves and up to 1.75m^2 per calf for Autumn born calves.

A solid floor is preferred. Fall shall be at least 1 in 30 to a drainage channel discharging into the underground tank (it is recommended that the fall should be 1 in 20).

Slatted floor pens normally used to house cattle may be covered with straw bedding for creep use. Under floor draughts should, as far as possible, be excluded. It is recommended that slats are covered with a suitable material to prevent straw bedding entering the slurry tank.

To minimise draughts in creep area level, a temporary canopy may be installed over the lying area, of plywood, boards or other suitable material. It is very strongly recommended that the eave height of the creep area is 4m so as to facilitate mechanical cleaning.

The location of the creep area depends on:

- The preferred management system: Autumn, Winter, early Spring or late Spring calving. No creep area is required for late spring calving.
- Where part of the herd is early calving it is recommended that the creep area be located at the end of the house with calved cows accommodated in the adjoining pen.
- Where most of the herd is housed after calving the preferred location of the creep is at the back of the slatted area. The recommended minimum width is 3m.

Separate external access to the internal divisions of creep area, particularly in Autumn and Winter calving herds, is recommended to facilitate meal feeding and inspection of calves.

Tight fitting sliding doors sufficiently wide to facilitate mechanical cleaning shall be provided at each end of a creep area more than 20m (5 or more bays) long and at one end of a creep area less than 20m (4 bays or less) in length. One sliding door shall have wicket door fitted, minimum 0.75m wide and 2m high to facilitate access for calf inspection etc. A channel 75mm x 75mm shall be provided across every opening and the effluent collected and diverted to a suitable holding tank. The channel shall be provided 600mm outside of the opening so as to collect any effluent seepage. The channel shall be constructed as specified in clause 2.8.

It is recommended that the barrier between the cow area and creep is a tubular steel gate framed with 50mm tubular steel and incorporating a creep gate. The height of gate over floor level shall be 1.5m, hung either to suitable RSJ posts or to 100mm heavy gauge GB tubing, and provided with animal-proof closers. A kerb about 175mm high either of concrete or 75mm thick treated timber shall be provided under the tubular barrier to exclude bedding from creep area getting on to slats. Alternatively, the barrier may be of 150mm solid concrete block walls built between 150 x 75mm RSJ uprights and incorporating a creep gate. To allow cows to see the calves the wall should be 1.1m to 1.2m high, and be installed with a horizontal top rail set at 1.5m over floor level.

One creep gate per pen shall be provided. The minimum opening shall be 350mm wide x 1m high.

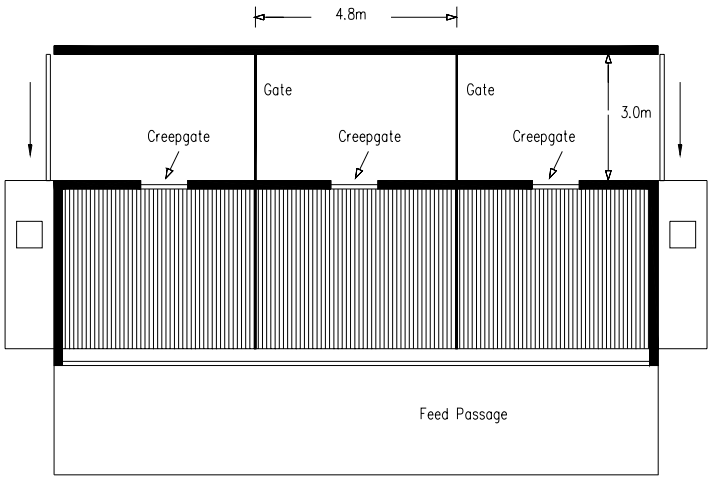

Figure 5 Slatted House and Creep

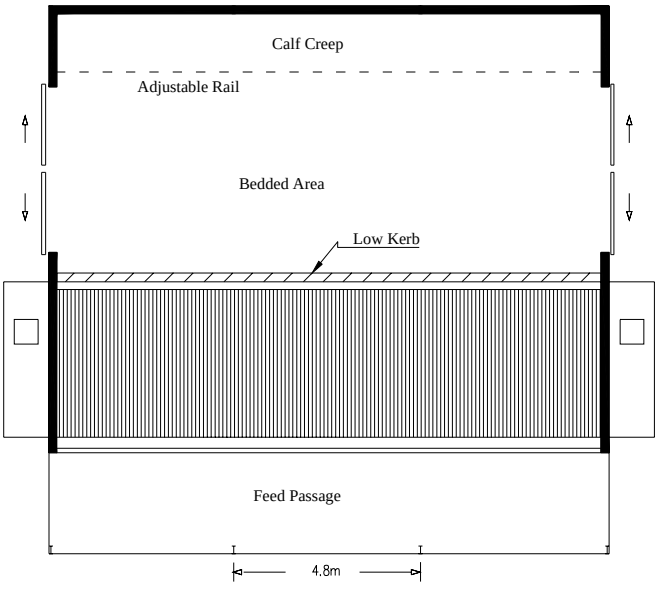

Figure 6 Bedded / Slatted House

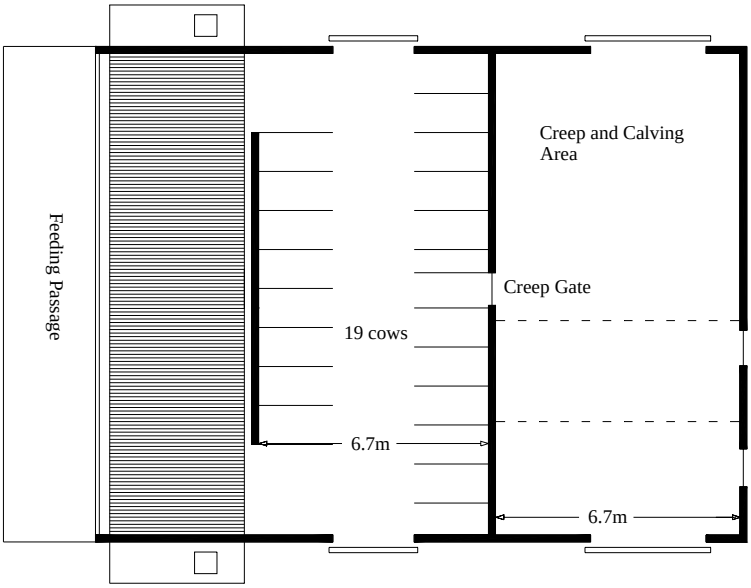

Figure 7 Adapted Existing Housing / Cubicle - Easy Feed

2.12 Recommended Minimum Animal Areas

These can be found on the Department of Agriculture and Food website (www.agriculture.gov.ie) under farm buildings.

3 Components

3.1 Slats

Slats shall comply with IS 249: 1993 Cattle Slats. A **"Certificate of slat manufacture [AES C.03]"** from a supplier approved by the Department shall be submitted. When laid, slats shall comply with the following requirements:-

1) Be free from any cracks, honeycombing, and chipping of the top corner arises.
2) **Have a full bearing of at least l50mm at points of support** (as per Figure 8)**.**
3) Finished slat floor shall be level and free from any rocking movement.
4) **Be capable of being replaced with minimum disturbance.** [Slats are components with a limited working life, and are unlikely to last as long as the building.]

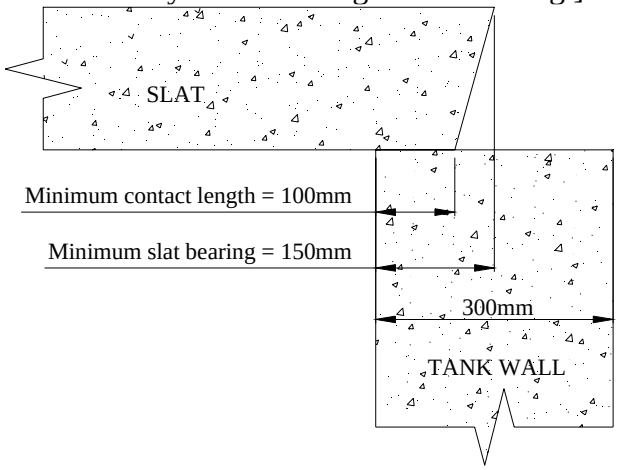

Figure 8: Diagram showing slat bearing.

3.2 Cubicle Beds

Solid Ground: These shall consist of 100mm concrete on 150mm well compacted hardcore. The finish shall be uniform, non-slip, capable of easy cleansing with a fall of at least 75mm from head to heel kerb. The heel kerb shall be at least 100mm wide and the bed height at this point shall be a minimum 225mm over a solid passage and a minimum 175mm over a slatted passage.

Suspended Cubicle Beds: These shall be supported at a maximum of 3.2m centres. The walls under the slab shall be raised level with the top of the slats. Reinforcement shall be placed in position having clear bottom cover of 50mm. Where meshes overlap the cross wire on one shall overlap a cross wire on the other. Suitable meshes are shown in Table 2. If it is desired to support cubicle beds at greater intervals than 3.2m, then the reinforcement shall be as for a suspended central passage (clause 8.9).

Well-supported leak-proof shuttering shall be provided to the underside of the slab area during construction.

Table 2

Mesh Reference	Pitch of Wires (mm)		Size of Wires (mm)		Weight
A.142	200	200	6	6	2.22
B.196	100	200	5	7	3.05

Alternatively 10mm H.Y. bars may be used at 150mm centres with similar bars at 300mm centres as transverse steel.

Precast Cubicle Beds: As an alternative to suspended cubicle beds and standard cubicle beds, precast cubicle beds with cast-in cubicle divisions are recommended.

Precast cubicle beds may be placed on slats under the following conditions only:

- The concrete slabs making up the cubicle beds shall be not more than 2.4m x 2.4m (2 No. cubicle beds).
- The slats under the precast cubicle beds shall be heavy duty.

Cubicle Beds Extending Over Standard Slats: Cubicle beds shall not extend more than 225mm over standard slats, and where they do the cubicle beds shall be designed and constructed such that slats can be replaced without damaging the cubicle beds. There shall be at least a 25mm clear space between the upper side of the slats and the under side of the cubicle beds. The cubicle beds shall be suitable reinforced.

[**The construction of standard cubicle beds on slats is very strongly discouraged. Cubicle beds on slats make slat-replacement extremely difficult and expensive. This practice shall not be permitted on or after 1st July 2007 (the use of precast cubicle beds on slats will still be permitted after this date).** However, if it is thought essential to place standard cubicle beds on slats the following shall be complied with: 1) All slats under the cubicle beds shall be heavy duty. 2) The slats shall be fully supported underneath during construction. 3) 1000 gauge polythene sheeting shall be placed on the slats prior to constructing cubicle beds. 4) Cubicle beds shall be laid to the standard for 'over solid ground' (see above). Concrete only, without hardcore, shall be used over slats.]

3.3 Cubicle Divisions

Cubicle Divisions shall be of galvanised tubular steel, not less than 43mm O.D. and 3.2 mm thick. They shall extend from the head wall to not more than 225 mm in from the kerb edge: if free-standing, they shall be installed close to the head wall. The top rail shall be at least 1.1m from the floor. An adjustable head-rail is strongly recommended, and is mandatory for cantilever cubicles. Within the above limits, a range of cubicle designs is accepted.

Note: Sizes of cubicle beds will vary according to animal size, but for dairy cows, beds shall be at least 2.1 m long and the distance between divisions shall be at least 1.1m centre to centre, and not more than 1.25m. Larger cows require 1.2m wide by at least 2.2m length. It is recommended that cubicle beds should be 2.6m long when up against a wall and 2.4 m when head to head. In addition it is recommended that the width of a cubicle bed be increased by 10% where one of the long sides is bounded by a solid wall.

Internal headwalls between cubicles and feed passage shall be at least 100mm, and be secured to every second cubicle.

3.4 Pen Dividers

Divisions between pens shall be 1.5m high with 300mm clear spacing between bars and between bottom bar and floor. Steel shall be a minimum of 50mm O.D. and 3.2mm thick, and up to 75mm O.D. depending on the width of the pen or on the weights of stock housed. Vertical bracing pieces shall be secured between each pair of horizontals at 2m intervals and staggered. Dividers may either be securely fixed, or hinged to form gates.

3.5 Feed Barriers

A wide range of feeding barriers may be installed. Normally the rail shall consist of a 80mm O.D. and 4mm thick tubular steel rail, fixed approximately 1.0-1.3m from the floor of the pen, with capacity for height adjustment. A barrier approximately 450-600mm high shall be positioned under the rail, of 100mm solid concrete or block work, or secured timber planks. [Blockwork is likely to fall unless a second rail is fixed directly above it]. Other feeding barriers, of equivalent strength, may be installed, as may proprietary barriers that include locking devices, forward hinging, or moveable sections. [Designs with hinged or moveable barriers may require that support stanchions be strengthened by web-stiffeners]. Barriers shall be hinged or otherwise suitably fixed to allow access to animals in an emergency and to allow movement of animals.

Ordinary rail barriers are not suitable where calves are running with cows. Adjustment rail or angle barriers are more suitable.

3.6 Access to Pens

Where feeding is carried out along the central passage only, access to pens may be from the rear. The access shall be controlled by a door or a heavy-duty tubular gate 1.2m wide. Doors or sheeted gates wider than 1.2m shall be sliding. All access doors and gates shall be framed and hung to be strong enough to ensure safe stock management and protection of personnel.

3.7 Protection and fixing of Pen Divisions, Feed Barriers and Fittings

It is recommended that pen divisions, feed barriers, and access fittings (Clauses 3.4, 3.5, 3.6) should be galvanised. Any exposed ungalvanised steel other than structural steel shall be given 3 coats of anti-rust paint. Timber doors and other timber joinery shall be given a primary coat, 2 undercoats, and a hard gloss finish coat of lead-free paint.

Where pen divisions, barriers, etc., are being fixed to already galvanised or painted stanchions, it is recommended that bolts be used rather than welded connections. Alternatively any welding damage shall be made good as described in the protection of structural steel clause in Specification S101.

3.8 Drinking Arrangements

Houses shall have at least one drinker between every two pens, mounted at a suitable height and protected by double 50mm rump rails at least 75mm and 150mm clear of the drinker. It is recommended that suitable proprietary drinkers with anti-dunging protection should be installed. Water supply shall be via a minimum 19mm flexible pipe located and securely fixed to prevent damage.

In all houses, drinkers mounted on concrete blocks, suitably located and protected may be used. Drinkers may be external to the house with access through a 600mm deep opening in the wall, provided they are protected against frost. Whichever system is adopted it should be capable of providing the large quantities of water required by housed animals, particularly cows in milk.

4 DESIGN OF TANKS

4.1 General Design

A minimum of 16, 18, 20 or 22 weeks storage shall be provided in all new and converted structures in line with the requirements of S.I. 788 of 2005 European Communities (Good Agricultural Practice for Protection of Waters) Regulations and any subsequent amendments to the regulations. However, where the Local Authority has specified a higher winter storage period, then this must be complied with.

Note: The requirements for the capacities of slurry, effluent, and soiled water stores which are defined in S.I. 788 of 2005 Regulations shall be followed. The regulations require that an additional freeboard of 200mm must be provided for all covered tanks and 300mm for all uncovered tanks. A tank covered by slats only is not considered to be covered in respect of allowances for rainfall and freeboard.

Where a holding lies partly in one county and partly in one or more other counties, the slurry storage on the holding shall be designed in relation to the county in which the longest storage period is required.

4.2 Setting Out

Great care is necessary in setting out tanks which are to be covered with slats and/or precast units to ensure that full bearing is provided. [Clauses 3.1, 4.9, 8.11 & 8.12]. Inaccurate setting out can result in dangerous and unacceptable conditions, which are very costly to rectify.

4.3 Tanks within Buildings

All tanks shall be provided with facilities for **the full agitation of slurry from point(s) outside the building.** This is done by the extension of tanks beyond the building. In any tank more than 16.0m long (3 x 4.8m bays, with agitation point at one end), external agitation points shall be installed at each end of each tank. However, it is strongly recommended that any tank longer than 11m should have an external agitation point at both ends. Under no circumstances shall such extended tanks or access points be roofed over or enclosed. Adequate space shall be provided at all agitation points to ensure that an agitator can be installed into the tank and the tank both fully agitated and emptied.

Access points shall not be installed inside any houses.

Full external agitation shall also be provided for in all designs involving the conversion or extension of existing buildings.

Where an existing building is being extended or converted and there is an internal agitation point, **then this agitation point shall be removed**. All necessary work shall then be done to allow for full **external** agitation of the existing building.

4.4 Agitation

The design of the tank at the agitation ends, and the design of the external agitation points, shall suit the chosen systems of agitation and emptying. Manufacturers' specifications and dimensions on guide rails, dividing walls, access chambers etc., shall be followed. Some systems require agitation every 4-6 weeks. [see also Clause 1.4 on safety procedures).

Where concrete piers are used they shall be finished flush with tank wall on inside face so as not to interfere with slurry agitation.

The use of simple aeration systems for the continuous conditioning and mixing of slurry are permitted. These systems shall require prior Departmental acceptance and may be subject to requirements for certificates of guarantee. Where these systems are used, the maximum tank length is increased to 52m for tank types B and C (clause 4.7). Where one of these systems is retrofitted into an existing building then the ventilation of the building shall be brought up to the standards as set out in Specification S. 101 (August 2003). The use of simple aeration systems is not recommend where the cattle are feed on bale silage.

4.5 Cover to Extended Tanks

To eliminate draughts and ingress of rainwater all extended tanks shall be covered by reinforced solid concrete slabs. External slats (maximum of 2 gang slats at each end) are permitted only when external slurry collection is essential. All external slabs and slats shall be designed to accommodate at least a 4 tonne dynamic wheel load (i.e. they shall be at least as strong as heavy duty slats). The specifications for reinforcement given are for the above stated loading, any heavier loadings will require a higher level of reinforcement. Where a tank is built under a cow collection yard it is permitted to have the collection yard fully slatted. All the slats used shall be heavy duty (tractor) slats.

Agitation/emptying points shall be provided by covered access openings within the slab or slats. Covers in every location shall be manufactured in steel with all elements galvanised to ISO 1461 (1999). Each cover unit shall consist of a frame; a hinged top-cover, either with a lock or safety catch, or with element(s) too heavy for a child to lift; and a separate safety grid underneath, hinged on the same side as the cover and also supported on (at least) the opposite side. The cover shall be hinged to lie back fully when opened, and the safety grid shall lean back at sufficient angle to stay open and be clearly visible in that position. The safety grid of minimum diameter 12mm steel or the equivalent shall have a maximum gap of 125mm between bars with the exception of one or (maximum) two apertures 225mm square, incorporated for slurry extraction.

Covers shall be manufactured to withstand a test load of 40KN [test procedure in accordance with IS EN 124:1994]. It is advised that where an access cover can be subject to heavy wheeled traffic it should be constructed to withstand at least an 80KN load.

4.6 Circulation

It is recommended that tanks, where possible, should have a circulation system (Figs. 9A & 9B).

- Type “A” (Fig. 9A) is one recommended design that consists of a set of transverse tanks set across the width of the house, each with a spine wall and with separate external agitation

points. This arrangement is very suitable for bay widths up to 6.4m, and allows for limitless extension of the building.

- Type “B” (Fig. 9B) tanks are suitable for use with suspended central passages, or where a double row of slats are required in each pen. These tanks shall not be longer than 37m (7 x 4.8m bays, with agitation points at both ends).
- Type “C” (Fig. 9C) tanks shall be not longer than 32m (6 x 4.8m bays, with agitation points at both ends), but it is strongly recommended that Type “C” tanks are no longer than 27.0m. When a 150mm pipe is installed at the top of the wall along the side of tank, for agitation purposes, the tank length can be up to 37m for tank type C with an agitation point at one end. The pipe shall run for the length of the tank and be secured in suitable locations to ensure that it cannot move. Where the pipe system is run from both ends of one tank, the pipes shall over lap by at least 4.8 metres and the total length of the tank shall not exceed 47 metres.

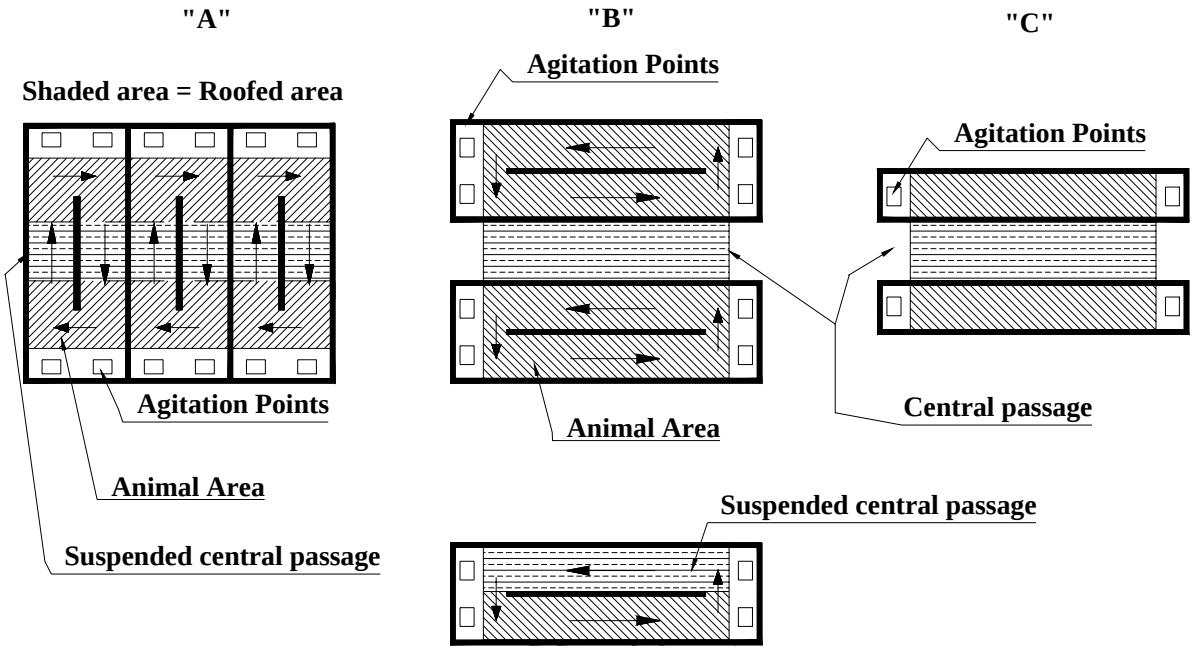

Figure 9 Slurry Circulation in Tanks (Examples)

4.7 Stanchions Erected on R.C. Tank walls

Note: Stanchions shall not under any circumstances be carried on slats or on insitu cast beams.

Tank walls shall be a minimum of 400 mm thick (depending on stanchion size) where the superstructure is to be supported on the walls. Where the steel stanchions are to be erected on the walls then the wall reinforcement shall be fixed in the walls as per clause 8.6, for each stanchion. The stanchions shall be positioned such that there is at least 150mm clear gap between the stanchion and the nearest internal edge of the tank wall, to allow full bearing for slats. Alternatively a 300mm wall may be constructed with 600mm x 600mm concrete piers with inner wall to be flush.

The stanchions shall be secured to the walls in an approved manner using steel base plates welded to the base of the stanchion and holding down bolts as per clause B7 of S101.

Portal Frames may be carried on tank walls provided a 600mm x 600mm suitably reinforced concrete pier with foundation pad is incorporated into the tank wall at the time of tank construction, for each portal stanchion. Concrete piers shall be finished flush with tank wall on inside face so as not to interfere with slurry agitation.

Note: For spine walls see clause 4.8.

4.8 Spine Walls

For ease in agitation and for structural reasons, (in particular the problem of full foundation support), pillar-and-beam type construction should preferably be avoided. Where pillar-and-beam type construction is used it is recommended that all pillars be circular. Solid spine walls, with opes, shall be constructed for the support of slats and suspended passages. It is strongly recommended that all internal wall corners be rounded.

It is strongly recommended that spine walls be positioned along the centre line of the tank. It is recommended that the space at each end of the wall should either be half the tank width or as wide as the wider of the tank divisions formed by the spine wall. Spine walls shall be constructed of reinforced concrete as per sections 6, 7 and 8. In all cases the spine wall shall be a minimum of 300mm thick. It is strongly recommended that stanchions do not rest on spine walls. Where a stanchion is being supported on a spine wall the wall shall be a minimum of 500mm thick (depending upon stanchion size), with the base plate of the stanchion counter-sunk into the top of the wall (See also clause 4.7).

Note: Where it is desired to cover an existing concrete tank, a detailed report shall be commissioned from a Chartered Engineer for the tank and a detailed description obtained on how to install and construct any necessary spine walls.

4.9 Reinforced Concrete Tanks

All tanks deeper than 1.2m, whether under buildings, partially under buildings, or entirely external, shall be constructed using the full concrete and reinforcement specifications in Sections 6, 7 and 8 below. Proprietary tanks, of precast concrete or other material, shall require prior Departmental acceptance and may be subject to requirements for certificates of guarantee.

All mass concrete tanks less than 1.2m deep shall be constructed with walls not less than 225mm thick. It is recommended that walls are reinforced with A142 steel mesh. Where mesh is used there shall be a minimum cover of 50 mm of concrete to the mesh.

4.10 Blockwork Tanks and Channels

Tanks, and channels, not more than 1.2m in depth, may be constructed with 225mm solid concrete blocks. Any such block wall longer than 10m shall incorporate [at max. 10m intervals] a 450 x 450mm pillar extended on the outer face of the wall. Walls shall be plastered both sides to a thickness of 12mm. [3:1 washed sand/cement with plasticiser incorporated]. **No tank or channel in contact with silage effluent shall be constructed of blockwork.** All blockwork tanks and channels shall be coated on the inside with a proprietary acid resistant bitumastic coating.

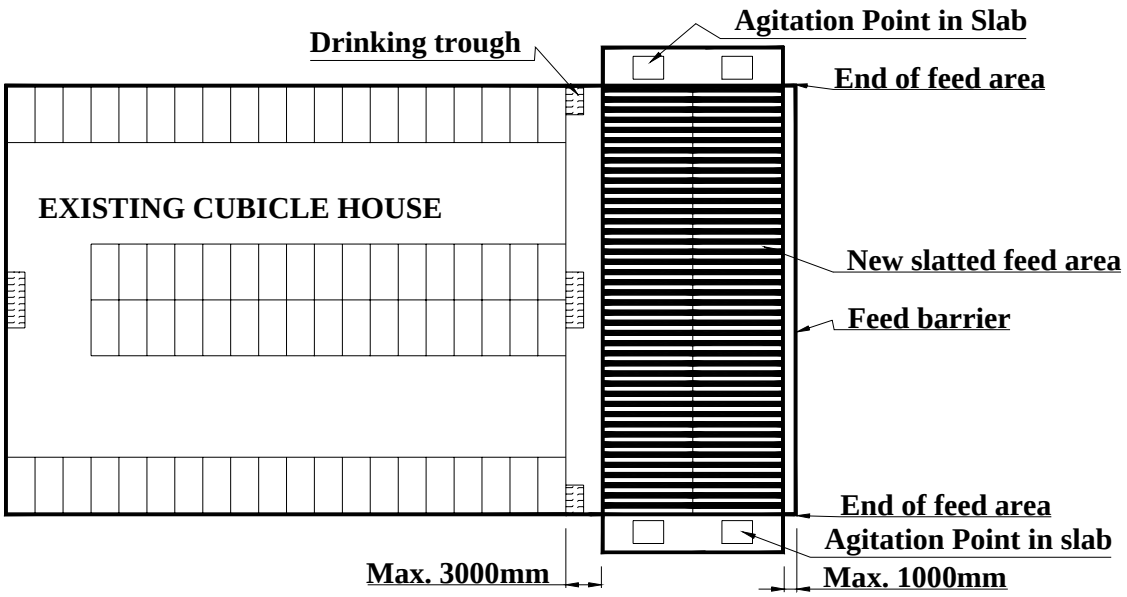

Figure 10: Slatted feed area in front of cubicle house.

4.11 The addition of slatted feeding area(s) to buildings

Where as part of a conversion or new building, it is required to build a slatted tank across the front of, or along the side of, a building to form a feed area, as shown in Fig. 10, it is very strongly recommended that the feed area be roofed. If it is decided, however, to omit the roof then the following additional conditions shall be complied with:

- The agitation points shall be outside the line of the sidewall of the house, and outside the line of any expected future roof.
- The agitation points shall be outside the feeding area.
- In difficult or dangerous site conditions the tank can be up to 3.0 metres from an existing house. In other conditions it is recommended that the maximum distance is 1.5 metres. The maximum distance from a new house is 1.5 metres.
- The tank shall be designed with full allowance for rainfall within the catchment area.
- The stanchions supporting the feed-barrier shall be either:
  a) Stub stanchions (maximum of 1.5m above ground level) of a maximum of IPE160, **or**,
  b) Be of the correct size for a stanchion for a building of the span of the feed area. These stanchions shall be of the correct height to allow the installation of the future roof, and shall be set in foundations of specified size for the stanchion selected.

4.12 Separate External Tanks

These shall be constructed to Clauses 4.9 or 4.10. Tank covers, where installed, shall conform to 4.5 above. Open external tanks shall be designed with full allowance for rainfall within the tank area, and shall conform to clause 4.1. External slurry tanks shall have at least two well-separated agitation points. Safety fencing around tanks shall conform to Clause 1.5. The layout of soiled water tanks, and sedimentation chambers, shall follow S129 (Farmyard Drainage).

Proprietary flexible covers are recommended for control of odours, greenhouse gasses, ammonia and rainwater.

5 SITEWORKS

5.1 Site

The site shall be carefully chosen with a view to minimising operational and constructional problems. It shall be well separated from potential fire hazards and sheltered if possible. As a general guide, a storage facility for silage effluent/slurry/soiled water should be located not less than 50m from any waterbody in the case of new farmyards, and not less than 10m in the case of extensions/modifications to an existing facility. The minimum distance between a storage facility and a public/private water supply source, either surface or ground, shall be 60m. In vulnerable situations this distance shall be increased up to 300m.

Extreme care shall be exercised to prevent any pollutant getting into the backfill around storage facilities.

Note: Any land drains shall be stopped at least 10m on the upstream side of a site and diverted around to re-connect with the drainage system at least 10m on the downstream side of the storage area.

5.2 Site Groundwater

Water table levels shall be checked by digging two holes deeper than the proposed tank floor level and covering them temporarily. After 48 hours the water level is noted. Where this is above tank floor level, flotation and structural problems may occur. Where the groundwater level is a problem, the water table shall be permanently lowered by providing field drain pipes with porous fill around the tank at floor level connected to an outlet drain. Any springs within the floor area of the tank shall be piped to this drain system under floor hardcore. If ground levels do not permit an outlet then a new site shall be sought, or the walls and floor of the tank shall be increased in thickness to counteract the flotation of the empty tank. Engineering advice shall be sought and followed.

5.3 Flooding

Flooding of open excavation around completed tank can cause floatation and extreme structural damage to concrete tank. **Precautions shall be taken to ensure this does not happen,** by preventing flood water from getting into the excavation, or by the addition of an outlet drain, or by partially filling the tank with water.

5.4 Excavation

Excavation shall be to a solid foundation, at least 1000mm beyond the tank wall on all sides. Excavation shall be levelled, and suitable hardcore or gravel to a depth of at least 150mm shall be fully compacted with a plate vibrator over the whole area. In some excavations it may be necessary to lay a 75mm layer of site concrete to provide a working surface before placing steel on the concrete floor.

For all excavations deeper than 1.25m deep, the banks shall be battered back at an angle of at least 45^{o} or supported by suitable shuttering. Excavations shall at all times comply with the relevant Health and Safety requirements.

5.5 Rock

Where solid rock is encountered in excavations it shall be removed below the required depth and a 75mm cushion of broken stone shall be replaced over the bed rock, consolidated with a plate vibrator, and blinded over with gravel or fine sand.

6 CONCRETE SPECIFICATION

6.1 Certificates

Concrete shall be produced in an audited plant only: It shall not be produced on site.

A numbered certificate, signed and stamped, shall be required for all concrete delivered to site. The certificate, the "Concrete Manufacturers' Specification Certificate", is produced in triplicate. **The top certificate, printed on light blue paper, shall be retained by the applicant** and given to and retained by the local AES Office of the Department of Agriculture for inspection upon completion of the works.

6.2 Concrete for Silage Effluent

For **purpose-built** silage effluent tanks and channels, concrete shall be purchased on the basis of a characteristic 28 day crushing strength of 40N/mm^2. Minimum cement content shall be 350 kg/m^3. The slump of unplasticised concrete shall not exceed 90mm. Maximum aggregate size shall be 20mm.

The concrete shall be ordered by requesting '40N concrete to be certified to the grant-aid standard of the Department of Agriculture and Food'.

If the Concrete Supplier requires further information the following shall be quoted to them:

- The concrete is to be to I.S. EN 206-1:2002: Strength Class: C32/40, 350 kg cement, maximum water cement ratio of 0.50, Exposure classes: XA3, XC4 (20 year life), Slump class: S2 (unplasticised), maximum aggregate size 20mm.

If plasticised concrete is desired, the slump class shall not exceed S3.

6.3 Concrete

For all other purposes including slurry tanks to which silage effluent may be directed, concrete shall be purchased on the basis of a characteristic 28 day crushing strength of 35N/mm^2. Minimum cement content shall be 300 kg/m^3. Slump of unplasticised concrete shall not exceed 90mm, and maximum aggregate size shall be 20mm.

The concrete shall be ordered by requesting '35N concrete to be certified to the grant-aid standard of the Department of Agriculture and Food'.

If the Concrete Supplier requires further information the following shall be quoted to them:

- The concrete is to be to I.S. EN 206-1:2002: Strength Class: C28/35, 300 kg cement, maximum water cement ratio of 0.60, Exposure classes: XC4, XF3, XA1 (20 year life), Slump class: S2 (unplasticised), maximum aggregate size 20mm.

If plasticised concrete is desired, the slump class shall not exceed S3.

Polypropylene fibres may be incorporated into the concrete mix to improve the properties of concrete. Only fibres which have been tested and approved by National or European approval authorities may be used. The use of fibres helps to reduce plastic cracking and improve surface durability but they are not a substitute for structural reinforcement (Section 8). Fibres shall be used in strict compliance with manufacturer's instructions and shall only be added at the concrete manufacturing plant. The concrete certificate (Clause 6.1), shall clearly show the amount and type of fibre added. The mix design, compacting, and curing of fibre concrete is the same as concrete without fibre.

Note: Where silage effluent is allowed into a slurry tank the effluent shall discharge via a pipe at least 300mm from the inner face of the tank wall.

6.4 Materials

Cement used in concrete and concrete products shall be certified to IS EN 197-1, and shall bear the Irish Standard Mark, or shall be certified by NSAI to be equivalent to IS EN 197-1. All aggregates shall be to IS 5 1990. Plasticisers and other admixtures shall be to EN 934. All admixtures shall be used in strict accordance with manufacturer's instructions, and shall be added only by the concrete-mix manufacturer.

6.5 Tests

The Department reserves the right to require that concrete should be tested in accordance with B.S.1881.

6.6 Curing of Concrete

All concrete shall be cured by keeping it thoroughly moist for at least seven days. Wetted floor slabs and tank walls shall be protected by polythene sheeting, kept securely in place. Alternatively proprietary curing agents may be used in accordance with manufacturer's instructions. When frost is a danger, straw bales shall be placed over the polythene on slabs. Concrete shall be at least 28 days old before being subjected to full load, or to silage or silage effluent.

7 CONCRETE WORK FOR TANKS

7.1 Tank Floor

The floor slab shall be not less than 225mm thick throughout. It shall extend 250mm outside the walls. Timber or steel forms 225 mm deep, shall be fixed around floor perimeter before placing footing steel, wall steel, and floor steel mesh where specified in Section 8. The concrete shall be thoroughly compacted, and compaction around steel reinforcement shall be carried out with a poker vibrator. The floor shall be finished smooth.

7.2 Tank Walls

Walls shall be 225mm minimum, or 400mm **minimum** where tank walls are to support super structure and slats. [Where stanchions are carried on tank walls see Clauses 4.7 and 4.8]. Spine walls shall be a minimum of 300mm and 500mm minimum where stanchions are supported.

Steel shuttering is recommended for tank walls but panels with timber may be used. All shuttering shall be clean and tight fitting to prevent loss of grout. To maintain cleanliness and facilitate removal they should be oiled lightly with proprietary mould oil prior to each use. Care shall be taken that oil does not get onto reinforcing bars and prevent bonding. All shuttering shall be properly tied and braced to withstand the pressure of the concrete.

7.3 Wall/Floor Joint

A key shall be formed in the floor at the centre of the proposed wall by using a splayed oiled timber runner temporarily fixed in the freshly poured concrete and withdrawn before final set. Alternatively a 150mm patent water bar or approved water-stop shall be fixed along the centre line of the proposed wall. Care shall be taken that the water bar is tied to the vertical steel to keep it in position during the pouring of the concrete floor (Fig. 11).

Within an hour or so (depending on weather) the surface of the proposed joint shall be sprayed with water and brushed off with a soft brush to expose the coarse aggregate. If left overnight, a stiff brush may be needed. The best joints are obtained by light brushing soon after pouring.

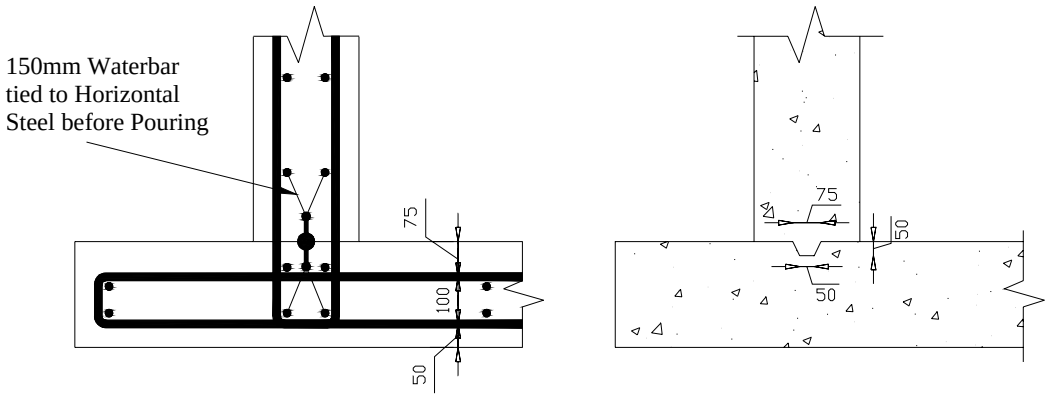

Figure 11 Wall-Floor Joints

7.4 Contraction Joints in Tank Walls

When an individual tank wall is more than 17m long, provision shall be made for substantially increasing the horizontal steel in the tank wall, or alternatively forming an induced type contraction joint with water bar. Where extra horizontal steel is adopted it shall be provided to all external walls of the tank to Table 3.

Table 3

Length of wall	No. of extra bars in each face
17 - 19m	1
19 - 24m	2
24 - 30m	3

(Spacing of horizontal steel shall be adjusted to accommodate the extra steel).

Alternatively an induced crack type vertical contraction joint shall be provided as per Fig. 12. Fifty per cent of the horizontal steel shall be discontinued across the joint (remove 50mm of horizontal steel on each side of joint from every second bar). A 200mm patent water stop shall be provided in the centre of the wall, and a 200 mm rearstop placed on the subbase across the wall footing as far out as the bottom steel, or across the complete floor in tanks less than 4m wide.

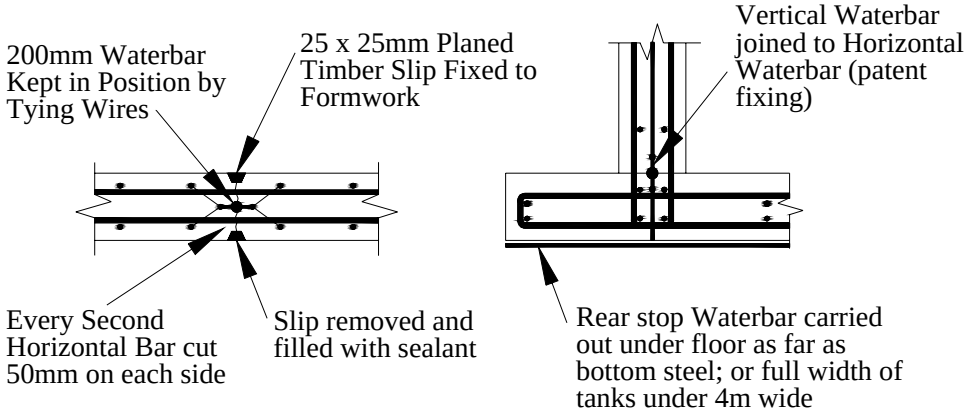

Figure 12 Contraction Joints in Tank Walls

All waterstops, and junctions, shall be fixed as per manufacturer's instructions. The wall joint shall be brushed out and sealed with acid-resistant sealer. In tanks longer than 17m, such induced vertical joints shall be installed, equidistantly, at intervals of not more than 13m.

7.5 Pouring Concrete to Tank Walls

All dirt and debris shall be removed from within the shuttering. Concrete shall be placed in evenly spread layers of not more than 600mm deep. Vibration, by poker vibrator of diameter not less than 50mm shall follow closely on placing. The poker shall be inserted at maximum 400mm centres. It shall be allowed to sink under its own weight to the depth of the layer plus 100mm into the layer beneath, and when air bubbles cease to rise, be withdrawn slowly but evenly leaving no significant depression in the concrete. Care shall be taken to prevent the vibrator making contact with either the shutters or the reinforcement. Concrete shall not be poured under 4 °C in a falling thermometer.

7.6 Removal of Shuttering

Shuttering shall not be removed from walls for at least 12 hours in warm weather, longer in cold weather. Shuttering under soffits of beams and slabs shall be left in position for at least 14 days. Tie bars on internal walls shall be cut or snapped off, and all small blemishes caused by removal of bolts and tie bars shall be filled with 1.5:1 washed sharp sand-cement mortar. Honeycombing, if it occurs, shall be repaired with a sand:cement mortar incorporating SBR (Styrene Butadine Rubber), or a water resistant polymer bonding admixture in accordance with manufacturer's instructions.

7.7 Back Filling

Back filling shall not be carried out until walls are at least 28 days old. Suitable excavated clay may be used provided it contains no top soil or excess water. Back fill shall be placed in layers, and thoroughly compacted. To prevent the possible ingress of pollutants to ground water the top metre of backfill shall be of impervious material and sloped away from the tank. Back filling with very heavy plant or the use of heavy vibrating rollers should be avoided unless special precautions are taken. Particular care shall be taken in backfilling under central passageways and cubicle beds [see also Clauses 3.2 and 8.8].

8 REINFORCEMENT

8.1 Steel Reinforcement

Steel reinforcement shall consist of high yield (H.Y.) steel with ribbed finish complying with the current edition of BS 4449. All steel shall be free from mill scale and heavy deposits of rust. Steel bars shall not be straightened and rebent. Where the length of bar required exceeds the length supplied, a lapped joint shall be adopted: the overlap shall be at least 40 times the bar diameter.

8.2 Tank Walls

Where a tank is 1.2m or more deep, both inside and outside faces of each wall shall be reinforced. If a tank is divided into two or more **non-interconnecting** compartments the partition wall shall also be reinforced on both faces as per Table 5 or Table 6 for outer tank walls. When tanks are interconnected, the spine wall shall be reinforced as per Table 7. Floor steel under spine walls and under reinforced compartment walls shall be so placed that every second anchor U-bar is placed either side of the wall. Distribution steel shall be placed, evenly spaced across full wall foundation.

8.3 Cutting, Bending and Fixing Steel

Anchor steel in wall footing shall be cut and bent in a U-shape to suit wall height as shown in Fig. 13. Wall footing steel shall be of the same diameter as main steel for walls (Clause 8.5), except that 12mm steel may be used where wall steel is 16mm. It shall extend into the floor a distance 'E' as shown, and shall extend into the toe of the wall a distance of 200mm beyond the outside face of the wall. Reinforcement for the wall shall be cut and bent in a U-shape to suit the wall thickness, as

appropriate (Table 4). Every second U-bar (long) shall extend to within 475mm of the top of the wall. Every other U-bar (short) shall extend up the wall at least one quarter the wall height (H) plus 300mm (Table 4). U-bar spacings are detailed in Tables 5 to 7.

Distribution (horizontal) steel at spacing "D" as determined in Tables 5, 6and 7 shall be placed **inside** U-bars in wall and floor as shown. Junctions of bars shall be secured with standard tying wire to ensure that steel is kept firmly in position during concreting. Tack welding may be used instead of tying wire.

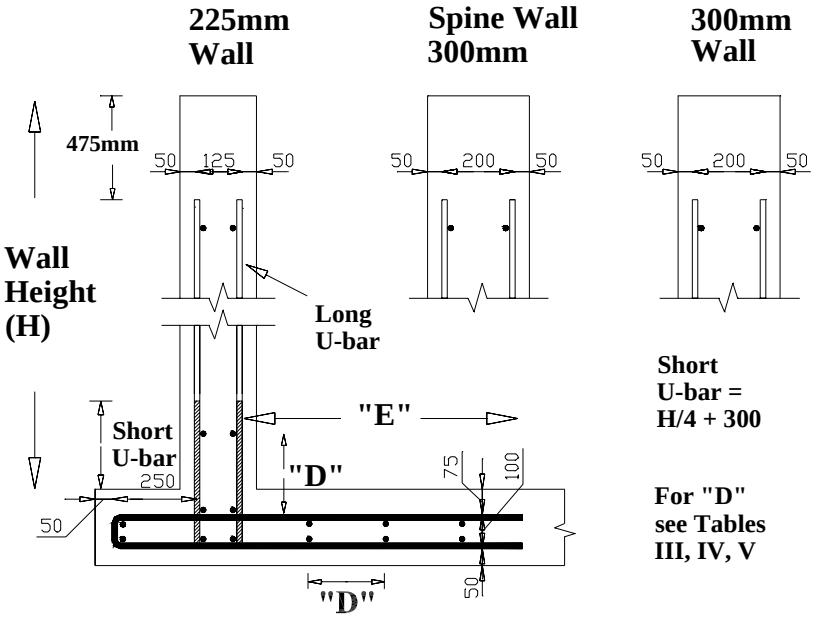

Figure 13 Floor and Wall Reinforcement

Table 4 Floor and Wall Reinforcement

Long U	Short U	Wall Height		"E"
1.2m	0.85m	Up to	1.5m	0.55m
1.5m	0.95m	Up to	1.8m	0.65m
1.8m	1.0m	Up to	2.1m	0.8m
2.1m	1.1m	Up to	2.4m	1.0m
2.4m	1.2m	Up to	2.7m	1.25m
2.7m	1.25m	Up to	3.0m	1.7m

8.4 Details of Steel Reinforcement in Walls

Reinforcing steel shall be provided as shown in the following tables and bent as shown in Figs. 12, 13 and 14.

Table 5: Values of "D" for Outer Tank Wall At Least 225mm Wide

Tank Depth: Not more than	**U Bars:** Vertical Steel and Wall footing steel, Both Faces	**D values for Horizontal Steel*,** Both Faces
1.5m	10mm @ 300mm centres	12mm @ 400mm centres
1.8m	10mm @ 225mm centres	12mm @ 400mm centres
2.1m	12mm @ 225mm centres	12mm @ 400mm centres

2.4m	16mm @ 270mm centres	12mm @ 400mm centres
2.7m	16mm @ 175mm centres	12mm @ 400mm centres
3.0m	16mm @ 135mm centres	12mm @ 400mm centres

Table 6: Values of "D" for Outer Tank Wall At Least 300 mm Wide

Tank Depth: Not more than	**U Bars:** Vertical Steel and Wall footing steel, Both Faces	**D values for Horizontal Steel*,** Both Faces
1.5m	10mm @ 400mm centres	12mm @ 300mm centres
1.8m	10mm @ 300mm centres	12mm @ 300mm centres
2.1m	12mm @ 300mm centres	12mm @ 300mm centres
2.4m	12mm @ 200mm centres	12mm @ 300mm centres
2.7m	16mm @ 240mm centres	12mm @ 300mm centres
3.0m	16mm @ 190mm centres	12mm @ 300mm centres

Table 7: Values of "D" for Spine Wall At Least 300mm Wide With Opes

Tank Depth: Not more than	**U Bars:** Vertical Steel and Wall footing steel, Both Faces	**D values for Horizontal Steel*,** Both Faces
1.5m	10mm @ 450mm centres	12mm @ 400mm centres
1.8m	10mm @ 400mm centres	12mm @ 400mm centres
2.1m	10mm @ 250mm centres	12mm @ 400mm centres
2.4m	12mm @ 250mm centres	12mm @ 400mm centres
2.7m	12mm @ 200mm centres	12mm @ 400mm centres
3.0m	16mm @ 250mm centres	12mm @ 400mm centres

- Where vertical steel is 10mm, horizontal steel of 10mm @ 300mm centres is accepted in place of 12mm @ 400mm centres.

8.5 Reinforcing Steel at Corners

At each corner of the tank a series of two horizontal U-bars shall be fixed as per Fig. 14. Each leg of the U shall be at least 900mm long and equal in diameter to the vertical steel. Also the long vertical wall bars within 900mm of the coners shall be extended up to within 50mm of the top of the wall to meet the top pair of horizontal U-bars. Each subsequent pair of horizontal U-bars shall be tied to each corresponding horizontal distribution steel bar in the height of the wall. A single leg vertical bar of the same diameter as the main vertical steel shall be fixed at the outside corner of the horizontal U-bars. The lower end of this vertical bar shall be bent diagonally into the floor for a distance of at least 500mm.

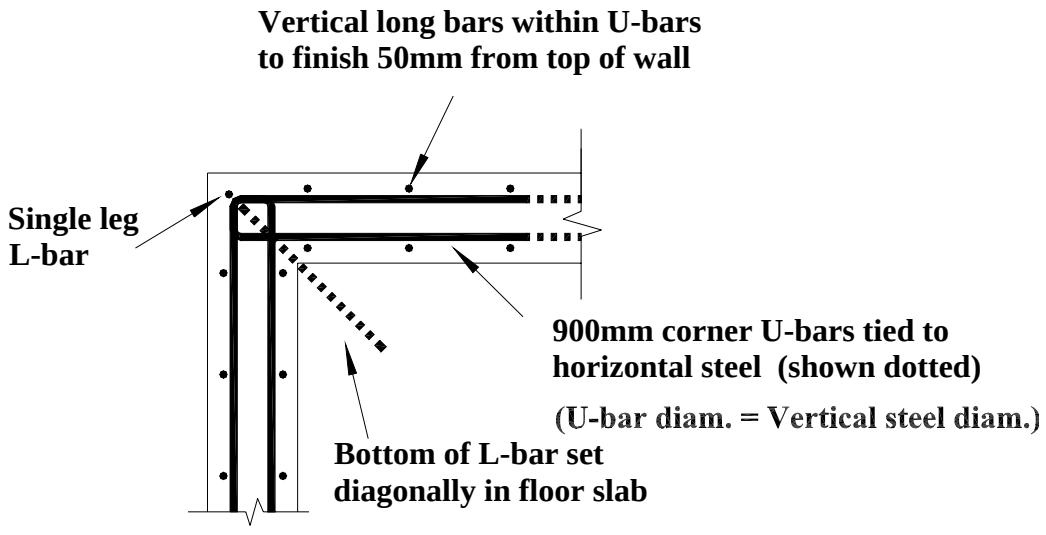

Figure 14 Reinforcing Details for Tank Corners

8.6 Reinforcing Steel Under Stanchions

Where stanchions are to be bolted to the wall all vertical steel (each face) shall be extended up to within 50mm of the top of the wall for a distance of 300mm each side of the proposed stanchion. Extended vertical bars shall be securely tied to a horizontal bar placed on each face within 100mm of the top of the wall.

Where it is intended to insert fencing posts into external tank walls, [Clause 1.5] the long bars shall be extended to within 50mm of the top of the wall for a distance of 300mm each side of the proposed post, and tied to a horizontal distribution bar on each face.

8.7 Steel Mesh in Floor

In tanks where the outer walls are more than 4m apart, and/or where tanks are subject to any groundwater pressure then the whole floor shall be reinforced with steel mesh (A142 minimum). Individual sheets of mesh shall be overlapped by 200mm on each side. Mesh shall also be overlapped 200mm across footing steel. Mesh shall be laid close to the top of the slab with a minimum of 75mm concrete cover.

8.8 Central Passage

This shall be solid or suspended as the design dictates. In the former case it shall consist of a 125mm concrete slab laid on 150mm compacted hardcore on solid foundation incorporating 1000 gauge polythene DPC.

In new buildings the minimum width of a central passage shall be 4.0m. It is recommended that the central feed passage in an animal house be, at least, 4.8m. Where animals are being feed silage at both the front and back of animal pens a strip of concrete, at least, 1 metre wide shall be provided along the feed face at the back of the pen in addition to the feeding passage at the front of the animal pen. In single-sided houses a concreted feed passage of at least 2 metres wide shall be provided at the front of the animal pens in all cases.

Note: All other solid floors within the building shall be installed to the above standard.

8.9 Suspended Central Passage

Where tanks extend under the passage the slab and supports shall be designed to match the required loading for the particular design of house. With standard plans this is taken to be a 7.8 tonnes axle load imposed by a single-axle feeder-wagon and a further 1.5 tonnes transferred to the tractor. The three specifications for reinforcement given below are for the above stated loadings, any heavier loadings will require a higher level of reinforcement, and shall be designed and certified by a Chartered Engineer.

TYPE A: Slab continuous over supports (Fig. 15a). Supports at a maximum of 3.2m.

- Type A design is suitable where tanks are running across the house, and the central passage is at right angles to the tanks.
- **Slab thickness:** 170mm minimum.
- **Bottom steel:** 12 mm @ 200mm centres.
- **Top steel over supports:** 12 mm @ 190mm centres. [Top steel shall extend at least 900mm into each span, measured from centre of support].

- **Distribution steel:** 10mm @ 300mm centres. [Fixed to both top and bottom steel with tying wire at each intersection].

TYPE B: Slab simply supported on wall (Fig. 15b.). Maximum span of slab 4.9 m.

- Type B design is suitable where slab is spanning the width of the central passage.
- **Slab thickness:** 195mm minimum.
- **Bottom steel across width of passage:** 16mm @ 150mm centres.
- **Distribution steel along length of passage:** 10mm @ 375mm centres. [Bottom steel should be bent up into the slab with a right-angled bend at the end of each bar.]

TYPE C: Slab spanning central passage with a central support wall running the length of the passage way (Fig. 15c). Maximum span between supports 3.2m.

- **Slab Thickness:** 170mm minimum
- **Bottom steel across the central passage:** l2mm @ 200mm centres.
- **Top steel over central support:** 12mm @ 190mm centres. [Top steel shall extend at least 900mm into each span measured from centre of central support.]
- **Distribution steel along length of passage:** 10mm @ 300mm spacing.

Note: When stanchions are to be erected directly on a suspended central passage, the bottom reinforcement in the slab for 300mm each side of the proposed stanchion shall be doubled across the span of the slab [i.e. spacing halved]. Also 5 No. 12mm top steel bars shall be placed across the full span of the slab at 150mm spacing and tied with standard tying wire to 12mm distribution steel placed at 300mm spacing. **The stanchion shall be no more than 500mm from the edge of the slab.**

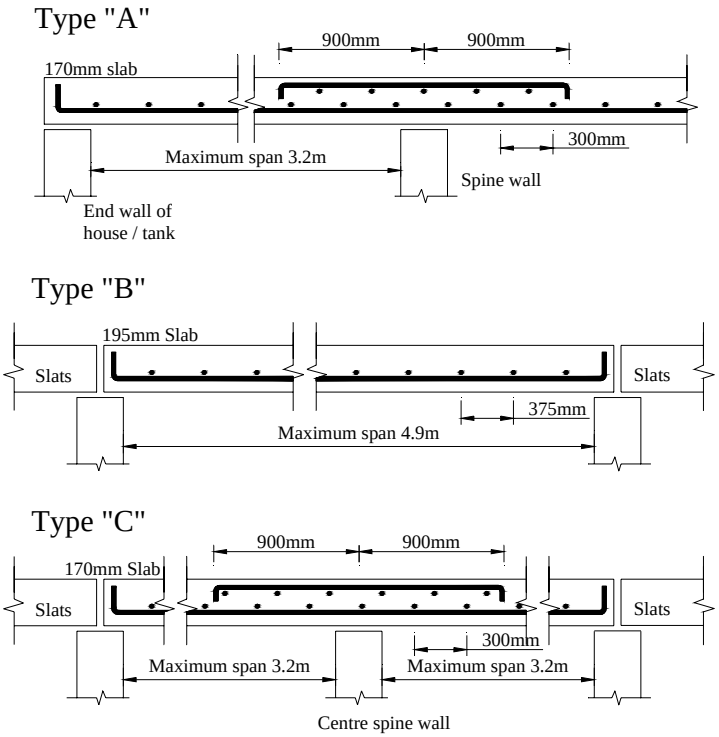

Figure 15 Suspended Slabs: Steel Details

Stanchions shall be welded to a 300 x 300 x 12mm base plate to be securely fixed to the concrete slab with 2 No. 20mm holding-down bolts for intermediate stanchions, or 4 No. 20mm holding-down bolts for corner stanchions, prefixed into concrete slabs. Alternatively, patent anchor-bolts may be used provided they are sized, and installed, in strict accordance with the manufacturer's specification and instructions.

8.10 Concrete Cover to Steel

Steel reinforcement shall be protected by adequate concrete cover from the corrosion caused by slurry or silage effluent. Standard patent spacer blocks shall be used to provide the minimum cover shown in Table 8 below, fixed to the reinforcement at regular intervals so that specified concrete cover is maintained throughout.

Table 8 Minimum Concrete Cover to Steel

Walls (both faces)	50mm
Tank Floor (bottom steel)	50mm
Tank Floor (top steel)	75mm
Beams	50mm
Slabs (bottom steel)	50mm
Slabs (top steel)	30mm

8.11 Access Opes within Slabs

Where openings are required in slabs they shall normally not be greater than 900mm square. All steel within a band 600mm wide on either side of such openings shall be doubled: i.e. spacing halved. A square reinforcing hoop of dimension equal to that of the opening + 100mm shall be used to trim all opes and a further square reinforcing hoop of dimension equal to the diagonal of the ope + 100mm shall be placed in the centre of the slab (Fig. 16). All opes in slabs/slats shall be fitted with safety access covers. (see Clause 4.5).

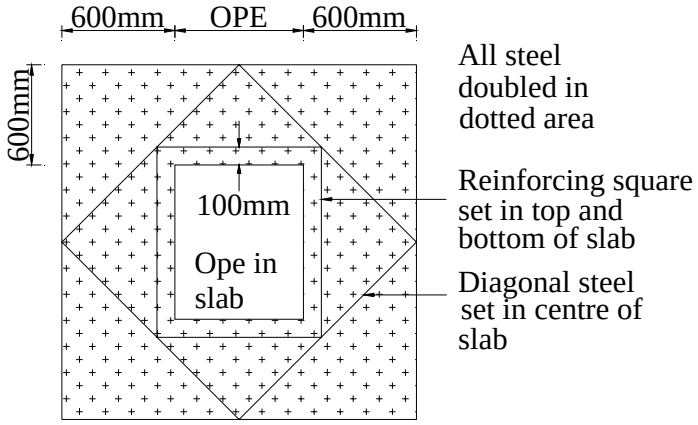

Figure 16 Ope in Slab

8.12 Beams

- Maximum unsupported length of beam 3.8m.
- 320mm deep beam (Fig 17).
- Beams shall be installed with at least 150mm bearing.
- The beams shall be reinforced as per Table 9.
- Longer beams, and beams to carry stanchions, shall be precast and purchased as per clause 8.12.

Table 9

Beams Simply Supported	Bottom Steel	Top Steel	Stirrups*
320mm x 320mm deep	4 No. 20mm H.Y. bars	4 No. 20mm H.Y. bars	10mm @ 200 centres along full length of beam

*Mild Steel (M.S.) may be used only for stirrups

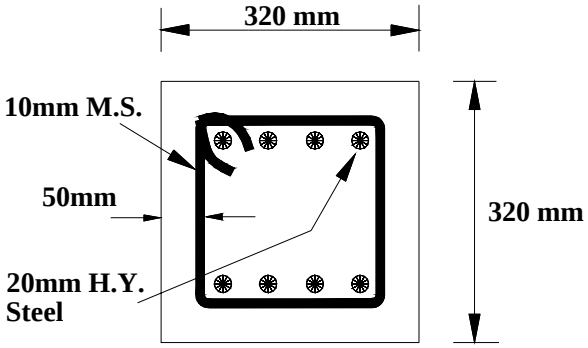

Figure 17 Beam

8.13 Precast Slabs and Beams

Precast slabs may be used provided they are at least as strong as units specified herein and suitably marked to prevent wrong installation. Precast units shall be installed with at least 150mm bearing, or greater if specified by the precast manufacturer. A manufacturer's certificate guaranteeing the load-bearing capacity of the units and a "Certificate of slat manufacture [AES C.03]" shall be required for all slabs and beams. **If stanchions are to be installed directly on the precast slabs or beams, then the guarantee shall cover this design**, and state that the beam or slab is strong enough to carry the maximum imposed loads that it will be subjected to (superstructure, passage, slats, animals, machinery etc).

Where slabs are being used as a rainwater cover for tank, all joints between slabs shall be sealed.

8.14 Ground shear key

A ground shear key shall be constructed when a tank is built on steeply sloping ground. The key shall be constructed on the downhill side of the tank. The key shall be constructed as shown in Figure 18. Vertical reinforcement shall be sized and spaced as per the tank wall being constructed. The horizontal reinforcement shall be 12mm diameter and spaced as per Figure 18.

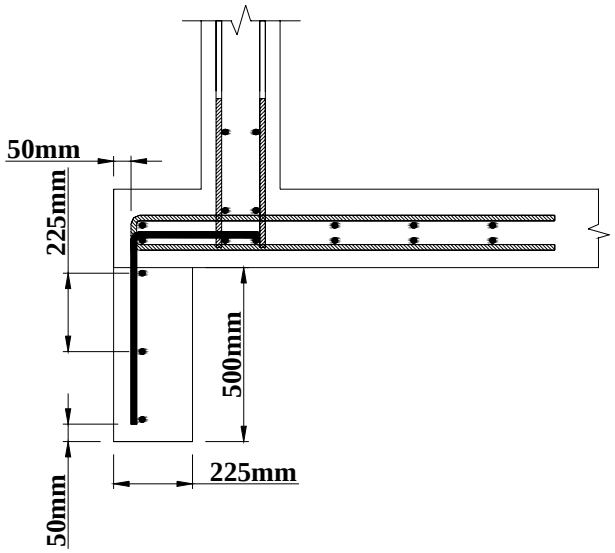

Figure 18 Details of Ground shear key

9 Certificates

The following certificates shall be collected, and given to the Department before grant-aid can be paid:

(1) "Slat" Certificate (Clause 3.1)

(2) “Concrete” Certificate (Clause 6.1)
(3) Precast Unit (where appropriate) (Clauses 4.9 & 8.12)
(4) “Protection of Structural Steel” Certificate (where appropriate)

10 Related Department Specifications

The current edition of the specifications listed below shall also be followed as required:-

1) ‘S101: Minimum Specification for the Structure of Farm Structures’ for all superstructures.
2) ‘S102: Cladding Materials’ for all roof and side cladding.
3) ‘S129: Farmyard Drainage’
4) ‘S124: Calf Housing’; and ‘S147: Calving Pens and Isolation Boxes’; where applicable,

Copies of these and other relevant Department specifications are available on the department website at: **www.agriculture.gov.ie** under ‘Farm Buildings’ or by contacting the one of the local offices of the Department of Agriculture and Food.