Concrete in dairies

D Roger Buchanan

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Recommended Citation
Buchanan, D Roger (1968) "Concrete in dairies," Journal of the Department of Agriculture, Western Australia, Series 4: Vol. 9 : No. 8 , Article 5.
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CONCRETE IN DAIRIES

By D. R. BUCHANAN

PRIME requirements for exposed concrete surfaces in dairies are that they should be easily cleansed and should not deteriorate in contact with milk and milk products. In milking stalls, animal races and on loading platforms hardwearing surfaces which offer good foothold are also necessary.

Production of durable concrete

The production of durable concrete is achieved by properly proportioning the mixture, thorough compaction, and continuous moist curing for not less than seven days after placement.

Generally, proportioning will only concern those in an area where premixed concrete is unavailable. Where premixed concrete is obtainable, a concrete having a minimum cement content of 600 lb. per cubic yard and a water : cement ratio not exceeding 0.50 by weight (4.7 gallons of water per bag of cement) should be specified, together with a slump in the range of 2 in. to 3 in.

Specification by compressive strength will have little significance in concrete for a dairy, as the strength performance of a floor will be more than adequate for the loads applied if the concrete is specified as suggested.

Where a farmer has to mix his own concrete he should select a coarse aggregate, such as river gravel or crushed rock, which is hard and sound and free of organic impurities, clay, wood particles or other deleterious matter, and which has particles as nearly as possible ranging uniformly in size from 3/16 in. up to 3/ in.

The fine aggregates (sand) should have similar characteristics and should be graded from fine material up to particles of 3/16 in. in size. It is not always possible to secure sands having these qualities, particularly where available materials are

Suggested mix proportions for different jobs, and water cement ratios

<table>
<thead>
<tr>
<th>Kind of Job</th>
<th>Gallons of water per bag of cement when sand is:</th>
<th>Suggested proportions for trial batch</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dry</td>
<td>Damp</td>
</tr>
<tr>
<td>Durable Concrete for Dairies</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>(Water-cement ratio 5 gals per bag)</td>
<td></td>
<td>4 1/2</td>
</tr>
<tr>
<td>Concrete for Cattle Races, etc.</td>
<td>5 1/2</td>
<td></td>
</tr>
<tr>
<td>(Water-cement ratio 5 1/2 gals per bag)</td>
<td>4 1/2</td>
<td>4</td>
</tr>
</tbody>
</table>

NOTE.—The increased proportion of sand when sand is damp or wet is required to compensate for the tendency of damp sand to 'bulk' (occupy a larger volume for a given weight of sand). The concrete should be thoroughly mixed for not less than 1 1/2 minutes after adding water. Longer mixing is no disadvantage.
dune sands or other single sized sands. These sands can be used without difficulty but they probably will require a slightly increased cement content in order to give a suitable degree of workability to the concrete.

Water for concrete is suitable if it is fit to drink. If a durable concrete is to be produced the amount of water added to the concrete must be strictly controlled. In assessing the amount of water required, it should be remembered that sand has a tendency to retain quite considerable quantities of water. Thus the amount of water added to the concrete during mixing may have to be reduced. The table below gives a reasonable indication of the type of mix suitable for durable floor construction and for compensation for the wetness of the sand.

**Floor construction**

The concrete floor to a dairy is normally constructed as a slab-on-ground. For economy this may be built as a thickened edge slab to provide a foundation for perimeter and internal walls. Alternatively the slab may be independent of the walls, with the walls founded separately. If this is done, it is essential that the slab be physically separated from contact with perimeter walls by a strip of bitumen-impregnated caneite or expanding cork set against the walls.

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D. R. Buchanan, B.E., A.M.I.E. Aust., is Divisional Engineer for Western Australia of the Cement and Concrete Association of Australia.

This article is one of a series which will have the general aim of helping farmers to make the best use of concrete on the farm.

Further details and information can be obtained direct from:

The Cement and Concrete Association, Manufacturers' Building, 212-220 Adelaide Terrace, PERTH. 6000
It is desirable to reinforce the concrete slab in order to minimise and control any tendency to shrinkage cracking. The amount of reinforcement required will depend on the shape of the floor to be laid. Generally, however, an A.S.A. A.84 mesh (ref. 606) will be satisfactory. This should be placed in the centre of the slab. Additional reinforcement is required where the slab has a thickened edge to receive external wall structures, as shown in the accompanying sketch.

It is important in planning a floor to make suitable provision for holding down bolts for stock rails and machinery bases rather than to attempt to cut these in later. Similarly, drains should be laid before floor construction. The top of all pipeworks should be clear of the underside of the slab.

A slab having a minimum thickness of 4 in. is suitable for most situations in a dairy. Allowance must, of course, be made for falls to drains which should be not less than 1 in 60 in the bails and 1 in 40 in the yards and for spoon drains and falls within the spoon drains.

In the interests of economy it is possible to accommodate spoon drains by thickening the slab to give 4 in. thickness below the invert. The underside of the slab should then be tapered to either side (see sketch). Reinforcement should be continuous through such thickened portions.

In sandy country it will be necessary to form up the profile, elsewhere hand shaping of the ground is normally sufficient.

### Placing Concrete

The preparation of the site should be carried out with care to give a smooth, level, well-drained surface to receive the concrete.

Where there is a high water table or where some limited excavation is necessary to remove organic or other spongy material, the site should be brought to level using crushed rock, the site then being surfaced with 2 in. to 3 in. of similar material. This should be thoroughly wetted down before placing of concrete is started, to minimise moisture loss from the concrete itself.

Concrete should be placed within one hour of mixing and should be thoroughly compacted by hand tamping or internal vibration, or by use of a vibrating screed. Where hand tamping or internal vibration is used, the surface should be finally screeded by hand. Surface trowelling should be avoided until just before the initial set, at which time the floor should be finished with either a hand operated wood float or better still, with a mechanical trowel, followed by a wood float.

It is inadvisable to finish a floor with a steel trowel where milk spillage can occur, or where cattle are standing or moving, as a slippery floor could result. Care should be taken to ensure that too much cement fines and water (laitence) is not worked to the surface during trowelling, as this will tend to produce a floor which gives a poor performance.

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**Journal of Agriculture, Vol 9 No 8 1968**
In milking bails and races, it is advisable to finish the floor with some form of grooving to ensure adequate foot-hold for stock. A grooving tool may be used to produce a diamond pattern on the floor, immediately following light brooming with a soft broom, but this type of finish can lead to difficulties in cleansing. It is probably best to groove the surface after wood floating using a stiff broom at 45° to 60° to the length of the stall, followed by use of a grooving tool at irregular centres, grooves following the same direction as the brooming.

This provides a floor which can be cleansed by hosing and sweeping down in one direction only.

Spoon drains and drainage outlets should be finished with a steel trowel.

Curing

The quality, freedom from surface crazing, wear resistance and durability of a concrete floor is improved considerably by moist-curing the floor immediately it is hard. In a dairy, as in most other areas demanding high performance from a concrete floor, it is essential that moist curing should continue for a period of not less than seven days. This can be achieved—

- by ponding the finished slab under water; or
- by covering with damp sand under continuous fog sprays; or perhaps more easily
- by the use of building paper which is laid over and in contact with the surface as soon as it has hardened sufficiently. The building paper should be well lapped and secured at joins and at the perimeter so that sheets will not be lifted by the wind; alternatively
- one of the many proprietary curing agents may be sprayed on to the surface, but such compounds need to be checked for suitability in the light of eventual surface treatments.

Protective surface treatments

To further improve abrasion resistance and to ensure impervious conditions the floor may be given one of several surface treatments. Such treatments can also improve the performance of existing floors which are porous or are dusting or spalling.

In areas where surface hardness is a prime consideration, it is recommended that the surface should be treated with either sodium silicate or zinc and magnesium fluosilicate.

Sodium silicate (water glass) is quite viscous and must be diluted at the rate of about one gallon of sodium silicate to four gallons of water. This is flooded over the surface and well scrubbed in with a hard broom, until the surface is uniformly coated. After the coat has hardened for at least 24 hours, it should be scrubbed down with water and a further coat applied. Two to three coats are normally sufficient.

Alternatively, a mixture of one part of zinc silico-fluoride to four parts of magnesium fluosilicate gives a good result. The solution should be made by using \( \frac{1}{2} \) lb. of this mixture per gallon of water for the first coat, and 2 lb. of the mixture per gallon of water thereafter.

It is applied in the same way as sodium silicate. However, there is a risk that silico-fluorides may release hydrogen fluoride gas and this mixture should be used only in well-ventilated premises with the operator's eyes and any skin or abrasions protected. About one gallon of the diluted solution will treat 20 yards of floor at each coat.

In areas where milk spillage is the main consideration the floor may be treated with a drying oil. Boiled or raw linseed oil may be used and should be applied hot. Two or three coats may be applied, each coat being allowed to dry fully before the next application. It is advisable to dilute the first coat with an equal quantity of turpentine.

Oil can be applied after the zinc and magnesium fluosilicate treatment where both surface hardness and resistance to chemical attack are desired.

As an alternative to oil, a varnish may be used. The types of varnish which are suitable are those high grade varnishes made from China wood oil, bakelite and phenolic resin, or polystyrene emulsion. Alternatively, treatment with an epoxy resin is extremely effective though more expensive in first cost.
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