Design of Slip-Resistant Surfaces for Dairy Cattle Buildings

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Performance specification for concrete floor surfaces

The floor should be:

- slip resistant
- easy to keep clean
- slightly abrassive
- impermeable
- maintenance free
- load bearing

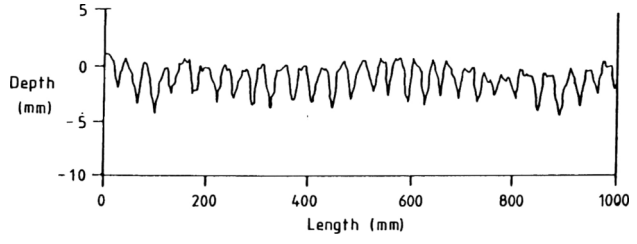
New Floors

The concrete surface should be textured to improve adhesion between the hoof horn and the surface.

Tamped Finish

The currently recommended tamped finish should have a tamp spacing of approximately 40 mm and a groove of 3-4 mm; this can be achieved with the edge of a board. The surface profile of the longitudinally tamped concrete is shown in Figure 1. (1)

FIGURE 1. Cross Section of the tamped concrete.



The concrete should not be compacted level with the forms as only shallow grooving would be formed and this would not be durable. It is convenient to cut a notch at each end of the tamping board to fit over retaining forms and thus provide the necessary depth of groove. It was found that the direction of tamping had no effect upon the amount of slip that occurred. This means that slabs can be tamped in any direction, except that drainage of surface water improves if the tamps run down any slope minimizing icing problems in winter. It must be stressed however that this finding only applies to tamped and not grooved surfaces.

Tests are continuing on further types of texturing with the aim of identifying the most slip-resistant surface finishes.

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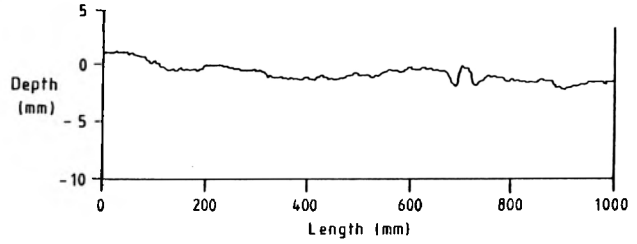
Brush Finish

This can be achieved by drawing a stiff brush over newly laid concrete. Although it is a very slip-resistant surface it is not recommended as it is too abrasive to cows hooves.

Steel Float Finish

It is formed by troweling freshly laid concrete with a steel float on trowel but it is not recommended as it makes a very slippery surface when wet or covered with slurry. A profile of such a surface is shown in Figure 2 (1).

FIGURE 2. Cross-Section of the steel float finished concrete.



Wood Float Finish

Formed with a builders wood float when leveling newly laid concrete. It provides better slip resistance if sprinkled with small particles of silicon carbide or aluminium oxide before the concrete sets. The grit should pass through a screen having 14-20 meshes per inch; coarser grit is sized through a screen having 4 to 6 meshes per inch. The coarser grit is better anchored into the concrete. The rate of application should be 1 kg/m^2. This surface can be recommended for use in milking parlours but it is very abrasive and should be therefore only recommended for small areas.

Grooved Finish

Wood-float-finish concrete combined with 12 mm wide grooves, 10 mm deep of "V" shape, set on a 40 mm right angle grid probably offers the most appropriate concrete floor finish. Some designers prefer 80 mm grid spacing; research work is in progress in England to clarify this matter.

Grooves can be formed on wet concrete by the use of a rake-shape tool fitted with groove farmers set at the desired spacing. Using this technology it is recommended that grooves be formed at 45° to the direction of travel

as it is not possible to achieve a grid pattern and maintain a smooth surface between grooves. Grooving a concrete surface will help to reduce culling due to slipping and will ensure better footing for cows especially when on heat when mounting often takes place (2).

Dealing with Slippery and polished Old Concrete Floors

Many producers find that floors in their still efficient dairy buildings become excessively slippery due to the scraping and removal of slurry from cubicle and feeding passages. They can be dangerous to both operators and to animals. Several techniques could be used to improve their non-skid characteristics, these include:

- Grooving with diamond-tipped discs, often 10 mm deep and 70-75 mm wide slots are used.
- Grooving with a carboundum-tipped flail machine producing grooves 2-3 mm deep at 40 mm spacing.
- Scabbling the surface with a pneumatically driven tungsten carbide tipped heads. This leaves a rough, abrasive finish.
- Heat scaling using propane gas welding equipment—a very slow method of roughening a surface as pieces of concrete flake off due to the expansion differential of hot surface. The head of the gas line should be fitted with a shield.
- Acid etching with diluted hydrochloric acid, 1:4 dilution applied to the surface at the rate of 0.35 $1/m^2$ (0.5 pint/yd^2). Acid should be added to the water in a plastic container and rubber gloves and boots should be worn when mixing and applying the acid. The acid should be applied through the rose of a watering can and brushed out over the surface with a soft broom.

  Leave the liquid on the surface for about 15 minutes or until all effervescence has ceased and then wash it away with plenty of water from a hose pipe. The process can be repeated with a stronger solution if necessary (1 part acid: 2 parts water). Approximate rate of work is 10 m^2/hour (12 yd^2/hour).

  The acid is intended to eat into the mortar surrounding the stones leaving them standing pround. If the surfaces of the stones themselves are irregular, the surface of the concrete will be roughened by the process. If the etching is ineffective or if the stones already have had their uppermost surface worn away, the surface will remain smooth.
- Applying epoxy resin onto which carborundum or small particles of banxite chippings are scattered while the surface is still tacky.
- Old concrete floors which have become cracked, polished and broken up should be relaid with a tamped finish applied. Patching is only advisable for small areas, ensuring that the surface texture matches that of the surrounding area.

How can slippery floors be avoided?

The problem can be prevented at the outset by ensuring that new concrete floors are of the right mix, properly compacted, have a slip-resistant texture applied and are properly cured. This will ensure that the floor and its slip-resistant surface texture are durable.

For areas such as collecting yards and cubicle passages the recommended concrete mix will contain 115 kg of damp sand and 195 kg of coarse aggregate to each 50 kg bag of cement. Use ordinary Portland cement and a maximum aggregate size of 20 mm. Quantities of water required cannot be specified owing to the extremely variable amounts of water already contained in the aggregates, especially in the sand. Use only just enough water to compact thoroughly. An over-wet sloppy mix will be porous and less durable than one which is no wetter than it has to be for good compaction. A vibrating beam is more efficient at driving out trapped air, or compacting, than hand compaction and should be the method used whenever possible.

The concrete should be cured either by covering with polythene or, preferably, by spraying with a resin-based curing liquid. "New concrete disease" can be avoided by scuffing the surface with a sleeper attached to a tractor scraper.

What is the "new concrete disease"?

Damage to cows hooves can be caused by the small aggregate particles and sharp peaks protruding from the surface. Scoffing freshly cured concrete with a concrete or steel beam attached to the tractor scofer blade will remove most of these protrusions. Also relatively high alkalinity may occur as a result of free lime on the surface being dissolved in water. This can be very aggressive to the feet of cattle.

What are the typical problems caused by slippery floors and broken up floors?

The Compton Lameness Survey (3) showed that upper leg lameness affected some 12% of 185,000 dairy cows examined. Damage to tissue is shown in Table 1.

TABLE 1. Percentage of affected tissues.

Leg tissue	% of leg lesions
Joint and ligament	47
Tendon	21
Muscle	9
Bone	7
Nerve	7
Other	10

Slippery floors which cause animals to fall on hard surfaces may result in injuries for example:

- rupture of the cruciate ligament of the stifle joint (4)

- injury to joints, muscles and tendons through over-extension of limbs during falls (5)
- radial nerve paralysis occurring when a cow falls onto its shoulder
- a cow whose obturator nerve may have been damaged during a difficult calving is susceptible to falling since she may have difficulty controlling the adductor muscles which keep the back legs together (5)
- dislocation may follow slips and falls, often of the stifle and hip joint (4)
- foot lesions associated with trauma from contact with hard protusions of badly laid concrete floors or even with loose particles of broken up concrete. Also prolonged exposure (in year-round housing systems) to hard surfaces can cause lesions particularly where cows need to turn sharp angles in exits and entrances to a milking parlour, collecting yard, etc.

References

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Sexing of sperm by flow cytometry

J. M. Morrell, K. D. Keeler, D. E. Noakes, N. M. Mackenzie, D. W. Dresser

Veterinary Record (1988) **122**, 322-324

Economics dictate that livestock producers will be under increasing pressure to optimise output. A technique for sex preselection could help by reducing the number of females required to produce a given number of progeny of the desired sex; the technique would be particularly useful to the dairy industry. Live mammalian sperm, stained with a vital dye and analysed by flow cytometry, show a bimodal fluorescence distribution. Such bimodality may represent two overlapping subpopulations of X- and Y-chromosome bearing sperm. To test this hypothesis, sperm from the two subpopulations were separated using the sorting capacity of a flow cytometer and were used for the insemination of suitably prepared females. The sex of the resulting progeny was determined either by anatomical criteria or by identification of the sex chromosomes by karyotyping. Insufficient data are available so far to provide statistically significant evidence in support of the hypothesis, but a preliminary sequential analysis indicates a progressive tendency towards significance.

An attempt to establish a herd serologically negative for infectious bovine rhinotracheitis

J. D. Corkish

Veterinary Record (1988) **122**, 552-554

To improve his position as an exporter of pedigree animals, an owner wished to establish his herd as serologically negative for infectious bovine rhinotracheitis (IBR). After a test on all animals older than six months the herd was split into seronegative and seropositive groups. The seronegative group was tested four times during the first year, twice during the second year and given a final test 12 months later; any positive animals were removed. The results indicated that in the right circumstances the establishment of an IBR seronegative herd is practicable.

Mycobacterium bovis in the anterior respiratory tracts in the heads of tuberculin-reacting cattle

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Veterinary Record (1988) **122**, 184-186

Twenty-five of 50 randomly selected tuberculin-reacting cattle were confirmed as tuberculous in the laboratory. All 25 cattle had macroscopic lesions in lymph nodes associated with the respiratory tracts but only one had lung lesions. *M bovis* was isolated from the anterior respiratory tracts in the heads of four of the 25 tuberculous animals and from a nostril lesion found in a fifth. For at least three of these five animals, the intervals between the final tuberculin test and their previously negative tests indicated that infection had established relatively rapidly. Four of them had been tuberculin tested solely because they were animals in contiguous 'at risk' herds. It would appear that although *M bovis* can be isolated from the anterior respiratory tracts in the heads of tuberculin-reacting cattle, it is unlikely that primary foci of infection exist in regions other than the lungs or associated tissues. The study demonstrates the potential for reactors with lesions to excrete *M bovis* and the continued importance of infected cattle in the epidemiology and eradication of the disease.