# 8 ■ Simplified cubicle housing systems for cattle

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**Eight simplified cubicle buildings combined with an open-air exercise area, intended for use with dairy cows and heifers, were monitored between 2006 and 2009. Recommendations are made regarding the design and construction of these simplified buildings based on the results of this monitoring, discussions with building and construction consultants and lessons drawn from experience in Switzerland (fact-finding visit in July 2007 and ART publications). This method of housing facilitates the tasks performed by breeders and reduces investment costs by nearly half compared with traditional buildings.**

# The various construction options (Table 1)

## Ventilation in the simplified cubicle housing systems

The buildings under study are between 4 and 9 m in width (Table 1) and are limited in height (from 4 to 5 m to the ridge). As a result, they are conductive to natural ventilation, even during the summer months. The primary issues of concern involve the risk of draughts in the area where the animals sleep.

When there is no siding on the sides exposed to dominant or cold winds, protection can be provided by means of an existing building used for other purposes: milking and storage of forages (Figure 1), barn hay drying (Figure 2), distribution of forages (Figure 3). Another solution is to take advantage of a natural windbreak. When buildings are used during the summer months, removable siding is essential for smaller-sized buildings that are low in height. Innovative, cost-efficient solutions with wood siding have been deployed (Farms 72 and 24).

Four farms erected single-slope buildings, which allow for simpler roofing ventilation. Six of the farms built at least one double-slope building. At Farm 61-B, the ridge is closed off with a steel roof. After two years of use, signs of condensation became visible. Several roofing ventilation options were recommended:

- An open ridge of about 20 cm with windbreak sheets: This solution is highly effective but costly. It was used only at Farm 61.
- A ridge set back about 12 to 15 cm, oriented opposite the dominant winds (Farm 14).
- A large one-metre opening with no protection (Farm 72).
- No opening on the ridge; the two rows of fibro-cement plates closest to the ridge are raised higher, or vents are created when other materials are used (with a clearance of several centimetres between plates): These solutions are simple and appear to be well suited for these buildings.

## Length of roof overhang

The roof overhangs must be adequately long to protect the rear of the stalls from rain and sun (Zähner et al., 2000). Overhangs of various lengths were installed at the farms that were monitored, depending on the specific circumstances:

- one metre for building heights of between 3.3 and 3.5 m (Figures 1, 3 and 4);
- 1.5 metres for a height of 4.3 m (Farm 50);
- the addition of a 0.5-m deflector to reduce the height (Farms 53-B and 72).

By monitoring these buildings, researchers were able to identify the level of protection provided by these installations. The rear of the stalls can become exceptionnally damp, but daily maintenance eliminates any negative impact.

## Cubicles/framework links and position of the posts

Stall separators connected to the wood framework were installed at two farms (Farms 14 and 61). The stall separators made of wood are thicker than the commercial metal tubes (12-14 cm compared with 5-7 cm). Consequently, for the comfort of the animals, the wood stalls must be wider from axis to axis than is the case with metal separators. In addition, the position of the ground retainer and neck bar is fixed and cannot be adapted to the animal's frame. As a result, modifications to the stall structure have been proposed.

The position of the structural posts should be considered, with several possible solutions:

- The position in the front of the cubicle stalls that was recommended in Switzerland (Agroscope FAT Tänikon, 2005) was adopted at two farms (Figures 3 and 4).
- The position to the rear of the cubicle stalls that was recommended in Switzerland was adopted at one farm (Figure 4). In order to protect them from excreta, the posts are raised by 20 cm on a concrete block encased in a PVC sleeve.
- The midpoint position was not recommended in Switzerland for new facilities. It was deployed at three farms, where the posts were set back either 30 cm from the cubicle threshold (Graphic 2) or 60 cm (Graphic 1).

## Roofing materials

Given the presence of an open-air exercise area, there is no need to install translucent plates in the roof in order to provide light. Translucent plates were installed in the roof at two buildings with closed double-slope roofs (Farms 14 and 61).

Since the simplified buildings are low in height, there is a significant risk of heat radiance on the animals during the summer. There is consequently a need for an insulating component at a low cost.

- Fibro-cement has been very widely used (Farms 14, 24, 31, 61, 72). Condensation is limited, and it helps to maintain the soundness of the building structure.
- Non-insulated steel is not recommended, given its very high capacity to radiate heat. It has been installed at two farms (Figures 2 and 4), but the animals pasture during the summer.
- PVC (Elycolor®) has been installed at one farm (Figure 3) where the animals do not remain in the building during the day in the summer months.

# Open-air exercise yards and excreta management

## Characteristics of open-air areas

For reasons of the animals' health and welfare, minimal open-air areas are recommended in Switzerland for new construction (M. Zähner, 2008). At the farms that were monitored, this area was an average of 2.9 sq.m per cow and varied from 1.5 to 5.5 sq.m (Table 2).

The use of hot-poured bituminous concrete as a ground surface was studied at several farms and adopted at one (Farm 72). The coating mixture costs 40% to 50% less than commercially produced concrete. It requires compliance with a set of specifications specific to animal husbandry that must still be validated.

For efficient drainage of contaminated rainwater, the recommended slope for open-air exercise yards is 2%. At four of the farms, the slope was between 1% and 2% (Table 2). This appears to be adequate for open-air exercise areas that are small in size with only a moderate volume of water to be drained. There are two potential solutions for separating blackwater from manure for treatment:

- The installation of collector pits before the manure storage: This solution is effective when scraping is performed with a tractor (Farms 14 and 50). But when mechanical scraping is used, there is a risk the pits will clog up more often.
- The solid manure could potentially be scraped in the direction opposite the slope. The blackwater then collects at the low point of the alleys.

It is preferable to protect the forage in the trough. A covering at a height of two metres, with a roof overhang of 1.50 m on the trough side, appears to be adequate (Figure 1). With the mobile troughs, the amount of work time required for the feeding process is cut in half, and the concrete surface area is reduced compared with a traditional trough. They can be installed in connection with open-air exercise areas (two farms monitored).

## Manure management

In order to reduce the cost of manure storage, the ideal solution is to manage only one type of manure (seven of the farms studied) and to treat low-content effluent from open-air areas (all farms monitored).

There are several possible solutions for effectively managing manure in open-air spaces: give preference to dry feed (Farm 50), provide an adequate supply of straw in the stalls, create a solid manure platform with a drainage wall and liquid collection (Farms 53-A and 72), install a pit that collects scraped manure and provides for initial drainage before transfer to storage (Farm 72).

# Investment cost and sources of savings

The solutions that were studied offer significant savings over a traditional building. Costs are reduced by an average of 46%, varying from 35% to 67% (Table 3). These results confirm the findings of the Swiss researchers at ART (Gazzarin and Hilty, 2002).

The following factors, which vary by farm, contributed to these savings:

- By building a great many of these features themselves, several farms saw significant additional savings (Table 3). Buildings that are low in height are easier for breeders to construct (Van Caenegem et al., 2004).
- Some breeders took the time to negotiate the cost of each construction job with contractors (as at Farms 50 and 53-A).
- A number of the buildings are quite compact, with three or four rows of stalls (Farms 24, 50, 53-B) or less space for the trough thanks to a mobile trough (53-B).
- The treatment of low-content effluent from open-air exercise areas and manure heaps ensures that this effluent can be managed at a lower cost (Institut de l'élevage et coll., 2007).
- With regard to the milking centre, several solutions have been adopted: Used milking parlour (Farms 50, 53-A), a collecting yard integrated into the housing (Farm 53-B), self-supporting prefabricated walls installed by the breeders (Farms 50, 53-B).

# References


*Agroscope FAT Tänikon, 2005. FAT construction sheets, 5 p.*

*Gazzarin C., Hilty R., 2002. FAT Report no. 586, 24 p.*

*Institut de l'Elevage, Chambres d'agriculture, Cemagref, 2007. Les effluent peu chargés en élevage de ruminants : Procédés de gestion et de traitements [Low-content effluent in livestock breeding: Management and treatment processes]. Technipel, 115 p.*

*Van Caenegem L., Herzog D., Ott H., Schmidlin A., 2004. FAT Report no. 607, 11 p.*

*Zähner M., 2008. Agroscope Rechenholz-Tänikon, 4 p.*


**Table 1: Description of eight simplified stall buildings with an open-air exercise area**

| Farm (placed in service) | Stalls | | Shape and type of framework (width) | Roofing (slope) | Characteristics and unique features |
|---|---|---|---|---|---|
| | Number | Position | | | |
| 14 (2006) | 44 spots, 2 rows | Back to back | Double-slope, wood (8 m 20) | FC* (28%) | Self-built, including framework, kit covering (made by Intrabois) |
| 24 (in progress) | 98 spots, 3 rows | Head to head | Double-slope, wood (7 m 95) | FC* (21%) | Covered trough, 2 robotic milkers built into the building, siding that is removable in summer, kit produced by Roiné |
| | | Single row | Single slope, wood (3 m 95) | | |
| 31 (in progress) | 50 spots, 2 rows | Head to head | Double-slope, wood (8 m 60) | FC* (21%) | No siding, protection via hangar, kit produced by Roiné |
| 50 (in progress) | 79 spots, 4 rows | Head to head | 2 single-slope, metal (8 m 80) | Steel (10%) | No siding, two separate troughs, completely self-built |
| 53-A (2008) | 52 spots, 2 rows | Head to head | 2 single-slope, wood | PVC** (8.5%) | Largely self-built (concrete with hired help, siding, tubular) |

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| | Number | Position | | | |
| 53-B (2007) | 81 spots, 4 rows | Head to head | Central double-slope, wood | Steel (23%) | Compact building, with built-in holding area including exercise area, mobile trough, 2 x 12 spots under double-slope |
| | | Single row | 2 lateral single-slopes, wood | Steel (30%) | |
| 61 (2005) | 72 spots, 2 rows | Back to back | Double-slope, wood | FC* (24%) | Covered trough, kit framework installed by Chaignard (53) |
| 72 (in progress) | 82 spots, 2 rows | Back to back | Double-slope, metal and wood | FC (24%) | Covered trough, kit framework, removable siding, surfaced ground |

*FC = fibro-cement plates **Elycor®

**Table 2: Characteristics of open-air living areas and management of manure and low-content effluent from milking in the eight farms monitored**

| Farm | Open-air living area | | Manure management | | | Treatment of low-level effluent |
|---|---|---|---|---|---|---|
| | sq.m per cow | Slope | Type | Scraping | Storage | |
| 14 | 5.5 | 5% | Manure | Scraper pulled behind tractor | Open-air manure pile | SBT* + spreading over meadow |
| | | | Slurry | | Concrete pit | |
| 24 | 1.5 | 2.5% | Slurry | ? | Pit with geomembrane | SBT* + spreading over meadow |
| 31 | 3.7 | ? | Manure | ? (work in progress) | | SBT* + filters planted with reeds |
| 50 | 3.9 | 2% | Manure | Scraper pulled behind tractor | Open-air manure pile, front slope | SBT* + ponding |
| 53-A | 1.7 | 1% | Manure | Mechanical scraper with jack | Open-air manure pile + drainage wall | SBT* + ponding |
| 53-B | 2 | 1.5% | Slurry | Mechanical scraper with jack | Pit with geomembrane | SBT* + spreading over meadow |
| 61 | 1.7 | 1% | Manure | Mechanical scraper with cable | Open-air manure pile, front slope | Straw filter + spreading over meadow |
| 72 | 3 | 1.5% | Manure | Mechanical scraper with jack | Open-air manure pile + drainage wall | SBT* + ponding |

*SBT = sedimentation and stormwater basin tank

**Table 3: Investment cost (€ per spot) of 6 simplified stall buildings with open-air exercise area and savings (%) compared with a standard building (1)**

| Farm (number of spots) | Project | Housing | | Milking station | Excreta management | Total |
|---|---|---|---|---|---|---|
| | | Self-built | Not self-built | | | |
| 14 (44 stalls) | Completed | 768 (2) | 943 | / | / | 768 |
| | Standard (1) | 1,686 | | / | / | 1,686 |
| | *(% difference)* | *(54.4%)* | *(44.1%)* | / | / | *(54.4%)* |
| 53-A (52 stalls) | Completed | 1,896 (4) | 2,527 | 887 | 425 | 3,274 |
| | Standard (1) | 3,300 (4) | | 2,020 | 1,126 | 6,446 |
| | *(% difference)* | *(42.5%)* | *(23.4%)* | *(52.8%)* | *(62.3%)* | *(49.2%)* |
| 53-B (81 stalls) | Completed | 1,697 (5) | 1,845 (5) | 1,184 | 302 | 3,183 |
| | Standard (1) | 2,703 (5) | | 1,811 | 1,006 | 5,520 |
| | *(% difference)* | *(37.2%)* | *(22.2%)* | *(34.6%)* | *(70.0%)* | *(42.3%)* |
| 50 (79 stalls) | Completed | 767 | Not estimated | 453 | 501 | 1,722 |
| | Standard (1) | 2,504 | | 1,682 | 986 | 5,172 |
| | *(% difference)* | *(69.4%)* | / | *(73.1%)* | *(49.2%)* | *(66.7%)* |
| 61 (72 stalls) | Completed | / | 1,678 (6) | / | 743 | 2,421 |
| | Standard (1) | 2,334 (6) | | / | 1,070 | 3,773 |
| | *(% difference)* | / | *(37.9%)* | / | *(30.6%)* | *(35.8%)* |
| 72 (82 stalls) | Completed | 1,570 (7) | Not estimated | / | / | 1,570 |
| | Standard (1) | 2,645 (7) | | / | / | 2,645 |
| | *(% difference)* | *(40.6%)* | / | / | / | *(40.6%)* |
| **Average savings** | | ***46.1%*** | | ***52.2%*** | ***51.9%*** | ***46.5%*** |

(1) Same-year reference cost for a fully covered, semi-open traditional standard building, with 2 rows of stalls, commercially built, slatted floors over slurry and effluent pit, open-air manure pile.

(2) Work time for 2 persons = 429 hours (masonry = 47%, construction = 53%)

(3) including cost of mechanical scraper with jack for manure (€460 per spot)

(4) including cost of mechanical scraper with jack for slurry (€207 per spot)

(5) including cost of mechanical scraper with chain for manure and slurry (€204 per spot)

(6) including cost of mechanical scraper with jack for manure and slurry (€304 per spot)

**Figure 1: Sectional view of building at Farm 31 (Agriculture Bureau 31)**

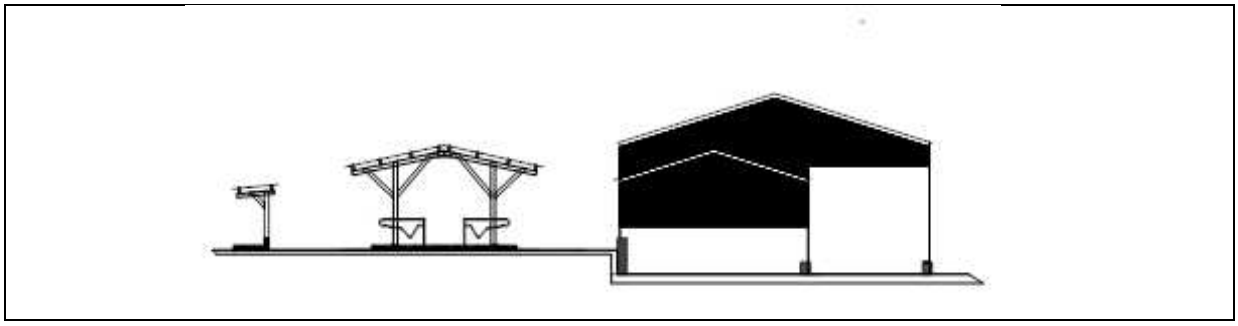

**Figure 2: Sectional view of building at Farm 50 (Agriculture Bureau 50)**

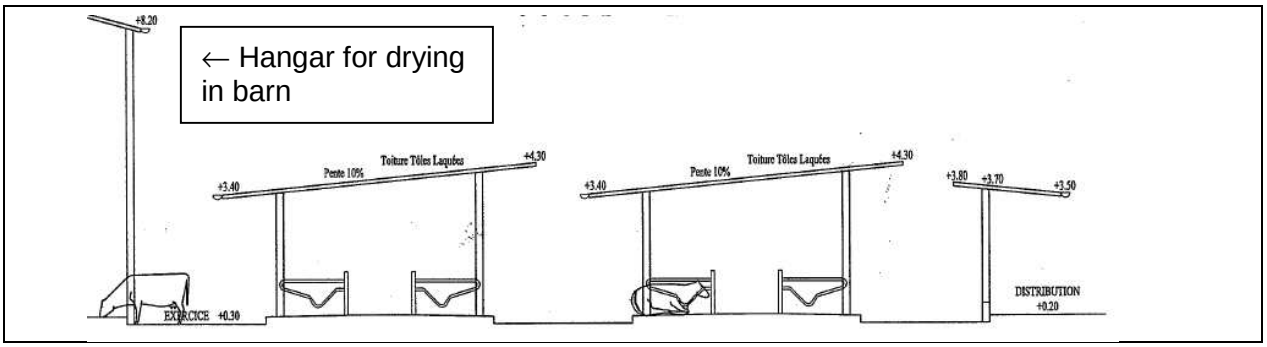


**Figure 3: Sectional view of building at Farm 53-A (Agriculture Bureau 53)**

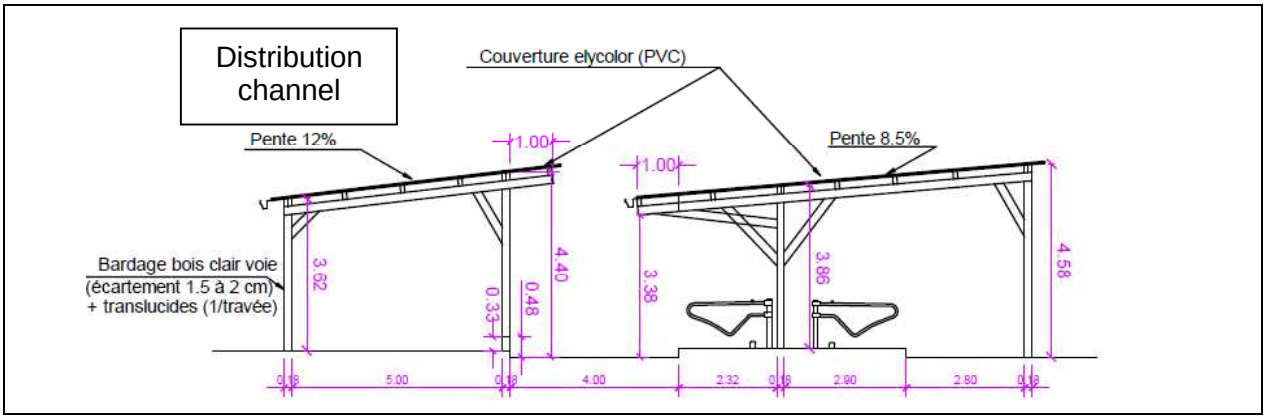

**Figure 4: Sectional view of building at Farm 53-B (Fromageries BEL Evron)**