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Production Systems

Comparative analysis of some investment costs for free rearing of female breeding calves

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Abstract. *The objective of the study is to compare and analyze investment costs for construction and technological equipment of buildings with different way for free rearing of female breeding calves, as a result of which to define the most economical and practically recommendable solutions with different capacity of dairy cattle-breeding farm. A total of 8 technological variants for freestall rearing of female calves and heifers in farms for 40, 60, 80 and 100 cows have been compared (4 variants for buildings with group cubicles on a sloping floor – for calves 3 to 18 months old and with Butterfly landings for heifers and 4 variants for buildings with group cubicles on straw bedding). It has been established that with the same farm capacity the variants for buildings with group cubicles on a sloping floor for calves and with a Butterfly landing for heifers are more economical than buildings with group cubicles on straw bedding by relative construction cost of the load bearing and fencing structures and by relative total construction cost, but they are more capital-intensive by relative construction cost of the floor profile. By increasing the farm capacity from 40 to 100 cows the parameters of the two types of technological variants (with group cubicles on a sloping floor for calves and Butterfly landing for heifers and with group cubicles on straw bedding) decrease – the relative construction cost of the technological profile drops from 299 to 203 BGN/st.pl. (up to 47,3%), the relative construction cost of the load bearing and fencing structures drops from 1388 to 832 BGN/st.pl. (up to 66,8%), the relative total construction cost - from 1650 BGN/st.pl. to 1080 BGN/st.pl. (up to 52,8%). The variant with group cubicles on a sloping floor for calves and with Butterfly landing for heifers on a farm with capacity for 100 cows is the most economical – up to 66,8% by relative construction cost of the load bearing and fencing structures of the buildings and up to 52,8% by relative total construction costs. The variant with group cubicles on straw bedding on a farm with capacity for 100 cows is more economical up to 47,3% than the other variants by relative construction cost of the floor profile.*

Keywords: buildings, female calves, heifers, technological floor profile, load bearing and fencing structures, technical and economic parameters

Introduction

In modern dairy cattle farms female breeding calves are basically free-reared. Calves up to the age of 12 months are usually placed in group cubicles and individual cubicles are used mainly for the pregnant heifers. Good practices in the world are the individual semi-open or open buildings for calves with group cubicles on a sloping floor or with thick non-changeable bedding and for rearing of heifers – Butterfly landings (Dinev et al., 1992; Graves et al., 2007; Margerison and Downey, 2005). In literature there are few publications concerning studies on built-up areas, construction costs and investments in buildings for female calves and heifers. The information in reference sources is mainly for buildings for cows only (Dimova, 2003; Dinev, 2007; Canada Plan Service, 2006; Holmes et al., 2005; Farm and Rural Buildings Pocketbook, 1991; Pereira, et al., 2003; Wohlfart et al., 2000), for buildings with closed reproduction cycle in which cows are reared together with female breeding animals (Dimova and Dinev, 2008) or for buildings with individual cubicles for pregnant heifers only (Dimova, 2009; LSU Ag Center, 2005).

In Bulgaria the issue about the technical and economic evaluation of variant solutions for rearing female calves in group cubicles on a sloping floor or with thick straw bedding, as well as heifers on Butterfly landings has been studied partially. Authors have found correlations between the way of rearing young breeding animals in farms for 40 to 100 dairy cows, the capacity and some technical and technological parameters: relative built-up areas and

cost of construction materials (concrete and steel) for the construction of the technological floor profile of the buildings (Dimova and Dinev, 2008). The effect of technological parameters on these factors has been studied (Dimova et al., 2010), but so far no comparative study has been carried out between the technological variants and no technical and economic evaluation has been made based on relative construction cost of the technological floor profile only, the load bearing and fencing structures only, and the total construction cost.

The objective of the present study is to compare and analyze investment costs for construction and technological equipment of buildings with different way for free rearing of female breeding calves, as a result of which to define the most economical and practically recommendable solutions with different capacity of dairy cattle-breeding farm.

Material and methods

The object of study are the 8 technical and technological solutions developed by the authors for free rearing of female breeding animals from 3 to 27 months of age on farms for 40, 60, 80 and 100 cows. Of these, 4 are variants for buildings with group cubicles on a sloping floor for calves from 3 to 18 months of age and Butterfly landings – for heifers (A variants, Figure 1) and 4 are variants for buildings with group cubicles on a straw bedding for calves and heifers (B variants, Figure 2). The variants have been

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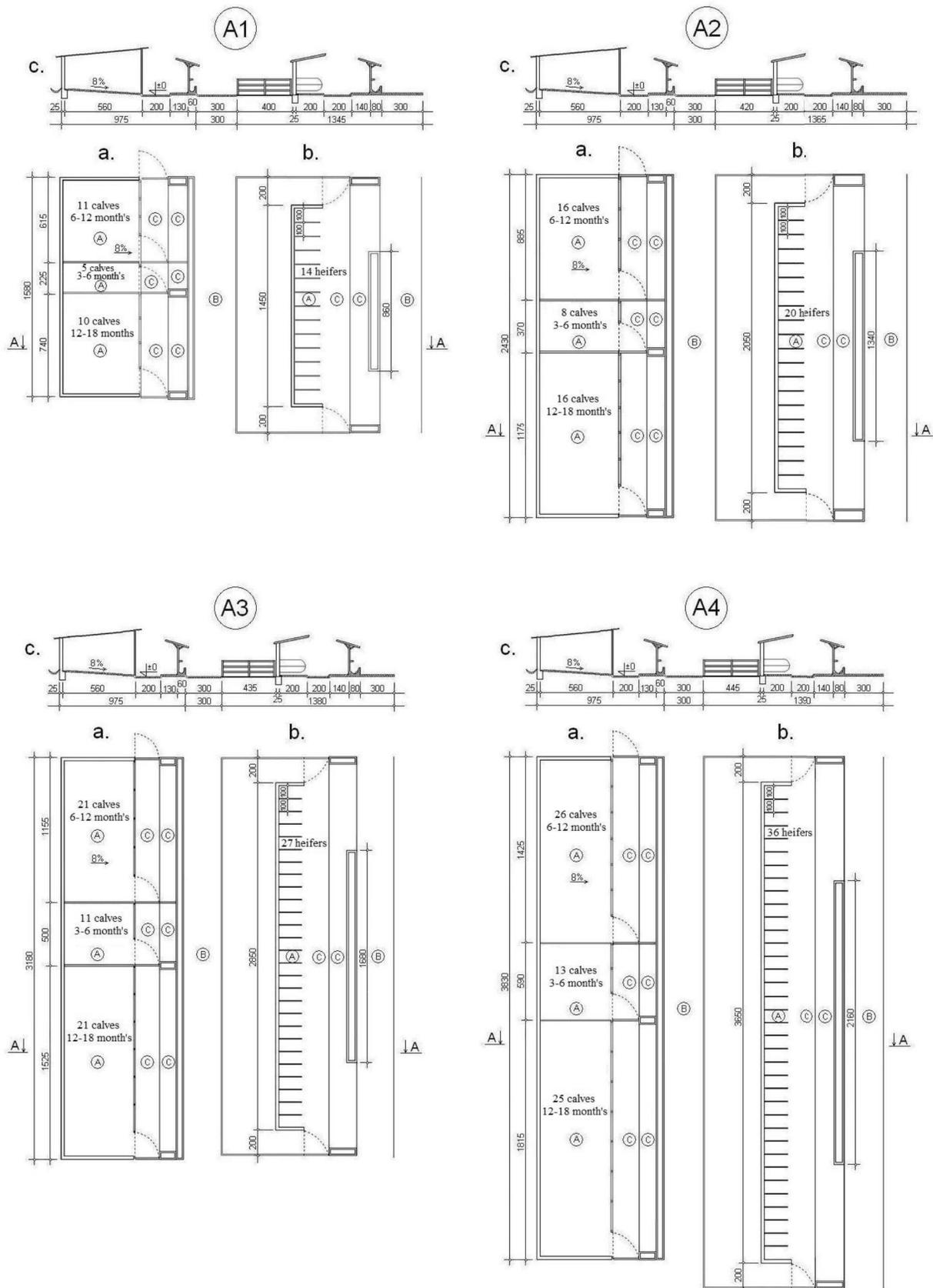


Figure 1. Variants (A) of rearing of female calves and heifers in farms with capacity; A1 - 40 cows, A2 - 60 cows, A3 - 80 cows, A4 - 100 cows, a. building with sloping floor for 3-18 month's calves, b. one-line covered landing type "Butterfly" for heifers, c. transversal section, A - zone for rest, B - zone forage allocation, C - zone for movement

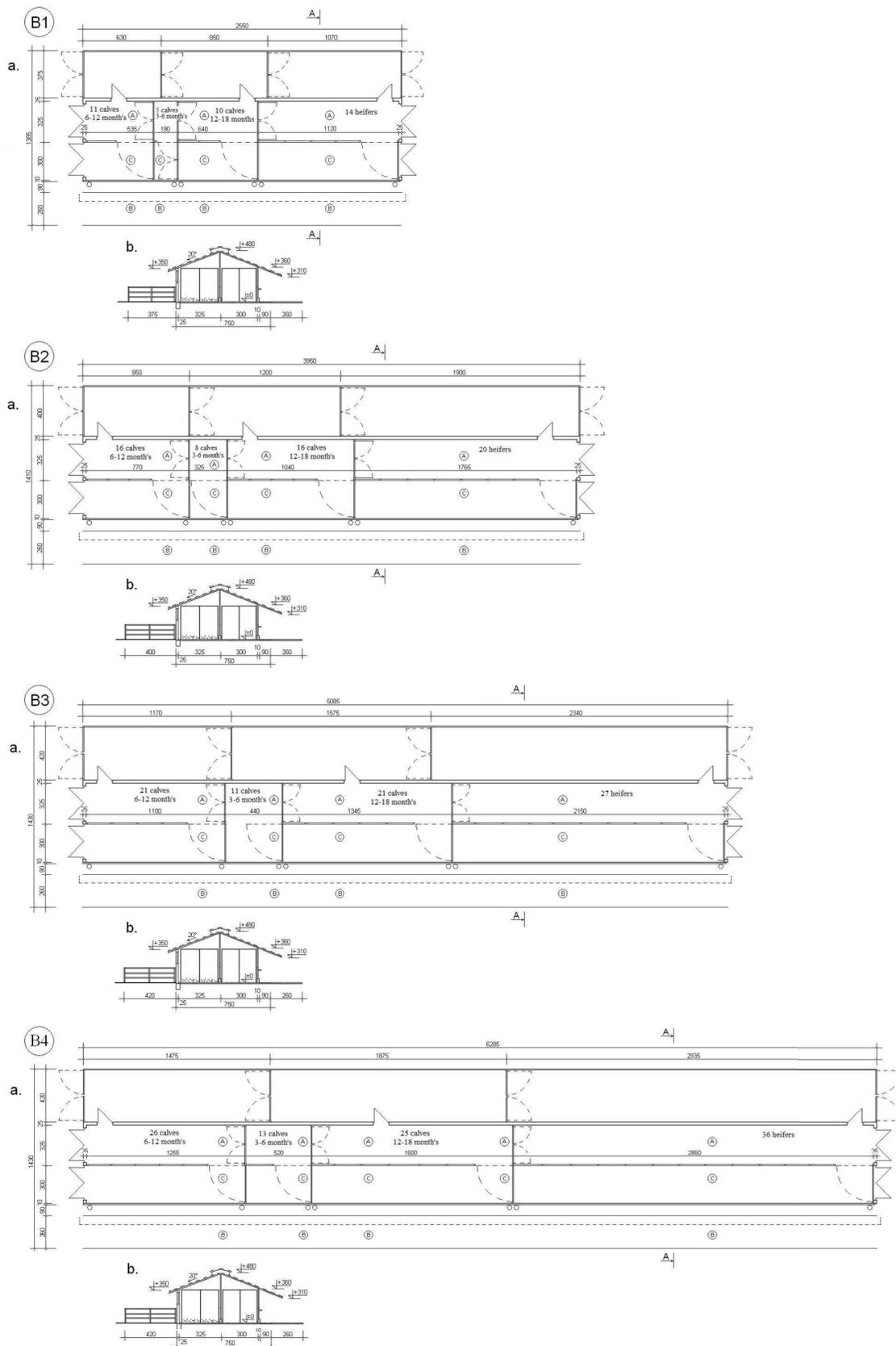


Figure 2. Variants (B) of buildings for rearing over straw bedding of female calves and heifers in farms with capacity B1 - 40 cows, B2 - 60 cows, B3 - 80 cows, B4 - 100 cows, a. plan, b. transversal section, A - zone for rest, B - zone for forage allocation, C - zone for movement

developed under the following identical start-up conditions:

The buildings have light-weight steel load bearing structures open to the south. The walls are of brick masonry – for A variant – solid, and for B variants – with windows along the northern longitudinal wall opened along the lower horizontal axis. Buildings A variants have a flat roof and with variants B a non-symmetrical gable roof with a ventilation slit covered with polycarbonate transparent material. In order to protect the fodder alley from rain the eave of the latter from the south has been extended up to 180 cm. In all variants the roof cover of the buildings is of sandwich panels produced from plasticized LT sheets and heat insulation from polyurethane.

Animals have been divided in the following age groups: calves from 3 to 6, from 6 to 12 and from 12 to 18 months and heifers (18 to 27 months). For all variants when determining the size of groups 100% of fertility of the cows and the same percentage of culling of calves during the respective age periods have been adopted (Technological standards, 1982).

It has been adopted the number of stock places to coincide with the number of animals in the building. Up to their fertilization (from 3 to 18 months of age) calves are raised in group cubicles with minimum area of 2,5 m²/capita (age 3 - 6 months), 3,0 m²/capita (6 - 12 months) and 4,0 m²/capita (12 - 18 months), respectively. Heifers are raised in individual cubicles 100 cm wide and 200 cm long on single-line covered Butterfly landings (variants A) or on a straw bedding in group cubicles with minimum area of 5,0 m²/capita (variants B) (Regulation No. 44/20, 2006). The same prerequisites have been adopted for the variants in each rearing method.

In variants A immediately next to the calf building (outside) a manure alley is formed 200 cm wide. Group cubicles have great floor sloping (8%), through which the movement of the calves provides self-sliding of the manure towards the alley. Next to the manure alley there is a feeding platform 130 cm wide, a manger 60 cm wide and a canopy above it and the feeding alley, 300 cm wide (Technological standards, 1982). The width of the feeding platform in the heifer sector is 140 cm, of the manger - 80 cm. On the border between the platform and the manger there is a tube neck restricting fixer, on the platform – water troughs for one or two groups of animals. It has been adopted all categories of cattle to have concrete flooring paddocks for exercise and heifers – an unpaved paddock to the north of the Butterfly landing.

In B variants all animals are reared in one building. Group cubicles are subdivided through a system of tube doors opened for cleaning only. In each cubicle zones are formed: for rest (on thick straw bedding), for movement (manure alley) and for feeding (manger alley under the eave of the building). Width of the manure alley (300 cm), width of the manger alley (350 cm) and width of the rest zone (325 cm) has been adopted (Graves et al., 2007). Between the manger alley and the manure alley 20 cm high wooden plank and a tube neck restricting fixer are installed. On the feeding alley immediately next to the plank there is a 90 cm wide terracotta tile strip. On the borders between the cubicles individual watering facilities are installed. For the various categories of cattle (except for the youngest calves – from 3 to 6 months) unpaved paddocks for exercise have been provided.

The straw bedding is appropriately cleaned 2 - 3 times a year, paddocks – once in 2 - 3 months and the manure alley – monthly. Before cleaning the alley animals are closed in the rest zone of the respective cubicle and after this is finished they are released. For all variants (A and B) loading the feed with mobile equipment (feed mixing trailer), addition of straw in the resting area by a machine for scattering of bedding and cleaning of manure alleys by a tractor with

a bulldozer bucket have been adapted.

Construction costs for the technological floor profiles of buildings and the paddocks adjacent to them have been studied, all construction costs for the load bearing and fencing structures of buildings and the total cost for the different variants. Costs for other buildings and facilities needed for the normal operation of farms (buildings for cows, technical and residential premises, buildings for the equipment, for storage of hay, straw, silage and concentrated fodder, etc.) are not the subject of this study.

In defining built-up areas buildings and paddocks have been arbitrarily divided into areas for rest (A), feed supply (B), exercise (C), structural elements (the structural element zone comprises the area occupied by walls and the load bearing columns of the planned buildings) (Figure 1 and 2). To construct the technological floor profiles in the zones concrete flooring has been adopted 10 cm thick, and in the zones for rest of heifers in variants A a soft clay floor is designed with a concrete strip of 80 cm under their knees when lying. The steel is subdivided into reinforcement (for reinforcing the flooring) and shaped (for intercubicle dividers, technological doorways, restricting fixers on the feeding alley, fences on the unpaved paddocks, etc.). Variants have been designed at regulated front for rated (dosed) nutrition for calves aged 3 to 6 months (40 cm), 6 to 12 months (45 cm), 12 to 18 months (50 cm), and for heifers (60 cm), respectively (Regulation No. 44/20, 2006; Technological standards, 1982).

The variants are compared and analyzed by the following parameters: relative built-up area, relative costs of basic construction materials (concrete, reinforcement and shaped steel) and relative cost of construction and erection works for building the technological floor profile, relative cost of construction and erection works for building the load bearing and fencing structures of buildings and relative total construction cost. The practically recommendable variants are determined with different farm capacity based on correlations in percentages (%) between the parameters for investment costs of each variant and the respective parameters of the most economical technical and technological solution.

As output data of the present study, results have been used about some of the technical and economic parameters for the variants obtained in a previous study by the authors (Dimova and Dinev, 2008). In determining the construction cost of the floor profile the cost of earth works (excavations, backfills, etc.) has also been included and all other construction and erection works completed (bedding rubble layer, formwork, water tight cement covering, transportation costs, etc.) in addition to the ones specified in the relative cost of materials. Construction cost has been calculated by prices (without VAT) of construction and erection works valid for May 2010.

The study makes use of the comparative analytical method. The relative values of the parameters have been determined per stock place (st.pl.) equivalent to one cattle place on the farm. The comparative analysis and evaluation of the results obtained are shown in tables, and the relative total construction value is also presented graphically.

Results and discussion

In Table 1 the technical and technological parameters of the studied variant solutions are shown. It is evident that their total values increase by increasing the farm capacity. By relative built-up

area and cost of concrete and reinforcement steel more economical are buildings with group cubicles on thick straw bedding (B variants) but they yield in relative cost of shaped steel to the buildings with group cubicles on a sloping floor for calves aged 3 - 18 months and Butterfly landing for heifers (A variants). Minimum relative built-up area (6,24 m²/st.pl.) has B1 variant on the farm for 40 cows - 2,4% less than the area of B3 (6,42 m²/st.pl.) with capacity 80 cows up to 46,3%, rather than A2 at 60 cows (9,17 m²/st.pl.), with marked maximum relative built-up area. The data in Table 1 show a similar relationship available between the built-up area and the concrete cost for the floor profile due to the method of its construction (flooring 10 cm thick). The capacity has almost no effect on the relative cost of concrete in variants B. Costs are identical (0,61 m³/st.pl.) for B1, B2 and B4, and their difference to B3 (0,62 m³/st.pl.) is just 1,6%. As for variants A, compared to the most economical variants the difference

in values varies from 42,6% for A4 (0,87 m³/st.pl.) to 52,5% for A2 (with the greatest relative concrete cost - 0,93 m³/st.pl.). By relative cost of reinforced steel variants B are considerably more economical than A variants. B4 is with minimum cost (2,97 kg/st.pl.) - 6,7% more economical than the next one B3 (3,17 kg/st.pl.) and from 2,1 to 2,8 times compared to A4 (6,32 kg/st.pl.) and the most metal consumable A1 (8,38 kg/st.pl.), respectively. The relative cost of shaped steel depends on the length of the building, as a major share in the total cost falls on the technological bafflers and doors in manure alley. Therefore, in buildings with less length higher values of this parameter are recorded. Considerably greater are costs to heifers in variants A, where except for intercubicle dividers a steel for fences of the yards is necessary. The least relative share of shaped steel has been noted for variant A4 (30,89 kg/st.pl.), followed by B4 (31,23 kg/st.pl.) with difference of 1,1%. Between A4 and B1, which

Table 1. Technical and technological parameters of the technological profile of the floor in buildings for free rearing of female calves and heifers *

Variant	Farm capacity, No. of cows	Total built-up area, m ²	Relative built-up area, m ² /stock place	Total concrete consumption, m ³	Relative concrete consumption, m ³ /stock place	Total consumption of reinforced steel, kg	Relative consumption of reinforced steel, kg/stock place	Total consumption of shaped steel, kg	Relative consumption of shaped steel, kg/stock place
A. Variants with group cubicles over sloping floor for calves and one-line covered landing type "Butterfly" for heifers									
A1	40	395.5	8.99	36.8	0.92	335.1	8.38	1688.0	42.20
A2	60	550.0	9.17	55.9	0.93	445.5	7.43	2143.6	35.72
A3	80	706.7	8.83	71.2	0.89	535.3	6.69	2567.4	32.09
A4	100	862.1	8.62	87.1	0.87	631.7	6.32	3089.6	30.89
B. Variants of buildings with group cubicles over bed of straw for calves and heifers									
B1	40	249.5	6.24	24.3	0.61	151.3	3.78	1884.5	47.11
B2	60	401.7	6.70	36.9	0.61	210.4	3.51	2372.6	39.54
B3	80	513.5	6.42	50.0	0.62	253.8	3.17	2675.5	33.44
B4	100	626.5	6.27	61.0	0.61	296.7	2.97	3122.8	31.23

* Data in the table are taken from a previous study of the authors (Dimova V and Dinev D, 2008. Interdependences between some of technological and technical and economic parameters in buildings for female breeding calves and heifers. International scientific conference "Bulgarian science and European research space", Stara Zagora, ISBN 978-954-93-2944-5, (5-6 June 2008), (Bg).

has the greatest cost (47,11 kg/st.pl.) of all studied variants, the difference grows to 52,5%. A3 has good parameters (32,09 kg/st.pl.), 3,9% greater cost than A4.

In Table 2 construction values (investments) for construction of the technological floor profile for the different variants are given. It is evident that the relative values of the different construction and erection works change similarly to the respective values of parameters for cost of materials. Concrete works, for example, cost the least in variant B1 (60 BGN/st.pl.), with minimum difference of 1,7% to B2 and B4 (61 BGN/st.pl.) and 3,3% - to B3 (62 BGN/st.pl.),

and the difference in values for variants A compared to B1 varies from 45,0% at A4 (87 BGN/st.pl.) to 52,5% at A2 (93 BGN/st.pl.). For reinforcing the technological profile of the floor in variants B around 4 BGN/st.pl. (for B3 and B4) to 5 BGN/st.pl. (for B1 and B2) are needed - with a difference of 25%, but for variants A values are 2 to 2,8 times greater with A4 (8 BGN/st.pl.) and A1 (11 BGN/st.pl.), respectively. Shaped steel requires minimum investments with variant A4 (112 BGN/st.pl.), which is 1,9% less than with B4 (114 BGN/st.pl.) and 4,5 to 53,6% less than the other variants (than A3 - 117 BGN/st.pl. and B1 - 172 BGN/st.pl., respectively). By relative value of excavation

and other works B variants are more economical than A variants, and B4 (24 BGN/st.pl.) is more economical than all other variants - 4,2 to 79,2% (than B1, B3 - by 25 BGN/st.pl. and A1, A2 - by 43 BGN/st.pl., respectively). The data in Table 2 show that of A variants the most economical by total relative value of the technological floor profile is A4 (248 BGN/st.pl.), by 20,6% more economical than A1 (299

BGN/st.pl.). Of B variants minimum investments are also with farm capacity of 100 cows – for B4 (203 BGN/st.pl.), 29,1% cheaper than B1 (262 BGN/st.pl.), and of the other variants 4,9 (than B3 - 213 BGN/st.pl.) to 47,3% (than A1). With the same farm capacity variants B are more economical than variants A from 14,1% - with capacity of 40 cows (262 BGN/st.pl. for A1 against 299 BGN/st.pl. for B1) to

Table 2. Construction value of the floor's technological profile in buildings for free rearing of female calves and heifers

Variant	Farm capacity, No. of cows	Value of construction and erection works for constructing the technological profile of the floor of the building									
		For concrete		For reinforcement		For shaped steel		For soil and other works		Total building cost*	
		Total for all building, BGN	Relative, BGN/stock place	Total for all building, BGN	Relative, BGN/stock place	Total for all building, BGN	Relative, BGN/stock place	Total for all building, BGN	Relative, BGN/stock place	Total for all building, BGN	Relative, BGN/stock place
A. Variants with group cubicles over sloping floor for calves and one-line covered landing type "Butterfly" for heifers											
A1	40	3662	91	439	11	6144	154	1711	43	11956	299
A2	60	5563	93	584	10	7804	130	2594	43	16545	276
A3	80	7086	88	702	9	9348	117	3374	42	20510	256
A4	100	8668	87	828	8	11248	112	4089	41	24833	248
B. Variants of buildings with group cubicles over bed of straw for calves and heifers											
B1	40	2418	60	199	5	6861	172	1000	25	10478	262
B2	60	3672	61	276	5	8638	144	1547	26	14133	236
B3	80	4976	62	333	4	9741	122	2004	25	17054	213
B4	100	6071	61	389	4	11368	114	2449	24	20277	203

*The value has been calculated by prices valid for May 2010 and the BNB exchange rate for May 12, 2010 → 1 BGN = 0,512 EUR

22,2% - with capacity of 100 cows (203BGN/st.pl. for A4 against 248 BGN/st.pl. for B4).

In Table 3 the total and relative values of the construction and erection works for the load bearing and fencing structures of buildings are shown (including working on paddocks for exercise and feeding of animals). The total relative construction value decreases with increase of the capacity from 40 to 100 cows both for A variants and for B variants. By that parameter more economical are the variants with group cubicles on a sloping floor for calves and Butterfly landings for heifers, since for the variants with group cubicles on straw bedding investments for fencing structures increase considerably – mainly for roofing of the building. In the farm for 100 cows, for example, B4 variant requires 398 BGN/st.pl. for roofing - 1,85 times more than A4 (215 BGN/st.pl.).

By increasing the farm capacity the relative values of load bearing structures in variants A drop to 14,8% - from 496 BGN/st.pl. (for A1) to 432 BGN/st.pl. (for A4). In B variants the minimum cost is for B3 (466 BGN/st.pl.), and its difference to the other options is from 1,9% (in B4 - 475 BGN/st.pl.) to 6,4% (in B1 - 496 BGN/st.pl.). A1 and B1 variants require the same investments for their load bearing structures, and A4 is more economical than all variants. The smallest differences (5,6 and 7,9%) are with A3 (456 BGN/st.pl.) and

B3, respectively. The relative value of wall fencing decreases with increasing capacity: up to 29,1% in A variants - from 239 BGN/st.pl. (A1) to 185 BGN/st.pl. (A4) and up to 59,3% - in B variants - from 481 BGN/st.pl. (B1) to 302 BGN/st.pl. (B4). By that parameter A variants have considerably less values than B variants – the difference between their respective most economical variants (A4 and B4) is 63,2%. Similar correlations between the variants are noticed in the relative values for roofing. A4 is cheaper than the other A variants by 2,8 - 6,0% (than A3 - 221 BGN/st.pl. and A2 - 228 BGN/st.pl., respectively), and B4 is cheaper than B variants by 1,5 - 5,3% (than B3 - 404 BGN/st.pl. and B2 - 419 BGN/st.pl., respectively).

The total relative construction value of the load bearing and fencing structures of the buildings for female calves and heifers decreases by increasing the farm capacity from 40 to 100 cows: up to 15,4% for A variants and up to 18,1% for B variants. The most economical is A4 (832 BGN/st.pl.), differing by 4,7% from the next one A3 (871 BGN/st.pl.), by 41,2% than the most economical in B variants - B4 (1175 BGN/st.pl.) and by 66,8% - than the most expensive variant B1 (1388 BGN/st.pl.). With the same farm capacity differences between variants A and variants B range from 38,1% - with capacity of 80 cows (871 BGN/st.pl. for A3 against 1203 BGN/st.pl. for B3) to 44,6 % - with capacity of 40 cows (960BGN/st.pl. for A1 against 1388 BGN/st.pl. for B1).

Table 3. Construction value of the floor's technological profile in buildings for free rearing of female calves and heifers

Variant	Farm capacity, No. of cows	Value of construction and erection works for constructing the supporting and surrounding constructions of the building*							
		For supporting constructions		For wall enclosure		For roof covering		Total building cost**	
		Total for all farm, BGN	Relative, BGN/stock place	Total for all farm, BGN	Relative, BGN/stock place	Total for all farm, BGN	Relative, BGN/stock place	Total for all farm, BGN	Relative, BGN/stock place
A. Variants with group cubicles over sloping floor for calves and one-line covered landing type "Butterfly" for heifers									
A1	40	19820	496	9575	239	9007	225	38402	960
A2	60	28828	481	12917	215	13705	228	55450	924
A3	80	36445	456	15560	194	17677	221	69682	871
A4	100	43213	432	18508	185	21461	215	83182	832
B. Variants of buildings with group cubicles over bed of straw for calves and heifers									
B1	40	19847	496	19252	481	16430	411	55529	1388
B2	60	29071	485	23357	389	25147	419	77575	1293
B3	80	37267	466	26680	333	32295	404	96242	1203
B4	100	47530	475	30195	302	39781	398	117506	1175

* The value includes the investments for the building and shaping of the yards for walking and feeding ; ** The value has been calculated by prices valid for May 2010 and the BNB exchange rate for May 12, 2010 → 1 BGN = 0,512 EUR

Table 4. Construction value of buildings for rearing of female calves and heifers

Variant	Farm capacity, No. of cows	Value of construction and erection works					
		For constructing the technological profile of the floor of the building		For constructing the supporting and surrounding constructions of the building*		Total building cost**	
		Total for all farm, BGN	Relative, BGN/stock place	Total for all farm, BGN	Relative, BGN/stock place	Total for all farm, BGN	Relative, BGN/stock place
A. Variants with group cubicles over sloping floor for calves and one-line covered landing type "Butterfly" for heifers							
A1	40	11956	299	38402	960	50358	1259
A2	60	16545	276	55450	924	71995	1200
A3	80	20510	256	69682	871	90192	1127
A4	100	24833	248	83182	832	108015	1080
B. Variants of buildings with group cubicles over bed of straw for calves and heifers							
B1	40	10478	262	55529	1388	66007	1650
B2	60	14133	236	77575	1293	91708	1529
B3	80	17054	213	96242	1203	113296	1416
B4	100	20277	203	117506	1175	137783	1378

* The value includes the investments for the building and shaping of the yards for walking and feeding ; ** The value has been calculated by prices valid for May 2010 and the BNB exchange rate for May 12, 2010 → 1 BGN = 0,512 EUR

The total and relative construction values for the variants, comprising all investment costs for construction and technological equipment of buildings (including yards for walk) are presented in Table 4 and Figure 3. From the data in the table it can be seen that despite lower investments for the floor profile in buildings with straw bedding (B variants), when all costs for their load bearing and fencing structures are included, more economical are the variants with sloping floor and Butterfly landings (A variants) - from 25,6% - with variants on a farm for 80 cows (1127 BGN/st.pl. for A3 against 1416 BGN/st.pl. for B3) to 31,1% - with the variants on a farm for 40 cows (1259 BGN/st.pl. for A1 against 1650 BGN/st.pl. for B1). The most economical is A4 (1080 BGN/st.pl.) and it has lower cost than the other A variants by 4,4 - 16,6% (than A3 and A1, respectively), and than B variants – by 27,6 - 31,1% (than B4 - 1378 BGN/st.pl. and B1, respectively). By increasing the farm capacity from 40 to 100 cows the total investments for rearing of female breeding calves decrease up to 52,8 % – from 1650 BGN/st.pl. (variant B1) to 1080 BGN/st.pl. (variant A4).

Conclusions

With the same farm capacity variants for buildings with group cubicles on a sloping floor for calves and with Butterfly landing for heifers are more economical than buildings with group cubicles on straw bedding by the studied parameters as follows: by relative construction cost of the load bearing and fencing structures - from 38,1 to 44,6 %, by the relative total construction value - from 25,6 to 31,1 %. With the same farm capacity buildings with group cubicles on straw bedding are more economical than the variants of buildings with group cubicles in sloping floor for calves and with Butterfly landing for heifers by relative construction cost of the floor profile - from 14,1 to 22,2%.

By increasing the farm capacity from 40 to 100 cows all studied parameters of the two types of technological variants (with group cubicles on a sloping floor for calves and with a Butterfly landing for heifers and group cubicles on straw bedding) decrease – the relative

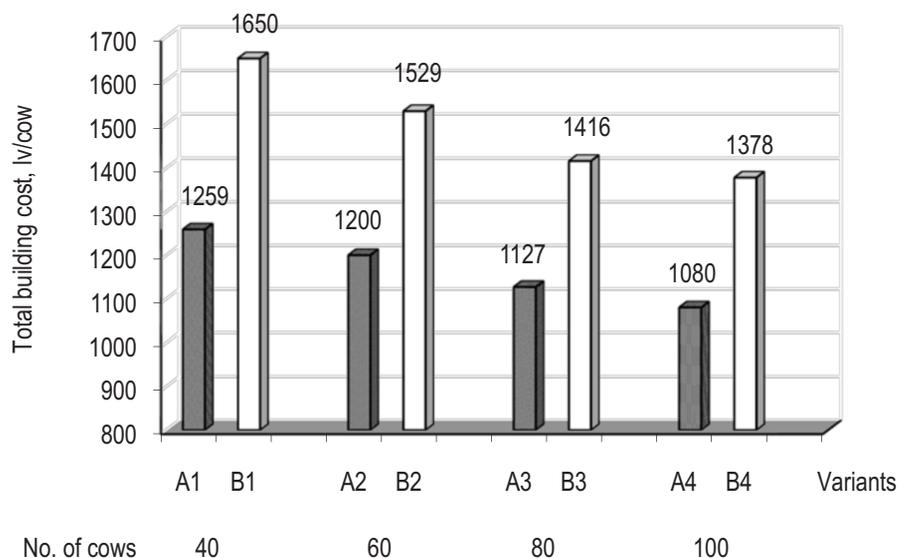


Figure 3. Building cost (investments) for constructing buildings for free rearing of female breeding calves: A - variants of buildings with group cubicles on a sloping floor – for calves from 3 to 18 months of age and Butterfly landings – for heifers; B - variants for buildings with group cubicles on a straw bedding for calves and heifers

construction cost of the technological floor profile decreases from 299 to 203 BGN/st.pl. (to 47,3 %), the relative construction value of the load bearing and fencing structures decreases from 1388 to 832 BGN/st.pl. (up to 66,8 %), and the relative total construction cost – from 1650 BGN/st.pl. to 1080 BGN/st.pl. (up to 52,8 %).

The variant with group cubicles on a sloping floor for calves and with Butterfly landing for heifers on a farm with capacity for 100 cows is the most economical. It requires less values of its parameters compared to the other variants, as follows: by relative construction cost of the load bearing and fencing structures of the buildings – up to 66,8%, by relative total construction cost – up to 52,8 %. The variant with group cubicles on straw bedding on a farm with capacity of 100 cows is more economical up to 47,3% from the other variants by relative construction cost of the floor profile. The most unfavourable solution is the variant with group cubicles on straw bedding on a farm with capacity for 40 cows.

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