THE REDUCTION OF THE THERMICAL ENERGY IN THE SWINES SHELTERS

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Abstract

In the designing, execution, endowment and exploitation of the farm for the swines growing and exploitation, it is taked into account first by the technological elements of the production process, wich impose the geometrical parameters of the structure in ensamble. The technical performance conditions: strength capacity, stability, ductility, durability, together with the factors wich interfere in the verification of the satisfaction of the quality requirements, satisfy also the requirements of hygiene, health, of the animals and of the peoples, and also the environment protection.The conception of the the swines shelters is made assuring the hygiene of: the air, the water, the hydrotermical hygiene of the interior environment, shining, ilumination, the accustic protection, the finishings quality, the proper manures evacuation, once with the exterior environment protection. In this paper we will analyse the way of assuring of the general and detailing conformation of the considered space in order to reduce the energetical consumption in the conditions of obtaining of an admisible minimal thermical confort in the sectors in winter conditions. We present the technical solutions of the conformations of this structures, to hold the temperature and humidity in the admited limits for each specie, this means to a level coresponding to the conditions in wich the health and the productions to not be affected, assuring an acceptable ambiance.

Key words: shelter, thermical confort, energy consumption

INTRODUCTION

The limitation, in the swines shelters, of the energetical consumption for the space heating can be realised using a general conception, designing an optimal volumetric configuration, refering surfaces and volumes needed on the animal head, at once time assuring the building thermical protection level, the heating and warm water preparing instalations efficiency, assuring thus the thermical and physiological confort conditions.

We design a shelter for swines growing and exploitation, with a starting effective of 450 sows of the Didactic and Experimental Station USAMV Cluj-Napoca, placed in the Cojocna locality, complying the actual rules at the designing project time.

The building is placed in the Cojocna village's exterior having the advantage of the link with the endowments from the existing superstructure and understructure.

THE MATERIAL AND THE METHOD

The geometrical parameters of the structure, in his ensemble, and that of the structural elements have been established taking into consideration the surfaces on the animal head, on the sectors, thus: waiting, reproduction -4 heads, gestation -24 heads, reproduction reiteration -9 heads, maternity - 8 heads.

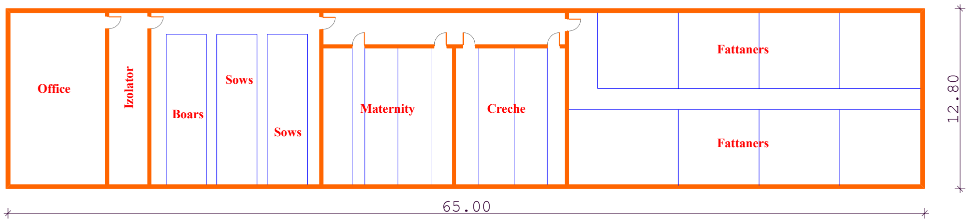
Besides this sectors, the building has also veterinary-sanitary spaces, a laboratory to prepar the seminal material, a pharmacy and a cloakroom.

The groundfloor building has the width 12.80m and the length 65.00m (13 bays of 5 meters), beeing divided as in the figure 1.

In the waiting, reproduction and gestation sectors, have been designed collective docks of 8m^2 each, and individual docks for the gestation control. Those two boars have each a dock of 10m^2.

In the maternity the sows are placed in 15 individual docks of 2.00x2.40m, in the nursery the piggys are placed in 6 collective docks and in the fattening sector the collective docks has 40 animals each.

Figure 1. The general view of the designed shelter



The foraging, the water alimentation and the ventilation are automatised, and the manure disposal is realised in the channels, with stoppers, provided with a waterproof insulation.

The docks coverings, completing the fenders, are made from concrete. The acces doors and the windows are made from wooden fir, and some of them will be thermoinsulated.

THE RESULTS AND THE DISCUSSIONS

In the preliminary design stage is checked the global thermical insulation coefficient „G".

a) We design the geometrical characteristics of the building:

- The area of the plate on ground and the ceiling:

$A_1 = A_2 = 12.50\text{m} \cdot 64.70\text{m} = 808.75\text{m}^2$

- The buiding perimeter:

$P = 2 \cdot (12.50\text{m} + 64.70\text{m}) = 154.40\text{m}$

- The free height:

$H = 2.60\text{m}$

- The area of the exterior elements:

windows: $13 \cdot 2 \cdot 4.70\text{m} \cdot 0.60\text{m} = 73.32\text{m}^2$
doors: $10 \cdot 1.00\text{m} \cdot 2.10\text{m} = 21.00\text{m}^2$
$A_3 = 73.32\text{m}^2 + 21.00\text{m}^2 = 94.32\text{m}^2$

- The exterior walls area:

$A_4 = P \cdot H - A_3$
$A_4 = 154.40\text{m} \cdot 2.60\text{m} - 94.32\text{m}^2 = 307.12\text{m}^2$

- The building outer cover:

$A = 2 \cdot 808.75\text{m}^2 + 94.32\text{m}^2 + 307.12\text{m}^2 = 2018.94\text{m}^2$

- The building volume:

$V = A_1 \cdot H = 808.75\text{m}^2 \cdot 2.60\text{m} = 2102.75\text{m}^2$

b) We calculate the coefficient „G" pursuant to table 1, on the base of the R'_{min} values for buildings designed after 1998:

Table 1.
The values of the resistance specific thermical resistances

no. crt.	the building element	A [m²]	R'm [m²·K/W]	γ	A·δ / R'min
1	The plate on ground	808.75	4.50	-	179.72
2	The ceiling	808.75	3.00	0.90	299.54
3	The exterior windows and doors	94.32	0.40	-	235.80
4	The exterior walls	307.12	1.40	-	219.37
	TOTAL	2018.94			934.43

It is considered: a building moderate protected; the high permeability class (without sealed elements).

Pursuant to annex 1 of the code C107-2005:

$n = 1,1 \cdot h^{-1}$

The global thermical insulation coefficient is:

$$G = \frac{\sum L_j \cdot \gamma_j}{V} + 0.34 \cdot n \quad \Rightarrow \quad G = 0.819\ \text{W/m}^3\cdot\text{K}$$

It is calculated the ratio between the area and the volume of the building:

$$\frac{A}{V} = \frac{2018.90}{2101.75} = 0.96\ \text{m}^{-1}$$

We check the thermical insulation level (pursuant to annex 2 of the code C107-2005):
GN = 0.89 W/m^3·K =>
GN > G (0.89 > 0.819)

Thereby, the posibility to realise in this conditions is analysed in the preliminary stage of the design, when we can interfere in the plane and vertical configuration of the building because the ratio: perimeter/area in plane and the glassed degree are geometrical parameters that affect the global thermical insulation coefficient.

The global thermical insulation level is appropiate if we use the corrected specific thermical resistances „R'$_{mi}$" used in the civil buildings design.

The resistance structure of the hall is realised from reinforced concrete columns and beams.

As closing vertical elements of the structure can be used masonries coresponding to european norms, assimilated in Romania (S.R.E.N.).

We study three constructive variants of exterior walls and the results are presented in the tables 2 and 3.

Table 2.
The values of the unidirectional thermical resistance

variant	wall's structure	The unidirectional thermical rezistance [m^2·K/W]			
		not insulated	insulated [cm]		
			5	10	12
1	-interior plaster -vertical hollows bricks -exterior plaster	0.571	1.707	2.840	3.290
2	-interior plaster -BCA -exterior plaster	0.889	2.025	3.159	3.609
3	-interior plaster -Porotherm ceramics blocks -exterior plaster	1.129	2.265	3.399	3.849

Table 3.
The values of the corrected specific thermical resistance

variant	Corection coef.	The corrected specific thermical resistance [m^2·K/W]			
		not insulated	insulated [cm]		
			5	10	12
1	0.650	0.371	1.109	1.846	2.138
2	0.650	0.578	1.316	2.053	2.345
3	0.650	0.734	1.472	2.200	2.500

The corrected specific thermical resistances of the BCA and Porotherm ceramics blocks structures, isolated with plystyrene of 5cm width are closer to the minimal resistance value recommended by the norms [1,2,3]: R_{min} = 1.40 m^2·K/W, for civil buildings. We choose this value because the interior thermical parameters in the reproduction-gestation-maternity sectors are closer, as value, to that from the civil buildings.

CONCLUSIONS

The improvement of the thermical protection of the exterior structural and nonstructural walls can be realised by a suplimentary thermoinsulating layer on the structure, for all constructive solutions of them.

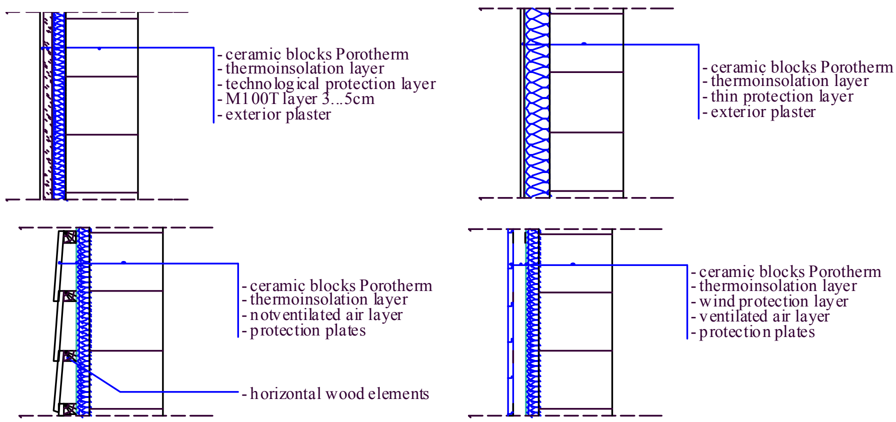
The place of this layer is usualy on the exterior side of the existing walls.

The exterior thermical insulation has the following advantages:
- realise, in optimal conditions, the correction of the thermal bridges,

- lead to a favourable structure regarding the vapour diffusion and thermical stability,
- protect the building structural elements, as the structure himself by the effects of the temperature variation.

In the figure 2 we present constructive variants for walls, used in practice. [1,2]

Figure 2. The walls constructive variants.



The proposed solution for the structural exterior walls to the swines shelter is that with ceramic blocks (Porotherm 25) with a 5 cm extra polystyren insulation, on the exterior side of the structure, protected by a thin plaster (5…10mm), reinforced with a tisue of fiber-glass. The thermoinsulation layer, from polystyren with dimensions of 1.20m x 0.60m, is fixed on the masonry by cleaving with a adhesive paste. The cleaving is realised locally in bands or in points. The joints will be small, postponed on adjanted rows. The adhesive must not to reach over the joints, because can lead subsequently to cracks in the finishing layer.

The finishing and protection layer is realised in successive layers. The finishing is realised with paint in water dispersion. The dilation joints will be placed in field of maximum 14.00m^2.

Knowing that the solution present small mechanical strength, especially to dinamic loads, it must be taked measures to consolidate the exposed zones, using plasters resistant to blows, or using tisues resistant to stretch.

To reduce the negative effect of the thermical bridges it must be assured the continuity of the thermoinsulation layer at windows level, doors level and elevation [5].

It is not recommanded the solution with BCA walls to the animals shelters because the interior humidity with values over 80%, lead to the succesive accumulation of the vapour mass in the structure.

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