MODEL CALCULATIONS FOR THE IMPROVEMENT OF THE MICROCLIMATE OF A RABBIT HOUSE

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***ABSTRACT**: The aim of this project was to plan the modernization of a farm building for rabbits. The model calculations were focus on the welfare viewpoint of the rabbit breeding, first of all ventilation, cooling and heating of the stable in order to approach the optimal microclimate for meat rabbits. Besides the planning of the thermal insulation and mechanical components also the possible financial resources were investigated for a future implementation. In order to meet the requirements of the application tenders of the National Land Fund and the Rural Development Programme the tenders for young farmers seem to be suitable for the realization of an investment like this.*

***Key words**: rabbit house, animal welfare, building engineering, microclimate, subsidy*

INTRODUCTION

The farmers are obliged to keep the animals in accordance with the scientific knowledge and experience in the rabbits, the genotype, age, level of development, adaptive capacity, physiological status and behavioural needs attention: sufficient places for the animals provide; adequate housing system to meet the environmental requirements of the animals; provide sufficient feed and water; care them according to welfare requirement; with attention to the behavioural and social needs of the animals [6].

The thermoneutral zone for rabbits is between 15-25°C [3]. Rabbits are much more tolerant to low temperatures than high temperatures and above 35°C they can no longer regulate their body temperature, so heat prostration sets in. The relative humidity (RH) should not be higher than that of the outside air by more than about 5% [7]. There is a significant vapour emission of the animals (Table 1) at 20°C [5].

Ventilation of the building is important to let in external fresh air to the building, but also its removes the gases from the rabbit house [4], which was produced by the rabbits (Table 2). Both of this gases have a negative effect on the production of the rabbits.

Table 1

Vapour emissions from rabbits [5]

	Fattening rabbits (g/h and kg)	Rabbit does (g/h and kg)
Respiration	1.92	1.82
Urine and droppings	1.80	3.00

Table 2

Carbon dioxide and ammonia emissions from rabbits [4]

Animal category	CO_2 emission g/h and animal	NH_3 emission mg/h and animal
Fattening rabbits	4.2	10.1
Rabbit does	11.0	55.9

The aim of our project was the modernization of a rabbit stable from animal welfare viewpoint. During the calculations and planning we focused on the thermal insulation of the building, the optimal temperature with RH for production and a better ventilation to ensure the removal of the harmful gases. The main objective is the rA possible financial resource was also looked for the investment.

MATERIALS AND METHODS

Rabbits have to be housed exclusively indoors. The air temperature should be between 10 °C and 28 °C. The minimum temperature for does at time of kindling and lactation and for growing rabbits is 15°C. The air flow rate, dust level, relative humidity, the concentration of carbon dioxide, ammonia and other gases in the rabbit house may be at a level which is not harmful for rabbits [6].

The original building (a building for storage, dimensions 33*28m) was built from sandwich panels on a concrete substructure and floor. The roof was made of profiled steel sheets without ceiling.

We plan to transform it to rabbit stable. In our plan we:

- build partition walls from sandwich panels,
- construct ceiling with 5cm thick of thermal insulation (polystyrene),
- construct an air handling system (ventilation + heating + cooling + RH regulation),
- the dimensions of the rooms are fitted to the installation of a commercially available cage type, which follow the WRSA guidelines regarding animal welfare [9].

Basic data for the calculations were the following:

- climate data of South-East Hungary,
- air velocity maximum 0.3 m/s,
- ventilation minimum 3 m^3/h and kg bodyweight,
- relative humidity between 50-70%,
- the animal stock is 800 breeding animals (does and bucks) and their progeny.

The climate of the region

The average monthly mean temperature at Szeged: the coldest month is January, and the warmest is July. The mean annual range of temperature of 21.6°C. The amount of average annual precipitation is 489 mm, the summer semester is wetter, and drier in the winter semester. The least precipitation falls from January to March period, while the wettest month is June. Szeged annual amount of sunshine shows great variability, in average it is 1980 hours. The sunshine duration in the summer months are the peak (250-280 hours per month), while in the November-January period is the minimum (monthly 50-80 hours). The continental climate is prevailing in Hungary, Szeged area was still dominated, but this region is characterized by bigger weather extremes. The average annual temperature is 11.2°C, precipitation is 520 mm based on the average of the past hundred years. Data were obtained from the Hungarian Meteorological Service.

The planning and the calculations were made by the BAUSOFT DANWATT software package.

RESEARCH RESULTS

In our case, a building consisting of lightweight composite panel was created. The climate and the requirement of the animals were taken into consideration within the expected maximum and minimum temperatures. The building was examined for energy saving. A ceiling was built and 5cm thermal insulation was applied, which was dramatically reduced the building's heat loss.

The heat transmission coefficient of the profiled steel roof was U=K=5.42 W/m^{2}K, at the same time the isolated structure was U=K=0.698 W/m^{2}K, which meant that the heat demand of a breeding animal room was reduced from 4313 W to 1176 W. The following formula was used:

$$Q = U\ (= K)\ x\ A\ x\ \Delta T$$ where

Q is the heat quantity,
U (formerly K) is the heat transmission coefficient,
A is the surface of the wall,
ΔT is the temperature difference between the two sides of the wall.

The dimensions of the outside temperature extremities were between -20°C in winter and 40°C in summer, while the inner temperature was 15°C in winter and 25°C in summer.

The building has 18 rooms for animals (Figure 1). In these areas an air-handling unit ensures the fresh air and heating in winter, cooling in the summer.

The building also contains two store rooms for feedstock and others. These rooms are heated with radiators. There is one locker room with shower room where fan-coil units will provide the room temperature. The building contains the engine room, which includes the air-handling unit, a boiler, a cooler and a hot water tank.

The air is drive from the air-handling unit to the rooms of animal via air ducts (600mm x 600mm) (Figure 1-2). The air intake takes place outside and the air inlets to the rooms are above the room entrance. There is a slight overpressure in the rooms. The air handling unit is a 125R Airvent type device (Figure 3) that allows 10,000 m^3/h of air input with cooling, heating, heat exchanging, RH regulation and air filtration facilities.

A Sanuer Duval condensing gas boiler (45kW) provides the heat to the calorifier of the air-handling unit, the radiators, the fan-coils of the locker room and the hot water tank (300 l). The heat demand is 30.4kW. The cooler temperature in summer is provided by a Galletti Estro MPE-027 H-type cooler (26kW) which is able to supply the 22kW cooling demand of the building.

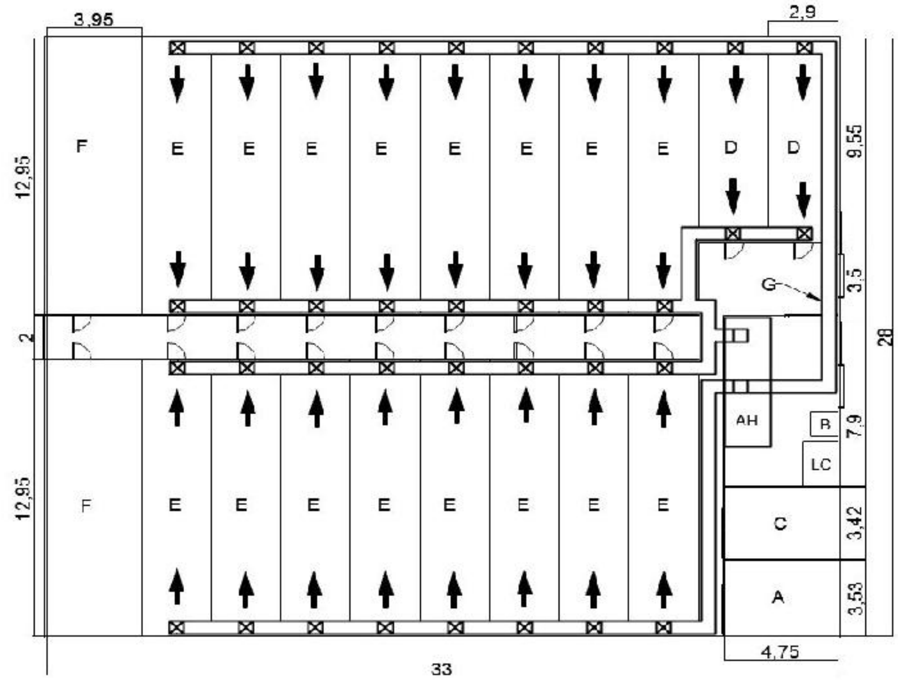

Figure 1. A top view of the building.

where

A - shower
B – boiler
C – locker room
D – room for bucks
E – rooms for does + progeny
F – store rooms
G – air duct
AH – air-handling unit
LC – liquid cooler
Arrows – air direction

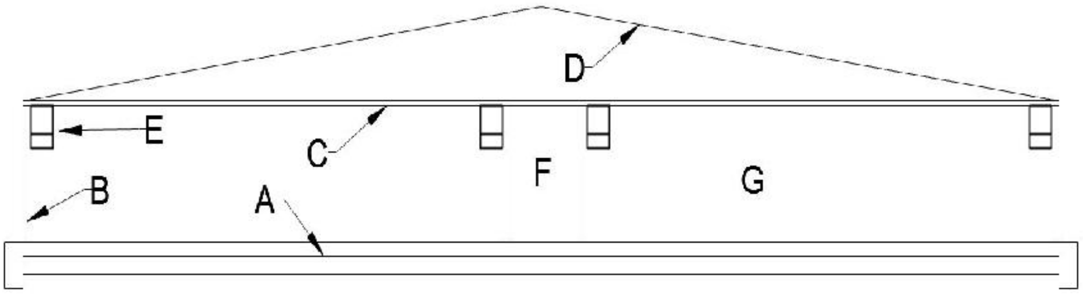

Figure 2. Cross section of the building

where

A - floor
B - wall
C - ceiling
D - roof
E – air duct
F - corridor
G – room for animals

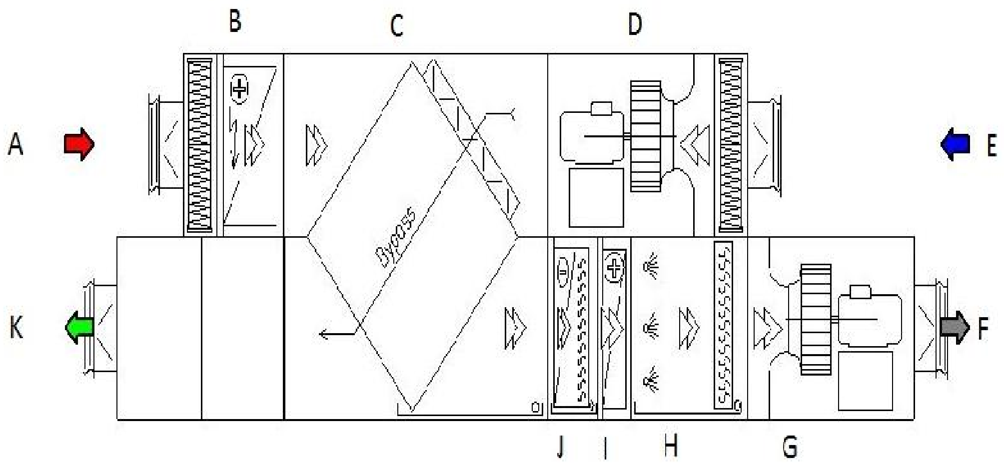

Figure 3. Air handling unit

where

A – fresh air
B – electric heating unit
C – heat exchanger
D – exhaust fan
E – air outlet
F – treated fresh air
G – inlet air fan
H – dehumidifier
I – heater calorifier
J – cooler calorifier
K – air outlet
Arrows – air direction

Financial background

The regulation was created in the sector also stepped up to the rabbit industry present before the possibility of tendering Rural Development Programme received targeted support for the agricultural year 2015 to 24/2014. (IX.6.) FM [1] and Regulation 54/2014. (IV.29.) [2]. These regulations are also "only" for animal disease prevention and overcoming of breeding rabbits for breeding and encouraged contention (de minimis subsidy level), but keeping, feeding and assets related to the rabbit production are not care. Rural Development Programme for the year 2016 appears breakthrough in the rabbit breeding industry at VP2-4.1.1.1-16 code, modernization of livestock farms with the title “Applications rabbit breeding sector” gave hope of large and small-scale and backyard farms’ actors alike. Although the call for applications not only support the rabbit producers, but other small branches as well. The level of operating exclusively in rabbit farms the application possibilities of load are minimum 48 pieces of female breeding rabbits to minimize the existence of the program. (48 pcs breeding does = 6004 SGM (Standard Gross Margin) values). In order to improve the competitiveness of the rabbit farms highly subsidized investments are needed with the construction, so the rabbit farms, and their buildings, facilities, expansion, renovation, modernization. As regards investment in the ventilation of the rabbit houses, heating and cooling technology are also supported. When improving the rabbit houses the modernization is the goal, where the buildings/structures’ thermal endowments, reduction of heat losses, the technological equipment of built-in lighting modernization, the energy-saving technologies and sourcing are financed.

However, the earlier rabbit breeding industry has undesirably low level of agricultural subsidies or support for individuals justly compensated, (published by the Rural Development Programme for the year 2016 "Modernisation of livestock farms" of title VP2-4.1.1.1-16 code for proposals [8],) during which the 50% beyond basic support for young agricultural enterprises + 10% extra funding could benefit. In the application system there is a start promotion for strengthening of family farming, job opportunities and thereby increasing rural employment.

CONCLUSIONS

If there is a tender for subsidy on reconstruction or on energy saving investments, the rabbit producers could find the ways of technological improvements. In our example the energy demand of the building was reduced for about one-fifth of the previous level with the possibilities of the implementation of animal welfare actions. The savings due to the renewal of the energetic system of the farm could relatively quickly return the cost of the renovation especially if the farmers apply for subsidy.

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