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CAD DESIGN OF THE ROOF FOR A NEW FARM STRUCTURE WITH DOUBLE FUNCTIONS

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Abstract: *In this paper are presented the CAD design modalities for construction of a dual function of a agrozootehnical building structure, the study focusing on designing and modeling the roof shape. In the first part of the paper are presented the current state of art regarding on existing livestock buildings. The second part of the study shows the conditions and parameters required for design and construction of livestock. The third part shows the CAD design and modeling of the agrozootehnical structure with dual function, in relations with the technical conditions. The end of this work shows the advantages of this type of agrozootehnical constructions and the conclusion of this work.* ***Key words:*** *roof design, roof-space, weldments profile, livestock farm.*

1. INTRODUCTION

Nowadays the optimal use of space and energy is an important research area. In this paper is presented the design and modeling of a new livestock farm with a dual function. Geometrical structure designed in the current study is based on a proposal for invention no. A / 00208, 09.03.2009 [5].

The main features of the zootechnical and agricultural building roof consist to provide a necessary climatic and protection environment of the inside animals or plants. The strong points of a structural building are given by the low weight and strong to the wind load.

The geometrical shapes of the roof are represented in many studies. The presented types of roofs are wood build up [1]. Among of the most used types of the roofs designed for zootechnical builds are presented as follow:

- Gable – is positioned at the center of the construction. The roof has a ridge in two directions.
- Hip – has four sloping sides. The angle of the hip rafters run at an angle of 45 degrees.
- Intersecting – designed by two different sections of the roof disposed at an angle of 90 degrees.
- Shed- have only one slope.

Wood frame structure is the most used method of zootechnical building [2]. These constructions are economical to build and provide a better comfort of the animals. The main constructions stage of the zootechnical wood builds are presented below:

- Platform frame
- Balloon frame
- Fastenings
- Plank and beam construction
- Truss-framed construction
- Foundations

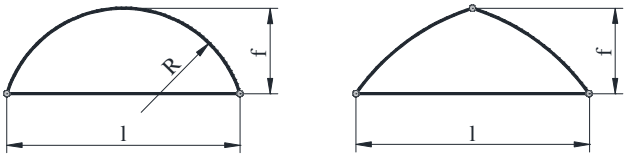
One of the main advantages of using wood in zootechnical constructions are given by the fast assembly of the structural elements.

Due to the advances of constructions technologies it tends to use the structural profile. This profiles allow easy modeling for different roof shapes beside ones of wood build.

Packer et all have studied design of the main geometrical shape of the roofs made by the metallic profile, also in this paper are shows the modalities and calculus of the elements connections assembly [3].

2. DESIGN CONSIDERATIONS

The proposed shape of the roof has a spatial structure, which is designed by the structural elements to get as more usable space.



a) b)

Fig. 1 Parameters of a lamellar roof
a) Two articulations, b) Three articulations

In figure 1 are presented two roof shapes defined by the width parameters length (*l*), radius of the arc (*R*) and the height of the roof (*f*). In this case is recommended a relationship between the height of the roof, must be greater than 1/7 (f≥1/7).

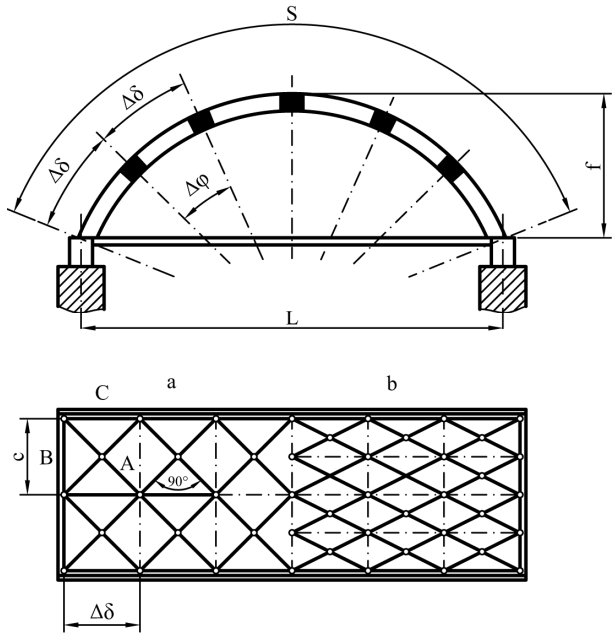


Fig. 2 Rectangular lamellar roof
A-lamellar nodes, B- support nodes, C- frontal nodes

In figure 2 is presented the rectangular lamellar roof where the dimensions of the spatial mesh result by dividing in equal parts the arc length *S* and of a roof length *L*. The radius of the exterior surface is chosen by the length and the height of the roof.

The geometrical parameters of the roof are presented by the following relations.
The half angle of the roof is given in next relations:

$$\sin\frac{\varphi}{2} = \frac{1}{2}\cdot \mathrm{R} \qquad (1)$$

Dimension of the roof radius is presented in relation:

$$\mathrm{R} = \frac{l^2}{8}\cdot f\cdot\frac{\mathrm{f}}{2} \qquad (2)$$

Distance between the center and the nodes is establishing as it follows:

$$\Delta\mathrm{S} = 2\cdot\frac{\Delta\varphi}{2} \qquad (3)$$

where,

$\Delta\varphi$ - angle of the lamellar roof
S - length of the roof arc

The φ angle is recommended to choose 45°. Due to the economic reason it is recommended that the distance between de nodes centers to be chosen in the range 0.7-1.5 m.

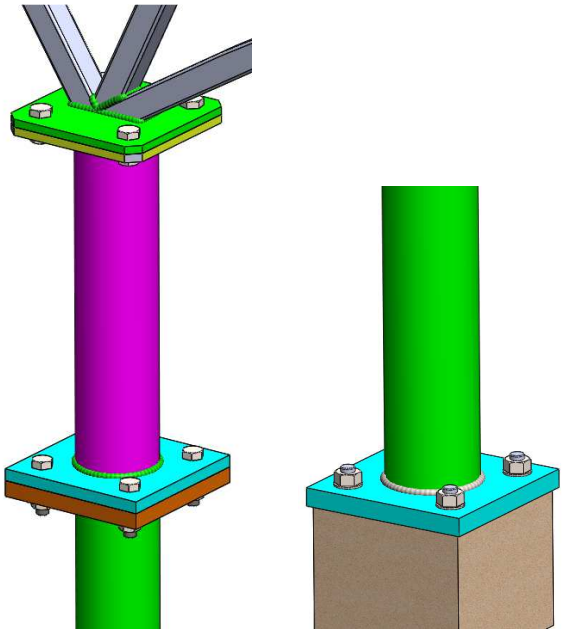
3. CAD ROOF DESIGN

Due to the actual easy building modalities with the structural elements it tends towards the construction of the agrozootehnical building from the structural profiles. The CAD design structure of this building and technical assembly modalities is done by the SolidWorks software.

This structure has a double functions, divided in two levels. The ground floor is designed for animals breeding and first floor is a greenhouse. The building walls of the ground floor are designed so can be easy moved outside from the farm.

Another important component of the farm structure are the supporting walls and longitudinal beam support of the second floor. Assembly connection of the metallic profile are given by the threads assembly and the welded profile, presented in figure 3.

In figure 3a are presented the connection modalities of the vertical column, bolted connection of the columns and the welded connections between the column and arched trusses profile. Bolted assembly between the vertical columns and the groundwork are represented in figure 3b. The square plates are welded from the ends of the vertical columns.



a) Column assembly b) Groundwork connection

Fig. 3 Connections of the structure elements

Design of the arched trusses are realized from the squared structural elements. The size of the chosen profile is 70x70x3.2 according with ISO standard.

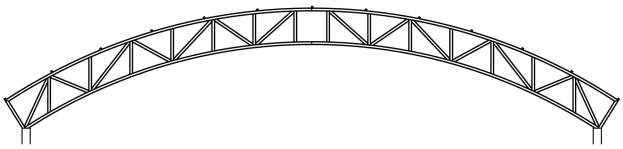


Fig. 4 Arched trusses design

The shape of the roof structure shown in figure 4 is chosen to give a better distributions of the masses in the support points of the structure.

Elements of the structure are made by bending the only of the location profile. The bending radius remains among limits to avoid deformation of the transversal section.

The overall dimensions of the build are presented in figure 5. For reinforcement of the greenhouse floor, in the middle of the animals' constructions are placed vertical columns as of the outside.

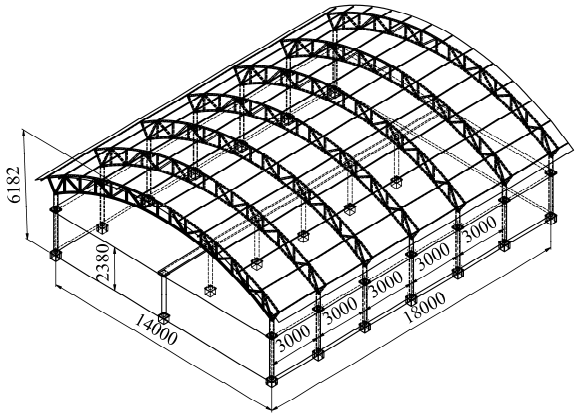


Fig. 5 Overall dimensions of the assembled structure

Following figure 6, shows the shaded isometric view of the proposed model. Access in the greenhouse can be done by the lateral side of the constructions.

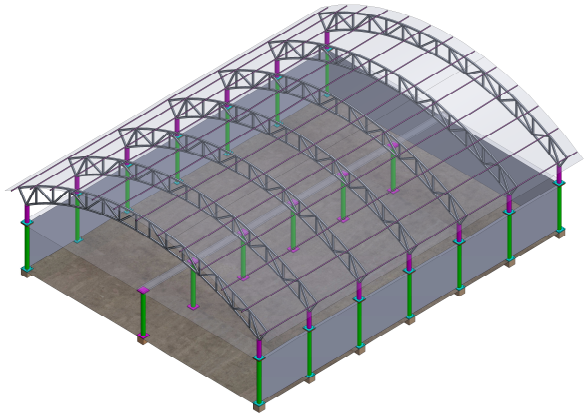


Fig. 6 Shaded model of the structure

Arch-frame buildings are covered with clear plastic. This plastic should be high quality with ultra violet stabilizers [6].

4. CONCLUSION

In this paper are presented the graphic design of a agrozootehnical farm with dual function. Using dedicated CAD software for

design of the structural construction the working design time is reduced and shape of the building can be improved from the planning stage, without the use of the materials and resource.

The presented model shows many advantages:

- Short assembly time;
- Better use of the construction space, due to the vertical merging of the functions;
- Creating favorable microclimate conditions inside because the building has two functions. The heat air resulted from the animals is distributed to greenhouse,
- Using metallic elements is reduced the fire risk.

5. REFERENCES

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PROIECTAREA CAD A UNUI ACOPERIS PENTRU O NOUĂ STRUCTURĂ DE FERMĂ CU DUBLĂ FUNCȚIUNE

În această lucrare sunt prezentate modalități de proiectare CAD in vederea construirii unei ferme agrozootehnice cu dubla functiune, studiul concentrandu-se pe proiectarea și modelarea formei acoperișului. În prima parte a lucrării se prezinta stadiul actual al formelor de acoperișuri în ceea ce privește asupra clădirilor destinate creșterii animalelor existente. Cea de a doua parte a studiului arată condițiile și parametrii necesari pentru proiectarea și construcția de animale. Cea de a treia parte prezinta proiectarea CAD si modelarea structurii fermei zootehnice cu funcție dublă, în relație cu condițiile tehnice impuse. Finalul acestei lucrări prezintă concluziile și avantajele acestui tip de construcție cu dubla funcțiune.

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