STRUCTURAL MODELING AND OPTIMIZATION OF AGROZOOTECHNICAL BUILDING

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Abstract

Within this analysis the structural and behavioral differences will be highlighted for external actions in this paper, but also the adaptation of the structure to the technological conditions imposed by the architectural and functional design of the agrozootechnical building structure. The construction will be considered for Iasy County. Thus, the prefabricated reinforced concrete frame structure with the corresponding roof panels from hot rolled profiles type IPE, will have the spatial cooperation between frames ensured by the stiffening beams that join the pillars in the longitudinal profile of the building. The pillar joints will be considered as articulated. The steel structure will have rigid-pole-beam joints, and the spatial co-operation will be ensured by the vertical contraventions present at the level of the pediments between the pillars, but also at the level of the marginal beams only between the marginal pillars. They will also be willing roof plane countervailing for increased rigidity of the wind and Earthquake. The wooden structure will have ensured the spatial cooperation between the frames only through the panels roof, not including other elements of braking and stiffening. The joints will be rigid between the pillar and the beam, and the continuity of the roof panels will be ensured by mounting the multinail plates at their joints. The structural optimization will be done through a comparative study of the three structural variants and the proposal of the one that meets all the beneficiary requirements.

Key words: Structural optimization, agrozootechnical farm, steel structure, wood structure and prefabricated reinforced concrete

Agrozootechnical farms in rural development policy have required continuous modernization and constant adaptation to the needs of the society by correctly dimensioning of their structure as well as increasingly flexible structures capable of covering as large as well as economic openings in order to be implemented by farmers. Structural modeling (Gavriloaia *et al*, 2009; Lungu I *et al*, 2010; Hohan R *et al*, 2012; Mihai P., 2010; Mihai P *et al*, 2007) and the optimization (Barbuta *et al*, 2014; Judele L *et al*, 2015; Judele L *et al*, 2018; Lepadatu *et al*, 2018; Lepadatu *et al*, 2005; Lepadatu *et al*, 2009) of their shapes and dimensions require advanced knowledge of structural calculation since the behavior of different materials in dynamic actions (Corobceanu *et al*, 2010a; Corobceanu *et al*, 2010b; Gavriloaia *et al*, 2016) is different. Thus, in this paper we approach a current theme (Alecu *et al*, 2018; Amarandei C. *et al*, 2011) which through the proposals made with structures of the agrozootechnical farm in three constructive variants (concrete, steel and wood) and comparative studies offer a wide range of choice and a customized optimization.

MATERIAL AND METHOD

The present work is about a construction with agrozootechnical destination, having the height regime "P". The building has a regular shape in the plan, being inscribed in a rectangle with dimensions 35x242 m, located in Iasi County. The projected building will have the strength structure of prefabricated reinforced concrete frames class C25 / 30 for both main beams, stiffening beams and columns. The columns will have a square section with a side of 30 cm, the main beams will have the dimensions 20x60 cm, and the stiffening beams will have the size of 20x50 cm. The main beams will have an angle to the horizontal plane of 15 ° and will support the roof purlins made of metal profiles IPE 270, class S235.

The infrastructure of the building will be made from insulated foundations of prefabricated reinforced concrete type C25 / 30, under columns The perimeter closure elements that will keep the biological inventory for the scope for which it was proposed for design and implementation will be made of high density polyethylene covers automatically activated according to the wind

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speed, humidity and temperature of the external atmospheric environment.

RESULTS AND DISCUSSIONS

Case A. Concrete frame structure
Prestressed concrete frame structure with steel purlins roof

The frame type structure of prefabricated reinforced concrete with the roof purlins related to hot rolled profiles type IPE, will have ensured the spatial cooperation between the frames provided by the stiffening beams that join the columns in the longitudinal profile of the building. The pole-beam joints will be considered as articulated.

At the level of the roof, profiles will be arranged as closure elements of cut sheet of type TR 106 R. Also on the south side of the frame over the sheet elements will be placed photovoltaic panels with dimension 196x98.5 cm In both sides of the frame, over the roof, respectively photovoltaic panels, a cable system will be applied to defrost the snow and ice in winter. There will be made partition elements of reinforced masonry with a thickness of 25 cm.

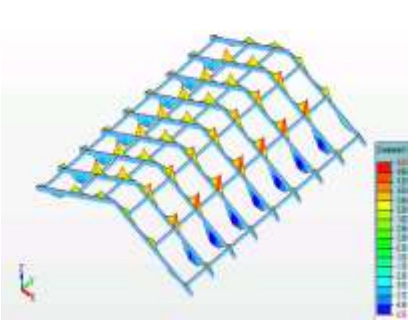


Figura 1 **Longitudinal reinforcement percentage required Az main and stiffening beams**

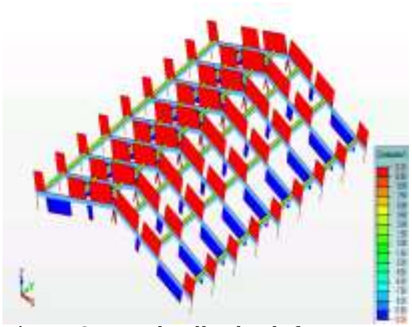


Figura 2 **Longitudinal reinforcement minimum percentage**

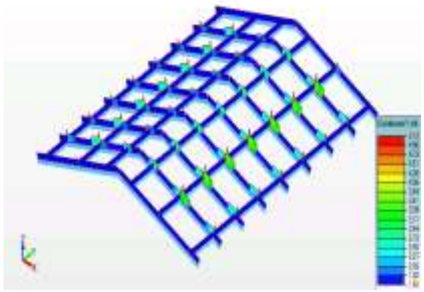


Figura 3 **Transversal reinforcement percentage required Atz for main and stiffening beams**

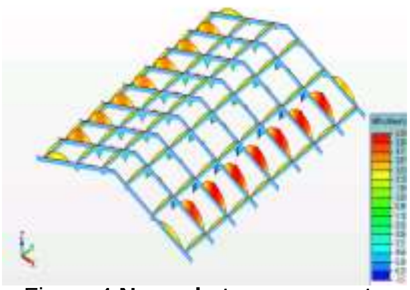


Figura 4 **Normal stress concrete value on z direction**

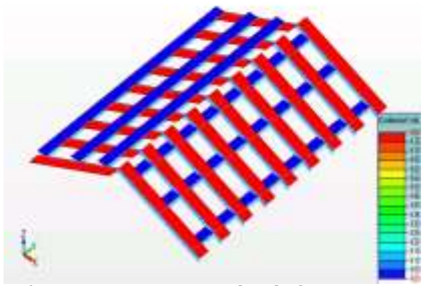


Figura 5 **Transversal reinforcement percentage required Aty for main and stiffening beams**

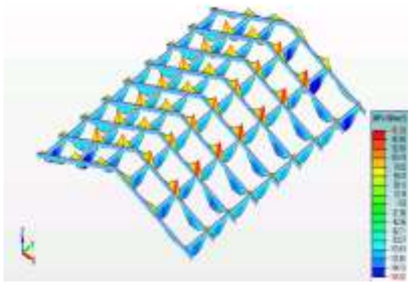


Figura 6 **Normal stresses on the reinforcement steel bars on z direction for main and stiffening beams**

Case B. Steel frame structure.
Frame structure with **steel profile**

The metallic structure will have rigid column-beam joints, and the spatial co-operation will be ensured by the vertical breaches present at the level of the pediments between the columns, but also at the level of the marginal beams only between the marginal beams. Also, there will be placed breaches on the roof plane to increase the rigidity of the wind and earthquake.

This structure will be composed of columns made of HEA 300 profiles, main beams of thick sheets welded with the shape of profile I with the web dimensions 650 * 2.5 and two flanges 300 * 2.5. Roof panels will be made of IPE 270 profiles. Vertical breaches will be present at the level of the pediment walls and breaches in the roof plane in the first beam, respectively the two central beams of the construction. These breaches will consist of profiles CHS 101.4C and CHS101.2C respective.

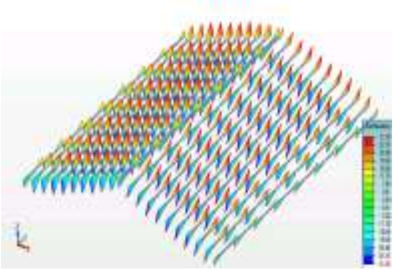


Figura 7 **Representation of the Fz efforts at the level of the roof panels on the maximum winding**

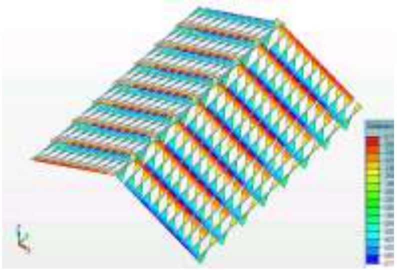


Figura 8 **Representation of the Fy efforts at the level of the roof panels on the maximum winding**

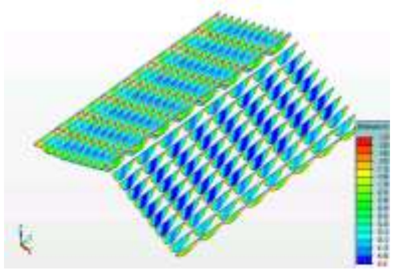
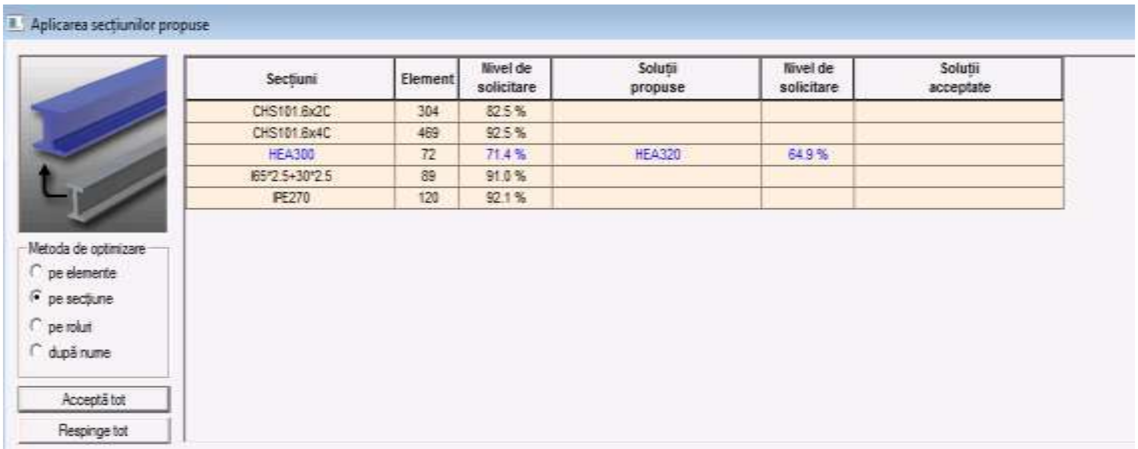


Figura 9 **Representation of the My efforts at the level of the roof panels on the maximum winding**



Secțiuni	Element	Nivel de solicitare	Soluții propuse	Nivel de solicitare	Soluții acceptate
CHS101.6x2C	304	82.5 %			
CHS101.6x4C	469	92.5 %			
HEA300	72	71.4 %	HEA320	64.9 %	
I65*2.5+30*2.5	89	91.0 %			
IPE270	120	92.1 %			

Figura 10 **Buildings sections optimization under resistance and stability conditions expressed as a percentage**

Case C. Wood frame structure

Wood frame structure with rectangle wood purlins roof

The wooden structure will have ensured the spatial cooperation between the frames only through the roof purlins, not including other elements of breaches and stiffening. The joints will be rigid between the pole and the beam, and the continuity of the roof purlins will be ensured by the mounting of multinail plates to their joints.

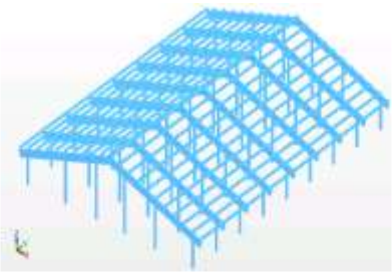


Figura 11 **Wood Structural Model**

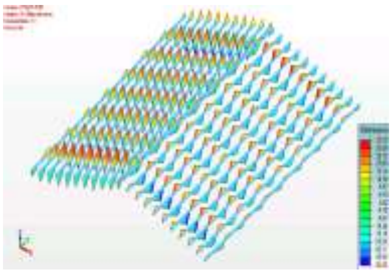


Figura 12 **Wood Structural Model**

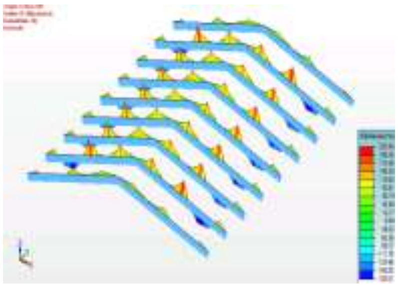


Figura 13 **Representation of the My efforts at the level of the roof panels on the maximum winding**

CONCLUSIONS

In this paper we highlighted the structural and behavioral differences in the external actions, but also the adaptation of the structure to the technological conditions imposed in the architectural and functional memory of the building. Following this study the following aspects were highlighted:

The frame-type structure of reinforced concrete shows an over-dimensioning from the initial pre-dimensioning conditions for the values of the loads of its own weight, the useful loads, the loads from the snow and the wind, but it presents a too flexible behavior, respectively with relatively large displacements following the seismic action for the given site.

In this context I consider partially impossible to achieve the structure on the proposed functional plan. In order to improve the behavior of the seismic actions, respectively for limiting the displacements, I recommend the adoption of specific measures through the arrangement of additional reinforcements at the level of the main beams and the poles, but under an efficient evaluation of the costs of realization.

The metallic structure shows a favorable behavior towards the actions to which it was subjected after the analysis. The presence of roof and pole vaults greatly limits lateral displacement. It provides a very good report regarding the use of sections in the construction elements, respectively an adequate dimensioning that prevents the use of excess materials. However, one of the problems of this structure is the relatively high volume of labor, with effects, of course, in the total cost of construction. The structure from wood material also has a good behavior towards the actions presented in the last chapters with relatively small effects, a rational use of the sections. One of the problems that could occur is the "massiveness" of the main beam, which presents some exceptional dimensions in my opinion.

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