The comparative analysis of the results obtained together with the solutions presented in the [6], [7], where the load is regarded as uniformly distributed along the perimeter of the frame and shows the following. Bending moments in the long side of the middle section are less than 7 %, the average cross-section is less than the short side by 9 %.The greatest reduction of bending moments coincides with the constructional unit and makes about 12 %.

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## TO ROOF FRAME OPTIMIZATION

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*This paper shows the design criteria truss, identified optimization problem for such structures. Shows an example of calculation for optimization lattice girder supporting roof trusses with a triangular lattice in order to find the most efficient configuration of the body structure.*

In the modern industrial, civil, agricultural, construction, and are often used in bridge girders [1, p. 77]. Material for their manufacture may serve as concrete, metal, wood. The geometrical dimensions of the farms are more dependent on the operating conditions. In general, the choices of geometrical parameters are taken into account the requirements of minimum weight farms, as well as the smallest area of the outer contour of the farm. Weight structures made up of weight belts and grids [2, p. 118]. With increasing height the belts farm weight decreases and increases the weight of the lattice due to increase in length and bracing struts. Determining the most effective configuration of the body farm is a major task of optimization.

Lattice trusses should be used small element, a simple form. The choice depends on the type of lattice design features of the farm; method nodal lattice compounds belts bearing on the kind of the column, the desired dimensions of the space between the array elements. The most commonly used with additional triangular lattice struts, since it has the least number of rods and assemblies.

Design criteria such as farm structures are the economic indicators – the cost, weight, complexity, and duration of erection or unique design and aesthetic aspects [3, p. 37]. However, in the latter case, the criteria for examining hard and their use do not fit into the framework of mathematical programming problems. There are currently quite a lot of approximate methods for solving optimization problems of building structures [4, p. 8]. One of the important problems in this area is the development and improvement of methods for solving engineering problems of structural mechanics, which have a maximum simplicity, reasonable accuracy. These methods include the isoperimetric, solving complex optimization for prestressed trusses [4; 5, p. 143]. When using the isoperimetric method in the classical sense solutions are obtained in the form of unilateral or bilateral isoperimetric inequalities characterizing a set of geometric shapes. These inequalities have some practical value and give satisfactory evaluation of physical-mechanical and geometrical characteristics (area, perimeter, aspect ratio, etc.).

As is known, various types of lattice trusses perceive lateral forces [6, p. 121]. As a rule, the system determines the overall complexity of grids manufacturing farm, its metal consumption [7, p. 78]. For example, for farms with parallel belts effective are the use of a triangular lattice, which allows you to obtain the minimum number of identical units and the minimum length of array elements [8, p. 301; 9, p. 113].

**Exemplas of optimization farm with a triangular lattice**

Consider the example of optimization roof frame triangular lattice (Fig. 1).

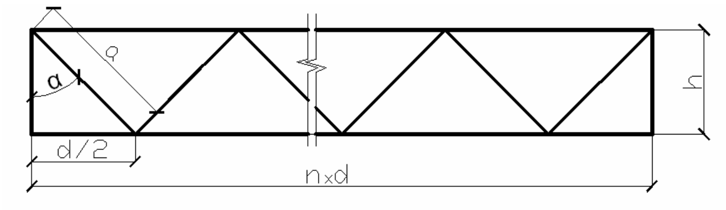


Fig. 1. Roof frame with a triangular lattice

Figure 1 shows the number of farm belts *n*, belt length *d*, length struts *h*, length struts and a variable angle to the vertical brace α. We define the perimeter and the sum of the lengths of internal bracing given the fact that:

$$d = 2a \cdot \sin\alpha\,; \quad (1)$$

$$h = a \cdot \cos\alpha\,. \quad (2)$$

The total length of all elements of the farm will be equal to:

$$U = 2a(2n\sin\alpha + \cos\alpha + n)\,. \quad (3)$$

The area bounded by the outer perimeter is equal to:

$$A = a^2 \cdot n \cdot \sin 2\alpha\,. \quad (4)$$

We define the ratio of the area of the farm limited to the length of the outer perimeter truss elements:

$$K = \frac{A}{U} = \frac{a^2 n \sin 2\alpha}{2a(2n\sin\alpha + \cos\alpha + n)}\,. \quad (5)$$

To differentiate the function *K* for an unknown corner α:

$$\frac{dK}{d\alpha} = 0\,. \quad (6)$$

$$2an\cos 2\alpha \cdot \left[2n\sin\alpha + \cos\alpha + n\right] = a^2 n \sin 2\alpha\left[2n\cos\alpha - \sin\alpha\right] \cdot \quad (7)$$

Will reduce the resulting equation for *an*:

$$d = 2a \cdot \sin\alpha 2\cos 2\alpha\left[2n\sin\alpha + \cos\alpha + n\right] = a\sin 2\alpha\left[2n\cos\alpha - \sin\alpha\right] \cdot \quad (8)$$

A further solution of (8) is possible by iteration with the substitution of arbitrary values of *n* and α. The angle of inclination to the vertical brace varies 30-60$^0$, usually a multiple of the value of *n* is 1.5 (3) *m*, and depends on the span of the building.

This optimization technique farm when changing the angle braces can be used for other types of lattices (diagonal, sub diagonal, rhombic). It should be noted that the proposed method of optimization of truss elements refers only to find the most effective configuration of the body structure. It does not take into account the properties of the raw materials, the possible deformation structures, as well as the types of external influences.

Thus, further research in this area must take into account external factors, their values and the material used.

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## CONVERSION OF DESIGN PRINCIPLES TO «GREEN» STANDARDS IN REPUBLIC OF BELARUS. SOLAR BATTERIES

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*The term «green building» is examined in the article. The definitions of solar batteries and solar panels are given. Advantages and restrictions on the use of solar energy are specified. Some examples of solar panels usage in constructions on the territory of Belarus are presented. The analysis of potential efficiency of solar batteries usage on the territory of the Republic of Belarus at the expense of favorable conditions of insolation is carried out.*

In the recent years the relation to housing construction in the highly developed countries has been changing under the influence of such global factors as exhaustion of natural resources, climate changes, overexploitation of lands and growth of population.

It is known that buildings around the world use 40 % of all consumed primary energy, 67 % of electricity, 40 % of raw materials and 14 % of reserves of drinking water, and also make about 35 % of emissions of carbon dioxide and nearly a half of all solid city waste [1]. In this regard, it is necessary to consider the main characteristics of housing in complex: environmental friendliness, profitability, energy efficiency, providing healthy lifestyle and comfort. These principles are fundamental in «green construction».

«Green construction» («Sustainable building») is a practice of construction and exploitation of buildings at simultaneous preservation or improvement of buildings quality, the purpose of which is to decrease the level of energy consumption and material resources throughout all life cycle of the building: beginning with a site choice for design, construction, operation, and finishing with repair and demolition.

The energy which is spent on production of materials is one of the main indicators: the energy consumption is lower, the used material is better. In this regard, steel, plastic, cement belong to the most energy-intensive construction materials, wood – to the least. That is why the statement that wood is the basis of the «green» house and is an environmentally friendly material is right.

The construction of buildings from wood on «green» technologies at this stage of development is actively conducted in the USA, Canada, Europe (Germany, Austria, France, Sweden, Norway, Finland), Japan, South Korea and some other countries. Belarus and Russia are lagging behind the developed countries and for the present use «green» technologies and materials only a little [2].

Most of people don't think over what amount of energy they consume and how these indicators can be lowered due to energy saving. Energy certification gives stimulus to people and to the organizations to invest in energy saving actions in their own buildings. In the Republic of Belarus within the pilot project energy certification of five buildings is carried already out and the results are very impressive [3]. The Renewable Power association has been created, the law «About Renewables» is adopted. Belarus entered the International agency on renewables.

The potential of solar energy in Belarus is rather big. Already now on roofs of private houses a large number of solar batteries appear [4].

«*Solar panels*» (solar batteries) are sets of the «solar cells» connected with each other and enclosed in a frame. «*The solar cell*» (a solar element) represents the small semiconductor device transforming light energy to electric energy.

This phenomenon was opened in 1839 by the French physicist Edmond Bekkerel and called in a consequence «photoeffect». The use of solar energy for receiving electricity has a number of advantages: it doesn't demand fuel, works constantly, silently. It has a long term of accident-free service, reliability, general availability, possibility of any change of power of operating system. Solar panels are an optimum choice for autonomous systems of power supply, but also they