transferred in the special place where LED lamps are installed. For some years of their usage the economic feasibility in installation of similar solar batteries weren't seen therefore in practice they aren't used widely in Minsk.

The solar thermal collector installed on a roof of one of buildings of Milavitsa factory allows to heat up to 500 l of water.

On the roof of the building of BGUIR and ecological university named after A.D. Sakharov solar batteries are installed, but their application is more for demonstration and education, than practical.

Requirements to modern housing are constantly growing: they can't be satisfied without the use of the most perfect technologies and materials. The ecological assessment of construction materials becomes equivalent to indicators of their bearing ability.

It is necessary to consider the main characteristics of housing in complex: environmental friendliness, profitability, energy efficiency, providing healthy lifestyle and comfort.

The energy which is spent for materials production is one of the main indicators: the lower is energy consumption, the better is material for usage.

The advantages of solar energy usage: lack of fuel need, permanent and silent job during the long term of accident-free service, reliability, general availabilвity, possibility of any change of power of system.

The restrictions of solar batteries usage: decline in production in winter time by one and a half or two times, low efficiency for use in heating systems, need of high energy efficiency and sufficient intensity of light.

Potential efficiency of use of solar batteries on the territory of the Republic of Belarus only at the expense of favorable conditions of insolation is more than 10 % higher, than in Poland, the Netherlands; is more than 17 % higher, than in Germany.

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EXPERIMENTAL STUDY OF WELDED BEAMS, SUPPORTED BY SLOPING REINFORCEMENT RIBON A FLAT BEND

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The article investigates the impact of the geometry and type of sloping reinforcement rib on the bending stiffness of reinforced thin-walled bars. Experimental study is designed to determine the coefficient changesin deformability of beams in the formulation along their length of sloping reinforcement rib. A quantitative assessment of the impact of sloping reinforcement rib on the stiffness of thin rods with bending moment is given.

The theory calculation of thin-walled spatial rods (they include I-composite beams) is continuously improving on the basis of the achievements in the field of theoretical and experimental studies. However, the foresaid does not apply to simple bending of thin-walled open section with sloping reinforcement rib.

In the special literature, predominantly national, only a few papers of theoretical [1, 2, 3, 5] and experimental [4, 6, 7] character are published, in which the authors discuss the issue of the steel continuous beams to flat bend with walls reinforced of sloping rib. The main disadvantage of these experimental studies was that they were conducted on models with small geometric dimensions (L = 1500mm). The lack of complete experimental data on the effect in an arbitrary section of the beam, as well as its bending stiffness required further research implementation, which are described below.

Moving in the middle of the span is found according to the formula Mor-Vereshchagin.

$$\Delta_i = \sum \int_0^l \frac{m_i \cdot M_P}{EI} dx . \quad (1)$$

Moments of cargo and unit status:

$$M_P^x = \left(\frac{ql}{2} \cdot x - \frac{qxl}{2}\right), \quad m_1^x = \frac{1}{2} x . \quad (2)$$

Installation of sloping reinforcement rib stiffness along the length of the element will change and therefore, to find a displacement mid-span it is needed to consider cross-sections with different rigidities.

That is why this equation moving section of the beam at mid-span:

$$\Delta_i = \sum \int_0^l \frac{m_1^x \cdot M_P^x}{EI} dx = 2\int_0^{\frac{1}{2}l} \frac{(\frac{1}{2}l)(\frac{ql}{2} \cdot x - \frac{qx^2}{2})}{EI} dx, \tag{3}$$

where I ≠ const.

As the moment of inertia in this case is variable, we will set its value piecewise intervals in which will be determined in accordance with Figure 1.

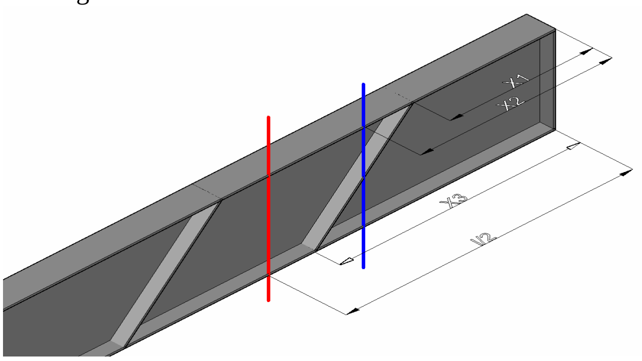

Fig. 1. Determination of intervals piecewise

Since the neutral axis passes through the center of gravity of the cross section, its position on a plot X3 ≥ x ≥ X1is determined from the condition:

$$t_f \cdot b_f \cdot (\frac{t_f}{2} + h_w - s(x)) + (h_w - s(x)) \cdot t_w \cdot (\frac{h_w - s(x)}{2}) - (t_f \cdot b_f \cdot (\frac{t_f}{2} + s(x)) + s(x) \cdot t_w \cdot \frac{s(x)}{2}) - \frac{t_r}{\cos\alpha} \cdot (b_f - t_w) \cdot (\frac{t_r}{2\cos\alpha} + s(x) - x \cdot \tan\alpha) = 0, \tag{4}$$

where s(x) – distance from the upper face of the bottom chord to the center of gravity of the cross section.

Hence:

$$s(x) = \frac{\frac{h_w^2 \cdot t_w}{2} - \frac{t_f^2 \cdot b_f}{2} + b_f \cdot t_f \cdot (\frac{t_f}{2} + h_w) + \frac{t_r \cdot (b_f - t_w) \cdot (x \cdot \tan\alpha - \frac{t_r}{2\cos\alpha})}{\cos\alpha}}{2 \cdot b_f \cdot t_f + h_w \cdot t_w + \frac{t_r \cdot (b_f - t_w)}{\cos\alpha}}. \tag{5}$$

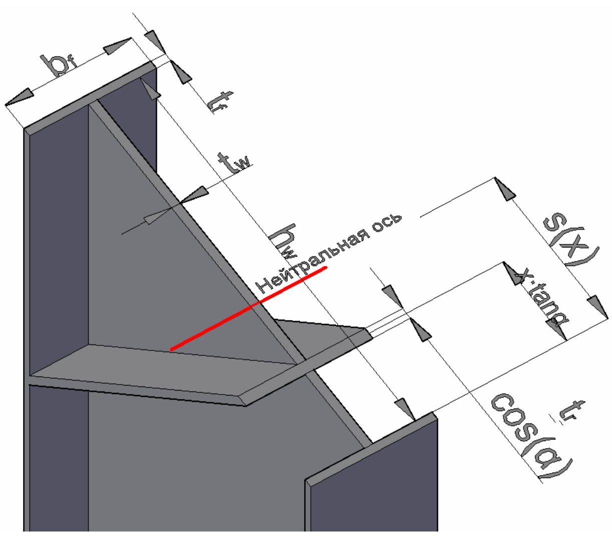

Fig. 2. Determination of the moment of inertia with tilt edges

Thus, the moment of inertia of I-section, supported by sloping ribs can be represented in the form:

$$I(x)=\begin{cases} 0\le x<x1\rightarrow 2\cdot(\frac{b_f\cdot t_f^3}{12}+b_f\cdot t_f\cdot(\frac{h_w}{2}+\frac{t_f}{2})^2)+\frac{t_w\cdot h_w^3}{12} \\ x1\le x\le x2\rightarrow(2\cdot\frac{b_f\cdot t_f^3}{12}+b_f\cdot t_f\cdot((\frac{t_f}{2}+h_w-s(|x1-x|))^2+(\frac{t_f}{2}+s(|x1-x|))^2))+ \\ +(\frac{t_w\cdot h_w^3}{12}+t_w\cdot h_w\cdot(\frac{h_w}{2}-s(|x1-x|))^2)+(\frac{b_r\cdot(\frac{t_r}{\cos(\alpha)})^3}{12}+\frac{t_r}{\cos(\alpha)}\cdot b_r\cdot(s(|x1-x|)-|x1-x|\cdot\tan(\alpha))^2) \\ x2\le x\le x3\rightarrow(2\cdot\frac{b_f\cdot t_f^3}{12}+b_f\cdot t_f\cdot((\frac{t_f}{2}+h_w-s(|x3-x|))^2+(\frac{t_f}{2}+s(|x3-x|))^2))+ \\ +(\frac{t_w\cdot h_w^3}{12}+t_w\cdot h_w\cdot(\frac{h_w}{2}-s(|x3-x|))^2)+(\frac{b_r\cdot(\frac{t_r}{\cos(\alpha)})^3}{12}+\frac{t_r}{\cos(\alpha)}\cdot b_r\cdot(s(|x3-x|)-|x3-x|\cdot\tan(\alpha))^2) \\ x3<x\le x4\rightarrow 2\cdot(\frac{b_f\cdot t_f^3}{12}+b_f\cdot t_f\cdot(\frac{h_w}{2}+\frac{t_f}{2})^2)+\frac{t_w\cdot h_w^3}{12} \end{cases}. \qquad (6)$$

Experimental studies of beams with sloping ribs on a flat bending was conducted on seven models of welded single-span simply supported beam pivotally-I-symmetric airfoil span L = 3 m cross-sectional dimension: the wall – 500×10 mm, horizontal sheets – 150×10 mm. Alignment along the length of the test beams and dimensions of inclined stiffening ribs are shown in Figure 3.

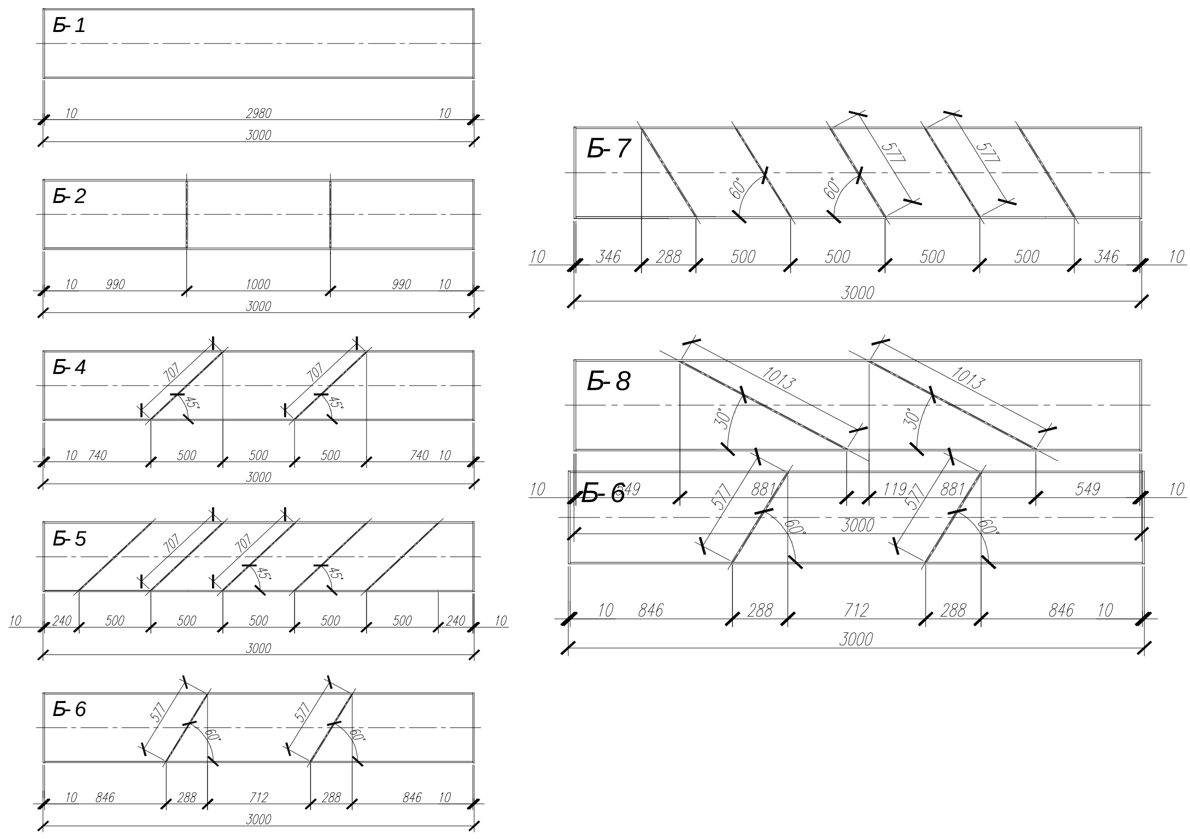

Fig. 3

Beams were made of steel BM-ST 3ps GOST 380-60 *, welding zones, walls and inclined ribs were conducted electrodes E-42A with a thickness of 8 mm seam. Each beam was tested in the horizontal position on the 200-ton hydraulic press.

The load as a concentrated force P was passed at mid span through the square stamp size 60×60 mm to the compressed zone in the plane of maximum stiffness.

Monitor stresses in these sections was performed using strain sensors mounted on the wall and belts in compressed and stretched zones.

The load was transmitted steps from zero to 32 tons with a constant step 4 tons. Moreover, the research was fulfilled for the load, increasing by stages, it was held for 20 – 25 minutes at each subsequent stage reaches.

Table 1 summarizes the data theoretically, numerical and experimental research.

Table 1 – Summary table of results

Name	Test data		Data of numerical solutions		Theoretical data	
	Deflection, mm	σx, max, MPa	Deflection, mm	σx, max, MPa	Deflection, mm	σx, max, MPa
B-1 (without ribs)	3,09	220,27	3,02	167,81	2,76	191,68
B-2 (2 ribs 90°)	3	220,27	3	167,37	2,76	191,68
B-4 (2 ribs 45°)	2,89	198,14	2,96	169,43	2,63	191,68
B-5 (5 ribs 45°)	3,01	166,73	2,91	168,78	2.62	191,67
B-6 (2 ribs 60°)	2,87	198,45	2,98	168,44	2,67	191,68
B-7 (5 ribs 60°)	3,08	177,75	2,96	167,72	2.69	191,67
B-8 (2 ribs 30°)	3,11	203,96	2,87	173,73	2,58	191,68

Thanks to setting sloping reinforcement rib the stiffness of reinforcement rods is increased. The deflection can be reduced by 1,3 – 14,5%. Normal stress σ_x in dangerous section can be reduced by 4,4 – 24,3 % while increasing the total weight of the structure by 1,8 – 13,3 %.

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ON THE USE OF TRUSSES WITH LOWER AND UPPER TYPE OF BELT BEARING

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The article deals with trusses of lower and upper type of belt bearing, types of the upper belt and mesh, the calculation of the most effective type. The cross section type of the chosen truss is analyzed as well.

Trusses make the bases of numerous framed structures and vary in their usage. They are applied in ceilings, floors, as profiled walls of covers, shifts, etc. Trusses are applied in various fields of engineering: bridges, frames of industrial buildings, sports objects, halls, stage constructions, tents and runways.

Trusses have various shapes depending on architectural and functional specifications of the design. Geometry of a truss is specified by the belt shape and the mesh type.