Determination of Optimal Parameters of Low Element Farms

Kholmurodov Aslon Ibragimovich[1], Abduazizov Inomjon Alisherovich[2]

[1]Associate professor, PhD of Samarkand state institute of architecture and construction, Samarkand, Uzbekistan

[2]Master's degree student of Samarkand state institute of architecture and construction, Samarkand, Uzbekistan

Abstract:

The optimal parameters of low-element trusses, which are effective for industrial building roofs, are determined in this article. When compared to double-angle trusses, these trusses are more affordable and industrial in terms of material use. The ideal distribution of stresses created in the truss rods can be attained for low-element trusses by accurately determining the eccentricity generated by the upper and lower bands' axes. Numerous research have been undertaken to identify the ideal values of eccentricity for low-element 18, 24, 30, and 36m arched farms functioning in specific climatic conditions.

Key words: Roofing, truss, arch, base, knot, sternum, eccentricity, bending moment, transverse force, longitudinal tension, joint, angle

Introduction: Low-element trusses perform well in the selection of new roofing trusses [6]. The truss must be industrial in addition to the amount of steel consumed for the project to be efficient. The amount of labor necessary to prepare the farm is determined by the number of farm stems and nodes. One of the constructive forms that has not been thoroughly studied is the topic of efficient design of low-element farms. The idea of material concentration is used in low-element farms, which means that the number of grids, regardless of the truss, is four columns, and the upper band is made of a single-stem rod. (Fig.1)

Main Part: Low-element farms provide good roofing with a span of 18 to 36 meters [5]. Crane beams are joined to nodes where farm columns are located, or to nodes where specific supplementary columns are built, in industrial buildings equipped with overhead cranes.

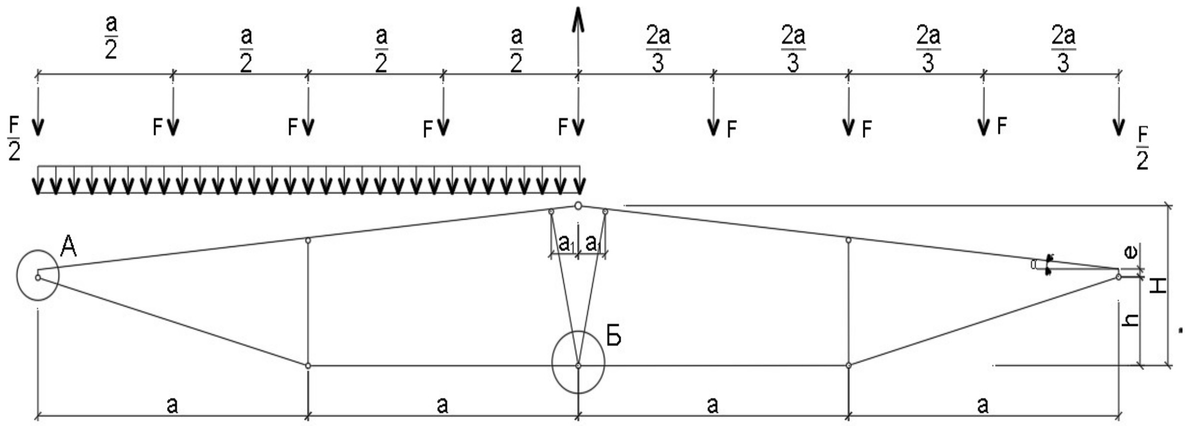

Figure 1. Calculation scheme of a low-element farm.

The truss-supporting columns can be hinged or fastened. The primary load-bearing structure is a sprung truss with an upper band slope of ***i*= 1/8.....1/10**. A soft roofing felt roofing can be used on a farm with such a slope. Farm trusses are normally positioned at the same a**=1/4*l*** distance from each other, whether vertically or obliquely.The apex node is hinged or braided, and the roofing structures can be progon or non-progon. Because the fences are sparingly placed on low-element farms, the upper bands are crushed and bent. High bands are built of wide-shelf spreads and structural joints, channels, and bent welded closed-contour virgin profiles to withstand such loads. The lower belt, which acts as a tensioner, should be constructed of angles or circular steels, and the columns should be built of compressive-strength profiles. Sprint beams, lightness like arches, and high virginity are all characteristics of low-element trusses. The drawback is that it doesn't operate well with one-way loads (snow, crane impact). The V-shaped columns help to mitigate this disadvantage of Sprengel farms. V-shaped columns do not operate when the truss is loaded symmetrically; when the truss is loaded symmetrically, the stresses created in the upper band are determined by the ratio $\xi = a_1 / a$. The distance between the apex node and the node to which the oblique column is linked is given by a_1 (see Figure 1). The farm's snow loading is fully determined if ξ**= 1/10 - 1/12**.

High belt weight accounts for 70-75 percent of the farm's total weight. The strains created by the bending moment account for 85 to 95 percent of the tension in the upper belt. The longitudinal forces in the top belt scarcely alter along the length of the belt since the slope is minor. The truss obtains a minimal weight when the absolute values of the bending moments in the upper belt rack and the column section are equal or close to each other. The bending moments generated in the truss upper belt are proportional to the height h, and the effective height $h \approx 2{,}8a \cdot t$ when the 18, 24, 30, and 36 m arched trusses are hinged to the columns and the accumulated loads are loaded with $a/2$ steps or uniformly distributed loads. When loaded in $2 \cdot a/3$ stages, the forces accumulated on 18m arched trusses should be taken to be $h \approx 2{,}3a \cdot t$. The angle formed by the upper band slope and the horizon is called **α**. The height is reduced slightly on farms equipped with overhead cranes.

An example. The following must be considered when designing a low-element farm. The farm is 24 meters tall, with a 6 meter step. Steel of the C235 grade has a low carbon content**.** (R_y=235 MPa) [1].

The normative and calculated spread loads are q^H=0,95 kH/m^2, q=1,18 kH/m^2, respectively. The prongs, which are arranged in stages of d = 1.5 m, transmit loads acting on the farm without roofing.

Solution: Calculated, accumulated loads acting on the top strip of the farm.

$P=q \cdot B \cdot d=1.18 \cdot 6 \cdot 1.5=10.62$ kH.

The above recommendations are used to create the geometric shape of the farm. High band slope: $i=0{,}1 \cdot L/2=0{,}1 \cdot 24/2=1.2$ м.

$h \approx 2{,}8 \cdot a \cdot tg\alpha=2{,}8 \cdot 6 \cdot 0{,}1=1{,}68$ м; $a_1 = \xi a = 0{,}1 \cdot 6 = 0{,}6$ м.

Because the top band of the truss is squeezed and bent, its cross-section is chosen from a virgin double profile, while the lower band is chosen from a single angle.

Numerical studies determined the ideal value of the eccentricity generated by the upper band and the bottom band, which is e = 10 cm. The farm's computation scheme is depicted in Figure 2.

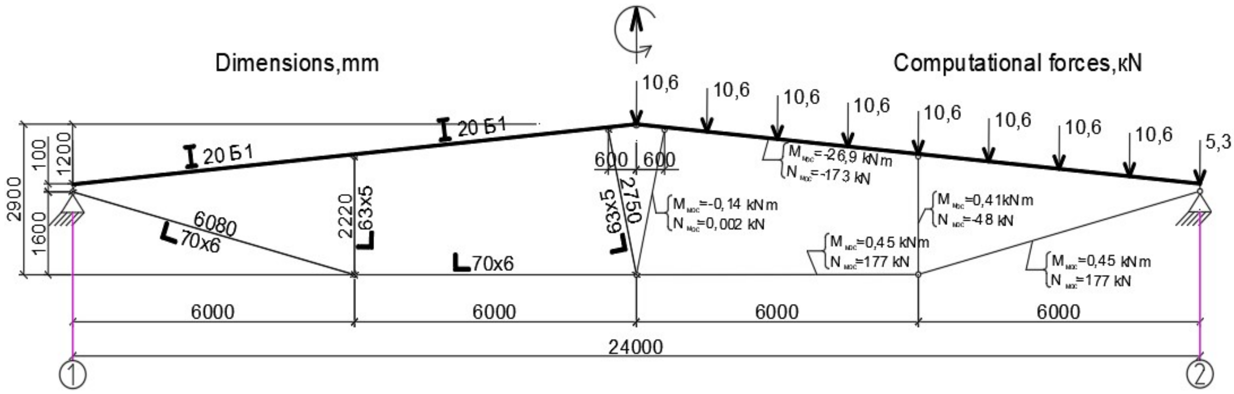

Figure 2. Farm calculation scheme.

The cuts selected for this farm are shown in Figure 2. The amount of steel consumed was 800 kg and the number of knots was 11, indicating that the farm was industrial.

At the base nodes of low-element trusses, the optimal distribution of bending moments in the upper band sections can be achieved as a result of proper selection of the eccentricity ***(e)*** generated by the bands. For farms of 18, 24, 30 and 36 m, these values are around ***e*** = 0-30 cm, ***α***= 6°- 8°.To find the ideal values of eccentricity for 18, 24, 30, and 36 m arched farms, numerous studies were undertaken, and the results of the calculations are provided in Table 1.

All calculations were performed using LIRA-CAPR 2017 [3], (A software package for the design and calculation of machine-building and building structures for various purposes-Kiev (Ukraine), 2017).

Table 1.

Farm porch, m.	Eccentricity, cm	Weight, kg.	Computational stresses in the upper band		Computational stresses in the lower band		The calculated stresses of the columns		Computational stresses of mortars	
			кНм	кН	кНм	кН	кНм	кН	кНм	кН
			M_x	N_x	M_x	N_x	M_x	N_x	M_x	N_x
18	0	458.8	-12.5	-153.0	0	156.0	0	-36.8	0	-0.09
	5	458.8	-11.8	-153.0	0	155.0	0	-35.1	0	-0.11
	10	521.7	-14.8	-152.0	0	154.0	0	-33.3	0	-0.12
	15	588.3	-22.0	-152.0	0	153.0	0	-31.5	0	-0.13
	20	588.3	-29.1	-151.0	0	152.0	0	-29.8	0	-0.15
	25	651.2	-36.1	-150.0	0	150.0	0	-28.0	0	-0.17
	30	691.8	-43.0	-150.0	0	149.0	0	-26.3	0	-0.182
24	0	893.4	-26.8	-180.0	0	184.0	0	-50.1	0	-0.095
	5	809.9	-25.9	-180.0	0	184.0	0	-48.5	0	-0.11
	10	809.9	-25.0	-180.0	0	183.0	0	-47.0	0	-0.12
	15	809.9	-26.2	-178.0	0	182.0	0	-45.4	0	-0.14
	20	893.4	-34.6	-179.0	0	181.0	0	-43.8	0	-0.153
	25	943.3	-43.0	-178.0	0	180.0	0	-42.2	0	-0.17
	30	943.3	-51.4	-178.0	0	179.0	0	-40.7	0	-0.19
30	0	1231.1	-41.3	-227.0	0	232.0	0	-62.4	0	-0.13
	5	1231.1	-40.3	-227.0	0	231.0	0	-60.8	0	-0.14
	10	1231.1	-39.1	-227.0	0	230.0	0	-59.3	0	-0.152

	15	1212.7	-38.0	-226.0	0	230.0	0	-57.7	0	-0.16
	20	1329.1	-44.0	-226.0	0	229.0	0	-56.1	0	-0.18
	25	1381.2	-54.7	-225.0	0	228.0	0	-54.5	0	-0.19
	30	1381.2	-65.3	-225.0	0	227.0	0	-52.9	0	-0.2
36	0	1882.0	-60.2	-275.0	0	280.0	0	-74.8	0	-0.12
	5	1882.0	-60.1	-275.0	0	280.0	0	-73.2	0	-0.9
	10	1882.0	-57.6	-274.0	0	279.0	0	-71.6	0	-0.14
	15	1738.9	-56.2	-274.0	0	278.0	0	-70.0	0	-0.16
	20	1738.9	-54.8	-273.0	0	277.0	0	-68.4	0	-0.17
	25	1875.7	-66.3	-273.0	0	276.0	0	-66.8	0	-0.184
	30	1960.3	-79.2	-272.0	0	275.0	0	-65.2	0	-0.2

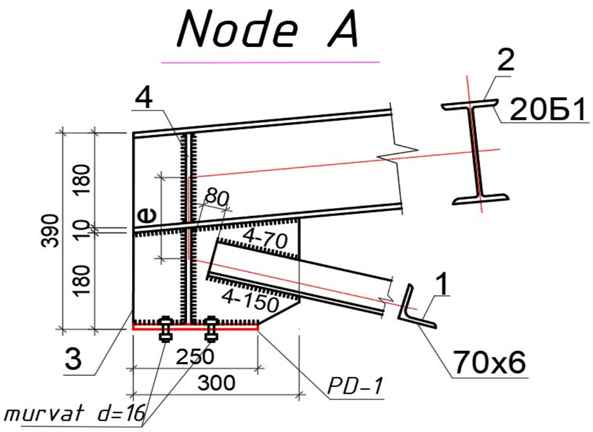

Figure 3. The base node of a low-element farm.

The use of low-element trusses in the design of industrial building roofing is now a viable option. Lightness, ease of building, and a low number of rods and knots distinguish such farms from other types of farms. Low-element farms also have the benefit of being able to be carried in a compact form from the factory to the construction site in the form of discrete linear elements. Numerical analyses were used to find the best parameters for low-element farms.

ХУЛОСА.

The minimal weight of the trusses depends on the value of the eccentricity generated by the upper and lower bands of the truss when the linear load operating on low-element trusses is q=7,1 кН/m. For farms with arches of 18, 24, 30, and 36 meters, the measurements are 0-5 cm, 10-15 cm, 15 cm, and 15-20 cm, respectively.

References:

1. SHNK 2.03.05-13. »Steel structures. Design standards »/ State Commercial Architecture of the Republic of Uzbekistan.-Tashkent,2013.p.171.
2. Design of metal structures. Special course, edited by V.V. Biryulev. Leningradstroyizdat. 1990. p.171.
3. "LIRA-SAPR 2017" A software package for the design and calculation of machine-building and building structures for various purposes-Kiev (Ukraine), 2017
4. Light metal structures of buildings and structures. Study guide., M. M. Sakhnovsky, Kiev. 1984.
5. Nilov A.A., Permyavov V.A. Steel structures of industrial buildings. Directory, Kiev.1986.
6. “Design Optimization of Steel Truss Structures” K.V.Venkatesha University of Oklahoma, 1989.