_____

Efficiency of application of metal arched structures

Rakhimov A.K.
Candidate of Technical Sciences, Assoc.,
Turaeva Sh.Kh.
Undergraduate.
Named after M.Ulugbek Samarkandis a state architectural and construction university.

Abstract: This article provides information on the through arch structures of coatings, the application of arch structures, including those made of profiled sheet, is analyzed. The basics of their calculation are given.

Key words: arches, shape, cross-section, tightening, support, beams, bending, load, corrugated board.

Structures with curvilinear arched forms provide significant opportunities for achieving architectural expressiveness, especially if the walls and the roof are united by a single design solution that allows you to eliminate the visual boundary of the transition between them. In addition to aesthetic appeal, the arched shape allows you to maximize the use of all useful interior space, minimizing the difference between the functional and building volume of the building. The low construction height and visual "lightness" of the arches allows not only to give an architecturally expressive appearance to the buildings, but also to provide internal natural lighting at the required level.

Arched structures are load-bearing systems of steel structures in rapidlybuilt buildings, active on the top.

Arches are load-bearing structures of positive curvature, interacting with the external force flow with their entire surface. Arched structures are classified mainly according to the type of static scheme and the way of perceiving the dissipation.

Themain type of arch structures is parabolic, but they can also have the shape of a part of a circle, a variable radius of curvature or even the shape of a chain line consisting of multiple conjugate linear elements. Thanks to this, arched structures allow to achieve high architectural expressiveness with a transparent demonstration of the constructive principle of operation and are widely used in various types of prefabricated buildings. (fig. 1,2,3,4,)[5].

From the point of view of the structural scheme, two-, three- and hinged arched structures are distinguished similarly to the frames. In fact, arches are obtained from curvilinear beams by securing both supports in fixed ones and ploughing the longitudinal axis. Because of this, spacer forces arise in the arches. The transfer of the gap is possible on the foundations or columns-buttresses, as well as on other adjacent structures capable of perceiving it. [1]

Efficiency of application of metal arched structures.

In arched structures, there are both prevailing compressive and transverse forces, as well as bending moments. Therefore, arches are calculated by the limiting states of the first group for strength during bending and compression with bending, stability in their plane and from the plane. Individual welded elements of solid-walled arches made of sheets also require local stability testing. Arched structures mainly have significant rigidity, however, for the gentle arches of the coatings of prefabricated buildings, special attention is paid to vertical movements, as they can lead to a change in the design scheme and an unforeseen "clicking" of the arch downwards. Solid-walled arches are made of rolled I-beam profiles or elements of tubular closed cross-section by bending in a heated state at the factory. Since the element undergoes plastic deformations during bending, the bending radius is technologically limited, and this method of making arches is not suitable for large cross-section profiles.

_____

_____

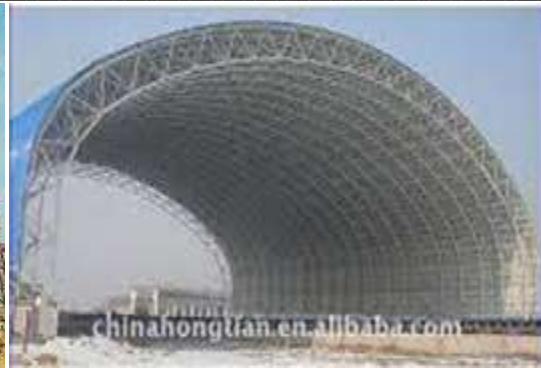Fig.1 Installation of through   arches Fig.2 Through arches with external and
inner cladding

Fig.3 Key assembly arched   Fig.4 Arched coating of the gym.

Construction
In modern times, frame arch coverings made of coldbent profiles are used. They are performed in severalstages, (Fig . 1)
In the first step, a straight profile with flat walls is rolled from a coiled steel with a thickness of t=0.8-l.5 mm (Fig. 5. a). In the second stage, the rectilinear profiles are rolled along a given radius and acquire a new shape with corrugated wallsand a wide shelf (Fig. 5. b). Curvilinear profiles are connected to each otheralong the longitudinal edgesby folding joints, forming enlarged arch blocks of 5-6 profiles each. [2]
        Enlarged blocks of bent profiles are installed in place in the coating sequentially with the help of a truck crane, starting from one of the ends of the building. Each subsequent block is connected to the previous one bymeans of folding joints along theedges of the profiles made by a folding machine.
The length of the finished arched profile corresponds to the length of the arc of the cross-section of the coating. (fig 6).

_____

_____

(a)   Rolling mill for the manufacture of arches

b) Vision of aročnio profile from profilirovannogo sheet

5 Fig. Scheme of the technological process of coating manufacturing

Fig. 6. Arched coating made of profiled sheet.

The field of rational application of arch coating depends on the design loads and the degree of aggressive exposure of the environment, as well as on the ratios of span, radius of curvature, thickness of steel in the profiles and distances between the load-bearing transverse walls of the building. [4]

In insulated buildings, the arched coating is made of two-lobed profiles of the same type. The distance between the layers of coating is determined depending on the thickness of the insulation, which is used as mineral wool plates or mats. (Fig. 7).

_____

_____

A-A   стальной профиль

Insulation

steel profile
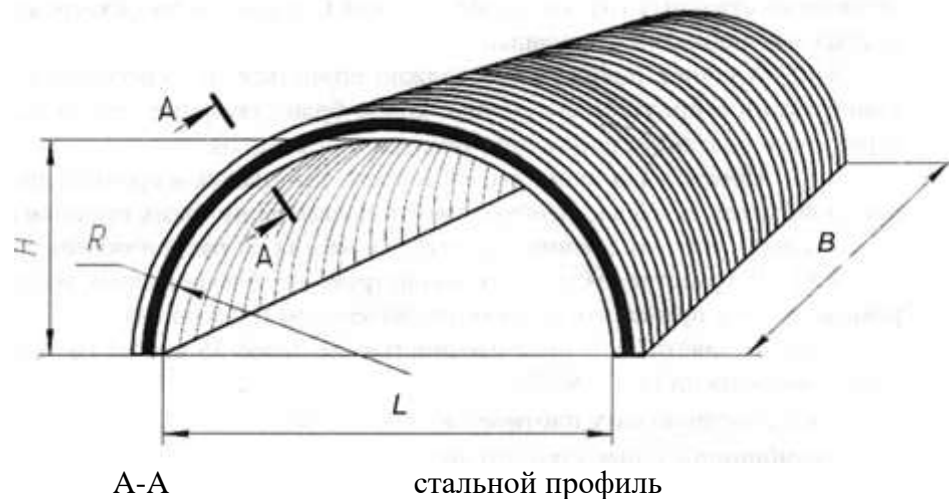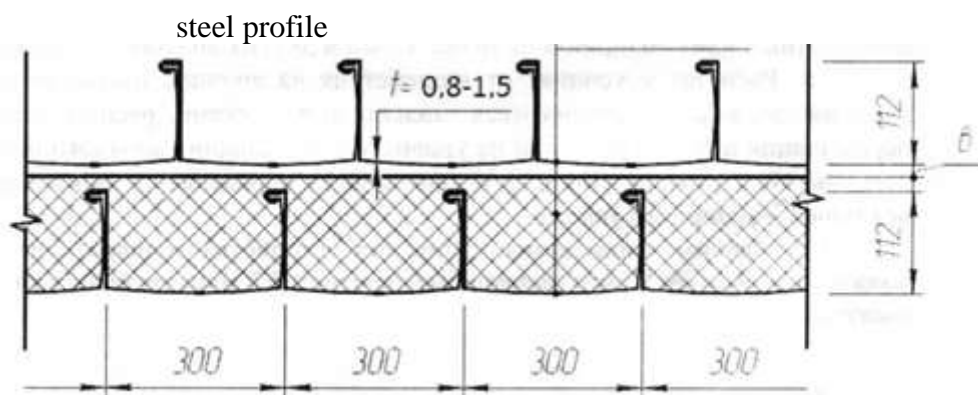
in = 25-30 mm inthe air layer
Fig. 7. Thebuilding has an arched coatingof me.

Spans of single-layer arched coating are accepted in the range from 6 to 18 m (Fig. 3), for two-liter- from 12 to 24 m. Arrowsand lifting the coating tofalse should be at least 1/3 of the span.

Walls and partitions in an arched building are made of rectilinear profiles, usually of the same type used for coating, and connect them to each other using a folding machine.

Arched coatings of this type are recommended for use..

1) With snow loads in I-V districts and wind loads in I-V districtsaccording to SNiP; "Loads and impacts"

2) In conditions of non-aggressive and slightly aggressive effects.

3) In areas with a seismicity of not more than 8 points.

Suspension transport in buildings with arched coating is not provided.

The spacer forces from the impact on the arched coating of the design loads should be perceived by steel puffs located across the building in the thickness of the floor or at the level of the nodes of the support of the arched coating on the supporting structures. The diameter and pitch of the puffs is determined depending on the magnitude of the spacer force.

The maximum length of the building is 72 m. [3]

Basic provisions of the calculation

The scheme of design loads for the length of the building does not change. The supportof the arched coating along the longitudinal edges ishinged, taking into account therigidity of the structures and the malleability of the joints on conventional bolts.

The calculationof the strength and stiffness of the product coatings is carried out according

_____

_____

to the SCAD program on the basis of the finite element method, taking into account the nonlinear supercritical operation of the structure.

Asingle arch made of a single profile is used as an ethology, the stability of which from the plane is considered to be ensured by fastening with adjacent arches. As finite elements, a flat rod is used, into which the unit arch is divided.

The calculated geometric characteristics of the cross-section of the profiles (thelargest area during longitudinal compression, the moments of inertia of the resistance during bending) are based on the help of reduction coefficients that take into account thespecificity of the work of thin-walled elements.

Inthe case of the forces from the opening of the arch coatings under the influence of the design loads are perceived by puffs. The step of the puffs is determined depending on the magnitude of the spacer forces.

As a result of the calculations performed, the values of the normal forces (N) and moments (M) are determined, the combination of which determines the stresses in the most stressed upper and n-edge fibers of the profile cross-section with the calculated combination of loads. [1]

Inthe waters

Andthe flow structures are parabolic, but they can also have the shape of a part of a circle, a variable radius of curvature or even the shape of a chain line consisting of multiple conjugate linear elements. Thanks to this, arched structures allow you to achieve high architectural expressiveness with a transparent demonstration of the constructive principle of operation and are widely used in various types of prefabricated buildings.

As a result of the analysis of the calculation of arched structures, the most effective are frameless arch coatings made of profiledlaminated sheet in terms of material consumption and labor intensity of manufacture and installation.

Literature:

1. Тсай Т. Н., Бородич М.К., Мандриков А.П. Строителнйе конструкци. Том 1. М.: Стройиздат, 1984. 656 с.
2. GOST 30245-2003. Профили сталнйе гнутйе замкнтйе свамйе квадратнйе и прямоуголнйе для строителнйх конструкций. Технические условия. М.: ФГУП ТсПП, 2004.
3. Steel structures made of thin-walled cold-groove profiles for frameless arched buildings for various purposes.STO9721441-001-2014.
4. KMK 2.01.03-19
5. https://vse-angary.ru/beskarkasnye-angary/?utm_referrer=https%3A%2F%2Fwww.google.com%2F

_____