Technology of installation and dismantling of soft synthetic fencing rod spatial dome

Boris Strigin
Moscow State University of Civil Engineering, Yaroslavskoe shosse 26, Moscow, 129337, Russia
E-mail: StriginBS@mail.ru

Abstract. This article deals with the issues of prevention, installation and dismantling of removable tent fencing, with an area of 1250 m², space-rod dome with a diameter of 43 m of a multi-purpose public center: dining room, cinema-concert and conference hall for 600 seats, dance floor for up to 1000 people. Subject of research: installation and dismantling works on soft synthetic fencing of the dome - shaped structure of the public center. Objectives: to determine the technological sequence and take into account the nuances of the process of operation, installation and dismantling of soft synthetic fencing of the spatial dome of the public center.

1. Introduction
The dome is an openwork large-span rod system, the idea is based on a geodesic dome. The structure is operated exclusively in the summer. Exclusion of snow loads in the winter, helped several times to facilitate the load-bearing frame and lengthen the service life of the coating. Soft synthetic dome fencing, given the unique design, requires a special technology for installation and dismantling, which allows you to quickly, efficiently and safely perform these operations. [1-7]

2. Materials and Methods
Two methods of installation work, as well as the technological map for the dismantling of soft synthetic fencing. [1-3]

   The description of installation of soft synthetic fencing contains several stages:
   1. Preparatory work.
   2. Devices and tools.
   3. Preparation of the shell for installation (Method #1, Method #2).
   4. Installation of soft fencing (MO): Method #1; Method #2.

   The stage of preparatory work includes washing and thorough cleaning of the site under the rod spatial frame, covering all protruding sharp parts, structures of elements of internal structures and peeling off the internal electrical equipment.

   At the second stage the inventory of necessary adaptations is made. Their composition depends on the method of installation.

   Preparation of the shell for installation includes the placement of mounting panels under the rod space frame and card tape with metal clamps on the axes in accordance with scheme No. 1 (Fig.3); connection of cord tapes by the Central hook and on a cord tape of Assembly panels metal clamps:
A) connect the top of the five mounting panels so that they form a closed circle (Ø=2.8 m) - Zenith svetoaeratsionnoe hole, checking the radius of the resulting circle, put it from the Central hook on the five cord tapes and make marks;

B) from marks on cord tapes to make connection of the axial parties of Assembly panels (see Fig. Five);

C) Assembly of installation is carried out on each axial direction of the clamps, using wrenches and mounting benches.

Then make installation of Poppet suspensions:

A) to make installation of Poppet suspensions according to the scheme (Fig. 1), i.e. the suspension hook should be oriented to the cable (in each specific place) perpendicularly (see Fig. 1.but.);

B) installation of long and short hooks of Poppet suspensions to make in strict accordance with the scheme (Fig.1);

C) installation of a Poppet suspension is made by two assemblers (one from each shell structure), completes it, mount, tighten the nut until it stops and fix with a cotter pin;

D) installation of suspensions can be made in two ways:

- the shell is spread out on the installation site-installation in the "floor" level;
- the shell is lifted behind the Central cable, thrown from the Central block (Telfer), installed in the anti-aircraft part of the dome frame, and is transformed upward as the installation of disc suspensions, and then lowered to the original position;

- installation in limbo (recommended in calm weather or 2-3 points).

After you want to sew switaerland Zenith hole tent (or lace up – if there is grommet); the shell is equipped with mounting fittings, lay at the installation site coving to the inner side of the stained glass (see Fig.2) and to bring under a cover ventilating sleeves, to fix their ballast, and opposite ends-to connect ventilating installations (Fig. 2); on the perimeter of the shell spread ballast at intervals of 50 + 70 cm .(see Fig.2).

Installation of a soft protection by method No. 1 is allowed at a wind no more than 3 points. It is necessary to include ventilation installations and to keep the air support intended for connection of hooks of Poppet suspensions to the bearing cable system in the corresponding zones of a skeleton. Then the Central hook (see Fig.3) connected to the cable system and fixed to the Central sprocket of the frame. Next, we fix the axial lanyards to the anchors of the" high " Foundation and produce tension cord tapes (Fig. 3). The next step is the installation and production of tension halyards padug (lower stabilization system) catenary belt MO (soft fence). Installation files the top (cap) of the stabilization system is made so:

A) make the layout of the halyards in accordance with the scheme (Fig. 4);

B) fix one end (each) of the halyard with a retainer;

C) tension and stabilization of the files with the clips.

After installation, it is required to remove the awning from the anti-aircraft aperture.

Installation of the lower and upper svetoaeratsionnyh aprons is the connection of soft panels-aprons (width of 90 cm) - with the main MO, by means of a nylon cord threaded h / W grommets-in the apron and soft bracket MO.

After final Assembly, MO and stabilize the system before the stress produce tension on the carrier cable system axial lanyards and lanyards intermediate "low" supports the Foundation and fixing hooks disc pendants and axial binding posts to produce.
Figure 1. Layout of mounting panels and installation of disc suspensions: 1-cinema booth; 2 - the screen; 3-soft fencing; 4-anti-aircraft aperture; 5 - the cable; 6-hook; 7-spring washer; 8-plate; 9-rubberized gasket; 10-washer Grover; 11-nut M18.

Figure 2. Map of the preparatory stage of installation of soft fencing: A - Soft fencing; Б - ledge tape with clips; В - closed (awning) anti-aircraft aperture; 1 - cinema booth; 2 - bandstand; 3 - soft fencing; 4 - ballast (sandbags); 5 - capital fencing (walls, stained glass).
**Figure 3.** Card mounting soft shell and files covering the bottom of the stabilization system: Г1, Г2, Г3, Г4 - the sequence of tension halyards padag; Б - the mark of the beginning of connection of panels by clamps; 1 - center hook soft shell and Poppet hanging shell; 2 - central sprocket hooks; Ж - capital fencing; Д - high Foundation.

**Figure 4.** Mounting map of the upper stabilization system of the soft fence: I, II, III, IV, V - axes of the rod spatial framework, axes of card tapes with schemes of connection of mounting panels of a soft protection; А, Б, В, Г, Д-sectors of the rod space frame and mounted soft fencing; 1.1 *1.2 – 7.7* - nylon halyards with clamps at the ends.

The layout and sequence of tensioning halyards:
- Spread the files over the shell surface according to the scheme
- fix one end of files across all sectors
- to make tension and fixing of files in т. 1*-7*
Sectors А and Г (tension produce from 1-7 synchronously in А and Г)
To produce tension and fixation of the shaft – sections Б and Д
To make tension and fixing of files-sections В.
Installation of a soft barrier of a rod spatial dome according to the method No. 2 is allowed at a wind to 5 points. Taking into account the order of fastening of hooks, we establish Poppet suspensions to the bearing cable system—see the scheme (Fig. 5). To fix the axial lanyards to the anchors of the "high" Foundation, you need to raise the cord tape with the clamps on the axis on the overlap of the projection room. Then install and tension the halyards of the coving - the lower the stabilization system (see Fig. 5.6);

Installation of the upper stabilization system files is as follows:
1. Arrange the files according to the diagram (Fig. 4);
2. Pin one end of the file (see Fig. 4) retainer;
3. To produce tension and stabilization of the file (Fig. 4); clamps; * before installing the files on a soft fence, moisten them (put them in a container with water for 4-6 hours).
4. Producing axial tension of the lanyards;

Lower switaerland apron is assembled from separate panels of technical material (identical or similar to it) recommended size of panels-6000*800 mm* (dimensions of the flag are determined from the conditions of their transformation in the period of operation for airing or closing it from excessive aeration during the cool period). Light-aerating apron (Fig. 6), the upper longitudinal side is attached to the soft dome bracket by means of grommets or local fixation of the straps*, the lower longitudinal side in the area of the major wall fencing, apron attaches with clamps and the area of stained glass – transforming rope (or nylon) braces.

**Figure 5.** The map of installation of a protection by method No. 2: A-axes of support rods of a skeleton and cord tapes with schemes; B-capital fencing (brick walls, stained glass); A, B, V, Г, Д sector frame mounting panels МО; 1, 2, 3, 4, 5 – the sequence of attachment of disc suspensions to the bearing wall of the cable system.

Pre-at each stage, the hooks of the axial clamps are raised and mounted. Stages of installation of soft fencing:
1) we hang МО for the Central hook and its fastening with the Central fishing rod
2) subsequent suspension according to the scheme 1,2,3,4,5 sequence of fastening of Poppet suspensions to a bearing wall of cable system; B-capital fencing (brick walls, stained glass).
Before proceeding directly to the dismantling of soft fencing, it is necessary to carry out a stage of preparatory work and check all the risks (industrial, fire, technological and environmental). [8-14]

First, you need to prevent soft fencing (MO), namely to wash the surface using pumps and allow time to dry, and then conduct a visual examination of the soft fence from the inside (the lumen) to identify defects in the bearing base of the material – through holes, the sprawling power of the base fabric, wear protective shielding coating; the detected defects apply to schemes of the respective mounting panels.

Next, it is necessary to dismantle all the "mobile" equipment of the interior, dismantle and disable all internal electrical equipment. It is also necessary to cover all sharp and protruding objects of structures and equipment, to cover the projection room, the lighting unit, the perimeter of the top of the capital walls.

After you want to wash and dry the dome area.

Dismantling of the soft fence begins with the fact that it is necessary to loosen the Foundation and disconnect the axial lanyards and clamps of the halyards of the upper stabilization system.

Dismantling of halyards of system of stabilization occurs in the following sequence:

1. Dismantle the halyards of the upper stabilization system, complete, number each set and preserve for storage;
2. Remove the files in the bottom of the stabilization system, to complement, conserve on storage;
3. Dismantle the lower switaerland apron, to carry out the necessary maintenance work and to preserve;
4. remove the clamps from the hooks of the disc suspensions and axial clamps.

After it is necessary to fix one end of a mounting cable on the Central hook and to remove it from the Central suspension bracket, to disconnect mounting panels of sectors "G" and " D " on an axis on 2/3 of its length-from a base support and to establish mounting benches along axial joints.

To make dismantling of a soft synthetic protection it is necessary according to the scheme-Fig.6

Further, the disconnection of the mounting panels is performed by two installers simultaneously on each site.

Dismantling of Poppet suspensions MO occurs as follows:

1. Dismantling of Poppet suspensions is made by two assemblers on each site (one assembler from above a soft protection, another-from below) or one - at consecutive twisting of a mounting cloth;
2. To complete fastening fittings on containers (in five containers - on quantity of Assembly panels).
Figure 7. Soft fence dismantling map outline: a - axes of support rods of a skeleton and cord tapes with schemes; б - capital fencing (brick walls, stained glass); в - film projection; г-stage with a movie screen; A; Б; В; Г; Д - sectors of the frame and mounting panels MO; 1; 2; 3; ... No.-sequence of dismantling of hooks of Poppet suspensions and axial clamps.

3. Results and Discussion

As a result of researches the sequence of technological operations of installation and dismantle of the soft synthetic protection making the technological map is revealed and developed. Production by two methods, allows you to perform work more convenient method taking into account the weather conditions. Method №2 (without blowing the shell) is a more advanced version of the first. It can be used when the wind speed reaches 5 m/s, as well as for installation work involved a smaller number of devices and parts.

Project risk management involves a set of methodology, methods, technical and software tools used in the design and implementation of projects, in this case in the field of housing and communal services, that facilitates the consideration and minimization of risks, ie unique processes that are time-limited and resource-intensive. [15-22]

A significant part of models and mechanisms for managing project risks are optimization problems, which are, as a rule, complex and multiextremal. [22-26]

Dismantling works are carried out with the use of schemes of mounting panels. Two installers are involved, which is the most important role-after the preparatory work, at the same time to disconnect the mounting panels. This operation is performed on each site. [27-29]

4. Conclusions

The technological map on performance of works on installation and dismantle of a synthetic awning which installation should be made in the described sequence is developed. A group of basic requirements for the structure of the frame, to the volume-planning solution of the dome space, to technological structures and storage of the coating during the winter period is revealed. The initial provisions of the methodology for the study of installation and dismantling works and the loads arising from them are found. Installation of the awning was successfully performed in the summer of 1967, the spring of 1968 and 1969, and dismantling in the fall of 1968 and 1969. The work was carried out efficiently and in the shortest possible time. The effectiveness of the selected solutions was tested.
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