

Zeitschrift:	IABSE structures = Constructions AIPC = IVBH Bauwerke
Band:	2 (1978)
Heft:	C-4: Structures in the USSR
Artikel:	A long-span space structure of a sports complex of the Central Sports Army Club (TSSCA)
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DOI:	https://doi.org/10.5169/seals-15109

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16. A Long-Span Space Structure of a Sports Complex of the Central Sports Army Club (TSSCA)

Design Institute: TSNIIiproektstal'konstruktziya, USSR

Dimensions:

Size of the building in plan: 110 x 306 m

Main span: 84 m

Material:

Steel grade for the main structures: C 46/33

Mass:

Steel consumption per m² of the roof: 115 kg

Loading:

Design load: 650 kg/m²

A steel frame of a space structure with a long-span roof made of prestressed units first worked out in TSNIIIPSK is designed for a covered Olympic Sports Complex of the Central Sports Army Club. The building size in plan is 110 x 306 m. Two main halls of the building will accommodate a football ground as well as track and field athletic ground with stands for 11'000 spectators.

Game halls, service rooms and other auxiliary rooms are disposed in the middle multistorey part of the building.

The span of main halls is 84 m.

The steel frame may be structurally divided into three parts. The middle part of the building is designed as a core, taking all horizontal loads acting in a longitudinal direction, constructed as a system of multistorey frames with a column spacing 12 x 12 m and its sizes in plan are 48 x 110 m.

The frames of the halls with the sizes in plan 126 x 110 m join the central core. A lateral rigidity of the adjoining frames is ensured by a knee-brace, formed by columns and stringers of the stands. Continuous rafter I-beams 120 cm high are provided in the plane of the main columns and are used during the erection for moving the roof units. The roof of main halls spanned 84 m with cantilevers 13 m each is formed of space units of 2.5 x 110 m size and alternate height,

consisting of space erection members 12 m long each. Erection members are assembled of flat pre-stressed and completely pre-fabricated panels. The panels are designed as the frame made of rolled angles with a stretched thin sheet steel skin. The panels form a space erection member by means of a cross lattice made of separate angles. The lattice is secured by high-strength bolts.

In the roof aeration skylights are provided along the erection unit spaced at each 24 m which are also used as expansion joints.

The advantage of this long-span structure are as follows: combination of supporting and enclosure functions; thin steel sheeting due to its pre-stressing takes vertical and horizontal loads; lack of lateral bracing at the level of covering — pre-stressed sheeting plays its role; the rigidity of the structure is considerably increased and the structural height is decreased; the sheeting of the upper chord plays additionally the role of a damp-proof layer and takes local loads and the panel sheeting of the lower chord serves at the same time as the floor of the service story and the room ceiling.

The erection unit structure gave an opportunity to fabricate large pre-stressed panels of 2.5 x 12 m size at an automated flowline at the shop and to carry out an industrial erection by units at flowlines.

A total steel consumption for the frame of the sports complex was 6'640 t; consumption of low-alloy steel 3'899 t.

Steel consumption for the roof at the design load equal to 650 kg/m² and the span 84 m was 3'793 t or 115 kg/m² of the roof.

The new structural solution of the roof gave 5 per cent of steel saving and reduced the construction period by 1,5 year.

(P.N. Troitsky,
I.L. Ruzhansky)

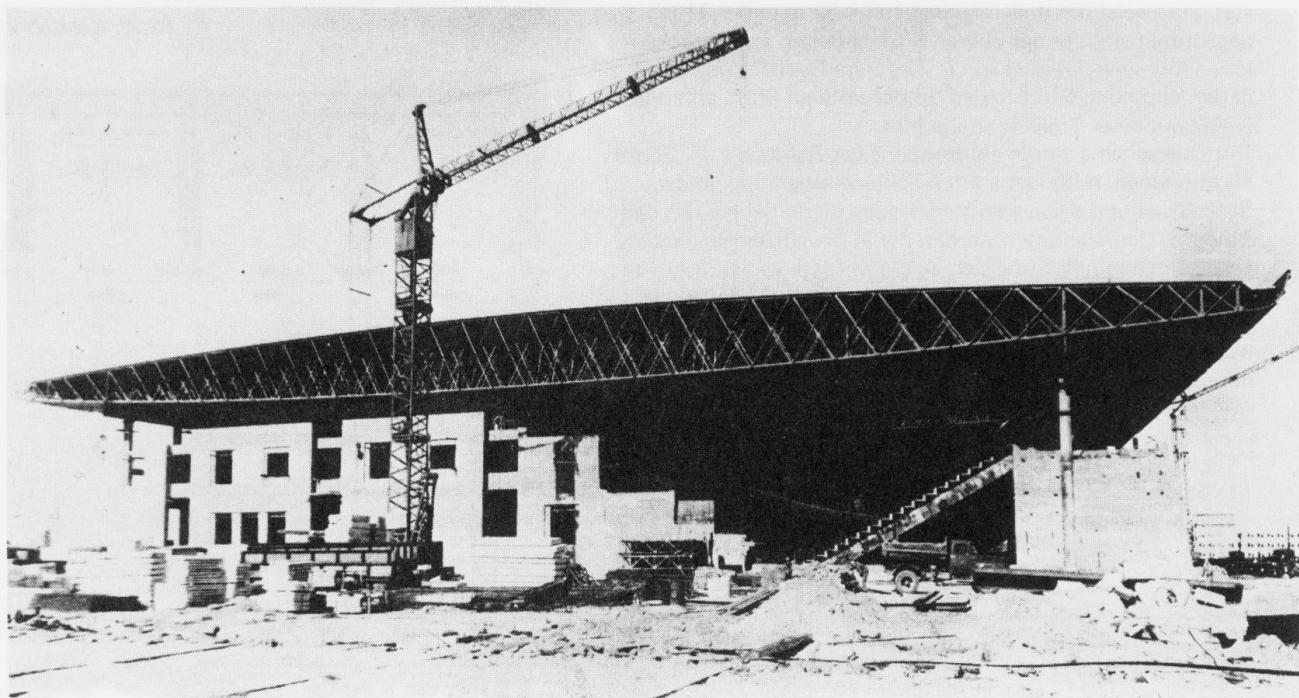


Fig. 1 General View of the Construction