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REINFORCED CONCRETE FRAME CONSTRUCTIONS FOR INDUSTRIAL BUILDINGS

Generalization and the analysis of experience of designing and construction of single-storied industrial buildings from reinforced concrete constructions is lead.

Проведено огляд і аналіз досвіду проектування і будівництва одноповерхових промислових будівель з рамними залізобетонними конструкціями.

constructions effective, reinforced concrete frame, single-storied industrial buildings

Introduction

Single-storey reinforced concrete frames were very popular for industrial, civil, agricultural buildings in the former USSR in the 80−90s of the 20th century. Nowadays it is important to find out what patents and inventions have been made for the last years in the leading countries. The generalization and analysis of single-storey buildings in reinforced concrete frame constructions was led at the department of computer technologies of construction of the airports faculty under supervision of Professor V.N. Pershakov.

The researches and publications analysis

Reinforced concrete elements are used in various engineering constructions, which depending on the constructive form and purpose, can be divided into the following kinds.

1. Prefabricated reinforced concrete frame (fig. 1) with straining beam.

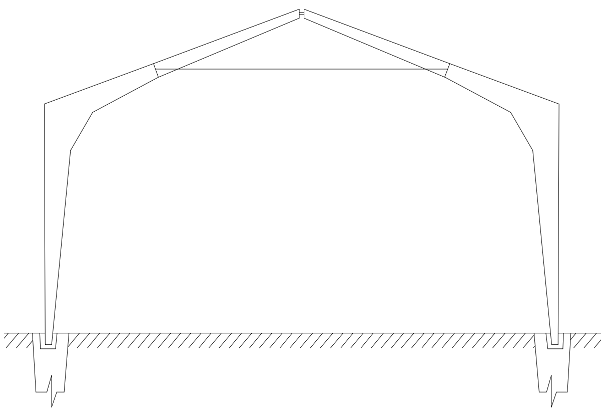

Fig. 1. Prefabricated reinforced concrete frame

Frame of such building include “angle” type subframes and span insertions. Elongated elements of subframe form column of prefabricated frame and shorts elements of subframe form part of composed crossbar. Nodes of junction of span insertions with crossbars are connected by straining beam [1].

2. Reinforced concrete frame (fig. 2) with straining beam.

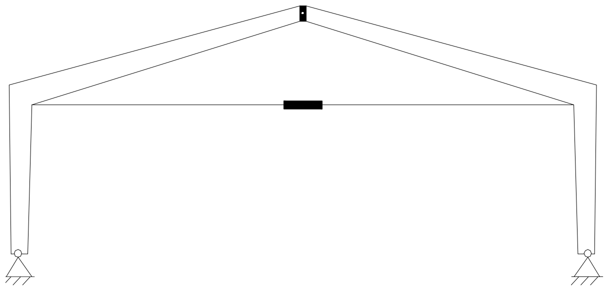

Fig. 2. Reinforced concrete frame with straining beam

Frame consists from two subframes, joined by straining beam, which include clutch for tensioning and weakening of rods. Clutch allows regulating stiffness of construction and frequency of own oscillation, which makes them different from forced oscillation of vibroactive equipment [2].

3. Frame of skeleton building (fig. 3) includes “angle” type subframes, with incline crossbar and stake of aeration lantern.

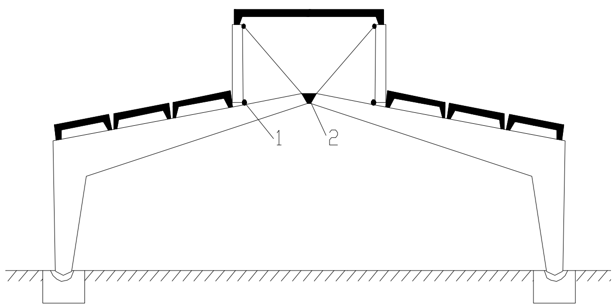

Fig. 3. Frame of skeleton building:
1 − Hinged connection with stake;
2 − Hinged connections of beams

With usage of hinges crossbars of subframe are joined between themselves and with bottom end of stake. Stakes joined with crossbar vertically or in an inclined way. Slabs of covering are supported by inclined crossbars and upper end of stakes [3].

4. Prefabricated frame of multispan building with straining beam (fig. 4).

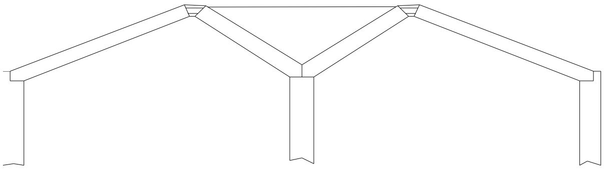

Fig. 4. Prefabricated frame of multispan building with straining beam

Crossbars of double frame from multispan building are of various lengths. Short crossbars are mounted on the middle column. Ridge nodes of frame are connected by straining beam. Prefabricated frame of multispan building consists of columns which supports crossbars. Optimal ratio of crossbar lengths is 1:2 [4].

5. Construction is the same as in previous case (fig. 5).

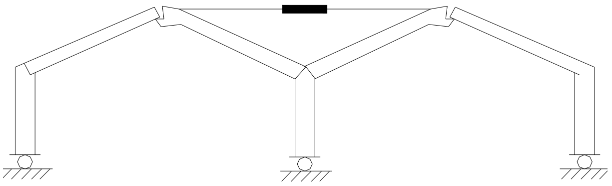

Fig. 5. Multispan frame with straining beam

But with one significant difference straining beam has clutch for tensioning and weakening rods. Such multispan prefabricated frame is very good for using vibroactive equipment [4].

6. Prefabricated frame of multispan building with straining beam (fig. 6).

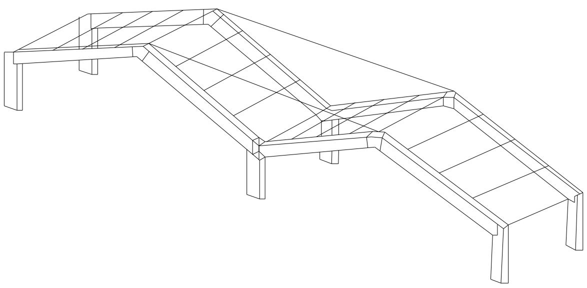

Fig. 6. Frame of multispan skeleton building with straining beam

Frame consists of columns which support crossbars. Joint between columns and frames can be rigid or hinged, and respectively joint between column and foundation is hinged or rigid. Crossbars are jointed with each other hingedly with the help of plate and bolts. Straining beam is connected to ridge nodes. Sometimes clutch can be used for tensioning and weakening rods. Economic effect of such construction is in series manufacture of frames of big height [3].

7. Frame reinforced concrete construction (fig.7) consists of two hingedly joined subframes in the ridge, which include crossbars and columns, reinforced concrete lattice beam with parallel chords, connected rigidly to crossbar.

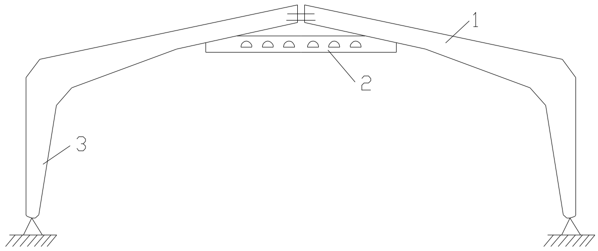

Fig.7. Frame of reinforced concrete construction:
1 − Crossbar of variable cross-section;
2 − Reinforced concrete lattice beam;
3 − Column of variable cross-section

Usage of lattice beam in the level of crossbar changes character of moment distribution in frame and reduces moment design value. This gives possibility to reduce consumption of concrete and reinforcement. Lower reinforcement chord of reinforced concrete beam receives tensile strain. Reinforcement consumption is lower if compared with metal straining beam [1].

8. Prefabricated reinforced concrete construction (fig. 8).

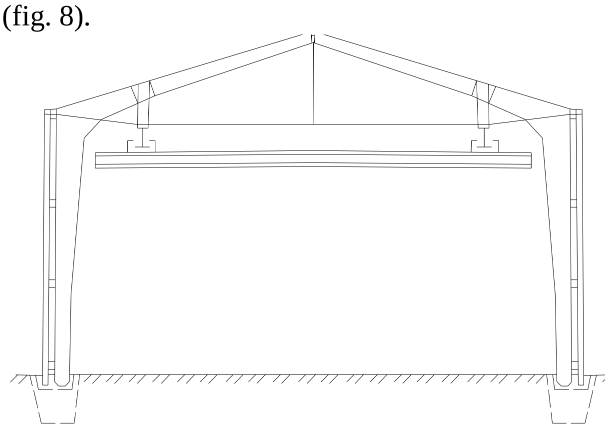

Fig. 8. Skeleton reinforced concrete construction

Frame consists of “angle” type subframes, rigidly connected from outside with plate. Plate includes prestressed rod elements which are fabricated separately. Span insertions and vertical cantilever for mounting crane rail of crane beam are connected to subframes in the zones of minimal bending moment. Prestressed straining beam is mounted in cornice nodes of frame with breaking it in the axis of sliding support for vertical cantilever [5].

9. Skeleton of construction (fig. 9) includes prefabricated three hinged frame with straining beam, girders,spillway tray on the roof, short reinforced concrete supports.

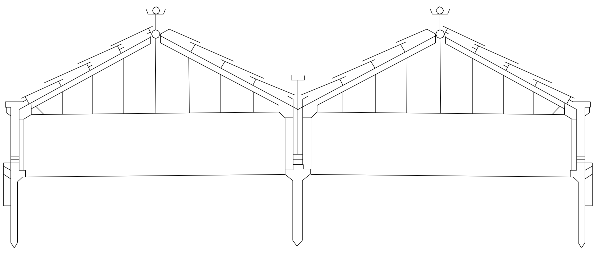

Fig. 9. Frame of bearing constructions of multispan building

Each frame consists of two prefabricated subframes. They are joined hingedly in ridge which simplifies their erection and transportation [5].

10. Prefabricated frame (fig. 10) consists of column, crossbar and node of joint, which include wedge-like gap, embedded elements from outside and inside of column and crossbar that provide possibility of rotation relatively to column.

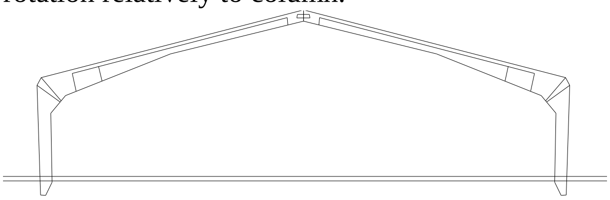

Fig. 10. Junction of column and crossbar of subframe

It is not necessary to use work of highly quail ficated mounter to install such a construction. Work can be done in inconvenient weather conditions. Construction of node joints is simplified, mounting duration is shortened [4].

11. Building includes three hinged frames (fig. 11) from two subframes with equalizing console, covering and wall slabs. Subframes are supported by foundations.

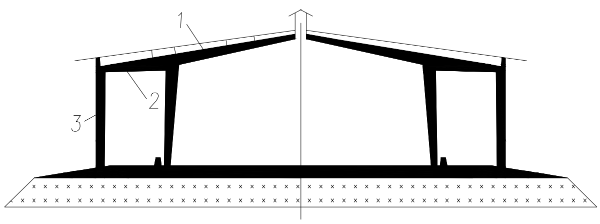

Fig.11. Frame construction of building:
1 − Subframe;
2 − Equalizing console;
3 − Wall slabs

Wall slabs are hung to consoles. Building also includes large sized floor slabs, situated in marginal spans and hung to wall slabs. Wall slabs are connected with subframes and floor slabs and make closed system which provides stability of frame [6].

12. Skeleton of agricultural building (fig. 12) consists of three hinged frames, made from “angle” type subframes and are connected with each other by distance bar.

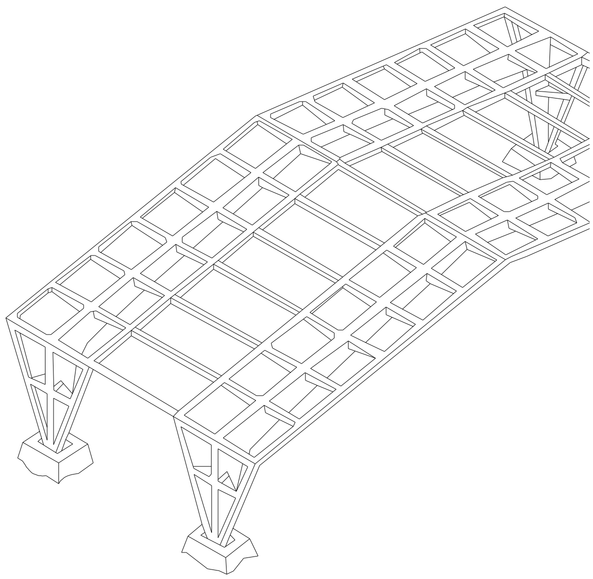

Fig. 12. Skeleton of agricultural building

Columns and crossbar of subframes include transversal console ribs and contour longitudinal ribs which make space construction of frame. Frame is supported by foundation. Construction solution of walls may vary [3].

These constructions have different benefits. All inventions are aimed at lowering material, labour and transportation consumption, increasing stability and safety of building frames. Also frame of reinforced concrete building is protected from fire. Concrete is completely non-combustible and has a slow rate of heat transfer, making it a highly effective barrier to spreading fire.

Conclusion

Construction should not just strive at achieving the cheapest building possible, but at providing the best benefits. It may be costly and may also include speed of construction, durability, sustainability issues, lettable space, etc.

Concrete is one of the most versatile, durable and cost-effective building materials. Concrete's range of structural solutions, its thermal efficiency, inherent fire resistance, acoustic and vibration performance, durability and low maintenance show that concrete can offer best value solutions.

Concrete frame construction has changed over the past twenty years and it continues to develop. The recent rises in reinforcement and steel prices have increased frame costs but the difference between steel and concrete frame costs remains insignificant.

Any alternative to steel frames would have not only to be of comparative cost but also offer better programme times and be an architecturally attractive option for designers and structurally have the ability to be easily used with non-concrete components. In addition, the structural solution should have widely available components and resources from competitive specialists.

With all their benefits, it is surprising that the use of concrete frames for industrial buildings is not very widespread .One of the main reasons for this may simply be inertia. The continued rise in steel prices and the development of a viable concrete option will do much to address this. In future, the new technologies of industrial reinforced concrete frame construction may make a real alternative to the "tin shed".

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