Tall building construction: some aspects of planning and organization

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Abstract
Tall building construction is a complex process requiring a special approach for its implementation. The paper deals with two general aspects of this process: planning and organization. Thorough description is given to development of the scheduling and network planning and organization methods in construction management.

Keywords: tall building, construction, planning, organization

1 Introduction
Taking into consideration the importance of the National project “Moderate and comfortable housing, to the citizens of Russia” and federal special program “Dwelling”, investment and construction sphere has the task to increase considerably technical and economic level of the construction, as the industry of material production, and to aim it at the solving of social issues of Russian population, to decrease the construction products cost, to shorten the schedule. Undoubtedly, this task is to be solved on the basis of advanced experience in technology and building process organisation, new building materials implementation and also in detection of the reserves providing the rise of investment effectiveness.

For this aim Moscow Government makes active steps for intensification and increasing of effectiveness of city construction complex and especially of the sphere of investment and construction cycle management which the principle points are considered to be:
coordination of the activity according management levels: building object – municipal district – administrative distric – structural departments of executive authority and construction complex;
formation of actual and forecast parameters of investment and construction programs;
development of the city build-up management information systems;
creation of rational management decision-making system.

To solve this problem the system of measures on effective cooperation of subjects and participants involved in city program realization on basis of their potential, progressive legislative and law-regulatory base which considers characteristics of capital. At the same time much attention is given to creation and use of network models of management of tall building construction city programs in Moscow.

The main aim of this research was to improve the management of tall building construction process in Moscow on basis of network planning methods and introduction of automates systems of network modeling in the practise of construction organisations during planning or execution phases on tall buildings.
2 Analysis of planning aspects

Scheduling and network planning are based mainly on technological methods of building construction. Planned schedule can be presented in different ways: linear graph, cyclogram and network diagram.

Schedule is used to determine for certain period of construction following data:
- distribution of capital investments;
- accomplishment of building and assemble jobs;
- basic material, technical and human resources requirements.

Schedule is designed for two construction stages: preparing period and main period. Taking into consideration the complexity of the latter, the main period in its turn can be divided in two additional periods—foundation laying and above-ground structure erection (Арутюнов et all, issue2, 2008).

The basic aims to be implemented when design construction scheduling are:
- the development of building and assembly job rational organization;
- determination of construction terms and terms of putting some parts of the complex into operation;
- effort estimation in certain periods;
- effective distribution of investments;
- determination of terms of the main structures, equipment, materials supplies;
- determination of the periods when traffic close by the site is limited and determination of the date when services and roads will be put in operation;
- determination of the dwellings and offices realization.

Initial data for scheduling are:
- project materials (general layout, construction and estimating parts and so on);
- normative or specified duration of building or complex construction;
- construction process conditions;
- the list of the main and auxiliary buildings and structures;
- effort, their estimation and resource capacity;
- information about availability of production plant of construction industry and the possibilities to use it further;
- information about conditions of supply and transportation of building structures, finished manufactures, materials and equipment;
- information about expected contractors and their qualifications;
- accepted decisions on construction organization methods and construction techniques;
- organization and technological schemes of single building erection and construction of the complex in whole, the division of the object and site into plots;
- similar projects, actual data about their accomplishment;
- data characterizing the contracting agencies and their material and technical basis;
- normative and reference codes

3 Analysis of organization aspects

At the stage of construction organization project assortment of the works included in scheduling should be enlarged and meet the following requirements: they should mark all the constant and auxiliary buildings and structures and the most scale works and also temporary structures of the preparing period; reflect the main stages of organizational and technical preparation and construction including foundation laying and above-ground structure erection; allow to determine the cost and resource capacity of the efforts (Арутюнов et all, issue5, 2008).

Scheduling at the stage of construction operation project provides for development of the complex network graph of building erection or its part which determine the sequence and the terms of work implementation with the maximum work combining and the normative time of construction facilities
operation. The need in human resources and the stages and work complexes accomplished by contracting agencies are determined too.

The development of the complex network diagram is recommended to carry out in the following order:
- to determine the input data of the project and detail the works, to determine labour-output ratio and estimate the constructive works;
- to develop initial network graph containing design, preparatory, main works and equipment supply distributed according to the stages, and also putting into operation;
- to collect and co-ordinate local graphs of works accomplished both general contractor and subcontractors;
- to analyse and calculate the graph after coordination of all graphs has been completed,
- to optimize the total network graph.

It is expedient to divide tall building construction into 4 cycles:
1) foundation laying;
2) underground structure laying;
3) above-ground structure erection;
4) roofing, finishing works of stairwells, elevator assembling;

The first cycle. If there is a “wall in soil” in building design, the main work at the stage of foundation laying will be “wall in soil” installation and then pile foundation laying or solid foundation slab laying concreted by the single block without division into plots.

The second cycle. Under underground structure of the building laying the main work is concreting of the underground structures. Depending on the size of the underground part of the building the effort is divided into certain number of plots for their flow accomplishment.

The third cycle. Under above-ground structure erection the main work is concreting of bearing structures or metal structures assembling. For long buildings every storey is divided into sites. For tall buildings this division is not necessary. In this case it’s necessary to organize flow construction simultaneously at several floors.

For this aim the building being erected is divided into floors, 8-10 stores are in 1 floor. At the top floors the works on structure concreting are carried out, at the bottom ones – the rest works.

The indispensable condition for such dividing is testing the ability of floor ceiling to withstand the random load fall from the certain height. If this condition is met, the dividing into floors is possible.

The construction works at the floor start from the first storey of the floor and can be accomplished in summer in this order:
- partition installing and wall heat-retention, then the workers move to the second storey of the floor;
- cabining of the first storey;
- walls and partitions plastering;
- sanitary engineering;
- preparatory works for floors;
- the preliminary finishing of the rooms;
- doors and windows installation;
- finishing of the rooms, electrical and sanitary devices installation.

In order to provide the works in summer the top ceiling of the floor should be dampproofed, and during winter period the floor should have the contemporary heating system.

The fourth cycle. The elevator assemble and roofing are accomplished after the main structures concreting has been finished.

The construction organization methods are determined by the type and degree of complexity of building objects and complexes.
When the object is complicated the choice of construction organization method should be based on quantity, uniformity and effort of specialized construction processes, technological interconnection of the processes in the total work complex and another organization conditions. At the same time it’s possible to combine separate and flow work organization methods.

When estimating the issues on organization process of tall building construction it’s necessary to determine the sphere of rational decisions from the point of view of sequence and methods of building construction. The consideration of organization principles includes:
- the issues on the spatial partitioning of the building into tiers, plots and sections;
- the direction and sequence of work development at tiers, plots, sections;
- characteristics of the main construction methods;

The initial data to develop and select organization schemes of building and assembly job methods are:
- building (complex) design decisions;
- the analysis of organization decision accomplished by the native and foreign experience for similar objects;
- information about material and technical potential of the companies employed in construction.

Developing organizing schemes it is necessary to proceed from the possibility to use effective erection methods providing the quality required and construction safety, which are fully realized under flow construction method.

Under tall building construction complex flow is organized involving all the range of building and assembly jobs. Forming the structure of building up complex flow one should take into account the complex content, building function, their design characteristics, characteristics of contracting agencies, equipment and other factors.

In order to organize the construction flow and provide opportune engineering preparation and the right sequence of construction technologies the duration of building process is divided into 2 periods: preparing period and the main one.

The works of the main periods start in general when preparatory works have been finished. During the main period underground and over ground parts of the main and auxiliary buildings are erected, the works on engineering facilities are finished, land improvement is conducted.

In order to organize the construction flow the structure is divided into horizontal tiers and vertical and horizontal plots which sizes can be equal or different.

The dimensions and limits of the tires and sections are determined by structural-spatial concept taking into consideration the requirements for spatial rigidity and firmness of the structures being erected.

The dimensions and number of plots may (and will) vary according to type of implemented works, at the same time the position of plot limits should let to stop and resume the construction works without harm to structural and work quality. When fixing the plots it’s necessary to take into account the possibility to fulfil different processes on the adjacent plots.

Technical and economical indicators included in explanatory note may contain the following data: the total duration of construction, including preparing period and period of instalment of equipment, maximum number of workers, man-hour of implementation of building and assembly jobs, the total labour-output ratio.

4 Conclusions

The result of given research is that the following tasks were solved:

- Analysis of scientific and practical works in the sphere of tall building design and development of organisation and technological documentation on object data was carried out. Characteristics of structural design of tall objects and technological aspects of tall building erection were revealed;
- Generalized network models on preparation and execution phase were elaborated;
- Methodical fundamentals of information maintenance technology and monitoring on basis of network modelling were developed in order to obtain true data at all levels of management of tall buildings investment and construction process.

Economic benefits are achieved due to effective management decisions adopted on the basis of full information, its variant consideration, shorten the time of formation and documentation quality increasing, probable reducing of management staff.

References
