Basic principles and experience of application of the flow-line production methods in construction

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Technical and economical progress in almost all branches of modern economy, including construction (irrespective of the social, economical and political system of a country) is due to the industrialisation and organisation of the technological flowline.

The flow-line method in building production is a scientific system (tried and tested in practice) which provides high efficiency of a technological process of construction, the most rational utilization of productive capacity of building organizations and their resources (workers, technical personnel, mechanisms, transport, building materials, financial means and so on).

The flow-line method has been successfully evolved and has found wide application in the Soviet Union where a great stride has been made from the flow-line development of small settlements to the flow-line high-speed construction of many housing, industrial, power, hydrotechnical, transport and agricultural projects.

Following the example of the Soviet Union, the German Democratic Republic, Czechoslovakia and other countries are extensively developing the flow-line methods of construction.

The application of flow-line methods has been recommended by the Committee on Housing, Building and Planning of the Economic Commission for Europe (UNO) and by the Board of the Construction Industry of the Constant Construction Commission (Council of Economic Mutual Aid).

The basic principles of the flow-line method of building production are determined by two main features: continuity and smoothness. By this we mean an uninterrupted and smooth execution of a technological process of construction with the full and smooth utilization of the productive capacities of building organizations and their resources;

- an uninterrupted and smooth supply of necessary building materials, structures and units;

- an uninterrupted and even output of building production (buildings, installations or their parts).

This calls for the following measures:

- to break down the general process of building production into constituent component processes;

- to divide the realization of these processes among the executing agencies;

- to create a production rhythm;

- to co-ordinate the constituent processes in time and space.

Accordingly, the flow-line construction method may be regarded as one of continuous and uniform output based on a breakdown of the total production process, the division of labour, the coordination and rhythmical execution of the elementary building processes.

Flow-lines are classified according to duration as follows: short-term flow-lines, the objectives of which are houses, buildings or their complexes; and continuous (long-term) flow-lines the objective of which is the program of a building or assembly organization of a certain productive capacity.

As to structure, flow-lines are divided into:

- primary flow-lines which represent the successive accomplishment of a process on a series of working areas (parts of a house or a building);

- specialized flow-lines (a series of partial flow-lines) are those of which the output consists of identical structural elements for one building or a series of buildings;

- whole-project flow-lines comprise groups of specialized flow-lines, the total output of which consists of complete construction projects or parts of such projects;

- complex flow-lines are a combination of organizationally related whole-project flow-lines for the output of buildings and installations of different types which form part of a single complex.

By the degree of development, flow-lines may be stabilized and non-stabilized, by degree of fragmentation they may be with partial or complete fragmentation of production processes (de-
Peculiarities of continuous flow-lines have been revealed; they provide the most complete application of production capacities of building-and-assembly organizations.

Methods for the calculation and definition of a completed output have been developed; they allow for the effect of the volume of construction work, the duration of project construction, the schedule of their completion, etc., on the value of a completed output.

Fig. 1. Cyclogram of the construction flow-line.

Characteristics of various flow-lines for different branches of construction have been determined; they provide accurate calculations of the main parameters of a flow-line and, consequently, the designing of the flow-line organization of construction. Corresponding instructions and forms have been developed.

In housing construction, a complex flow-line of the development of settlements and housing estates is also used for all jobs connected with the engineering accomplishment of the territory. In using a whole-project flow-line we break down the process of construction of dwellings and public buildings into four or more technological stages (erection of the underground part of the buildings and above-ground structures, roofing, trimming and other operations).

In industrial and power construction the designing of the flow-line organization of work follows after choosing the starting lines. A complex flow-line for the construction of industrial enterprises may number up to 20 whole-project flow-lines used for constructing all the buildings, communication lines, and so on.

In the construction of hydro-power projects, a complex flow-line consists of a series of whole-project flow-lines used for constructing hydro-power houses, shipping structures, dams, and so on.

In the complex flow-line of canal construction the whole-project flow-line of the construction of a canal bed itself is a leading one. In designing a canal (for sections with a different technology of excavation and fleet of machines and mechanisms) we use parallel flow-lines executed by complex and mechanized teams of workers.

The complex flow of underground railway construction consists of a series of whole-project flow-lines providing the tunneling of vertical and slope shafts, distillation tunnels, the construction of stations, and so on. The passing through distillation tunnels is a leading flow-line, carried out with a complex and mechanized flow-line section.

Territorially-separated construction (for example, agricultural construction) is used for constructing projects at relatively small costs which are separated one from another at the distance of many kilometres. In this construction, for the flow-line execution of work new forms of building organizations and their subdivisions have been implemented (complex mobile detachments, columns, teams and the like).

The preparation of plans for flow-line construction and the organization of its execution are governed by regulations.

The State Committee on Building of the Council of Ministers of the Ukrainian SSR issued "Instructions for the organization of the flow-line construction of housing developments" in 1961 and “Provisional Instructions for planning the flow-line construction of industrial enterprises” in 1963.

Provision is made for planning documents meeting the requirements of flow-line construction methods (irrespective of branches of construction) — standardised technological charts for building processes, standard technological specifications for unit building output and cyclograms showing the development of construction flow-lines in time and space.

The unique terminology has been worked out for flow-line construction methods and has been adopted both in the USSR and other countries. This terminology has been given to the Committee on Housing, Building and Planning of the Economic Commission for Europe (UNO) and to the Board of the Construction Industry of the Constant Construction Commission (Council of Economic Mutual Aid) for discussion and recommendation on their instruction, to all the countries concerned.

In the mass-sectors of construction (housing, industry, etc.), it is desirable to use the more efficient system of continuous flow-lines. House-building combines are playing an important part in the organization of house-building flow-lines extending over a number of years. Such combines make it possible to establish integral flow-lines beginning in building industry enterprises and ending at the building site with the commissioning of construction projects.

The special features of continuous flow-line production (long duration, selection of construction projects according to the predetermined production capacity of the building organization, series production, specialization, stability of complex material and technical supplies, high level of standardization) determine the prospects for its future widespread use in construction.

At present the laws of the continuous flow-line are used as a technological basis for the application of mathematical methods and computer techniques in building with a view to finding the optimum solutions for problems of the nationwide planning of construction. For example, the flow-line construction of a group of the greatest heat power stations in the Ukrainian SSR has been planned and is being executed.

In the organization of the flow-line construction, new ways of control for the construction progress with the help of electronic computer techniques and related network graphs are of great importance.

The efficiency of the flow-line method of construction is illustrated by several examples. Experience has shown that the time of housing construction carried out with the help of flow-line methods is reduced by 25–30 per cent, labour intensiveness is 1.5–2 times more than planned.

The Novokrivrozozye ore beneficiation combine in the Ukrainian SSR has been constructed in a period of 26 months (using flow-line methods) instead of 40 months (as per usual norms), which provided additional benefits in about 1 million tons of fine concentrate.

The flow-line construction of the Zhdanov 1700 MW was completed in 15 months, i.e. 1.5 times faster than was planned.

The flow-line construction of the Krementchug hydro-power station (625 thous. kw capacity) was completed 2 years earlier than the period stated in the plan.

The transition of the construction of the distillation tunnel of the Kiev subway to the flow-line method made it possible to complete its construction twice as fast.

The theory and practice of flow-line construction serves as a basis for the establishment and development of scientific research in building production.

The Research Institute of Building Production operating in Kiev deals with the elaboration of the flow-construction theory and its practical application in housing, industrial, rural and hydrotechnical construction. Working in this field also are the chairs of the Kiev, Kharkov, Novosibirsk, Rostov and other civil engineering institutes.

International co-operation, to which the Soviet Union, the Czechoslovak Socialist Republic and the German Democratic Republic are contributing, has already been established among scientists and practitioners concerned with flow-line construction methods.

In conclusion the author expresses the hope that the discussion
of the problems raised in the paper will promote still better international co-operation in this field.

References