

System Approach of Organization Methods and Ways of Road Construction Mobilization

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Abstract. The schedule of work is one of the main documents of the programme of work. It reflects the decision on the organization of work, the chosen organization method and the way of its mobilization, the sequence of technological processes, the arrangement of equipment and workers in private flows, contains other production and technical information. Profit is created in the sphere of material production, but it gets its specific form at the stage of circulation in the process of selling products, works or services and various non-sales operations. In a market economy, profit is of particular importance. It is a source of self-financing of the economic and social development of an enterprise. Profit is one of the summarizing indicators characterizing production efficiency. It reflects the final financial result of production and economic activity of an enterprise. Profitability characterizes the final financial result and the efficiency of production and economic activity.

1. Introduction

These main economic indicators largely depend on the organization of the highway construction work (proper arrangement of equipment and labour resources, the degree of use of fixed production assets, and the coordinated work of production units in the production process). These issues are solved in the process of production planning and management. In this case, an important role is played by the choice of the organization method and the way of work mobilization. These issues constitute the content of this paper [1,2,3,4,5,6,7,8,9].

First of all, it is necessary to deal with the very concepts of “Organization of construction” and “Organization of construction work”. They are interpreted differently in different sources (figure 1).

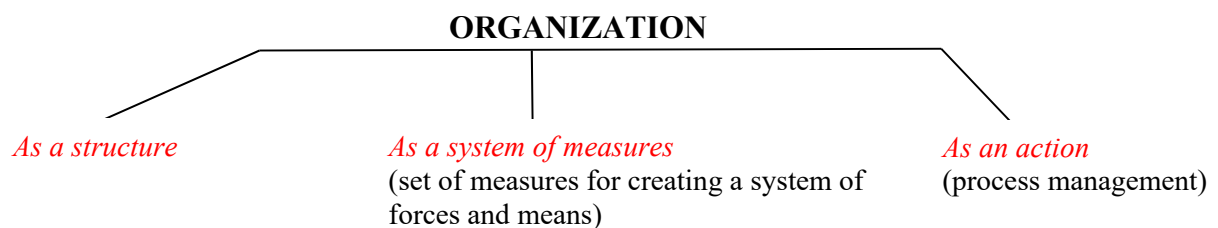


Figure 1. “Organization of construction” and “Organization of construction work”



2. Materials and Methods

The method of work organization can be considered as an activity for the alignment of all elements of a particular object, system in time and space. In this sense, the organization of road construction work involves the arrangement of equipment and workers at construction sites and their use in the course of work.

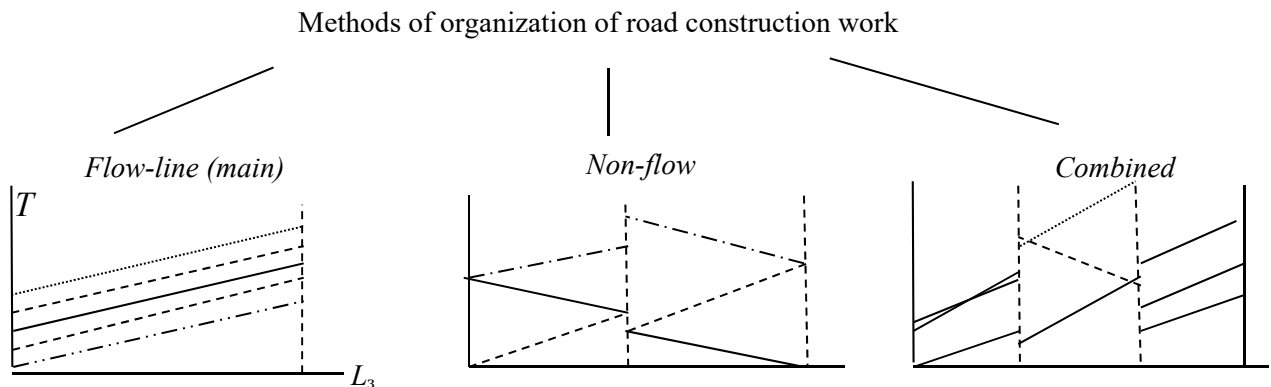


Figure 2. organization of road construction work

The main feature of the *flow-line method* is the specialization of units in the performance of a strictly defined type of work.

The main ideas of the flow-line method:

- after the completion of work by the last unit, finished products are issued continuously and rhythmically at certain intervals (as a rule, every shift);
- works are performed by specialized units (private flows);
- each specialized unit is assigned to its own area (work zone);
- flows may have a different pace of work, so the pace must be coordinated;
- the aggregate of private flows forms a complex flow.

3. Results and discussions

1. Required pace of work:

$$V_{pw} = L/[T_s - (\sum t_{loss})], \text{ m/cm or m/day,} \quad (1)$$

where T_s — specified construction period; t_{loss} — (loss of time due to bad weather (t_{bw}); flow mobilization (t_{mob}); days off ($t_{d.off}$); time of routine break (t_{rb}); reserve time (t_{res})).

2. The length of the work zone (a_{wz}) or (a) — the area in which one specialized unit performs the entire set of work assigned to it. It must be equal to V_{pw} or exceed it.

3. Time of the flow mobilization t_{mob} is the time from the first private flow entering the road to the last private flow entering it:

$$t_{mob} = t_s [(n-1) + m + k], \quad (2)$$

where t_s — flow step (time to complete one work zone; for $t_s=1$, the work zone is completed for 1 shift; for $t_s=0.5$ — for half shift); n — the number of private flows; m — the number of reserve work zones; k — the number of routine breaks per work zone.

4. The length of the complex flow (or the front of work in progress):

$L_{fr} = \sum a_n + \sum a_m + \sum a_k$ — the total number of main work zones, reserve work zones, and routine breaks per work zone.

5. Period of steady flow:

$$T_{st} = T_s - (t_{mob} + t_{demob}). \quad (3)$$

During the period of steady flow, finished products are issued.

Flow parameters are shown in figure 3.

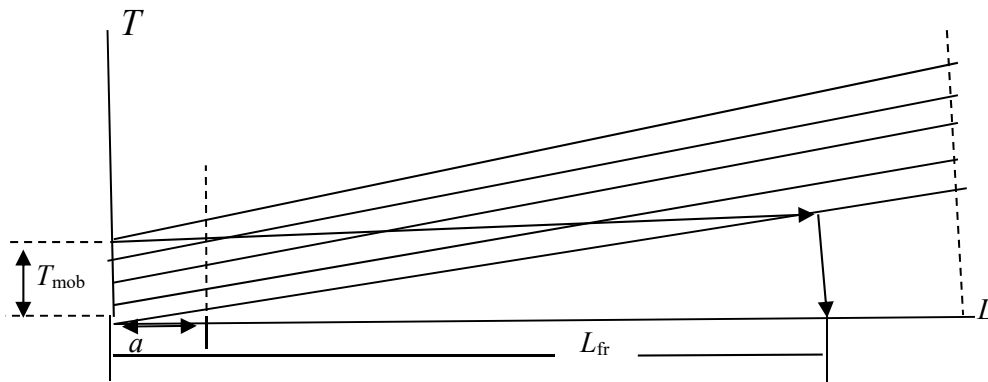


Figure 3. Parameters of the flow-lie method of work organization

Non-flow method is used in the construction of areas of small length, when the time of flow mobilization is commensurate with the construction time, and also in areas with large concentration of work (deep excavations, high embankments, approaches to bridges and overpasses, etc.). It is common in the overhaul and reconstruction of roads, when the work area is limited and does not allow the flow to be expanded to a length L_{fr} .

Advantages of a flow-line method:

1. High quality of work, caused by its narrow specialization.
2. Finished products are issued continuously (in the case of a non-flow method, a gravel base can be laid on the whole area, on which cars will run, and it will be contaminated before laying asphalt concrete).
3. The pace of construction is significantly higher than with a non-flow method.

Disadvantages of a flow-line method:

1. The presence of the mobilization period, when the equipment of the latest flows stands idle.
2. The large length of L_{fr} , which reaches several kilometres, does not allow it to be used for the overhaul and reconstruction of roads along which the transit movement of cars does not stop.
3. The need for an equipment in the flow-line method is significantly higher than that of the non-flow method. Disadvantages of the flow-line method are advantages of the non-flow method and vice versa. The same can be said about the advantages of both methods. The way of work mobilization characterizes not the arrangement of equipment and workers within the flows, but the arrangement of construction organizations and enterprises along the length of the road under construction.

There are two ways of mobilization of road construction work:

- “from the head” or from one point;
- on a wide front.

The essence of these ways is shown in figure 4 and figure 5.

The second way is characteristic for the construction of long roads, when they pass through the territories of several administrative territorial entities, each of which builds a section of the road using its own road-building organizations on its own territory. This is how the roads Don, Crimea, Amur and others are built.

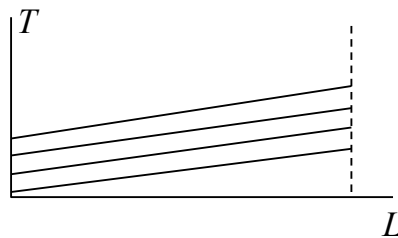


Figure 4. Way of mobilization “from the head”

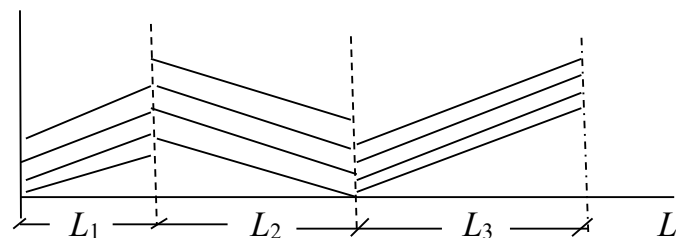


Figure 5. Mobilization of work on a wide front

The mobilization of work on a wide front allows reducing the time of commissioning of the road [10,11,12].

4. Conclusions

Today, there are no strict methods for assessing the efficiency of work organization methods. One of them was proposed by Professor Mogilevich V.M. (SIBADI) in the 70s of the last century. It is based on the calculation of the coefficient of conditional efficiency of the flow E_f :

$$E_f = T_{st}/T_d = [T_d - (t_{mob} + t_{demob})]/T_d, \quad (4)$$

where T_{st} and T_d — the time of the steady flow and the directive period for the construction of the road, respectively.

It is obvious that E_f is less than 1.0, and the flow efficiency is higher if E_f is closer to unity.

The author recommends the following intervals of the values of E_f and the levels of efficiency associated with it:

- with $E_f > 0.7$, the flow-line method is effective;
- with $0.30 \leq E_f \leq 0.7$, both methods of work organization are equally effective;
- with $E_f \leq 0.3$, the non-flow method is more efficient.

This approach does not stand up to strict criticism for the following reasons:

- the SIBADI methodology uses only one efficiency criterion - the time of work performance. In the market conditions, it is not the main one, since the main are economic criteria (construction cost, profit, profitability);
- the values of E_f are accepted “a priori” and do not have a strict justification.

Apparently, the assessment of efficiency of the organization method and the way of work mobilization should be based on a set of criteria (economic, mathematical and production), which should include: cost and actual cost of work, profit and profitability, the level of use of fixed production assets, taking into account their idle time in the period of mobilization and demobilization of works, completion date of the construction.

The organization of the production base and ensuring its rhythmic work largely determine the rhythm of the construction process, its technical and economic indicators. In recent years, calculation methods have appeared, which are based on probabilistic planning and the use of economic and mathematical methods for designing transport structures [1–9, 13–16].

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