Method For Determining The Minimum Number Of Sorting Routes Depending On The Length Of Wagon Groups

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ABSTRACT

Currently, the formation of multi-group freight trains in accordance with the established procedure at all marshalling yards of JSC "O'zbekiston temir yo'llari" is carried out on the basis of the experience of the relevant personnel. Therefore, one of the urgent tasks is to improve the process of forming such trains based on the introduction of information technologies. This article analyzes the number of train assignments by type in terms of train formation and concludes that due to a decrease in the share of single-group trains by 93% over the past 5 years, the share of multi-group trains has increased by 31%. A method has been developed for determining the minimum required number of marshalling tracks depending on the length of a group of wagons using the Fibonacci number, and the results of the implementation of the developed method at the Chukursay marshalling yard are shown.

Keywords: Train formation plan, single-group trains, multi-group trains, modular train, operational planning, marshalling yard, Erlang distribution law.

In the world, one of the leading places is taken by the use of information technologies and tools for finding the best scheme of routes for the transportation of goods and a technical and economic assessment of possible options for the delivery of goods. Globally, in rail transport, the speed of delivery of goods is 230-250 km / day and the value of this indicator is 1.5 times less than that of other modes of transport, and given that the main reasons are associated with idle time of cars at loading and unloading, intermediate and technical stations [1], then it becomes necessary to introduce information technologies into the transport processes of organizing car flows with the timely delivery of loaded wagons. In this regard, the use of information and energy-saving technologies,

The number of train assignments by their types in terms of the formation of trains, developed with JSC "O'TY" for 2016 / 2017-2019 / 2020, has been analyzed (table 1). As a result, it was concluded that due to a decrease in the share of single-group trains by 93% over the past 5 years, the share of multi-group trains increased by 31% (including 19% accounted for by combined-section trains), and the technology is not sufficiently substantiated from a scientific point of view. operational planning of the movement of sectional trains, depending on the volume of car traffic.

The indicators of the idle time of transit wagons with processing by years at the main railway stations of JSC "O'TY" are analyzed. As a result, it was found that the standard idle time of transit wagons with processing at main railway stations increases. This, in turn, required the definition of a scientific direction for the organization of local car traffic based on information technology. It was found that the main reasons for the failure to fulfill the expected results of the analyzed indicators are associated with the performance of technological operations for the processing of car flows and the formation of multi-group freight trains in the prescribed manner at main railway stations based on the experience of the relevant personnel.

A number of scientists were engaged in research work to improve the performance of the marshalling yards [2-10]. Over the years, they have achieved positive results in their research in this area. However, research on improving methods for determining the minimum required number of sorting tracks depending on the length of a group of wagons on the basis of information technologies has been insufficiently performed.

In the course of the study, based on Fibonacci numbers, the relationship between the number of groups in a multi-group train with the minimum required number of sorting tracks was determined [11-12]. The scheme, drawn up on the basis of this relationship, allows the relevant station personnel to determine the minimum number of marshalling tracks required to form a train, depending on the number of groups in the train.

In production, the disbandment of trains is carried out not only on free sorting tracks, but also on free parts of the track. This, in turn, requires checking the possibility of placing a group of wagons on the planned track of train disbandment.

Table 1

Results of the analysis of the number of train assignments by their types

No. p/p	Classification of trains	Kind of trains	Number of train assignments by year				Change in 2020 compared to 2016	
			2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	(+) increase	(-) decline
1	Single-group trains	Through trains	55	61	64	64	16%	-
2		Plot trains	9	7	9	7	-	13%
3		Routes from loading points	5	1	3	1	-	80%
4		Container trains	0	0	1	0	-	-
5		Route trains	10	3	8	10	-	-
		Total	**78**	**72**	**85**	**82**	**16%**	**93%**
6	Multi-group trains	Groupage trains	32	30	30	27	-	16%
7		Export trains	19	15	18	14	-	26%
8		Transfer trains	35	36	39	39	12%	-
9		Prefabricated section trains	63	60	62	75	19%	-
		Total	**149**	**141**	**149**	**155**	**31%**	**42%**
Total			**227**	**213**	**234**	**237**	**25**	**15**

As part of the study, a method has been developed for determining the minimum required number of sorting tracks depending on the length of a group of wagons using the Fibonacci number. In this method, a group of wagons previously received at the station is placed on the track of the sorting yard by destination. Here, the length of the filled part of each sorting path is determined by the formula:

$$L_{(i)fill} = \sum_{l=1}^{j} L_l^{cut} \quad (1)$$

Here L_l^{cut} is the length of a group of wagons dismantled from the hump, m.

Based on the processing of statistical data, it was established that the length of a group of wagons in a multi-group train of one destination obeys the Erlang distribution law. After determining the value $L_{(i)fill}$, the condition is checked $L_{(i)fill} \geq L_{comp}$ (where L_{comp} is the set length of the train, m).

Fulfillment of this condition means that the train is fully accumulated according to the length norm, otherwise it will be possible to dissolve the next group of wagons on this track. The possibility of dissolving a group of wagons on a specific track is checked based on the following conditions:

$$L_{(i)fill} + \lambda_i \cdot L_l^{cut} \geq L_{comp} \quad (2)$$

Here λ_i is a Boolean variable reflecting the dependence of the length of a group of wagons in a train planned for dismantling on the length of a specialized sorting track

$$If\ \lambda_i = \begin{cases} 1, \text{ that, a group of wagons are disbanded on a specialized track;} \\ 0, \text{ that, a group of wagons are disbanded on a non-specialized track.} \end{cases} \quad (3)$$

If condition (2) is satisfied, then a group of wagons is placed on the given track along the length, otherwise it is required to search for another track or a free part of the track to be dismantled from the hump.

According to the plan for the formation of trains of JSC "O'TY" station "Chukursay" forms trains for a total of 17 destinations. Of these 9 destinations, i.e. 53% falls on the formation of multi-group trains. As a result of the implementation of the developed method at the Chukursay marshalling yard, the hump technological cycle was reduced by 12%, the time of sorting processes of transit trains with processing was reduced by 5%, and the processing capacity of the hump was increased by 14%.

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