Improvement of service technology on railway branch roads

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Abstract. The article highlights the issues of effective use of shunting locomotives by introducing shunting winches on branch lines of railway transport, as well as improving the technology of effective service for freight forwarders. For this, the article envisages achieving it by optimizing the sequence of execution of several technological processes. Including: the time it takes for one wagon to be occupied for entering and exiting the branch tracks, the number of wagons entering and exiting the branch tracks during the time interval in question, as well as revising the locomotive occupancy times depending on the wagon, freeing the shunting locomotive from additional inefficient work issues of more efficient use of shunting locomotives by introducing shunting winches are scientifically based.

1 Introduction

Development and justification of measures for effective use of the station's shunting locomotive to other operations by using winches when working with wagons on branch roads.

The average daily time spent on bringing in and taking out wagons from the station to the freight front is determined as follows:

\[ T_{\text{pu}} = t_{\text{pu}} \cdot N_{\text{v}} \]

here:

\[ t_{\text{pu}} \] - the duration of a wagon's occupancy for loading and unloading, hours.

\[ N_{\text{v}} \] - the number of wagons entering and leaving the branch road during the period of time.

The average daily number \( N_{\text{v}} \) of the locomotive taking out wagons to the branch road during a certain month and the time for the necessary shunting of the locomotive \( t_{\text{pu}} \) during the loading and unloading of wagons are values that are functionally dependent on the load turnover [1-3].

Increasing the turnover of wagons is achieved by reducing the technological time spent on loading and unloading wagons at the freight front.

The technologically based time of the general shunting work for bringing wagons into and out of the branch track with a railway locomotive includes:

1. Escort the locomotive with wagons from the station to the appropriate track of the access road of the owner of the main branch road;

2. Delivery of wagons to the loading-unloading front by locomotive, including:

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2 Methods

Fig. 1. Busy time of the locomotive depending on the wagon.
We determine the calculation for the distance to the branch road less than $l_{o,k.b.} < 3000 m$.

Using the following formula:

\[ t_{o,k.b.}^{1-yr} = a + b \cdot m_{o,k.b.} \]

where $a$, $b$ are maneuver indicators calculated and change depending on the duration of movement of the locomotive on the shunting track; Fig. 2.

Duration of refilling of wagons on branch road.

In order to reduce the time of bringing and delivering wagons to the loading and unloading front of the branch lines according to the working technology of the shunting locomotive, we scientifically analyze the possibility of achieving many economic benefits by reducing the load on the shunting locomotives with the effective use of shunting winches.

A shunting winch is a special traction mechanism for moving platforms, tanks and other non-self-moving railway vehicles, depending on the type of wagons. It can be used as an alternative to a shunting locomotive to pull and hold wagons, change loaded wagons for empty wagons, or, conversely, replace unloaded wagons with loaded wagons at the loading and unloading front of railway depots [1, 7-9].

There are several types of winches, which can be classified according to their technical structure and type of drive - electric and pneumatic, and according to the number of drums - double-drum and single-drum. Table 1.

The main specifications of shunting winches include pulling power, steel rope capacity and steel rope winding speeds.

<table>
<thead>
<tr>
<th>Maneuver winches</th>
<th>Drag force on the drum, kg</th>
<th>Mass of a railway wagon, tons</th>
<th>Winding speed of steel rope in 1 layer, m/s</th>
<th>Drum steel rope capacity, m</th>
<th>Diameter of steel rope, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main adjunct TL-8 B</td>
<td>5000</td>
<td>500</td>
<td>315</td>
<td>0.035 (0.38)</td>
<td>220 (230)</td>
</tr>
<tr>
<td>0.3</td>
<td>2</td>
<td>0.14</td>
<td>3.2</td>
<td>24.9</td>
<td>1.5</td>
</tr>
<tr>
<td>20.4</td>
<td>0.4</td>
<td>12.1</td>
<td>0.3</td>
<td>3.2</td>
<td>0.14</td>
</tr>
<tr>
<td>1.1</td>
<td>0.3</td>
<td>0.4</td>
<td>104.43</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Providing information on the completion of the work:

Disconnecting wagons
Close the end valve of the air main
Suppressing to Tozmoz
Placement of wagons at the unloading front
Change the direction of the switch with 3 arrows...
Delivery of wagons from the park to the branch road
Notification of the readiness and location of the...

Actions to be performed
Time to grow actions
Separate actions are a waste of time
2 per. Mov. Avg. (time to grow actions)

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The operating principle of the maneuver winch is as follows:

A loop ring is installed on the steel rope of the main drum to fix it to the carriage, and the steel rope of the auxiliary drum is clamped to the main steel rope ring. Each of the drums is independently driven by a clutch. The clutch is turned on and off using a handle or an electromagnet. Opening the wire steel rope ring of the main drum and pulling on the automatic coupling of the car is done by reversing the auxiliary drum.

Fig. 3. Working diagram of double-drum shunting winch

1 - maneuver; 2 - main steel rope; 3 - auxiliary steel rope; 4 - Place of installation of main and auxiliary steel ropes; 5 - auxiliary drum; 6 - Carriages in movement.

According to the results of the analysis of the scientific research on the current condition of the railway branch roads, we can see that the existing winches have reached the end of their service life and in some places they have been completely removed from the working technology. As a result, there is an increase in the number of requests from customers to the station for retransmission of wagons in order to take empty wagons and place loaded wagons at designated loading and unloading points on the branch roads [2,5,13-15].

In many cases, during the loading and unloading of loose cargo on common and non-common railway branch lines, shunting locomotives are needed for the purpose of loading and unloading wagons directly into the loading holes, but this is the case when shunting locomotives are used to sort wagons on the station’s receiving-departure routes, work with thermal trains, and taking into account the need to carry out work such as removing unloaded wagons from the branch tracks, will lead to changes in the operational plan intended by the station’s shunting dispatcher [2,3,10-12].

The amount of time that can be saved as a result of using shunting winches instead of using the station’s shunting locomotive for shunting wagons at the loading and unloading fronts of the branch road (pulling wagons from the scale farm and pushing wagons due to the...
fact that there is one dumping place or, on the contrary, loading wagons, etc.) can be determined based on the comparative graph presented in Fig. 4.

Fig. 4. Duration of re-release of wagons to branch road

From both graphs, we can distinguish that in Figure 2, the time spent to provide wagons is 104.43 minutes, and in Figure 3, this indicator is equal to 76.65 minutes. Comparing these two graphs, the time taken to re-deploy the wagons in Figure 3 is 26.6% less than the time required to deliver a new group of wagons in Figure 4.

On non-general use branch roads, a batch of locomotives engaged in shunting work (wagons) is charged 31.049 soums for a 30-minute period based on the customer’s application, and 127.142 soums for shunting on station roads based on the contract for one wagon. The TEM2, ChM2 locomotives used for shunting on the branch lines of JSC “Uzbekistan Railways” stations are TEM2, ChM2 locomotives. If we compare the costs of diesel fuel consumption of TEM2 locomotives for 1 hour of shunting with the money collected for the shunting of one batch, the following result is obtained:

According to the P10-01 tariff manual of the TEM2 locomotive, the fee for shunting for one batch of wagons on unnamed branch roads is 31,049 soums for 0.5 hours, if the hourly diesel fuel consumption of a TEM2 locomotive is equal to 15 liters on average for a loaded shunt, 1 liter of diesel fuel is 19.12. The price on the stock exchange on 2022 corresponds to 13,210 soums. If we calculate the total time spent for 76.65 minutes to re-release wagons to the branch road shown in Figure 3 above, it is 1.225x15x13,210=242,734 soums, and the customer will be charged 3x31,049=93,147 soums for 3 parties. In this case, 242,734-93,147=149,587 soums, the railway will suffer 1.6 times as a result of pulling the locomotive into a shunt without using a winch. In conclusion, by applying shunting winches to branch lines, the time of shunting locomotives can be diverted to other operations, leading to the improvement of a number of indicators such as total carriage and freight turnover.
References

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