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COMPARISON OF TECHNICAL AND ECONOMIC PERFORMANCE OF WIRE AND CHAIN TRACKS USED IN STRENGTHENING LOADS IN OPEN TRAFFIC

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Annotation:
The article discusses the first procedures for the correct placement of goods, the choice of securing means in order to fully comply with the traffic safety requirements when placing and securing goods on railway transport. In addition, it is shown that it is important to use the fasteners optimally, to correctly select the types of fasteners depending on the type of load and to determine their number in the prescribed manner using calculations.

Keywords
Wagon, fastening, chain, wire rope, traffic safety, economic performance, impact forces, fastening tools, open movement structure.

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Introduction

One of the important factors in the open rolling stock is the placement of cargo in accordance with the established scheme, the effective use of loading and unloading mechanisms, the proper organization of the transport process and ensuring the safe delivery of cargo. Ensuring traffic safety requires the placement of loads on open rolling stock and the use of the correct means of fastening.Fastening of loads to open and closed rolling stock in railway transport can be done with pulls, fasteners, beams, cassettes, pyramids, nails, turnstile supports and other fastening elements according to the shape, parameters, nature of possible displacement and other factors. [1, 3, 5, 10, 13]. In the selection of fasteners, along with the strength of the fastening element, the task is to make it a cost-effective option, ie to achieve high quality at a lower cost. We analyze the technical and economic performance of c`hains and wire ropes, which are widely used in fastening loads.

Methods

Based on the above drawing, the structure of chain and wire ropes, taking into account the impact strength and parts of fasteners, allows the shipper to choose an alternative type of cable by comparing the technical and economic performance of chain and wire ropes [2, 4, 7, 9, 11-15].

Using the given formula it is possible to calculate the cost of a chain set (taking into account the ratio of forces acting on the diameter).

$$C_a = 2 \cdot m + d + l_a \cdot s_i \text{ ,thousand sum} \qquad (1)$$

m-the cost of the chain hook;

d – the price of the chain drive;

l_a - the length of the chain required to fasten the load;

s_i – 1 meter chain price (i=1-5;)

The value of the ratio of the forces acting on the set of chains (hook + chain + fastener + hook) to the diameter and length by the calculation formula is given in detail in Table 1.1

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Table 1.1

Permissible force, kN	3,2 kN	5,7 kN	9,0 kN	10,7 kN	22,9 kN
Chain diameter, mm	6 mm	8 mm	10 mm	13 mm	16 mm
Length,m	Cost(thousand suм)	Cost(thousand suм)	Cost(thousand,sum)	Cost (thousand, sum)	Cost (thousand, sum)
1	280	352	413	603	809
2	308	393	474	700	962
3	336	434	535	797	1115
4	364	475	596	894	1268
5	392	516	657	991	1421
6	420	557	718	1088	1574
7	448	598	779	1185	1727
8	476	639	840	1282	1880
9	504	680	901	1379	2033
10	532	721	962	1476	2186
For each additional 1m:	s_1= 28	s_2 =41	s_3 =61	s_4 = 97	s_5 =153

The cost of the required length of wire rope (relative to the diameter) is determined by

$$C_i = c_i \cdot l_b \cdot n, \text{ thousand sum} \qquad (2)$$

c_i- Price of 1 meter wire rope (i=1-7);
n- -number of rope windings;
l_b-the length of wire required to fasten the load;
(2) The values of the ratio of the forces acting on the wire rope to the diameter and length are given in detail in Table 1.2.

Table 1.2.

Number of packages	Forces acting on the diameter of the cable, kN;						
	4mm	4,5мм	5мм	5,5мм	6мм	6,5мм	7мм
2	2,7	3,5	4,3	5,3	6,2	7,3	8,5
3	4,2	5,3	6,5	7,8	9,4	11,0	12,7
4	5,5	7,1	8,6	10,5	12,4	14,7	17,0
5	6,8	8,8	10,8	13,1	15,5	18,3	21,5
6	8,4	10,7	12,9	15,8	18,7	22,0	25,2
Price relative to the diameter of wire ropes, 1m (in soums):	c_1=880	c_2=1110	c_3=1370	c_4=1660	c_5=1980	c_6=2320	c_7=2690

An alternative type of fastener must be used to secure the loads against longitudinal and transverse shear. One of the most important factors in ensuring traffic safety is

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the type and number of uses, taking into account the forces acting on the fasteners. [4, 12, 14, 16]

Taking into account the results of the calculations in Table 1.1 -1.2, the price ratio is determined using the formula N by comparing the cost of chain ropes and the length of the wire rope in the forces acting on each other in the fastening of loads:

$$N = \frac{C_a}{C_i}, \text{ once} \qquad (3)$$

Here: *N* is an integer rounded to the nearest whole number.

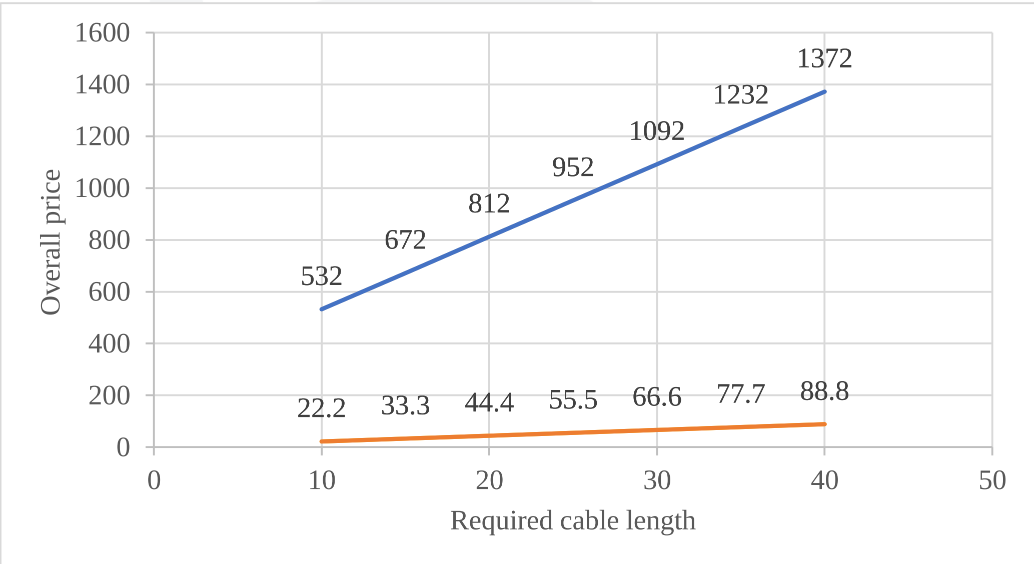
The prices of chain and wire ropes are shown in the following graphs, taking into account the forces acting on the fastener and the length.

Results

A comparison of the cost of 6 mm diameter chain rope and 4.5 mm diameter 2 coil wire ropes is given in Table 1.3.

Table 1.3.

Length, meters	10	15	20	25	30	35	40
C_a,thousand sum	532	672	812	952	1092	1232	1372
C_i, thousand sum	22,2	33,3	44,4	55,5	66,6	77,7	88,8
N	24	21	19	18	17	16	16



1.4 graphics. Graphical representation of the price of chain and wire ropes.

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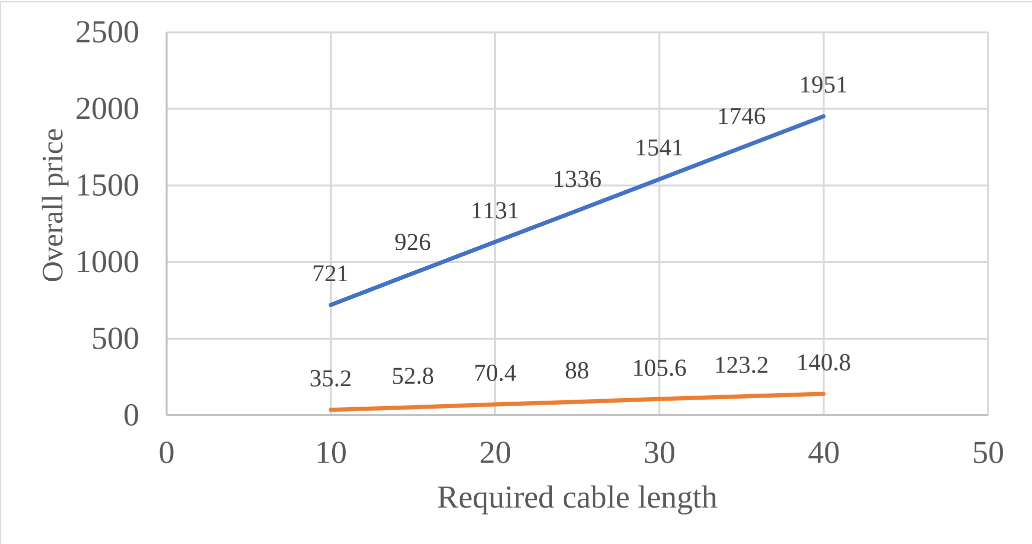
A comparison of the cost of 8 mm diameter chain ropes and 4 mm diameter 4 winding wire ropes is given in Table 1.4.

Table 1.4

Length,meters	10	15	20	25	30	35	40
Ca, thousand sum	721	926	1131	1336	1541	1746	1951
C_i , thousand sum	35,2	52,8	70,4	88	105,6	123,2	140,8
N	21	18	17	15	15	15	14

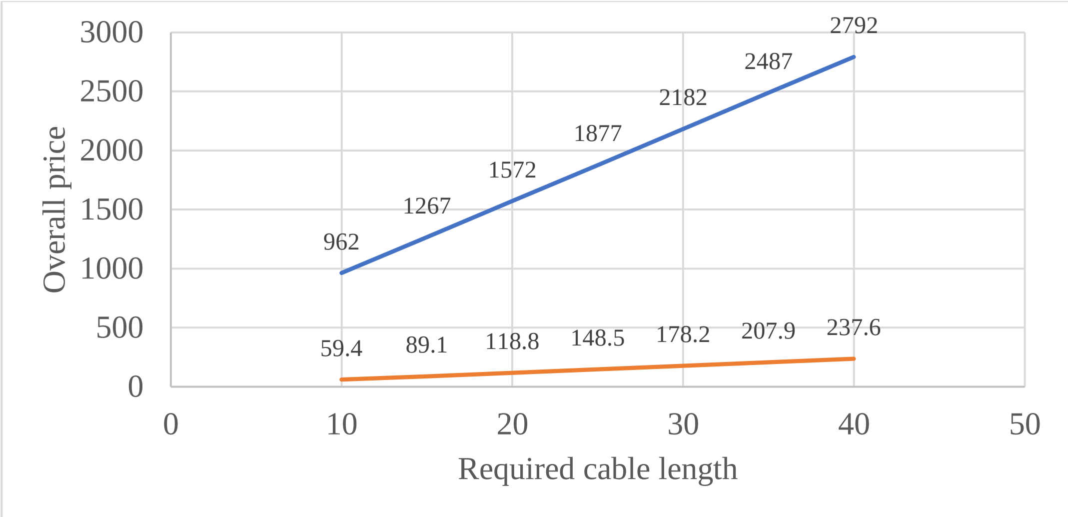


2-graph. Graphical representation of the price of chain and wire ropes.

A comparison of the cost of a 10mm diameter chain rope and a 6 mm diameter 3-wire wire rope is given in Table 1.5.

Table 1.5

Length,meters	10	15	20	25	30	35	40
C_a, thousand sum	962	126 7	1572	1877	2182	2487	2792
C_i, thousand sum	59,4	89,1	118,8	148,5	178,2	207,9	237,6
N	17	15	14	13	13	12	12

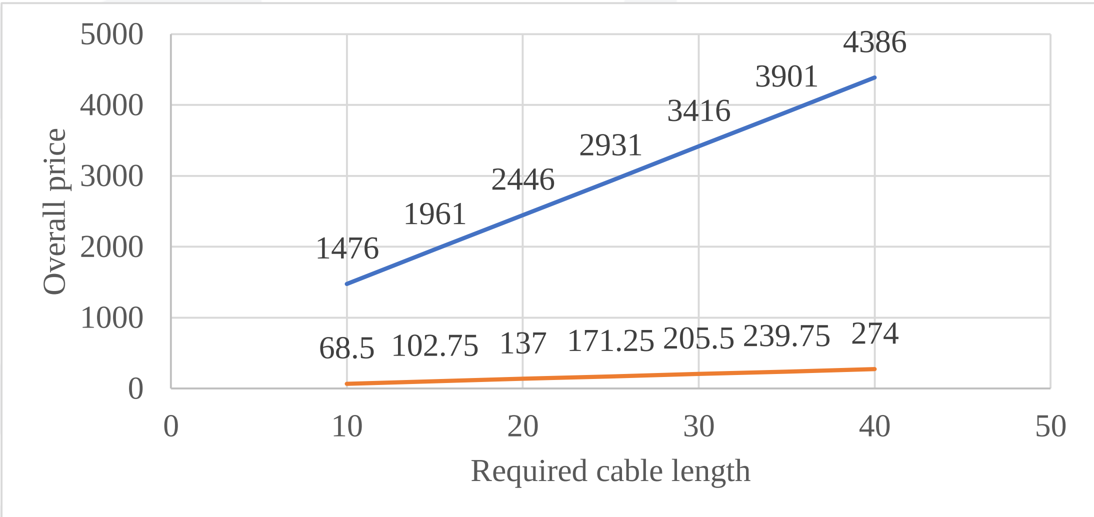


3-graph. Graphical representation of the price of chain and wire ropes.

A comparison of the cost of 13 mm diameter chain rope and 5 mm diameter 5 coil wire ropes is given in Table 1.6.

Table 1.6

Length,meters	10	15	20	25	30	35	40
C_a, thousand sum	1476	1961	2446	2931	3416	3901	4386
C_i, thousand sum	68,5	102,75	137	171,25	205,5	239,75	274
N	22	20	18	18	17	17	17



4-graph. Graphical representation of the price of chain and wire ropes.

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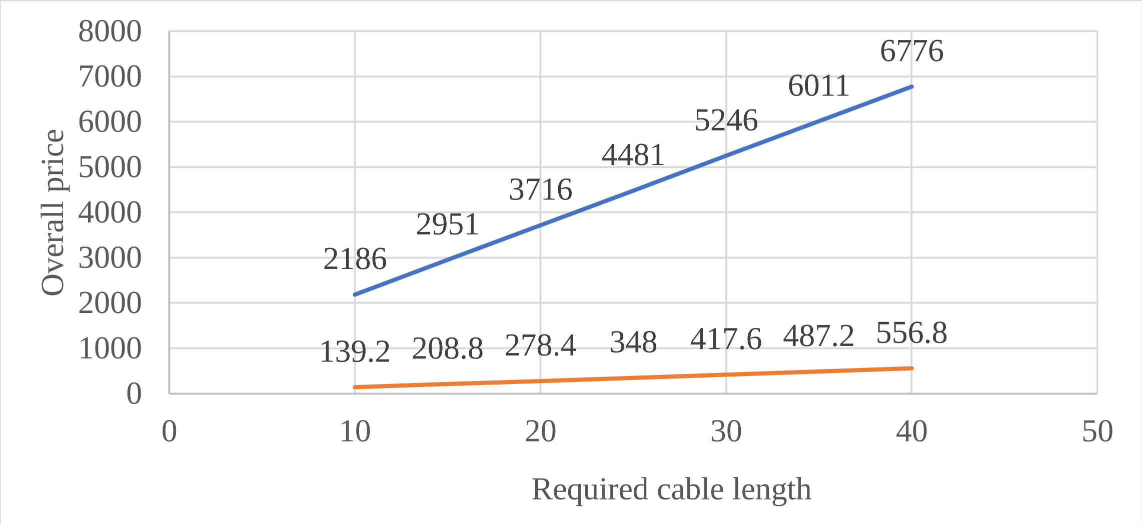
A comparison of the cost of 16 mm diameter chain ropes and 6.5 mm diameter 6 coils of wire ropes is given in Table 1.7.

Table 1.7

Length,meters	10	15	20	25	30	35	40
C_a, thousand sum	2186	2951	3716	4481	5246	6011	6776
C_i, thousand sum	139,2	208,8	278,4	348	417,6	487,2	556,8
N	16	15	14	13	13	13	13



5-graph. Graphical representation of the price of chain and wire ropes.

- The choice of an alternative fastening tool by the shipper depends on several factors[5]:
- Cost of fastening tool;
- Number of uses;
- High security;
- The amount of time spent on strengthening;
- Strength;
- Shelf life;
- Lack of load displacement.

When choosing the optimal option of fastening means, the consignor can choose its several advantages and disadvantages on the basis of the basic data in Table 1.8.

Table 1.8

Use of chain rope		Use of wire rope	
Advantage	Disadvantage	Advantage	Disadvantage
Fastening loads to wagons is done more easily than with a wire rope.	For goods transported in one direction, there is a cost of re-shipping the cable to the shipper	Low cost compared to chain rope	Attaching loads to wagons is done more complicated than with a chain rope.
Reusable use is available	Tross is not available at all shipping stations	Availability at almost all loading stations	Disposable
Strength of load against longitudinal and transverse displacement[6]	High cost compared to wire rope.	It is possible to re-sit in case of failure during transportation.	The formation of the elongation of the wire rope at the expense of the forces acting during the movement

Discussion

Through his research, he has been able to help shippers make efficient use of the chain and wire ropes used to place and secure cargo in open rolling stock. Tables 1.3 - 1.7, taking into account the forces acting, determined the number of replications of the value of the chain rope N through the ratio of Ca to Ci. [7, 8, 9-16] Of course, in order to fully comply with the requirements of traffic safety in the placement and fastening of goods on the rolling stock in railway transport, it is necessary to correctly place the goods on the basis of established criteria. In addition, it is important to choose the right means, materials, types of fastening cargoes and determine their number in the prescribed manner using accurate calculations, economic indicators.

Conclusion:

A method of quantifying the number of alternating wire trosses used instead of chain trosses has been developed. In the safe implementation of the transportation process, along with the correct placement of cargo on the wagons, the choice of fasteners is calculated on the basis of technical and economic indicators.

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