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Research Article

EXPERIMENTAL PRODUCTION CARGO-HANDLING DEVICES FROM SYNTHETIC WOVEN TAPES

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Abstract

Thanks to the development of the production of high-strength synthetic fibres, the use of textile slings has become available for both large factories and small enterprises. Currently, textile slings are becoming more and more popular load-grabbing devices. The lightness, flexibility and high load capacity of this type of sling allow you to solve many tasks in the field of lifting and moving cargo, which until recently were considered impossible. In some cases, they are the only possible device for strapping and strapping cargo. To a greater extent, this applies to goods that need careful handling. In numerous studies on the choice of mounting cranes, the issues of parametric compliance of cranes with the characteristics of the mounted elements are solved. In this work, the analysis of the relationship between the mass of the mounted elements and the load capacity of synthetic slings is carried out. The article presents the positive qualities of synthetic belt slings that are used in rigging work, describes the materials from which synthetic slings are made, as well as deformation and mechanical characteristics.

Keywords

Assembly cranes, lifting devices, rigging, textile slings, rope properties, rope systems, rope extensions, mounted elements.

INTRODUCTION

In numerous studies on the choice of erection cranes, the issues of parametric correspondence of cranes to the characteristics of the mounted elements are being solved. In this paper, an analysis of the relationship between the mass of mounted elements and the carrying capacity of synthetic slings was carried out.

Thanks to the development of the production of high-strength synthetic fibres, the use of textile slings has become available for both large factories and small enterprises. Nowadays, textile slings are becoming more and more popular load-handling devices. The lightness, flexibility and high carrying capacity of this type of sling allow solving many problems in the field of lifting and moving goods, which until recently were considered impossible [1, 2]. In some cases, they are the only possible device for tying and slinging cargo. To a greater extent, this applies to goods that need careful handling [3].

Textile slings are slings made of textile webbing in various designs and materials. Textile tape slings are manufactured in accordance with the requirements of RD 24-SZK-01-01 "General-purpose cargo slings on a textile basis" [4, 5].

Slings are made from different polymers: polyamide (kapron), and polypropylene, but slings made of polyester fibres are more often used, primarily from polyester (polyester), since in addition to high abrasion resistance and strength, it has a whole range of unique properties. The standard carrying capacity of a single-branch sling is 0.5 ... 25.0 t and a four-branch sling is 1.25 ... 60 t. In some cases, such slings are also made with a much larger carrying capacity. For example, round-spun slings on a textile basis up to 100 tons [6, 7].

METHODS

In the example of the construction of the “Sports Complex” facility in Fergana, experimental slings of 4 geometric parameters were used, developed, manufactured and tested by the applicant on a foreign-made machine, STL-PP - 1000 - with a carrying capacity of 1.0 tons; STL-PP - 2000 - with a carrying capacity of 2.0 tons; STL-PP - 4000 - load capacity - 4.0 tons. For installation using STL data, structural metal elements and metal structures of facades, ceilings and coverings of the main hall measuring 54 x 60 m were taken as the basis, mounted in November-December 2018 and January-February 2019. The facility is serviced by 4 tower cranes KB - 4, with Q max. - 5 tons, two truck cranes ZIL - "Ivanovets" with Q max - 16 tons. and one Chinese-made crane XCMG QV 30 K5–I–c Q max – 30 tons. - equipped with a computer dynamometer. The total mass of mounted metal structures is more than 300 tons. [8, 9]

Depending on the value of the mass of the load and the frequency by mass, the proposed synthetic woven slings of four types and parameters were used. Mounted elements were painted or primed, and their capture by looped slings did not damage the lined surfaces [10,11].

Table 1. Distribution by weight of metal elements of the coating and facade cladding (object "Sports Complex" in Fergana)

Gro. num. X	*Weight of the element, tons*	*The average value of the mass in the Xi group, tons.*	*Mass group frequency by mass n_i*	*Particular Pi= $\frac{n_i}{860}$*	*Distribution variance $\sigma^2 = (x_i - x)^2 \cdot Pi$*	*Type and parameters of the recommended sling*
1.	0-0,05	3	280	0,325	1,30	STL-PP - 500
2.	0,06-0,2	7	190	0,221	1,11	STL-PP - 500
3.	0,211-0,5	12	130	0,151	12,23	STL-PP - 1200
4.	0,51-0,7	25	98	0,114	55,18	STL-PP - 1200
5.	0,71-0,10	35	60	0,070	67,27	STL-PP - 1600
6.	0,10-1,5	48	44	0,051	89,96	STL-PP - 1600
7.	1,51-2,0	58	34	0,040	29,16	STL-PP - 2000
8.	2,1-2,5	75	24	0,030	7,68	STL-PP - 2000
		295	860	1,000	264	

RESULTS

Establishing the law of distribution of mounting elements by mass, taking into account the existing tendency to increase the mass of individual elements, will make it possible to predict the distribution of element types based on the initial level. This technique will allow taking into account the use of rigging equipment by lifting and transporting equipment in the construction of complex and especially complex buildings and structures [12].

The distribution of elements by weight of metal structures throughout the object is characterized by the data given in Table 1.

With the maximum allowable error Δ=0.05 t. and the degree of probability t=4, to obtain the distribution law with a probability of 0.95 (t=2), the sample size

N≥t^2·σ^2/Δ^2 ≥4·264/0,16≥660 (1)

Since, 660<860, having a sample with the accepted error value is sufficient.

Having provided this actual distribution in the form of a histogram, we can assume that it is approximated with sufficient accuracy by the

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μ^2– distribution law is known in mathematical statistics with a degree of freedom n=2. After determining the law of distribution of mounting elements by the mass of mounting elements and a specific construction object in a specific period, it is legitimate to formulate the problem of predicting changes in this distribution in the future [13, 14].

It is assumed that the revealed distribution law is organically inherent in the process under study. The problem is reduced to predicting the parameters of the μ^2 distribution (the number of degrees of freedom, the number of groups by mass and their frequency).

The distribution curve under the influence of structural changes "stretches" to the right. Knowing the step of the groups by mass and their frequency, determined based on the analysis of the design documentation of the object, it was established the change in the number of degrees of freedom μ^2- distribution in such a way that the function is approximated to the predicted extreme values of the frequencies of the group by mass (see Fig. 1.) [15-21].

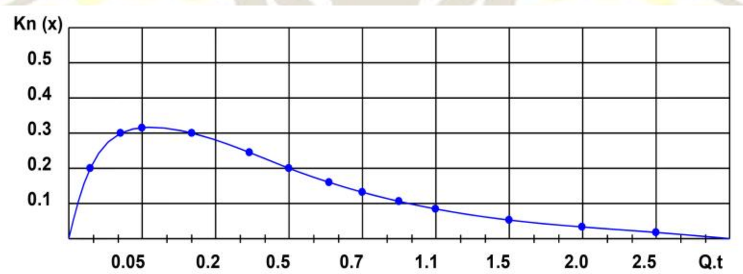

Fig.1. Distribution curve of elements by mass of structures

This analysis makes it possible to pre-plan the acquisition of equipment for the lifting mechanism, that is, to take into account the use of various synthetic slings for structures of various weights.

Conclusion

Synthetic cables can be successfully used in loading and unloading operations with the required safety factor in the production of rigging, while it is necessary to take into account the range of weight characteristics of the goods being transported. When wrapping a transported load with a synthetic rope with a protective cover (in the absence of mounting loops), it does not scratch the surface, as happens when using a steel cable. This property is relevant when moving objects made of soft materials or with a finishing layer.

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The direction for further research on the technology of rigging using textile-based slings lies in the detailed development and research of universal slings.

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