Published: November 30, 2020 | **Pages:** 179-184
Doi: https://doi.org/10.37547/tajet/Volume02Issue11-28

IMPACT FACTOR
2020: 5. 32
OCLC - 1121105677

Determination Of Line Tension Insurance Belts With Additional Shock Absorber

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ABSTRACT

The article presents a diagram of the recommended design of a safety harness with an additional shock absorber. The principle of operation of the safety device is given. A method is proposed for calculating the tension of the harness sling. Using the balance of forces, a formula is derived to determine the tension of the sling. Graphical dependences of the change in the tension of the sling on the change in the coefficient of stiffness of the shock absorbers and on the force of the worker's weight at different angles of inclination of the sling to the horizontal axis are constructed, the main parameters of the safety belt are substantiated.

KEYWORDS

Bracing device, Vest, Buckle, Gas canister, Backrest, Carabiner, Vibration, Stiffness.

INTRODUCTION

Seat belts are widely used in construction, construction and installation, repair and restoration, maintenance or other types of work at height, to correct (maintain) the working condition and to protect the worker in the event of a fall from a height. A well-known seat belt that includes a belt, a belt, a carabiner sling, and a belt with a sewn shock absorber [1]. Belt failure is the inconvenience of the shock absorber (a large length of belt is required to ensure complete safety, which increases material consumption and labor intensity of production).

MATERIALS AND METHODS

In the work of V.A. Oguretsky [2]. the safety belt is made with a shock absorber in the form of a sewing tape in a certain part of the belt. At the same time, it was revealed that the breaking force of the belt reaches 7890 N. The disadvantage of this design is the limited deformation of the stitching tape, which does not allow the necessary depreciation and insurance when falling from a height.

The belay device includes shoulder, chest and hip straps and corresponding buckles for them sash, distribution ring, sling and carabiner [3]. The disadvantage of this design is the impossibility of ensuring sufficient reliability during operation and has a narrow range of applications.

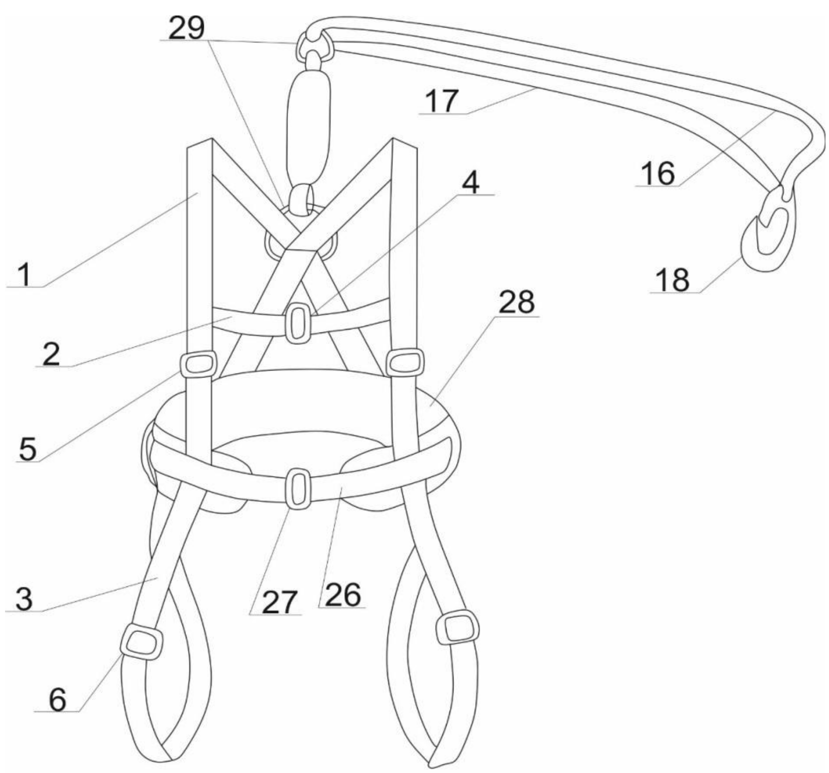


Figure 1: View of the belts of the belay device

The design includes a shoulder strap 1, a chest strap 2, a hip strap 3, a buckle 4 of a chest strap 2, a buckle 5 of a shoulder strap 1, a buckle 6 of a hip strap 3, an adjusting strap 7, a distribution ring 14, a halyard 16 (sling) with a snap hook 18 and shock absorber 15 and in parallel with it a separately installed textile (or spring) shock absorber 17, collar 19, belt 26, buckle 27 of belt 26, sash 28, distribution ring 29. In this case, the length of the shock absorber 17 is made (15 ÷ 20)% less, than the length of the sling 16 with shock absorber 15.

The safety device works as follows. When a person working on a sling 16 breaks off and hangs, the shock absorber 15 is deformed, and in parallel with the sling 16, the installed textile (spring) shock absorber 17 is deformed more than the shock absorber 15 due to the shorter length by (15 ÷ 20)%, while energy is significantly absorbed. In this case, thanks to the installed shock absorber 17, abrupt changes in dynamic loads are eliminated (due to greater deformation and dissipation). This also eliminates the rupture of the line 16 by reducing the sharp dynamic loads by the shock absorber 17.

Determination of the tension force of the harness sling. During the operation of the belay device, it is important to determine the tension of the sling. Depending on the value of the tension of the sling, the technology of its manufacture is determined. In this case, it is provided for the safety of the line breaking, as well as the lines in the line. To determine the tension force in the sling, we will draw up a design diagram and consider the equilibrium conditions. Figure 2.4 shows a design diagram for calculating the tension of the belay device sling.

According to the design scheme, the following forces act on the sling of the safety device: G - force of the worker's weight; T1 is the tension force of the sling (in a rigid zone with a length l1); C1x1 - elastic force of the line shock absorber; C2x2 - elastic force of the additional shock absorber; R is the reaction force of the distribution ring.

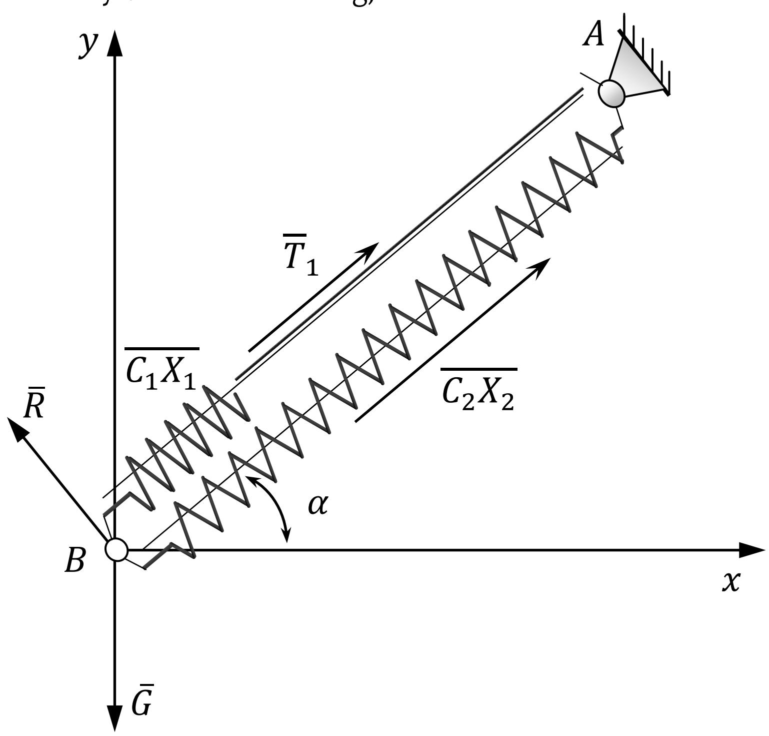


Figure 2: Calculation scheme for calculating the tension of the belay device sling

RESULT AND DISCUSSION

According to the equilibrium condition of the system [4,5,6], projecting all forces on the X and Y coordinate axes, we obtain:

$$\Sigma F_i(X)=(c_1x_1+c_2x_2)\cos\alpha+T_1\cos\alpha-R\sin x=0;$$

$$\Sigma F_i(Y)=-G+(c_1x_1+c_2x_2)\sin\alpha+T\sin\alpha+R\cos\alpha=0 \qquad (1)$$

Where, **α** – the angle of inclination of the sling to the X-axis.

From system (1), excluding R, we obtain:

$$-G+(c_1x_1+c_2x_2)\sin\alpha+T_1\sin\alpha+\frac{T_1\cos\alpha+(c_1x_1+c_2x_2)\cos\alpha}{\sin\alpha}\cdot\cos\alpha=0 \quad (2)$$

From (2), after some transformations, we obtain an expression for determining the tension [7,8,9] of the lines of the belay device:

$$T_1= G\sin\alpha- c_1x+c_2x_2 \qquad (3)$$

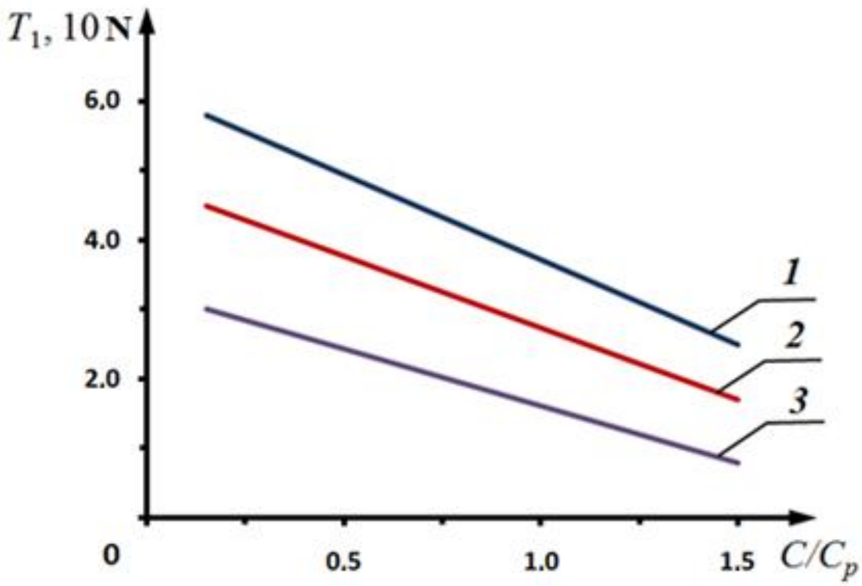
It should be noted that the tension of the sling according to (3) depends mainly on the weight of the worker, the elastic forces of the shock absorbers, as well as the angle of inclination of the sling to the x axis.

By numerical solution (3), graphical dependencies of the parameters were built, according to which it is possible to choose and recommend the required values of the tension of the belay device sling.

Figure 3. the graphical dependences of the change in the tension of the sling on the change in the coefficients of the stiffness of the shock absorbers with the variation of the force of the worker's weight are presented.

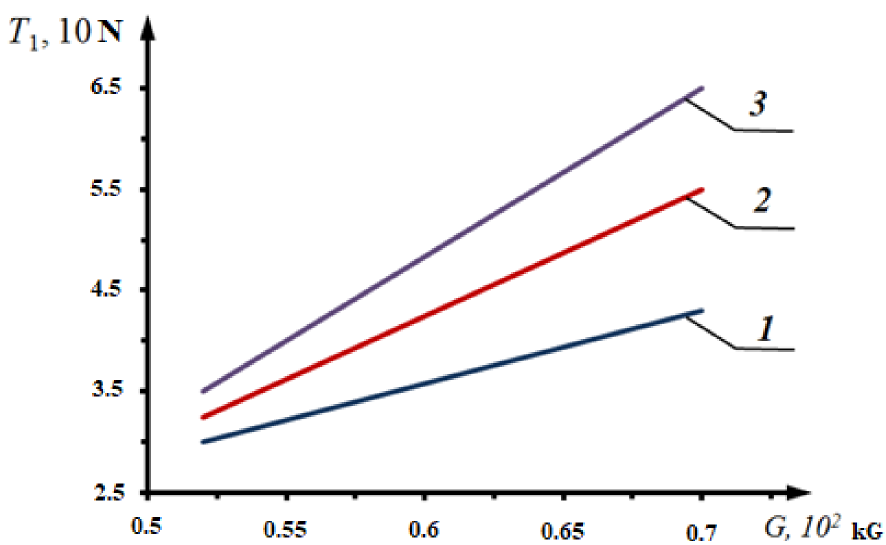
The analysis of the obtained graphs shows that with an increase in the stiffness coefficients of shock absorbers from s / sρ = 0.25 to s / sρ = 1.5, the line tension decreases from 31.2N to 6.8N with a working weight force of 55 kg but a linear pattern. With an increase in the weight of the worker to 75 kg, the tension of the sling decreases from 58.9 N to 21.3 N. This means that with a large weight of the working shock absorbers, it is necessary to choose more rigid ones. Therefore, the recommended values are s / sρ = (0.8 ÷ 1.0), at which the tension of the sling T1≤ (25 ÷ 40) N is provided.

Figure 4. the graphical patterns of the change in the tension of the sling from the force of the weight of the working belay device at different angles of inclination of the sling to the X axis are presented. From the graphs in Fig. 4. it can be seen that an increase in the weight of the worker leads to an increase in the tension of the sling according to a linear pattern. Moreover, the greater the angle **α**, the greater the tension of the sling (see curves 1, 2, 3, Fig. 4.). The recommended parameter values are: **α**≤ (), at which T1≤ (25 ÷ 45) N are provided.



1– at $G = 75\,kg$; 2 – at $G = 65\,kg$; 3 – at $G = 55\,kg$.

Figure 3: Graphical dependences of the change in the tension of the sling on the change in the stiffness coefficients of the shock absorbers with the variation of the weight force of the worker



1– at $\alpha = \frac{\pi}{4}$; 2 – at $\alpha = \frac{\pi}{3}$; 3 – at $\alpha = \frac{5\pi}{12}$.

Figure 4: Graphical patterns of changing the tension of the sling from the weight of the working belay device at different angles of inclination of the sling to the X axis

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CONCLUSIONS

On the basis of the equilibrium condition of the worker in the belay device, a formula was obtained to determine the tension of the belay device sling. Graphical dependences of the change in the tension of the sling on the change in the coefficients of the stiffness of the shock absorbers with the variation of the force of the weight of the worker are constructed. The parameters of the harness are recommended.

REFERENCES

1. USSR author's certificate No. 1498506, class. A 62 B 35/00, 09/10/87
2. V.A. Oguretsky Research and develop personal protective equipment against falls from a height. diss. Cand. tech. sciences. Kemerovo, 2004, pp. 42-47.
3. Safety and restraining harness USP 2 Zh uk.
4. Mansurova M.A., Djuraev A., Mansuri D.S., Umarova Z.M. Kinematic and dynamic analysis of the linkage moving materials with elastic elements of sewing machines Monograph, ed. Rakhima Jalila, Khujand-2016, p. 194.
5. Djuraev A., Mamatova D.A. Development of structural schemes and methods for calculating belt drives with variable parameters. Ed. Fan va texnologiya, Tashkent, 2019, 232 p.
6. Musalimov V.M., Sergushin P.A. Analytical Mechanics. Lagrange equations of the second kind ", St. Petersburg State University ITMO, 2007, 53p.
7. Panovko Ya.G. "Foundations of the applied theory of vibrations and impact" Ed. "Mechanical engineering", M., 1976, 320 p.
8. Djuraev A., Kuliev T.M., Choriev Sh.N. Improving efficient, resource-saving designs and scientific foundations for calculating the parameters of cleaners for raw cotton and fiber Monograph, ed. Innovatsiya Tashkent, 2020. 259 p.
9. Anvar Djuraev, Tokhir Kuliev, "Designing and methods of calculating parameters of a fibrous material cleaner from large litter", International Journal of Advanced Science and Technology, Vol. 29, No.8s,(2020), pp. 444-452.