

LOAD OF BELAYING CHAIN WITH CLIMBING FALL AND ITS RESULTS FOR FALLING CLIMBER

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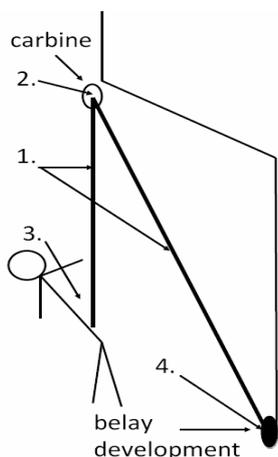
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INTRODUCTION

All binding instructions for construction of ropes are defined by the norm ISO 892, which of course designates maximal impact force (12kN for 15G, 80kg). This value is measured in the first fall with fall factor¹ 1,77. Action part of testing rope is $4,6 \pm 0,6$ m and thus the following differences are unlike the real fall. In case of the real fall, the action part of rope is in series of tens of meters and fall factor¹ is then from 0,2 up to 0,8.

METHODS

Impact force is measured by dynamometers inserted between free end of rope and the harness. The force on belaying aid is measured by tensometers. Belaying aid is fixed either tightly to the rock face or on sit harness of a belayer. Differences between them are given by losses in friction forces and elastic and plastic deformations of the rope. Impact of inertia is detected and measured by the system for 3D analysis of movements – QUALISYS (www.qualisys.com) and weights of single segments of the body are estimated from the weight of the complete body.



1. dynamic rope
2. friction of ropes in carbine
3. the elastic (viscosity) human body of falling
4. slip of rope in belay device with or without an elastic (viscosity) human body of belaying person

Figure 1: The points of change (loss) the kinetic energy

Impact force is the most often measured as a variable, but other significant aspects are also inertial forces of single segments of the body. These forces differ with regards to the attachment manner of the climber. For human body not only the absolute value of overloading is essential but also its acting time.

RESULTS AND DISCUSSION

The kinetic energy of a real fall is transformed in another type of energy. For example heat absorption in rope, elastic or plastic deformation of rope ect.

¹ Fall Factor — fall length to rope length ratio. Max. value used in climbing sport is 2.

Friction forces which are acting between rope and carbine are estimated. This phenomenon depends on coefficients of friction between carbine and rope [2] (Figure 1). The place for decrease in impact load is given by a slip of rope in the belaying device [3] (Figure 1). On Figure 2., there is the comparison of peaks of impact force of the human body and the steel weight. The evolution of detected peaks is well seen, too. The difference of absolute values of impact forces determinates the absorption of part of energy in visco – elastic human body.

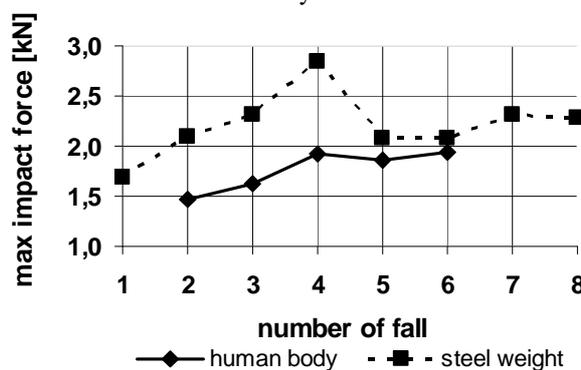


Figure 2: The difference of peaks of impact forces of the human body and the steel weight

Next value is contact pressure from sit harness. This device is the most important to transfer energy to human body.

Acting time of impact force as well as magnitude of the impact force are important variables with highest influence on the rope and the human body by fall catching.

CONCLUSIONS

The real load of the whole belaying chain is different from the measured data by normalized examination and makes the basic values for another way of experiments and mathematical-physical processing of the measured data.

ACKNOWLEDGEMENTS

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