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DERIVATION OF THE RESOLVING SYSTEM OF EQUATIONS FOR FLAT BENDING OF A ROD WITH VARIABLE BENDING STIFFNESS

The theory of the stress-strain state of a rectilinear plumb line of a round rope, taking into account the interaction between its wires, was developed by prof. Glushko M.F. [1]. This theory was applied to plumb lines of round balancing ropes in [2]. At the bottom of the shaft, two plumb lines of the balancing rope bend substantially under their own weight, forming a pear-shaped loop. Tension devices for the rope in this part of the shaft, where groundwater flows, turned out to be inoperative. Plumbs of round ropes are delimited by wooden log cabins up to 10 m high to prevent overlapping (entanglement) of plumb lines of adjacent ropes due to their significant torsional deformations. Due to the large torsional deformations of round ropes, their wires in one section are loaded very unevenly [2]. During the operation of the lifting machine, the ropes saw through the demarcation logs, the zinc protective coating of the wires of the rope is broken, this is also facilitated by the displacement of the wires due to significant deformations of the torsion of the ropes, so their service life does not exceed 3 years, despite the fact that they are loaded only by their own weight.

Flat metal and rubber ropes do not require delimiting devices in the loop. In practice, the operation of the ropes, it was found that the size and shape of the rope loop depends on the parameters of the rope: its flexural rigidity and linear weight. The works [2-3] are devoted to the calculation of the shape of the loop of balancing ropes, where the differential geometric Frenet dependencies are not taken into account, which, together with the equations of static equilibrium, constitute a complete system of differential equations for the statics of flexible rods.

In accordance with [4-5], a resolving system of six non-linear differential equilibrium equations for a planar bending of a rod is obtained below, which can be used to analyze the deformations of balancing mine ropes.

We will assume that a curvilinear rod, the dimensions of which are very small in comparison with the length and radius of curvature of its axial line, under the action of external forces, takes a shape that differs significantly from the original one. In this case, however, the rod material works only in the elastic stage, and the length of its elastic line passing through the centers of gravity of the cross-sectional areas remains unchanged.

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