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THE CLIMBER-TETHER INTERFACE OF THE SPACE ELEVATOR

Abstract

The detailed interactions between the space elevator tether and the traction device of the tether climber are critical to the feasibility of the space elevator. Identifying and parameterizing these interactions leads to the development of a set of requirements necessary for a functioning climber. We refer to this set as the "climbability condition". Defining this condition requires understanding in three main areas: the mutual friction between the surfaces of the tether and the traction device, the internal stresses transmitted from the surfaces to the bulks of the materials and the design of both the tether and the traction device.

A study group of the International Space Elevator Consortium (ISEC) is examining these areas in depth. Assuming a tether consisting of many laminations of single crystal graphene we propose several tether lamination designs, based on soon-to-be-available technology, which should provide sufficient friction for climbing. Given these designs, we identify the shear stresses between laminations of the tether and in the structure of various types of climber wheels. Because the behavior of materials made of mono-molecular sheets is not well understood theoretically and because no general theory predicts the macroscopic friction between such materials and more conventional ones, we prescribe tests to determine the mutual coefficient of friction between the tether surface and the surface of a climber wheel. Equally important is to describe how pressure is applied to the contact area and then transmitted to the bulk of the material. For this we present an early climber design based mostly on currently available components.

Finally, we outline a preliminary climbability condition.