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BENEFITS AND DEVELOPMENT OF A HIGH STAGE ONE FOR THE SPACE ELEVATOR

Abstract

There are substantial advantages to anchoring the space elevator ribbon to a platform above most or all of the Earth's atmosphere. The Lofstrom Loop is a suitable technology to support such a platform, and is proposed as stage one of the space elevator. It is specifically designed to cope with atmospheric challenges such as wind, ice, and lightning, and it transmits these forces down to the Earth's surface without putting stress on the ribbon. Without such a solution, the atmosphere adds fluctuating loads of several hundred tons weight on to the ribbon. Forces on the ribbon would have to be sustained from geosynchronous orbit, which means the whole ribbon has to be stronger and therefore thicker. Anchoring the ribbon above the stratosphere avoids this penalty and leads to a 17-fold saving in the total mass of the ribbon.

Choosing the exact altitude of the transfer platform is a tradeoff between cost and the advantages to the overall space-elevator project. An analysis is performed showing a range of altitudes from 15 km to 100 km. The range between 20 and 50 km is best, with a preference for 50 km. Some work has been done on how to build smaller versions as prototypes, and a development path is outlines.

One question is whether payloads should be winched up to the transfer platform or travel up the tubes. The vehicles or winch cables carrying payloads may be subject to significant cross winds. The options are considered and a recommendation is made for the vehicles to travel up like electric trains.

To avoid space debris, it is necessary to move the ribbon from time to time. Two cases are identified and analyzed: one when there is no payload on the section of the ribbon that needs to be moved, and the more complicated case when the payload has to be moved with the ribbon. Moving a payload with the ribbon requires more force for a longer time than is needed in the simpler case. An arrangement of two Lofstrom loops at right angles is suitable, forming a cross when viewed from above.