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REVIEW ON SPACE ELEVATOR

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ABSTRACT

The concept of space elevator was first proposed in 1960's as a method getting in to the space. A space elevator is an ultimate transport system access to space from earth. This system is just imagination some decades ago but in earlier days the inventions of new materials such as carbon nanotubes make space elevator possible. The design of cable we used carbon nanotubes which is strongest material in the world. The given paper describes concept of space elevator, material to be used, design of cable and climber, advantages and limitation of space elevator and effect on human body and environment.

***Keywords*: *Carbon Nanotubes, Cable, Climber, Space Elevator, Space Transportation*.**

I. INTRODUCTION

A space elevator is a very important invention for space transportation system. Because this system can bring the low cost and safe transportation, the use of space elevator for the space transportation having low impact on environment and human body [1]. The basic concept of space elevator is to string a cable from the earth surface to an altitude beyond geosynchronous orbit [2]. Theoretically the length of the cable could be constructed is 144,000 km [3].

II. HISTORY

First idea of space elevator was proposed by Tsiolkovski who was father of rockets [1]. Tsiolkovski thought experiment on a tower in to space. But idea of space elevator in which cable is used proposed by Yuri Artsutanov in 1960. His idea about space elevator was appeared in a Sunday supplement to Pravda in 1960 [4]. Jerome Pearson also gave his contribution in the discovery of space elevator. Pearsondiscovery included using the space elevator for zero net energy space launching, and for launching payloads from the elevator from the elevator tip to reach other planet without requiring rockets [4]. The science frication writer wrote a famous novel about space elevator. The Fountains OfParadie published in 1979. In these novel contains details about space elevator [1].

III. SPACE ELEVATOR

Space elevator constructs on the equator of the earth consists of a cable between the ground and anchor station in space. The length of the cable is 100,000 km and length of the cable is depends on mass of anchor station. To construct 100,000 km cable we required material having 50 Gpa tensile strength [1]. One question occurs however a 100,000 km long cable sticking up in to space, this is due to spinning of earth. The cable for the space

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elevator is long enough and one end is fix on the earth also earth is spinning therefore spinning of earth will sling it outward [5].

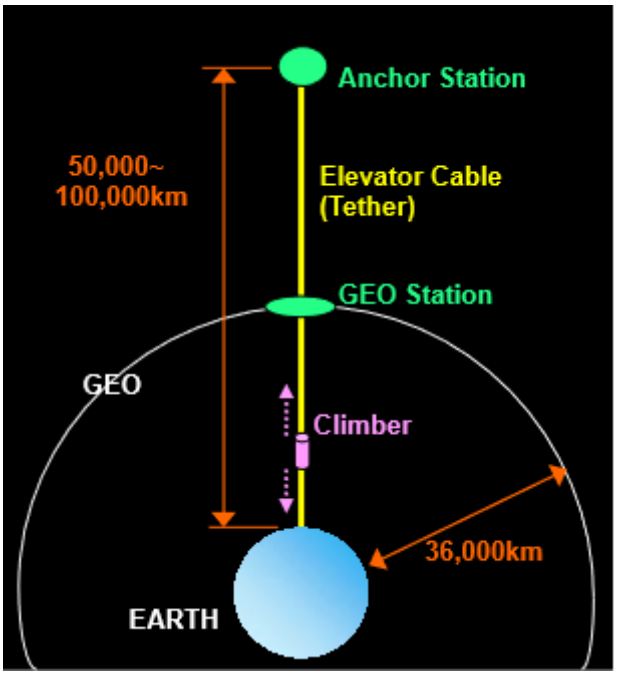

Fig.1Basic figure of space elevator [1].

IV.CONSTRUCTION OF SPACE ELEVATOR

Generally, the construction of space elevator takes following steps:

1. Launch of initial module to geostationary orbit by orbit.
2. Deploy initial cable from the station.
3. Connect the cable on the earth port.
4. Strengthen the cable and the anchor station by transporting cable and station module by the climbers along the cable.
5. Completion of construction and start of normal operation.

V. PRODUCTION OF CABLE

One of the major and important parts in the space elevator program will be production of cables. The cables are unique in design; strength of the cable is very high and high performance requirements. Let's consider our design and starting points and then determine where the major production hurdles will be. To begin with we have:

- Nanotubes are made in short lengths.
- We may need to work with lengths as short as several centimetres.
- No defects in the cable are allowed.
- The epoxy must hold the nanotubes, be strong yet flexible and burn up at several hundred degrees
- The length of the finished cable is to be approximately near about 100,000 km.

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- Production time for each cable must be no more than one year.

Possible useful points include:

- Nanotubes are grown aligned.
- The cable can be made in shorter lengths and then combined for faster production.

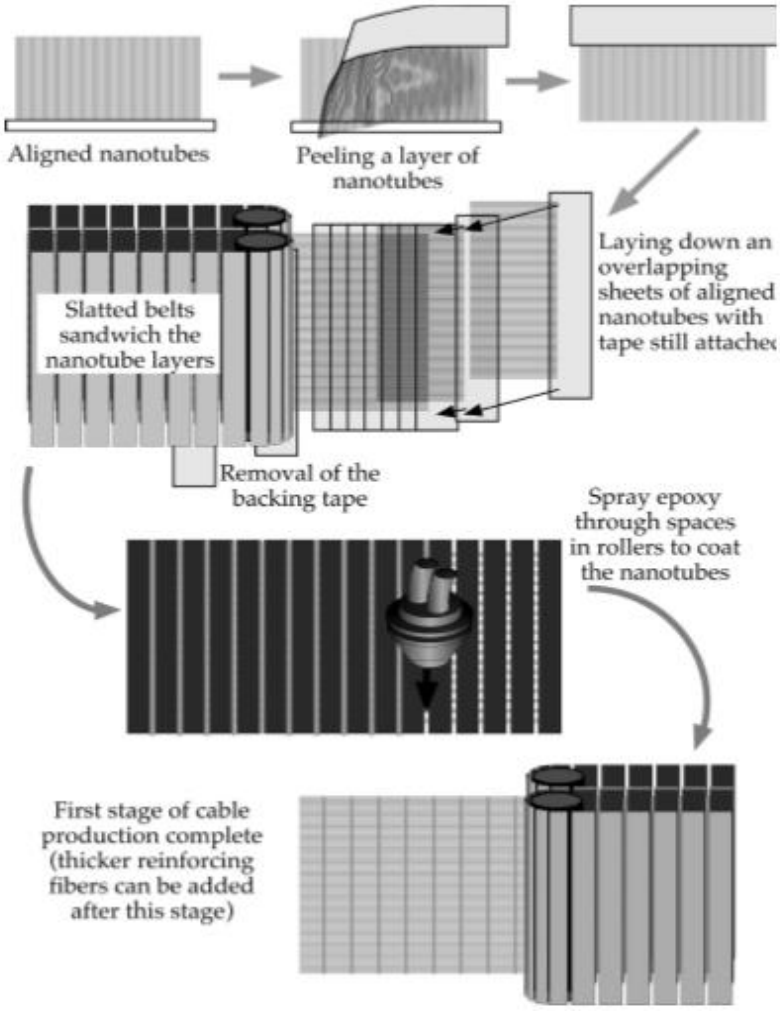

Fig.2 Possible scenario of cable production.

VI. CLIMBER

The climber will be designed similar to a spacecraft with some important differences. The mass, power, reliability and such are comparable to a spacecraft but the launch forces that the climber will be subjected to are minimal compared to that of a spacecraft during launch. However, unlike a spacecraft the climber will feel gravitational forces for most of its life. The climber will also have some unique mechanical requirements spacecraft generally do not encounter. The major components of the climber are the locomotion, cable deployment and power systems. There will be little 'thinking' to be done on the climber and minimal communications.

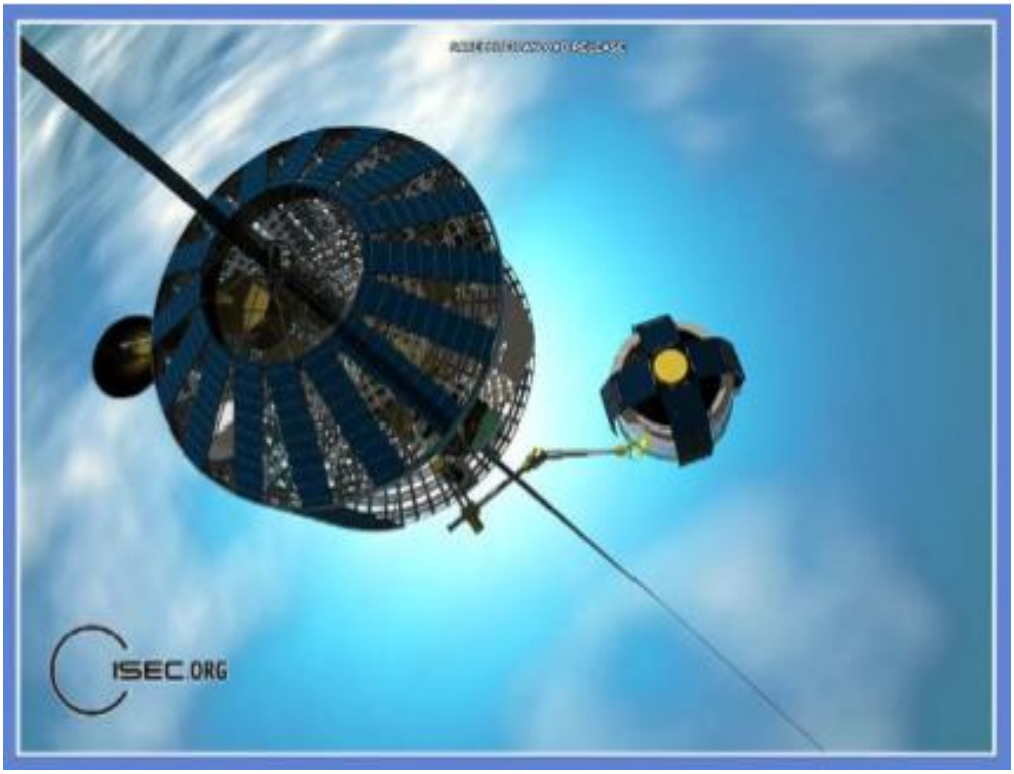

Fig. 3 Climber as a spacecraft [6].

The following are important component in climber design:

- **Motor specification**: The motor would be based on permanent magnet brushless multi-pole technology to achieve a high efficiency with low mass.
- **Track and roller system**: The track and roller system to grab the cable must be designed to hold without damaging cable. In considering our cable design it is important that the track system grab the small structure of our cable uniformly.
- **Power system**: The climber half of the power transmission system consist of photovoltaic cell for receiving the incoming laser power and power conditioning system.
- **Thermal issues**: This is the one issue related to climber that must be considered is thermal. In running photovoltaic cell more temperature is produce. Due to carbon composite structures we get additional radiative cooling because carbon composite are good thermal conductor.
- **Structures**: The support structures of the climber will require much less strength than that of a standard spacecraft since it will face no launch forces. The structure of the climber will be designed for a slowly varying load in the vertical direction with the primary structural loads existing between the cable and locomotion system.
- **Control system**: The control system on the climbers will be required to monitor the speed of ascent, the tension in the cable, the splicing process and the climber location. During most of the climb the system will be in a slowly changing system with little complexity in the control required. Beyond geosynchronous, the climber will need to switch modes from a climbing mode to a braked descent. The final, and probably most important, responsibility of the climber controls is to stop the descent and lock the climber in place for use as a counterweight at the far end of the cable

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.**Communication**: Communications like control will be minimal. The only communications that will probably be present in the climbers are low baud rate diagnostics and emergency contacts [5].

VII. ADVANTAGES

1. Place heavy and fragile payloads in any Earth orbit (with a circularizing rocket) or send them to other planets.
2. Space elevator used to deliver payloads with minimal vibration.
3. Space elevator used to bring heavy and fragile payloads down from space.
4. Deliver payloads to space at a small fraction of current costs.
5. Send a payload into space or receive a payload from space every few days.
6. The most important of space elevator to solve survive problems and failures and be repaired.

VIII. LIMITATIONS

1. Stabilisation of climber dynamics.
2. Dynamical stabilization of cable.
3. Legal problems.
4. International cooperation.

IX. CONCLUSION

The space elevator has great potential for improving access to earth orbit, space and the other planets. The space elevator can be a key piece in the development of the moon and use of its resources for advanced space development. The human kind should not stay on the earth but they needs to expand the range of their activity to space for surviving on the next century therefore space elevator is the key for humans. Natural resources on the earth including energy resources will run out and cannot sustain human growth by the rsesources only on the earth. The space elevator makes the constant transportation of payload from the earth to space is possible. After some time the space elevator is not just a dream system has come at present. And if the most optimistic visions of building a space elevator would be realized, then actually we can say that it is the first step towards development of earth.

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