The BABEL Tower: A Super-Tall Structure with a Sub-Orbital Elevator

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ABSTRACT

The idea of reaching the heavens has captivated humans throughout the ages. Rockets have proved extremely inefficient in overcoming this challenge and constructing a "Centrifugally Extended Carbon Nano-Tube Tether Space Elevator" (CECNTTSE) presents unsolved technological challenges. The authors conclude that to efficiently achieve the goal of unrestricted movement away from Earth's gravitational pull; both the current state of the art and the proposed method for a Space Elevator should be reinvented. Therefore, the authors propose the "Buoyant Advanced Building Elevator Lightweight" (BABEL) Tower, a new concept of "a floating tower" capable of reaching up to the Karman Line and beyond. While providing the structural support to a sub-orbital elevator and offering a better launching platform for space vehicles, with built-in rocket engines, directed specifically to LEO but also beyond. Using a (hybrid) LTA and electromagnetically driven elevator car, this super-tall tower could lift tremendous amounts of cargo (and passengers) while avoiding problems associated with space elevators, and could be more feasible in a shorter time. This concept combines characteristics of the Skylon Tower (of London) and the Burj Khalifa (of Dubai) into a flared tensegrity structure with buoyant platforms, "linked" every 2.5 km and tethered to the ground. This anchor-mooring system will support a beam-stalk like buoyant shaft. The estimated aspect ratio (2.5:100) for each wing of its "Y-shaped footprint" will be 2500 meters wide at sea level. The platforms and the shaft "must be built" following a modular principle. Its buoyancy will be generated using a perfect vacuum inside its cells, thus becoming; lighter than air, free from the scarce availability of helium, and safe from hydrogen's reactiveness. Because its foundations would have to resist the up-thrusting forces that the buoyant structure will produce (instead of the compressive forces caused by weight), the engineering of this buoyant tower is structurally comparable to a maritime spar platform for deep-water oil-extraction. This concept will have a high potential efficiency in reducing the cost per kilogram to be in transit to orbital insertion. In providing an infrastructure of planetary scale, this tower could provide the requisite platforms for other uses such as astronomical observation, clean solar energy distribution (by laser beaming), space tourism, telecommunications, research laboratories, aerosols dispersion, carbon and methane sequestration, airship hub terminals, etc.

Keywords: *Orbital Transfer Vehicle Platform, Space Elevator, Space Faring Infrastructure, Sub-Orbital Elevator, Super Tall Tower, Tethered-Buoyant Structure*

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1. INTRODUCTION

As a premise of this work, we understand that the current state of the art for launching payloads to orbit should be renewed by a new approach because, “to access space, payloads must gain significant potential and kinetic energy. …, regions above aircraft altitude are accessed using rocketry, where mass is expelled at high velocity in order to achieve thrust in the opposite direction. This process is extremely inefficient as rockets must counter the gravitational force during the flight by carrying mass in the form of propellant and must overcome atmospheric drag” (Quine et al., 2009).

Therefor, a sub-orbital structure like the BABEL Tower “avoids problems associated with a space tether including material strength constraints, the need for in-space construction, the fabrication of a cable at least 50,000 km in length, and the ageing and meteorite-damage effects associated with a thin tether or cable in Low Earth Orbit” (Quine et al., 2009).

Furthermore, a super-tall building as the BABEL Tower overcomes a better option than a 5 km or 20 km altitude “free-standing structure” (Quine, 2007). Because, the spaceport facility located at the top of the tower at 100 km altitude offers a better starting point for the operation of vehicles propelled by chemical rockets and fostering the develop of other new technologies (See Table 1).

Finally, we argue that the BABEL Tower certainly will be the tallest structure erected and tethered at the Earth, and without no doubt, it will become literally a symbol of our purpose, the effort of the human civilization to reach the sky.

2. BACKGROUND

The study “The space elevator: Thought experiment; or key to the universe” (Clarke, 2003) indicates that, “Space elevators (SE) have also sometimes been referred to as beanstalks, space bridges, space lifts, space ladders, skyhooks, orbital towers, or orbital elevators”.

In an article named”Challenges in building space elevators” (Kaushal & Arora, 1964), they described that the concept of an orbital tower was primarily suggested in the XIX Century:

The key concept of the space elevator appeared in 1895 when Russian scientist Konstantin Tsiolkovsky was inspired by the Eiffel Tower in Paris to consider a tower that reached all the way into space, built from the ground up to an altitude of 35,790 kilometers above sea level (geostationary orbit, GSO). He noted that a “celestial castle” at the top of such a spindle-shaped cable would have the “castle” orbiting Earth in a [GSO] .

Tsiolkovsky’s tower would be able to launch objects into orbit without a rocket. Since the elevator would attain orbital velocity as it rode up the cable, an object released at the tower’s top would also have the orbital velocity necessary to remain in geostationary orbit.

[However Nelson Semino, in a lecture held in the Katolieke Universiteit of Leuven, has pointed out that”... this [modern] simplistic description of an orbital insertion system is erroneous and incomplete, because releasing spacecrafts without built-in propulsion systems from the spaceport would result in space junk piling up in the neighborhood of the Space Elevator. ... It must be recognized that Tsiolkovsky’s proposal was meant as a device to attain orbital altitudes for a subsequent powered journey and not for orbital insertions system. ... Tsiolkovsky was a rocket scientist well aware of the cost of reaching space altitudes but had no ideas of telecom, meteorological, GPS, (or any other type,) of satellites. ... To him, the goal of the proposed SE was as an exercise purely academical ... only intended to exemplify how conservation of energy could be of benefit when employed in a scheme to reduce launching costs ... (Semino, 2012)].

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