

A2_4 Light bridge

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Abstract

Light bridges are used in the Halo series of games. This paper discusses the viability of such a bridge and finds that it is not possible due to the required power being impractical and so high that it would vaporise anything that tried to use such a bridge.

Introduction

In the Halo series of games, light bridges, sometimes referred to as energy bridges, are used on alien planets as a means of traversing terrain. These are bridges,

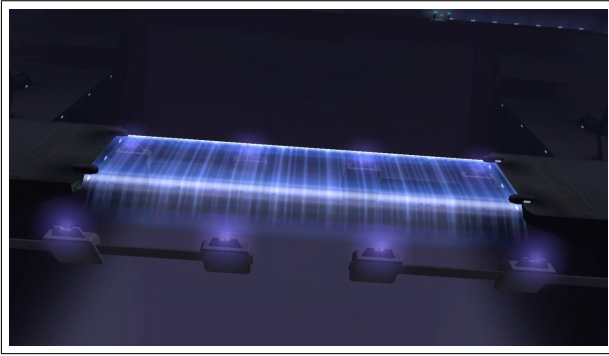


Fig. 1: A Halo light bridge as it is depicted in the first game of the franchise, *Halo: Combat Evolved* [1].

that when activated, appear to use light to provide a walk-able surface between two platforms. The bridge can support the weight of ordinary human soldiers, the Master Chief (who is supposed to weigh substantially more than an ordinary human^a, one reference gives his mass as 179 kg [2]) and the Halo equivalent of a tank, the Scorpion (which has a mass of 66,000 kg [3]). The acceleration due to gravity on these alien worlds is unlikely to be equivalent to that of Earth, however, the soldiers are able to move as if it were Earth like gravity.

Radiation pressure

The simplest way to calculate the intensity of light needed is by considering the required radiation pressure^b. It can be shown that the radiation pressure

^aThe Master Chief is supposed to be a human, augmented by a suit. The suit is meant to be so powerful that it required special training from an early age so to avoid killing the occupant.

^bIt is possible to get to the same result by considering the momentum of the incident photons, but this is a cleaner approach.

is,

$$P_r = \frac{I}{c}, \quad (1)$$

where I is the intensity of the incident light and c is the speed of light [4]. Equation 1 implies that the incident light is absorbed, it is therefore useful to consider the more realistic case of the light being reflected to some extent. This is done by introducing a reflectivity constant, R ,

$$P_r = (1 + R) \frac{I}{c}. \quad (2)$$

This is valid, as when the reflectivity is zero, equation 2 is equal to equation 1; when the incident object is perfectly reflective, equation 2 is equal to twice that of equation 1, which is logical if the momentum is considered.

Just like floating ...

The pressure due to gravity on an object will be,

$$P = \frac{mg}{A}, \quad (3)$$

where m is the mass of the object, g is the acceleration due to gravity and A is the surface area in contact with the ground^c. Equating equations 2 and 3, and re-arranging for intensity, gives,

$$I = \frac{mgc}{(1 + R)A}. \quad (4)$$

As intensity is the power per unit area, equation 4 can be reduced to the power required,

$$W = \frac{mgc}{1 + R}. \quad (5)$$

For a human of 80 kg, wearing shoes whose soles have a reflectivity^d of 30%, the required power^e would be 1.81×10^{11} W. For both the Master Chief and the Scorpion, a higher reflectivity is likely (due to them

^cGround is used here as a generic term.

^dEstimate based on data from [5].

^eThis is using the acceleration due to gravity as 9.81 ms^{-2} and the speed of light as $2.998 \times 10^8 \text{ ms}^{-1}$.

being made out of metal). Using a reflectivity^f of 90%, gives a power of 2.77×10^{11} W and 1.02×10^{14} W, for the Master Chief and Scorpion, respectively.

Conclusion

From the calculated powers, it is obvious that a light bridge would not be practical from an energy point of view. To make this point more obvious, the cost to run the light bridge, if all the light was used to support each object, for a single minute^g would be £603,000, £923,000 and £340,000,000 for the human, Master Chief and Scorpion respectively. Practically, it would cost significantly more and the high power required by the light bridge would vaporise anything which attempted to cross it. Therefore, the light bridge depicted in the Halo franchise is currently impossible to construct with known physics.

References

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- [4] P. A. Tipler and G. Mosca, *Physics for Scientists and Engineers*, 6th ed. (W.H. Freeman and Company, New York, 2008)
- [5] *Tables of Physical & Chemical Constants*, (16th edition 1995). 2.5.9 Light Reflection. Kaye & Laby Online. Version 1.0 www.kayelaby.npl.co.uk (2005)

^fEstimate based on data from [5].

^gUsing 20p per KWh.