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A1 1 Moonfall: Earth's Mightiest Shed

A. Botan, H. Williamson, R. Henson, M. Norman, J. Charlesworth

Department of Physics and Astronomy, University of Leicester, Leicester, LE1 7RH

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Abstract

Could the gravitational force exerted by the moon approaching the surface of the planet tear a shed from where it stands? Frankly speaking, no, the moon would simply make everything "lighter", and the gravitational force is simply not powerful enough to tear a standard shed apart. In this situation the forces on each wooden plank would be about 18N parallel to the normal line and 8.2N perpendicular, which would overall lead to strains in the order of 10^{-7}.

Introduction

In the 2022 disaster movie Moonfall [1], a group of protagonists hide in a shed to avoid the debris caused by the Moon's gravity pulling objects towards it, away from the Earth's surface. In this paper, we investigate whether the pull of gravity of the Moon at such a close distance would be capable of pulling the shed as well.

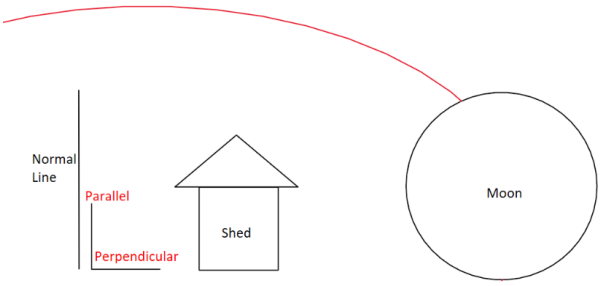

Figure 1: Hand-drawn diagram illustrating the direction of the forces simulated and the not-to scale arc from which the simulation begins.

Method

To calculate the forces acting on the shed the distance to the Moon must first be estimated. We use a minimum estimate based on the fact that in this scene the moon is not visibly burning up, as it does in later parts of the film, and so we conclude that the Moon must be outside the atmosphere, which is considered to end at around 100 km. First, we computed the angle at which the Moon is aligned horizontally with the shed. We know the distance from the centre of the Earth to the centre of the Moon, and additionally we know the distance from the centre of the Earth to the shed, and so we can form a simple right angled triangle and use Eq (1):

$$\theta = \cos^{-1}(\frac{b}{c}). \tag{1}$$

With an angle and 2 known distances (b = Earth-Shed and c = Earth-Moon) we can simply use the cosine rule to work out the (a = Shed-Moon) distance:

$$a^2 = b^2 + c^2 - 2bc\cos(\theta). \tag{2}$$

Afterwards, the force has been split into perpendicular and parallel components, $\sin(\theta)$ and

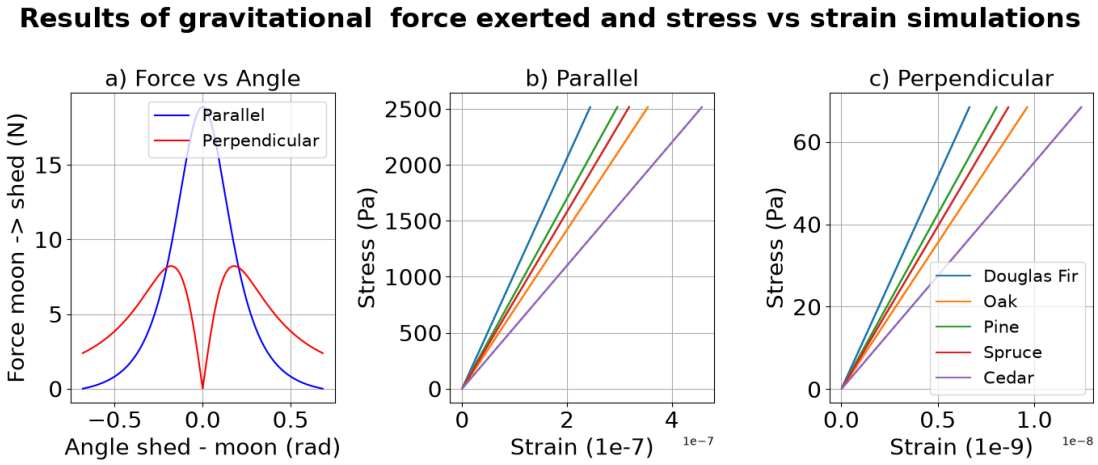

Figure 2: a) Perpendicular and Parallel gravitational forces (relative to the normal line on the surface of the Earth at the point of the shed) of the moon exerted on the shed. b) and c) are the stress and strain experienced by some our 5 chosen wooden planks, with different shear and compressive strengths. Figures b) and c) share a legend. [2].

$\cos(\theta)$ respectively.

With the distance between the shed and the Moon now known, we can simply use Newton's Law for gravitational force to work out the force exerted by the Moon:

$$F = \frac{GMm}{r^2}. \tag{3}$$

We modelled the shed as a standard plank of wood of dimensions $2400 \times 150 \times 50$ mm, akin to what one would acquire from a hardware store, and assuming the material is oak, would be a mass of approximately 13 kg [3]. Modelling more planks could be a more appropriate model, however, as the area will increase as well, the stress experienced by the shed will be distributed over a larger area, thus lead to the same strain. It is stated in the movie that the Moon has an artificial mass consistent with the mass of our Moon, thus this is the mass used for this simulation and our simulation starts when the moon would theoretically be "in line" with the shed, and ends on the other side of the line.

Discussion and Conclusion

In Figure 2a the gravitational force exerted by the moon is simply not strong enough ($\sim$8.2 N sideways and $\sim$ 18 N upwards, which is even less than the weight of the plank of $\sim$ 130 N) to have any effect on the shed, even at such short distances, unlike most of the dramatic effects seen in the movie. Going one step further to test for stress and strain in Figure 2b and 2c, we can see that the stress exerted would be relatively small, with the parallel stress getting to about 2500 Pa and 65 Pa perpendicular, and, as a result, the wooden plank would not experience a large "stretch", indicated by the maximum magnitude of 10^{-7} of the strain.

In conclusion, the shed surviving the moon's fly-by is possibly the most realistic part of the movie, and other effects, such as people flying or a tractor getting dragged were exaggerated and do not hold any relation to reality.

References

[1] Roland Emmerich. *Moonfall*. Around the 1h 13min mark. 2022. URL: https://www.youtube.com/watch?v=XhZ5TF1OyzM (visited on Oct. 20, 2026).

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[3] WoodCalcs. "Timber Weight Calculator — Estimate Wood Weight by Species". Timber wood mass malculator. URL: https://woodcalcs.uk/timber-and-board/timber-weight-calculator/ (visited on Oct. 20, 2026).