Understanding Landslides Through Granular Flow Simulations

Introduction

Landslides are a significant threat to infrastructure, humans, and the environment. In this project, we simulate landslides in the lab and see how various parameters alter granular flow to help formulate landslide mitigation strategies

Objective

The objective is to study how:

- Different properties of the resultant shape of the particles
- The velocity of the granular flow

vary as a function of the angle of inclination of the inclined plane on which the grains are released.

Experimental Setup

Set the angle of incline, the cameras in appropriate locations, and measure required mass of the granular particles

Drop the grains from the top of the inclined surface and allow the structure to fully form and reach a stable state

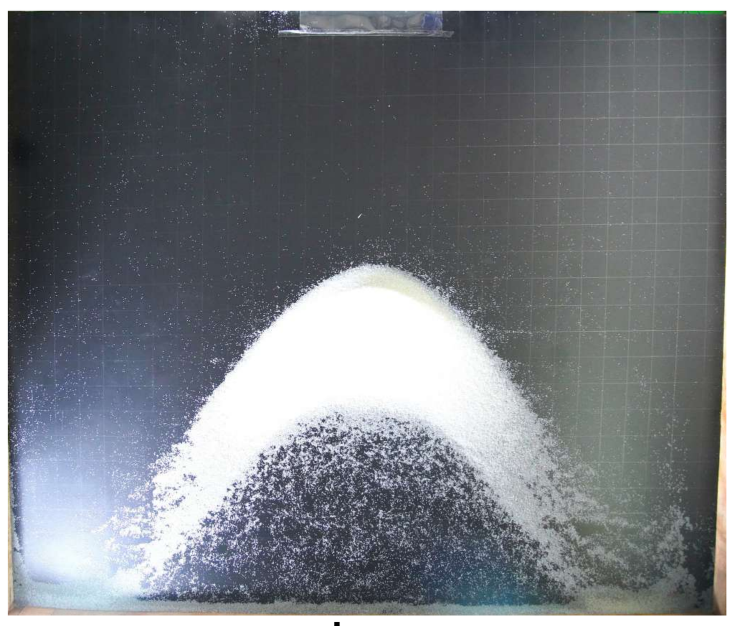
Captured flow at the inlet with the highspeed camera and took an image of the final structure formed

Used ImageJ to do curve-fitting on the image of the final structure and obtained the necessary parameters

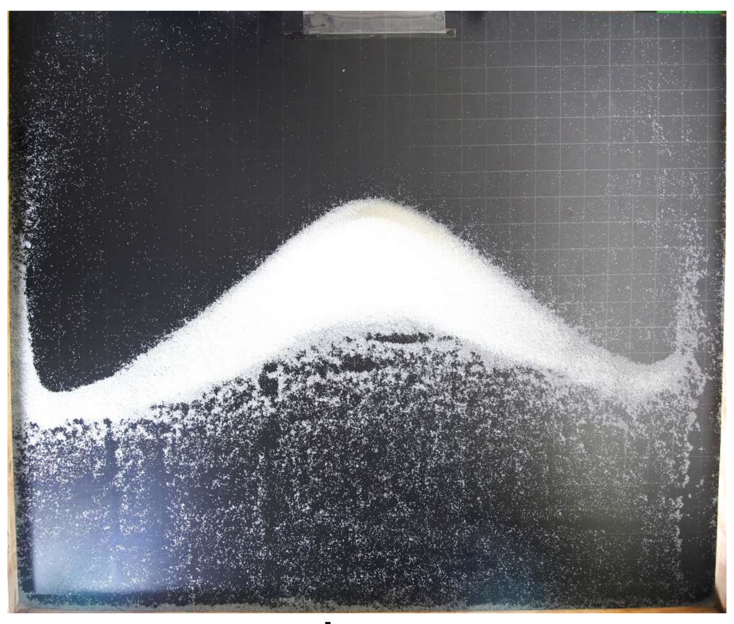
Results and Discussion

Resultant Structures Formed

35 degrees

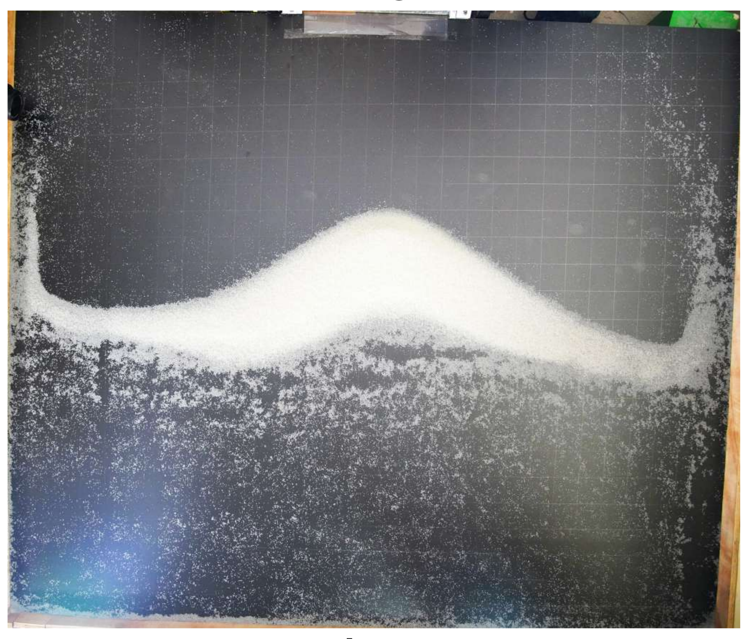


40 degrees



45 degrees

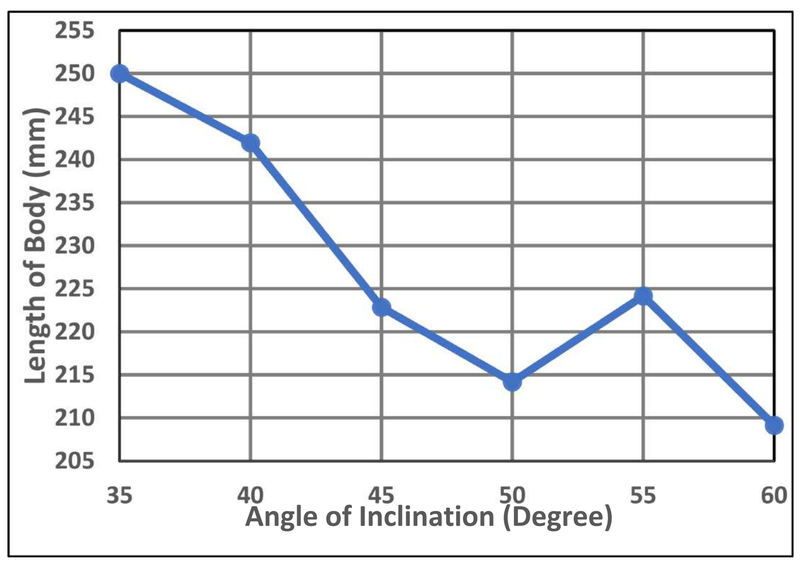
50 degrees

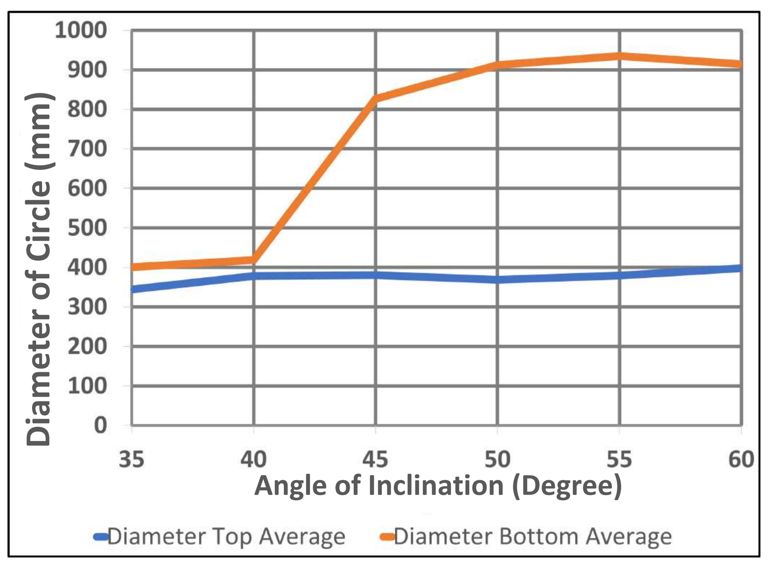


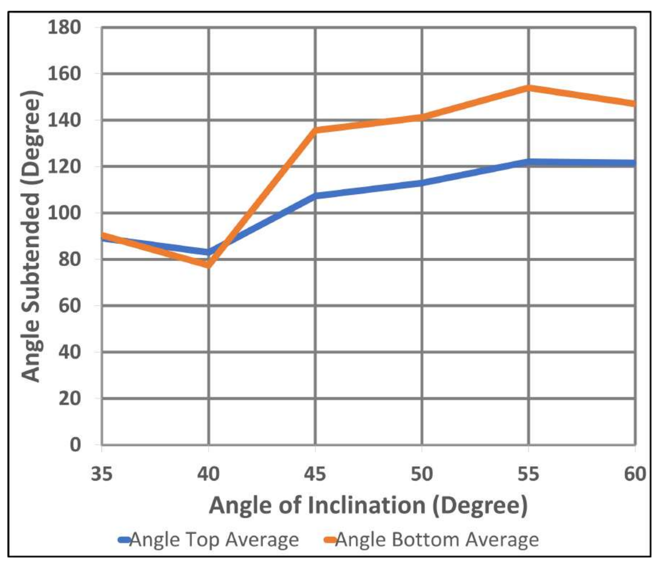
55 degrees

60 degrees

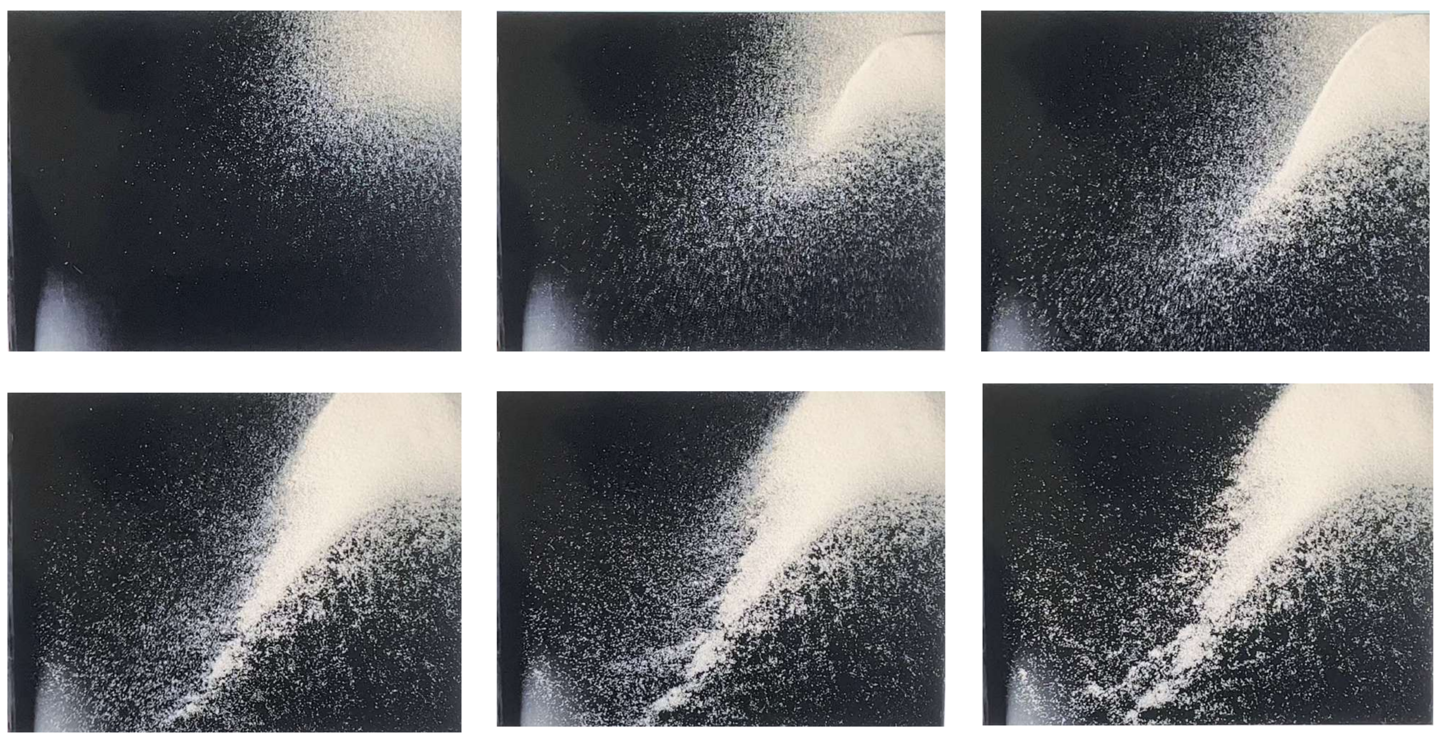
Static-recurve shape formed: a vortex-like structure on each side of the main central tongue-like profile. Flap-like designs could also be seen on the tongue shape's outer surface.







Close-up of vortex-like structure formed



Stages of vortex structure formation captured by high-speed camera (10,800 fps)

Conclusion

Through this experiment, we have deepened our understanding of granular flow behavior. By reading the graphs, we can see how the angle of inclination of a mountain terrain will affect the flow of debris on the surface and we can predict how far and wide the debris will fall onto the flat ground at the foothills of the mountain. This will help formulate landslide prevention and damage control strategies.

References

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