Indian Institute of Technology Gandhinagar

ME 206

STATICS AND DYNAMICS

COURSE PROJECT REPORT

Group Number: 12

Project Title: Center Of Percussion Of Equilateral Triangle

22110270	Tapananshu Manoj Gandhi
22110276	Trivedi Vatsal Gaurangkumar
22110278	Utkarsh Srivastava
22110286	Vidhi Shah
22110287	Viraj N Vekaria

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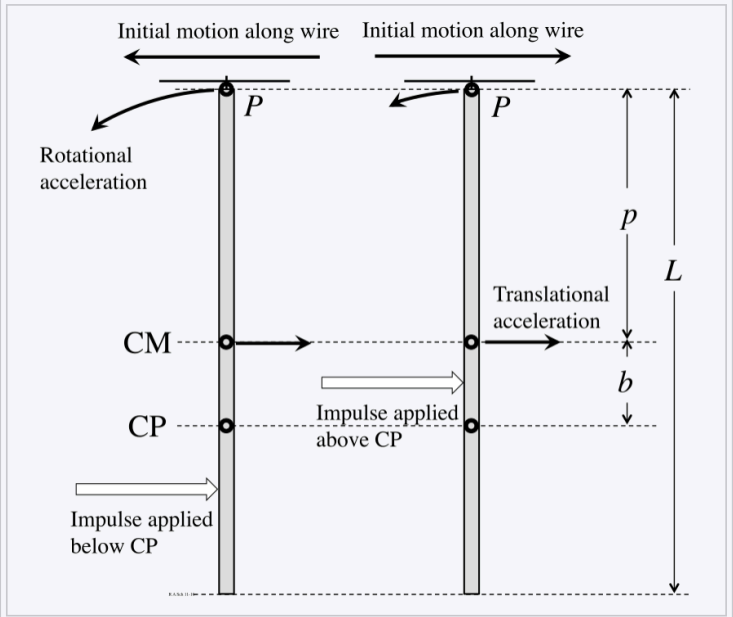
Mentored by-
Prof. Jayaprakash KR

Introduction:

The centre of percussion is the point on an extended massive object attached to a pivot where a perpendicular impact will produce no reactive shock at the pivot. Translational and rotational motions cancel at the pivot when an impulsive blow is struck at the center of percussion. The centre of percussion is often discussed in the context of a bat, racquet, door, sword or other extended object held at one end.

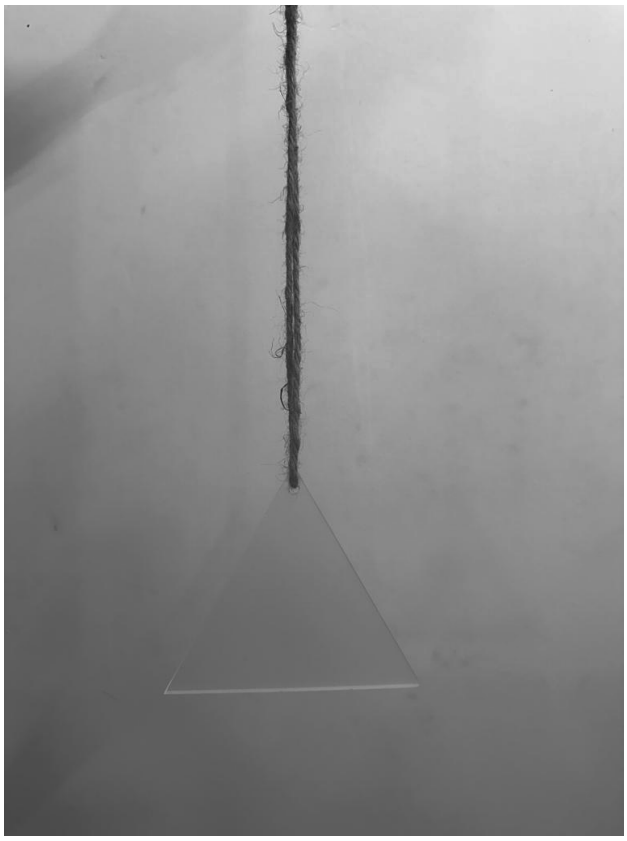
This report investigates the centre of percussion for an equilateral triangle oscillating about one of its vertices. The unique challenges posed by the asymmetry of this geometric shape prompt a dual examination through theoretical and analytical lenses. Our aim is to reconcile these perspectives, shedding light on the rotational dynamics of irregular objects

The equilateral triangle's distinct geometry prompts a closer look at its behaviour during oscillation. We begin by exploring the theoretical foundations governing its motion under an applied force at the vertex. Subsequently, analytical methods are employed to derive expressions for the centre of percussion. The report critically compares theoretical predictions and analytical solutions, offering insights into the complexities of rotational dynamics for non-uniform shapes.



Effects of a blow on a hanging beam. CP is the Center of Percussion, and CM is the Center of Mass of the beam.

Experimental Design:



We have made a triangular lamina with the acrylic sheet and made a hole in it to hang it with string.

Fabrication Details:

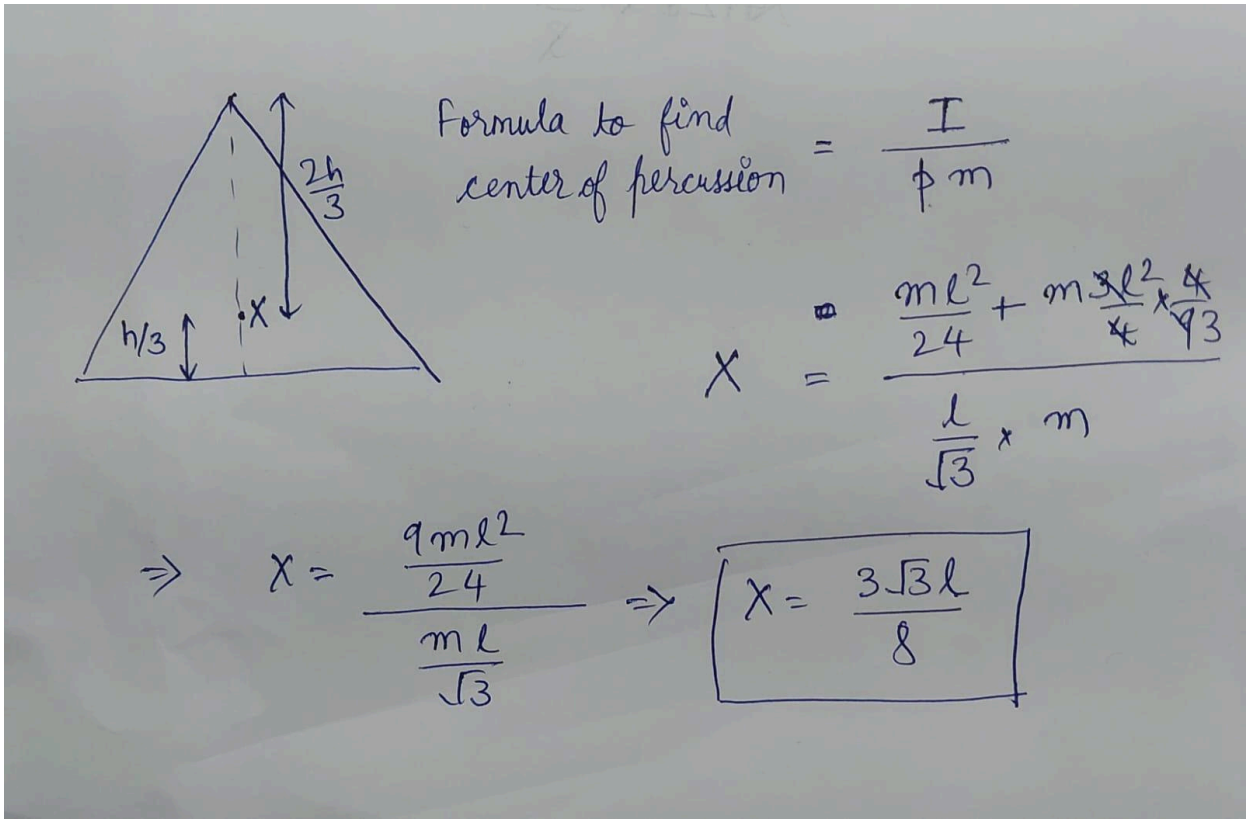
1. Materials and Tools:

    - Acrylic Sheet
    - Thread
    - Hanger

2. Fabrication Steps:

- We designed an equilateral triangle with a hole in it on Fusion 360.
- The design was lasercut on an 0.5 mm acrylic sheet.
- A thread was passed through to the hole and adhered to the a stable platform for a stable initial state

Theoretical Calculations:

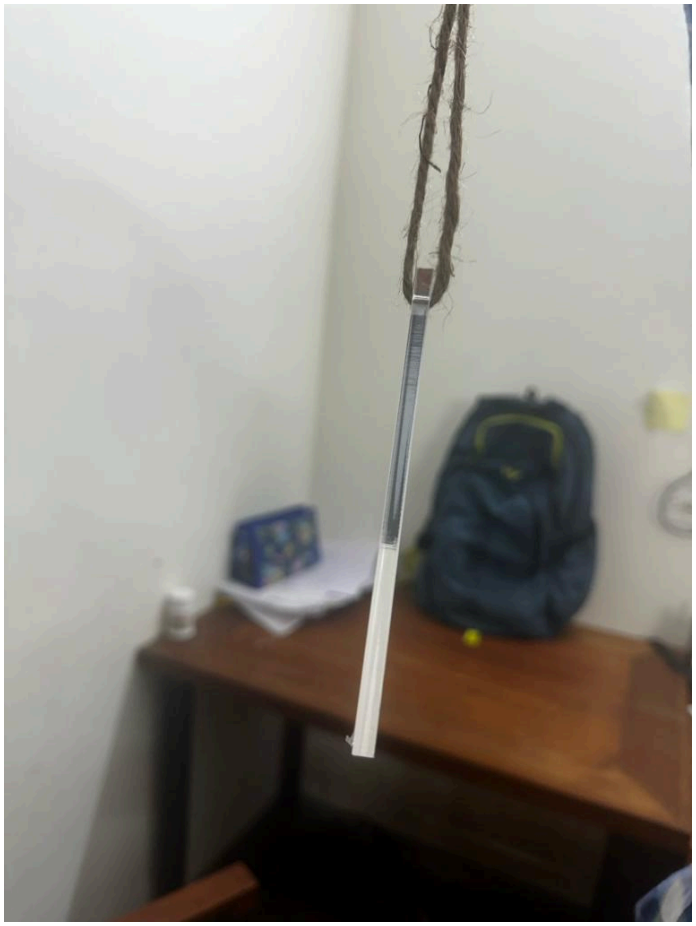


Measurement Techniques (figure showing the rough setup):

The camera shooted the various interactions to the sheet from sideways.

There were no solid measurement aspects to the camera, it was just used to watch the initial instant movement of the thread which will bear the reaction force.

A scale was put parallel to the surface of the sheet, to note the distance at which we were hitting the surface and the corresponding flinch in the string was observed.



Results:

Flinch at x = 5 cm:

It was observed that the string moved along with the sheet instantly after the flinch.

Flinch at x = 10 cm:

It was observed that the string actually moved a little back, opposite to the direction of the flinch at the initial instant..

Flinch at x = 8 cm:

It was observed that the string almost remained the same for some instant just after the flinch.

Conclusions and Comments on the values recorded and calculated:

From the following experiment, it can be verified that:

- The theoretical value of the distance of the centre of percussion from the pivot comes out to be 8.963 cm
- The experimental flinches suggest similar behaviour at distance = 8 cm as at that point minimal reaction force on the thread was seen.
- Therefore the consistency between the two values can be observed and verifies the problem statement.

Scope for improvement:

Experimental Validation: If feasible, consider incorporating experimental validation to complement theoretical and analytical approaches. Real-world experiments can provide empirical data to verify and refine theoretical predictions, adding robustness to your findings.

Sensitivity Analysis: Conduct a sensitivity analysis to explore how variations in parameters, such as the dimensions of the equilateral triangle or properties of the material, impact the location of the centre of percussion. This analysis can offer insights into the stability and reliability of the results.

References:

[1] *Center of Percussion. (n.d.). Harvard Natural Sciences Lecture Demonstrations. https://sciencedemonstrations.fas.harvard.edu/presentations/center-percussion*

In-Text Citation: (Center of Percussion, n.d.)

[2]S. (2016, July 27). Center of percussion - baseball bat theorem. Physics Forums: Science Discussion, Homework Help, Articles.

https://www.physicsforums.com/threads/center-of-percussion-baseball-bat-theorem.879865/

In-Text Citation: (2016)

[3]Center of percussion. (2022, October 20). Wikipedia. https://en.wikipedia.org/wiki/Center_of_percussion#:~:text=The%20center%20of%20percussion%20is,at%20the%20center%20of%20percussion.

In-Text Citation: (Center of Percussion, 2022)

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Thank You