Group Project 3

Goal: Construct a method of launching the blocks at the boar tigers to neutralize as many as possible.

Facts:

- Blocks: 5x1x1 m, wall thickness: 10 cm, steel density: 7850 kg/m^3
- Cannonballs: 0.3m diameter, fire at: 1600 m/s, mass: 200 kg

Lacking:

- How the steel block will move after struck by the cannonball
- Linear and angular velocities of the block or block/cannonball system after the collision
- Total mass/volume of the block

Assumptions:

- We assume that both angular and linear momentum are conserved and as a result Kinetic energy is not conserved
- We are not taking air resistance or friction into account
- Collision is essentially instantaneous
- No external forces are acting on the system
- Rectangular prism
- Collision of cannonball and block will be maximally inelastic, addition of the mass of the clay ball will not change the center of mass considerably

Equations:

$$\Delta E_{sys} = W_{surr} + Q \qquad E_e = \frac{1}{2} K_s (S_f - S_i)^2$$

$$E_K = \frac{1}{2} m\vec{v}^2 \qquad \Delta E_K = \vec{F}d$$

$$F_{\text{net},\perp} = \frac{m\vec{v}^2}{R} \qquad \frac{\Delta\vec{p}}{\Delta\vec{v}} = \vec{F}_{net}$$

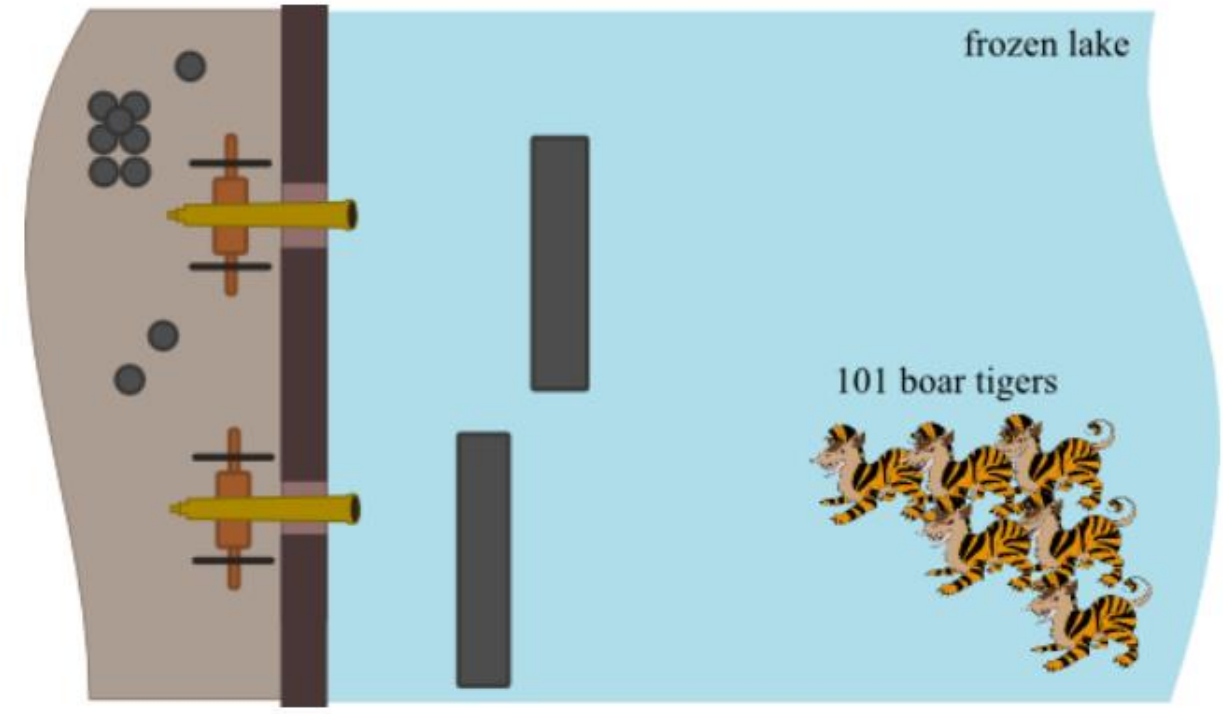
$$m_1\vec{v}_1 + m_2\vec{v}_2 = (m_1 + m_2)\vec{v}$$

$$K_{rot} = \frac{1}{2} I\omega^2 \qquad \Delta L_{tot}$$

$$I = \frac{L}{\omega} \qquad L = mvr$$

$$\omega = \frac{\Delta\theta}{\Delta t}$$

Representation:



Justification of Assumptions:

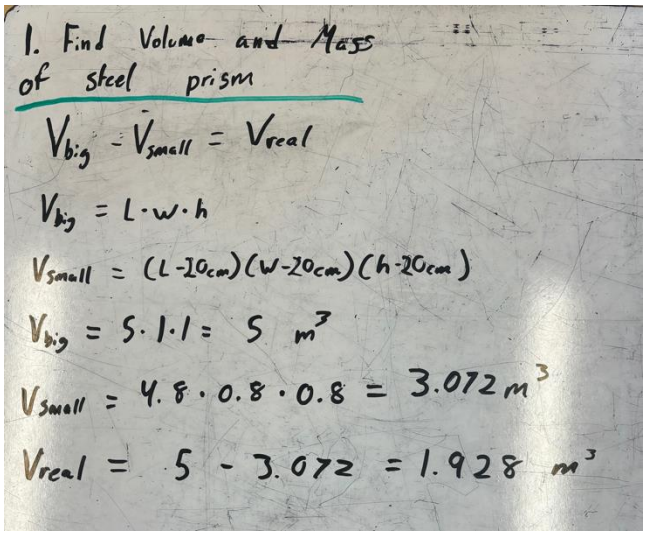
- They

Plan of Approach:

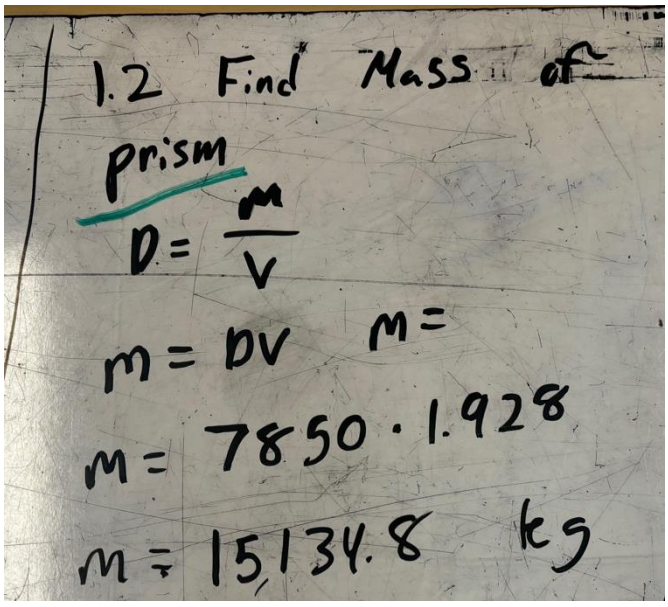
1. Find volume and mass of steel block
2. Use point particle system to find mass and velocity
3. Find moment of inertia of the steel block
4. Find linear velocity of center of mass of block using conservation of momentum
5. Find angular momentum of block
6. Find total speed of the block (angular + linear)

Calculation w/ Explanation:

1. Find the volume of the steel hollow rectangular prism



2. Find mass of prism using given density



3. Find the moment of Inertia of the hollow rectangular prism
4.

Evaluation of Solution:

- They

Evaluation of Model:

- Assuming

Improvements to Model:

- Account for air resistance and friction
- Account for energy lost due to inelastic collision of cannonball/block
- Canonball may not hit