Penn Engineering
University of Pennsylvania

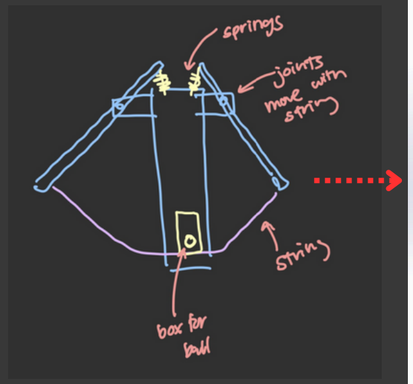
Undergraduate Lab Projects

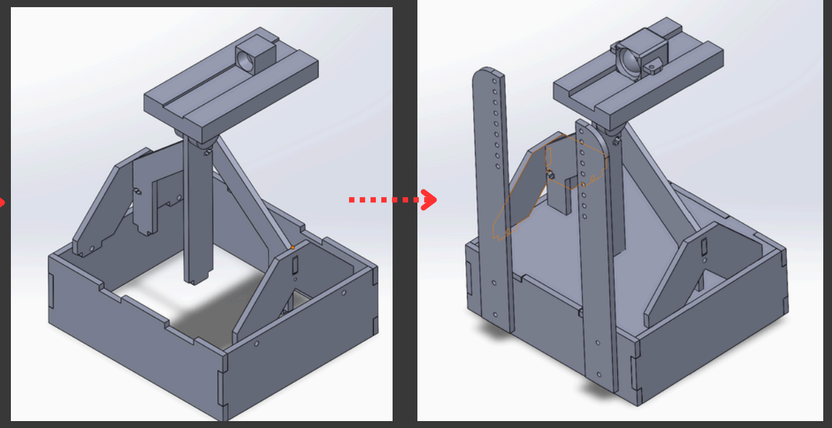
Trained in the traditional engineering and experimentation methodology through structured lab projects as a Mechanical Engineering undergraduate. Key projects include: Seige machine, Kinematics Launcher, Bridge, and Bottle Rocket.

Made use of the school’s Rapid Prototyping Lab to laser cut MDF, Acryclic and FDM 3D printers to extrude small PLA structures.

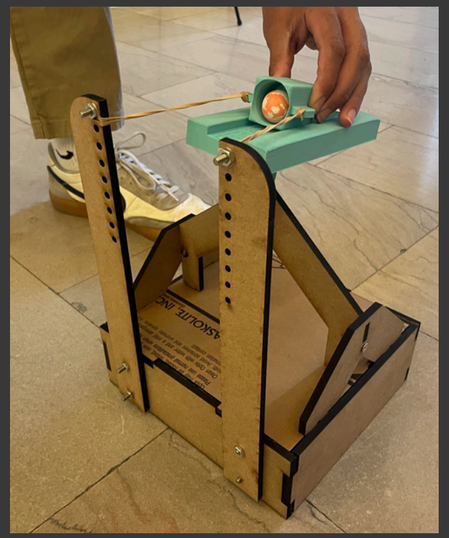
MEAM 1010: Intro to Mechanical Design

Seige Machine



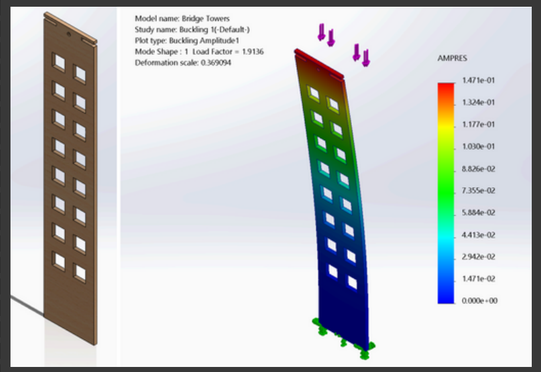


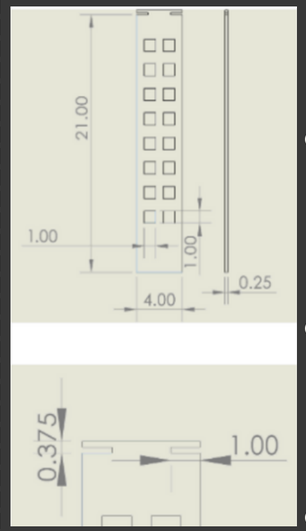
- Inspired by spring-loaded crossbows
- Utilized press fits for crossbow to attach to the large structure
- Fastener t-slot joints at the edges of the large structure
- Fastener lap joints on the crossbow itself
- Iterated on base design to manage reaction force generated by elastic rubber bands

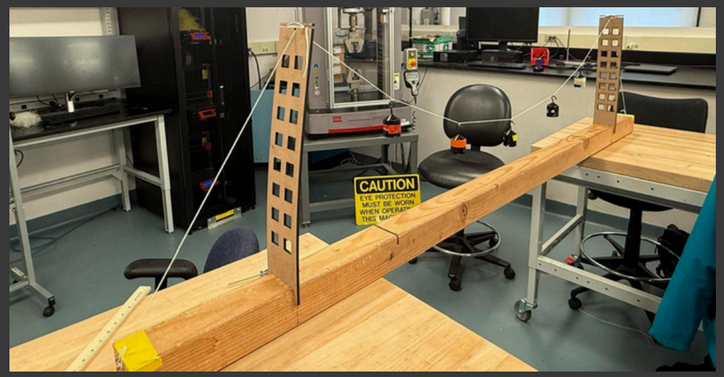


MEAM 2470: Mechanical Engineering Lab 1

Bridge Project



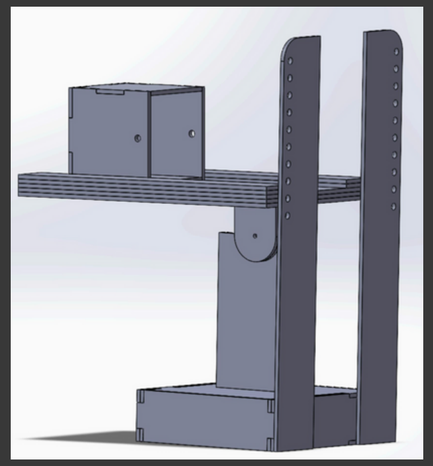




- Designed and built wide-span suspension bridge with 21″ MDF towers; FEA validated tower safety factor of 1.91 under 25 N load.
- Modeled cable sag via parabolic arc-length integration, calculated required pre-load cut length (75.7″) and hanger tensions (20–25 N range).
- Derived tension–elongation model from MTS tensile tests to predict cable stretch; total elongation measured at 4.7″.
- Implemented bowline knots + cleated loops for secure cable anchoring; optimized for cost.
- Final bridge passed test with 7.5″ sag clearance (vs. 6″ minimum), validating calculations and fabrication.

MEAM 2480: Mechanical Engineering Lab 2

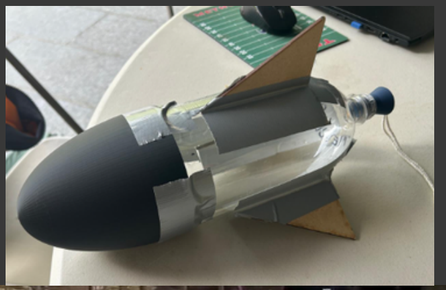
Launcher Project



- Designed and manufactured adjustable slingshot-style launcher in SolidWorks; tunable angle (0–40°) and variable pullback energy.
- Iteratively improved design (track extension, kicker mechanism, structural backplate) to reduce friction and stabilize launches.
- Built Python model of projectile motion with drag; optimized launch angle and energy via numerical simulation.
- Calibrated model with experimental testing; derived correction multipliers for angle (0.66) and pullback (2.65).
- Validated energy transfer with onboard acceleration sensors; achieved >5 m launch distance.

MEAM 2480: Mechanical Engineering Lab 2

Model Rocket Project



- Designed and fabricated a pressurized water–butane rocket with 3D-printed PLA nosecone (optimized 0.08″ wall thickness) and MDF fins (sealed for water resistance) to minimize drag and maximize stability.
- Conducted 7+ experimental launches across varied angles (40–75°) and fill volumes (100–750 mL), recording trajectory outcomes under different wind conditions.
- Simulated two-phase flight (thrust + coasting) using ideal gas law, Antoine equation for butane vapor pressure, and drag modeling, implemented in Python.
- Applied OpenRocket aerodynamic modeling to determine center of pressure (6.76″) and center of mass (5.33″) for static stability margin analysis.
- Optimized launch parameters via brute-force grid search over angle and water fill volume; trade off accuracy vs. robustness for demo day.