

### Design Exercise #3. Design of Frame - Calculations

Assigned: 3/11/15, Due: 3/18/15

This is the first major element of your machine that will be designed and built this semester.

The top level functional requirement for your design will be a single-human-powered catapult to hurl a potato that fits within a 1m x 1m x 0.5 m box when cocked.

Grading:

15 points (style, grammar, organization),

80 points (Design Content: Calculations),

5 points (Design Content: Functional Requirement-Design Feature Mapping),

The second level functional requirements for your design will be

- A) **a machine frame to contain all components and allow adjustment of the range**
- B) an element to store energy for release on firing and transfer that energy to the potato
- C) a latch to hold the catapult in the loaded position, released by the supplied an automatic latch mechanism
- D) a cocking mechanism designed around a single-human-powered energy input mechanism, such as a ratchet or a hand pump

This design exercise is to develop a design to fulfill functional requirement A.

**Constraint One: The device in one configuration must fit into a box 1m x 1m x 0.5 m in the loaded and cocked position.**

Identify the third level functional requirements for FR A (call them A1, A2, ...). Some example functional requirements might be:

- hold the pivot for the counter-weight/spring
- comply with the ground so as to remove location-to-location variations
- keep the machine stable during cocking and firing
- provide an aiming adjustment
- couple the pivot to the ground-compliance device in a way that has minimal deflection due to forces exerted by the pivot
- mount the ratchet
- stop the travel of the potato-hurling mechanism

This is not an exhaustive list nor is it necessarily independent.

**Design Output:** Produce a report that includes the mapping of Functional Requirements to Design Parameters. Include a rough draft (hand sketches OK) of your frame. Detail any preliminary design decisions and the rationale for them.

Using the already selected energy storage element, perform some basic load calculations on your frame. For instance, if frame deflection is going to be an issue, estimate forces on the frame and perform a basic deflection calculation for the cross-section and material that you want to use.