ME 322 Machine Design Project Specification, Spring 2009

I. Torsion Catapult for Pumpkin Chunkin (or trebuchet)

1. Pumpkins must weigh between 8 & 10 pounds.
2. No part of the machine shall cross the firing line.
3. Machine can use linear springs, torsion springs, flywheels, or cords wrapped around its axle (pivot point) to create stored energy.
4. Motorized winches and/or other cranking devices must be used to set the device (or arm).

II. Automatic Potato Launcher

1. Design a mechanical launcher for potatoes, up to 2 lbs
2. The machine must automatically load and launch at least 5 spuds (in succession, one at a time)
3. Range should be a minimum of 50 yards.
4. Hand crank, electric, or gasoline powered
5. No chemicals or explosions.

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Work in teams of 2.
Choose either project.
You may augment these specifications by obtaining my approval.
Design must include the following elements:

- Frame
- Motor or hand crank
- Shafts with couplings and keys
- Power transmission by shafts through gears, chain, or belt
- Springs
- Bearings for drive train components
- Brake or clutch
- Bolts

Design Drawing Requirements:
Overall Layout Drawing of Machine (Frame + major components)
Hand drawings with drafting tools, Pro/E, AutoCAD or other CAD drawings are fine. (CAD recommended).
- Create assembly and component drawings as necessary to document and explain your design.
- Label all major components and assemblies in assembly.
- Show basic, overall dimensions.
- Be professional looking as possible (title block with border, drawing numbers, etc.).

Define Design Requirements:
Translate specifications into useful engineering design parameters. (e.g., Calculate horsepower/speed motor requirements, forces, acceleration limits, preloads, etc.). This will help you to analyze forces and evaluate stresses.
Define Assumptions and Additional Specifications:
Define all criteria necessary to complete your design. (e.g., Temperature limitations, link lengths, acceleration, size, etc.).

Select Purchased Components:
Initially you must select your power source: motors, pneumatics, springs, or hydraulics. Find real catalog items when possible; get shaft sizes, general dimensions and mounting arrangement from the web or a catalog. See me if you have any trouble. You must show all design calculations used in selecting a component. Note: vendors may have design aides and engineering data to help select the correct component. (Forces, power and shaft sizes would be needed to select bearings, motors, etc.)

Design and Analysis Components
It would be impossible to completely design and analyze all aspects of your machine in this semester. So, use your engineering judgment to design and evaluate the most critical items, listed below as a minimum. Make certain to size appropriately all purchased items and select materials for all fabricated items.

Design and Analyze (First project submission items 1-4) (Final project submission-all items)
1) Power source and requirements (motor, hydraulics, pneumatics, etc.)
2) Major frame elements, 2 most critical locations
3) Fasteners
4) Shafts

Later you will add:
5) Springs
6) Keys
7) Couplings
8) Gears and Belts
9) Bearings
10) Clutches

Analysis Procedure
1) Rough design of machine, and basic dimensions.
2) Force/load/acceleration analysis of machine.
   (Determine forces and locations based on your rough design, specification, & assumptions.)
   FBD of machine.
   FBD of components.
3) Estimate power requirement (size motor, pressure, spring rates, etc)
4) Design structure and links (material, cross section and firm up dimensions).
   State and apply appropriate design calculations.
   Evaluate stresses and factors of safety.
5) Repeat as necessary for successful design.
6) Select components using appropriate engineering data and methods.

Conclusions
Conclude your report with a summary of the margins of safety and design life of the components and the overall machine. Discuss the strengths of your design and how it met the specifications.
Discuss what additional analyses you would like to do if given additional resources.
Discuss what you would change about your design in a redesign effort.

Format:
The project should be presented as a design report using a word processor. As there will be several project updates, do not turn in original hand drawn sketches (attach copies).
DO NOT ATTACH ORIGINAL SKETCHES OR CALCULATIONS!

Note:
It is appropriate to make Pro/E models for design and drawings. However, for large frames you may need to use idealized beams to do stress analysis for accuracy and speed of computation.