Project 2 Overview

MEMS 1029 – Spring 2022

Companies, businesses, and agencies commonly draft documents called Request for Proposals (RFP). This document specifies what a client is looking to obtain, which oftentimes is a new or unique item/asset or service. Interested businesses or parties can then submit their proposed method or solution, and if selected by the client, win the right to work on the request.

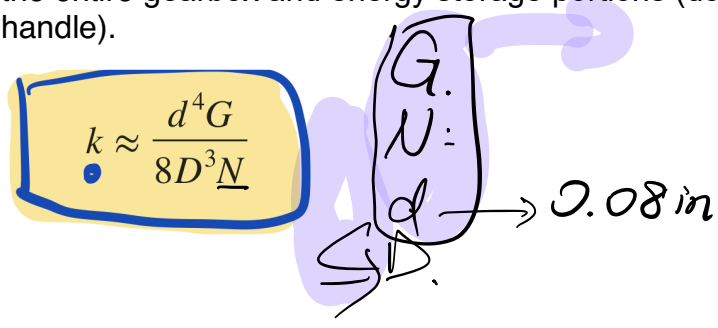
A potential client has issued a Request for Proposal and management has passed the project on to your engineering team. The client is looking into the feasibility of developing a device capable of charging a modern cell phone by converting human mechanical energy into electrical energy. The device must be capable of storing the energy so it may be used when it is needed. As such, **your group is responsible for the portions of the device including the human input and the mechanical energy storage**. You do not need to look into how to convert the stored mechanical energy to electrical energy for use in the phone.

Your final design **must incorporate gears and springs**, though you will also need to **design any shafts used and select the necessary bearings** for the device to function. Also, instead of a formal report there will be a technical presentation that you will create and deliver, as well as supplementary materials detailing your design calculations.

Design Criteria

The key criteria outlined in the RFP are as follows:

- Device must be capable of storing 10 Watt-hours of energy.
- Energy storage must be done using springs, but you may use different types of springs and have as many as you want.
- Input power must come from a human-powered hand-crank. The design of the hand-crack is up to you, e.g. the size, the shape, etc.
- Device must have a gearbox and gear train, but you may use any number and combination of gears, as well as any type of gear train.
- You should seek to minimize the size of the system, which we'll define as the "bounding box" (3-dimensional rectangular cuboid) or "bounding cylinder" that can encompass the entire gearbox and energy storage portions (doesn't need to include crank handle).



As this is a feasibility study, there are several design variables you may want to keep in mind concerning the device, including but not limited to:

1. Weight
2. Size
3. Estimated Cost
4. Ease of use/User friendliness
5. Functionality

At the end of your presentation you should make final recommendations on feasibility of the idea. Note that as this is an RFP, that this is actually a *competition*, and that the engineering management (Dr. Ludwick, Dr. Whitefoot, and the two TAs) will be selecting a winner or winner(s) based on the "best" design(s) and how they addressed the feasibility criteria above.

Deliverables

Your team's deliverable will be a 10-12 minute video recording of a design review presentation that you will be presenting internally to engineering management. The point of the presentation is to describe your design, giving only the important details and explaining how it will work and the general findings of the feasibility study. The presentation can be done in Powerpoint or another similar software and recorded live using Zoom or some other tool.

The presentation should include the following:

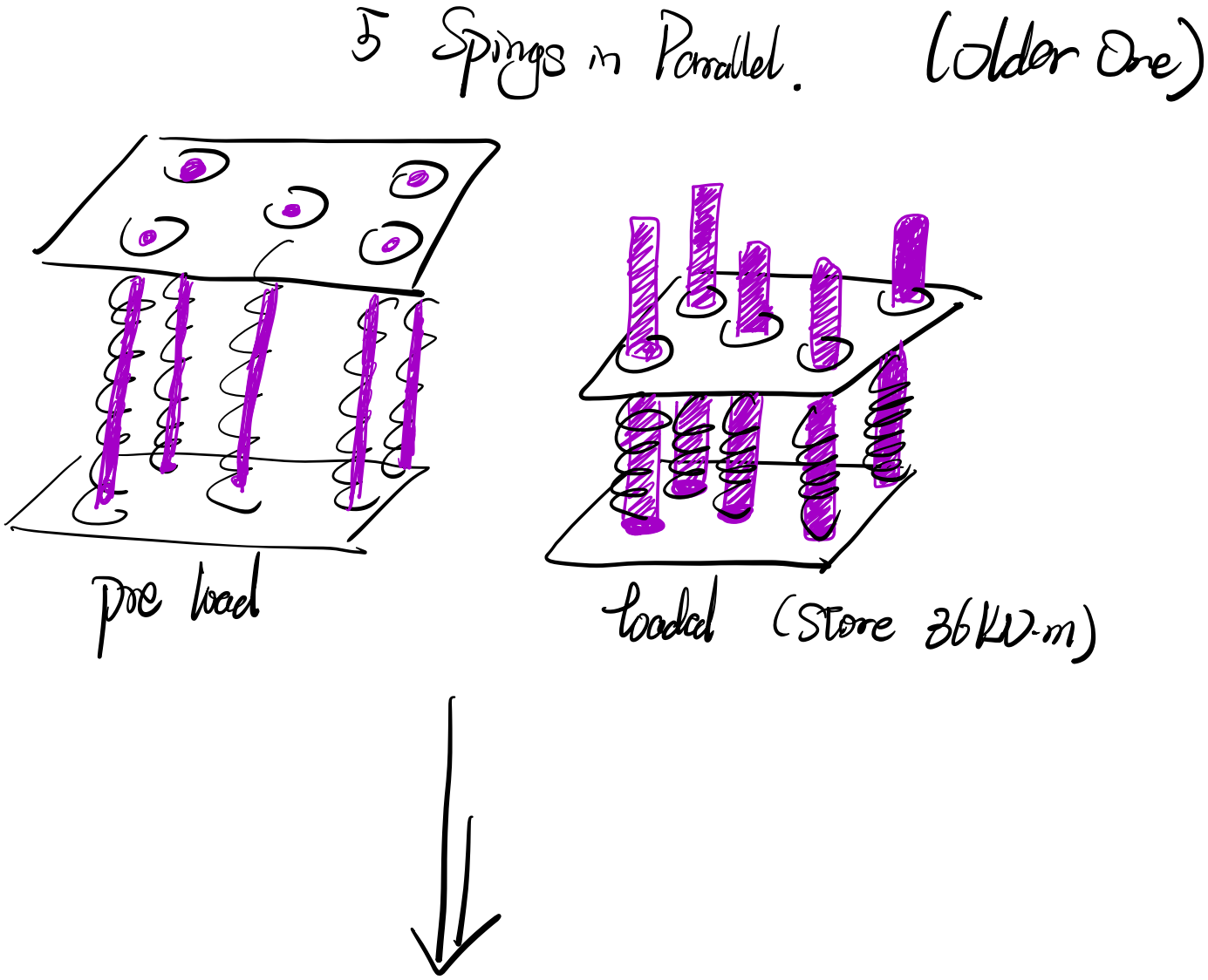
1. **Cover Slide -** Course, date, assignment title, team member names, explanation of contributions from each team member (how work was divided)
2. **Design Name** – Be creative.
3. **Objectives** - Discuss the requirements and constraints for the device.
4. **Design and Analysis** – How does your design of the device meet the criteria? Why did you select the gear train and spring arrangement that you did?
5. **Feasibility** – What steps did you take to make the device as realizable as possible? State whether the client's idea is feasible and provide reasons as to why or why not.
6. **Solid Model and Engineering Drawings** – Using Onshape, Solidworks, etc., draw a solid model of the device - the hand-crank, gear box, and energy storage setup that meets the client's requirements. Be sure to clearly show 3 different views of the model due to its compact nature. Use sub-assembly views if necessary to explain the operation and components. Note: A video of the gear train in animation would be helpful, but not required. It is recommended that you select components where the supplier also provides CAD models of their parts, so you can import these directly into your model.
7. **Bill of Materials** – Add a complete Bill of Materials listing all of the components used in your design, with specific vendors and part numbers wherever appropriate.

The supplemental materials to upload to Canvas are:

1. **Design Calculations** – Include all Free-body Diagrams, variables, equations, etc. to show the design will function and meet the requirements. There should be enough detail that another engineer could understand your work.

Upload a PDF copy of your presentation along with a link to your live video recording and the supplemental materials

Due date: Friday March 18th, Close of Business (6:00 pm)

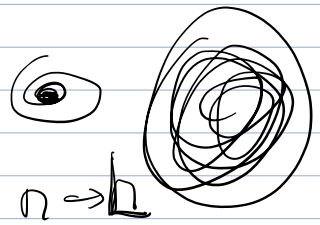


K $\frac{1}{2}Kx^2 = U = 3600$

$F = K \cdot \frac{2\pi \square \text{ rad}}{\square \text{ mm}}$ [N]

$10 \cdot (2\pi r)$

$F \cdot 10(2\pi r) = U$

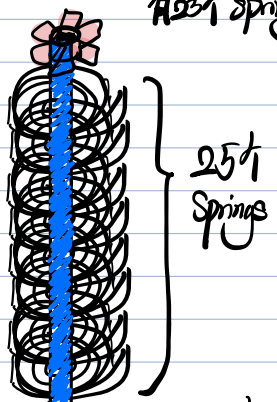


$(F \cdot r) \cdot (10 \cdot 2\pi) = U$

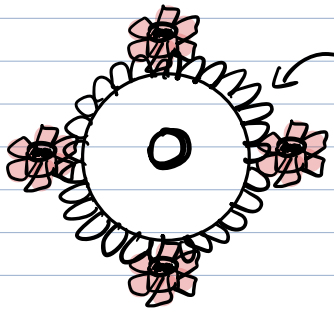
$\text{Torque} = \frac{U}{(2\pi)(n)}$

3600

每个 shaft 上有1个 small spring gear
有25个 springs



4个 small spring gear
↓ 共同起动
1个 bigger spring



目前. Assume: Gear ratio = 10.

Given: 1个 spring 的 Torque: 8.3 inch·lbs ⇒ □ N·m
⇒ bigger spring 上有 100x □ N·m

Task: 找到 Input crank (转动处) → Input 与 bigger spring 之间的 gear ratio.

Assume: 人可给出的 Torque.

上后, 把 gear ratio 分成
一系列 Gear Train.