

BACKGROUND

Schweitzer Engineering Laboratories designs and manufactures a wide range of electronic products. The center of gravity (CG) is needed by SEL in order to conduct failure analysis on their devices. For complex electrical parts it can be difficult to determine the CG.

OBJECTIVE

The objective of this project is to create a device capable of calculating the CG of SEL products.



SEL Products

REQUIREMENTS

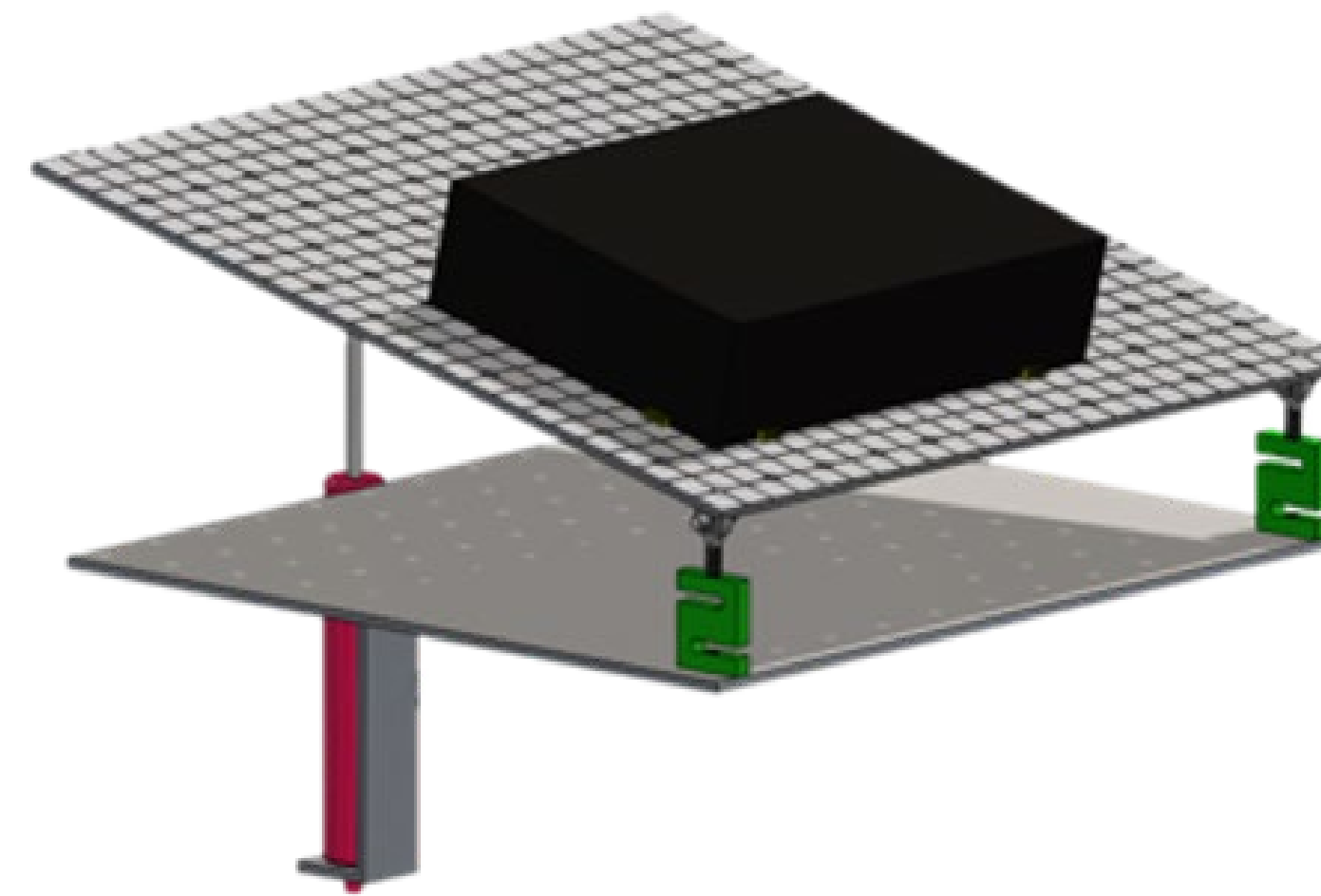
- Calculates 3D center of gravity for any object
- Automatic operation
- Accuracy within 1% or 0.1 inches of actual value
- Can hold a static load of 50 lbf
- Operate 1-year maintenance free
- Operate using standard 120V AC outlet
- \$5000 budget



DESIGN ITERATIONS



Previous Team



Snapshot 1 Design



Final Design

Load cells (green) support the bottom plate. Clevis rod ends and ball joint rod ends form the hinge which allows the upper plate to tilt. A 150 lb_f linear actuator is used for tilting table.

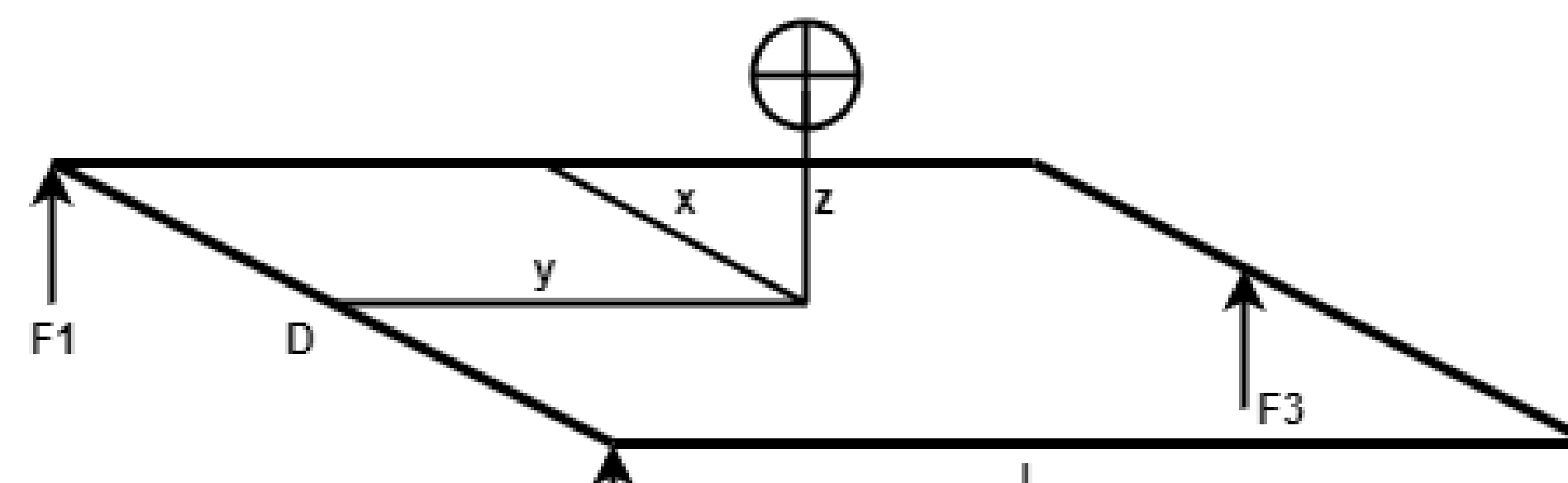
DEVELOPMENT OF MATH MODEL

The device uses three different load cells which act as the feet of the device. Force measurements are taken first while the table is level in order to calculate the X and Y coordinates. The table is then lifted by the actuator to a known angle where new force measurements are taken to calculate how the center of gravity shifts forward in order to find the Z coordinate.

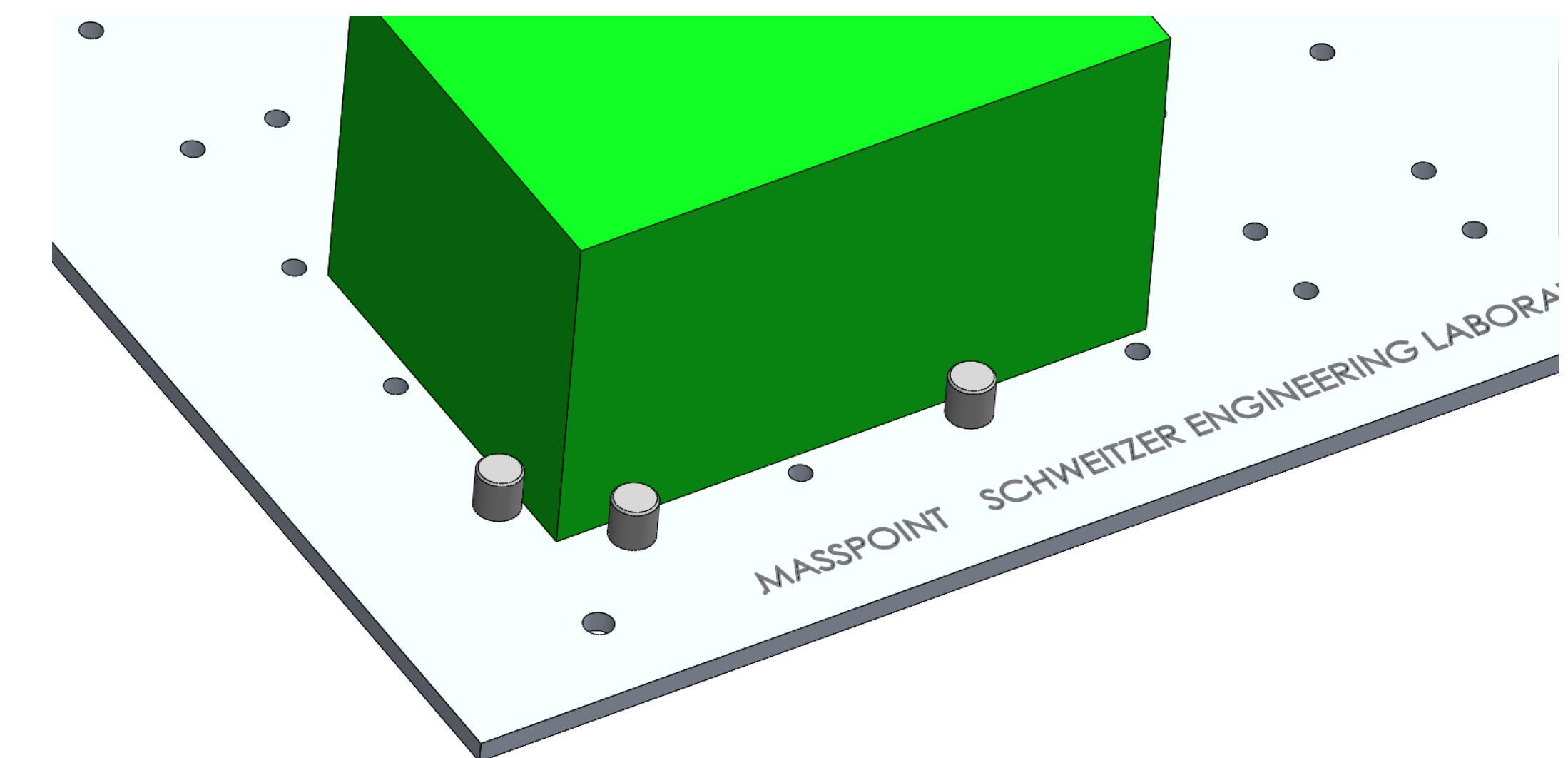
$$x_{cg} = \frac{D(F_3 + 2F_2)}{2W}$$

$$y_{cg} = \frac{LF_3}{W}$$

$$z_{cg} = y_{cg}(\cot(\theta) - \frac{LF'_3}{Wy_{cg}\sin(\theta)})$$



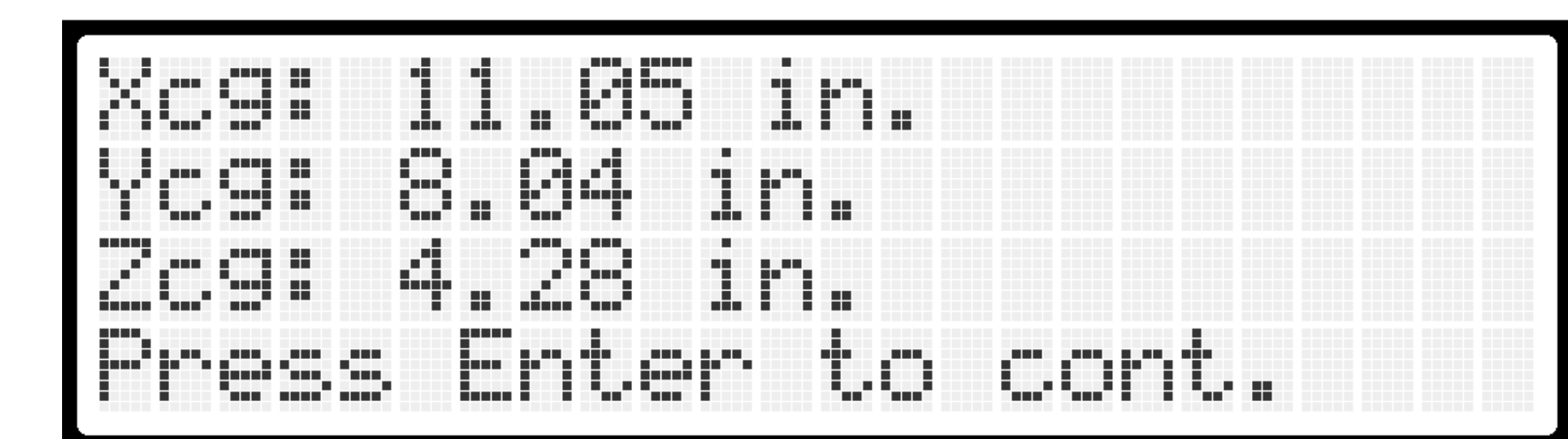
PEGBOARD DESIGN



Use of a pegboard design allows for the mounting of custom fixtures and the testing of a variety of different sized objects. A numbered grid on the table surface allows for the locating and input of custom origins for testing.

User Interface

- Rotary encoder for switching between device functions.
- Tare:** Record load cell values while loaded under the weight of the device and fixtures.
- Select An Origin:** Allows the user to set a custom XY origin.
- Take CG Measurements:** Records load values, actuates, and records angled load cell values. The CG is displayed on the LCD screen.



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