DEPARTMENT OF MECHANICAL ENGINEERING

Team 10
The Platinum Engineers
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Problem Definition

Play is recognized as a fundamental right for all children. The act of engaging in various forms of play is a crucial mode of learning through which children can develop physically, socially, and emotionally.

There is a clear need to increase the accessibility features of many playgrounds that lead to inclusivity for children of all mobility levels.

"Nothing excludes children more than having the special piece of equipment that everyone wants to play on be inaccessible to some. Ensure that the coolest play activity is usable by all."

— Inclusive Play Design Guide

Design Calculations & Analysis

Transmission Governing Equations:
- *Given* $\Rightarrow$ *Gear ratio:* 1296:1 *Output torque:* 7801.92 ft-lb
  - Eq1: $i = 1 + Z_{ring} / Z_{sun}$
  - Eq2: $Z_{ring} = Z_{sun} + 2 * Z_{planet}$
  - Eq3: $Z_{sun} = Z_{ring} / 3$
  - Geometrical Validation:
    - $(Z_{sun} + Z_{ring}) / 3$ = Whole Number
    - $Z_n / 3$ = Whole Number

	Stage 1 & 2	Stage 3 & 4
Z_{sun}	**12**	**21**
Z_{planet}	**24**	**42**
Z_{ring}	**60**	**104**

- *Bore Diameter:*
  - F.S. = Sys / τmax
  - τmax = (T * (d/2)) / J

|		
Stage 1 : **0.5 in**	*Stage 3* : **1.6 in**
Stage 2 : **0.9 in**	*Stage 4* : **2.75 in**

Solar Energy Calculations:
- *Battery life:*
  - 3 kWh battery capacity / 1.5 kW power draw = **2 hours of continuous run time**
- *Time to Recharge (Assuming 4 m² of solar panels in park):*
  - Avg kWh/m² per day in MD (Mar-Nov): 4.51 kWh
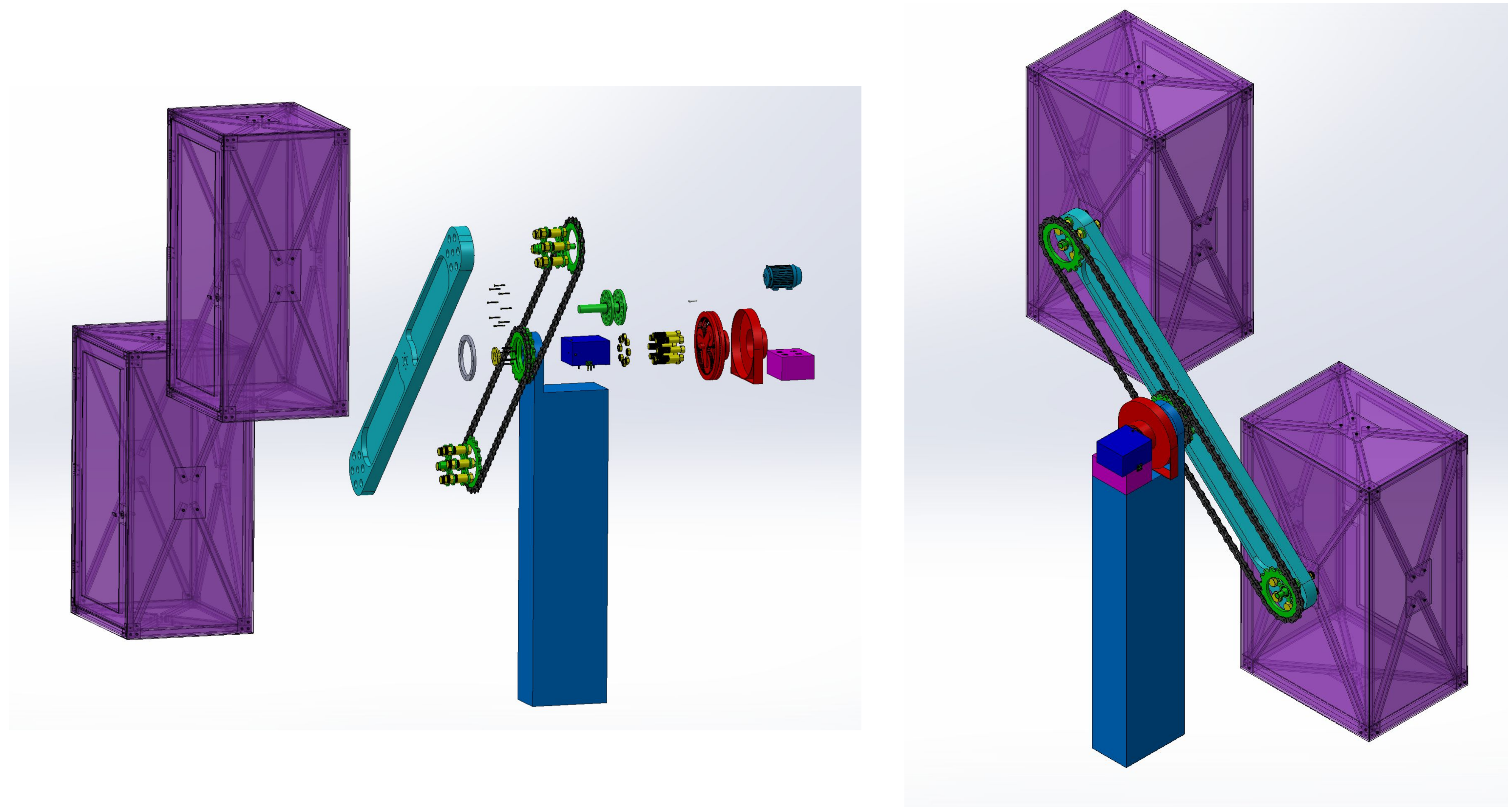 - 3 kWh/(4*4.51 kWh/day) = **approximately 4 hours to recharge fully**

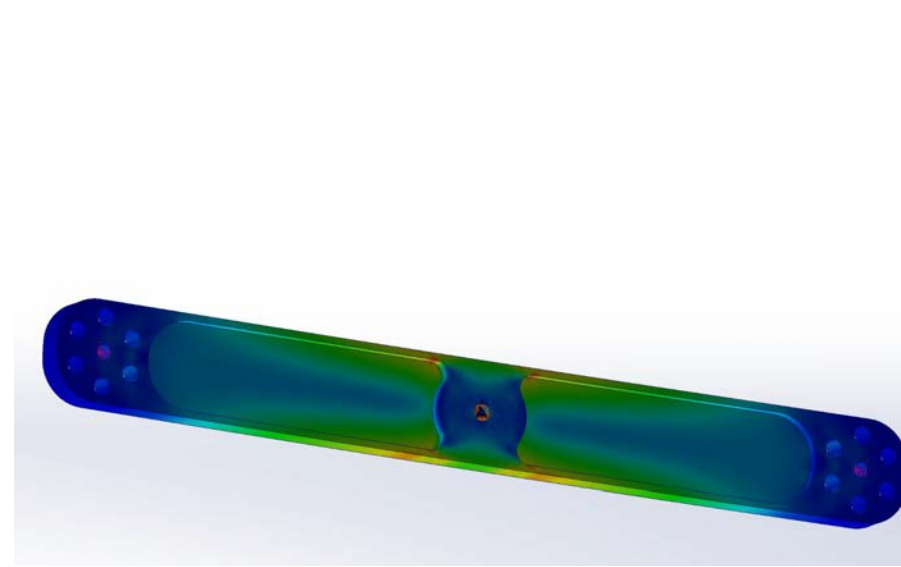**Shaft Deflection:**
- *Governing Equations:*
  - $M_e = W_T (x_2 + x_3)$
  - $M_f = W_T (x_3)$
  - $\sigma_{bending} = (M* (d/2)) / I$
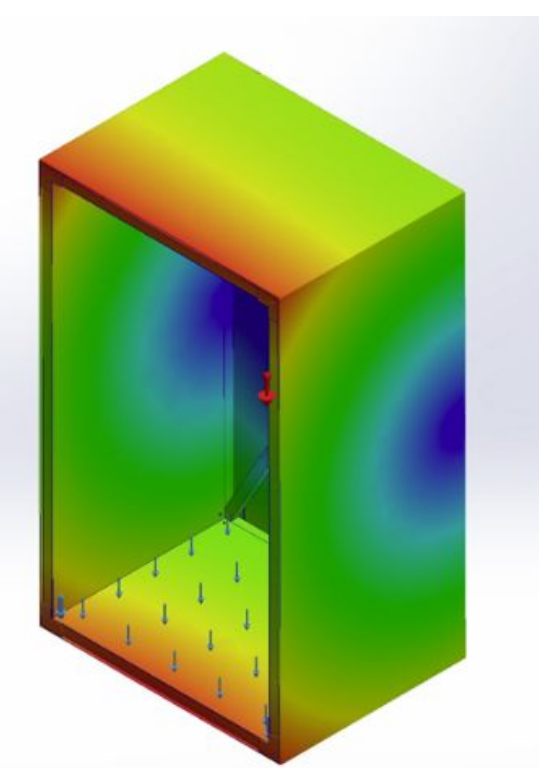   - *Shaft Diameter* = **2.5 in**
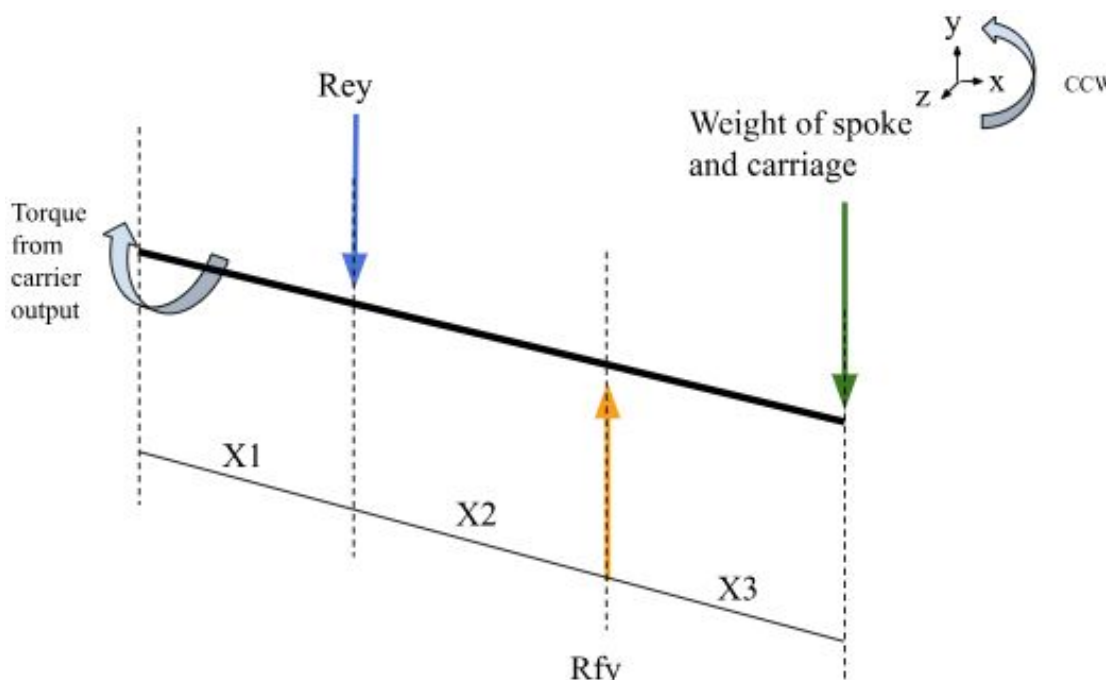
Final Design

Spoke FEA:

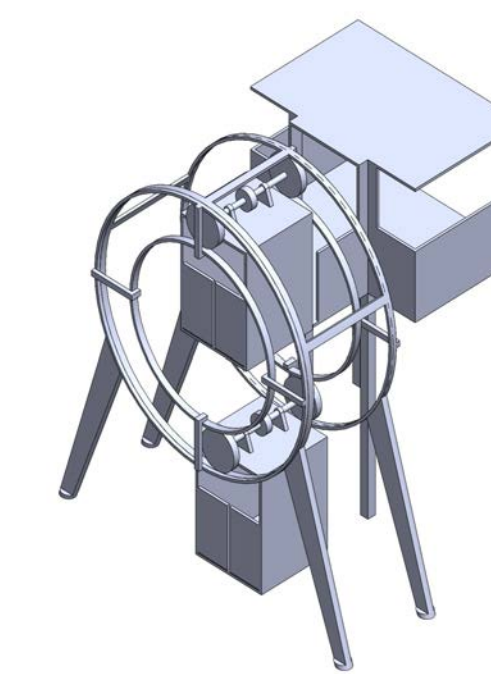**Deflection results:**
Min: 0 mm
Max: **5.02 mm**

Carriage FEA:

Deflection results:
Min: 0 mm
Max: **2.66 mm**
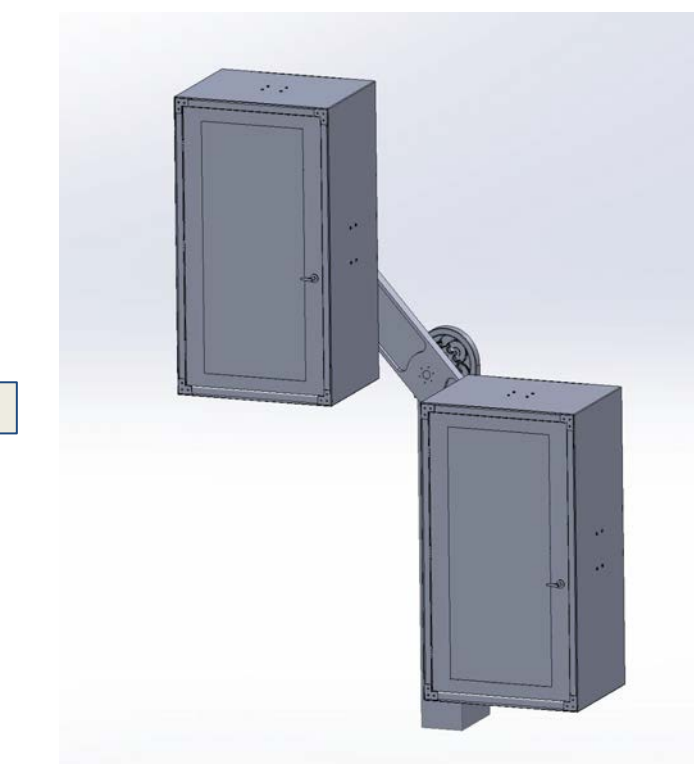
Prototype & Test Results

First Stage

Second Stage

Third Stage

Final Stage

Tests required for full-scale design:
- *IV-Curve Tracer Test:*
  - To ensure solar charging ability is functional and efficient
- *Shaft Deflection Test*
  - Using a Instron machine to ensure structural integrity of the load-bearing shafts
- *Maximum inclination test:*
  - Using an inclinometer in the carriage to ensure slope stays below 1:12, per ADA guides
- *Vibration control test:*
  - Using an accelerometer to ensure critical damping during braking periods