University of Louisiana - Lafayette
Department of Mechanical Engineering
MCHE 484: Engineering Projects II

Weekly Progress Report (10)

To: Dr. Yonas Niguse

Cc: Yonas Niguse, Katie Kaliszeski, Matthew Dubea, Andre Signoret

From: **Full Throttle Engineers |** Katie Kaliszeski, Matthew Dubea, and Andre Signoret

Due Date | Presentation Date: April 16, 2025

Sub: Weekly Progress/Plans

1. **Targets Planned Last Week:**
    a. Finalize SolidWorks parts
    b. April 9th, Acadiana 500 meeting – will verify specifications
2. **Targets Completed:**
    a. Rear axle fully completed, installed brass bushings.
    b. Banana seat mounted securely:
        i. Front secured via bike mount TIG welded to frame.
        ii. Rear supported by a custom CNC-machined T-shaped insert for anti-wobble lateral support.
    c. Rear tires (10-inch diameter) mounted successfully.
    d. All frame welds completed using TIG; front fork extension, seat support, axle housing
    e. Rear axle width -19.5 inches, complying with rule (17–20 in)
    f. Crank arm - 4 inches with outer pedal at 8.25 inches from center front wheel (within 12-inch max)
    g. Center of Gravity measured at about 22 in (horizontal) and 23 in (vertical) from front wheel center.
    h. Wheelbase confirmed at 23.8 inches (front wheel center to rear wheel center)
3. **Targets Not Completed:**
    a.
4. **Plan of Action for the Next Week:**
    a. Conduct test rides to evaluate handling, cornering, and rider position effectiveness
    b. Finalize race-day strategy based on test results (turning techniques, braking zones, rider transitions)
    c. Prepare spare parts and tool kit for race day, considering field repairs if necessary
5. **This Weeks Achievements & Success or Problems and Concerns (if any):**
    a. Achievements/Success:
        i. Major assembly milestones completed
            1. Secured frame and seat with TIG welding and CNC parts for durability
            2. Confirmed legal compliance of:
                a. Rear axle width
                b. Wheel base
                c. Crank radius
                d. Pedal width
    b. Problems/Concerns:
        i. Weather on race day

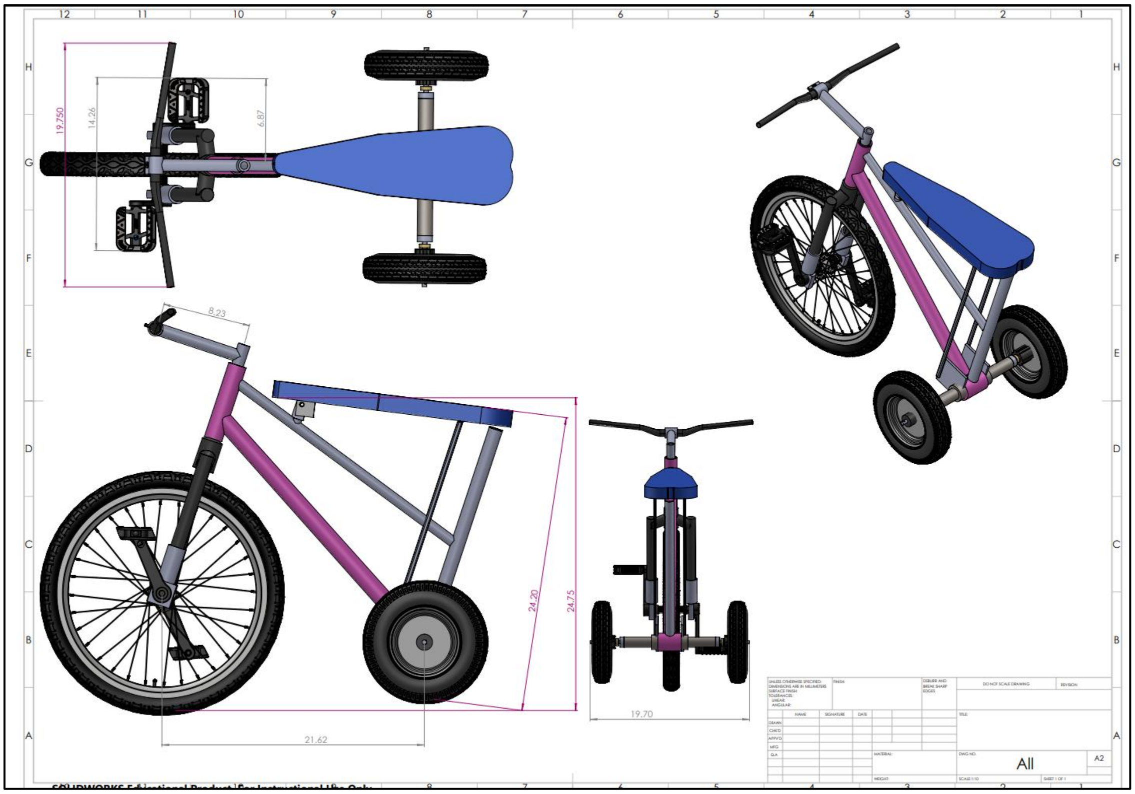

Figure 1: Up to date SolidWorks Assembly

Table 1: Tricycle Design Specifications Summary

Component	Dimension (in)
Front Wheel	20
Rear Wheels	10 in (ea)
Crank Arm Length	4
Pedal Tip Distance from F. Wheel Center	8.25 < 12
Total Pedal Span (outer)	16.5 < 24
Pedal Height (vert. clearance)	6
Seat Height	~23-24
Handlebar Width	8.5 < 9
Rear Axle Width	~19.5 < 20
Center of Gravity (H)	~22
Center of Gravity (V)	~23
Wheelbase	23.75

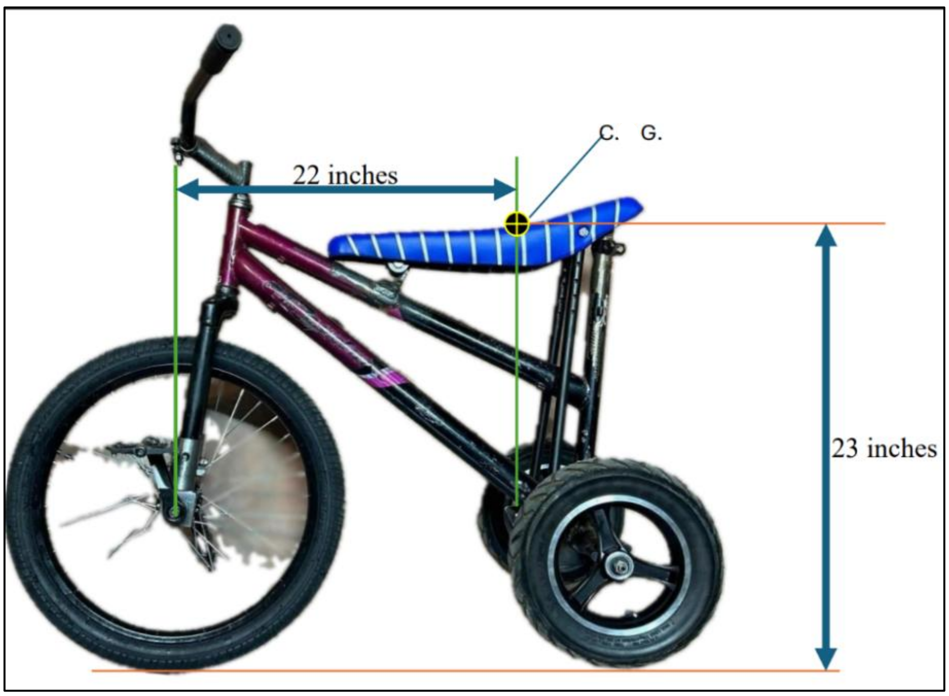

Figure 2: 2-D Approximation of Riders CG

Once the vertical and horizontal positions of the Center of Gravity (CG) are known, calculation to obtain theoretical tipping angle is performed.

1. Our theoretical tipping angle when riding:

$$\theta_{tip} = arctan\left(\frac{\frac{(Rear\ \ Width)}{2}}{Center\ of\ Gravity\ Height}\right) = arctan\left(\frac{\frac{(19.5)}{2}}{23}\right) \approx\ 22.98°\ degrees$$

The trike can leak up to about 23° degrees before experiencing tipping on average.

Lower CG → higher tipping angle → more stability,

2. Tricycle design weighs 34-35 lb, in addition to average weight rider of 170 lbs, total weight of trike and rider of 204.5 can be assumed, and gravity as 32.2 ft/s^{2}. Formula for the designs total mass system is shown as:

$$m = \frac{weight}{g} = \frac{204.5}{32.2} = 6.356\ slugs = 92.9\ lbm\ or\ 42.15\ kg$$

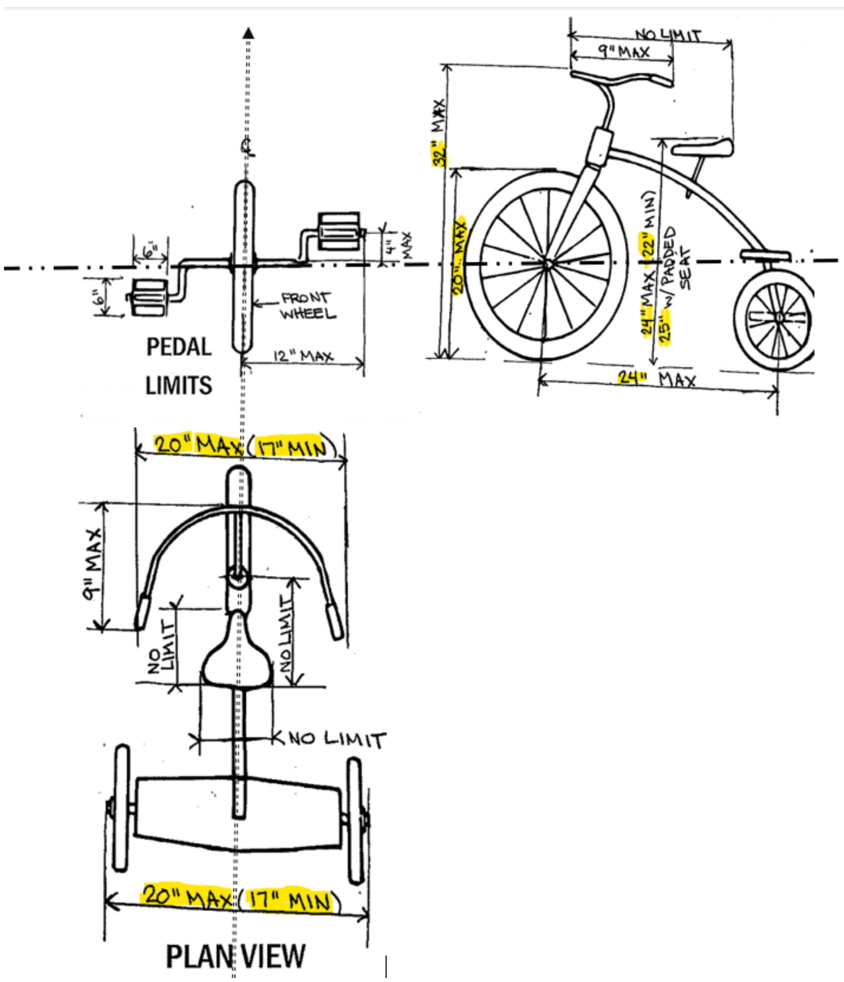

Table 2: Other Formulas of Interest to Potentially Calc to ensure safety. (Chat GPT)

Risk / Concern	Math Used to Solve	Design Decision Impacted
Tipping or Rollover	$\theta_{tip} = arctan(\frac{(\frac{track}{2})}{CG\ height})$	Adjust CG height, axle width, seat position
Frame Failure Under Load	$\sigma = \frac{F}{A}$, $\sigma_{allowable} > \sigma_{actual}$	Select appropriate material thickness and joint strength
Wheel Slip / Loss of Traction	$F_{friction} = \mu \times N$, compare to forward force	Limit pedal torque or adjust weight distribution
Overturning While Turning	$a_{lat} = \frac{v^2}{r}$, compare lateral force to tipping threshold	Set speed limits or increase turning radius
Structural Buckling or Bending	Euler's buckling formula $P_{cr} = \frac{\pi^2 EI}{(KL)^2}$	Bracing, tube diameter, and support placement
Bearing Overload	$Load_{bearing}$ = Radial Load + Axial Load	Choose proper bearings and bushings
Fatigue Failure from Repetition	Use S-N curves and Miner's Rule: $\Sigma(n/N) < 1$	Avoid long-term cyclic stress
Ergonomic Injury (Knee/Leg Reach)	Anthropometric data + kinematic joint calculations	Stem length, pedal width, seat offset