

ENGINEERING NOTES FOR

PLTW EDD
Sem One 2026

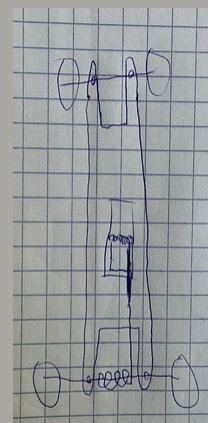
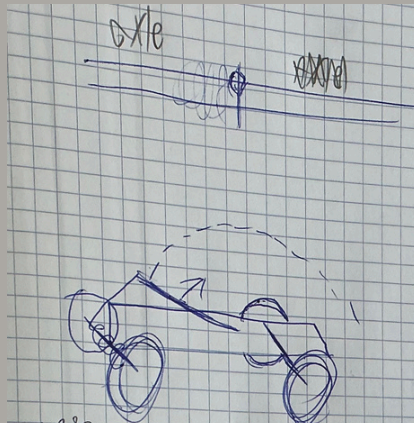
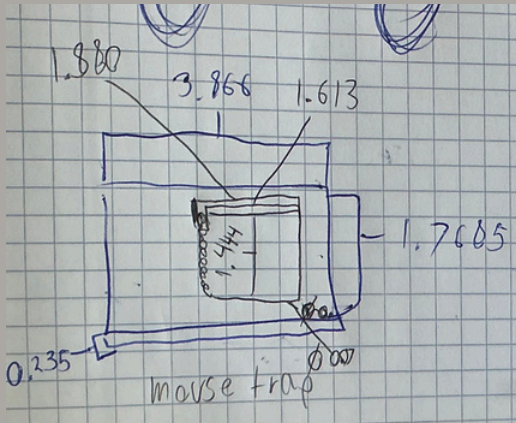
Mousetrap Car
Engineering Project

KIRAN PATEL

OUR DESIGN PROCESS

PART 2 : BRAINSTORMING

PRELIMINARY SKETCHING DIRECTION & DIMENSIONS



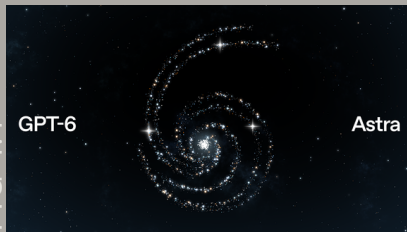
OUR DESIGN INSPIRATION SPARTAN MOTOR COMPANY



OUR DESIGN PROCESS

PART 3 : DESIGNING

FIG 1.1



SEPTEMBER 4TH:

DURING THE DESIGN PROCESS, OPENAI ROLLED OUT CHATGPT ASTRA 6, WHICH WE USED TO FIGURE OUT OUR SPACING BETWEEN THE AXLES BASED ON THE PARAMETERS GIVEN FOR THE PROJECT. (FIG 1.1)

FIG 1.2



BASED ON THIS AND SOME PRELIMINARY SKETCHING WE DISCUSSED THE DESIGN IN CLASS FOR A FEW WEEKS, PAUSING FOR THE OCCASIONAL BREAK. ONE OF THE FIRST ISSUES WE NOTICED WAS PEERS HAVING ISSUES WITH “JANKY” METHODS OF ATTACHING THEIR LEVER ARMS TO THE TRAPS THAT WERE REQUIRED TO PROPEL OUR CAR, SO WE FIGURED THAT IT WOULD SERVE US WELL TO DESIGN SOMETHING BETTER FOR THE ARM, GOING THROUGH SEVERAL ITERATIONS BEFORE FINALLY FINDING ONE JUST LONG ENOUGH TO BE A GOOD LEVER ARM BUT JUST SHORT ENOUGH TO NOT SNAP IN HALF WHEN PRINTED. (FIG 1.2-1.5)

FIG 1.3

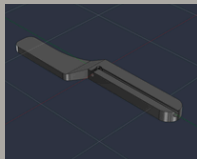


FIG 1.4

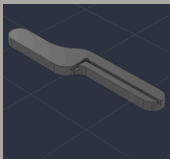


FIG 1.5

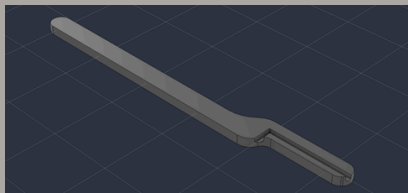
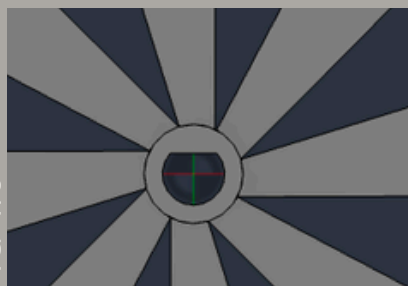
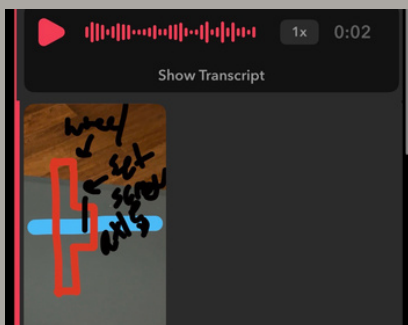


FIG 1.6



WE FOUND THAT THE SQUARE VEX AXLES WERE SUBOPTIMAL SINCE PEOPLE HAD TO DESIGN VERY ODD CONTRAPTIONS, INCLUDING ONES BASED ON HOT GLUE AND STRAWS TO USE THEM, SO WE OPTED FOR THE DOWELS INSTEAD, HOWEVER THE DOWELS WE WERE PROVIDED WERE THICKER THAN IDEAL, SO WE PURCHASED A LENGTH OF $\frac{3}{16}$ " DIA WOODEN DOWEL FOR A THINNER AXLE AND SLEEKER LOOK OVERALL.

FIG 1.7



THE ONLY BENEFIT OF THE VEX AXLES IS EASIER WHEEL MOUNTING, WHICH WE SOLVED BY USING A D SHAPED THROUGH HOLE ON THE WHEEL HUB AND CHISELING A FLAT SPOT ONTO OUR AXLES (FIG 1.6) INSTEAD OF AN EARLIER PROPOSED SET SCREW DESIGN WHICH WAS DIAGRAMMED IN A SNAP MESSAGE (FIG 1.7)

OUR DESIGN PROCESS

PART 3 : DESIGNING

FIG 2.1



FIG 2.2

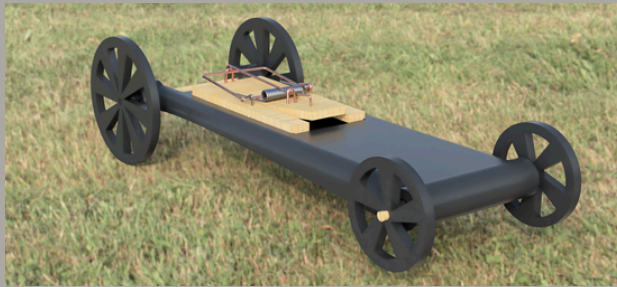


FIG 2.3



FIG 2.4



FIG 2.5



FIG 2.7

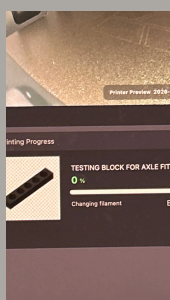


FIG 2.8



FIG 2.9

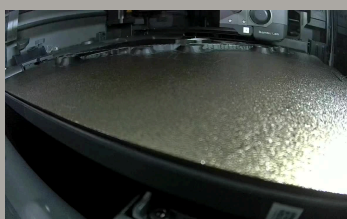


FIG 2.10



SEPTEMBER 5TH:

WE NOTICED OTHER GROUPS WERE HAVING SIGNIFICANT ISSUES WITH FRICTION, SO WE SET ABOUT TO DEVISE WAYS TO REDUCE THAT

ORIGINALLY BART SUGGESTED BEARINGS WHICH WOULD ORDINARILY WORK BUT THEY WERE PROHIBITIVELY EXPENSIVE (\$21.99 PER PC) AT THE LOCAL ACE HARDWARE, SO WE OPTED FOR $\frac{1}{4}$ " ID X $\frac{3}{8}$ " OD X $\frac{1}{2}$ " LENGTH STEEL SPACERS INSTEAD. (FIG 2.1)

FROM MY PREVIOUS EXPERIENCE WITH PINEWOOD DERBY (100% WIN RATE), WE KNEW THAT THE MOST COST EFFECTIVE WAY TO REDUCE FRICTION BETWEEN THE METAL AND WOOD FOR US WOULD BE USING GRAPHITE POWDER LUBRICANT, WHICH WAS ACQUIRED AT HOME DEPOT. ADDITIONALLY, WHEEL BALANCING WEIGHTS THAT ARE USED TO MANAGE C.O.G ON PINEWOOD DERBY CARS WERE ADDED TO THE BACK TO MAKE SURE WE HAD SUFFICIENT BUT MANAGEABLE WEIGHT OVER THE POWERED AXLE.

OUR FIRST DESIGN WORKED WELL (FIG 2.2 & 2.3) AND WENT ON AVG 40', BUT IT WAS FAIRLY HEAVY AND SLOW, SO WE REDESIGNED FOR LIGHTER WEIGHT AND BETTER LOOKS , MOVING THE MOUSETRAP FORWARD IN THE DESIGN AND CREATING HEXAGONAL SQUARES TO GET OUR CHASSIS WEIGHT UNDER 45G (43.22G).

SEPTEMBER 6TH

UNFORTUNATELY THIS DOES MEAN IT IS NECESSARY TO GO AHEAD AND EXTRACT THE PERFECTLY PRESS-FIT STEEL SEGMENTS (TOLERANCE TESTING IN FIGS 2.4 - 2.7) , WHICH MAY OR MAY NOT HAVE RESULTED IN THE DESTRUCTION OF CHASSIS MODEL 1 (FIG 2.8).

REGARDLESS, THE SECOND CHASSIS PRINTED WELL (FIG. 2.9 & 2.10) , SINCE IT HAD THE SAME TESTED DIMENSIONS FROM THE FIRST CHASSIS, ALLOWING US TO PRESS-FIT EVERYTHING.

OUR DESIGN PROCESS PART 3 : DESIGNING

Threaded Brake Travel Calculation
Given:

- Target distance: 25 ft = 300 in
- Rear wheel diameter: 2.0 in
- Thread: 5/16-24 UNF
- Thread pitch: 24 threads per inch
- Threaded shaft rotates at the same speed as the rear axle

Step 1: Find Wheel Circumference

$$C = \pi D$$
$$C = \pi(2.0)$$
$$C = 6.28 \text{ in}$$

Step 2: Find Number of Wheel Revolutions

$$N = 300 \div 6.28$$
$$N = 47.75 \text{ revolutions}$$

The rear axle rotates approximately 47.8 times over 25 ft

Step 3: Find Nut Travel per Revolution

A 24 TPI thread moves the nut:

$$1 \sim 24 = 0.04167 \text{ in/revolution}$$

Step 4: Find Required Threaded Travel

$$L = (47.75)(0.04167)$$
$$L = 1.99 \text{ in}$$

Result

The nut needs approximately:

$$1.99 \text{ in}$$

of usable threaded travel to activate the brake after 25 ft.

A threaded section of about 2.1–2.2 in would provide some adjustment margin.

Comparison

5/16-18 UNC requires about 2.65 in of nut travel.

5/16-24 UNF requires about 1.99 in of nut travel.

The 5/16-24 thread therefore reduces the required threaded length by about 0.66 in, or 25%, while also allowing finer adjustment of the brake position.

FIG 3.1

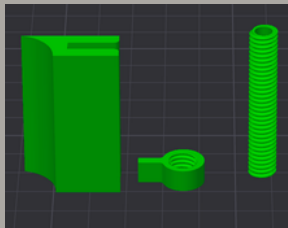


FIG 3.2

$$\begin{matrix} & 1 & 2 & \cdots & n \\ \begin{matrix} 1 \\ 2 \\ 3 \\ \vdots \\ m \end{matrix} & \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ a_{31} & a_{32} & \cdots & a_{3n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix} \end{matrix}$$

FIG 3.3

SEPTEMBER 10TH:

DESPITE HOW WELL THIS SYSTEM FUNCTIONED, IT WAS APPARENTLY NOT CONSTRUCTED DURABLY ENOUGH, SINCE WHEN THE CAR WAS BUMPED BY A PASSERBY IN THE HALLWAY THE REAR AXLE SHATTERED, LEADING TO ME HAVING TO FIX THE ISSUE WITH SOME CYANOACRYLATE GLUE, AN XACTO KNIFE, AND SOME BLACK MASKING TAPE IN MR. LANE'S LINEAR ALGEBRA ON THE DAY BEFORE A TEST. (FIG 3.3 & 3.4) THIS, HOWEVER, POSED NO ISSUE IN OUR TRIALS, SINCE THE REST OF THE CAR WAS BUILT TO THE POINT THAT A SMALL DETTERENT SUCH AS OUR REAR AXLE SNAPPING IN HALF WOULDN'T BE A PROBLEM, AND WE PROCEEDED WITH THE TRIALS AS SCHEDULED, SUCESSFULLY ACHIEVING THE REQUIRED ACCURACY NUMEROUS TIMES AFTER ADJUSTING THE FISHING LINE TO HELP FIX THE INCREDIBLY MINISCULE PROBLEM OF OUR REAR AXLE SNAPPING IN HALF. THE CAR RETAINED MOST OF ITS APPEARANCE AFTER THE AXLE FIX (FIG 3.5), LOSING ONLY THE GROOVED PART ON THE REAR THAT WAS A GUIDE FOR THE NUT ON THE AXLE,

FIG 3.4

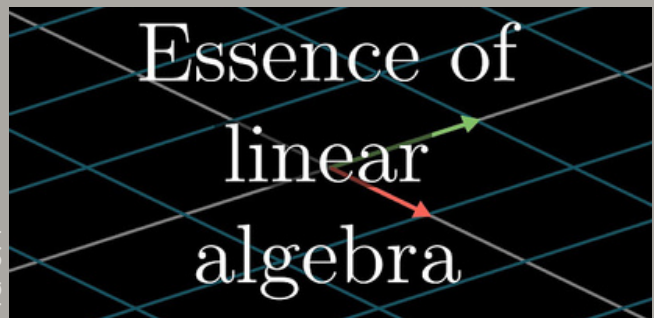
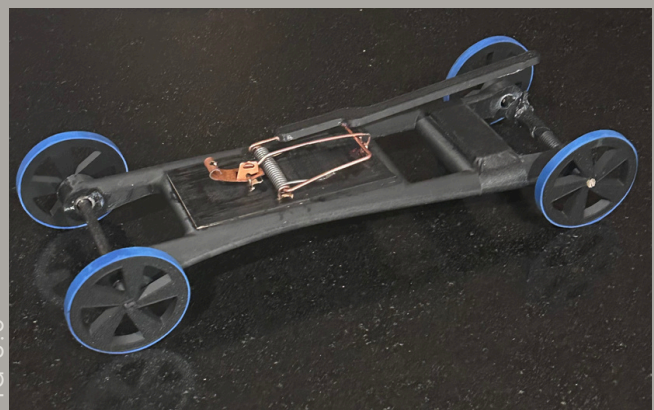


FIG 3.5



OUR DESIGN PROCESS

PART 4 : TESTING

WHEN WE FIRST STARTED TESTING WE OBSERVED THAT THE CAR WAS GOING EITHER TO FAR OR NOT FAR ENOUGH WHEN TESTING AT SCHOOL SO WE CHANGED THE AMOUNT OF STRING BEING PULLED BY THE MOUSE TRAP BY ADDING STOPPER KNOTS.

ADDITIONALLY, AFTER THE FIRST FIVE TRIALS WE SWITCHED TO USING THE REAR WHEELS TO LINE UP THE CAR, FOR NO REASON OTHER THAN TO BE ABLE TO CELEBRATE EARLIER SINCE IT WOULD BE CLEARER IF IT WENT 25 FEET OR NOT WITHOUT HAVING TO WALK OVER TO CHECK WHICH WOULD RENDER THE TESTING RANGE USELESS FOR OTHERS

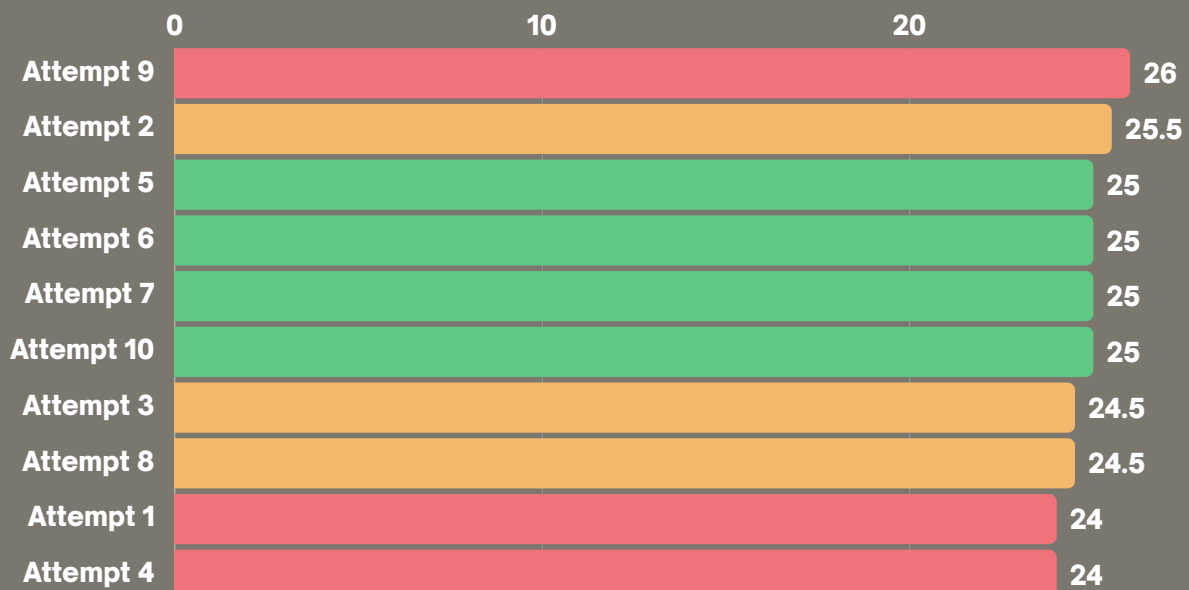
TRIAL 5 MEASURED
FROM FRONT WHEEL
TO BLOCK



TRIAL 6 MEASURED
FROM REAR WHEEL
TO BLOCK



TRIAL 7 MEASURED
FROM REAR WHEEL
TO BLOCK



F E E T T R A V E L E D

