

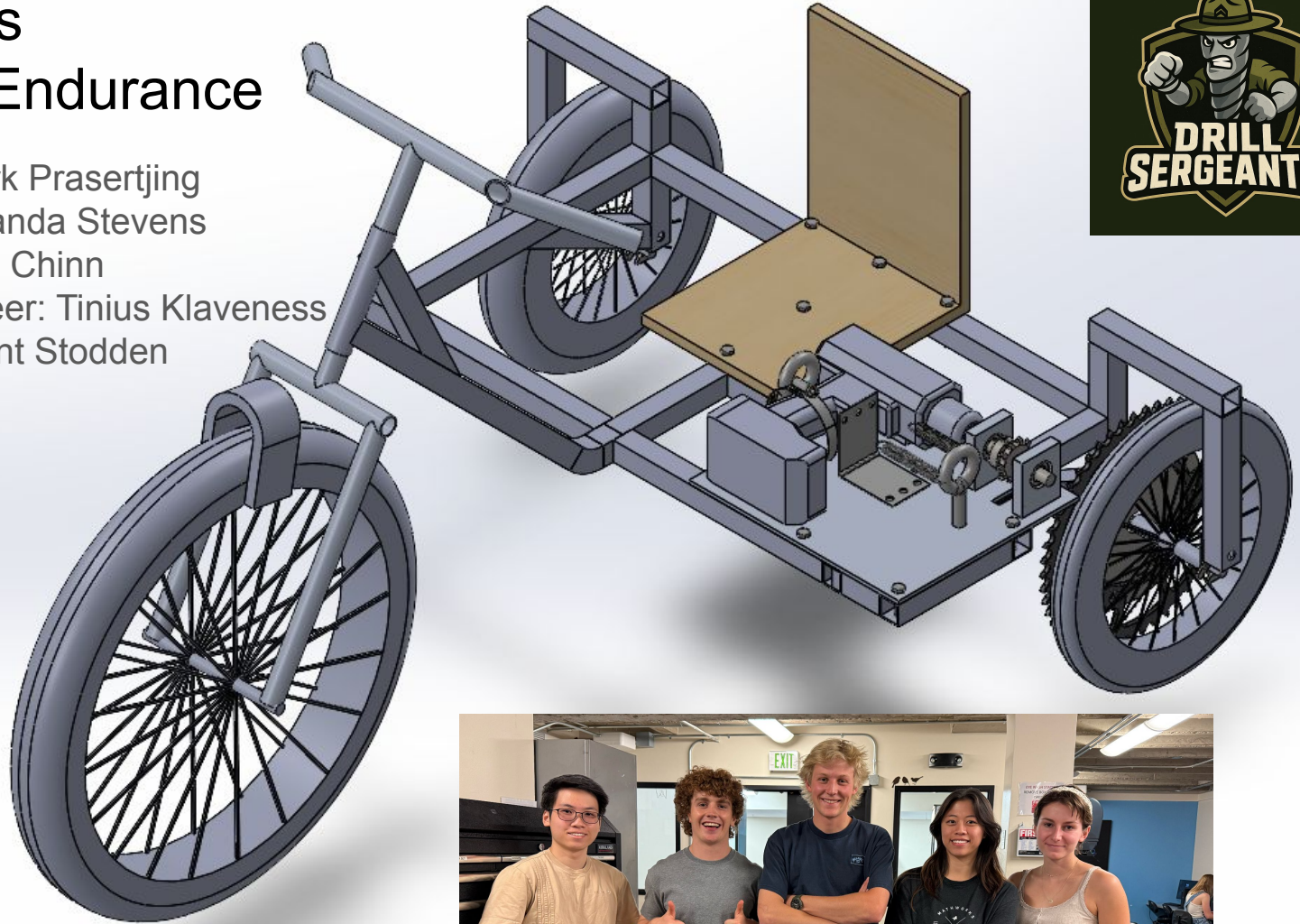
Original Slides for Design Review

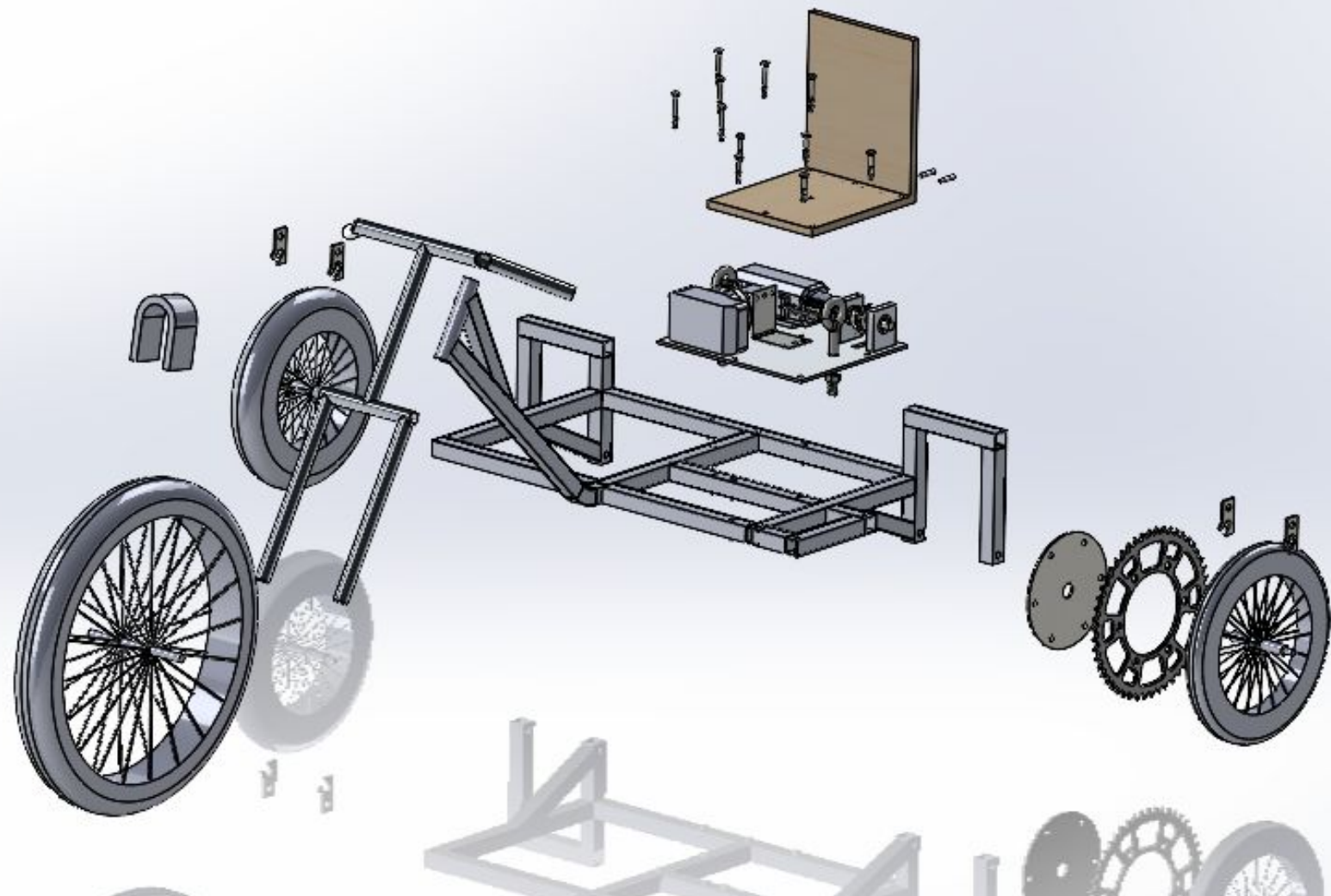
Drill Sergeants

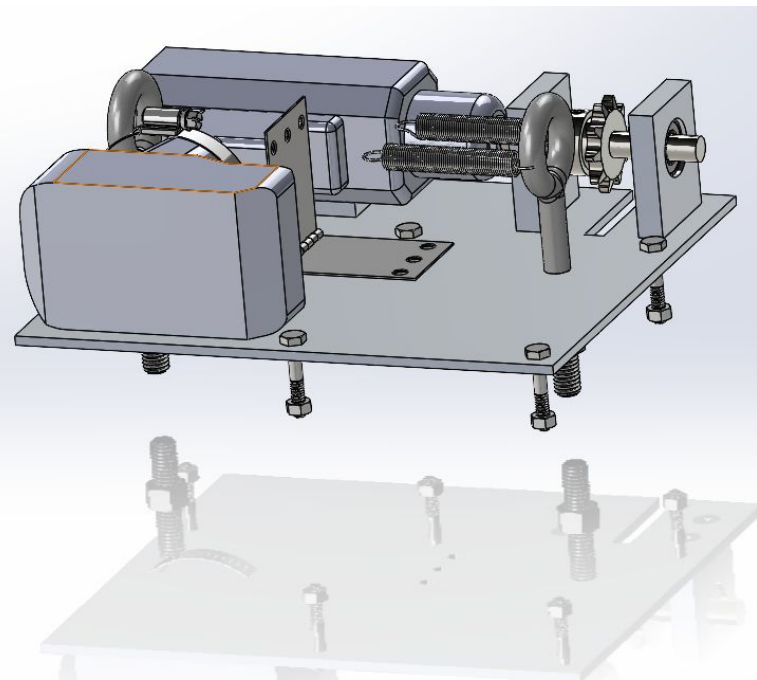
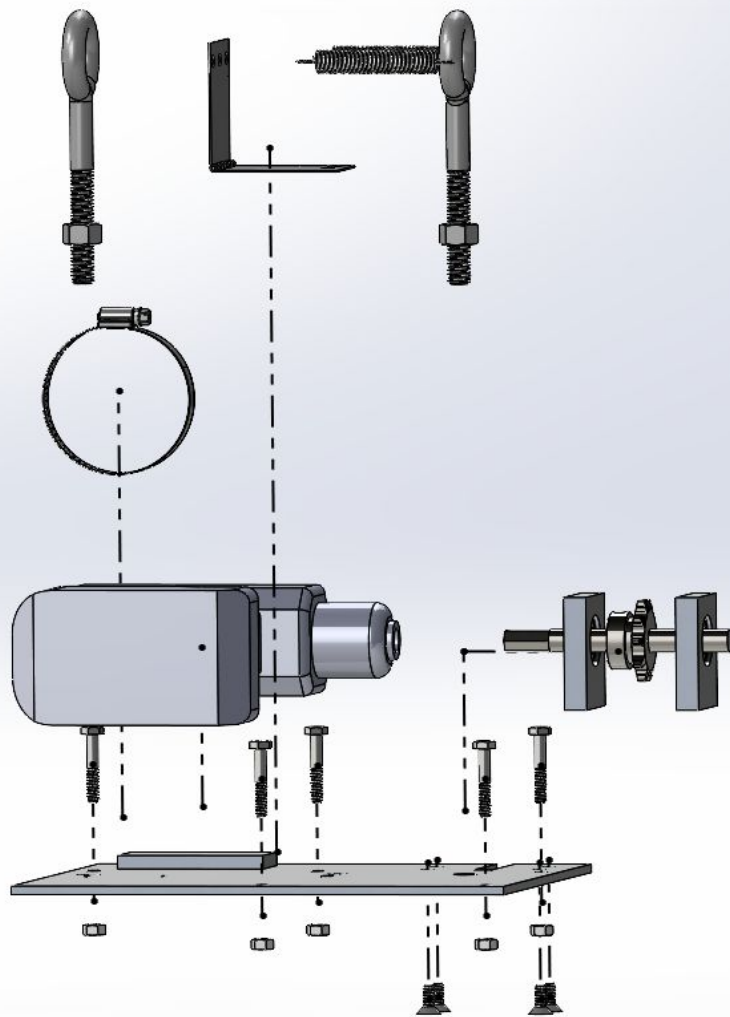
Competition: Endurance

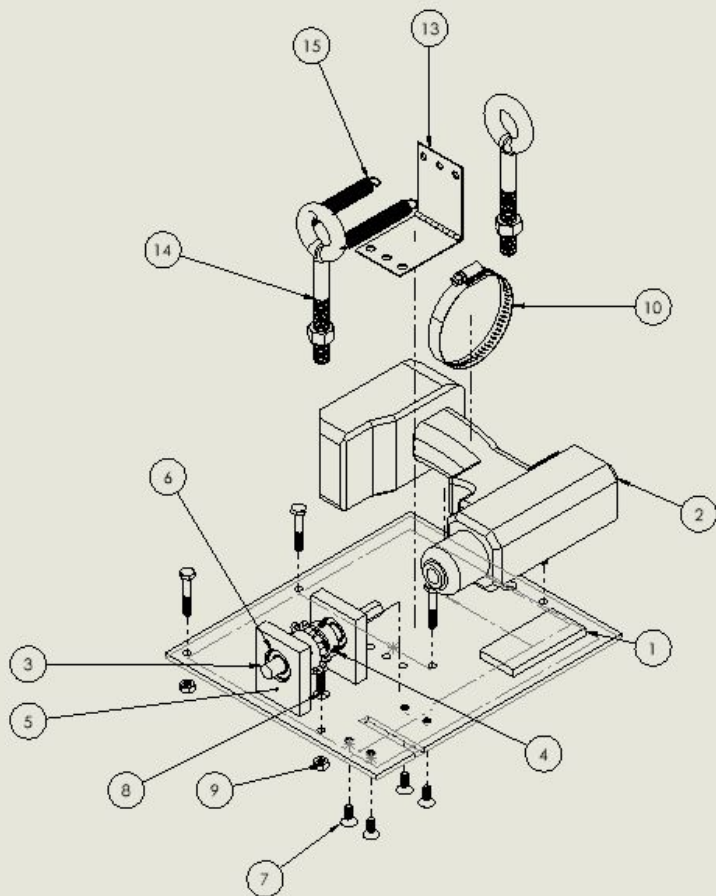


Project Manager: Mark Prasertjing
CAD Engineer 1: Amanda Stevens
CAD Engineer 2: Ailin Chinn
Manufacturing Engineer: Tinius Klaveness
Testing Engineer: Trent Stodden



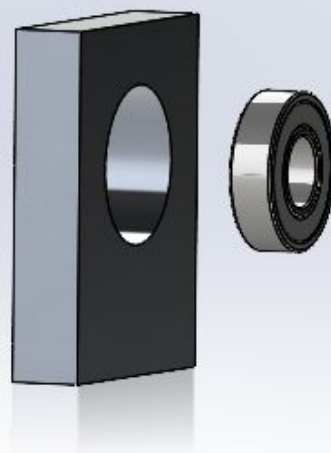




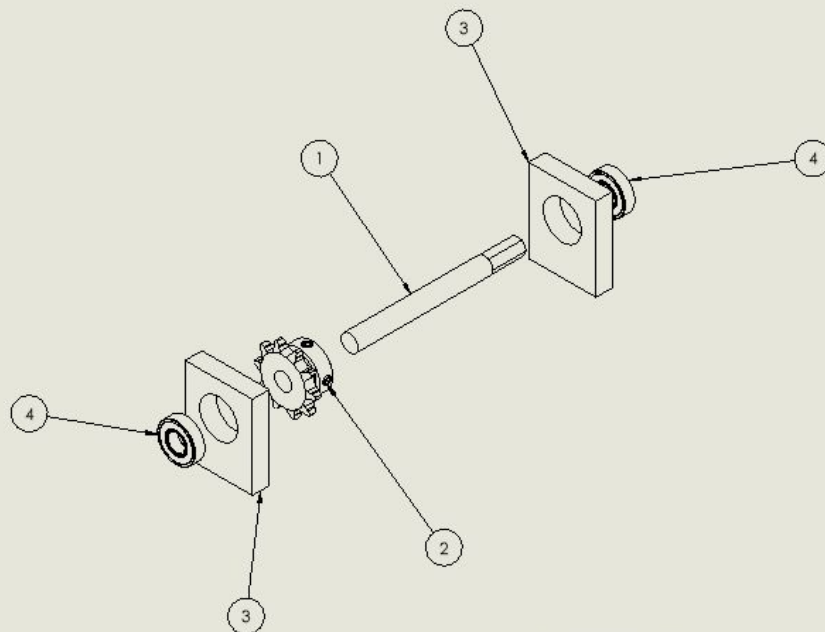


ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	Drill Plate V2 - Mark		1
2	Drill CAD Model - Mark		1
3	Drill Shaft		1
4	6280K641	Roller Chain Sprocket	1
5	Pillow Block		2
6	60355K691	Ball Bearing	2
7	91253A539	Black-Oxide Alloy Steel Hex Drive Flat Head Screw	4
8	92245A546	Mil. Spec. 18-8 Stainless Steel Hex Head Screw	5
9	95505A601	Medium-Strength Steel Hex Nut	5
10	5415K23	Worm-Drive Clamps for Firm Hose and Tube	1
11	1603A7	Surface-Mount Hinge with Holes	1
12	1603A7	Surface-Mount Hinge with Holes	1
13	1603A7	Surface-Mount Hinge with Holes	1
14	9494T54	Closed Eye Routing Eyebolt - Not for Lifting	2
15	5108N541	Music Wire Steel Extension Spring with Loop Ends	2

DRAWING: 01-000001 SPEC: BND DIMS: 0-015 4-000 1-000 MILLIMETER SURFACE: 1-000 TOLERANCE: 1-000 MATERIAL:		PART: 1		DIMS: A1-D BREAK SHAP DIMS: 1		D2 A1-D SCALE DRAWING:		REVISION:	
NAME:		SIGNATURE:		DATE:		TITLE:			
DRAWN:									
C.D.P.									
APPROV:									
H.D.									
G.M.				MATERIAL:		DIMS: 1-D		Bike Assembly V7 ^{A3}	
				DIMS: 1-D		DIMS: 1-D		DIMS: 1-D	

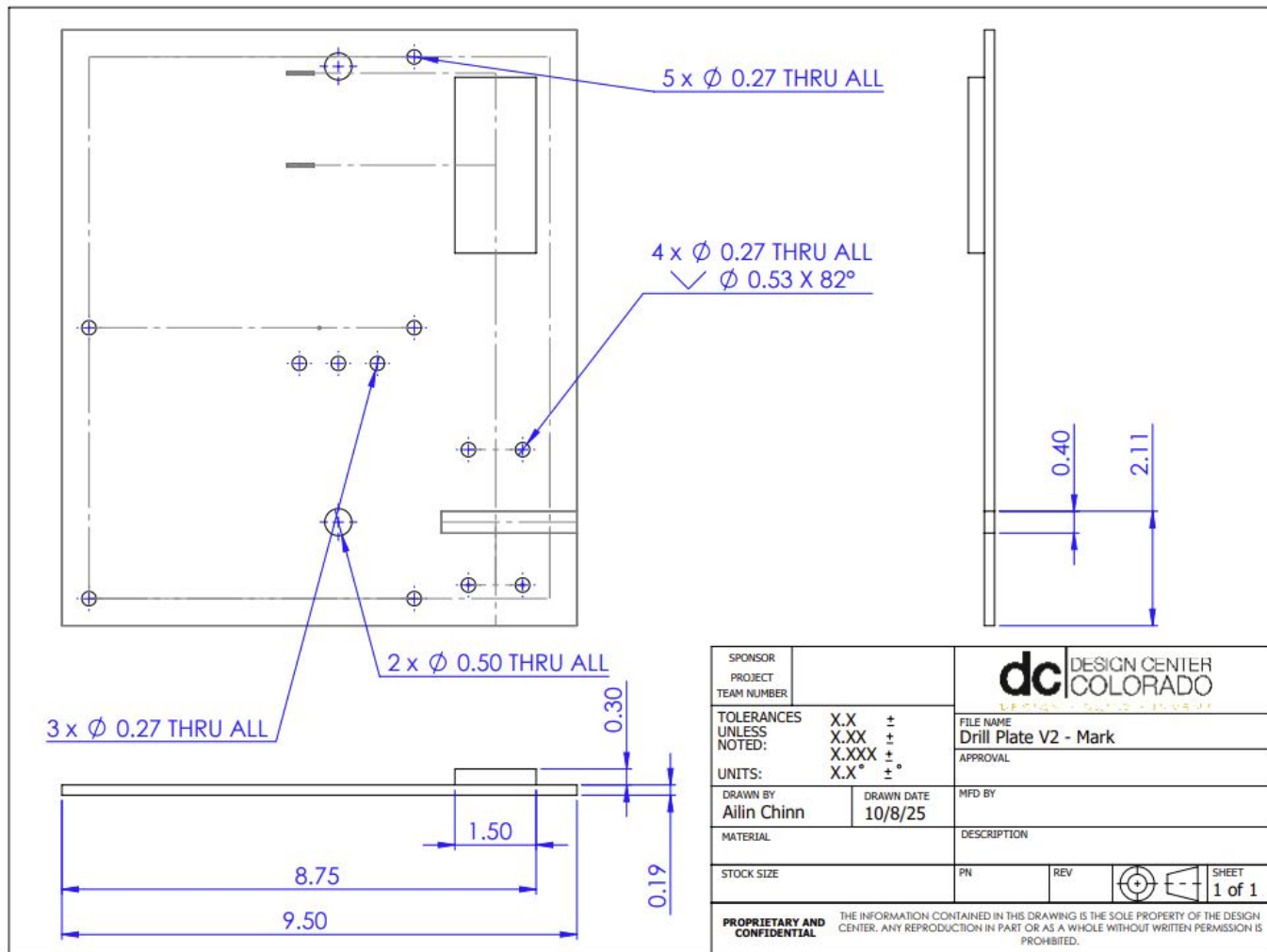


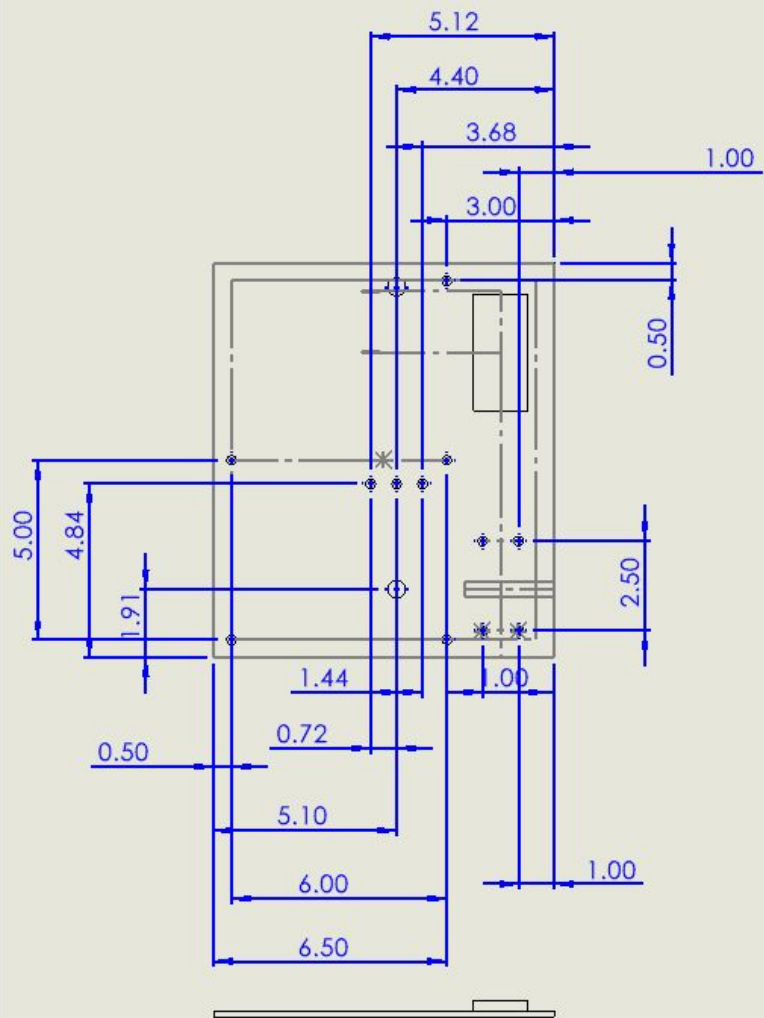
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	Drill Shaft		1
2	6280K641	Roller Chain Sprocket	1
3	Pillow Block		2
4	60355K691	Ball Bearing	2



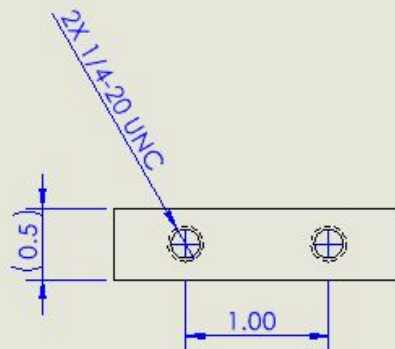
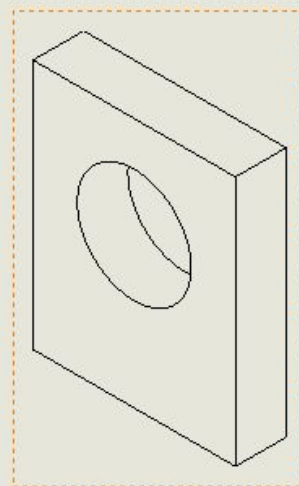
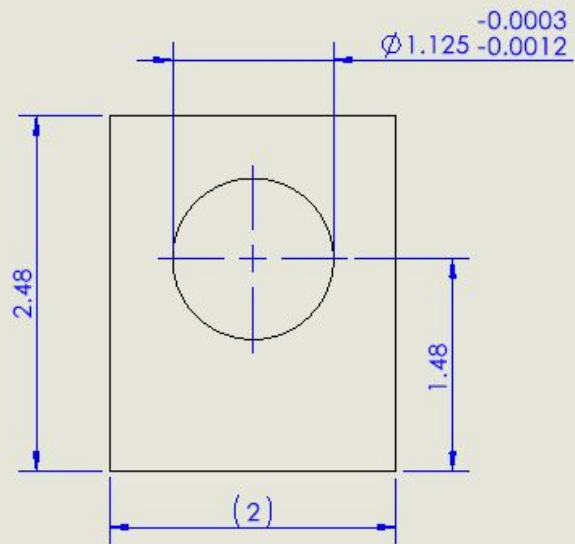
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS		FINISH:		DRAFTER AND CHECKED		DO NOT SCALE DRAWING		REVISED	
SURFACE FINISH: ROUNDERNESS: LINEAR ANGULAR:									
DATE:	SIGNATURE:	DATE:		TITLE:					
DRW:									
CHK:									
APP:									
MGR:									
G.A.				MATERIAL:		DWG NO:		A3	
				WEIGHT:		SCALE:		SHEET 1 OF 1	

Drill Shaft and Sprocket



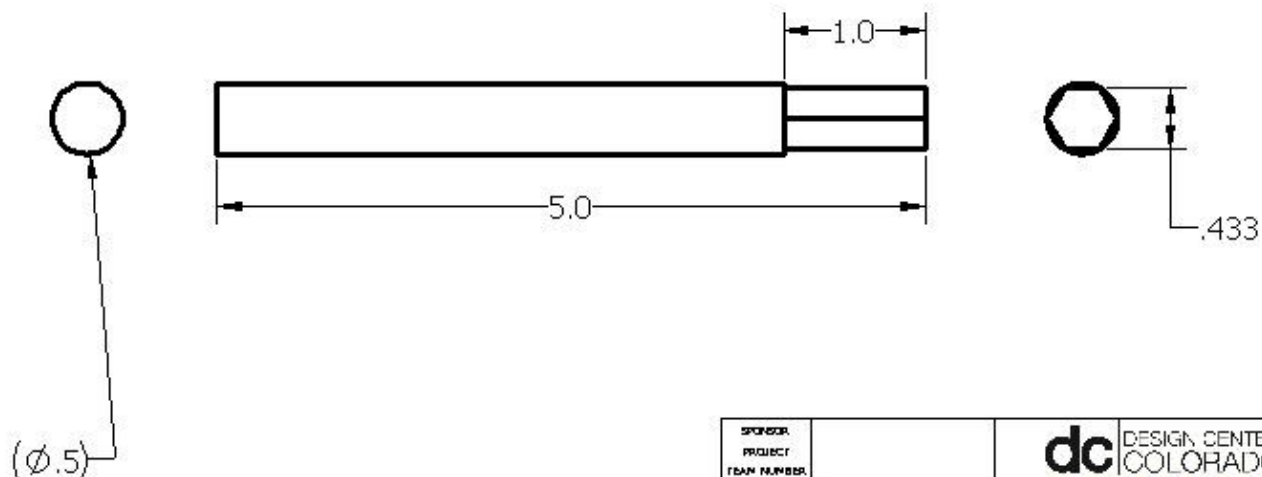


SPONSOR			
PROJECT			
TEAM NUMBER		FILE NAME Drill Plate V2 - Mark	
TOLERANCES	X.X ±	APPROVAL	
UNLESS NOTED:	X.XX ±		
	X.XXX ±	MFD BY	
UNITS:	X.X" ±		
DRAWN BY	Ailin Chinn	DRAWN DATE	10/8/25
MATERIAL		DESCRIPTION Pt.2	
STOCK SIZE		PN	REV
		  SHEET 1 of 1	
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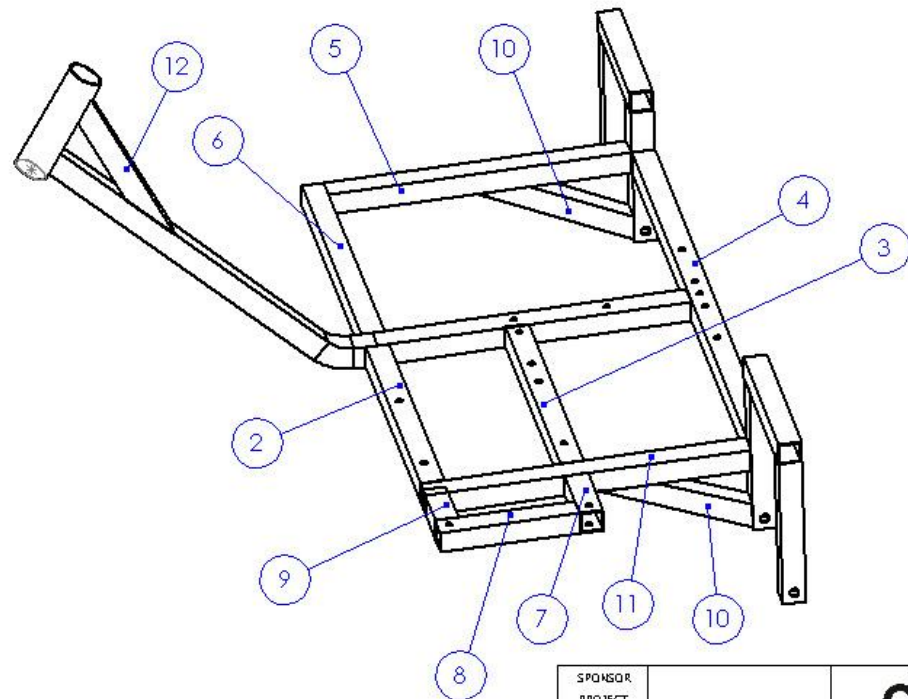
SPONSOR		dc DESIGN CENTER COLORADO	
PROJECT		FILE NAME Pillow Block V2	
TEAM NUMBER		APPROVAL	
TOLERANCES UNLESS NOTED:	X.X ± 0.05 X.XX ± 0.01 X.XXX ± 0.005		
UNITS:	X.X° $\pm 1^\circ$		
DRAWN BY Tinius Klaveness	10/08/25	MFD BY	
MATERIAL 6061 Aluminum		DESCRIPTION	
STOCK SIZE		PN	REV
			SHEET 1 of 1
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REVISIONS		
REV.	DESCRIPTION	DATE

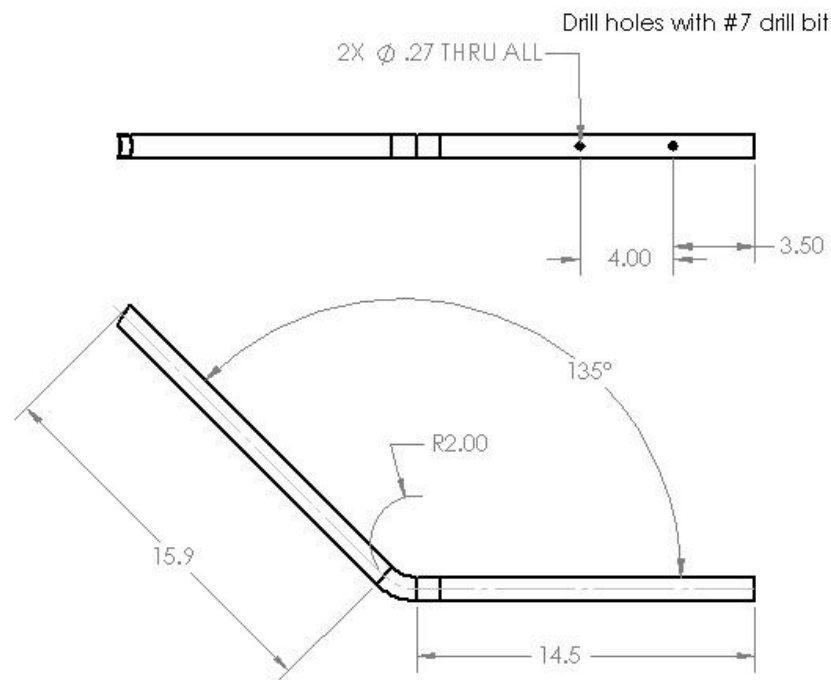


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X.XXX ±0.01			
X.XXXX ±0.005			
UNITS: INCHES X.X" ±1"			
DRAWN BY		DRAWN DATE	
		MFD BY	
MATERIAL		DESCRIPTION	
STOCK SIZE		PN REV A	
		 SHEET 1 of 1	
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Frame Drawings



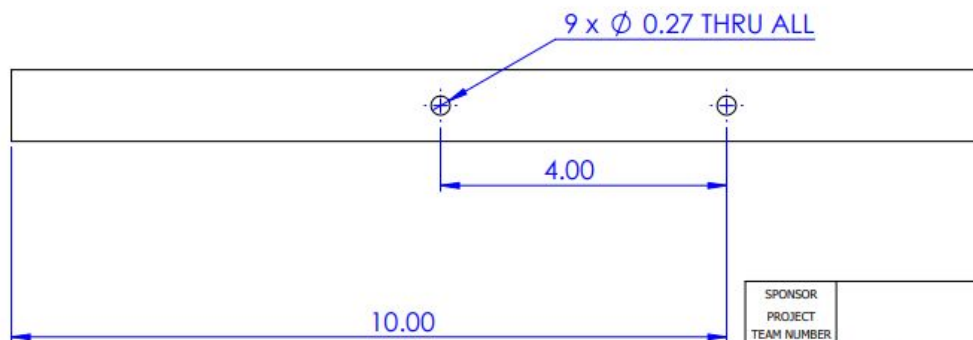
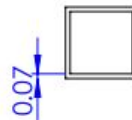
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UNITS:		X.XX ± X.X° ±°	APPROVAL
DRAWN BY	DRAWN DATE	MFD BY	
MATERIAL		DESCRIPTION	
STOCK SIZE		PN	REV
			SHEET 1 of 1
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PROJECT		FILE NAME	
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TOLERANCES	X.X ±	APPROVAL	
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NOTED:	X.XXX ±		
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MATERIAL		DESCRIPTION	
STOCK SIZE		PK	REV
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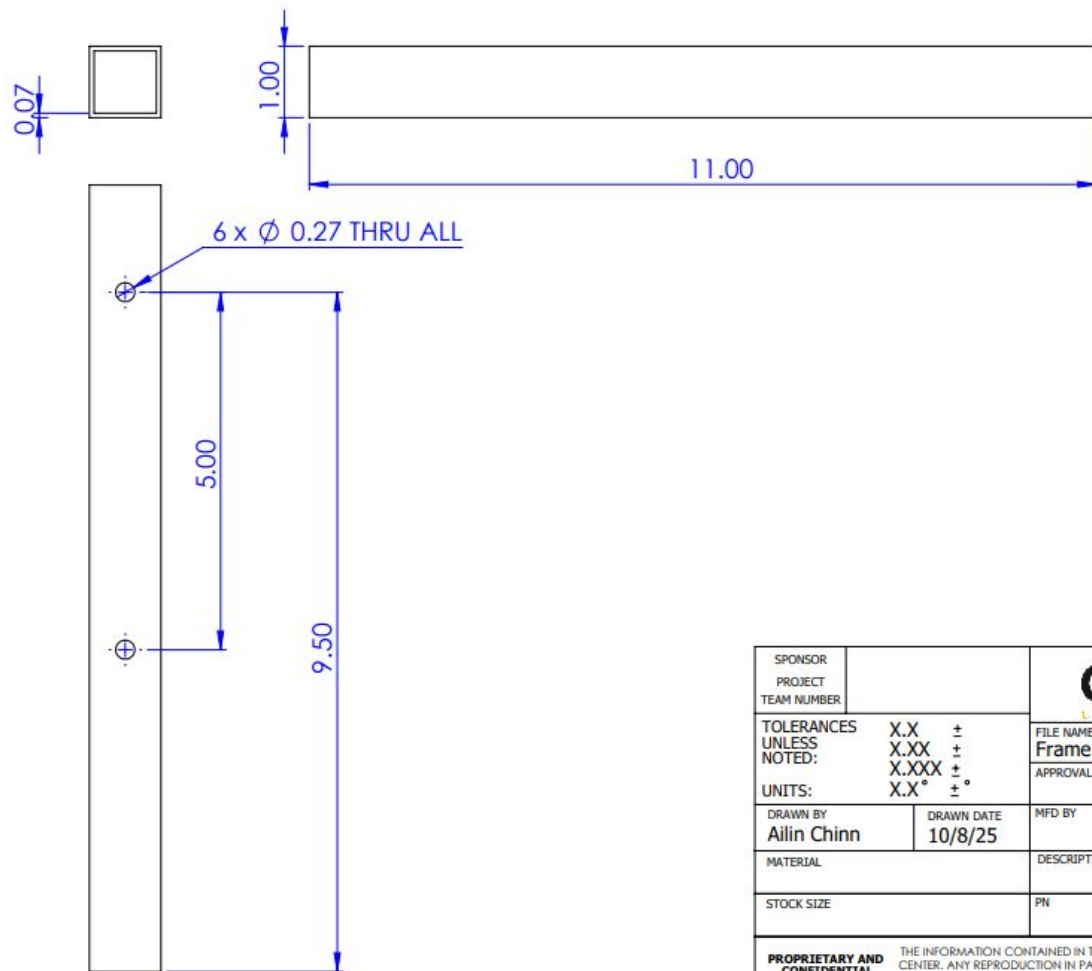
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1 of 1



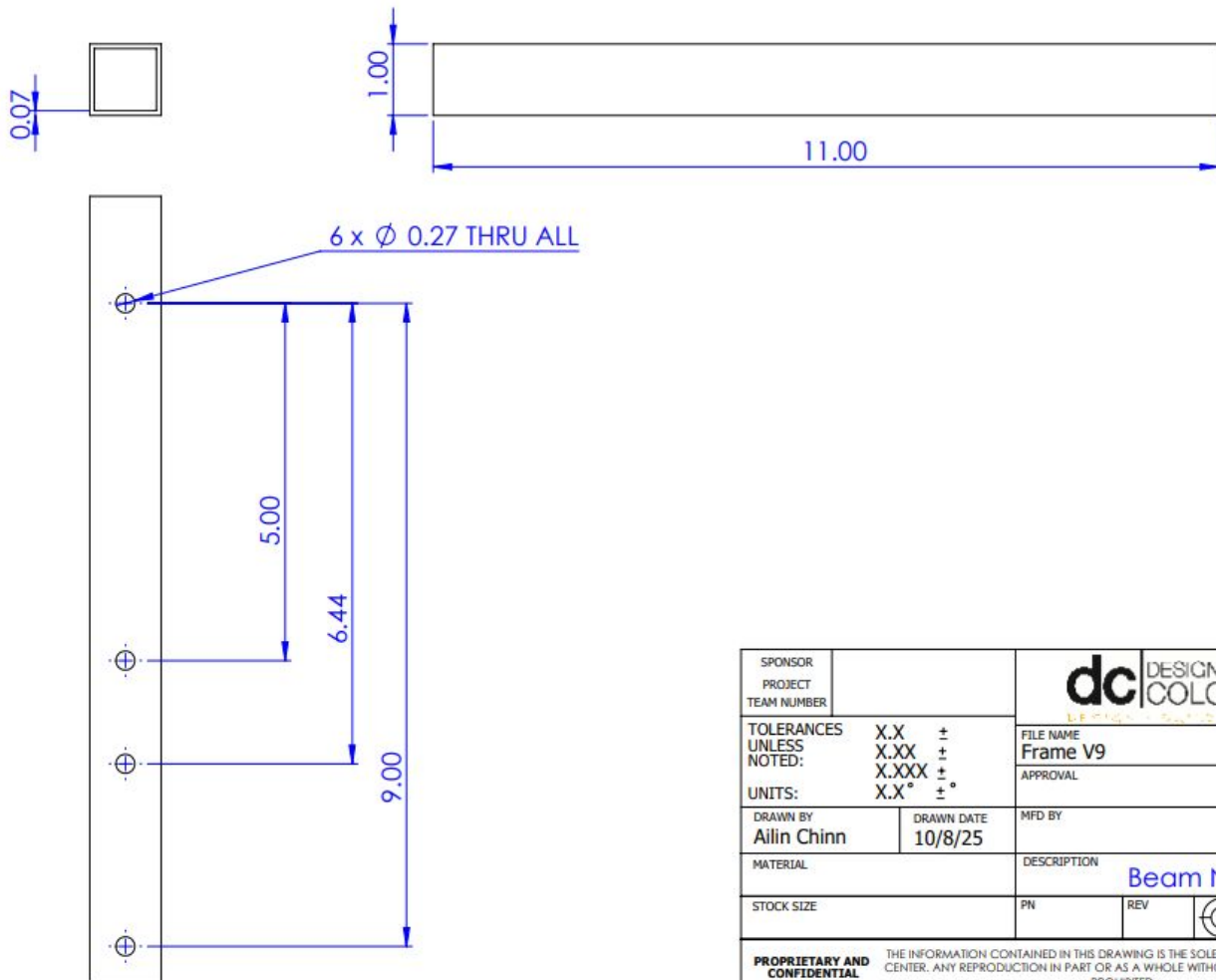
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UNITS:		
DRAWN BY Ailin Chinn	DRAWN DATE 10/8/25	MFD BY
MATERIAL		DESCRIPTION Beam No.1
STOCK SIZE	PN	REV
		 SHEET 1 of 1

PROPRIETARY AND CONFIDENTIAL

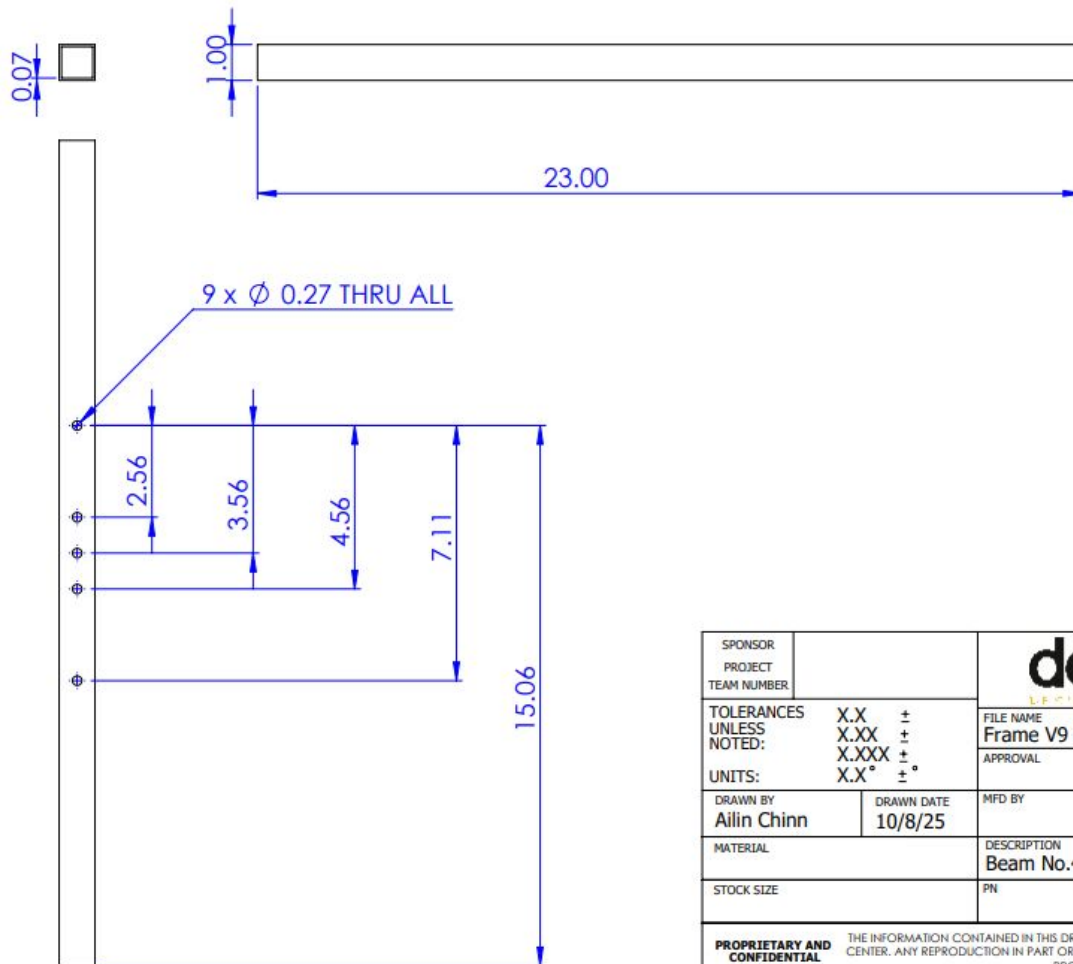
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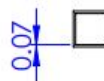
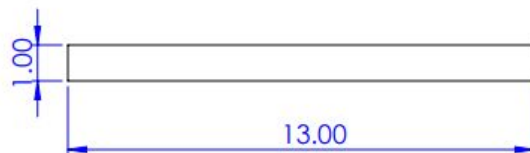
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DRAWN BY Ailin Chinn	DRAWN DATE 10/8/25	MFD BY	
MATERIAL		DESCRIPTION Beam No.2	
STOCK SIZE		PN 	REV 
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		SHEET 1 of 1	



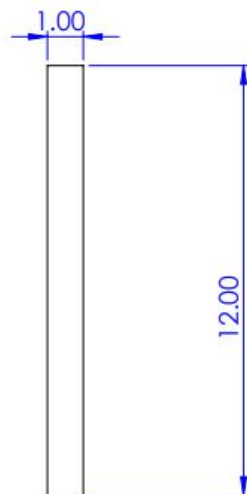
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NOTED:	X.XXX ±	
UNITS:	X.X° ±°	
DRAWN BY	DRAWN DATE	MFD BY
Ailin Chinn	10/8/25	
MATERIAL		DESCRIPTION
		Beam No.3
STOCK SIZE	PN	REV
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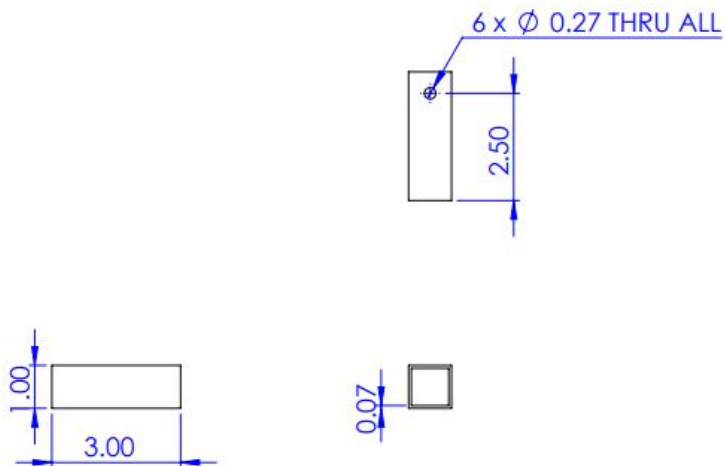
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UNLESS	X.XX ±		
NOTED:	X.XXX ±		
UNITS:	X.X° ±°		
DRAWN BY	Ailin Chinn	DRAWN DATE	10/8/25
MATERIAL		MFD BY	
STOCK SIZE		DESCRIPTION	Beam No.4
		PN	REV
			SHEET 1 of 1
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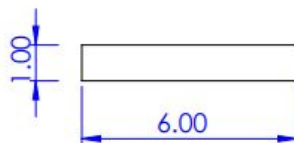
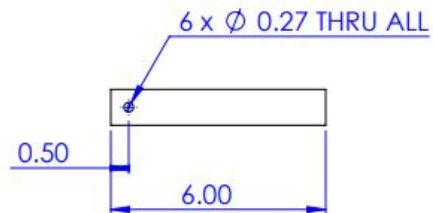
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DRAWN BY Ailin Chinn	DRAWN DATE 10/8/25	MFD BY	
MATERIAL		DESCRIPTION Beam No.5	
STOCK SIZE	PN	REV	  SHEET 1 of 1
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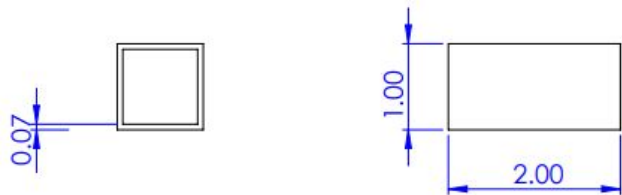
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UNITS:	X.X° ±°		
DRAWN BY	Ailin Chinn	DRAWN DATE	10/8/25
MATERIAL		DESCRIPTION	
STOCK SIZE		Beam No.6	
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		 	SHEET 1 of 1
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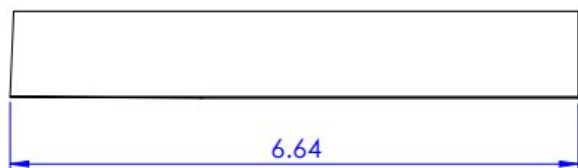
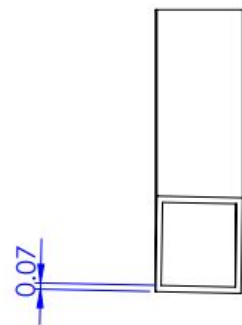
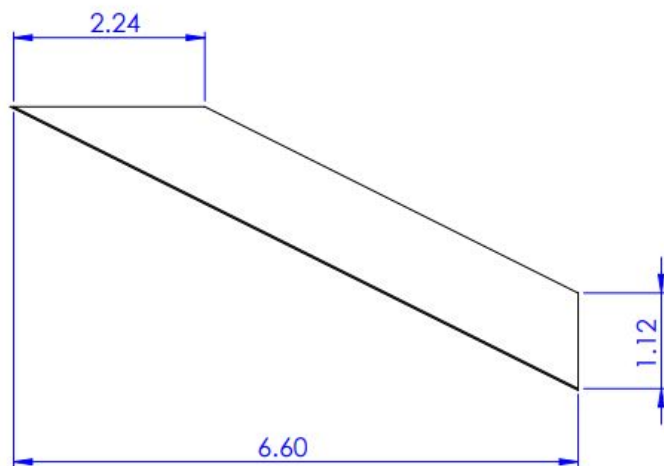
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UNITS:	X.X° $\pm$		
DRAWN BY	Ailin Chinn	DRAWN DATE	10/8/25
MATERIAL		DESCRIPTION	
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STOCK SIZE		PN	REV
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		 SHEET 1 of 1	



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TOLERANCES UNLESS NOTED:		X.X ± X.XX ± X.XXX ± X.X° ±°	FILE NAME Frame V9
UNITS:			APPROVAL
DRAWN BY Ailin Chinn	DRAWN DATE 10/8/25	MFD BY	
MATERIAL		DESCRIPTION Beam No.8	
STOCK SIZE		PN	REV
			SHEET 1 of 1
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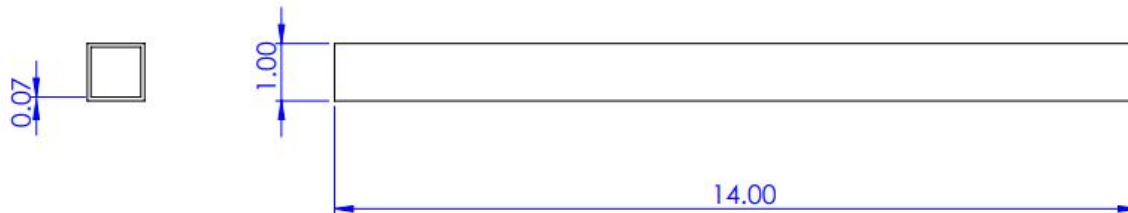


SPONSOR PROJECT TEAM NUMBER		 Let's Design. Let's Grow. Let's Build.	
TOLERANCES UNLESS NOTED:		X.X ± X.XX ± X.XXX ± X.X° ±°	FILE NAME Frame v9
UNITS:			APPROVAL
DRAWN BY Ailin Chinn		DRAWN DATE 10/8/25	MFD BY
MATERIAL		DESCRIPTION Beam No.9	
STOCK SIZE		PN	REV
		 	SHEET 1 of 1
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PROJECT			
TEAM NUMBER			
TOLERANCES UNLESS NOTED:		FILE NAME	
X.X ±		Frame V9	
X.XX ±		APPROVAL	
X.XXX ±			
UNITS:			
X.X" ±"			
DRAWN BY		MFD BY	
Ailin Chinn		10/8/25	
DRAWN DATE		DESCRIPTION	
MATERIAL		Beam No.10	
STOCK SIZE		PN	REV
			SHEET
			1 of 1
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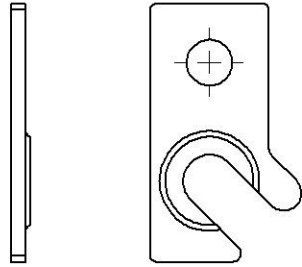
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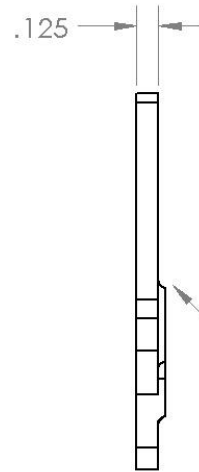
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DRAWN BY Ailin Chinn		MFD BY 10/8/25	
MATERIAL		DESCRIPTION Beam No.11	
STOCK SIZE		PN	REV
			
PROPRIETARY AND CONFIDENTIAL		SHEET 1 of 1	

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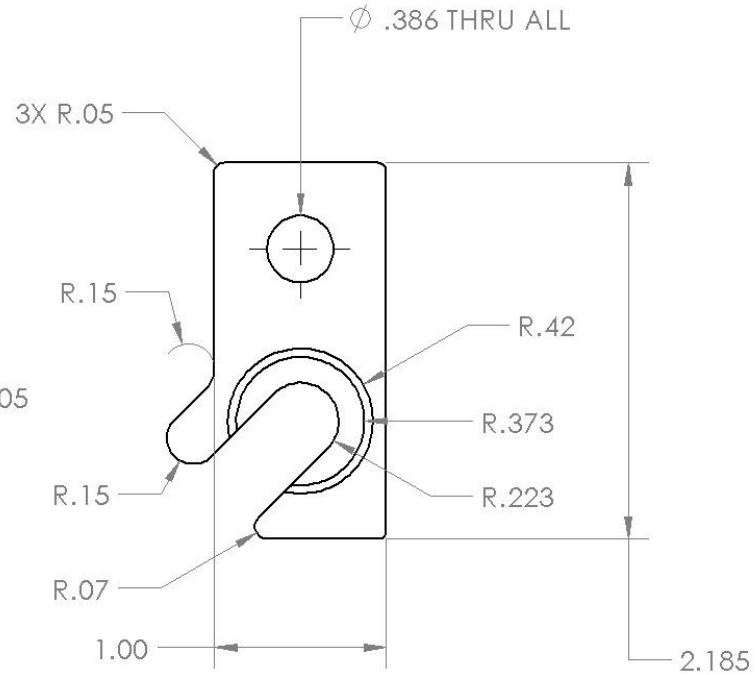
Same dimensions as Left Dropout, only mirrored, manufacture symmetrically

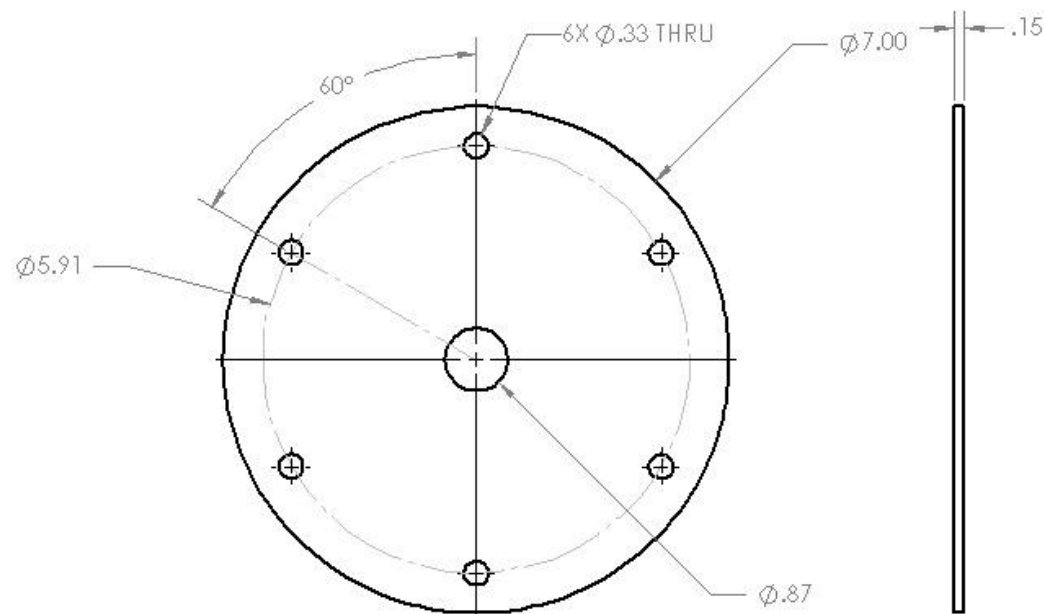


“Right” Dropout
(Mirrored)



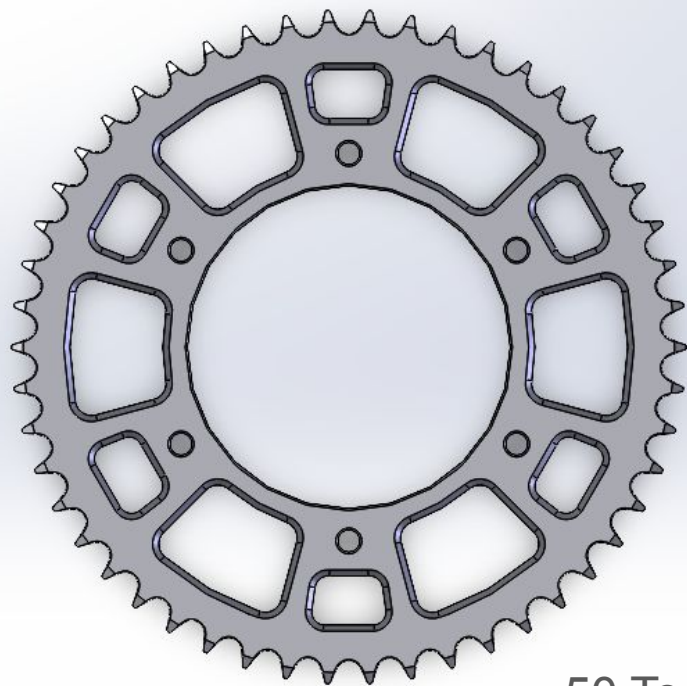
“Left” Dropout



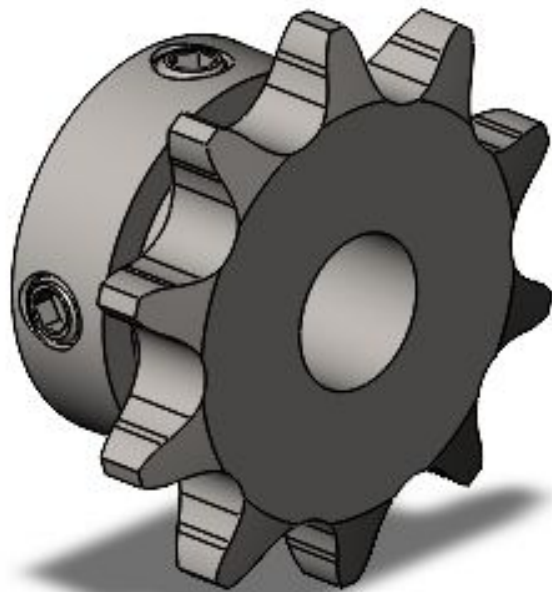


SPONSOR			
PROJECT			
TEAM NUMBER			
TOLERANCES UNLESS NOTED:		X.X ±	FILE NAME
		X.XX ±	Sprocket adapter
		X.XXX ±	APPROVAL
UNITS:		X.X" ±"	
DRAWN BY		DRAWN DATE	MFD BY
MATERIAL		DESCRIPTION	
STOCK SIZE		PK	REV
			
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		SHEET 1 of 1	

5:1 Gear Ratio



50 Tooth



10 Tooth

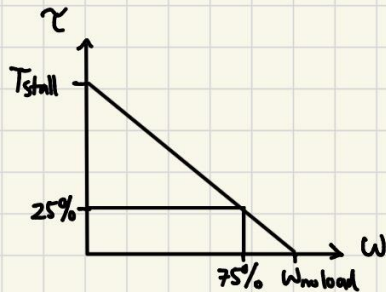
	A	B	C	D	E	F	G
1	Item	Location on Vehicle	Source	No. of Parts	Price (\$)/ part	Total Price (\$)	Link
2	Pillow Block Bearings	Pillow blocks	Amazon	10	1.025	10.25	https://www.amazon.com/PGN-R8-2RS-Sealed-Bearing-Lubricated/dp/B07GT92P1H/ref=sr_1_1_sspa?crid=1QCCEK5EYTXN&dib=eyJ2IjoIIMSJ9.1EL1gaG-aBhhcKdvrdbb_yAX1X1-Xn0lmb2AUUHzdn22Sh9ORP5Aihokl_3r-3iegwgJk-2CLvRy3NoXZqvl_UUjxdqfsXLcFmVgDHJB5-oartohuJ1LKuzhQXqlq2A-6SwFD1hXTJd74ZJlQcOqhmgpl_9UfM5GkvjObvDuNL2a52dM8t8gMsQY80PHlj-PVtkrI01qpG8XUhOZcTcOseipea47zJlUzCw1zpeow_7ydk78AwXyJysYq-DqetV/m47_kJrASKUwCjvsTxJnQ&dib_tag=se&keywords=r8%2Bbearing&qid=1759699894&refinements=p_36%3A-1700&mid=386419011&srefix=R8%2Bbearing%2Caps%2C135&sr=8-1-spons&sp_csd=d2lkZ2V0TmFIZT1zcF9hdGY&th=1
3	1/4" 20, 1.5 inch screws	Drill plate	Amazon	1 box (25)	0.6264	15.66	https://www.amazon.com/Hex-Bolts-Stainless-Steel-Partially/dp/B07FP1W67X/ref=sr_1_2_sspa?crid=1H6Q4VU7BDMW5&dib=eyJ2IjoIIMSJ9.MS77ge16HE2Hrh_Ox-ngBYqhZAqOEmiwL6PYm7zlFihohy-WUjDNkbl_Ylfi6jMFamxUQLBKhuiub_HeUOB12LuJ44LKWWWHhmje7soy6-_X_LzJeoQv6Hviroi-xPugd8q3HP7AOEhoF8Uvg2oxQ_6yt3XDuDcSvhlhfh_bV1kTNoCdoXwchTUYk3xkfqlYJlnVPXcxPujJsFL4ATckO8xJ9iOB6hGOKPk4Dse3xU_tthxH2OzE6egGtrneZjKWescBpna0gHLhnYoVBqRkyU&dib_tag=se&keywords=1%2F4-20%2Bx%2B1.5%2Bpartial%2Bthread&qid=1759891292&srefix=1%2F4-20%2Bx%2B1.5%2Bpartial%2Bthread%2Caps%2C108&sr=8-2-spons&sp_csd=d2lkZ2V0TmFIZT1zcF9hdGY&th=1
4	1/4" 20, 2 inch screws	Seat	Amazon	1 box (25)	0.77	19.25	https://www.amazon.com/Hex-Bolts-Stainless-Steel-Partially/dp/B07FP43KBP/ref=sr_1_2_sspa?crid=1H6Q4VU7BDMW5&dib=eyJ2IjoIIMSJ9.MS77ge16HE2Hrh_Ox-ngBYqhZAqOEmiwL6PYm7zlFihohy-WUjDNkbl_Ylfi6jMFamxUQLBKhuiub_HeUOB12LuJ44LKWWWHhmje7soy6-_X_LzJeoQv6Hviroi-xPugd8q3HP7AOEhoF8Uvg2oxQ_6yt3XDuDcSvhlhfh_bV1kTNoCdoXwchTUYk3xkfqlYJlnVPXcxPujJsFL4ATckO8xJ9iOB6hGOKPk4Dse3xU_tthxH2OzE6egGtrneZjKWescBpna0gHLhnYoVBqRkyU&dib_tag=se&keywords=1%2F4-20%2Bx%2B1.5%2Bpartial%2Bthread&qid=1759891292&srefix=1%2F4-20%2Bx%2B1.5%2Bpartial%2Bthread%2Caps%2C108&sr=8-2-spons&sp_csd=d2lkZ2V0TmFIZT1zcF9hdGY&th=1
5	1/4" 20, 0.75 inch countersink screws	Pillow blocks	Amazon	20	0.4195	8.39	https://www.amazon.com/Socket-Screws-Countersunk-Stainless-Thread/dp/B08QJ5PGBD/ref=sr_1_4?crid=1LH7NML3S1T8Z&dib=eyJ2IjoIIMSJ9.FWfBpAuHo4FG0rl75bJTDjMxvum7udMM941rJlDz5dZluoOvdGyl_hlx9texXtLaCH1Ljb3OUdK-kEj7caBrYElzWkgXLJ8Ab5qAlKuj5xChS2OT7lGEIntQHov_bLZtHBPwErSN2TLpnbEhmGj7yApbl_47048_F6zuuwxpT_oMmWQ3OB7f0Laf43f4ma2Rm9SkHjnEKfhr78R3GMcyOgdgS6lMfxWj5y-so5Bhic.bnFCJWY9jP1zCVdXJsDnKwXajzDclF3FXkUff9EW9k&dib_tag=se&keywords=1%2F4%2Bin%2B20%2Bflat%2Bhead&qid=1759891618&srefix=1%2F4%2Bin%2B20%2Bflat%2Bhead%2Caps%2C113&sr=8-4&th=1
6	Drill shaft sprocket	Drill Shaft	McMaster	1	20.48	20.48	https://www.mcmaster.com/6280K641/
7	1/4 inch nuts	Drill Plate, Seat	Amazon	1 box (50)	0.1198	5.99	https://www.amazon.com/Wensilon-Stainless-Steel-Hex-Nuts-50pcs/dp/B0CDT6MZ5Z/ref=sr_1_2_sspa?crid=3l2BD8KWNLD00&dib=eyJ2IjoIIMSJ9.FYBqPVq-DzD8JrHLnNG9orsCPLhCNlUUIQPuvd_rYgsxuOG1-g0Mu2FNgi3eVb76zARuDFydLSh83u4jJK7Hx9jLRdMwCbVY-CFrwc2V919m-CJ_HBQDhJfghJGJ3m7o5svBITDXiauNTIy9-pgi_KxhhyvurhNpe3knm49B8uws18c3CNDKF7wknFHyX15L1QopY1zXmGhLXGyd-PlcEcUwQSO3ebHKEf1JzaifU_xMhu4N0FoRlJdZ_efi9e8VUOuYPshWh3Yy3bKC7dWY&dib_tag=se&keywords=1%2F4%2Binch%2Bnut&qid=1759892837&srefix=1%2F4%2Binch%2Bnut%2Caps%2C120&sr=8-2-spons&sp_csd=d2lkZ2V0TmFIZT1zcF9hdGY&th=1
8	Worm Drive Hose Clamps 1/2" x 0.023", 3" diameter	Drill Plate/Drill	Amazon	10 pack	1.499	14.99	https://www.amazon.com/OURU-Stainless-Adjustable-Plumbing-Automotive/dp/B0BH7CHHYX/ref=sr_1_10?crid=2TVJ7GPD3DWC9&dib=eyJ2IjoIIMSJ9.ARZmj2aQbsIFPAqdWApRkKdYND9C8h1xbmDl4TCFIHye3EyzkTqGKG0cpVSQwqZ0bWQOxM420UajTHKPMXbGxX_fo3HWICyAuhBNRQitOWRquJYERYE_L661yhrCbP1Pv8iJ18f1MhZSj01aSusYMo82TTPDceE64cm6n6nug_2boBKk6uykrBXP-3fGzlrzj0DUY-pSlibkXXxBTnetKL06uAxEsUyThzAKIsK4.ClkgxL-RVOOxs50BbQplqK0Sc68tBp68-ih_R5xlGGg&dib_tag=se&keywords=worm%2Bdrive%2Bhose%2Bclamps%2B1%2F2%22%22%2Bx%2B0.023%22&qid=1759935401&srefix=worm%2Bdrive%2Bhose%2Bclamps%2B1%2F2%22%2Bx%2B0.023%2B%2Caps%2C108&sr=8-10&th=1

Design Review - Hand Calculations:

No load speed: $\omega_{\text{no load}} = 412 \text{ rpm}$

Stall torque: $T_{\text{stall}} = 240 \text{ in-lb}$

Back wheel diameter (with sprocket): $D_{\text{back}} = 12 \text{ in}$



$$\text{Note: } T = (240 \text{ in-lb})(0.25) \\ = 60 \text{ in-lb}$$

$$\therefore F = \frac{T}{r} = \frac{60 \text{ in-lb}}{6 \text{ in}} = 10 \text{ lb}$$

$$\text{Note: } \omega = (412 \text{ rpm})(0.75) \\ = 309 \text{ rpm}$$

$$\therefore V_{\text{max}} = 309 \text{ rpm} \times \frac{2\pi(6 \text{ in})}{1 \text{ rev}} \times \frac{1 \text{ mile}}{63360 \text{ in}} \times \frac{60 \text{ min}}{1 \text{ hour}} \\ = 11.03 \text{ mph}$$

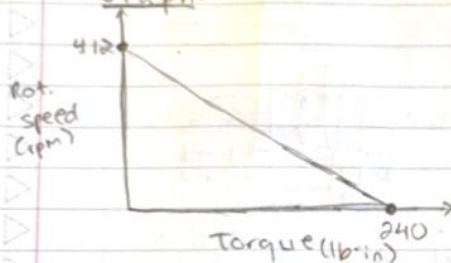
We can also calculate mechanical power:

$$P = T\omega$$

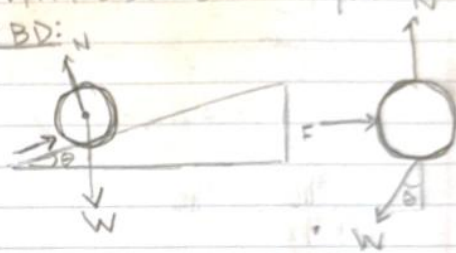
$$= \left(60 \text{ in-lb} \times \frac{1 \text{ ft}}{12 \text{ in}}\right) \left(309 \text{ rpm} \times \frac{2\pi \text{ rad}}{1 \text{ rev}} \times \frac{1 \text{ min}}{60 \text{ sec}}\right) \times \frac{1 \text{ hp}}{550 \text{ ft-lb/sec}} \\ = 0.294 \text{ hp}$$

2.1.1 Gear Ratio Calculations

- stall torque ≈ 240
- no load rpm ≈ 412
- approx angle of steepest hill on course $\approx 8^\circ$
- approx length of steepest part of course $\approx 0.04 \text{ km} = 4 \text{ m}$
- weight of vehicle (max) = 50 lbs
- weight of person (max) = 190 lbs (Timius weight)
- diameter of wheel including tire = 13 in
- Running @ 75% no load rpm, 25% stall torque
- Graph:



∴ FBD:



$$\sum F_x = 0 = F - W \sin \theta$$

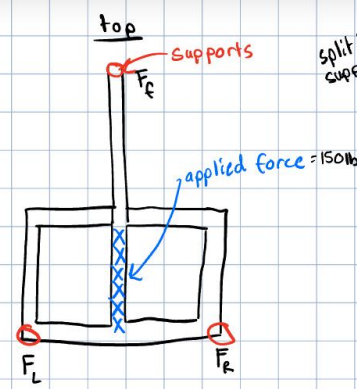
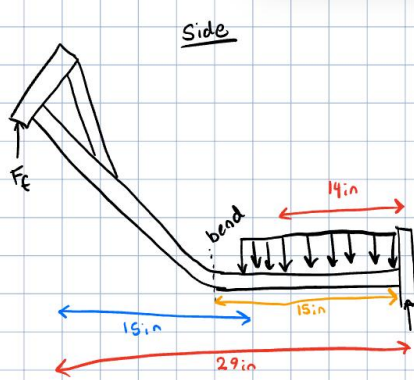
$$F = 240 \sin(8^\circ) = 33.4 \text{ lb}$$

$$\text{Torque Wheel} = F \times r = 33.4 \times \frac{13}{2} = 217.11 \text{ lb-in}$$

$$\text{Torque Motor} = 240 \times 0.25 = 60$$

$$\text{ratio} = 217.11 : 60$$

$$3.61 : 1 = 7 \text{ round to } 5:1$$



split between back supports
Sum of forces
 $F_L + F_R = 150 \text{ lb}$

Moment, side, about back

$$-150 \cdot 7 + F_L \cdot 29 = 0$$

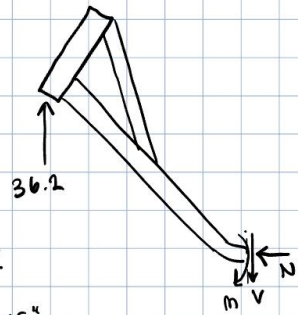
$$F_L = 36.2 \text{ lb}$$

$$F_R = 113.8 \text{ lb}$$

$$F_R + F_L = F_R = 113.8$$

$$F_R = F_L = 56.9 \text{ lb}$$

Factor of Safety at Bend calculations



$$N = 0$$

$$V = 36.2$$

$$M = 36 \cdot 14 = 504 \text{ in lb}$$

$$\sigma = \frac{M y}{I} \quad y = 0.5$$

$$\sigma = 3024 \text{ psi}$$

$$I_{max} = \frac{3V}{2A}$$

$$I_{max} = \frac{3 \cdot 36.2}{2 \cdot 0.1258} = 431.7$$

$$\sigma' = \sqrt{3024^2 + 3 \cdot 431.7^2} = 3115.1 \text{ psi}$$

$$I = \frac{b_o^4 - b_i^4}{12}$$

$$I = \frac{1 - 0.065^4}{12} = 0.0833$$

$$A = 0.1258$$

mild steel yield strength
 36,000 psi

$$FOS_{bend} = 11$$

Drill Powered Bike

Mark P.

Project Manager

SIMPLE GANTT CHART by Vertex42.com

<https://www.vertex42.com/ExcelTemplates/simple-gantt-chart.html>

Task	Assigned To	Progress	Start	End
Project Planning				
Planning Document	All Team Members	100%	9/20/25	9/25/25
Finish Design Review	All Team Members	100%	9/25/25	10/7/25
Finalize CAD Design	Amanda and Ailin	25%	10/8/25	10/19/25
Purchase Materials	All Team Members	20%	10/8/25	10/22/25
Manufacturing + Testing				
Manufacture Parts	Tinius + Other	0%	10/30/25	11/5/25
Assembly	Trent, Amanda, Tinius	0%	11/1/25	11/10/25
Revisions (From Demc Tinius + Other		0%	11/14/25	11/17/25
Testing	Trent, Mark		11/17/25	11/20/25
Run Off				
Run Off	All Team Members	0%	12/4/25	12/4/25
Presentations, Evaluations, Reports				
Design Review	All Team Members	100%	12/7/25	12/7/25
Report Draft	All Team Members	0%	12/7/25	10/30/25
Hardware Demonstrati	All Team Members	0%	10/12/25	10/12/25
Final Vehicle Test Dem	All Team Members	0%	11/21/25	11/21/25
Final Design Report	All Team Members	0%	11/22/25	12/5/25

Project start: **Sat, 9/20/2025**

Display week: 1

