44585A

“HSI ECHO”

Engineering Notebook

2025 - 2026

HARMONY
PUBLIC SCHOOLS

Date 10/27/2025 Event Name Robo Feast Frenzy V5RC Pushback Tournament

Innovate Award Submission Information Form

Instructions for team: Please fill out all information, printing clearly. This form should be included immediately after the Engineering Notebook's cover page. In the case of physical notebooks, this form can be printed out and placed in the notebook. For digital notebooks, this form can be scanned in and included. Teams may only submit **one** aspect of their design to be considered for this award at each event. Submission of multiple aspects will nullify the team's consideration for this award.

Full Team Number: 44585A

Brief description of the novel aspect of the team's design:

Our drivetrain features a "dropped-traction" center wheel configuration, made possible with custom-cut 48T gears embedded directly into the wheels. This compact and unconventional design "exploits" VEX tolerances to enhance resistance to perpendicular force, reduce turning radius, and improve acceleration. By integrating these modifications into a single, space-efficient system, we made a highly maneuverable drivetrain that delivers consistent and reliable performance during use.

Identify the page numbers and/or the section(s) where documentation of the development of this aspect can be found:

Page 53 documents the initial **testing** that revealed the need for a redesigned drivetrain. **Pages 61–64** detail the **assembly** process used to implement the new system in response to those findings. Finally, **page 73** presents the **follow-up testing** that confirmed the effectiveness of the redesigned drivetrain in resolving the identified issues.

Explain why your submission is unique from other approaches to the problem it solves or task it performs:

Our submission is unique from other anti-strafing solutions by saving on internal space through the exploitation of existing VEX tolerances and the usage of custom-cut components not typically used for this purpose.

Table of Contents (Pg. # is the Slide #) *Texts are hyperlinked to the page number

Table of Contents

Table of Contents

Table of Contents

July 2025

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	Robotics Camp					26
27	28	29	30	31		

- Breaks
-Intersession
-Extra curricular events
- Half day
- Holiday
- No school
- Tournament days

Introduction to the Notebook

Introduction to the Notebook

This section illustrates the organization of our notebook and highlights important information regarding the way we set our notebook for organization and clear documentation according to the Engineering & Design Process.

- Bullet points tell off the main idea and will usually be used during the introduction to the game such as the game manual, brainstorming ideas, criteria, and step by step building pages.

- Further bullet points lead off the main idea continuing giving an example or definition and will be used mostly in the manual and brainstorming pages. Example:

<GG4> There is no touching during the match
Drive team. Embers are prohibited from touching robots, field elements or blocks during the match unless:

- During Driver control period, they may touch their own robot if it hasn't moved and only to
- Turning the robot on and off
- Plugging in the battery
- Plugging a V5 robot radio

- Blank spaces
- These spaces will be covered with an X including the creator of the page initials to show the end of a page that will not be covered with information. ex:

J.N.

Project Introduction to the Notebook
Name Jimena Nieblas Date 06/21/2025

Introduction to the Notebook (Cont.)

- Colored Coded pages

  These color tabs/page tabs will be placed in the top right corner of every page or before starting a new step of the engineering design process which will also be colored coded on the table of contents to explain which sections of the EDP it falls into. For Example, such as if it's the introduction or the first step of the engineering design process. Ex:

Introduction to the notebook

Build and Program

Define the problem

Test Solution

Generate concepts

Implement Solution

Miscellaneous

*(1)

- Breaks
-Intersession
-Extra curricular events
- Half day
- Holiday
- No school
- Tournament days

Color Coded Calendar

- Color Coding our monthly calendar will allow us to better maintain organization of our time and plan better. This also condenses information into colors allowing for easier communication.

- Asterisk Symbols *(0)

  -Pages may have photos, links, or videos marked with an asterisk and number. These are references to citations, or other resources located in the Appendixes. This system ensures clarity and avoids interrupting the flow of the Engineering Design Process.

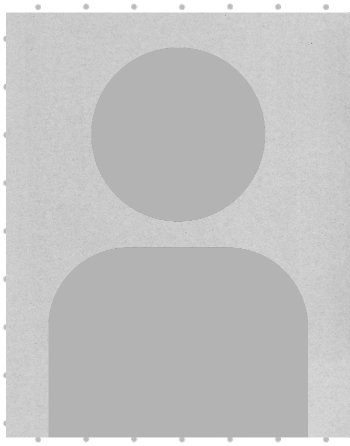
Meet the team

[*(2, A, B, C, D, E]

Marco Sanchez

Captain - Programmer - Lead Builder - Driver - Auxiliary Documentation [DRIVE TEAM]

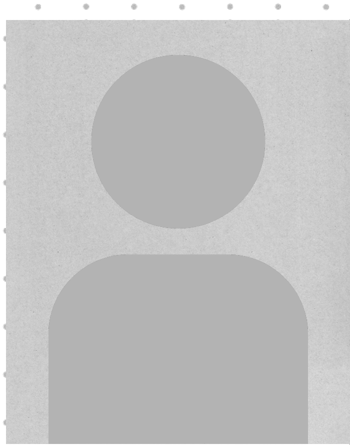
“For this ‘2025-2025 VEX Season, I want to grow in my knowledge of real world STEM, to gain valuable skills in Programming, Building, and Designing. “



Marc Melero

Auxiliary Programmer - Auxiliary Builder - Backup Driver Fundraising - Scouting - Financials [DRIVE TEAM]

“For this season, I want to become a more professional builder and learn complex building techniques.”



Jimena Nieblas

Lead Documentation - Lead Brainstorming - Scheduling

“For this 2025-2026 VEX season i want to grow in my documentation, and teamwork skills. To earn Design award even when competing against other grades above me who have more experience and knowledge in the VEX Documentation.”

Roberto Fierro

Auxiliary Builder - Auxiliary Inventory Management - [DRIVETEAM]

“This season, I want to become a good builder, and learn the proper ways to professionally build a robust Robot.”

Aidan Martinez

Lead inventory management - Auxiliary Builder

“My goals for this season is to gain more knowledge in engineering and to learn from the obstacles that get in the way. “

J.N.

Team Designations

Team Lead/Captain: Marco Sanchez

- Leading the team: Ensuring that all team members are on task and working towards the team's goals. Resolving conflicts and providing solutions that benefit the entire team.
- Facilitating communication: Keeping the team's workspace tidy, following the engineering design process, and fostering an environment of collaboration and sportsmanship.
- Setting goals and timelines: Creating realistic goals, setting timelines, and allotting time for each task to ensure the team's success.
- Public Relations

Technical Writer & Documentation: Jimena Nieblas

- Recordes design ideas and decisions with clearity
- Includes sketches, photos, and diagrams to support the design process.
- Explains why certain choices were made based on testing and feedback.
- Collaborates with the team to accurately reflect everyone’s contributions.
- Prepares the notebook for judging aiming for awards like Design or Excellence .

Builders:Marco Sanchez, Marc Melero, Roberto Fierro

- Builds the robot based on the teams design/brainstorming/decision matrix
- Installs and organizes motors, sensors, and other robot parts
- Makes improvements(modifications) based on the testing and feedback
- Works with the programmer to ensure everything functions properly

Team Designations

Programmer: Marco Sanchez

- Programmes autonomous and driver control modes
- Tests and debugging to make sure everything works correctly and smooth
- Works with builders and drivers to improve performance over all
- Updates codes as the robot design or strategy changes

Inventory Management: Aidan Martinez, Roberto Fierro

- Organize storage areas for easy access and efficient workflow.
- Label and categorize parts systematically for quick identification.
- Perform regular audits to verify inventory accuracy.
- Communicate with other team members about inventory needs and updates.
- Prepare inventory reports for team meetings or competitions.

Scouter: Marc Melero, Aldan Martinez

- Watches matches and records the robots performance
- Identifies strong teams for alliance selection
- Shares strategy tips based on data recorded

J.N.

Drive Team

Driver: Marco Sanchez

- Practices to improve speed and accuracy for matches
- Works closely with the programmer and builder
- Follows strategies and adapts during matches
- Stays calm and focused under pressure in tournaments, and practice

Loader: Turn-based with the exception of full time Driver

- Quickly and accurately load objects into loader
- Follows the match strategy and timing and informs the driver.
- Communicates with the driver when needed
- Practices to ensure speed and consistency during tournament matches

Scorekeeper: Marc Melero, Roberto Fierro, Jimena Nieblas

- Keeps accurate records of points earned during matches
- Notes penalties or fouls earned either our team alliance, or opponents
- Helps analyze team and opponents performance
- Supports strategy planning with data (helps documenting)

The Engineering Design Process

The engineering design process is a step-by-step way of solving problems where we start by understanding the challenge, then come up with ideas we create and build a prototype, test how well it works, and keep improving it until we have a solution that really works.

Define the problem

- Understand the problem we need to solve.
- Determines the limits and goals based on the problem

Generate Concepts

- Looks into existing solutions or similar ideas for inspiration
- Draws out our own possible designs or approaches
- Compares our ideas using a decision matrix based on our goals and limitations (Criteria)

Build and Program Solution

- Develops solutions for each part of the system (robot)
- Implement and evaluate each idea
- Makes sure each solution meets our goals and stays within the limits (Criteria)

Test Solution

- Reviews how well our solution works
- Identifies the strengths and weaknesses
- Looks for opportunities to make our robos build and program better

Present

- We share our solution with others for feedback and growth
- Clearly explains the problem and how our design solves it using both visuals and spoken presentations. (Documentation)

*(1)

Why the Engineering Design Process?

Our notebook is organized around the steps of the Engineering Design Process, which are essential for clearly showing how we developed our solution to this year's challenge across all areas of robotics, including programming and building.

The process begins with identifying the criteria and constraints of the challenge. From there, our team generates ideas for each subsystem, ranks them using those guidelines, and selects the top concepts to build and test.

Each section of our notebook follows the Engineering Design Process — from brainstorming and designing, to building, testing, evaluating, and presenting.

By structuring our notebook this way, we're able to clearly demonstrate the development of our designs, the decisions we made, and the results we achieved.

J.N.

Miscellaneous:
Our Resource Management

HARMONY
PUBLIC SCHOOLS

Why do Resource Management?

Inventory tracking and Resource management is directly tied to our **project timelines** and **budget planning**. Before each **build phase**, we cross-reference our inventory to ensure we have the necessary parts. If not, we adjust our design or initiate procurement. This approach reduces wasted time and supports our **engineering design process**.

Each item is logged in Google Sheets with the following criteria:

- Item name and category *(Structural, Pneumatic, Electronic, Tools, Other)*
- Available Stock
- Status updates: (*In stock, In short supply, Out of Stock, Ordered)*

This system allows us to:

- Monitor material usage trends
- Identify frequently reused components
- Flag items for replacement or repair
- Plan timely purchases to avoid shortages

*The picture is hyperlinked into the Material Inventory google sheets.

*(2)

HSI Inventory Management

Column 1	Item name	Type	Stock	Status	Available Stock	In use
Column 1	Pnuematic Tubing Rolls	Pnuematic	##	In stock	4	
Column 1	STRAIGHT | Pnuematic Fit.	Pnuematic	##	In stock	15	5
Column 1	L | Pnuematic Fittings	Pnuematic	##	In stock	10	0
Column 1	T | Pnuematic Fittings	Pnuematic	##	In stock	9	0
Column 1	Rotation Sensor	Electronic	##	In stock	3	1
Column 1	Low Profile Bearing Flat	Structural	##	Ordered	0	0
Column 1	2" Omni Wheels	Other	##	In short supply	2	
Column 1	Stardrive Shaft Collar	Structural	##	In stock	48	18
Column 1	High Strenght Shaft	Structural	##	In stock	6	1
Column 1	6P - 8T Sprockets	Other	##	In short supply	2	2
Column 1	6P - 16T Sprockets	Other	##	Out of stock	0	0
Column 1	6P - 32T Sprockets	Other	##	In short supply	6	2
Column 1	6P - 40T Sprockets	Other	##	In stock	8	0
Column 1	6P - Chain Packs	Other	##	In stock	3	1
Column 1	Post Hex Nut-Retainers	Other	##	In stock	41	16

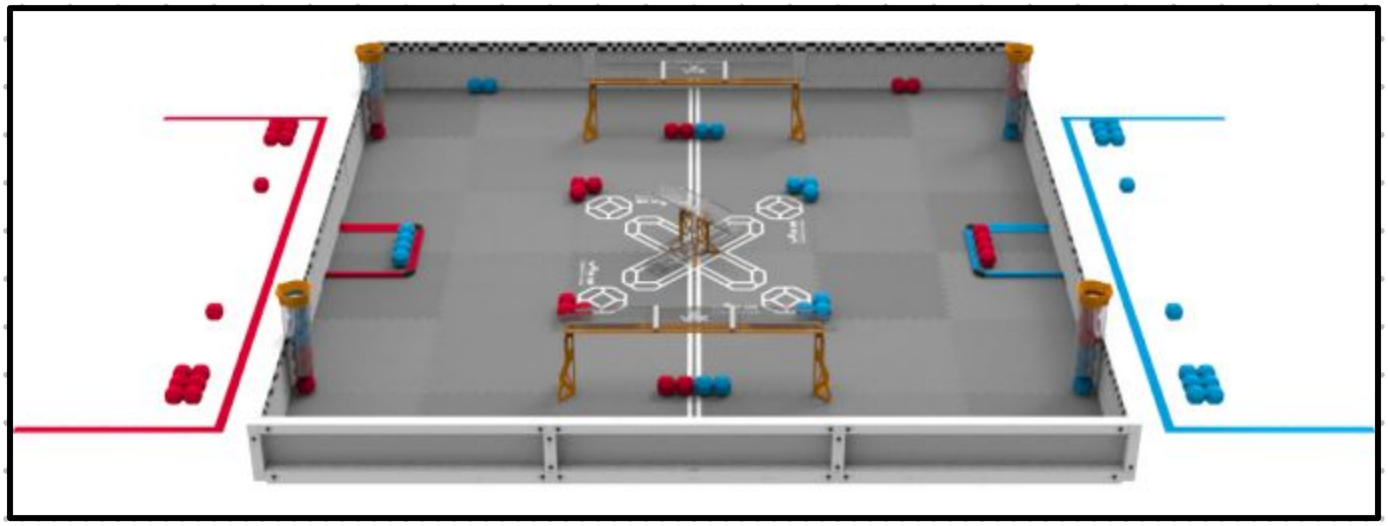
Step I:
Define the problem

Section 1- Game Objective

*Each picture is hyperlinked into their selected game manual section.

Pushback is played on a 12' x 12' square field.

Two alliances, one red and one blue,
each consisting of two teams,compete in Head-to-Head matches that include a 15-second Autonomous Period and a 45-second Driver-Controlled Period.The objective of the VEX Pushback game is for alliances to score colored Blocks into Goals and strategically remove opponent Blocks during the Autonomous and Driver-Controlled Periods to earn points and win matches. *(3)



During the Autonomous Period, alliances can earn the Autonomous Win Points (AWP) by completing four assigned tasks, and the alliance with the most points at the end receives an Autonomous Bonus.

Additionally, teams can compete in driver-controlled and autonomous Robot Skills Matches in which a single robot tries to score as many points as possible.

Section 2 -General Definitions: *(4)

Adult – Anyone who is not a Student or another specific role, like the Head Refe...

Alliance – A group of two Teams that work together during a Match.

Alliance Station – The area where the Drive Team Members must stay during the Match.

Autonomous Bonus – Extra points given to the Alliance that scores the most during the Autonomous Period.

Autonomous Win Point – An extra Win Point given to an Alliance that completes certain tasks by the end of the Autonomous Period in a Qualification Match.

Disablement – A penalty for breaking safety rules. A Team that gets a Disablement cannot control their Robot for the rest of the Match, and their Drive Team Members must put their controllers on the ground.

Disqualification – A penalty for a serious rule violation. In a Qualification Match, the disqualified Team gets zero Win Points, Auton Win Points, Auton Points, and Strength of Schedule Points. In an Elimination Match, both Alliances get disqualified and lose the Match.

Drive Team Member(s) – A Student(s) who stands in the Alliance Station and controls the Robot during a Match.

Entanglement – When a Robot gets caught, hooked, or attached to an opponent's Robot or part of the field.

Field – The whole playing area, including the Floor and the Field Perimeter.

Field Element – Parts of the playing area, like white tape, the Ladder, Wall Stakes, and other structures or accessories.

Field Perimeter – The boundary around the Field.

Floor – The flat area inside the Field. Inside the field perimeter

Game Design Committee (GDC) – The group that created V5RC PushBack.

Holding – A status for a Robot. A Robot is Holding if it meets any of these conditions during a Match:

- *Trapping* – Limiting the movement of an opponent Robot, approximately the size of one form field tile or less.
- *Pinning* – Preventing the movement of an opponent Robot through contact with the Field Perimeter, a Field or Game Element, or another Robot.

Section 2 -General Definitions cont.:

- *Lifting* – Controlling an opponent's movements by raising or tilting the opponent's Robot off of the foam tiles

Match – A timed event where Teams play High Stakes to earn points. It includes:

- Autonomous Period – A time when Robots run on pre-programmed commands and sensors.
- Driver Controlled Period – A time when the Drive Team Members control their Robots remotely.

Robot – A machine that has passed inspection, designed by Student Team Member.make tasks autonomously or control from a Drive Team Member.

Student – A person is considered a Student if they meet both of the following criteria:

1. Anyone who is earning or has earned credit toward a school, diploma, certificate, or other equivalent before VEX Robotics World.

- *Middle School Student* – A Student born after May 1, 2010. Any Students who meet this criteria may also compete as High School Students.
- *High School Student* – Any Student that is not a Middle School Student.

Team – One or more Students make up a Team.

- A Team is classified as a Middle School Team if all members are Middle School Students.
- A Team is classified as a High School Team if any of its members are High School Students, or if the Team is made up of Middle School Students who declare themselves High School Students by registering their Team as a High School Team.
- Once a Team has competed in an event as a High School Team, that Team may not change back to a Middle School Team for the remainder of the season.
- Teams may be associated with schools,community/youth organizations,or a group of neighbor students.

3 Types of students related to robot build-

- *builder*-The student(s) on the robotics team that assemble and repair the robot
- *Coder*-The student(s) that write the computer code that is downloaded onto the robot
- Designer-The student(s) on the robotics team who design the robot build

*Adults may not work on the robots build,code,and design. However, may help students learn the basics.

- *Time out* - A single break period no longer than 3:00 minutes

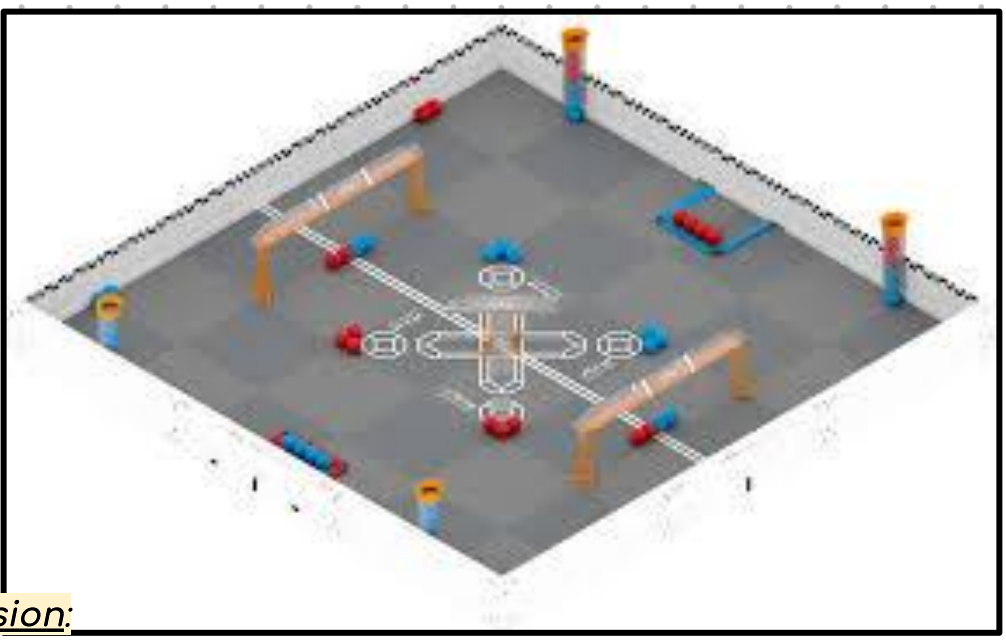
Section 2 -Field overview:

*Each picture is hyperlinked into their selected game manual section.

- 88 Blocks; 44 blue blocks
  - 2 Pre loads
  - 12 Match loads
  - 18 that start the match in predetermined locations
  - 12 That start Match in the Loaders

- 44 Red blocks
- - 2 Pre-loads
- - 12 Match loads
- - 18 that start the match in predetermined locations
- - 12 That start the match in loaders
- 4 Loaders,two adjacent to each alliance station
- 4 Goals
- 2 Long goals
- 2 Centered goals, one upper and lower
- 2 park zones, one red and one blue

*(5)



Team Conclusion:

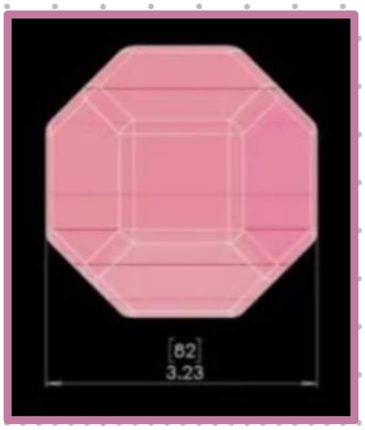
Due to the large number of game elements involved in this year's challenge, we believe that designing a robot capable of cycling quickly and efficiently is critical to maintaining a competitive edge. The ability to handle repeated tasks with speed and reliability will significantly impact overall scoring potential, making rapid cycling not just an advantage, but a key strategic priority in our robot's design.

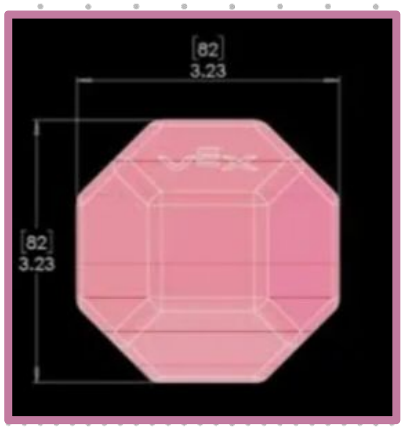
Section 2 -Game-specific Definitions:

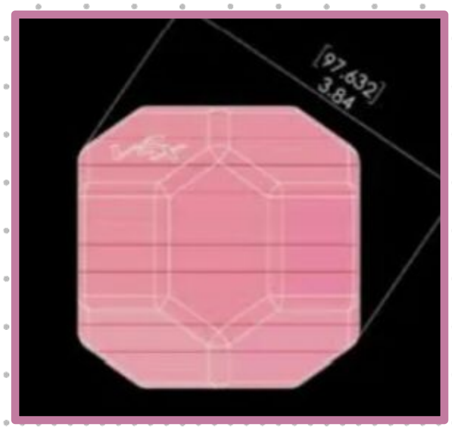
*Each picture is hyperlinked into their selected game manual section.

*(7)

- *Block-* A block is a either blue or red 18-sided hollow plastic polygonal object with flat sided faces,and has a weight of approximately 40 grams. Additionally each cross-section measures 3.25"(82mm)between pairs of opposing flat faces,and 3.85"(98mm) between pairs of opposing corners



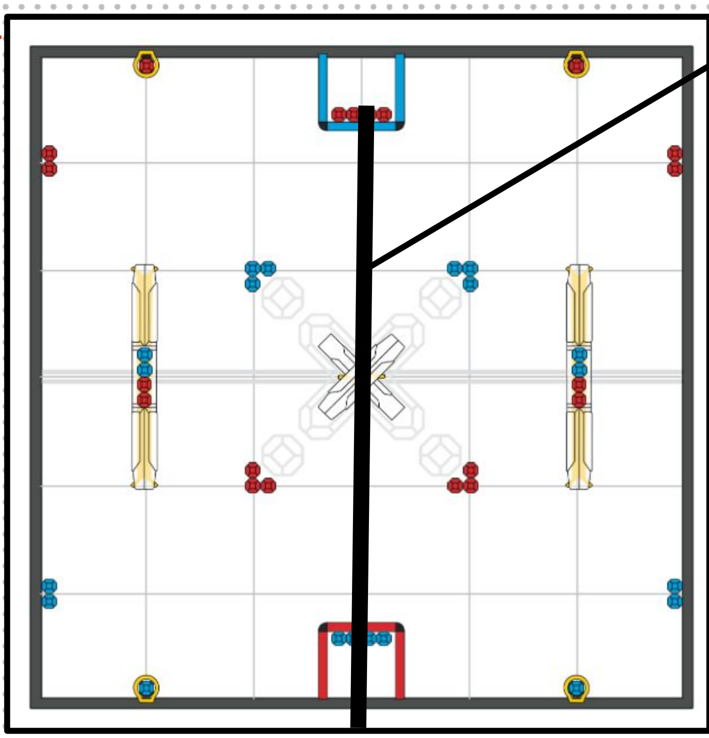




- *Autonomous Line-* A pair of white tape lines that run all along the field, and the spaces between the lines are <SG7>

This black line represents the Autonomous line.

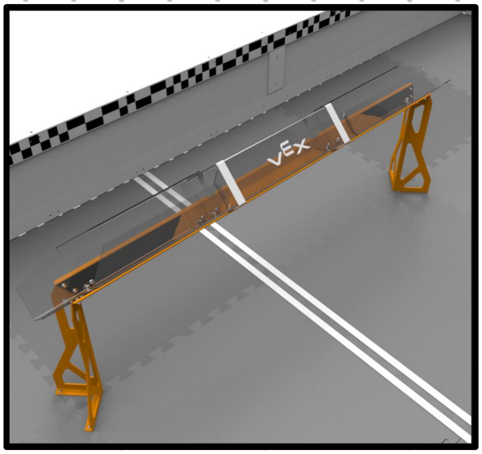
*(6)



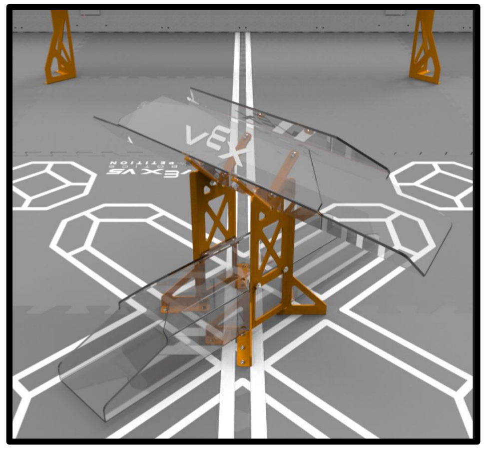
J.N.

*Each picture is hyperlinked into their selected game manual section.

*(8)



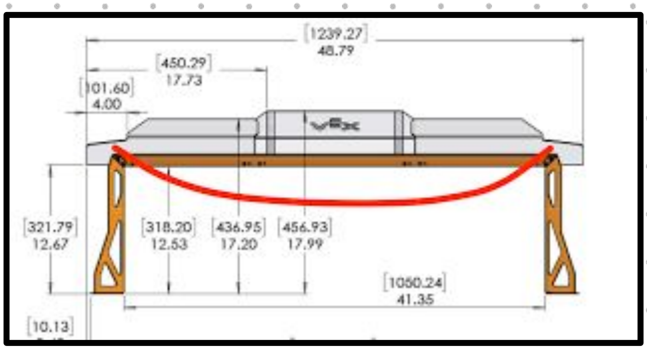
*(9)

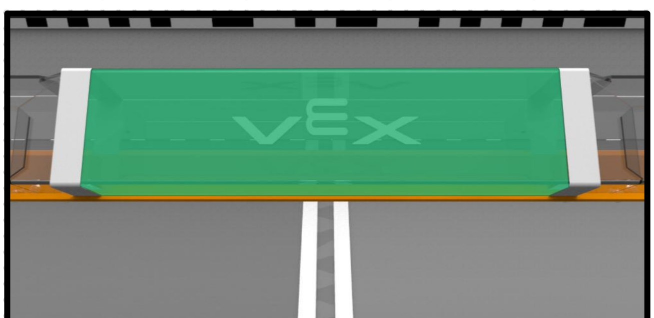


*(10)

- *Controlled*- A control zone status that is put at the end of autonomous period and also at the end of a match.<SC3>

- *Goal*- A goal is a field element that is made out of plastic and metal components. Each goal has a defined goal zone
  - Long goal:Each long goal is 48.8"(1239 mm)hold up 15 blocks.
  -Center goal,upper and lower:each goal is 22.6"(574mm) and each goal can old up to seven(7)blocks.





- *Central Zone*-Is a defined of the goal that can be controlled (used) by an alliance at the end of a match.

  -Long Goal: The control zone ofna long goal consists of the space between the white tape lines (highlighted in green, can also hold up to three (3) blocks.

  -Center Goal upper and lower: The control zone for a center goal includes the entire goal and hold up to seven (7) blocks.

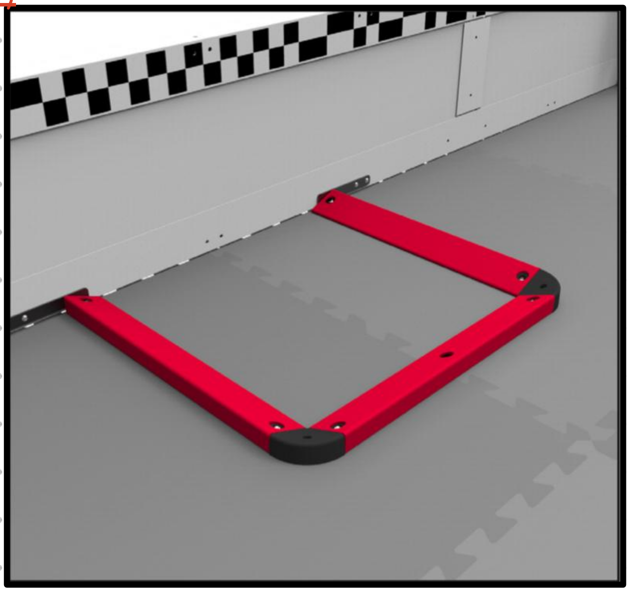
Section 2 -Game-specific Definitions cont.:

*Each picture is hyperlinked into their selected game manual section.

*(14)

- *Loader-* One of four 21.34"(542mm) tall plastic vertical rubber structure that is attached to the field perimeter.(holds up 6 blocks)

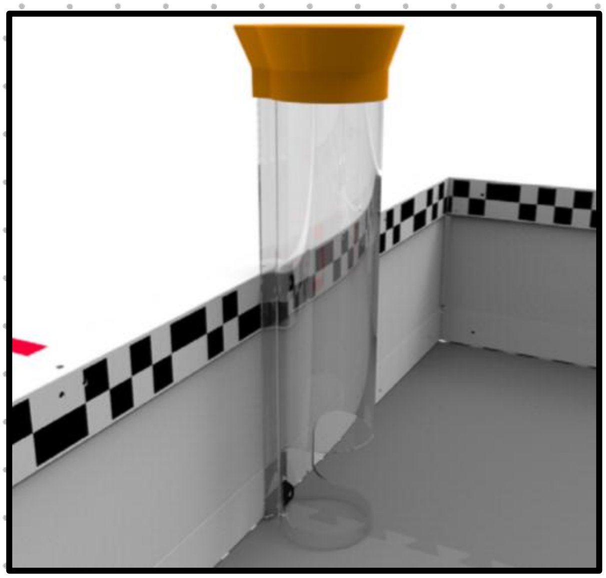
*(13)



J.N.

- Match Load-One of all 24 blocks,12 per alliance,that begin the match in the Llience selection and can be introduced in during a match<SG9>

- *Parked-* A robots status (location) at the end of a match <C4>
- *Parked Zone*- is a field element that marks the location where blocks start a match. Also used for robots to park at end of a *match-* parking zones are made of blue/or/red plastic each consisting of 18,87"(479mm) wide X 16,86"(428mm) deep.



*(12)

Team Conclusion;

Our Robot must be able to access the Match Loading Zones, and be capable of quickly cycling match loads from this tube.

I.E., our sizing must be strictly adapted to These match loads.

Our Robot Drivetrain must also be capable of climbing the parking zone barrier quickly, effectively, and reliably.

Section 2 -Scoring :

*(14)

<SC4> A robot is only considered parked if it meets criteria;

a. The robot is not in contact with floor outside of parking zone.
b. The robot is not in contact with any field elements.
c. The robot is at least partially parked within vertical projection.

<SC5> Scoring of the autonomous bonus will be evaluated immediately after the autonomous period ends.

a. Parked robots points excluded from autonomous bonus calculation.
b. Tie in autonomous period grant 5-point autonomous bonus to both alliances.
c. Violations in autonomous period award autonomous bonus to opposing alliances.
d. If both alliances commit violations <GG13> for resolutions.

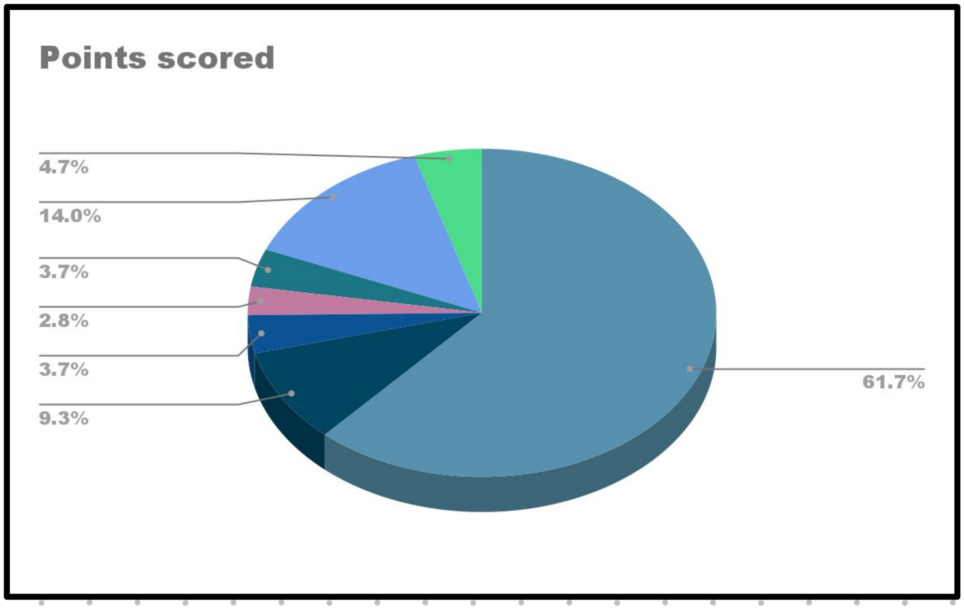
<SC6> Autonomous win points awarded if;

1.) 7+ blocks scored is Alliance color
2.) Blocks scored in 3+ different goals
3.) 3+ blocks of Alliance color removed
4.) No violations during autonomous period

Autonomous Bonus	10 Points
Each block scored	3 Points
Each control zone in long goal	10 Points
Controlled center goal- Upper	8 Points
Controlled center goal- Lower	6 Points
1 parked alliance robot	8 Points
2 parked alliance robot	30 Points

Point Breakdown - Match

TYPE	POINT VALUE	MAXIMUM POINTS
Block Scored	3	132
Long Goal Control Zone	10	20
Top Goal Control Zone	8	8
Bottom Goal Control Zone	6	6
Single Robot Park	8	8
Double Robot Park	30	30
Autonomous Bonus	10	10



*The color blocks next to the Type of scoring is a key showing which ways are the best for scoring points shown on the Pie chart.

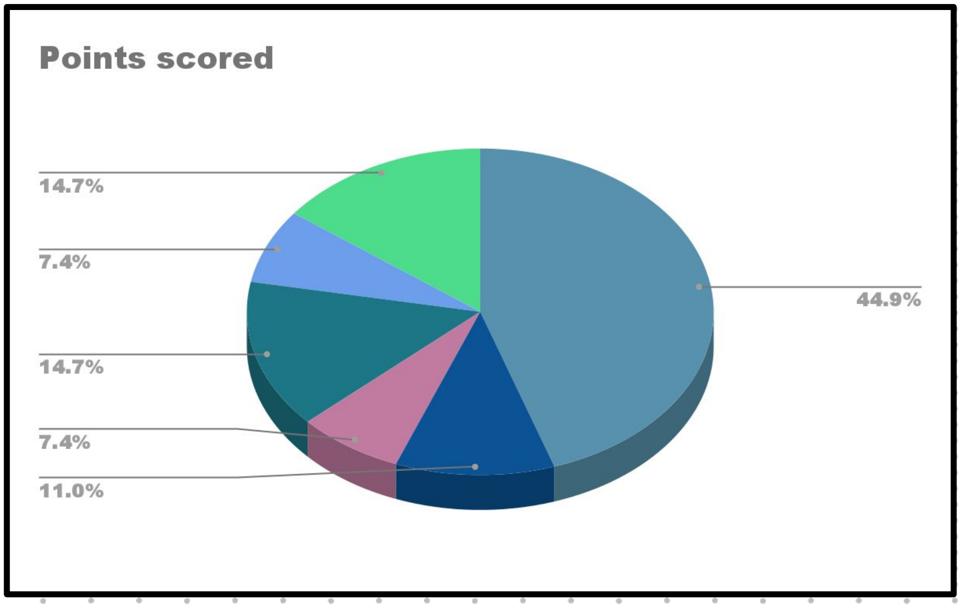
*The picture is hyperlinked into the linked Chart.

Conclusion

- Scoring blocks in goals is the most effective way to earn points.
- We believe scoring more blocks will be more impactful than focusing on control bonuses.
- Control bonuses may still offer a quick and easy way to gain points.
- Due to the value of blocks, teams will likely hoard opponents' blocks to reduce their scoring potential.
- Parking will likely be rare in matches, as the time spent parking could be used to score more blocks, which offers faster and more consistent points.

Point Breakdown - <u>Skills</u>

Type of Scoring	Point Value	Maximum Points
Block Scored in Goal	1	61
Parked Robot	15	15
Long Goal Control Bonus	5	10
Center Goal Control Bonus	10	20
Each Cleared Park Zone	5	10
Each Cleared Loader	5	20



*The color blocks next to the Type of scoring is a key showing which ways are the best for scoring points shown on the Pie chart.

*The picture is hyperlinked into the linked Chart.

Conclusion

- Scoring blocks in goals is the most effective way to earn points.
- We believe scoring more blocks will be more impactful than focusing on control bonuses.
- Control bonuses may still offer a quick and easy way to gain points.
- Parking will likely be rare in matches, as the time spent parking could be used to score more blocks, which offers faster and more consistent points.

August 2025

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4	5	6	7	8	9
10	11	12	13 First Day of School	14	15	16
17	18	19	20 ~First Team Practice 3:55-6:00 p.m.~	21 ~Robotics Practice 3:55-6:00 p.m.~	22	23
24	25 ~Robotics Practice 3:55-6:00 p.m.~	26 ~Robotics Practice 3:55-6:00 p.m.~	27 ~Robotics Practice 3:55-6:00 p.m.~	28 ~Robotics Practice 3:55-6:00 p.m.~	29	30 ~Robotics Practice 8am-12 pm
31						

- No Practice

-Intersession

-Extra curricular events

- Half day

- Holiday

- No school

- Tournament days

Name Jimena Nieblas

Week of: 08/17-23/2025

Monday

No Practice

Tuesday

No Practice

Wednesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Rules and Expectations + Finalize Team Roles

Thursday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time:3:30-6:00 p.m.

Goal: Introduce Team Member Roles + Unpack Materials, Organize, and begin field assembly.

Friday

No Practice

Saturday

No Practice

Sunday

No Practice

Week of: 08/24-31/2025

Monday
Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time:3:30-6:00 p.m.

Goal: Complete Field Assembly + Complete Materials Organization and Inventory Tracking

Tuesday
Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time:3:30-6:00 p.m.

Goal: Research Ideas and possible design solutions to the season challenge.

Wednesday
Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time:3:30-6:00 p.m.

Goal: Continue researching ideas and possible design solutions.

Thursday
Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time:3:30-6:00 p.m.

Goal: Begin narrowing down a Robot Vision, through sketches, inspiration, and team discussion

Friday
No Practice

Saturday
All team members present

Meeting time: 8am-12pm

Goal: Complete Brainstorming, begin Decision Matrix for individual Systems.

Sunday
No Practice

Step 2: Generate Concepts

Constraints &. Criteria

- Constraints- are the limits or rules our design must follow (such as size, power, or motor limits)
- Criteria- are the goals or features we want our robot to achieve, such as speed, torque or any special features.

Constraints:

- Robot must fit within a 18x18x18 size limit
- The total motor power cannot exceed 88W

Criteria Drivetrain:

- Must have a appropriate speed ratio
- Uses a combination of omni and standard wheels
- Limited to no more than 6 motors
- Screw joints
  -reduces friction

Criteria: Scoring

- Is able to score blocks in any of the goals
- Must score blocks into the control zone

Criteria: Intake

- Is able to collect multiple balls at once
- Must have and include a Speed ratio

J.N.

September 2025

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1 ~Team Practice 3:55-6:00 p.m.~	2 ~Team Practice 3:55-6:00 p.m.~	3 ~Team Practice 3:55-6:00 p.m.~	4 -Team Practice 3:55-6:00 p.m.~	5	6
7	8 ~Team Practice 3:55-6:00 p.m.~	9 ~Team Practice 3:55-6:00 p.m.~	10 -Team Practice 3:55-6:00 p.m.~	11 -Team Practice 3:55-6:00 p.m.~	12	13 ~Robotics Practice 8am-12 pm
14	15 ~Team Practice 3:55-6:00 p.m.~	16 ~Team Practice 3:55-6:00 p.m.~	17 ~Team Practice 3:55-6:00 p.m.~	18 ~Team Practice 3:55-6:00 p.m.~	19	20 ~Robotics Practice 8am-12 pm
21	22 ~Team Practice 3:55-6:00 p.m.~	23 ~Team Practice 3:55-6:00 p.m.~	24 ~Team Practice 3:55-6:00 p.m.~	25 ~Team Practice 3:55-6:00 p.m.~	26	27 Robotics Practice 8am-12 pm
28	29	30				

Breaks

-Intersession

-Extra curricular events

- Half Day
- Holiday
- No school
- Tournament days

Week of: 09/01-06/2025

Monday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Introduce Notebook/Documentation procedure, ensure proper procedure for edits, suggestions, etc. + Continue Design Matrix's

Tuesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Continue Design Matrix's + Begin assembly on Drivetrain Prototype in accordance with the completed Drivetrain Decision Matrix.

Wednesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Drivetrain Assembly

Thursday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Drivetrain Testing + Documentation

Friday

No Meeting

Saturday

No Meeting

Sunday

No Meeting

Week of: 09/07-13/2025

Monday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Conclude Drivetrain testing, begin Decision Matrix for Intake

Tuesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Acknowledge Testing Results, redesign accordingly.

Wednesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Begin Research and Design for new Drivetrain, alongside Decision Matrix for the Intake.

Thursday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Begin Decision Matrix for the new Drivetrain + Begin Assembly of intake according to the decision Matrix.

Friday

No Meeting

Saturday

All team member present

Meeting time: 8am-12pm

Goal: Reassemble the field with brand new Field Tiles, + Continue Intake Assembly

Sunday

No Meeting

Week of: 09/14-20/2025

Monday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Begin building Drivetrain in accordance with the Design Matrix.

Tuesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Continue Drivetrain assembly.

Wednesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Program the Drivetrain + Testing and Document Results

Thursday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Conclude Drivetrain Programming + Document Code

Friday

No Meeting

Saturday

All team members, ex. Aidan, present

Meeting time: 8am-12pm

Goal: Iron out bugs, attempt to program using VEXPro's in C++ for efficient 66W usage.

Sunday

No Meeting

Week of: 09/21-27/2025

Monday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Begin assembly of Intake Mechanism according to Decision Matrix.

Tuesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Continue intake Assembly

Wednesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Continue intake Assembly

Thursday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Continue intake Assembly

Friday

No Meeting

Saturday

No Meeting

Sunday

No Meeting

Drivebase Decision Matrix Criteria

Base Scale velocity, strafing,durability, agility, coding complexity, space

Velocity –

- **0** – Very slow or too fast , causes slipping or loss of control, making it hard to play defense or navigate.
- **1** – Moves at a steady pace; not the fastest but can reach key areas like loading and goal zones.
- **2** – Fast and controlled; easily maneuverable and efficient at reaching all necessary zones.

Strafing –

- **0** – No counter-strafing ability.
- **1** – Limited strafing; some sideways movement.
- **2** – No strafing, very consistently stable under perpendicular to axle pressure.

Durability –.

- **0** – Fragile; components easily break or detach under pressure.
- **1** – Reasonably durable; may show wear or minor failures under stress.
- **2** – Very strong and resilient; holds up well in repeated or high-impact scenarios.

J.N.

Drivebase Decision Matrix Criteria (cont.)

Agility –

- **0** – Turns slowly or requires large space to maneuver.
- **1** – Moderate agility; can handle most turns with some effort.
- **2** – Highly agile; can make tight turns and quick direction changes with ease.

Coding Complexity –

- **0** – Advanced; includes complex features like odometry, path planning, or autonomous routines.
- **1** – Somewhat complex; requires intermediate control logic.
- **2** – Simple; basic coding requires, likely to work very well with little errors.

Space –

- **0** – Very limited; not enough room for mechanisms or electronics.
- **1** – Adequate space; tight fit but manageable.
- **2** – Spacious and efficient layout; ample room for mechanisms, wiring, and maintenance access.

J.N.

Decision Matrix - Drivetrain.

1. 66W – 3.25" Drivetrain

- **Summary**: A high-power drivetrain with strong velocity and decent agility. However, it lacks coding simplicity and space efficiency,
- Strengths: Fast movement, good maneuverability, moderate torque
- Weaknesses: Complex code, limited internal space, complex programming

2. 44W – 3.25" Drivetrain

- **Summary**: Balanced performance across all categories. Offers strong durability, simple coding, and spacious layout, making it ideal for modular builds and reliable match play.
- Strengths: Durable, easy to code, spacious.
- Weaknesses: Significantly slower, and moderately weaker and less agile.

3. 66W – 2.75" Drivetrain

- **Summary**: Compact and agile with high speed, but suffers from low coding simplicity and limited space. Best suited for aggressive playstyles but harder to maintain.
- Strengths: Agile, fast, high torque, maximum acceleration.
- Weaknesses: Tight layout, complex programming.

Mechanism	Velocity	Strafing	Durability	Agility	Code. Complexity	Space	Total
66W - 3.25" DT	2	1	1	1	0	1	6
44W 3.25" DT	1	1	2	1	2	2	9
66W 2.75 DT	2	1	1	2	0	1	7

Team Conclusion:

We have selected to build a 44W 3.25" Drivetrain due to superior scores on the design matrix.

Step 3:
Build & Program

Drivetrain Assembly

To initiate development of our competition drivetrain, we will be rebuilding the proven four-motor drivetrain base used during the 2024–2025 High Stakes VEX Robotics World Championship. This base was selected for its reliability, coding simplicity, space efficiency, and durability.

Materials Used;

Structural Components

- 1x2x35 Aluminum C-Channel (4)
- 0.5" Standoffs (4)
- Custom Trimmed Polycarbonate (4)

Motion Components

- 3.25" Omni-Directional Wheel (6)
- 3.25" Traction Wheel (2)
- 60T Gear (6)
- 36T Gear (8)
- 12" Shaft (4)
- Star-Drive Shaft Collar (8)

Fasteners & Spacers

- 2.5" Screw (12)
- 0.125" Washer (28)
- 0.25" Spacer (12)
- #32 Rubber Band (8)

Electronics & Power

- 11W Motor (4)
- 200 RPM Cartridge (4)

Formulas

$$\text{Gear Ratio} = \frac{\text{Driven Gear Teeth}}{\text{Driving Gear Teeth}}$$

$$\text{Output RPM} = \frac{\text{Motor RPM}}{\text{Gear Ratio}}$$

$$\text{Speed} = \frac{\text{Wheel Diamet.} \times \text{Pi.} \times \text{RPM} \times 60}{12 \times 5280}$$

Specs (In accordance to the Math)

- Gear Ratio = 5/3
- Output RPM = 333.3... RPM
- Speed = 3.22 MPH

Drivetrain Assembly

Note: *This drivetrain is constructed in two symmetrical halves. The following steps detail the complete assembly of Halve 1. Halve 2 is built identically in reverse orientation.*

Step 1: Prepare the C-Channel

- Select a 1x2x35 aluminum C-channel as the structural base.
- Insert 2.5" screws at every interval where a 3.25" wheel will be mounted.
- Skip holes designated for motor placement.
- (Optional) Mark screw joint locations beforehand for precision. this build proceeds without pre-marking.

Step 2: Mount the 60T Gears

- Slide a 60T gear onto each odd-numbered screw joint.
- Do not use washers at this stage.

Step 3: Prepare Motor Mounts

- Install motor caps on the four even-numbered intervals using 0.5" screws.
- Attach bearing flats at these locations, leaving one hole open to allow shaft passage.
- Slide one 0.125" washer onto each even numbered screw joint to prevent metal-on-metal contact.

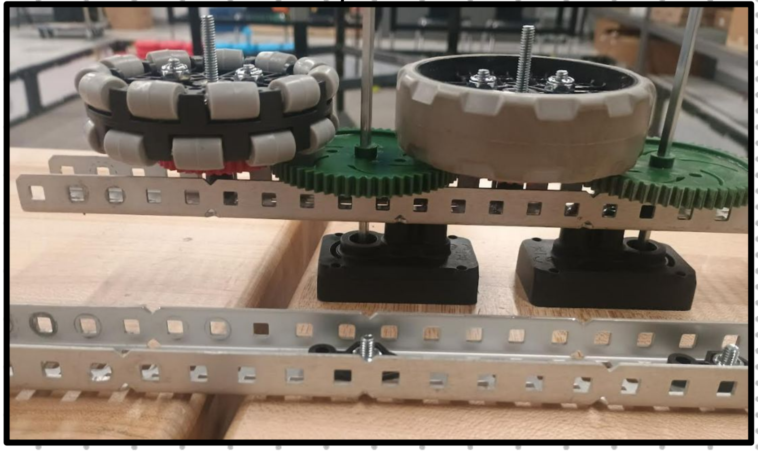
Step 4: Assemble Wheels

- Attach a 36T gear to each wheel using 0.5" screws and nylock nuts.
- Use square bore inserts for wheels aligned with motor shafts.
- Use round bore inserts for passive wheels.

Step 5: Install Wheels

- Slide each wheel-and-gear assembly onto the even-numbered shafts.
- Ensure that the 36T gears mesh cleanly with the previously mounted 60T gears.

Step 5 Product



Drivetrain Assembly (cont.)

Step 6: Add Spacers

- Slide three 0.25" spacers onto each shaft supporting a 60T gear.
- Slide one 0.25" spacer onto each wheel shaft.

Step 7: Engage Motor Shafts

- Insert square shafts into the motor cartridges.
- Confirm full engagement and proper alignment.

Step 8: Enclose the Assembly

- Position a second 1x2x35 C-channel over the entire assembly.
- Secure the structure by driving nylock nuts onto the exposed shaft ends using a power drill.
- Ensure the final structure forms a rigid “sandwich” configuration.

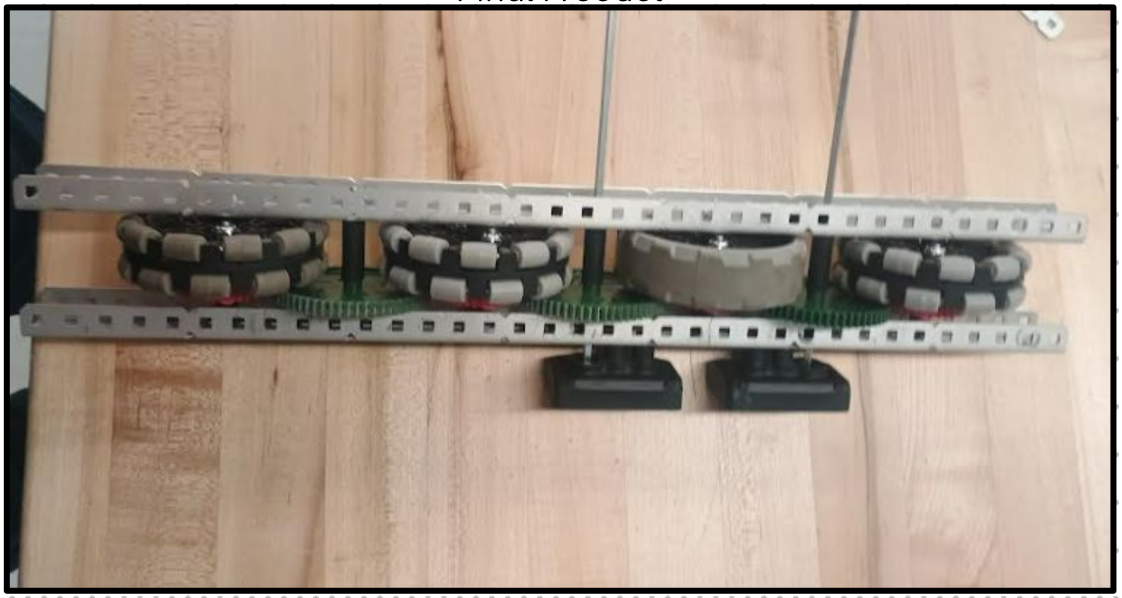
Step 9: Perform Quality Checks

- Rotate the drivetrain manually to check for friction or binding.
- Verify motor-to-gear mesh and ensure all shafts spin freely.

Step 10: Reinforce the Ends

- Mount custom-trimmed polycarbonate pieces at both ends of the assembly.
- Use 0.5" standoffs to reinforce the piece and enhance structural durability.

Final Product

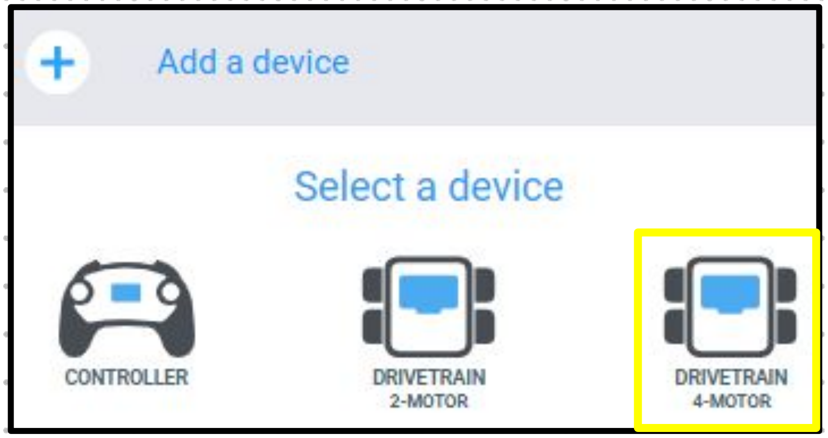


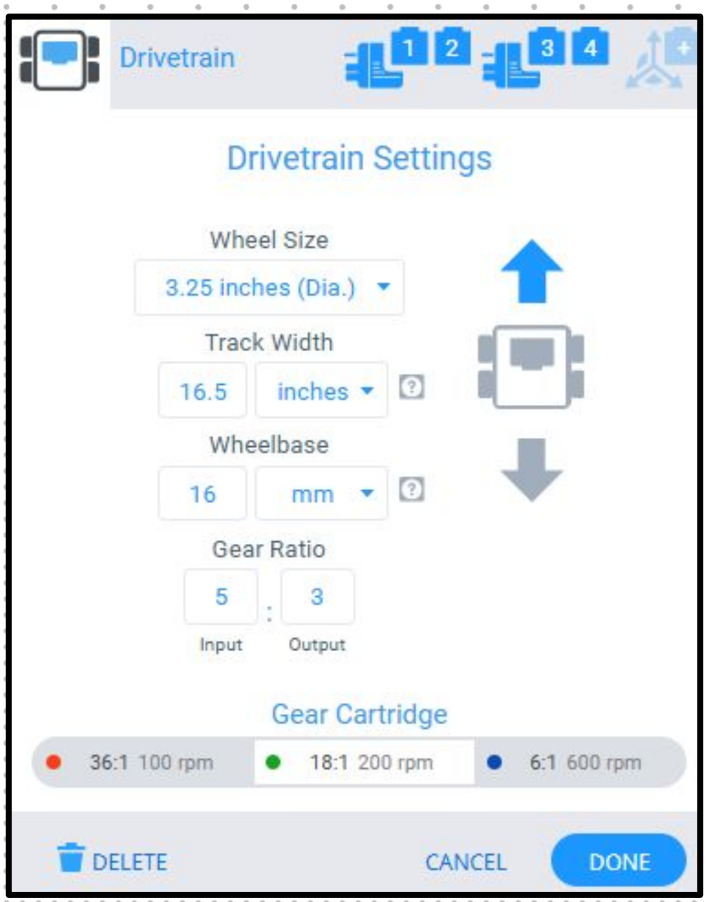
Drivetrain Programming

Our drivetrain code is built using VEXcode V5's 4-motor drivetrain template, which provides a foundational script for basic movement.

Additionally, we chose this template for its simplicity and reliability. It allows us to focus on autonomous programs and driver control logic without building a drivetrain class from scratch.

After entering the relevant information into the Drivetrain Settings menu, VEX generates a short script, However, to ensure proper directional control, we manually adjusted the motor group Configuration in the generated configuration code.





For our drivetrain to move in the proper orientation, we must set the "right Motor group" to have their reversal set to "true". Otherwise, our robot spins in circles.

```
// Robot configuration code.
motor leftMotorA = motor(PORT1, ratio18_1, false);
motor leftMotorB = motor(PORT2, ratio18_1, false);
motor_group LeftDriveSmart = motor_group(leftMotorA, leftMotorB);
motor rightMotorA = motor(PORT3, ratio18_1, true);
motor rightMotorB = motor(PORT4, ratio18_1, true);
motor_group RightDriveSmart = motor_group(rightMotorA, rightMotorB);
drivetrain Drivetrain = drivetrain(LeftDriveSmart, RightDriveSmart, 299.24, 419.09999999999997, 16, mm, 1.6666666666666667);
```

Project Drivetrain Programming

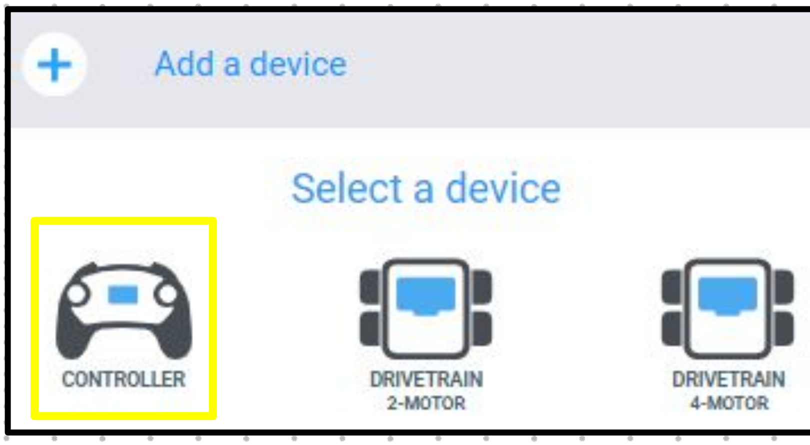
Name Marco Sanchez

Date 9/04/2025

Drivetrain Programming (Cont.)

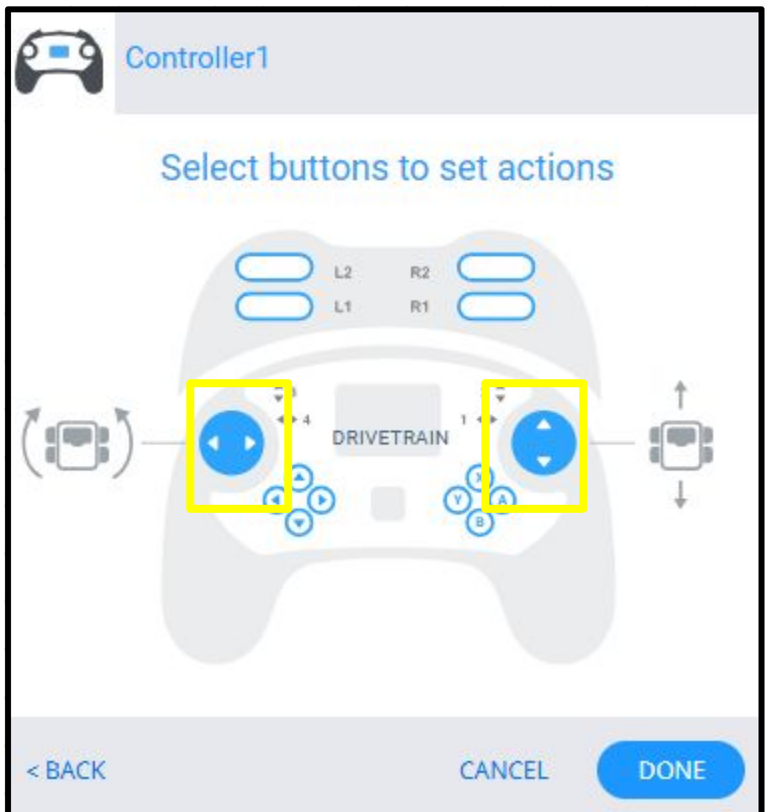
After completing our drivetrain code, we programmed it to respond to dual joystick input using VEXcode V5's built-in Joystick drivetrain control template.

This template auto-generates a script that maps joystick axis values to motor group speeds, enabling driver control.




```
int drivetrainLeftSideSpeed = Controller1.Axis2.position() + Controller1.Axis4.position();
int drivetrainRightSideSpeed = Controller1.Axis2.position() - Controller1.Axis4.position();
```

This program pulls the joystick values and maps them to motor speeds using a linear scaling function. This ensures proportional control. I.E., small joystick movements result in slow turns, while full joystick triggers maximum speed.




```
  }
  // wait before repeating the process
  wait(20, msec);
}
```

The program repeats the joystick position polling every 20 milliseconds.

Step 4:
Test Solution

Drivetrain Testing

Test 1: Durability Stress Test

Testing Method Used

- Robot was dropped vertically and horizontally from a height of 2 feet.
- Each orientation was tested twice, totaling four impact trials.
- Post-drop inspection focused on corners, gear mesh, and motor mounts.

Results:

- No visible bending, cracking..
- All screws, shafts, and polycarbonate reinforcements remained in place.

Conclusion: Passed. Drivetrain exhibits high durability under simulated match stress.

Test 2: Velocity Trials

Method Used:

- Robot was timed driving back and forth on the 12ft Pushback Field..
- Five trials were conducted to account for human error.
- Speed was calculated using the formula:

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} \times \frac{3600}{5280}$$

Results:

Trial	Time	Speed
1	~2.4	3.19 MPH
2	~2.5	3.18 MPH
3	~2.5	3.17 MPH
4	~2.6	3.17 MPH
5	~2.5	3.18 MPH

Conclusion:

- Average speed: **3.18 MPH**, slightly below the calculated speed of **3.22 MPH**.
- Marginal error attributed to stopwatch latency and human error.
- **Conclusion:** Passed. Velocity is consistent and within acceptable range..

Drivetrain Testing

Test 3: Strafing Resistance

Method:

- Robot was placed on a VEX foam tile.
- A clawbot applied perpendicular force to the robot until it moves 12" to simulate match stress.
- Intended to measure resistance using motor stress feedback, measured in watts, from the clawbot with visual confirmation of the Drivetrain strafing.

Result:

- Drivetrain failed to resist lateral movement.
- Traction wheels provided minimal counter-strafing support.
- Robot slid easily across the tile surface.
- **Conclusion:** Failed. Current wheel configuration lacks sufficient lateral resistance

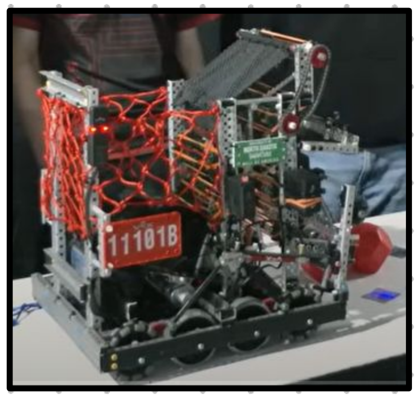
M.S.

Step 2:
Generate Concepts

Research Intake and Scoring Concepts.

- 1101B Barcots Getting There Basket Mech Robot

A high-capacity intake mechanism designed to hold a large number of blocks. Ideal for hoarding, but its slower cycling and tendency to jam make it less reliable during matches.



*(11)

Pros:

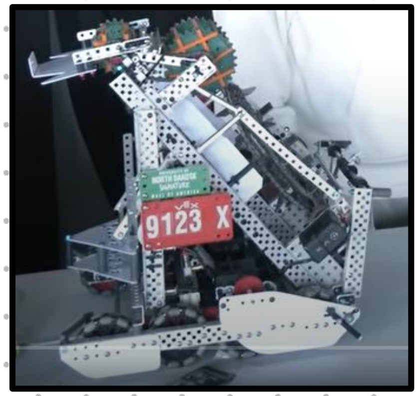
- Very high block capacity
- Suitable for long-duration possession strategies

Cons:

- Prone to jamming under pressure
- Slow block cycling reduces scoring efficiency

*Slant Mech Robot

An angled intake system optimized for quick alignment with goals and fast cycling. Best for rapid scoring, though it struggles with middle goal accuracy and has moderate capacity.



*(12)

Pros:

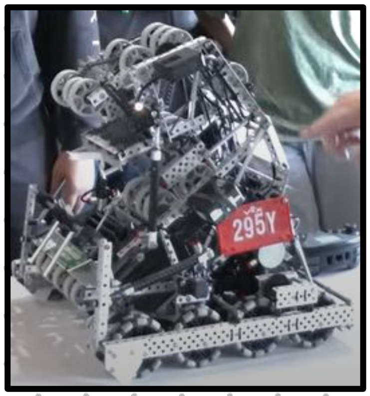
- Fast block cycling
- Quick goal alignment improves scoring speed

Cons:

- Moderate block capacity
- Middle goal scoring can misfire

*C-Mech Robot

A high-capacity intake with efficient cycling. Offers strong performance but consumes significant air and raises the robot's center of gravity.



*(13)

Pros:

- High block capacity
- Fast and smooth cycling

Cons:

- High pneumatic usage
- Elevated center of gravity may impact balance

Intake Decision Matrix Criteria

Goal Consistency

- **0** – Intake fails to align or deliver blocks consistently; frequent misfires or missed cycles.
- **1** – Intake can deliver blocks with moderate reliability; occasional misalignment or dropped blocks.
- **2** – Intake consistently delivers blocks in proper orientation and timing for scoring across all match scenarios.

Block Capacity

- **0** – Intake can only gather one block at a time; multi-block attempts result in jams or drops the block.
- **1** – Intake can collect multiple blocks, but is inconsistent or slow.
- **2** – Intake reliably gathers and retains multiple blocks without jamming or dropping blocks.

Driver Preferability

- **0** – Controls are unintuitive or laggy; driver struggles to operate intake effectively.
- **1** – Intake responds adequately to driver input; some delay or learning curve present.
- **2** – Intake is highly responsive and intuitive; enables fluid control and quick decision-making.

M.S.

Intake Decision Matrix Criteria (cont.)

Coding Complexity

- **0** – Requires advanced logic, sensor integration, or timing sequences to function properly.
- **1** – Needs moderate coding effort; includes basic automation or conditional logic.
- **2** – Operates with simple, reliable code; minimal debugging or advanced logic required.

Space Efficiency

- **0** – Intake occupies excessive space or interferes with other subsystems.
- **1** – Intake fits within the robot but requires compromises in layout or wiring.
- **2** – Intake integrates cleanly with other systems; leaves room for wiring, maintenance, and future upgrades.

M.S.

Project Intake Ranking System

Name Marco Sanchez

Date 09/09/2025

Decision Matrix Intake and Scoring Mech

1. Basket Mech

- Summary: High-capacity intake ideal for hoarding, but slower cycling and prone to jams.
- Strentghs: Excellent possession, simple motor layout.
- Weaknesses: prone to jamming, slow cycling.

2. Slant Mech

- Summary: Fast cycling and goal alignment, but moderate capacity and occasional misfires.
- Strengths: Dynamic speed ratio, optimized motor use.
- Weaknesses: Inconsistent middle goal scoring.

3 .C-Mech

- Summary: Balanced performance with smooth cycling and strong possession, but high pneumatic usage.
- Strengths: Reliable intake, fast cycling.
- Weaknesses: Elevated center of gravity, high air tank usage.

Mechanism	Goal Consistency	Block Capacity	Driver Preferability	Code Complexity	Space	Total
Basket Mech	1	2	1	2	1	7
Slant Mech	2	1	2	1	2	8
C-Mech	2	1	1	2	0	6

Team Conclusion:

We selected the Slant Mech for scoring due to its scoring ability and consistent goal alignment and quick cycling.

Step 2:
Generate Concepts

Drivetrain Redesign Decision Matrix

After analyzing drivetrain testing results, particularly the failure in strafing resistance, we initiated a full redesign of our drivetrain. Below is an updated decision matrix, that will influence our drivetrain rebuild, reflecting the testing results.

Mechanism	Velocity	Strafing	Durability	Agility	Code. Complexity	Space	Total
66W - 3.25" DT	2	1	1	1	0	1	6
44W 3.25" DT	1	1	2	1	2	2	9
66W 2.75 DT	2	1	1	2	0	1	7

We revised the Decision Matrix to reflect updated criteria scores. The 44W drivetrain was downgraded to a score of '0' in the strafing category due to its inability to resist lateral force. And both 66W drivetrains were upgraded to a score of '2' for Strafing, as their configurations allow for 'dropped' traction wheels that significantly enhance resistance against strafing.

Mechanism	Velocity	Strafing	Durability	Agility	Code. Complexity	Space	Total
66W - 3.25" DT	2	1	1	1	0	1	6
44W 3.25" DT	1	0	2	1	2	2	8
66W 2.75 DT	2	2	1	2	0	1	9

Step 3:
Build & Program

Drivetrain II Assembly

NOTE: To develop our redesigned drivetrain, we constructed a 66W base utilizing 450 RPM cartridges on 2.75" wheels with a "dropped-traction configuration".

This design, inspired by *2654E Echo's High Stakes Winter Robot, was selected for its enhanced strafing resistance, improved speed, and proven durability in competitive play. By adopting this configuration, we aim to a
address the lateral stability shortcomings identified in our previous drivetrain.

Additionally, we also used custom "half-cut" gears in this design, inspired by 229V *Ace's High Stakes Worlds Robot.

Materials Used;

Structural Components

- 1x2x35 Aluminum C-Channel (4)
- 1" Aluminium Angle (L) (4)
- Custom Trimmed Polycarbonate (4
  0.25" Standoff (4)
  4 Hole Long - Trimmed C-Channel (4)

Motion Components

- 2.75" Omni-Directional Wheel (6)
- 2.75" Traction Wheel (2)
- 48T Gear (8)
- 36T Gear (8)
- 12" Shaft (6)
- Star-Drive Shaft Collar (10)
- Brass-Round Bore Inserts

Fasteners & Spacers

- 2.5" Screw (12)
- 0.125" Washer (28)
- 0.25" Spacer (10)
- #32 Rubber Band (12)

Electronics & Power

- 11W Motor (6)
- 600 RPM Cartridge (6)

Formulas

Gear Ratio = $\frac{\text{Driven Gear Teeth/}}{\text{Driving Gear Teeth}}$

Output RPM = $\frac{\text{Motor RPM/}}{\text{Gear Ratio}}$

Speed = $\frac{\text{Wheel Diameter. X Pi. X RPM X 60}}{\text{12 X 5280}}$

Specs (In accordance to the Math)

- Gear Ratio = 4:3
- Output RPM = 450 RPM
- Speed = 3.68 MPH

Drivetrain II Assembly - Steps

Note: *This drivetrain is constructed in two symmetrical halves. The following steps are the assembly of Halve 1. Halve 2 is built identically in reverse orientation.*

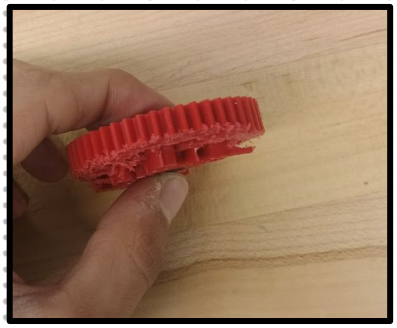
Unlike the previous drivetrain, which centered all screws within holes, this design intentionally exploits VEX tolerances by misaligning the traction wheel screw downward to create a "dropped-traction" wheel.

Step 1: Prepare the C-Channel

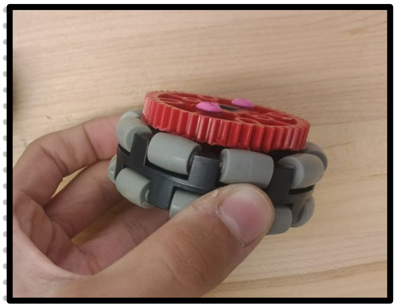
- Select a 1x2x35 aluminum C-channel as the structural base.
- Install the trimmed C-channel along the top lip of the 1x2x35 C-channel, securing it with 0.25" standoffs.
- Insert 2.5" screws at every interval where a 2.75" wheel will be mounted.
- Pay special attention to the traction wheel location: using existing VEX tolerances, purposefully misalign this screw toward the bottom of the VEX hole to achieve the dropped-traction effect.
- Install your motor caps.

Step 2: Wheels and Gears

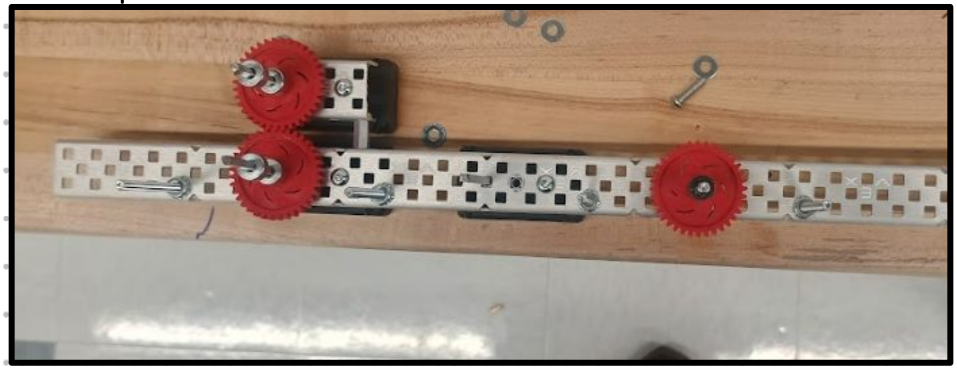
- Take a 48 Tooth Gear and cut it in half only about halfway deep. This is to ensure the gear will fit inside the wheel and allow it to be 3 holes wide.
- Take the custom half-cut 48T gears and attach each one to a 2.75" wheel using 1" screws. Ensuring the gear's inner portion fits inside the wheel as designed.
- Slide a 36T gear aligned with each motor shaft position.
- Insert round bore inserts into the Gear and Wheel assemblies, then slide them down your screw-joint shafts.



Step 2: Gears & Wheels



Step 1 Product



Drivetrain II Assembly - Steps

Step 4: Spacing and Alignment

- Slide three 0.25" spacers on top of the screw joint supporting a 36T gear.
- Slide two star-drive shaft collars down each 36 Tooth Gear Motor Shaft.
- Secure shafts in place using star-drive shaft collars where necessary.
- Slide 3, 0.125" Washers down each Wheel Screw-Joint.

Step 5: Enclose the Assembly

- Position the second 1x2x35 aluminum C-channel with a trimmed C-channel attached via 0.25" standoffs over the assembly, creating a sandwich structure.
- Secure with nylock nuts tightened evenly to maintain rigidity without warping.

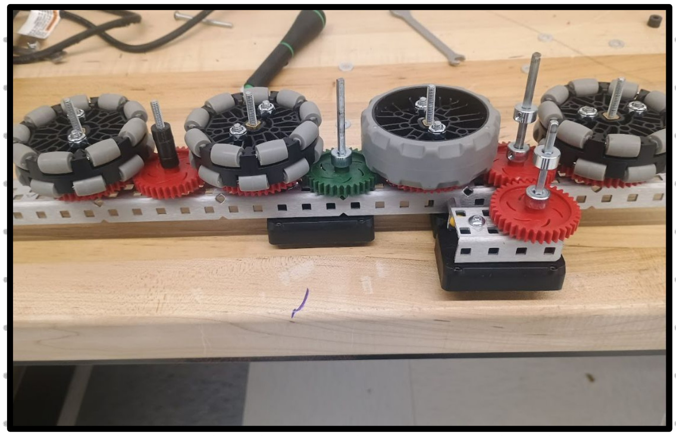
Step 6: Reinforce Structural Corners

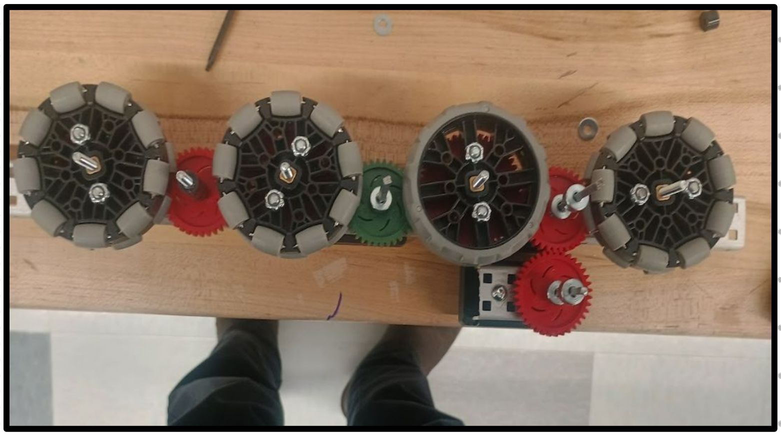
- Attach 1" aluminum L-angles (angles) at each corner of the assembly for additional structural support.

Step 7: Final Quality Checks

- Manually rotate the drivetrain to ensure there is no friction, binding, or misalignment.
- Verify all gears mesh smoothly and shafts spin freely without excessive play.
- Confirm that the dropped-traction wheel maintains intended alignment and proper contact with the ground.

Step 4 Product





October 2025

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1 No Team Practice	2 No Team Practice	3	4 Robotics sleepover 2pm-
5 Robotics sleepover -8am	6 ~Team Practice 3:55-6:00 p.m.~	7 ~Team Practice 3:55-6:00 p.m.~	8 ~Team Practice 3:55-6:00 p.m.~	9 No Team Practice	10	11 No Team Practice
12	13	14 No Team Practice	15 No Team Practice	16 No Team Practice	17	18 Robotics Practice 8am-12 pm
19	20 Team Practice 3:55-6:00 p.m.~	21 Team Practice 3:55-6:00 p.m.~	22 Team Practice 3:55-6:00 p.m.~	23 No Team Practice	24	25 No Team Practice
26	27 Team Practice 3:55-6:00 p.m.~	28 Team Practice 3:55-6:00 p.m.~	29 No Team Practice	30 No Team Practice	31	Robotics sleepover 2pm-

Breaks

-Intersession

-Extra curricular events

- Half Day

- Holiday

- No school

- Tournament days

Week of: 10/05-11/2025

Monday

Present Team Members: Marco S, Marc M, Robert F, Jimena N **Absent Team members: Aidan M**

Meeting time: 3:30-6:00 p.m.

Goal: Document Drivetrain II Programming, Test the Drivetrain, Team Building Exercises

Tuesday

Present Team Members: XX**Absent Team members: XXXX**

Meeting time:XX

Goal: Drivetrain II Test Documentation, Assemble Intake Prototype

Wednesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Continue intake assembly

Thursday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Continue intake assembly

Friday

No Meeting

Saturday

Robotics sleepover 2pm-

Sunday

Robotics Sleepover -8 am

Week of: 10/12-18/2025

Monday

No Meeting

Tuesday

No Meeting

Wednesday

No Meeting

Thursday

No Meeting

Friday

No Meeting

Saturday

All team members present

Meeting time: 8am-12pm

Goal: Finalize Intake Design, and mount it to the Drivetrain - Design Testing Solutions

Sunday

No Meeting

Week of: 10/19-25/2025

Monday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Document Intake Assembly

Tuesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Intake Testing

Wednesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Intake Testing

Thursday

No Meeting

Friday

No Meeting

Saturday

No Meeting

Sunday

No Meeting

Week of: 10/26-31/2025

Monday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal:Intake Test Documentation

Tuesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Scrimmage with Sister Teams

Wednesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Organization and Inventory Management of news party delivery.

Thursday

No Meeting

Friday

No Meeting

Saturday

No Meeting

Sunday

No Meeting

Drivetrain II Programming

To support our redesigned drivetrain, we expanded our pre-existing drivetrain script to accommodate two additional motors, bringing the total to six. This required updating motor group definitions to now include two additional ones.

Since our drivetrain now utilizes blue-cartridge motors, which operate at 600 RPM before gearing we updated that in the code, the "ratio" is now 6:1.

For our drivetrain to move in the proper orientation, we must set the motors that in line with each other to be reversed, and the stacked motor to not be. This is so that the motors work together.

```
// Drive motors
motor leftMotorA = motor(PORT19, ratio6_1, true);
motor leftMotorB = motor(PORT20, ratio6_1, false);
motor leftMotorC = motor(PORT9, ratio6_1, true);
motor_group LeftDriveSmart = motor_group(leftMotorA, leftMotorB, leftMotorC);

motor rightMotorA = motor(PORT11, ratio6_1, true);
motor rightMotorB = motor(PORT12, ratio6_1, false);
motor rightMotorC = motor(PORT1, ratio6_1, false);
motor_group RightDriveSmart = motor_group(rightMotorA, rightMotorB, rightMotorC);

drivetrain Drivetrain = drivetrain(LeftDriveSmart, RightDriveSmart, 219.44,
                                   11.938, 330.2, mm, 1.3333);
```

M.S

Step 4:
Test Solution

Drivetrain II Testing

Test 1: Durability Stress Test

Testing Method Used

- Robot was dropped vertically and horizontally from a height of 2 feet.
- Each orientation was tested twice, totaling four impact trials.
- Post-drop inspection focused on corners, gear mesh, and motor mounts.

Results:

- No visible bending, cracking..
- All screws, shafts, and polycarbonate reinforcements remained in place.

Conclusion: Passed. Drivetrain exhibits high durability under simulated match stress.

Test 2: Velocity Trials

Method Used:

- Robot was timed driving back and forth on the 12ft Pushback Field..
- Five trials were conducted to account for human error.
- Speed was calculated using the formula:

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} \times \frac{3600}{5280}$$

Results:

Trial	Time	Speed
1	~2.3	3.63MPH
2	~2.2	3.68 MPH
3	~2.2	3.68 MPH
4	~2.2	3.69 MPH
5	~2.24	3.68 MPH

Conclusion:

- Average speed: **3.675 MPH**, almost exactly our calculated speed of **3.68 MPH**.
- Marginal error attributed to stopwatch latency and human error.
- **Conclusion:** Passed. Velocity is consistent and surpasses expectations..

Drivetrain II Testing

Test 3: Strafing Resistance

Method:

- Robot was placed on a VEX foam tile.
- A clawbot applied perpendicular force to the robot until it moves 12" to simulate match stress.
- Intended to measure resistance using motor stress feedback, measured in watts, from the clawbot with visual confirmation of the Drivetrain strafing.

Results;

Trial	Clawbot Wattage
1	6.5W
2	6.4W
3	6.5W
4	6.5W
5	6.5W
6	6.5W

Result:

- Drivetrain provides acceptable amounts of counter-strafing.
- Traction successfully create high contact with the field tile.
- Robot required an acceptable amount of force to move perpendicular to it's wheels.
- Results were consistent, averaging at 6.5W.
- **Conclusion:** Passed. Current wheel configuration provides sufficient lateral resistance.

Step 3:
Build & Program

Intake Structural Assembly Steps - Prototype 1.0

Note: The following assembly steps provide a streamlined representation of the prototype build. Throughout assembly, minor modifications were made in response to informal testing. These iterative changes were not individually recorded, to prioritize rapid prototyping. The steps below reflect the idealized assembly sequence that would have been followed had the design been finalized from the outset.

Materials Used;

Structural Components

- 5-Wide Full-Length C-Channels (x2)
- 2-Wide Full-Length L-Channels (x2)
- 3-Wide Trimmed L-Channel (x1)
- 1-Wide Trimmed L-Channels (x2)
- 3-Wide C-Channel (X4
- 3-Wide Trimmed C-Channel (X1)

Motion Components

- 48T Sprockets (x6)
- Flex Wheels: 3.25" (x6), 2.00" (x5)
- VEX High Strength Chain (Est. 36")

Fasteners and Spacers

- 0.325" Screws (est. x26)
- 1.5" Screws (x8)
- Thin Nylock Nuts (est. x26)
- Assorted Spacers (0.25", 0.75", 1")
- Brass Circular Inserts (x8)
- Square Inserts (x4)
- Bearing Flats (X4)
- Shaft Collars (x2)
- Keps Nuts (x8)

Rollers

- #64 Rubber Bands (x15)
- 12" Vex Low Strength Shaft (X2)

Pneumatics

- 50mm Pneumatic Piston (x1)
- Pneumatic Tubing (1 spool)
- Pneumatic Tank (x1)
- Straight Fittings (x4)

Electronics

- 600 RPM Motor (x1)
- 5.5W Motors (x2)
- Solenoid (x1)

Formulas

Gear Ratio = <u>Driven Gear Teeth</u>/ Driving Gear Teeth

Output RPM = <u>Motor RPM/</u> Gear Ratio

Intake Speed = $\dfrac{\text{Wheel Diameter} \times \text{Pi} \times \text{RPM} \times 60}{12 \times 5280}$

Specs (In accordance to the Math)

- Gear Ratio = 1:1
- Output RPM =
  Stage 1: 200 RPM
  Stage 2: 600 RPM
  Stage 3: 200 RPM
- Speed =
  Stage 1: 1.25 MPH
  Stage 2: 6 MPH
  Stage 3: 2.75 MPH

Intake Structural Assembly - Prototype 1.0

Note: Our team performs all metal trimming using a saw under direct mentor supervision and while wearing proper PPE. However, for this particular build, the C-Channel was trimmed using a Dremel tool by our mentor after we finalized the design requirements.

Step 1: Skeleton Frame Installation

- Select two 3-Wide Standard C-Channels and mount them vertically (upright orientation) approximately 3 inches from the rear-most edge of the drivetrain chassis or four VEX holes inward.
- Secure each vertical C-Channel using two 0.325" screws and nylock nuts.
- At the top-most center hole of each vertical C-Channel, install a full-length C-Channel using a single 0.325" screw to create a pivot joint.
- Rotate the full-length C-Channel forward and secure its opposite end to the front-most edge of the drivetrain, forming a sloped intake skeleton.
- Repeat this process symmetrically for both sides.

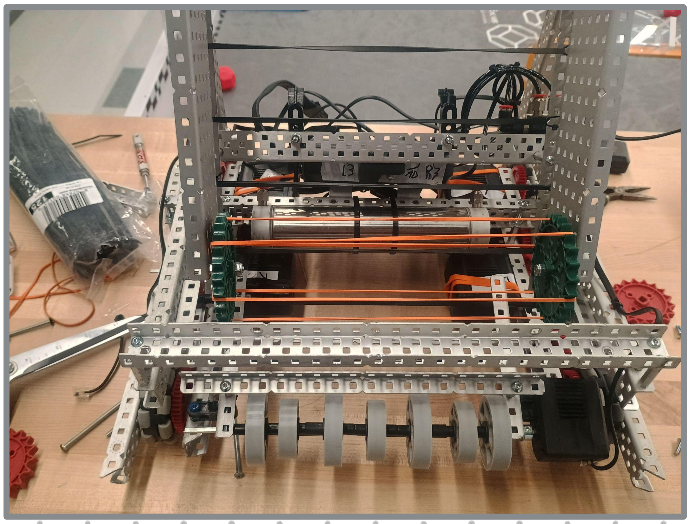
Step 2: Intake Roller Mounting

- Trim two 1-Wide L-Channels to a length of 4".
- Install bearing flats at each end of the L-Channels to support a roller shaft.
- Determine appropriate spacing manually to accommodate a balanced configuration of flex wheels on the shaft.
- Insert the shaft through the bearing flats and mount the L-Channels to the sloped C-Channels using 0.325" screws and screw joints.
- Repeat for both sides to complete the roller subassembly.

Step 2.1: Motor Integration

- Mount a 5.5W motor to the right-side L-Channel using two 1.5" screws.
- Insert the roller shaft into the motor's output socket and secure with a shaft collar to prevent axial displacement.

Step 2:
Result



Intake Structural Assembly Steps - Prototype 1.0

Step 3: Roller Gear Assembly

- Attach two 5-Wide C-Channels horizontally to the outer face of the 3-Wide C-Channels, with the open “C” orientation facing outward.
- Secure each with two 0.325" screws and nylock nuts.
- Along each 5-Wide C-Channel, install six 1.5" screws spaced every eight holes using Keps nuts—these will serve as mounting points for the 48T gear rollers.
- Mount six 48T gears with circular inserts onto the screw joints and secure with nylock nuts, ensuring low-friction rotation.
- Loop five #64 rubber bands between each gear and its opposite-side partner to create elastic rollers.
- Connect all gears using high-strength chain and route the chain to a 600 RPM motor via a shaft interface.

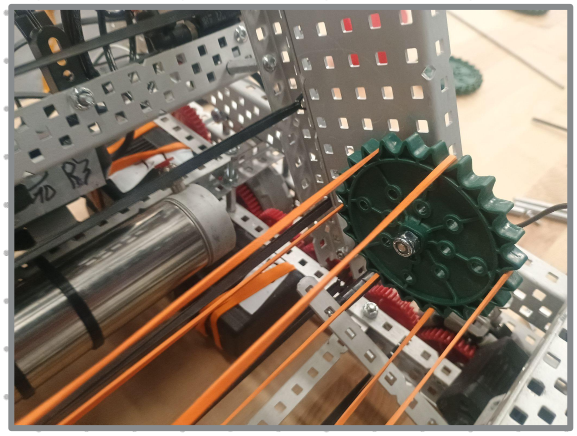
Step 4: Top Roller Assembly

- At the top of the sloped intake frame, install a 5.5W motor using two 1.5" screws.
- Insert a shaft through two bearing flats and into the motor’s output socket.
- Mount four flex wheels onto the shaft two 3.25" and two 2.00" in alternating configuration.
- Secure the shaft with collars and verify smooth rotation.

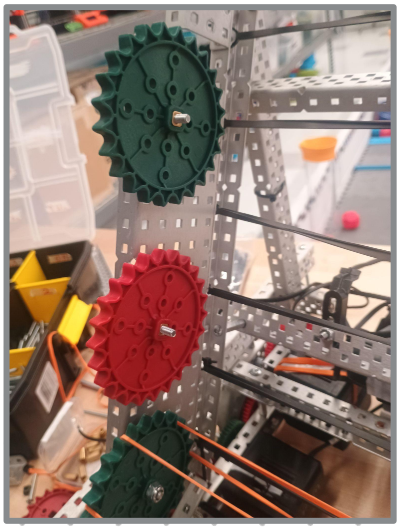
Step 5: Elastic Tensioning and Structural Reinforcement

- Install rubber bands along the sloped intake frame at intervals of three holes using zip-ties.
- Begin from the bottom edge and terminate approximately 3 inches below the top roller assembly.
- To counteract the added tension, install a trimmed C-Channel at the base and two 3-Wide L-Channels at mid-height, directly connecting the two 5-Wide C-Channels.
- These reinforcements should apply outward force to maintain structural integrity under elastic load.

Step 5: Result



Step 3: Result



Intake Structural Assembly Steps - Prototype 1.0

Step 5: Elastic Tensioning and Structural Reinforcement

- Install rubber bands along the sloped intake frame at intervals of three holes using zip-ties.
- Begin from the bottom edge and terminate approximately 3 inches below the top roller assembly.
- To counteract the added tension, install a trimmed C-Channel at the base and two 3-Wide L-Channels at mid-height, directly connecting the two 5-Wide C-Channels.

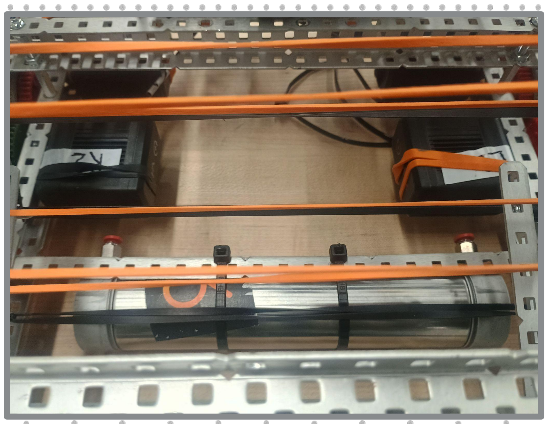
These reinforcements should apply outward force to maintain structural integrity under elastic load.

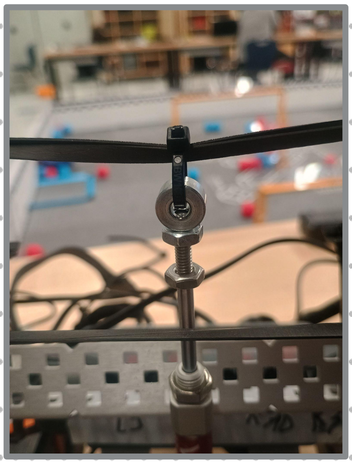
Step 5.1: Block Hoarding Barrier

- Install a trimmed 3-Wide L-Channel horizontally just below the top roller or above the rubber band rollers.
- This barrier prevents premature block ejection and supports hoarding functionality.

Step 6: Pneumatic Actuation

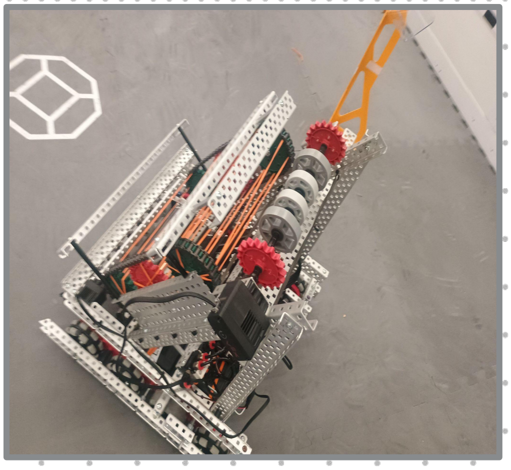
- Mount a 50mm pneumatic piston to the L-Channel supporting the VEX Brain.
- At the piston's output shaft, attach an empty shaft collar and thread a zip-tie through its center hole.
- Loop the zip-tie through the nearest rubber band to enable actuation-based tension release.
- Complete the pneumatic system by installing all required fittings, tubing, and the pneumatic tank.





Step 6: Result

Final Result



Intake - Programming

```
// Extra motors
motor IntakeStage3(PORT15, ratio18_1, false);
motor IntakeStage1(PORT17, ratio18_1, false);
motor IntakeStage2(PORT14, ratio18_1, false);

// Pneumatic piston
digital_out MiddleGoal(Brain.ThreeWirePort.A);
```

This script allows our future code to know what the motors and solenoids are, and where they are connected.

```
// Control IntakeStage3 with L1 and L2
if (Controller1.ButtonL1.pressing()) {
  IntakeStage3.spin(forward);
} else if (Controller1.ButtonL2.pressing()) {
  IntakeStage3.spin(reverse);
} else {
  IntakeStage3.stop(coast);
}

// Control IntakeStage1 and IntakeStage2 with R1 and R2
if (Controller1.ButtonR1.pressing()) {
  IntakeStage1.spin(reverse);
  IntakeStage2.spin(forward);
} else if (Controller1.ButtonR2.pressing()) {
  IntakeStage1.spin(forward);
  IntakeStage2.spin(reverse);
} else {
  IntakeStage1.stop(coast);
  IntakeStage2.stop(coast);
}
```

This script allows us to send commands to motors, now organized by intake stage level, to move.

```
while (true) {
  // Set intake motor velocity and torque
  IntakeStage3.setVelocity(100, percent);
  IntakeStage2.setVelocity(100, percent);
  IntakeStage1.setVelocity(100, percent);
  IntakeStage3.setMaxTorque(100, percent);
  IntakeStage2.setMaxTorque(100, percent);
  IntakeStage1.setMaxTorque(100, percent);
```

This script ensures our motors are always operating at maximum power.

```
// Pneumatic piston control with ButtonX and ButtonA
if (Controller1.ButtonX.pressing()) {
  MiddleGoal.set(true);  // Extend piston
} else if (Controller1.ButtonA.pressing()) {
  MiddleGoal.set(false); // Retract piston
}
```

This script allows us to send commands to our solenoid (Our Piston).

Step 4:
Test Solution

Intake Testing

Test 1: Cycle Speed

Testing Method Used

- Place 5 blocks evenly on the field and start the robot from a fixed location.
- Time how long it takes to intake all blocks using a stopwatch.
- Repeat 5 trials and calculate average cycle time.

Results:

Trial	Time (Seconds)
1	17.7
2	16.9
3	16.8
4	18
5	17.5

Conclusion: Passed. Intake exhibits reasonable consistency and never jammed.

Test 2: Friction

Method Used:

- Run intake motors without any blocks or external load.
- Record wattage draw over a 10-second interval via VEX Brain.
- Repeat 3 times.

Results:

Trial	Watts
1	5.5
2	5.5
3	5.5

Conclusion:

- Average friction: 5.5W
- Marginal jumping from 5.49-5.51.
- **Conclusion:** Passed. Friction is consistent and within tolerable levels.

Intake Testing (cont.)

Test 3: Scoring Accuracy

Method:

- Intake and score 5 blocks into the long goals from a fixed position.
- Count how many blocks land correctly in the scoring zone and how long it takes.
- Repeat 5 trials and calculate success rate.

Results;

Trial	Score Rate (% of 5)	Time Taken (Seconds)
1	100%	22
2	80%	28
3	100%	20
4	100%	19
5	100%	20

Result:

- Intake had a 96% Score Rate overall.
- Time taken was reasonable and consistent with prior testing, only increase by aligning with the goal.
- Results were within tolerable consistency limits, with only one trial straying from the norm.
- **Conclusion:** Passed. Intake exhibits reasonable accuracy.

November 2025

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1 Robotics Practice 8am-12 pm
2	3 ~Team Practice 3:55-6:00 p.m.~	4 ~Team Practice 3:55-6:00 p.m.~	5 ~Team Practice 3:55-6:00 p.m.~	6 No Team Practice	7	8 No Team Practice
9	10 No Team Practice	11 No Team Practice	12 No Team Practice	13 ~Team Practice 3:29-7:00 p.m.~	14 Robofeast Frenzy - Competition	15 No Team Practice
16	17 Team Practice 3:55-6:00 p.m.~	18 Team Practice 3:55-6:00 p.m.~	19 No Team Practice	20 No Team Practice	21	22 No Team Practice
23	24	25	26	27	28	29 No Team Practice
30						

Breaks

-Intersession

-Extra curricular events

- Half Day

- Holiday

- No school

- Tournament days

Week of: 11/01-08/2025

Monday

Present Team Members: Marco S, Marc M, Robert F, Jimena N **Absent Team members: Aidan M**

Meeting time: 3:30-6:00 p.m.

Goal: Research Matchload Intake and Descore Mech Concepts - Team Discussion & Decision Matrix

Tuesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Document Matchload Intake Concepts, Matrix, and Scrimmage with Sister team - 44585B begin assembly of Match Loader and Descore Mech.

Wednesday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-6:00 p.m.

Goal: Complete Match Loader and Descore Mech Assembly, Documentation of Build Steps + Testing.

Thursday

No Meeting

Friday

No Meeting

Saturday

No Meeting

Sunday

No Meeting

Week of: 11/09-16/2025 | (Interim Testing)

Monday

No Meeting

Tuesday

No Meeting

Wednesday

No Meeting

Thursday

Present Team Members: Marco S, Marc M, Robert F, Aidan M, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-7:00 p.m.

Goal: Research, Program, and Document a simple Autonomous routine for Skills and Match. Organize "Pit" Parts Package for Competition.

Friday

Robofeast Frenzy - Competition

Saturday

No Meeting

Sunday

No Meeting

Week of: 11/17-24/2025

Monday

Present Team Members: Marco S, Marc M, Robert F, Jimena N **Absent Team members: Aidan M**

Meeting time: 3:30-5:00 p.m.

Goal: Reflection of Competition Performance, Team Discussion

Tuesday

Present Team Members: Marco S, Marc M, Robert F, Jimena N **Absent Team members: XXXX**

Meeting time: 3:30-5:00 p.m.

Goal: Documentation of Reflection + Organize Weak Points for our redesign.

Wednesday

No Meeting

Thursday

No Meeting

Friday

No Meeting

Saturday

No Meeting

Sunday

No Meeting

Week of: 11/25-31/2025 | (Thanksgiving Break)

Monday

No Meeting

Tuesday

No Meeting

Wednesday

No Meeting

Thursday

No Meeting

Friday

No Meeting

Saturday

No Meeting

Sunday

No Meeting

Step 2:
Generate Concepts

Research Descore Mech Concepts

*Obtuse-Angle Pivot Joint - 25mm Piston (Est. 140 Deg.)

This design features the widest brace angle and shortest piston. It offers maximum reach into goal zones but risks bending easily. It also requires vertical expansion space, reducing the horizontal space needed.

Pros:

- Very low expansion space required
- Very Long Reach

Cons:

- Risks bending easily

*(14)

*Obtuse-Angle Pivot Joint - 50mm Piston (Est. 110 Deg.)

This joint uses a moderate brace angle and piston length, offering a balanced trade-off between reach and rigidity. It requires a moderate amount of horizontal expansion space.

Pros:

- Balanced, can adjust as needed.

Cons:

- High Air Usage, (Cannot be Rubber-Banded)

*(15)

*Obtuse Angle Pivot Joint - 75mm Piston (Est. 100 Deg.)

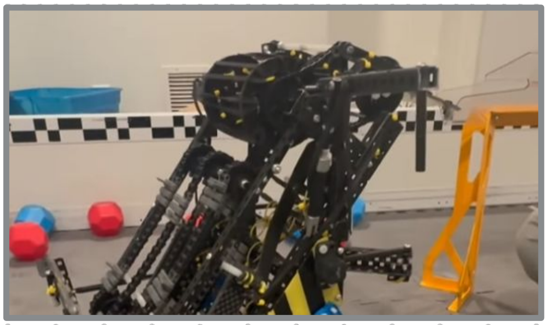
This joint has the tightest brace angle and longest piston,maximizing reach and strength at the cost of expansion space. It's ideal for robots where it can shoot almost directly sideways.

Pros:

- Very Strong/Robust
- Very Long Reach

Cons:

- Very High Air Usage
- Requires high expansion space



*(16)

Research Matchload-Intake Concepts.

*Halfcut C-Channel - Standoff Match Loader w/o supports

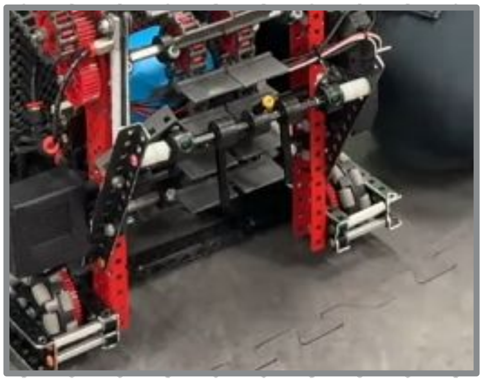
This design utilizes a trimmed C-channel with standoffs attached, actuated by a 75mm pneumatic piston. It offers moderate structural integrity.

Pros:

- Lightweight
- Space-efficient

Cons:

- Structurally Weak
- Creates friction on the floor



*(17)

*1x16 L-Channel - Standoff Match Loader - Triangle Bracing

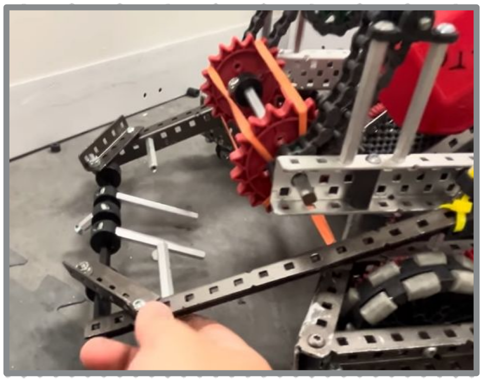
This design uses a 1x16 L-channel with triangle bracing, actuated by a 50mm piston for low pneumatic usage. Its lightweight frame making it very weak, but counteracted by it's bracing.

Pros:

- Lowest air usage
- Extremely Lightweight

Cons:

- Triangle Braces can get caught on matchloads.
- Strong on the corners, **still weak in the center**.



*(18)

*1x18 L-Channel - High Strength Shaft Match Loader - Wheel Supports

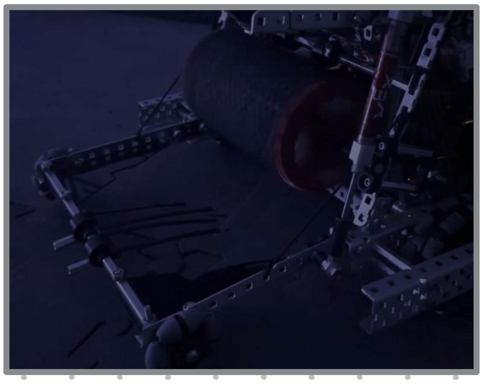
This robust matchloader uses a 1x18 L-channel with a high-strength shaft attached and wheel supports, powered by a 75mm piston. Despite its heavier build and high air usage, it maintains full drivetrain maneuverability during use.

Pros:

- Extremely Robust
- Low Friction on the floor

Cons:

- High pneumatic usage



*(19)

Descore Mech - Decision Matrix Criteria

Structural Integrity

- **0** – Mechanism bends or flexes under light pressure. Unreliable during regular use.
- **1** – Withstands moderate force but may deform or misalign under repeated stress.
- **2** – Rigid and durable. Maintains alignment and function even under aggressive use.

Air Consumption

- **0** – Mechanism requires excessive pneumatic usage. Strains tank capacity and limits actuations.
- **1** – Moderate air demand. Manageable with careful actuation timing.
- **2** – Highly efficient. Minimal air usage allows frequent actuations without expending too much air.

Space Efficiency

- **0** – Mechanism interferes with other systems or expands robot footprint significantly.
- **1** – Fits within robot layout with minor compromises to wiring or component placement.
- **2** – Integrates cleanly. Preserves internal space and allows easy access for maintenance or upgrades with room for further expansion.

Reach Distance

- **0** – Limited reach; struggles to access scoring zones or requires perfect alignment to function.
- **1** – Moderate reach; can descore in most scenarios but may require precise positioning.
- **2** – Excellent reach; consistently descends into scoring zones from various angles with minimal repositioning.

Descore Mech - Decision Matrix

1. Obtuse-Angle Pivot Joint - 25mm Piston (Est. 140 Deg.)

- Summary: A wide-angle, short-stroke descore arm that prioritizes vertical reach with minimal expansion footprint but sacrifices rigidity.
- Strengths: minimal expansion space, long reach.
- Weaknesses: prone to bending, limited structural support.

2. Obtuse-Angle Pivot Joint - 50mm Piston (Est. 110 Deg.)

- Summary: A moderately angled, mid-stroke design offering a balanced compromise between reach, strength, and spatial integration.
- Strengths: balanced reach, adaptable deployment .
- Weaknesses: high air consumption, cannot be rubber-banded

3 . Obtuse Angle Pivot Joint - 75mm Piston (Est. 100 Deg.)

- Summary: A tightly braced, long-stroke mechanism delivering maximum strength and reach, optimized for lateral deployment at the cost of space and air efficiency.
- Strengths: high structural integrity, extended reach .
- Weaknesses: very high air usage, large expansion footprint.

Mechanism	Structural Integrity	Air Consum ption	Space Efficienc y	Reach Distance	Total
25mm Piston (Est. 140 Deg.)	0	1	1	2	4
50mm Piston (Est. 110 Deg.)	1	1	1	1	4
75mm Piston (Est. 100 Deg.)	2	0	1	2	5

Team Conclusion:

We selected the 75mm Piston (Est. 100 Deg.) Descore Mech Design due to its Structural Integrity and Reach DIstance.

Matchload-Intake Decision Matrix Criteria

Structural Integrity

- **0** – Mechanism bends or flexes under light pressure. Unreliable during regular use.
- **1** – Withstands moderate force but may deform or misalign under repeated stress.
- **2** – Rigid and durable. Maintains alignment and function even under aggressive use.

Air Consumption

- **0** – Mechanism requires excessive pneumatic usage. Strains tank capacity and limits actuations.
- **1** – Moderate air demand. Manageable with careful actuation timing.
- **2** – Highly efficient. Minimal air usage allows frequent actuations without expending too much air.

Friction Profile

- **0** – Controls are unintuitive or laggy; driver struggles to operate intake effectively.
- **1** – Intake responds adequately to driver input; some delay or learning curve present.
- **2** – Intake is highly responsive and intuitive; enables fluid control and quick decision-making.

M.S.

Matchload Intake - Decision Matrix

1. Halfcut C-Channel - Standoff Match Loader w/o supports (Option “A”)

- Summary: A lightweight, space-efficient design using a cut C-channel and standoffs, actuated by a 75mm piston.
- Strengths: Lightweight, Space-efficient
- Weaknesses: Structurally Weak, Creates friction on the foam tiles.

2. 1x16 L-Channel - Standoff Match Loader - Triangle Bracing (Option “B”

- Summary: A low-air-usage intake with triangle bracing and a 50mm piston, offering lightweight but strong structure but vulnerable center structure.
- Strengths: Lowest air usage, Extremely Lightweight
- Weaknesses: Triangle braces can get caught on matchloads, Weak center

3 .1x18 L-Channel - High Strength Shaft Match Loader - Wheel Supports (Option “C”)

- Summary: A robust, drivetrain-friendly intake with wheel supports and a high-strength shaft, powered by a 75mm piston.
- Strengths: Extremely Robust, Low friction on the floor
- Weaknesses: Very High pneumatic usage

Mechanism	Structural Integrity	Air Consumpti on	Friction Profile	Total
Option C	2	0	2	4
Option B	1	2	0	3
Option A	0	1	0	1

Team Conclusion:

We selected the 1x18 L-Channel - High Strength Shaft Match Loader - Wheel Supports Design due to it’s Structural integrity and Friction Profile.

Step 3:
Build & Program

Descore Mech - Assembly

Note: We selected the 75mm Piston (Est. 100 Deg.) Descore Mech Design due to its Structural Integrity and Reach DIstance. All metal modifications were performed under mentor supervision using appropriate PPE.

Materials Used;

Structural Components

- 1-Wide L-Channel, trimmed to 4" (x1)
- 1-Wide L-Channel, trimmed to 2" (x1)
- 4" Aluminum Standoff (x1)
- 3" Aluminum Standoff (x1)

Fasteners and Hardware

- 0.5" Star-Drive Screws (x3)
- 2" Star-Drive Screw (x1)
- Thin Nylock Nut (x1)
- Keps Nuts (x6)

Pneumatic Components

- 75mm Pneumatic Piston (x1)
- Pneumatic Tubing (1 spool)
- Straight Pneumatic Fittings (x2)
- Solenoid Valve (x1)

Formulas

Reach Angle Estimate = Arccos[(Standoff Length ÷ Piston Stroke)]

Maximum Actuations = Tank Capacity / Cylinder and Tubing Volume

Deployment Footprint = Horizontal Reach × Sin(Brace Angle)

Specs (In accordance to the Math)

- Reach Angle = 115mm
- Maximum Actuations = 14.75, or 14 full actuations.
- Deployment Footprint = 75mm.

Descore Mech - Assembly Steps

Step 1: Piston-to-L-Channel

- Thread a Keps nut onto the output shaft of the 75mm pneumatic piston.
- Align the left-most hole of the trimmed 4" L-Channel with the piston shaft.
- Secure the L-Channel by threading a second Keps nut onto the opposite side, forming a rigid mechanical joint.
- Ensure both nuts are fully tightened to create a stable “sandwich” configuration.

Step 1.1: Brace Angle Adjustment

- Manually bend the L-Channel upward at the piston joint to achieve an approximate brace angle of 100°, deviating from the default 90° orientation.
- Confirm that the angle allows for lateral deployment without obstructing adjacent subsystems.

Step 2: Standoff Installation

- At the right-most hole of the 4" L-Channel, install a 3" aluminum standoff using a 0.5" star-drive screw.
- Tighten securely to ensure axial stability.

Step 3: Cross-Support Installation

- From the piston interface, count two VEX holes along the L-Channel.
- Insert a 2" star-drive screw through the channel at that location.
- Secure the screw using a Nylock nut on the opposite side to form a fixed pivot point.

Step 3.1: Secondary L-Channel Attachment

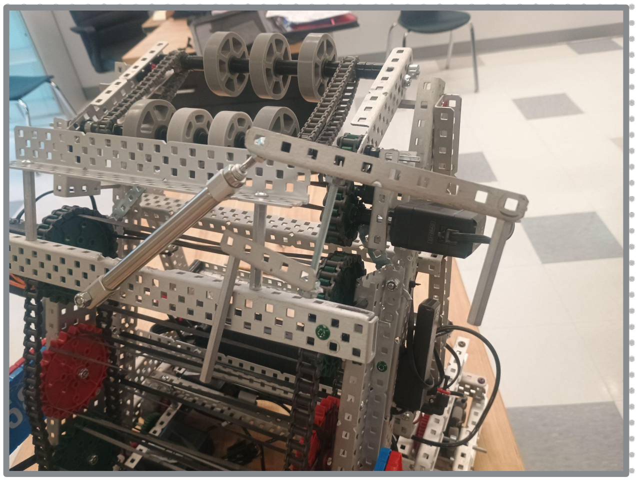
- Using the same sandwiching method described in Step 1, mount the right-most hole of the 2" L-Channel onto the exposed end of the 2" screw.
- Secure with two Keps nuts—one on each side of the channel—to ensure rotational stability.

Step 4: Secondary Standoff Installation

- At the left-most hole of the 2" L-Channel, install a 4" aluminum standoff using a 0.5" star-drive screw.
- Confirm that the standoff aligns with the primary brace angle and does not interfere with piston motion.

Step 5: Final Bot Integration

- Mount the entire descore assembly onto the cross-brace beam located at the top of the intake structure.
- Align the piston body centrally and secure it using a 0.5" star-drive screw and Nylock nut.



Descore Mech - Programming

```
// Pneumatic piston
digital_out Descore(Brain.ThreeWirePort.A); // Controls Descore Mech Piston
digital_out Matchload(Brain.ThreeWirePort.B); // Controls Matchloader Piston
```

This script allows our future code to know what the solenoids are, and where they are connected.

```
// Descore Pneumatic piston control with ButtonX and ButtonA
if (Controller1.ButtonX.pressing()) {
  Descore.set(true);  // Extend piston
} else if (Controller1.ButtonA.pressing()) {
  Descore.set(false); // Retract piston
}
```

This script allows us to send commands to our solenoid, and thus, our piston.

M.S.

Matchload Intake - Assembly

Note: To ensure safe modification of the dense steel High Strength Shaft, which was materially too thick for handheld drilling and too thin to safely handle without slipping, we submitted a formal request to use our school's Drill Press. The drilling was performed by our mentor in accordance with relevant safety protocols. All other trimming were completed by team members using PPE.

Materials Used;

Structural Components

- 1x18 L-Channel, trimmed to 7" (x1)
- High Strength Shaft, 24" trimmed to 16" and drilled with 11/64" bit on both ends (x1)
- 2.75" VEX Green Wheels (x2)
- 0.5" Aluminum Standoff (x1)
- 1" Aluminum Standoff (x2)

Fasteners and Hardware

- 1.5" Star-Drive Screws (x3)
- 0.375" Star-Drive Screws (x2)
- 0.5" Star-Drive Screws (x5)
- Thin Nylock Nuts (x6)
- Keps Nuts (x2)
- 0.5" Spacers (x2)
- 0.125" Spacers (x4)
- High Strength Shaft Collars (5)

Elastic Components

- #64 Rubber Band (x1)

Pneumatics

- 75mm Pneumatic Piston (x1)
- Pneumatic Tubing Roll (x1)
- Straight Pneumatic Fittings (x2)

Formulas

Maximum Actuations = Tank Capacity ÷ (Cylinder Volume + Tubing Volume)

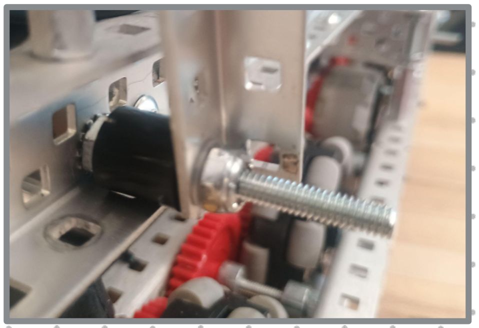
Specs (In accordance to the Math)

- Actuation Limit = 14.75, or 14 full actuations.

Matchload Intake - Assembly Steps

Step 1: Screw Joint Installation

- Select two 1.5″ star-drive screws.
- Insert each screw into the top intake C-Channel, approximately 1″ inward from the front edge, using a central hole. (This C-Channel is attached above the middle of the drivetrain base below it.)
- Secure each screw with a Keps nut to form a screw joint: screw head, C-Channel, Keps nut.
- Repeat on both sides.



Step 1: product

Step 2: L-Channel Mounting

- Slide a 0.5″ spacer onto each screw.
- Mount the trimmed 7″ L-Channel onto the screw, aligning the hole with the spacer.
- Secure with a thin Nylock nut, leaving slight rotational clearance to form a screw joint.
- Repeat for the opposite side.

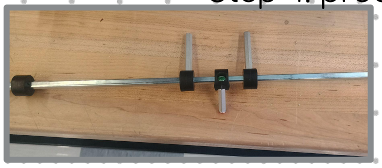
Step 3: High Strength Shaft Integration

- Drill a 1/8″ hole through the opposite end of each L-Channel.
- Insert the trimmed 16″ High Strength Shaft through both drilled holes, ensuring smooth passage and alignment.

Step 4: Shaft Collar Installation

- Install five High Strength Shaft Collars along the shaft.
    - Center-most colla (Angled inward)r: secure with a 0.5″ screw and a 0.5″ standoff.
    - Adjacent collars (angled outward): secure each with a 0.5″ screw and a 1″ standoff.
    - Outermost collars: secure each with a 0.375″ screw and Nylock nut.
- Confirm all collars are tightened and space correctly.

Step 4: product

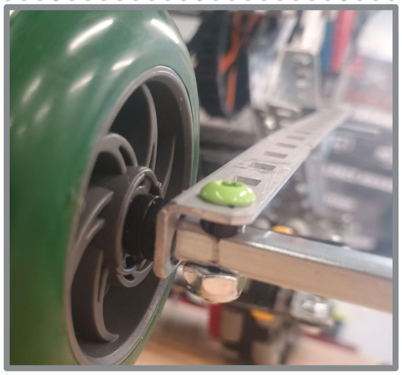


Step 5: Wheel Installation

- Drill a 1/8″ hole through the center bore of each 2.75″ green wheel.
- Slide both wheels onto the High Strength Shaft, positioning them between the outer shaft collars.
- Add a 0.125″ spacer between each wheel and its adjacent L-Channel.

Step 6: Shaft Locking

- Secure the shaft ends using 0.375″ screws, each paired with a 0.125″ spacer and a Nylock nut.



Step 6: product

Matchload Intake - Assembly Steps

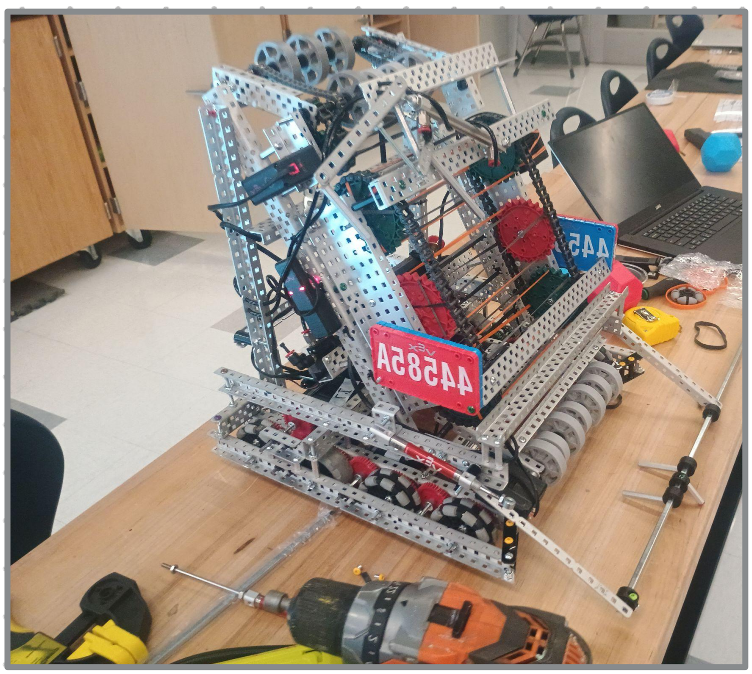
Step 7: Pneumatic Piston Installation

- Position the 75mm pneumatic piston along the inner face of the trimmed L-Channel.
- Align the piston's base with the 4th hole inward from the front edge of the L-Channel.
- Secure the piston using a 1.5" star-drive screw and a Nylock nut, ensuring the shaft faces toward the intake.
- Extend the piston shaft and align it with the nearest hole on the intake's 5-Wide C-Channel.
- Attach the piston shaft to the C-Channel using a second 1.5" screw and secure with a Nylock nut.
- Verify full range of motion and ensure no binding occurs during extension or retraction.

Step 7: product

M.
S.

Final Product:



Matchload Intake - Programming

```
// Pneumatic piston
digital_out Descore(Brain.ThreeWirePort.A); // Controls Descore Mech Piston
digital_out Matchload(Brain.ThreeWirePort.B); // Controls Matchloader Piston
```

This script allows our future code to know what the solenoids are, and where they are connected.

```
// Matchload Pnuematic piston control with ButtonY and ButtonB
if (Controller1.ButtonY.pressing()) {
  Matchload.set(true);  // Extend piston
} else if (Controller1.ButtonB.pressing()) {
  Matchload.set(false); // Retract piston
}
```

This script allows us to send commands to our solenoid, and thus, our piston.

M.S.

Step 4:
Test Solution

Descore Mech - Testing

Test 1. Structural Integrity

- Perform 10 consecutive descoring cycles with the full drivetrain power, against loaded goals. (Significantly more aggressive than normal use)
- Observe for bending, misalignment, or hardware loosening.

Results:

- No visible bending, otherwise damage..
- All screws and hardware remained in place.

Conclusion: Passed. Descore Mechanism exhibits high durability under simulated match stress.

Test 2: Air Consumption

Method Used:

- Fully actuate the piston repeatedly until the tank is depleted.
- Count total full cycles before pressure drop prevents reliable extension.
- Compare against calculated actuation limit.

Results:

- 16 Actuations were reached before tank PSI reached 5psi and the piston started moving rather slowly.
- **Conclusion:** Passed. Descore Mech significantly surpassed calculated actuation limit.

M.S.

Matchload Intake - Testing

Test 1: Air Consumption

Method Used:

- Fully actuate the piston repeatedly until the tank is depleted.
- Count total full cycles before pressure drop prevents reliable extension.
- Compare against calculated actuation limit.

Results:

- 12 Actuations were reached before tank PSI reached 20psi and the piston was unable to pull the matchloader back up.
- **Conclusion:** Passed. Matchload Mech slightly below the calculated actuations, however, still within tolerable levels.

Test 2. Structural Integrity

- Perform 10 consecutive matchload "lineups" with the full drivetrain power, against loaded matchload tubes. (Significantly more aggressive than normal use)
- Observe for bending, misalignment, or hardware loosening.

Results:

- No visible bending, otherwise damage..
- All screws and hardware remained in place.

Conclusion: Passed. Matchload Mechanism exhibits high durability under simulated match stress.

Test 3. Friction Profile

- Compare drivetrain friction and turning speed with matchloader deployed.
- Confirm smooth motion and minimal drag.

Results:

- Drivetrain Speed remained exactly the same. (See Slide 72: Drivetrain II Testing)
- Turning radius was affected by around 45 degrees.

Conclusion: Passed. Matchload Mechanism exhibits low friction when deployed..

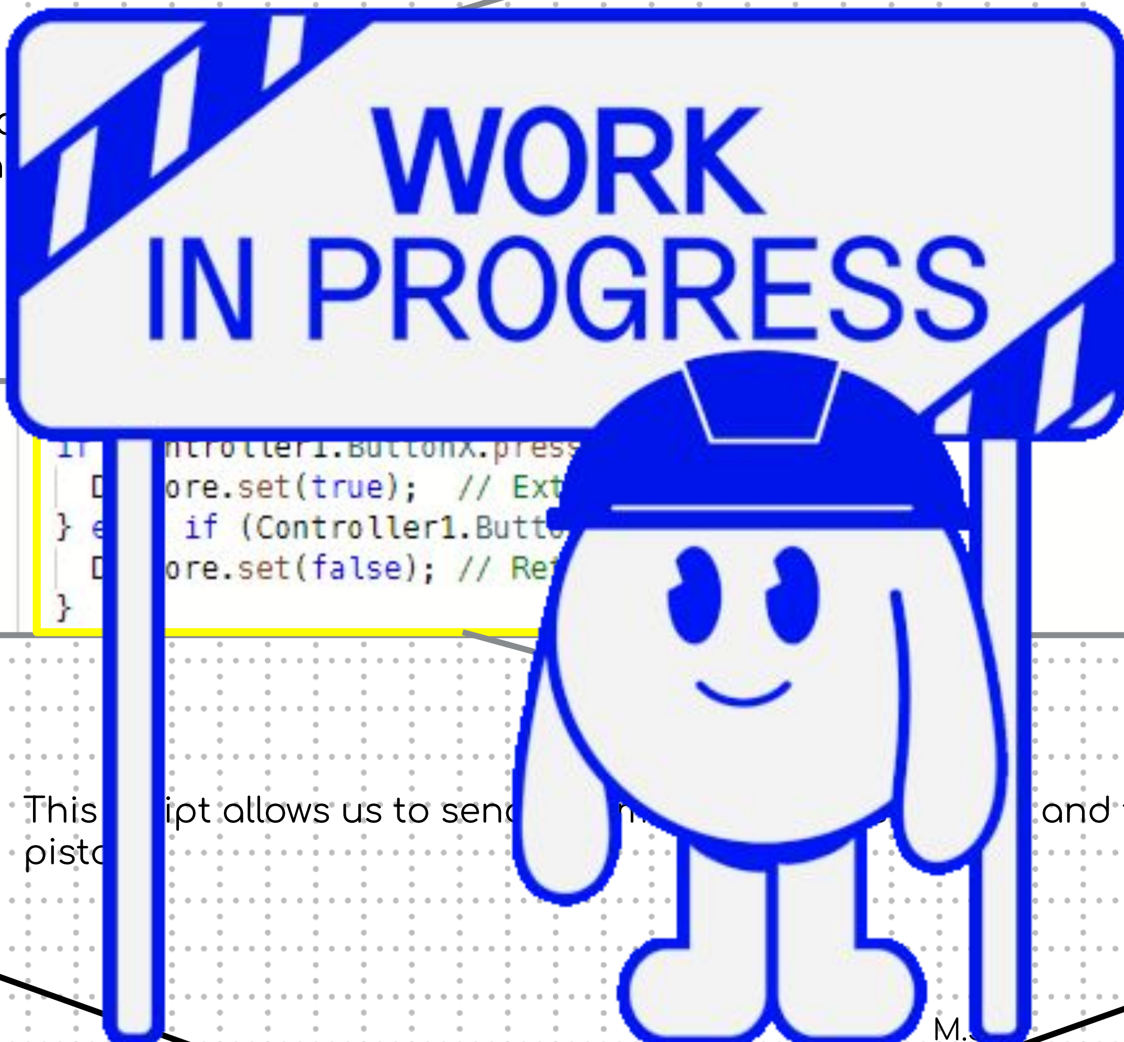
Step 3:
Build & Program

[MarSanchez2010/44585A---HSI-Echo: 44585A's Code](#)

GIT HUB CODE REPOSITORY

```
// Pneumatic piston
digital_out Descore(Brain.ThreeWirePort.A); // Controls Descore Mech Piston
digital_out Matchload(Brain.ThreeWirePort.B); // Controls Matchloader Piston
```

This sc
and wh




```
                                                                      A
if   ntroller1.ButtonX.press
  D   ore.set(true);  // Ext
} e   if (Controller1.Butt
  D   ore.set(false); // Ret
}
```

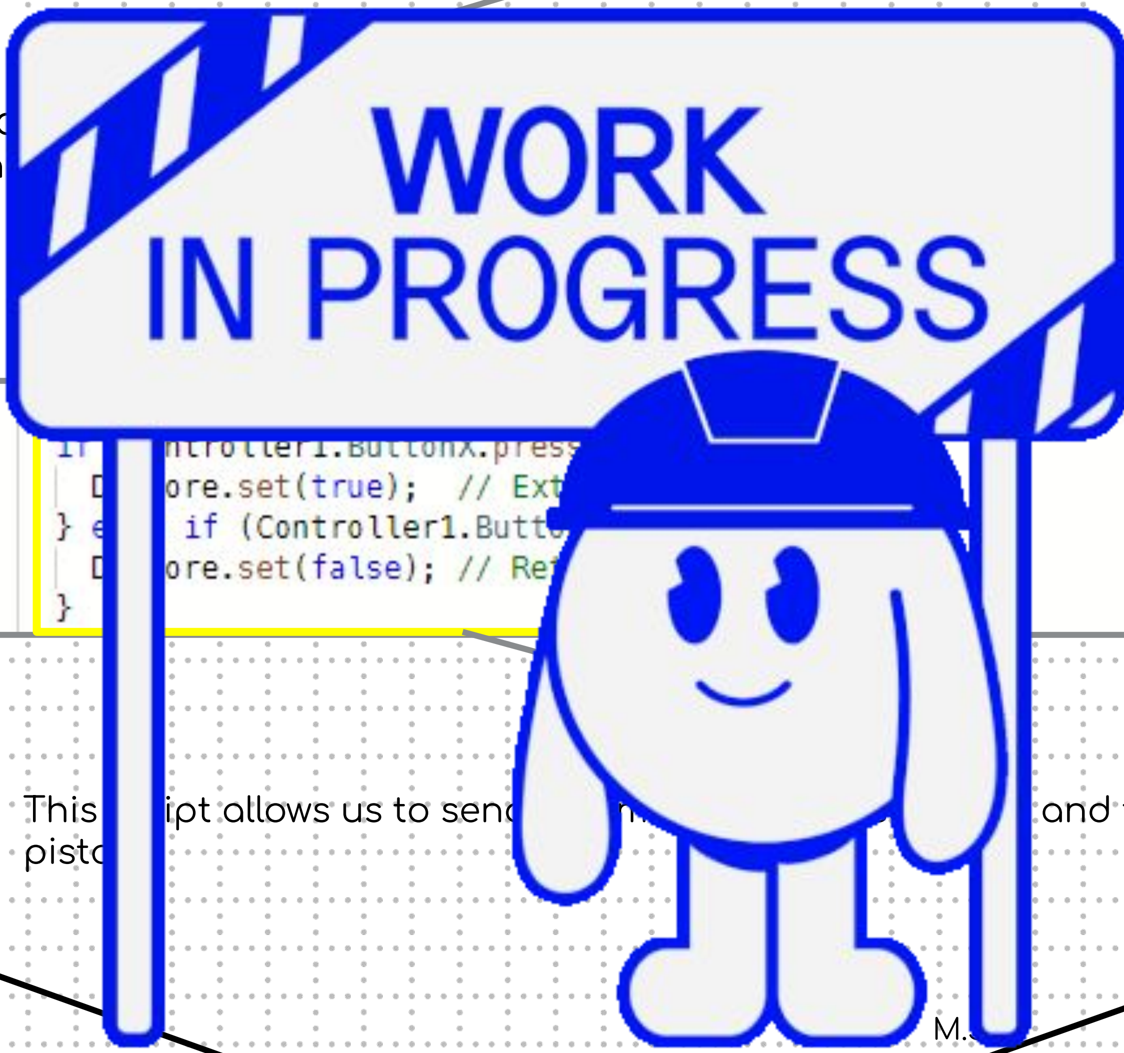
This   ipt allows us to send   and thus, our
pisto

M.

Descore Mech - Programming

```
// Pneumatic piston
digital_out Descore(Brain.ThreeWirePort.A); // Controls Descore Mech Piston
digital_out Matchload(Brain.ThreeWirePort.B); // Controls Matchloader Piston
```

This sc
and wh




```
A
if   ntroller1.ButtonX.press
  D   ore.set(true);  // Ext
} e   if (Controller1.Butt
  D   ore.set(false); // Ret
}
```

This   ipt allows us to send   and thus, our
pisto

M.S

Appendix A
Citations

*1 - Engineering Design Process Diagram - (N.d.). Pltw.org. Retrieved November 1, 2025, from https://lms-content.pltw.org/curriculum/Gateway_Notebook_Design_Process.pdf

*2 - 44585 “Makerspace” Resource Management Screenshot - (n.d.). Google Docs. Retrieved November 1, 2025, from https://docs.google.com/spreadsheets/d/1IHvtvry5luU4aGBOuAIfgyFIpBm469cC4upckNn0jXU/edit?usp=sharing

*3 - Game Objective Description - (N.d.-b). Vexrobotics.com. Retrieved November 1, 2025, from https://www.vexrobotics.com/push-back-manual?srsltid=AfmBOooepO5u3ZCZzfu5zZrZerWd_jWjql-xMJYE49zedpVZcjDnB2jN

*4 - General Definitions - (N.d.-b). Vexrobotics.com. Retrieved November 1, 2025, from https://www.vexrobotics.com/push-back-manual?srsltid=AfmBOooepO5u3ZCZzfu5zZrZerWd_jWjql-xMJYE49zedpVZcjDnB2jN

*5 - Field Overview Diagram - (N.d.-b). Vexrobotics.com. Retrieved November 1, 2025, from https://www.vexrobotics.com/push-back-manual?srsltid=AfmBOooepO5u3ZCZzfu5zZrZerWd_jWjql-xMJYE49zedpVZcjDnB2jN

*6 - Autonomous Line DIagram - (N.d.-b). Vexrobotics.com. Retrieved November 1, 2025, from https://www.vexrobotics.com/push-back-manual?srsltid=AfmBOooepO5u3ZCZzfu5zZrZerWd_jWjql-xMJYE49zedpVZcjDnB2jN

*7 - Block Dimensions Diagram - (N.d.-b). Vexrobotics.com. Retrieved November 1, 2025, from https://www.vexrobotics.com/push-back-manual?srsltid=AfmBOooepO5u3ZCZzfu5zZrZerWd_jWjql-xMJYE49zedpVZcjDnB2jN

*8 - Long Goal Control Zone Diagram - (N.d.-b). Vexrobotics.com. Retrieved November 1, 2025, from https://www.vexrobotics.com/push-back-manual?srsltid=AfmBOooepO5u3ZCZzfu5zZrZerWd_jWjql-xMJYE49zedpVZcjDnB2jN

*9 - Center Goal Control Zone Diagram - (N.d.-b). Vexrobotics.com. Retrieved November 1, 2025, from https://www.vexrobotics.com/push-back-manual?srsltid=AfmBOooepO5u3ZCZzfu5zZrZerWd_jWjql-xMJYE49zedpVZcjDnB2jN

*10 - Matchloader Tube Structure Diagram + Park Zone - (N.d.-b). Vexrobotics.com. Retrieved November 1, 2025, from https://www.vexrobotics.com/push-back-manual?srsltid=AfmBOooepO5u3ZCZzfu5zZrZerWd_jWjql-xMJYE49zedpVZcjDnB2jN

*11 - Hoardbot Robot Concept - FUN Robotics Network [@FUNRoboticsNetwork]. (n.d.). *11101B barcbots getting there | pits & parts | push back robot* [Video]. Youtube. Retrieved November 1, 2025, from https://www.youtube.com/watch?v=Ax2tWIHpOj4

Half Scale

Appendix B
Citations

*12 - Slant Mech Robot Concept - FUN Robotics Network [@FUNRoboticsNetwork]. (n.d.-b). *Shanghai RuiGuan team 9123X | pits & parts | push back robot* [Video]. Youtube. Retrieved November 1, 2025, from https://www.youtube.com/watch?v=2J2D__8QCcs

*13 - C-Mech Robot Concept - FUN Robotics Network [@FUNRoboticsNetwork]. (n.d.-a). *295Y PARTY | pits & parts | push back robot #vexrobotics* [Video]. Youtube. Retrieved November 1, 2025, from https://www.youtube.com/watch?feature=shared&v=PevP7q_ZJqw

*14 - Obtuse-Angle Pivot Joint Concept (50mm Piston - 140 Deg.) - Markley, R. [@RileyMarkley]. (n.d.). *40000A | vex push back | great planes reveal* [Video]. Youtube. Retrieved November 1, 2025, from https://www.youtube.com/watch?si=d_FhEzkvXI-rxDwW&v=DU_8VR4RAv4&feature=youtu.be

*15 - Obtuse-Angle Pivot Joint (75mm Piston - 110 Deg.) - Overclock Robotics [@overclockrobotics775]. (n.d.). *VEX push back | 16099A highlander reveal* [Video]. Youtube. Retrieved November 1, 2025, from https://www.youtube.com/watch?v=kMECxu9Tf8g

*16 - Obtuse Angle Pivot Joint (100mm Piston - 100 Deg.) - Nameless Robotics [@Nameless66556Z]. (n.d.). *66556Z fall robot explanation* [Video]. Youtube. Retrieved November 1, 2025, from https://www.youtube.com/watch?si=_BdWSK4DDczpsFn9&v=JIxJG2_xXtQ&feature=youtu.be

*17 - Halfcut C-Channel, Standoff Match Loader w/o supports - Theory, 4886s-String [@4886S-StringTheory]. (n.d.). *4886S VEX push back RI1W* [Video]. Youtube. Retrieved November 5, 2025, from https://www.youtube.com/watch?v=EJx783VEQtg

*18 - 1x16 L-Channel, Standoff Match Loader, Triangle Bracing - Robotics, L. T. C. [@ltcrobotics6271]. (n.d.). *Vex push back 44252A ri10hr robot explanation* [Video]. Youtube. Retrieved November 5, 2025, from https://www.youtube.com/watch?v=ijGnrYby3iM

*19 - 1x18 L-Channel, High Strength Shaft Match Loader, Wheel Supports - 1028A [@1028a]. (n.d.). *1028A WASHED | early season reveal | vex push back* [Video]. Youtube. Retrieved November 5, 2025, from https://www.youtube.com/watch?v=9Ka81CDm3-U

[Drivetrain II] Robotics, A. [@acerobotics229]. (n.d.). *Worlds robot explanation | 229V ace robotics | VEX high stakes* [Video]. Youtube. Retrieved November 5, 2025, from https://www.youtube.com/watch?v=cxpzO-LriDg

[Drivetrain II] Echo, 2654e [@2654E]. (n.d.). *2654E echo | V2 robot explanation video | VEX high stakes* [Video]. Youtube. Retrieved November 5, 2025, from https://www.youtube.com/watch?v=Wj1L_OZ68vs

Half Scale

Intellectual Property Statement

Patent Documentation Protocol This notebook is maintained to document the conception, development, and reduction to practice of original inventions. All entries are dated, signed, and witnessed to establish priority of invention under applicable patent law.

Confidentiality Statement This notebook contains proprietary engineering processes and strategic documentation. Unauthorized use, reproduction, or distribution is strictly prohibited. Disclosure is limited to *authorized persons, competition judges,* and relevant *RECF personnel.*

I, Marco Sanchez, hereby verify that the entries included within this document were made on the stated dates and reflect the original work of ourselves, the authors. Mentor involvement was limited to supervision and safety oversight as required by the Harmony Public Schools Handbook and RECF Student Centered Policy.

Digital Signature: ____________________

Date Signed: 11/2/2025