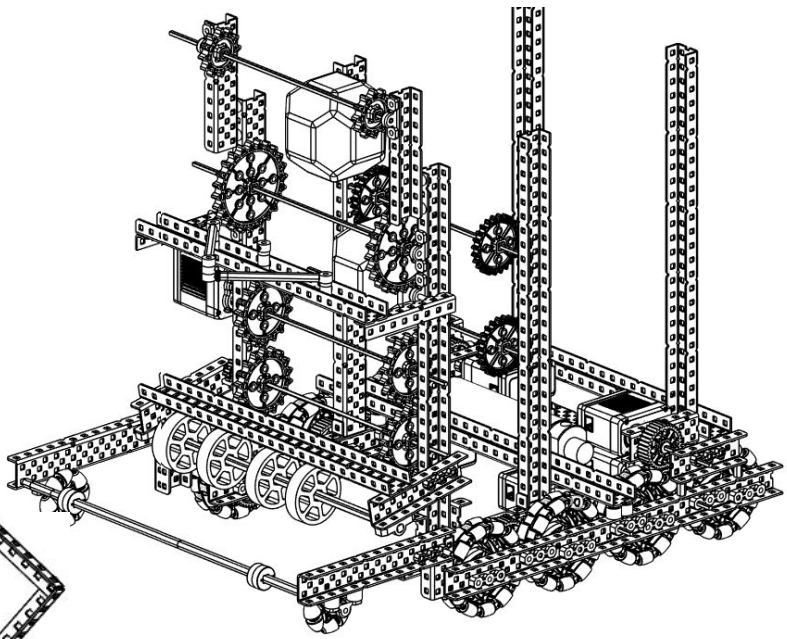
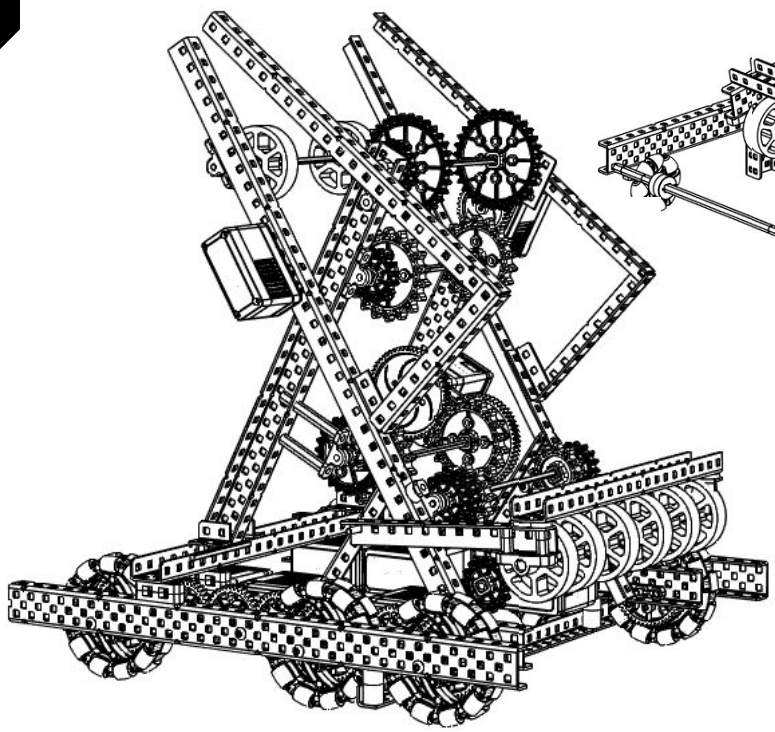
2941H

MECHA SQUAD





Engineering Notebook

Main Notebook

Started: 9 May 25

Finished: ongoing

Book 1 of 1

Table of contents

Table of contents

Welcome to our

Engineering notebook

Why are we documenting?

• To document all progress on the robot and relevant aspects

• Development of engineering and designing skills

Why are we documenting digitally over written?

• Improve neatness and consistency of the document

• Increase accessibility and time efficiency

• Although the documentation is online, it is designed for a printed viewing experience

Our method:

1. Create digital project page of important design developments and accomplishments

2. Label and format project page in chronological order

3. Print pages as soon as possible

Who is documenting?

• Everyone competing under the 2941H team number should contribute to slides in a way.

Note: Some pages are reprinted or printed later due to things like pictures being added to the cover or biographies since these are not always available yet when we make the slide. To compromise we add a placeholder image and reprint the slide with the desired images in place of the placeholder.

Colour/Format guide

Black

Black is used as the default colour

Red and Blue

Red and Blue is used for the tournament summaries and analysis

Grey

Grey means to rotate the notebook 90 degrees

When applicable:

Topic: Size 17

Title: Size 35

Subtitles: Size 20
Admin: Size 15
Default text: Size 14
Page number: Size 14

Date on pages should be written as: (Eg)
12 Feb 25

12 being the day
Feb being the first 3 letters of the month
24 being the year (2025)

Team Biography

We are 2941H Mecha squad from Otumoetai college in Tauranga, New Zealand. Together our team strives for excellence and are constantly looking for more ways to innovate, learn and improve. Combined our team has 14 years of experience in VEX Robotics and a lots of other experience in the STEM field. This year we have a very well balanced team, Our team leader Tom with 6 years of experience, Indie and William with 3 years of experience, Finn with 2 and Rosa coming onto the team as a rookie. Each skill set compliments and supports the others.

Picture added later on 7th of January 2026

Team goals

1. Win a Trophy

Win a trophy at 2026 V5RC nationals.

2. Complete at least 3 design cycles over the Push Back season

We aim to complete 3 design cycles to create 3 robots to find the best solution to the V5RC game.

3. Use sensors

Utilize sensors such as rotation sensors, color sensors and optical sensors

4. Qualify for VEX worlds

Qualify for worlds through winning a worlds qualifying award at vex nationals. Awards include: Tournament champion, tournament finalist, robot skills, excellence and design.

5. Place top 5 in robot skills

Place in the top 5 in the skills challenge at the 2026 V5RC nationals.

6. Win a tournament

Win a minor tournament

Team Members

Tom van de Pol

Name: Tom
Year level: 13
Experience: 6 years of VEX
Strengths: All rounder
Roles: Team leader, Driver, Primary Notebooker, Lead alliance communicator, Builder

Indie Minshall

Name: Indie
Year level: 12
Experience: 3 years of VEX
Strengths: Building, game understanding
Roles: Drive coach, Builder

Rosa Sharp

Name: Rosa
Year level: 13
Experience: Rookie
Strengths: Coding
Roles: Programmer, Secondary drive coach, Secondary Notebooker, Timer, Builder

Team Members

William Hofsteede

Name: William
Year level: 12
Experience: 3 years of VEX
Strengths: Driving, Building, reaching the top shelf
Roles: Driver, Builder

Finn Montgomery-Klein

Name: Finn
Year level: 10
Experience: 2 years of VEX
Strengths: Building, Coding
Roles: Programmer, Builder

Our Design Cycle

1. Identify the problem

- Describe the problem using written or drawn representation
- State what the solution would ideally accomplish

2. Brainstorm solutions

- Come up with possible solutions
- Credit external sources
- Possible positives and negatives
- Create labelled diagrams
- Create brainstorm statement

3. Select and Plan

- Decision matrix
- Prototype or CAD the most suitable solution(s)
- Finalise the decision

4. Build the solution

- CAD the solution
- Build the solution

5. Test solution

- Attend a tournament

Initial Timeline

Timeline update 0

This is our initial Timeline. Our aim with this timeline is to use it as a general reference to keep progress.

Name: Tom

Monthly goals

Aim

Our aim for monthly goals:
Our aim for monthly goals is to set one or more goals per month and make an effort to achieve them

Monthly goals
May

1. Thoroughly analyze the game challenge
Completed on: 13rd May 2025

2. Build team synergy
Completed on: 31st of May 2025

3. Design 3 or more different robot concepts
Completed on: 17th of May 2025

Note: These pages have been edited to add the dates the goals they were/were not completed on. These dates will have been added on the day they were completed on or in the case of non completed goals they will have been added on the last day of the month

Name: Tom, Indie, Rosa, Finn, William

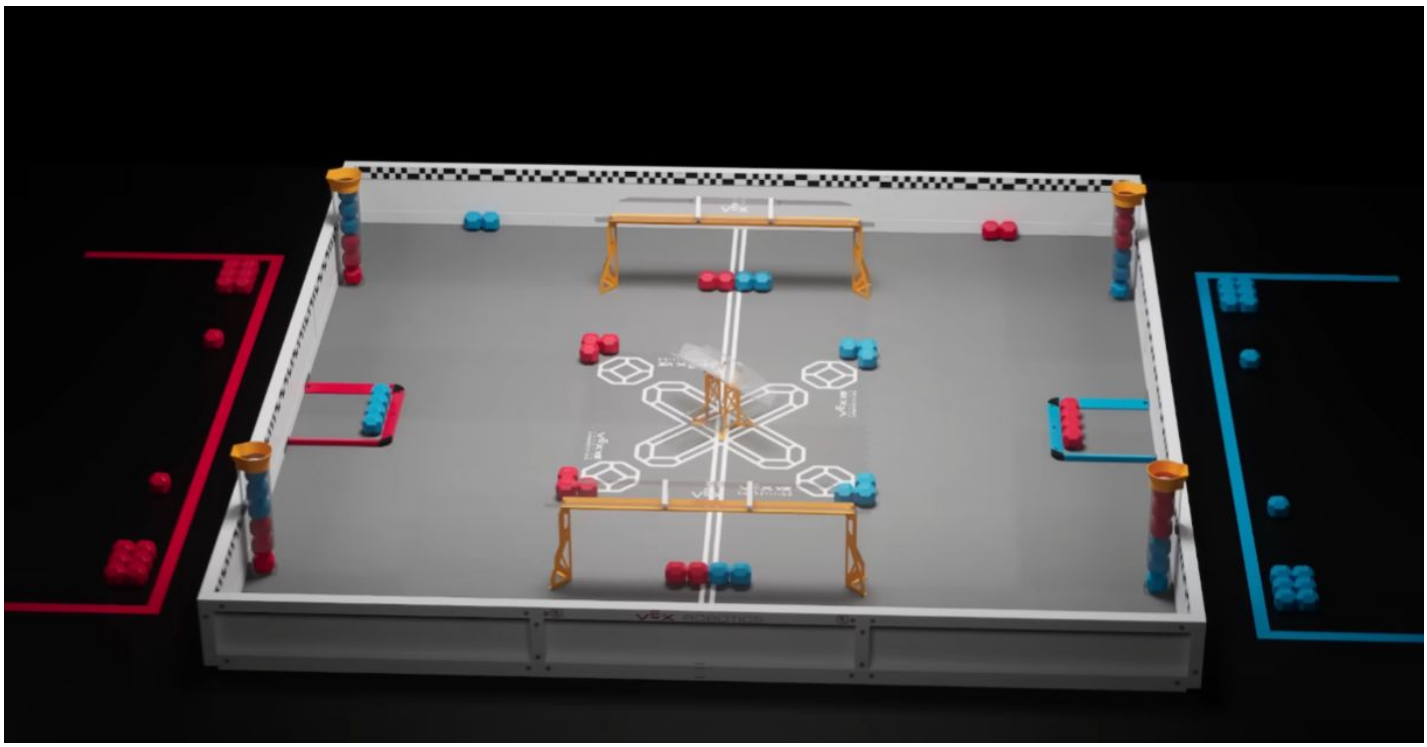
2941H

Design Cycle 1

Initial Game Analysis

Field Layout

High Stakes is on a 12 foot by 12 foot field. Our first observations are:
- This field is very open with almost no challenges in the Z axis
- There are alot of blocks on the field, approximately 88, 44 of each color
- There are 44 spaces for blocks to be scored
- The loading tubes start favouring the alliance
- The goals aren't very large therefore our robot design won't be restricted by them
- We start with 12 match loads and 2 preloads at must be on the robot at the start of the match



Initial Game Analysis

Blocks

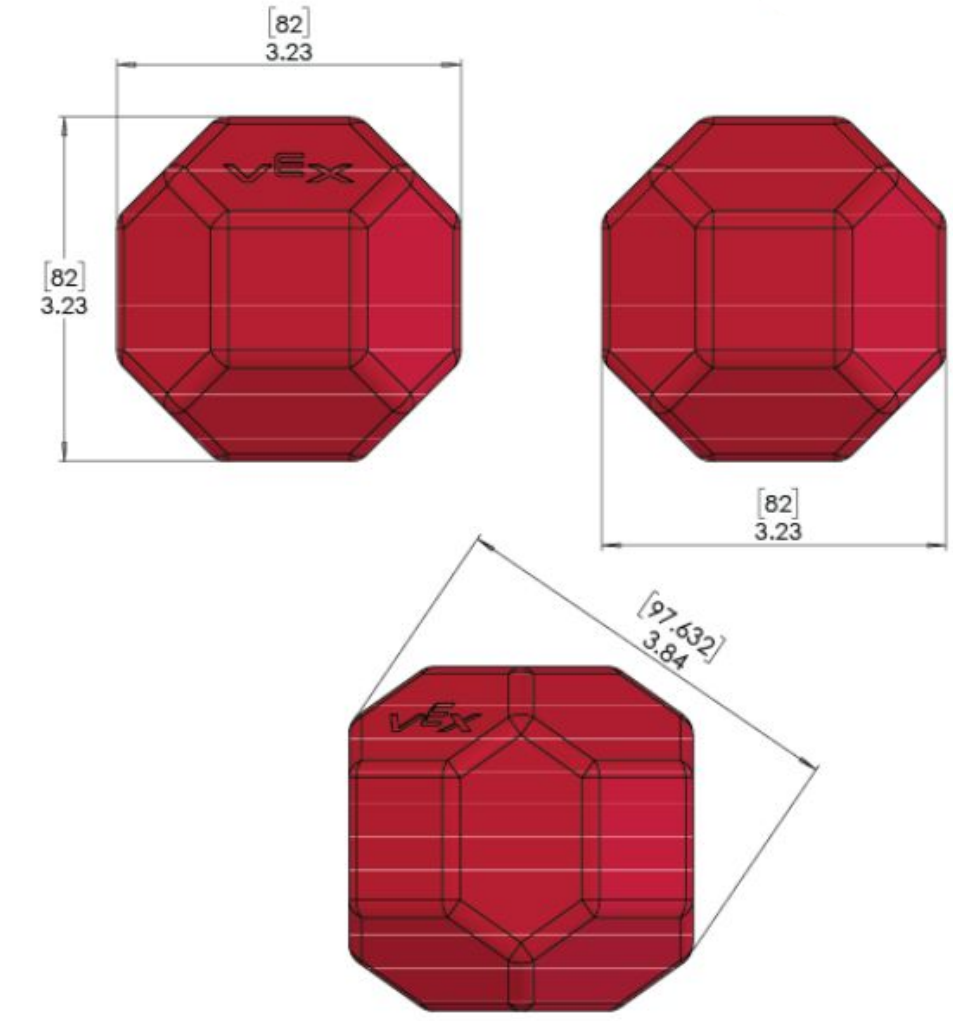
Game Elements-Blocks

The game starts with 88 blocks including match loads and preloads. The blocks consist of 18 sides and are 3-¼ inch from flat to flat.

- Flat sides allow for easy pick up and grip
- Blocks don't roll
- Can’t be compressed
- Small and light

Challenges

There are relatively small leading to guiding problems within intake systems as well as requiring a low intake to effectively gain control.



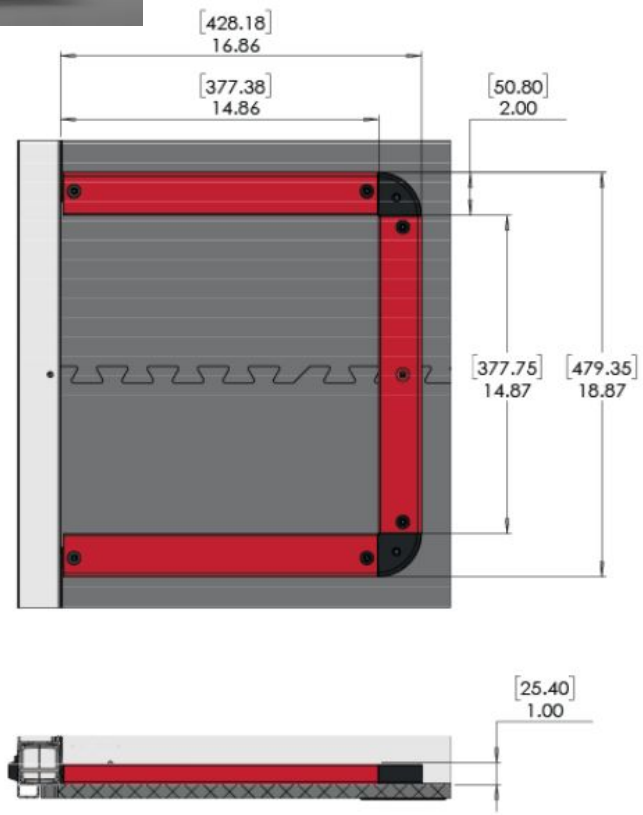
Mass = 40 ± 4 grams

Initial Game Analysis

Parking Zones

Description: The purpose of the parking zones is at the end of the match, the bots from the two teams need to both fit inside the parking zones for bonus points. One robot inside the alliance parking zone is +8 bonus points. Both bots inside the alliance parking zone is +30 points.

Challenges: The border of the parking zones is like a ramp, with the vertical side being from the outside, and the ramp being from the inside. This will make getting inside the parking zone a lot more difficult. Due to the big jump of the outside of the ramp, it will be harder to overcome it. Another challenge is fitting two bots inside the parking space for the 30 point bonus, because there is very limited space.

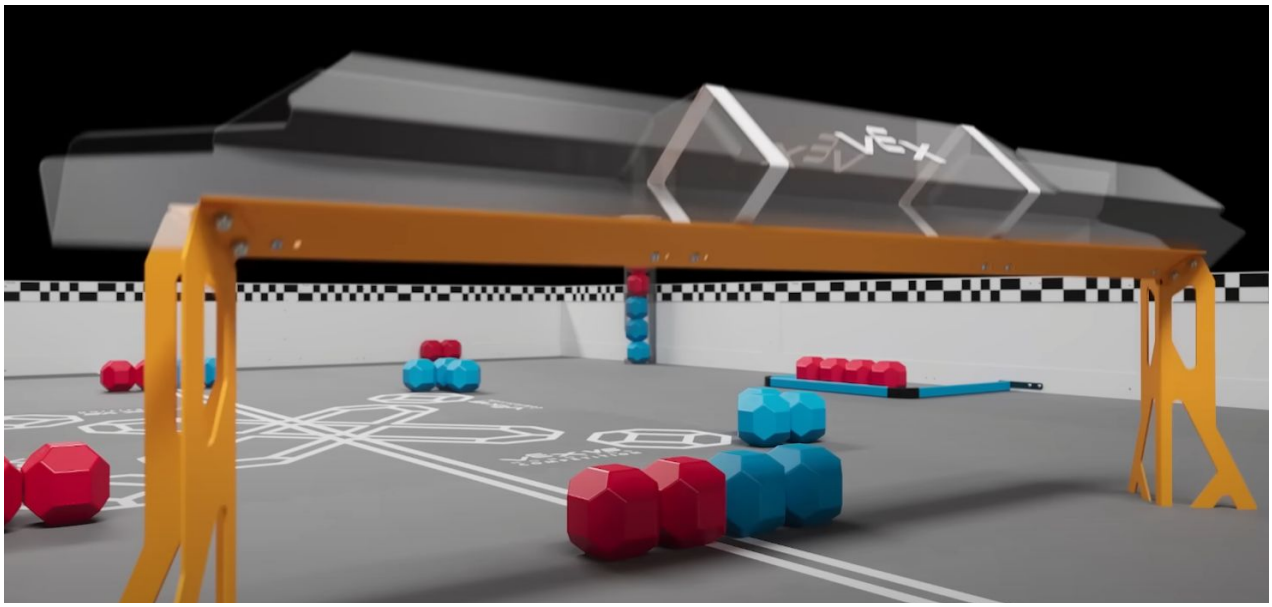


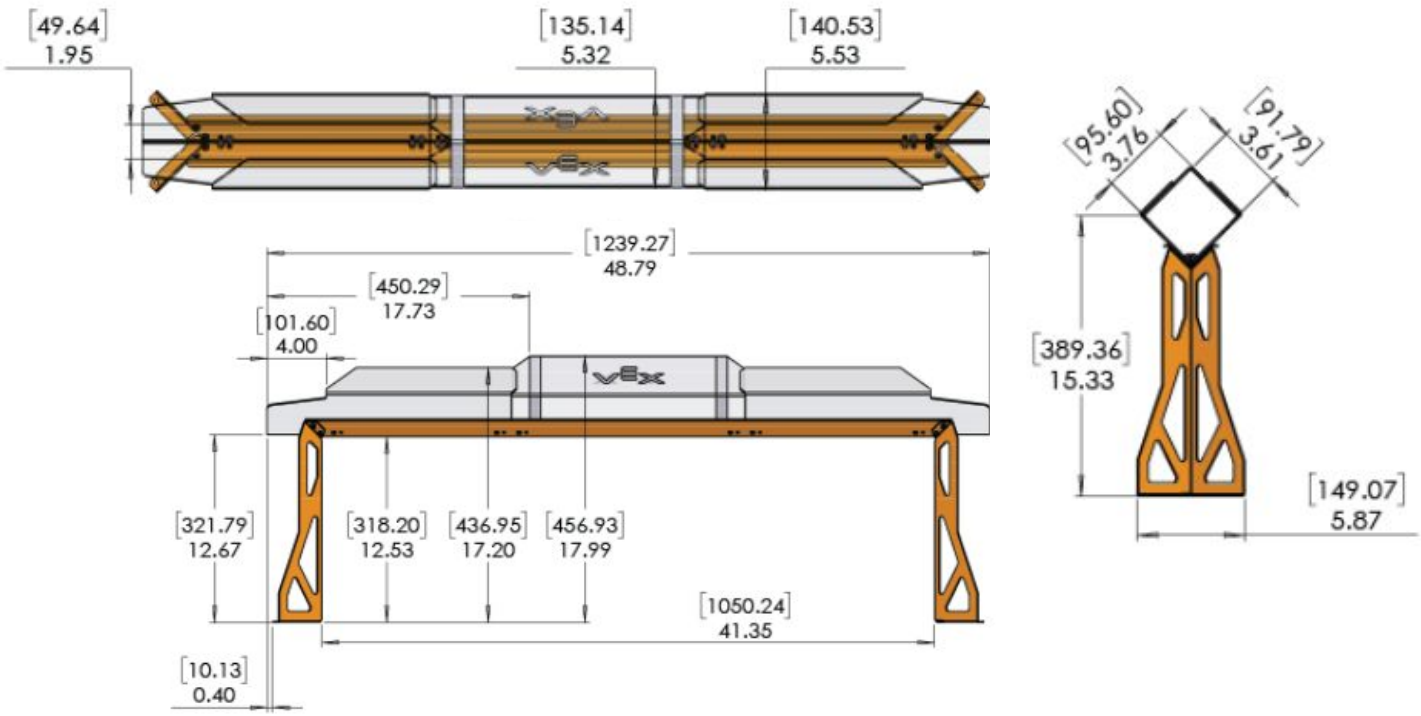
Initial Game Analysis

Long Goals

Description: There are 2 long goals which fit 15 blocks each. The middle 4 places on the goal are called the controlled zone. The 2 white lines indicate where the controlled zone start. The controlled zone is also fully enclosed from the top and bottom making the only entry points from 2 opposing sides.

Challenges: Once the goal has a lot of blocks in it adding blocks could result in blocks being pushed out the otherside or pushing blocks further into the middle. Depending on the order and color of the blocks this could be seen as a positive or negative.





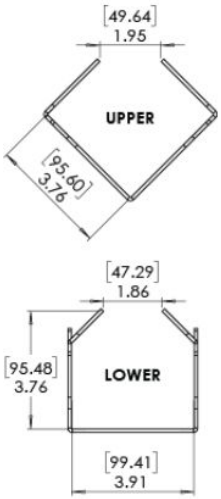
Name: Tom

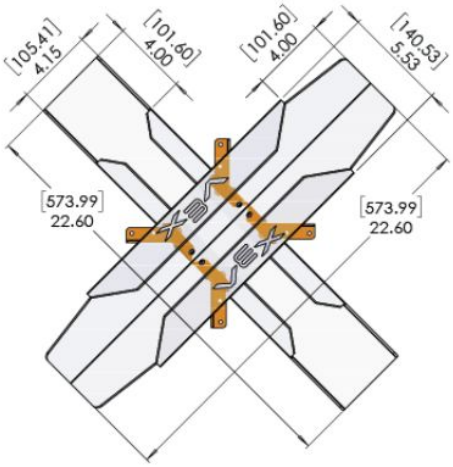
Initial Game Analysis

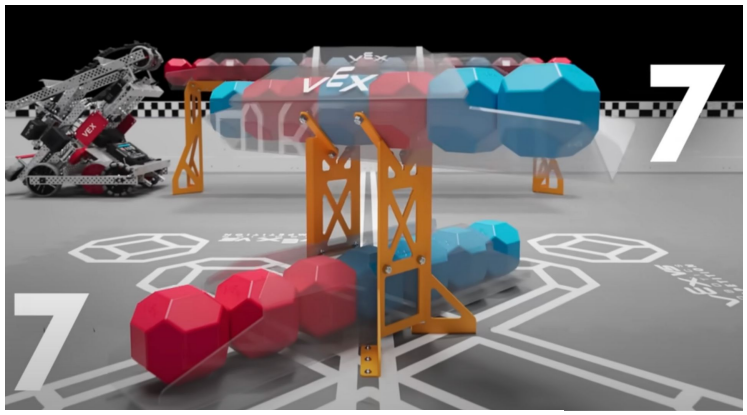
Centre Goals

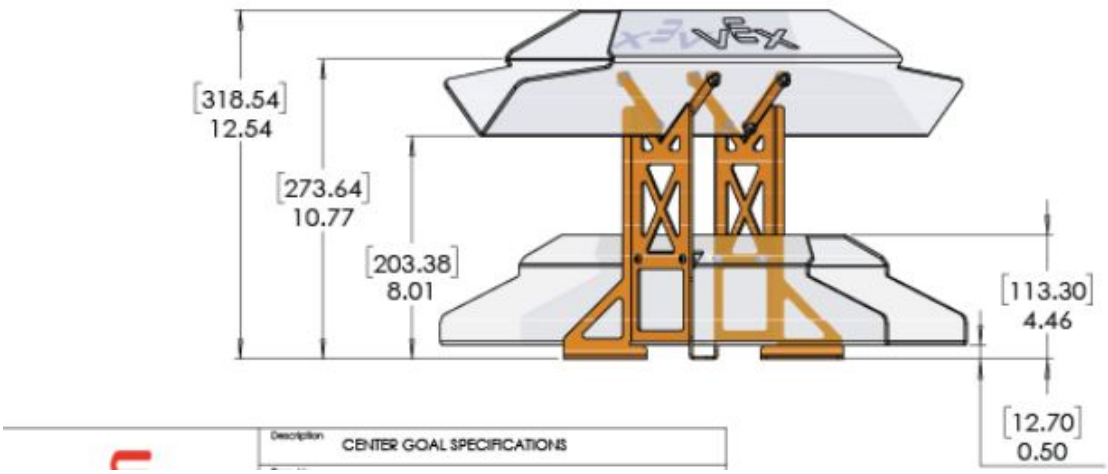
Description: There are two centre goals, a high one and a low one, going at opposite angles as indicated by the markings on the field. The entirety of the centre goals are effectively ‘control zones’, where the points aren’t determined per block but are instead determined by the most coloured blocks inside the goal. They can each hold up to 7 blocks. Having the majority in the upper goal is worth +8 points, and having the majority in the lower goal is worth +6 points.

Challenges: They’re highly contested and is in the centre of the field so it’s a busy area. Hard to maintain control over them and keep the alliance blocks in the majority. They’re also at different levels so placing the blocks inside of them is more difficult as it isn’t a controlled height, so maneuvering between the two or finding a compromise for this is important.









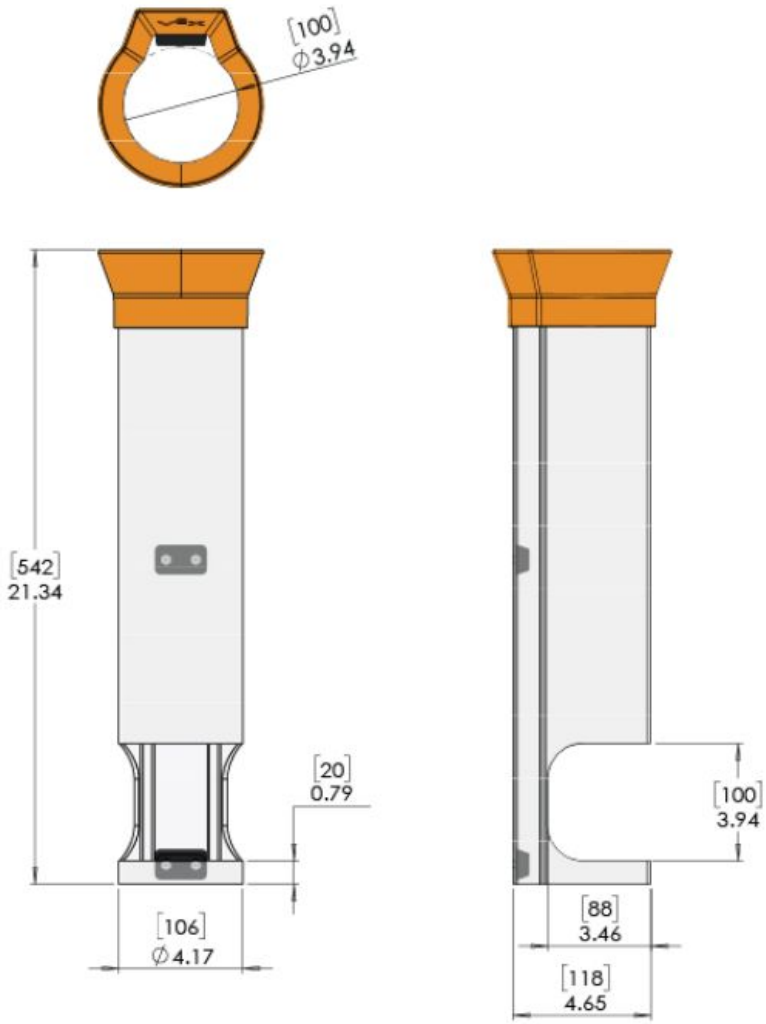
Name: Rosa, Finn

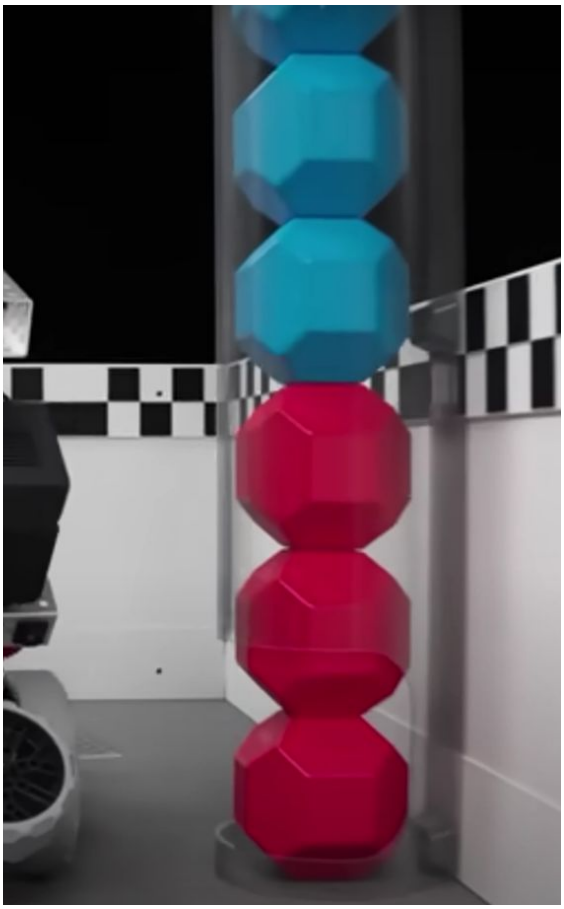
Initial Game Analysis

Centre Goals

Description: There are four “loaders” replacing the standard match loading system held by previous games. These loaders have the capacity for 6 blocks and start the game prepopulated with 3 red and 3 blue. To prevent the block from rolling out there is a small lip at ground level> driving teams are able to load this during any point of the game.

Challenges: These loaders are a primary method of populating the field with blocks and are relatively easy to use. No elevation is needed however deloading the opponents blocks would require time and storage space. Only one block can be taken at a time. Limiting speed at loading can oceer.



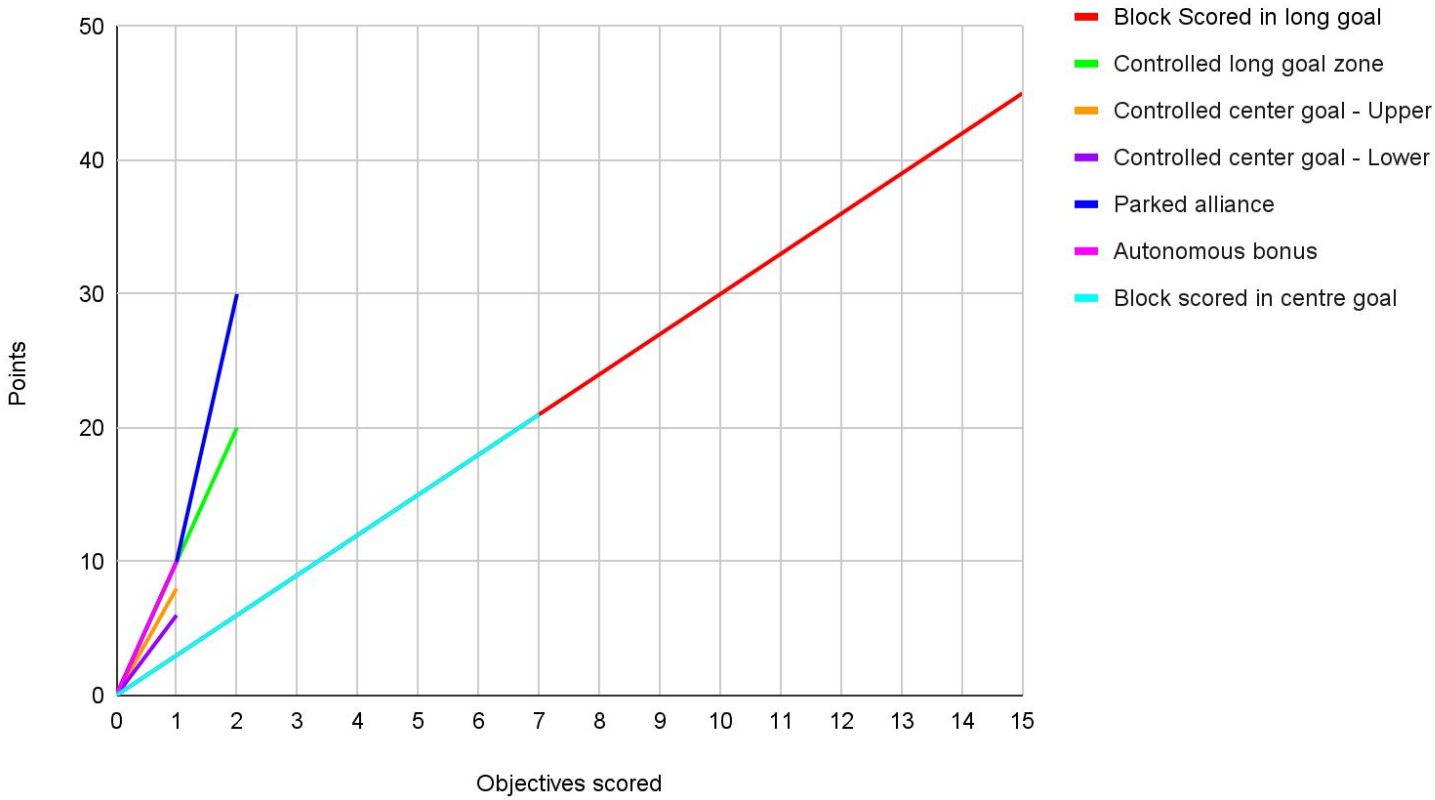


Name: Indie, William

Game strategies

Points

Point overview



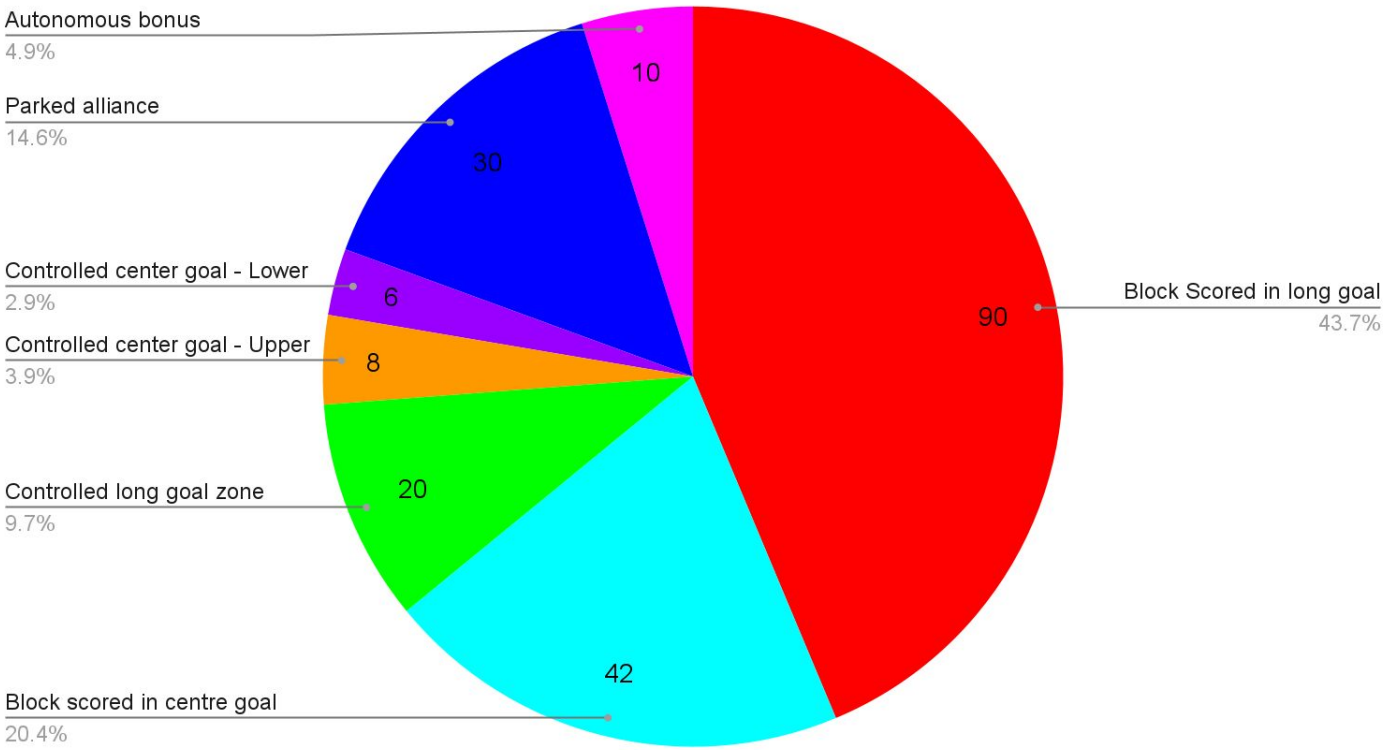
We have plotted this line graph to show the point values of each scoring objective. It appears putting blocks into the long goal has the biggest turnover by far. With a maximum of 90 points per fully filled up goal (excluding the control bonus). The Centre goals come in with the second most points with their value being transferred into accessibility. The double parking bonus also provides a lot of points the main thing that sets it apart is the instantaneousness of which these points can be gained. As for the bonuses they act as a swing factor. Once a bonus has been gained by a alliance if the opposing alliance decides to take the bonus for themselves it swings the score by double the points. For example the long goals. The score would swing 20 points. +10 for the alliance that has taken the bonus and -10 for the team that has lost the bonus. The autonomous bonus doesn't feel very impactful this game. But nevertheless it is still safe way to earn 10 points. Gaining the autonomous win point may well be the autonomous priority this season.

Name: Tom

Game strategies

Points

Points maximums



We have created this pie chart to show the point maximums/the perfect score. 43.7% of the points come from scoring blocks in long goals their main value coming from the amount of blocks that can be scored in them (30). Inherently the long goals don't actually provide more points per block the centre goals value will come from their accessibility and the control bonus. The centre goals control bonus are much easier to achieve as placing 1 block anywhere in the upper goal could give 11 points (3+8).

Name: Tom

Game strategies

Scoring points

Scoring blocks in long goals

- Most points when maxed out (90 pts excluding bonus)
- Stationary large goal and cannot be manipulated or moved
- Could be highly contested throughout the whole game
- Control zones are a bonus (10 pts) but also a swing factor. Once the bonus has been acquired by any team, switching to the bonus to the other alliance would effectively be a 20 point swing.
- Unsafe points

Scoring blocks in top centre goal

- Most points when maxed out (21 pts excluding bonus)
- Highly contested due to being in middle of field.
- Team with most blocks inside (4+/7) gets 8 pt bonus.
- Noticeably lower than long goals.
- At angle from bottom of field (y=-x)
- Stationary, set position and angle.
- Unsafe points

Scoring blocks in bottom centre goal

- Most points when maxed out (21 pts excluding bonus)
- Highly contested due to being in middle of field.
- Team with most blocks inside (4+/7) gets 6 pt bonus.
- Extremely low (slightly above ground)
- At angle from bottom of field (y=x)
- Stationary, set position and angle.
- Unsafe points

Controlled Long goal

- Most points when maxed out (20 pts)
- May not be the main focus but once the long goals become full, They could become the deciding factor.
- Swing factor when bonus is shifted to the other team the point difference is x10
- Unsafe points

Game strategies

Scoring points

Controlled Upper centre goal
- Most points when maxed out (8 pts)
- More accessible than long goal control zone
- Has high value all throughout the game
- Swing factor when bonus is shifted to the other team the point difference is x10
- Unsafe points

Controlled Lower centre goal
- Most points when maxed out (6 pts)
- More accessible than long goal control zone and Upper centre goal
- Has high value all throughout the game
- Swing factor when bonus is shifted to the other team the point difference is x10
- Unsafe points

Scoring parking area
- Max Points per game (30)
- Most valuable at the end of the game with minimal time left
- Sacrifices control of the goals
- Only 8 points if one bot within area.
- Safe points

Autonomous bonus
- Max Points per game (10)
- Control zones could be highly valuable as they will serve as king makers for the autonomous bonus
- Scoring blocks early could result them in being pushed out
- Safe points

Autonomous Win Point
- 1 Win point if achieved regardless if win or loss
- The set tasks align with getting a lot of points in autonomous as a whole

Initial Game Analysis

Significant robot rules

While reading through the manual there are some rules which are significantly different from previous years. These are important to highlight before designing our first robot.

Rule: SG2: No horizontal dimension may exceed 22” (558.8 mm) at any point during the Match.

Analysis: This rule contradicts R5: Robots must fit within an 18” x 18” x 18” volume (At the start of a match) since a 18”x18”x18” sized robot could have a 25” horizontal dimension. We are unsure of what this means

Rule: SG3: Vertical expansion is limited

Analysis: No part of the Robot may exceed an overall height of 22” at any point during the Match from the ground. Overall a simple rule. We don't see height as a significant aspect of this game. But it will be nice to have more freedom with large moving mechanisms.

Initial Game Analysis

Significant Gameplay rules

These are important to highlight before designing our first robot as they will dictate how we approach the game.

Rule: SG9 Match Loads may be introduced during the Match under certain conditions

Analysis: This means you can only match load in the driver controlled period and you can only take them through the bottom opening.

Rule: SG10 Don’t reach inside enclosed sections of Goals.

Analysis: This simply means we will have to indirectly interact with the blocks to claim control zones

Rule: SG11 Park Zones are protected during the endgame

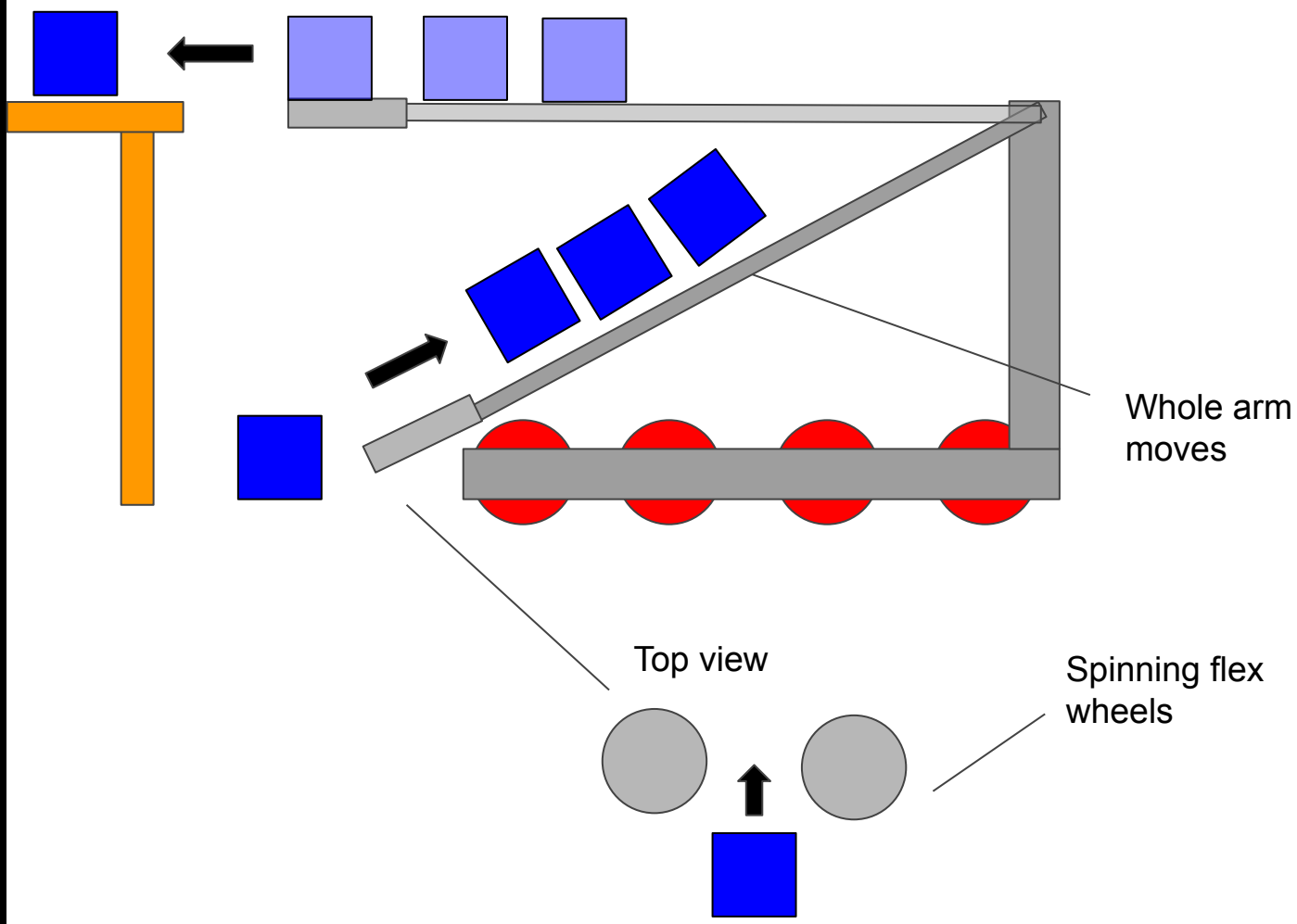
Analysis: This is fairly common and effectively means in the last 20 seconds you cannot touch the opposing parking zone

Robot Concepts

Concept 1

This first concept is called the Tray. essentially the robot drives around picking up blocks from the ground using the 2 horizontal flex wheels. These then go onto the arm and when we are ready to score we can raise the arm to either the same height as the long goal or the upper center goal height. This robot concepts strengths lie in:
- Simplicity
- Time efficiency

While still remaining competent in other categories



Name: Tom

Robot Concepts

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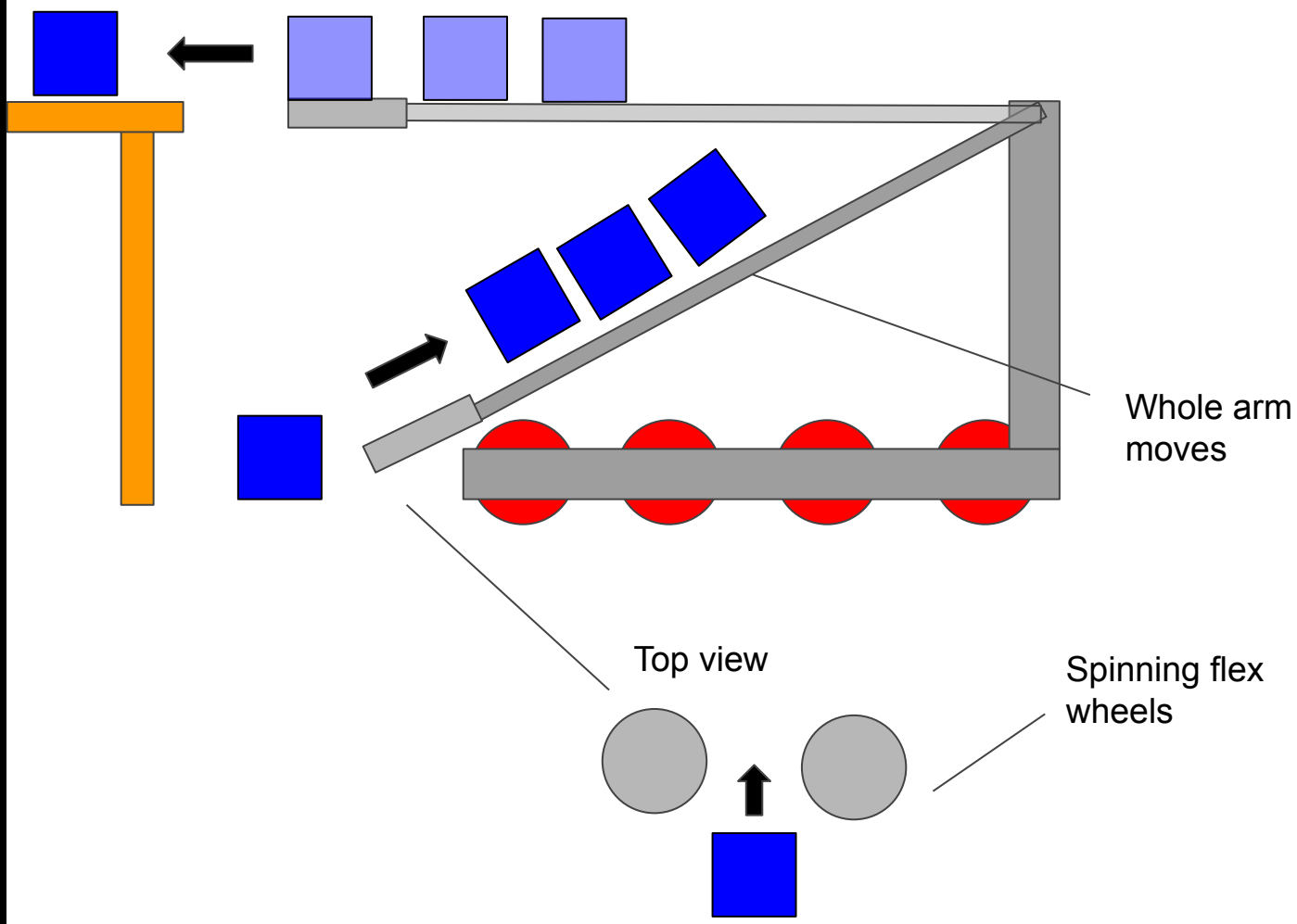
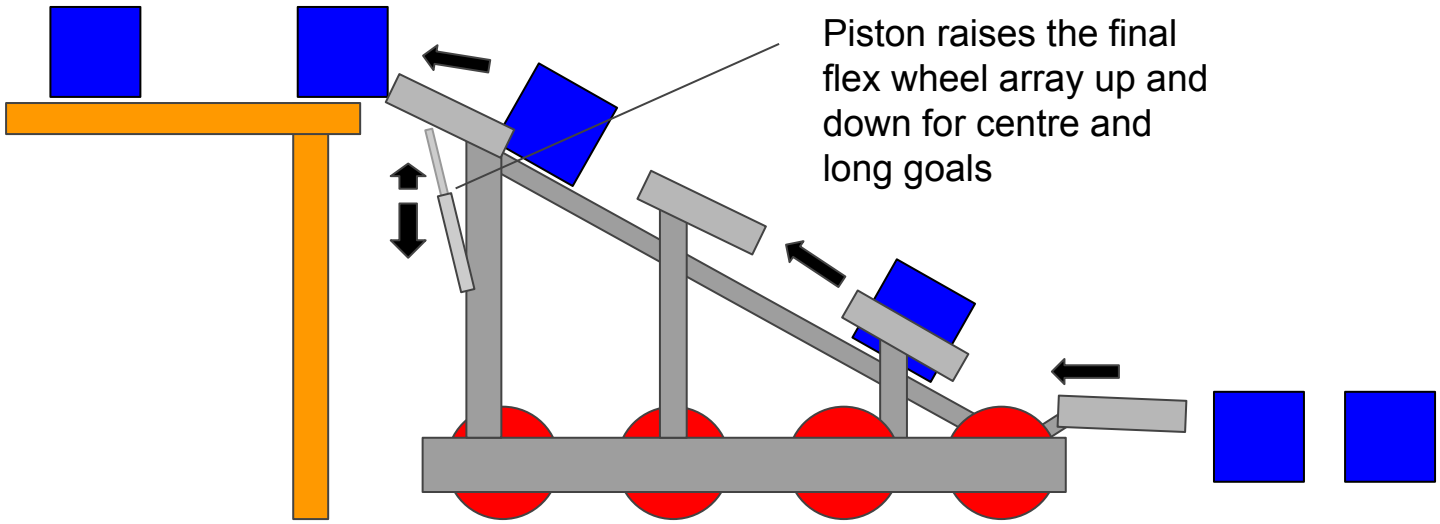


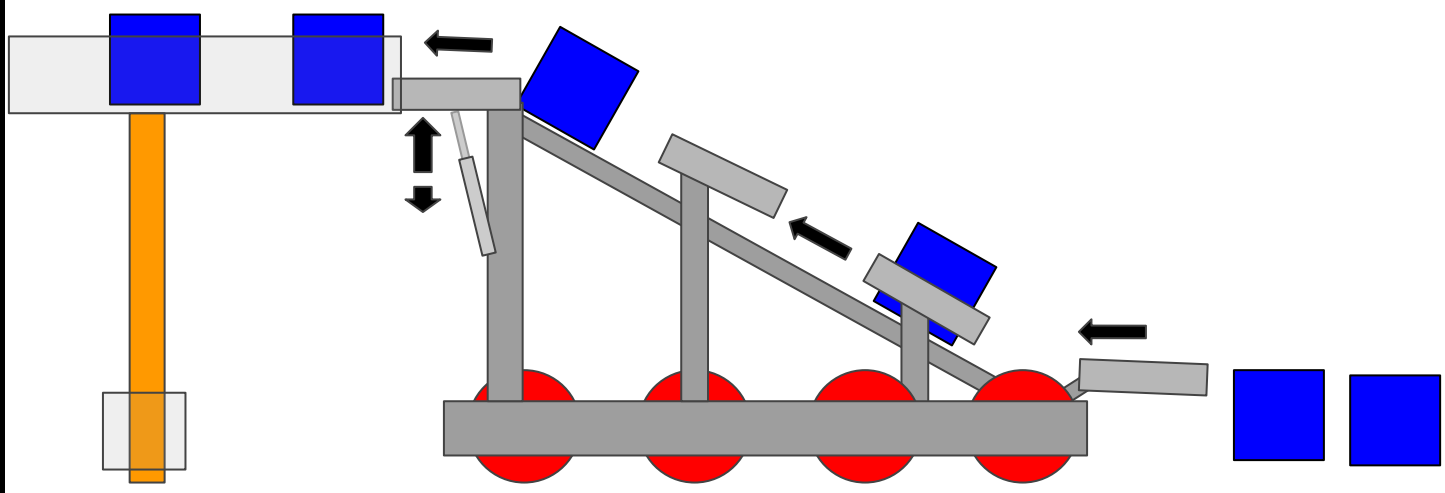
Name: Tom

Robot Concepts

Concept 2

The second concept is the flex bot, where blocks are collected and carried up to the top of the bot using flex wheels. There is a piston at the edge that controls the angle of the final flex wheel to easily and precisely adjust the position that the blocks are ejected at. This makes it easy to score in any height of goal and increase the points we can get from scoring, but descoring is weak. Flex wheels are meant to be used to intake and shoot objects, but they do not have much launch power.



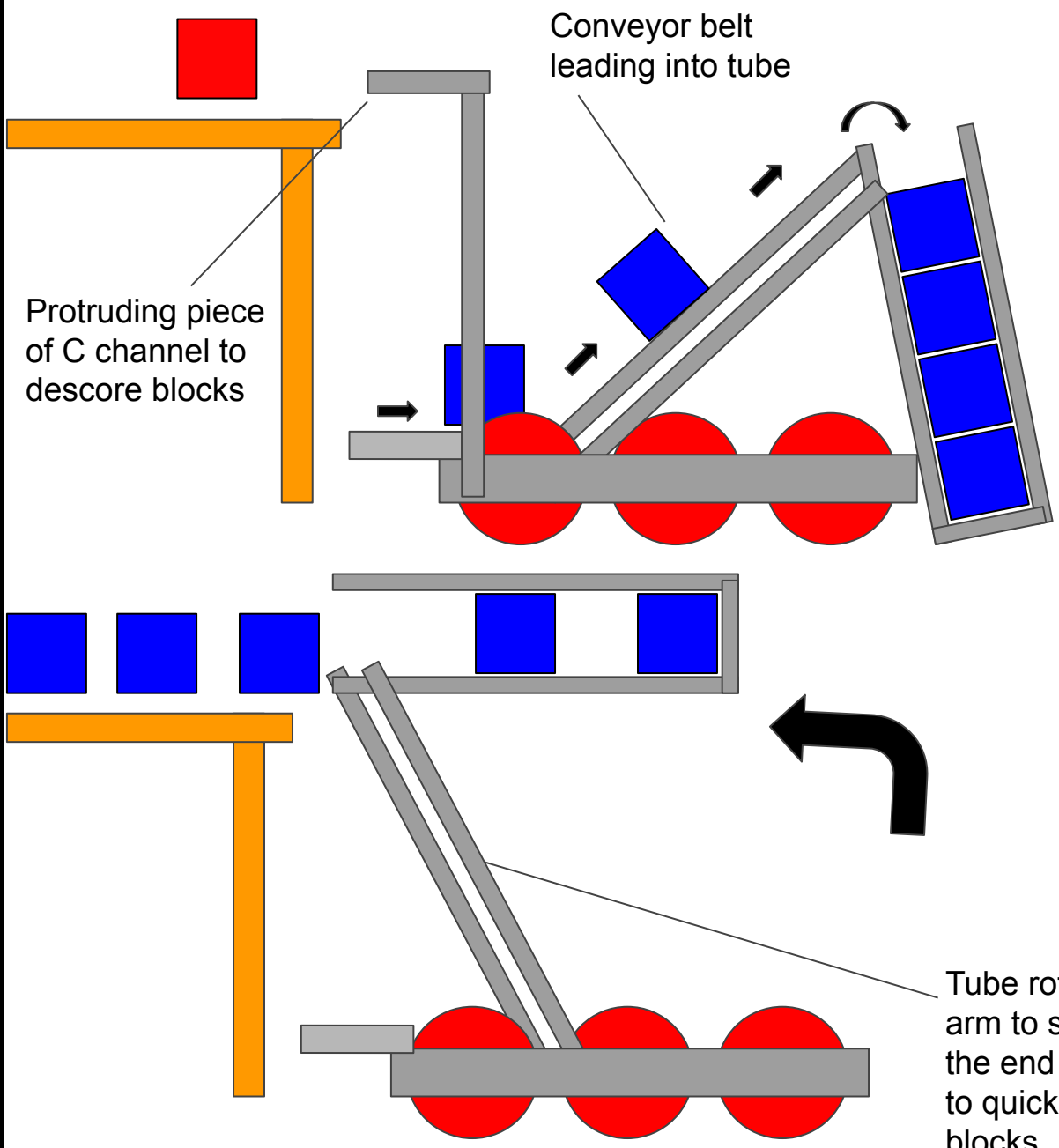


Name: Tom

Robot Concepts

Concept 3

The third concept is the Slam Arm. The bot moves around and collects blocks to carry up a conveyor belt which carries them into a tube at the top. When the tube is full, it is rotated up to the height of the goals, which can be easily controlled with different angles for the centre goals and long goals. When it is slammed into the goal, all the blocks inside the tube are scored quickly. Due to the size of conveyor and tube though, it isn't the most size efficient, especially for the parking bonus. Descoring is also a big part of the game and this bot has a long arm with the purpose of descoring the other team's blocks quickly to make room for the blocks in the tube to be scored which is a strength.



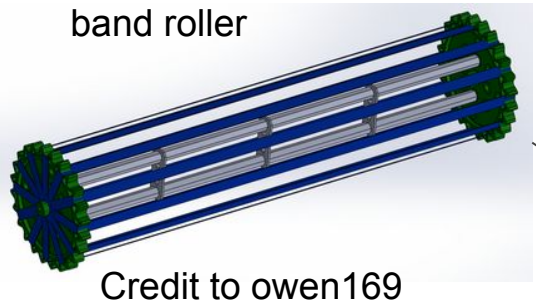
Name: Tom

Robot Concepts

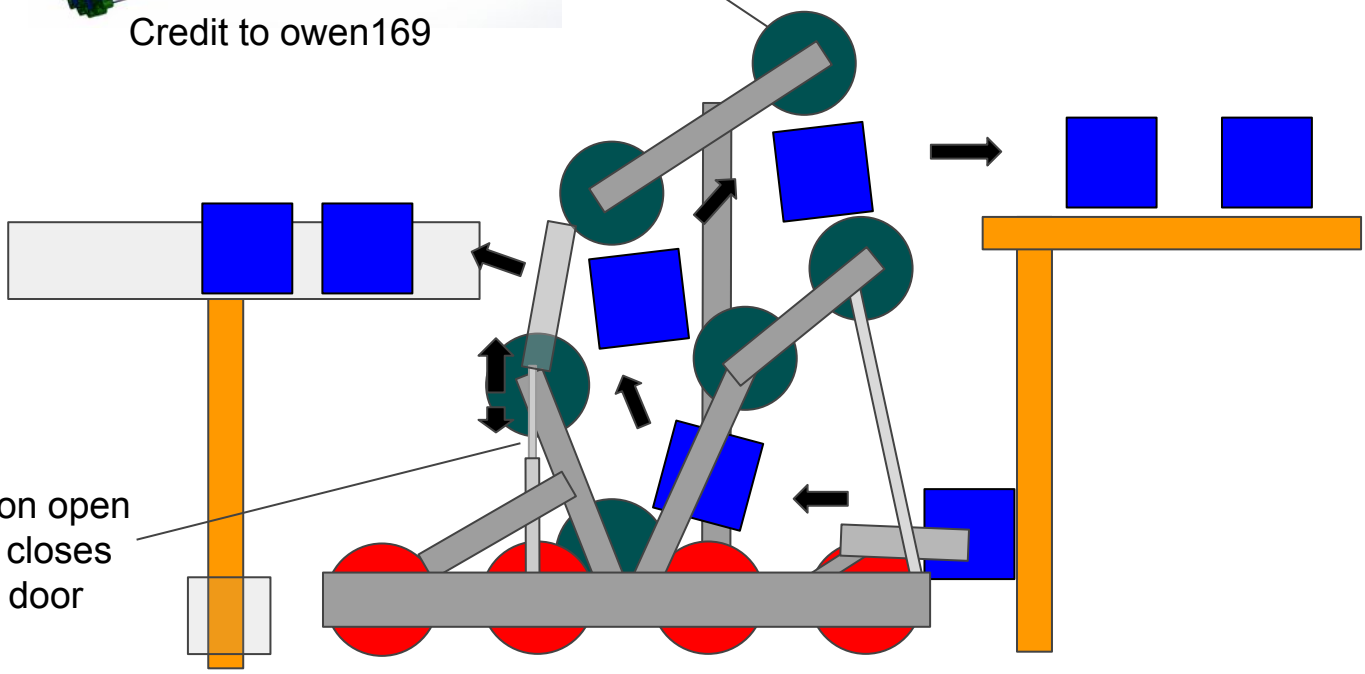
Concept 4

This robot concept is the Flex. The bot moves around and collects blocks through a bottom front intake, which is carried up a series of rubber band rollers with different points for outaking depending on the different goal heights. There is a piston to open and close a trap door for the mid goal height to outtake blocks through there, whereas otherwise they outtake through the top system into the long goals. This is strong with the ability to score in all the goals, allowing us to have a chance at the middle and long goal control bonus, but there is room for error, where if the piston isn't controlled perfectly, blocks could come out or not go out where they need to.

Example of a rubber band roller



Credit to owen169



Piston open and closes trap door

Robot Concepts

Decision matrix

This matrix demonstrates the ratings of different aspects of our robot concepts. We rated them on a range of different things, which are their complexity, block scoring efficiency, time efficiency, parking efficiency, and their ability to counter opposing robots. By seeing their strengths and weaknesses numerically displayed, we could see what bots are the overall best or worst.

Bot Name	Complexity	Block Scoring Efficiency	Time Efficiency	Parking Efficiency	Counter watch
Tray	4	6	5	4	6
Flex	7	8	7	7	5
Sack	8	8	8	4	8
Slam arm	8	5	7	5	8

Robot concepts

Design change

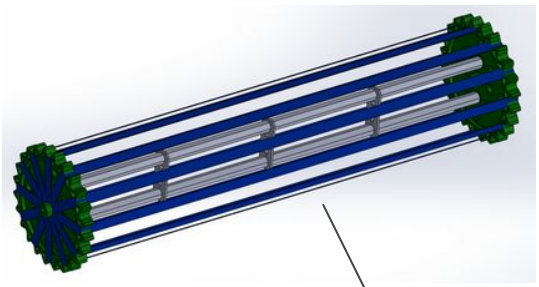
Important:
Over the span of the last 2 weeks we have unfortunately received news that both William and Finn with a heavy heart will have to step away from the immediate team due to personal reasons. Until early 2026 possibly after New Zealand nationals. Both William and Finn want to stay on the team and keep supporting in the background but we acknowledge there are limitations of what they can do while away from the team.

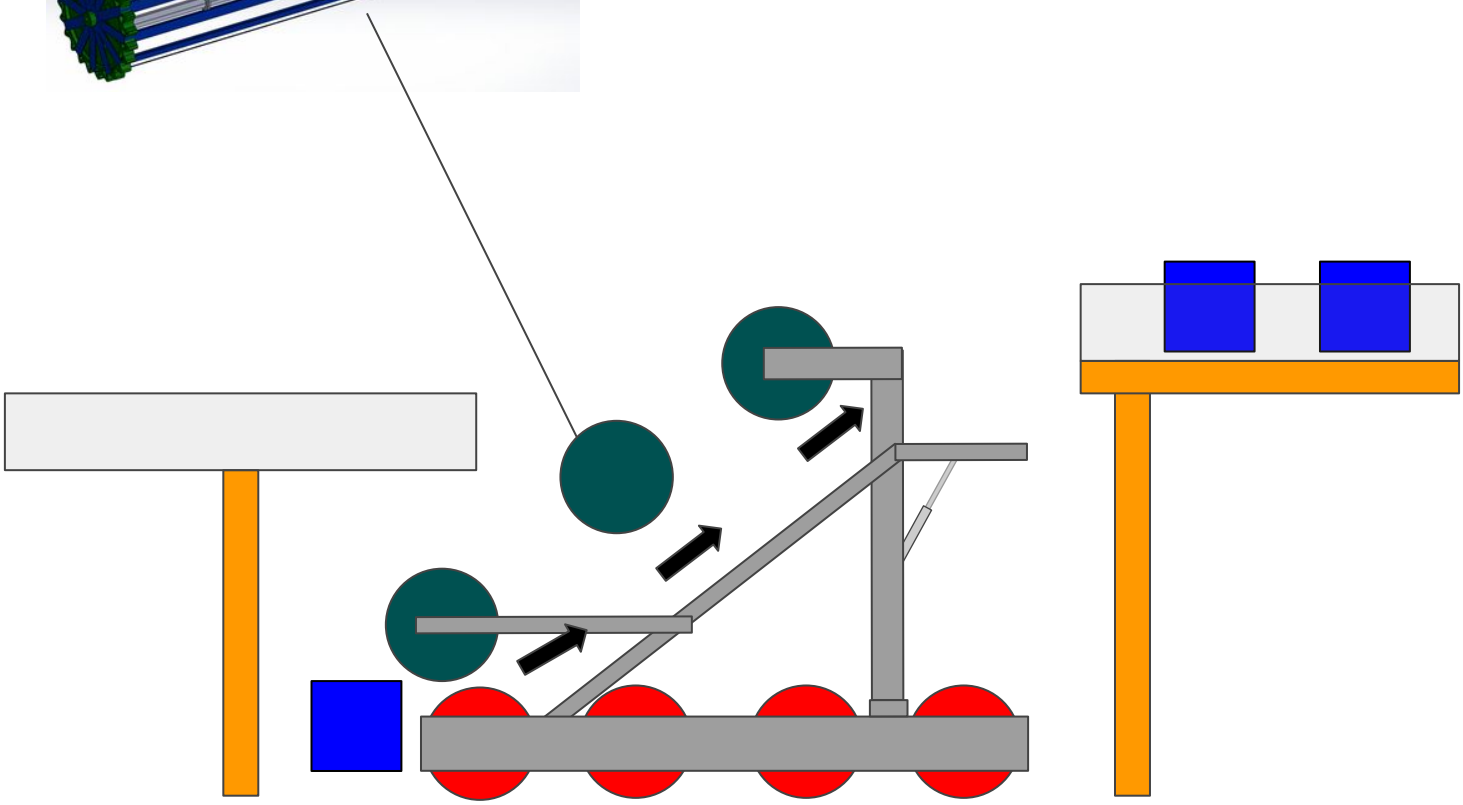
We've realised that recruiting a new teammate comes with its challenges. While Rosa does have a strong STEM background she hasn't been extensively been involved with something like VEX robotics. While theoretical work like game analysis, game strategy and robot concepts are relatively easy to grasp understanding building technique and philosophy is something that is learnt through experience and doing. As mentioned above we are also now effectively a 3 person team since William and Finn have had to essentially temporarily leave the team. Rosa will now be primarily the new programmer after Finn had to temporarily step away for personal reasons from the team. Even with this dedicated role we still find it important for everyone in the team have a relevant understanding of building, CADing, Driving, programming and design. Therefore we have decided to set our robot 1 initial concepts aside for the moment and design a much simpler robot to help Rosa get settled into building and VEX as a whole. There are no tournaments planned until late july so this step backwards in our design ambitions seems like the right one to move forward.

Robot Concepts

Concept 4

For our new simple concept we have come up with a simple ramp bot with 3 rubber band rollers. That will bring the blocks up up the ramp to the goals. There is a piston that raises up a piece of C channel for the long goal and it can be put down for the middle goal and the intake can be run backwards for the lower middle goal.





Name: Tom

Monthly goals

June

1. Implement Rosa into the team and robotics ecosystem

Completed on: 30th June 2025

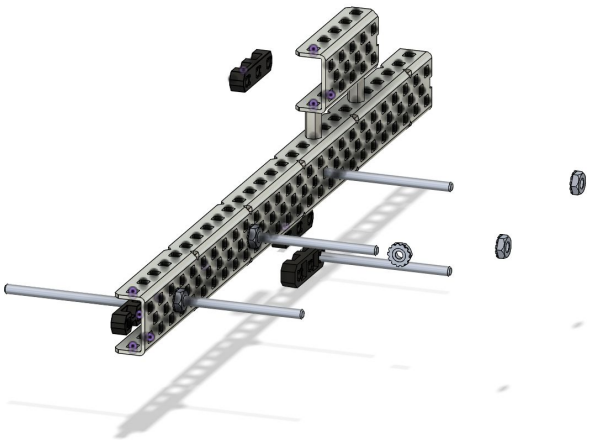
2. Build a complete robot

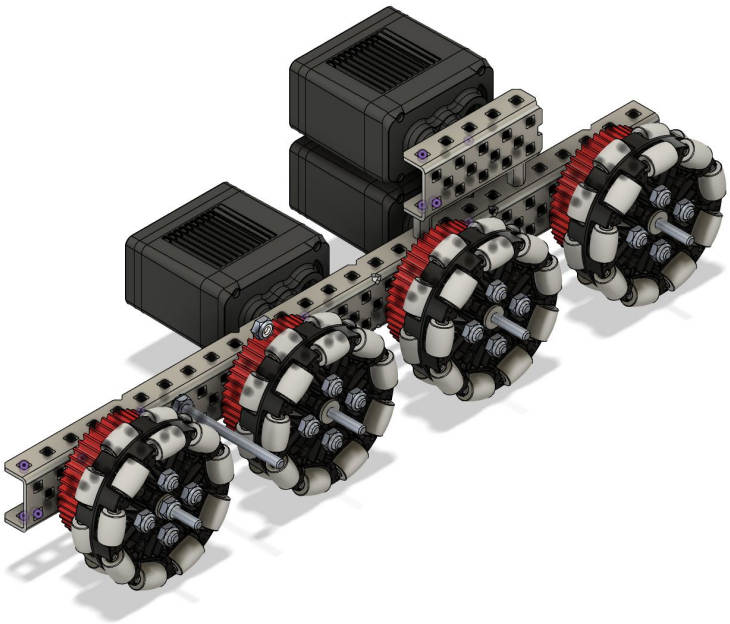
Completed on: not completed

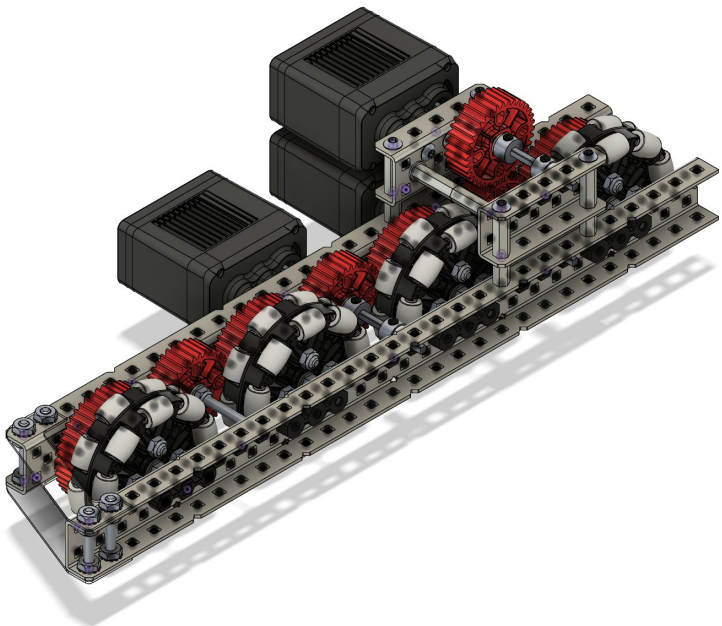
Note: These pages have been edited to add the dates the goals they were/were not completed on. These dates will have been added on the day they were completed on or in the case of non completed goals they will have been added on the last day of the month

Name: Tom, Indie, Rosa

CAD
Update 1







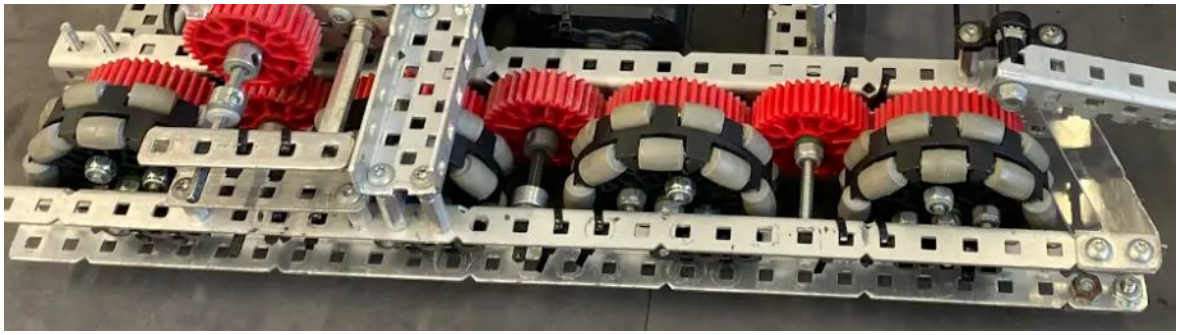
We had Rosa remake part of our last season's drive to get familiar with fusion 360 and our library and an understanding of CADing

Name: Tom

Building

Drivetrain update 1

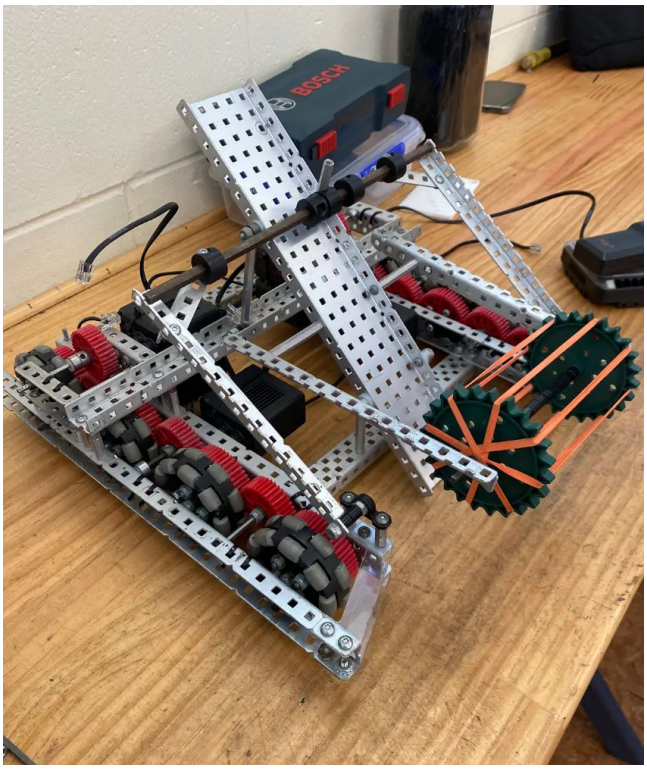
Below are pictures of our drive train we have chosen to go with the same philosophy as previous seasons. The more wheels the more surface area to spread the robots weight therefore the less the robot will sink into the tiles and reduce out speed, acceleration and consistency in autonomous period and skills. We are running standard 11W motor with blue 600 cartridges driving a 36 tooth gear which is driving a 48 tooth gear with the 2.75” anti static omni wheel. We believe this specific combination of motors, gears and wheels gives us the most optimal balance between speed acceleration and compactness.



Name: Tom

Building

Intake update 1

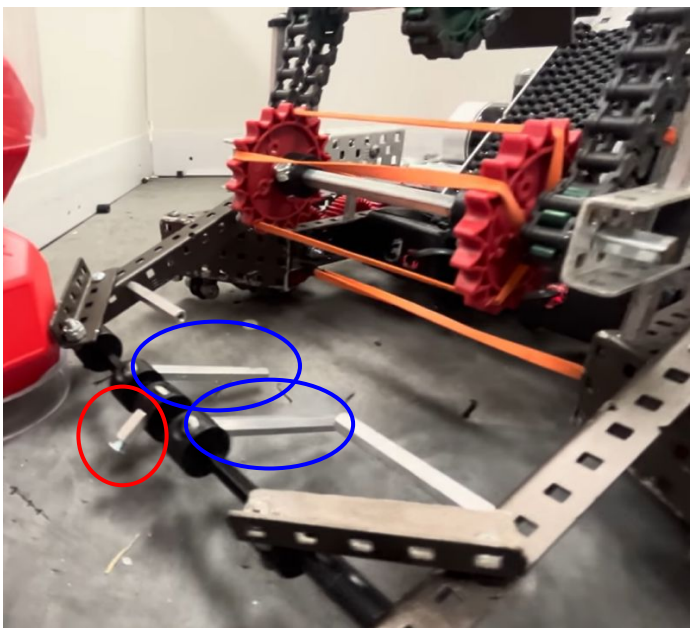


Picture shows the ramp being added and a front stationary rubber band roller. As Well as a new addition.

While building the intake we also saw seen some match load mechanisms.
We like this specific one by 44252A because it doesn't use any motors and allows us to keep our top intake instead of side rollers so we intend to try it out on this robot and expand further after we grasp a deeper understanding of the match loader

Credit to 44252A

In the community this match load mechanism is being referred to as a little will. From our observations we have discovered what will probably be the fundamentals of matchloaders this season. The small front standoff is used to get under the blocks and then 2 larger standoffs allow the blocks to slide out of the match loader over the small lip at the bottom. Our one problem with a standoff design like this is that it's not very adjustable which is necessary for tuning. We suspect a bent custom plastic piece might be a better option in the future



Monthly goals

July

1. Build a complete robot

Completed on: not completed

Note: These pages have been edited to add the dates the goals they were/were not completed on. These dates will have been added on the day they were completed on or in the case of non completed goals they will have been added on the last day of the month

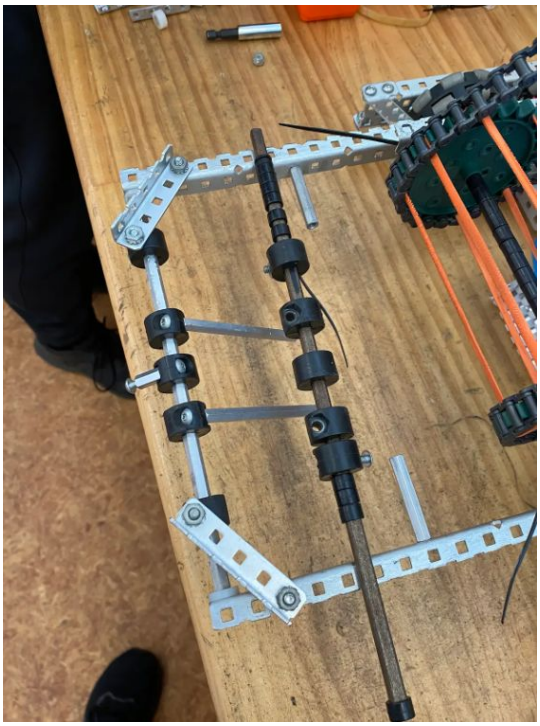
Name: Tom, Indie, Rosa

Building

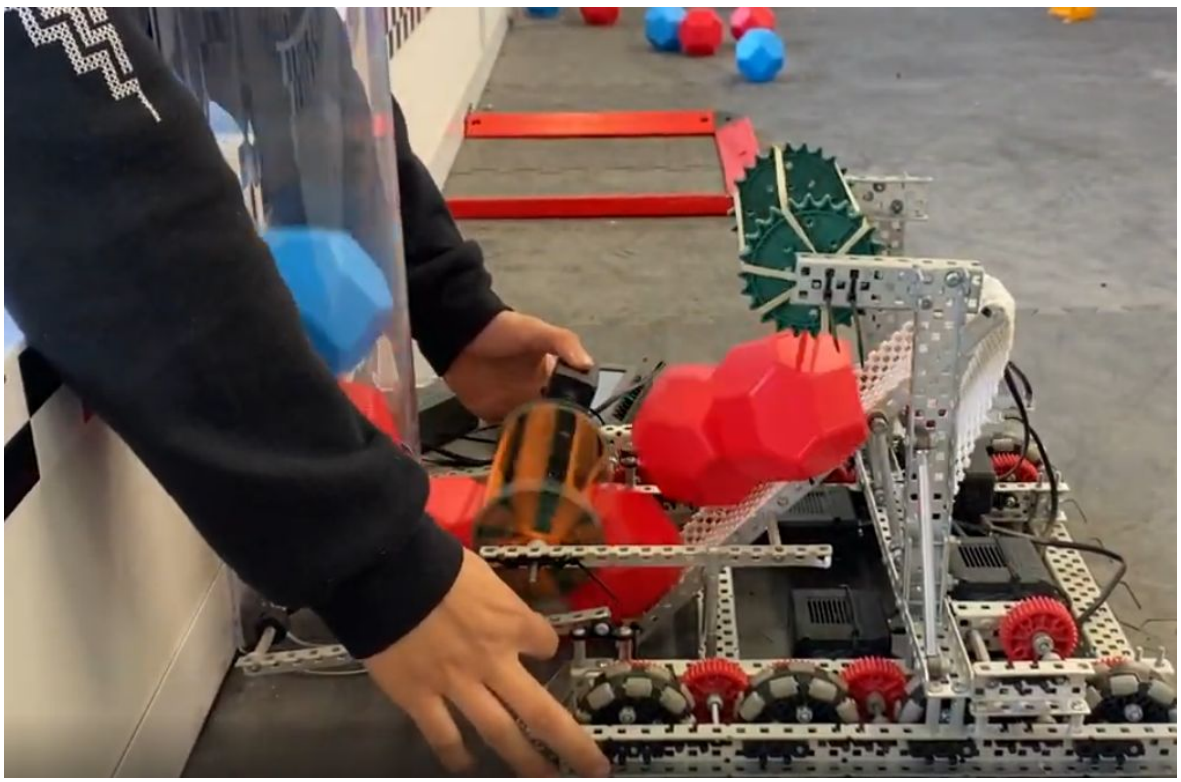
Intake and match load update 2

As stated before we began building this robot we do not intend to use this robot to compete but rather to get a feeling of the game and its elements

We aren't confident a long standoff like this won't bend in a match since other robots will be trying to prevent us from match loading while we are trying to match load. So we are also trying to see if we can switch it out with a high strength shaft.



Below is a picture of our match load and front roller of our intake successfully intaking blocks out of the match loader. We have also discovered due to the blocks ball like shape we need to put grip mat on the ramp otherwise it will just spin in place. Essentially rolling it up the ramp



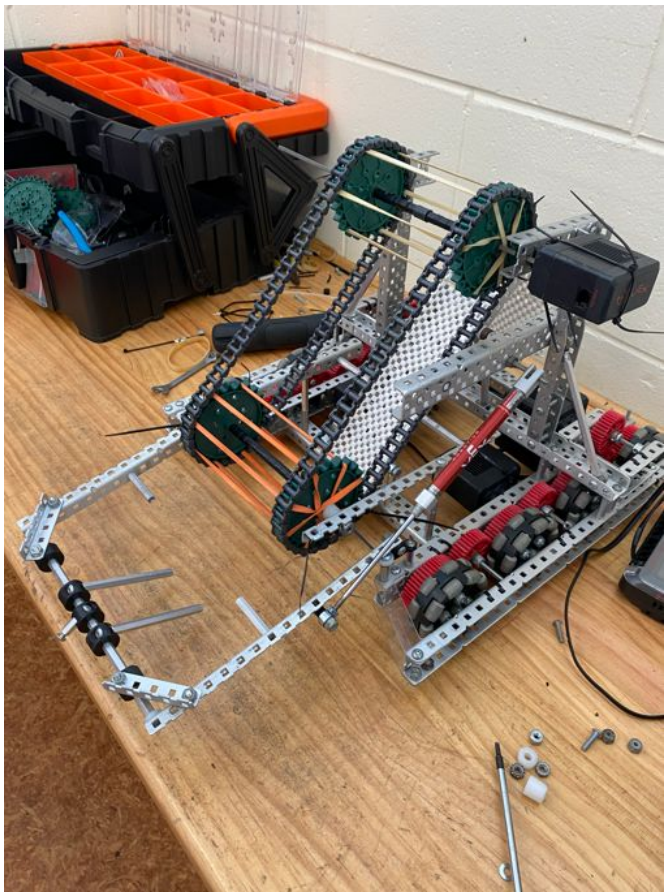
Name: Tom

Date: 12 July 25

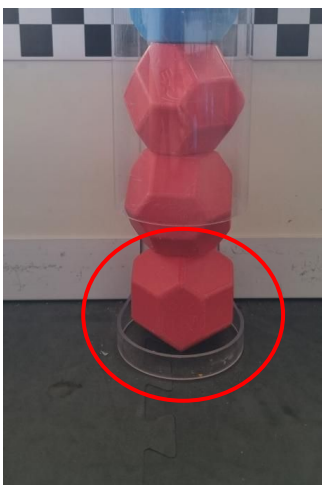
Building

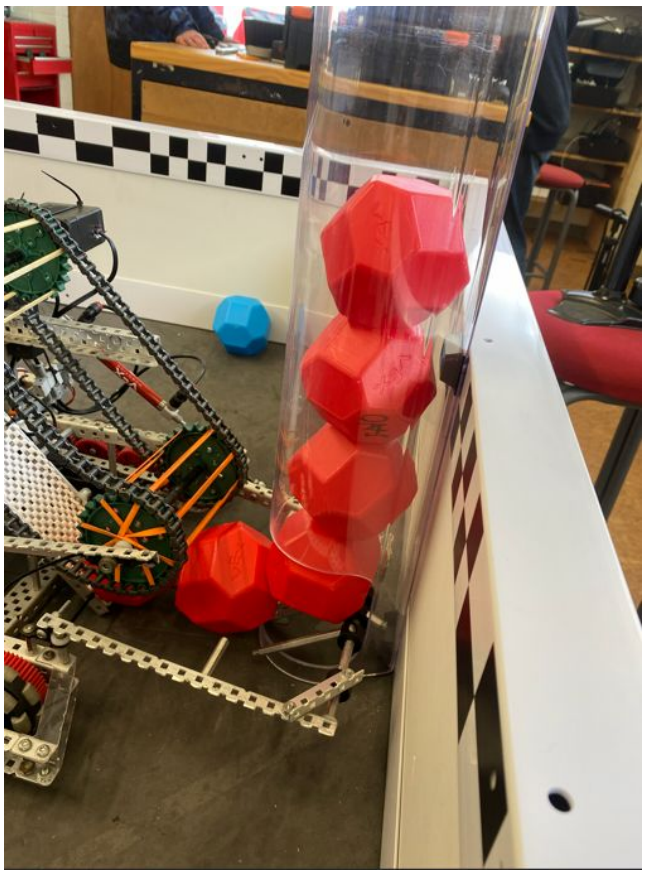
Intake and match load update 3

We have added another roller at the top of the intake and connected them with chains so we only have to use one motor to drive the intake. We have also added a piston to bring the match loader mechanism up and down



One thing we have noticed is that for the match loader to properly work it must be at a very specific position which most likely cannot be replicated in a match. We also noticed that when the block is at this specific angle the match loader can't get underneath





Name: Tom

Completed Robot
Evaluation

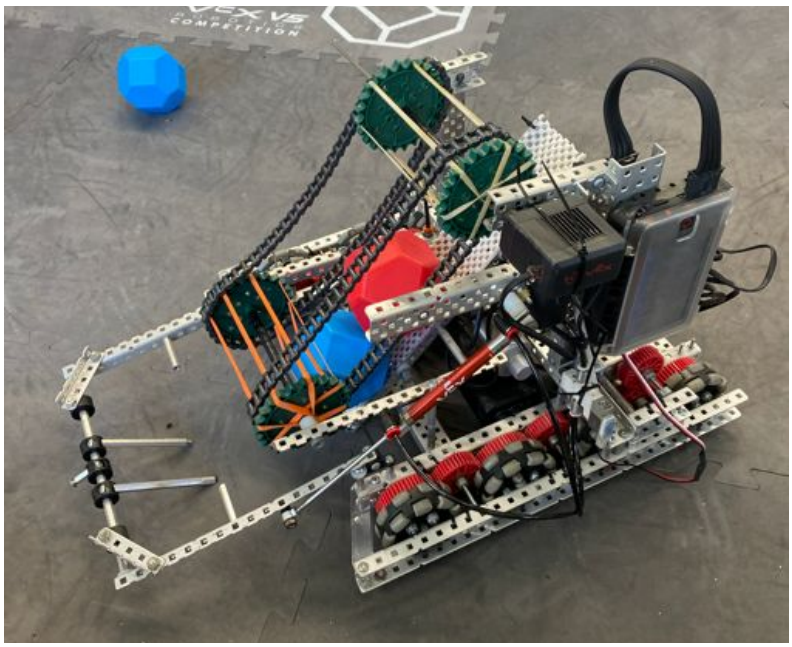
While the robot is not fully complete and we have not added the piston extender ramp for the long goal nor made any extra improvements or refinements we are happy with our discouverys and the learning that has been done.

Drivetrain: As expected a good balance between speed, torque and acceleration. We want to stay with the 36 tooth and 48 tooth ratio because out of the 7 different gears VEX offers. The 36 tooth and 48 tooth are the 3th and 4th smallest gears making it easier to go over the parking barrier. While we can go over the parking barrier with this drive we can only go over it backwards where the wheels are more exposed and there are no gussets. Some potential changes we would like to make to the drivetrain include: switching to the bigger 3.25” wheels from the current 2.75” ones, Making the wheels more open, mounting the wheels lower on the drive C channel.

Intake: Rubber band rollers work really well to move the blocks up in the intake but we are aware that the bottom front roller’s rubber bands can get stuck on other peoples robots pretty easily. So we want to explore flex wheels as an option for that front roller. We also now understand the importance having gripmat on smooth surfaces in the intake otherwise the blocks will just spin in place.

Matchload: We like the concept 44252A has come up with but after trying it for ourselves we think the concept is good but the execution is too hard and want to try using polycarb to recreate the shape the standoffs make. We are also very conscious about the bottom lip of the match load and how fragile it is. So we want to find a good way to stop the match loader from going down too far.

We are happy to move on to the next design cycle and review new ideas based on robot 1



Name: Tom

Monthly goals
August

1. Attend a tournament
Completed on: 16th August 2025

2. Build a complete robot
Completed on: 15th August 2025

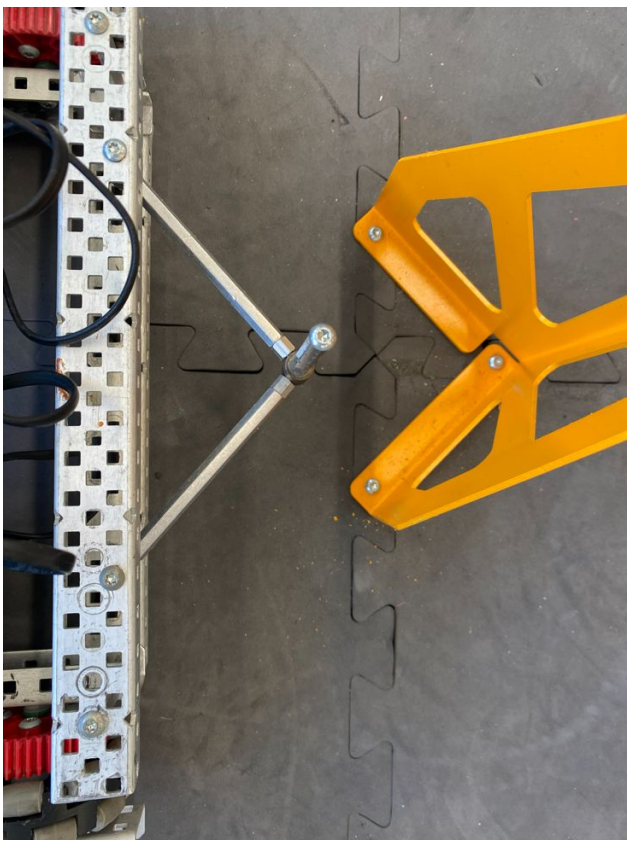
Note: These pages have been edited to add the dates the goals they were/were not completed on. These dates will have been added on the day they were completed on or in the case of non completed goals they will have been added on the last day of the month

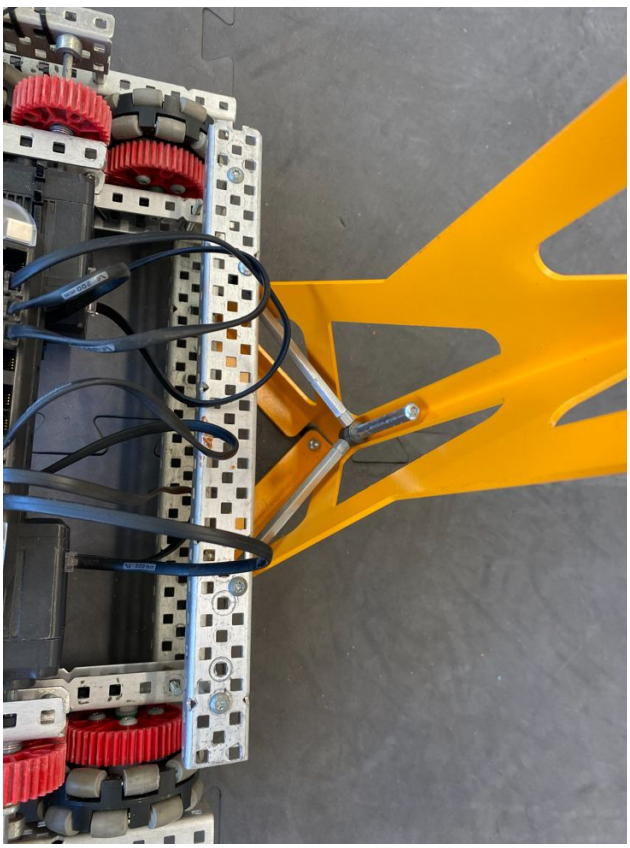
Name: Tom, Indie, Rosa

Building
Alignment

Before we fully take apart the robot for the rebuild we wanted to test a long goal aligner. From testing we concluded this should held up line up with the goals and help us score more consistently in driver and autonomous period.

We expect to encounter defense from other robots to stop us from scoring our blocks. This aligner should help us to stop getting pushed of the goal as easily when kept pressed into the goal.





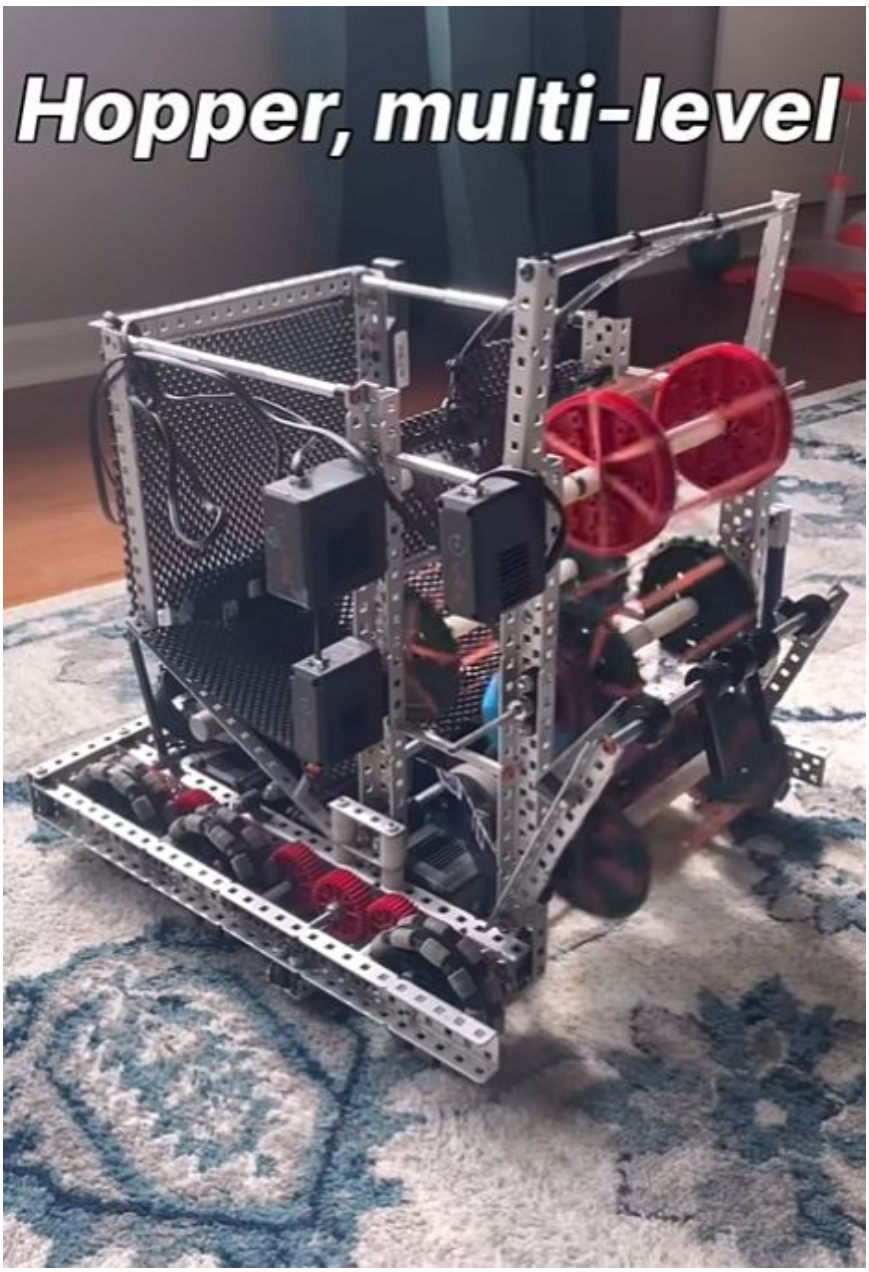
2941H

Design Cycle 2

Robot Concepts

Concept change

After some research branching out into other teams designs and ideas online. We've learnt that hopper or storage bots might be a better place to start. Having the ability to store at least 7 blocks seems very important so that we can get control zone in the long goal in one go. Robots with smaller capacities won't be able to score a lot of blocks in the goal at once and will have to leave the goal and collect blocks leaving the goal unattended for another robot to come score their own blocks instead or descore our blocks. We refer to this as a “cycle”. A hopper bot like this can store a lot of blocks.



Credit to 9039H

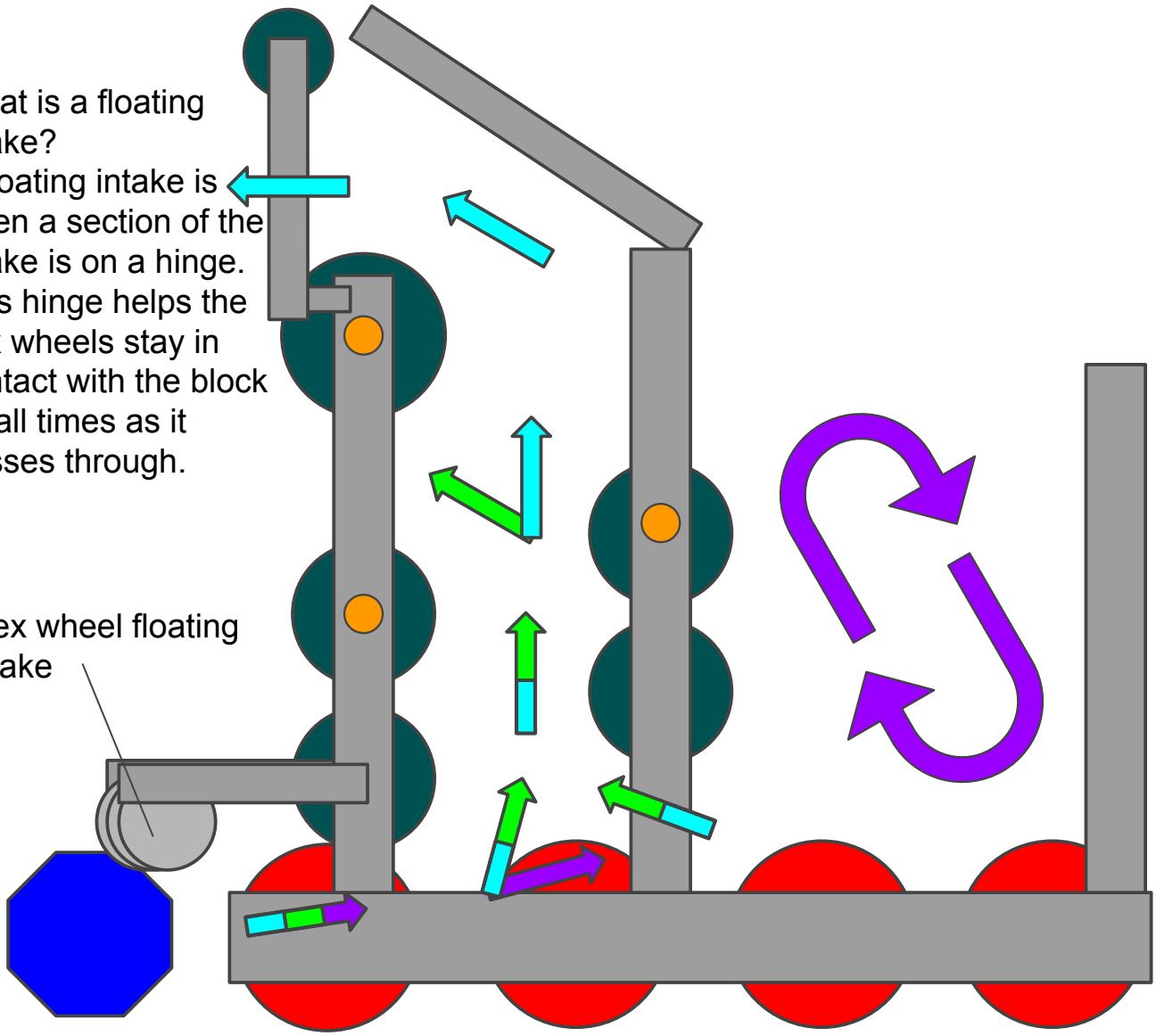
Name: Tom

Robot concepts

Concept 1

This is the hopper design we are trying to store as many blocks as we can and on demand score them into the desired goal. The **purple path** allows the blocks to go from the floating intake to the hopper storage where the blocks will just idle and sit until they are ready to be scored alternatively the **purple path** can be reversed to score blocks into the lower center goal. The **green** path sends the blocks from the hopper or directly from the floating intake to the middle goal. The **cyan** path brings the blocks from either the floating intake or hopper storage to the long goal. Due to our motor allocations, by simply spinning our 3 **motors** forwards or in reverse we are able to achieve all of these different combinations of actions.

What is a floating intake?
A floating intake is when a section of the intake is on a hinge. This hinge helps the flex wheels stay in contact with the block as all times as it passes through.

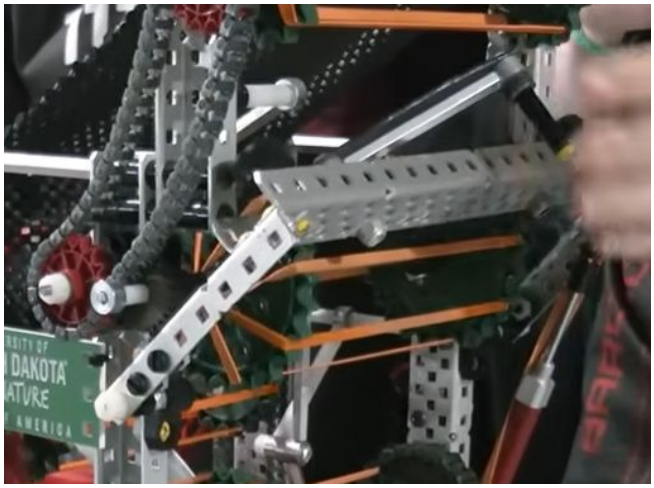


Name: Tom

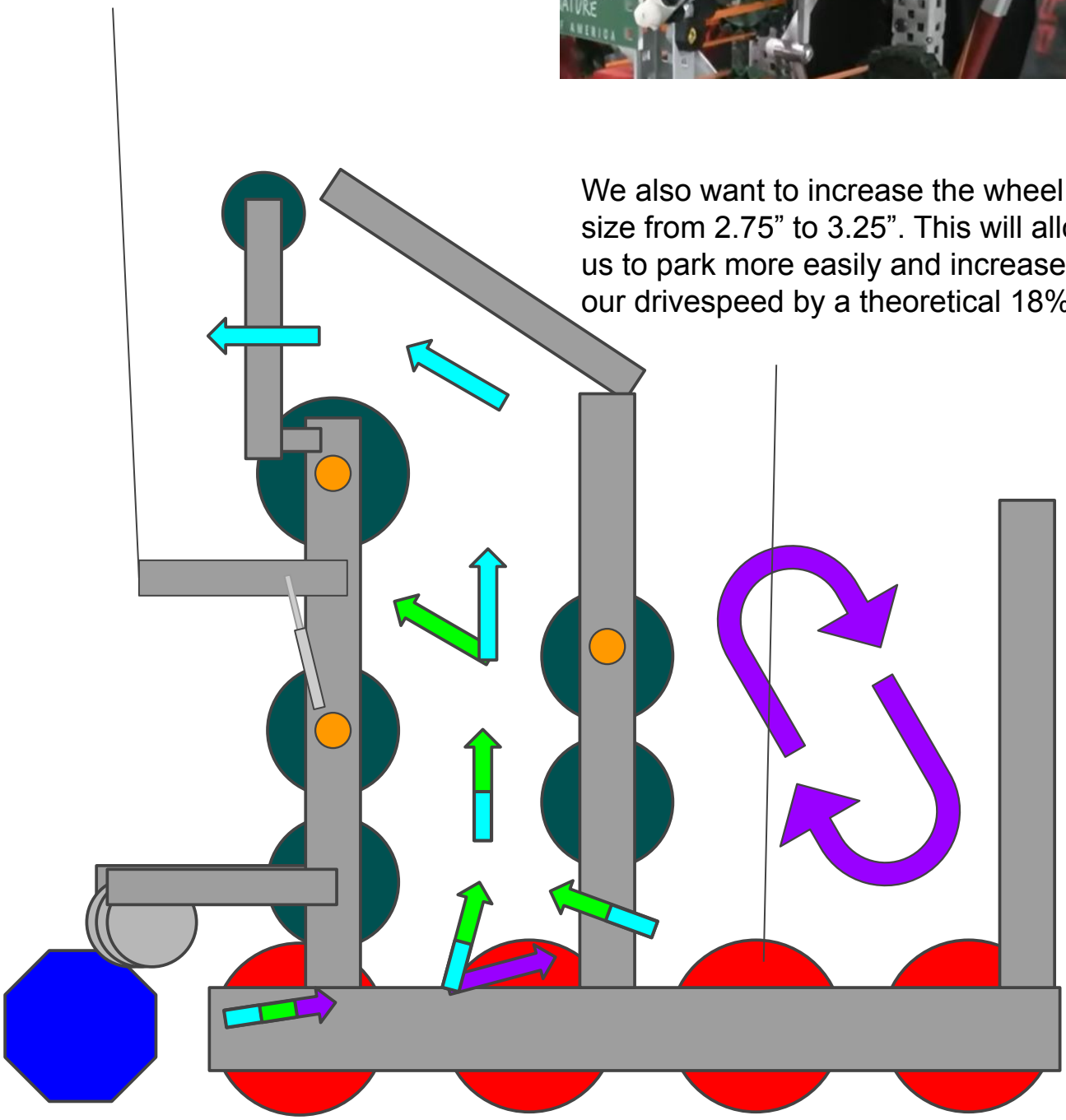
Robot concepts

Concept 1

We also wanted to add the standoff off aligner here but after seeing a flip up piston design that doubles as a long/middle goal descore mechanism by 11101B we want to put ours on a hinge like that as well.



We also want to increase the wheel size from 2.75” to 3.25”. This will allow us to park more easily and increase our drivespeed by a theoretical 18%



Name: Tom

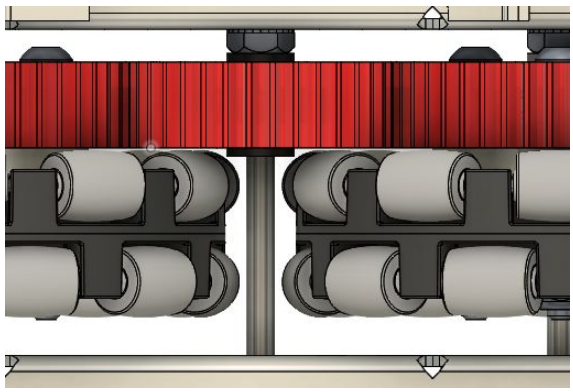
Date: 2 Aug 25

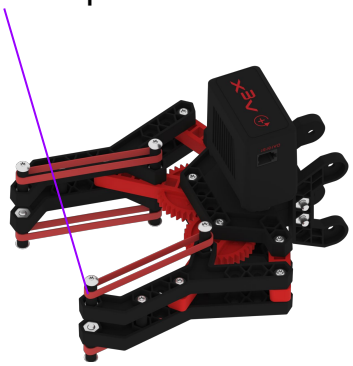
CAD
Purpose

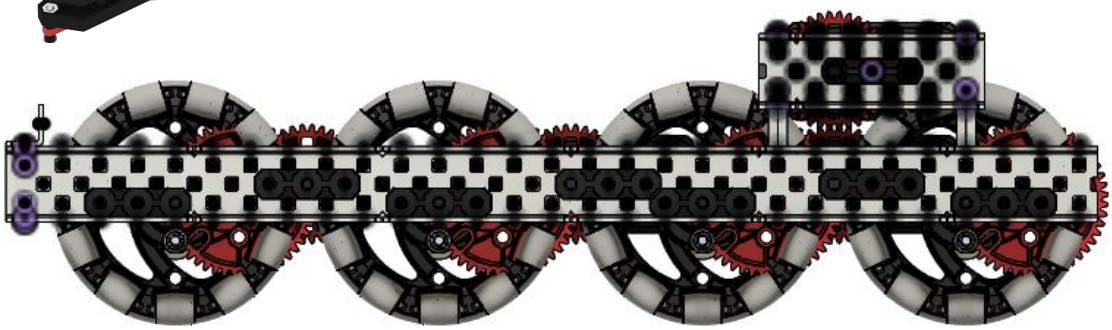
Many teams CAD their robots fully before starting to build them. But our purpose for CAD is slightly different. Rather than creating a complete robot we aim to plan out and CAD important structural features like fundamental bracing and for example main intake structure. This helps us make sure that fundamental mechanism will fit and mesh together on the robot nicely.

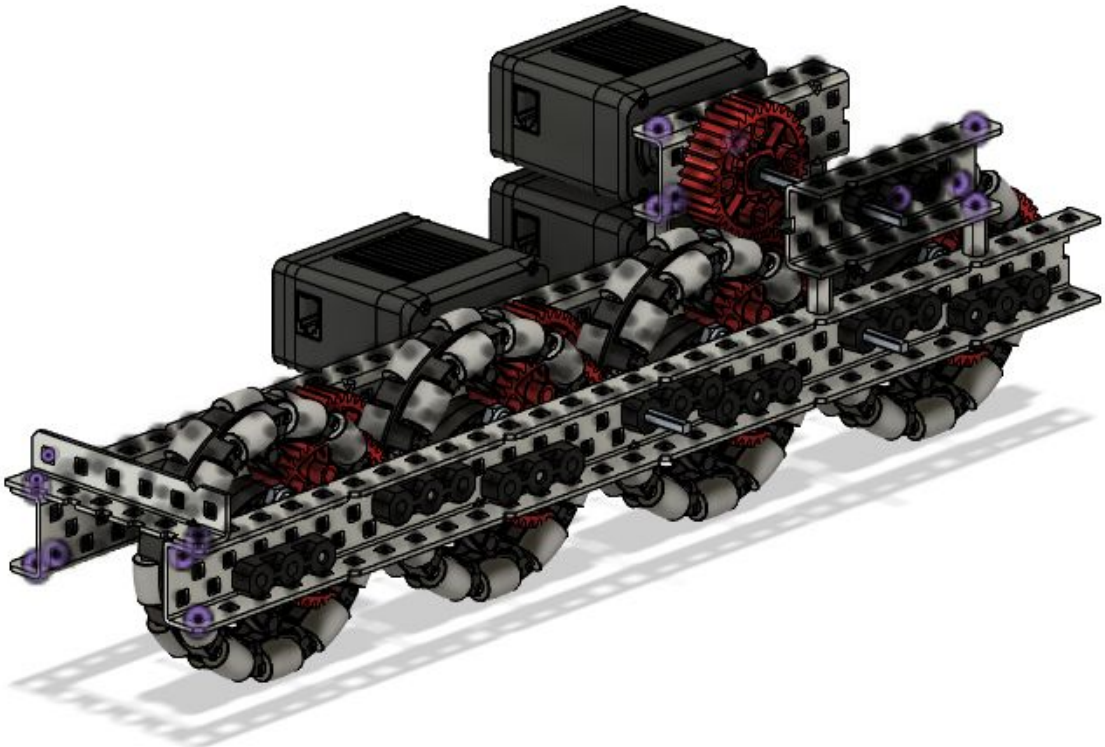
CAD
Update 1

This is the drive we have come up with. It is exactly the same gear ratio (36t-48t) 6 11W 600 rpm motors the only difference is the 2.75” antistatic omni wheels have been switched out for 3.25” omni wheels which will help us easily clear the parking barrier. One problem with this drive thought is that the clearance between the wheels are very close together and there isn't enough room for shaft collars 0.5 OD spacers and 0.375 OD spacers are all too big. To solve this problem we have used the 0.25” OD spacers from the V5 Clawbot’s claw.







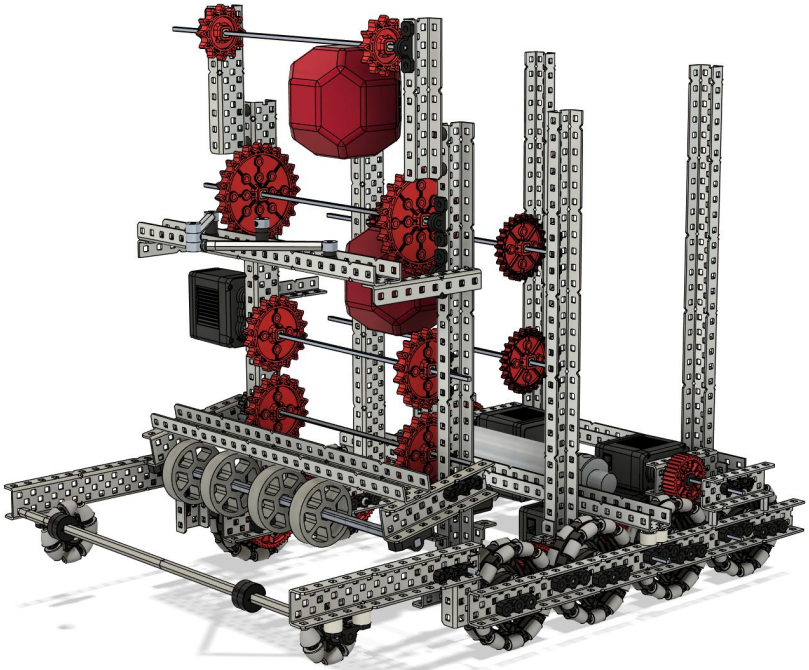


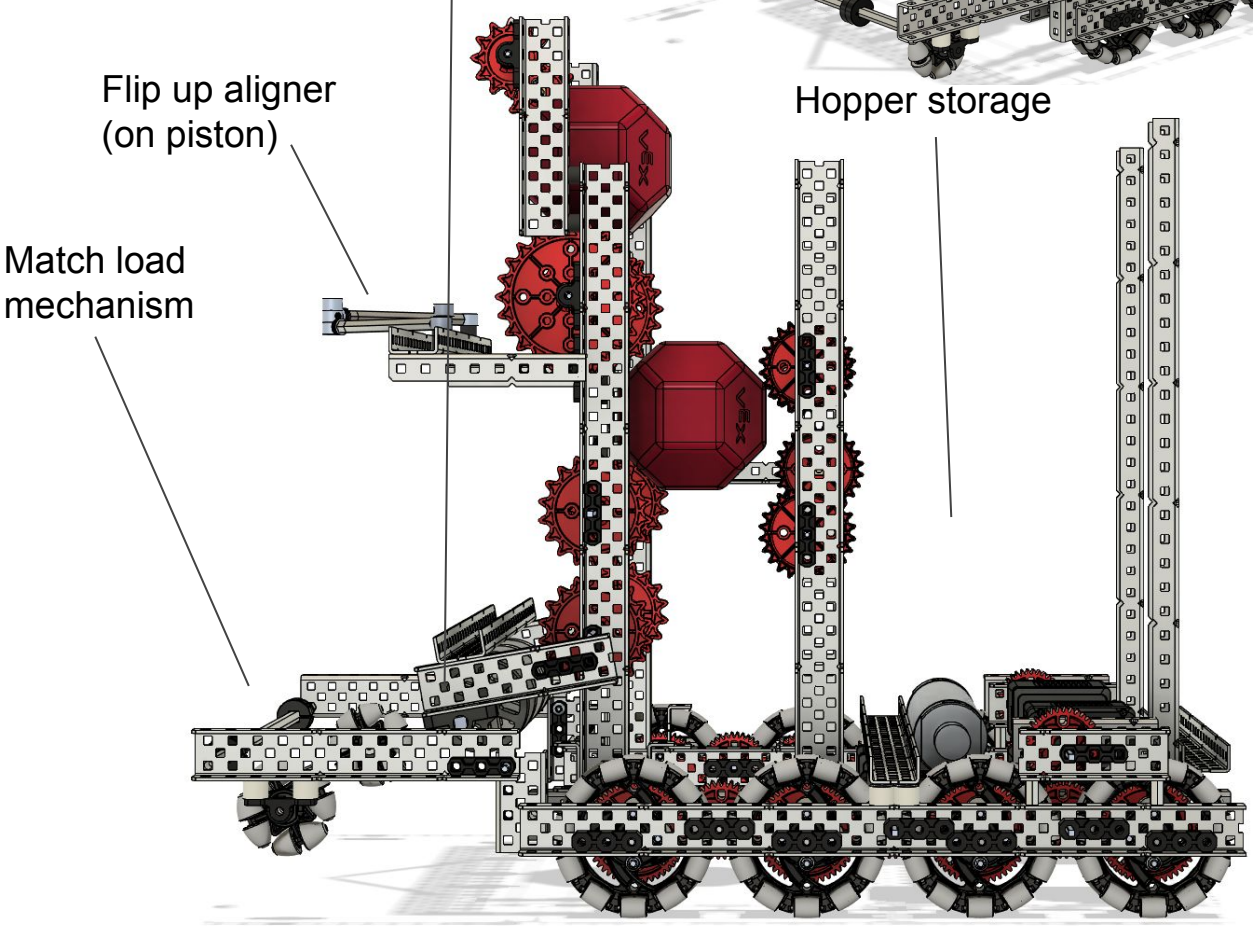
Name: Tom

CAD
Update 2

This is the main frame work for the intake and where all the rubber band rollers and floating intake will go. Where the reservoir, alignment and potential match loader will go. We are still debating if we will add the match loader for this upcoming tournament since it'll take a lot of time to tune and get right.

Overview:

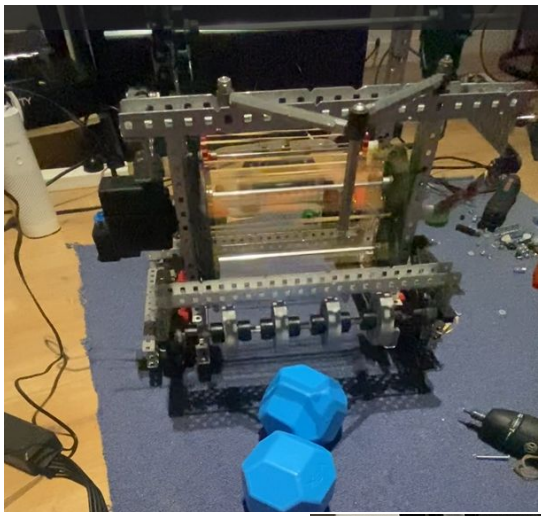


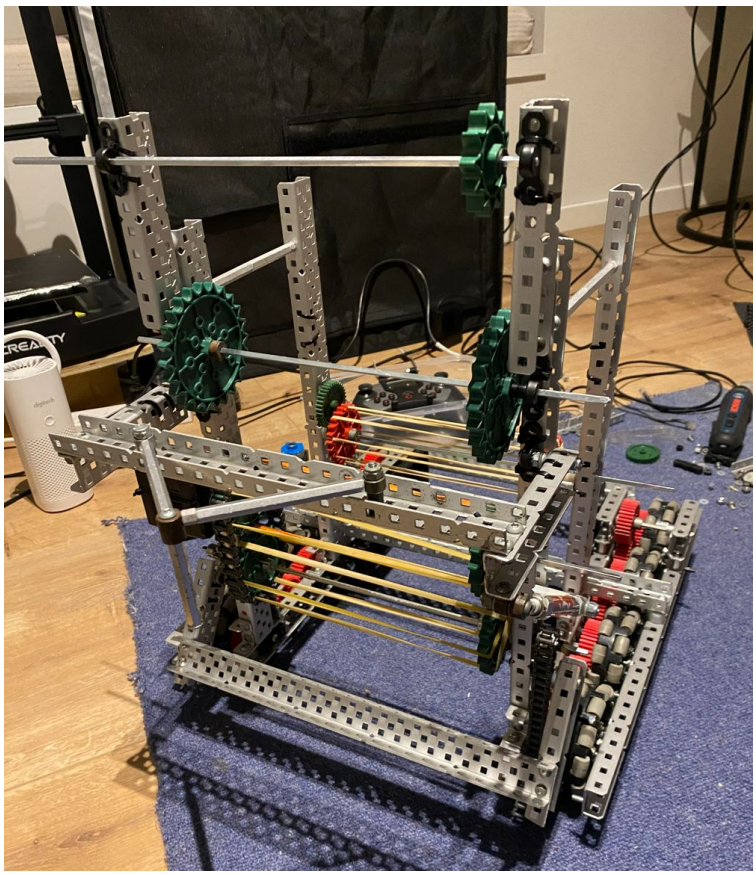


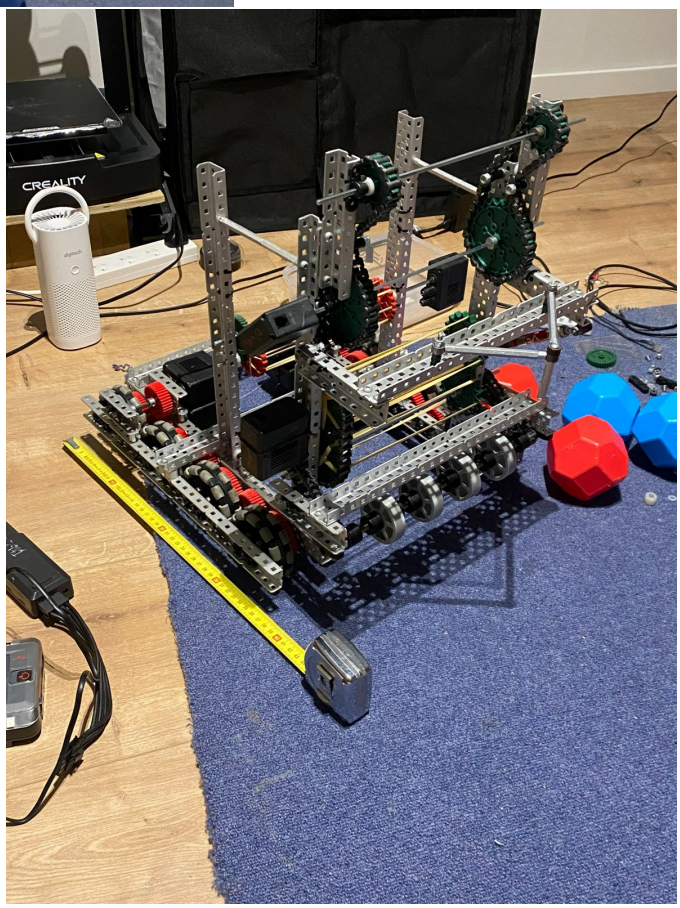
Name: Tom

Building
Update 1

Our first plan of action was to build the drive. Some fundamental building techniques we used when building the drive is using zipties to attach all the bearings we suspect this robot could get heavy quickly and screws and nuts can make up to 3rd of the robot's weight. Since our wheels are bigger than before and our robot is theoretically 18% faster cutting weight wherever possible is important to preserve our fast acceleration and agility.

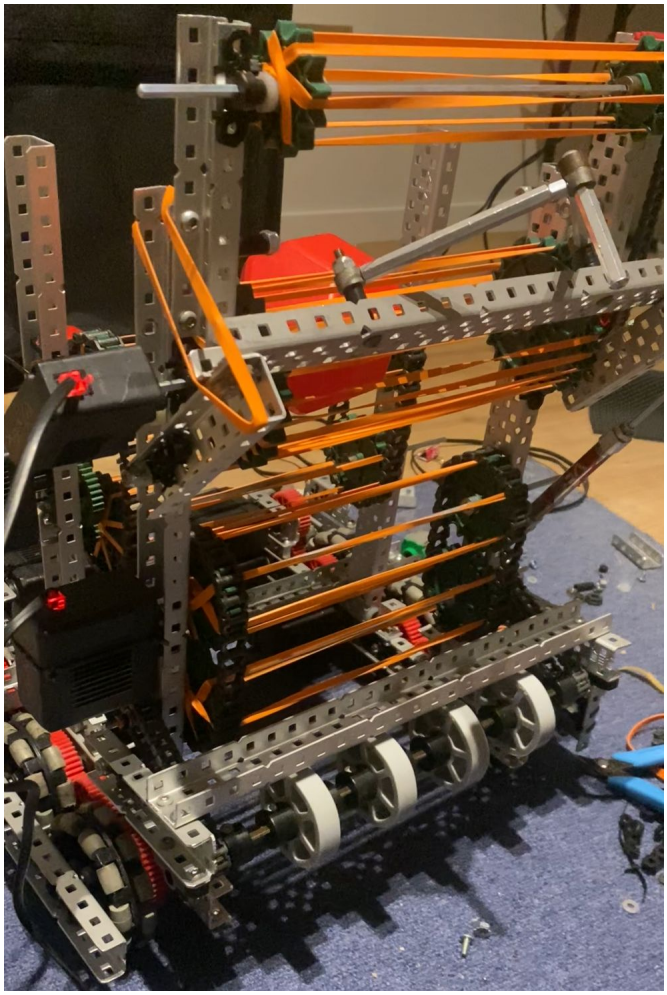






Name: Tom

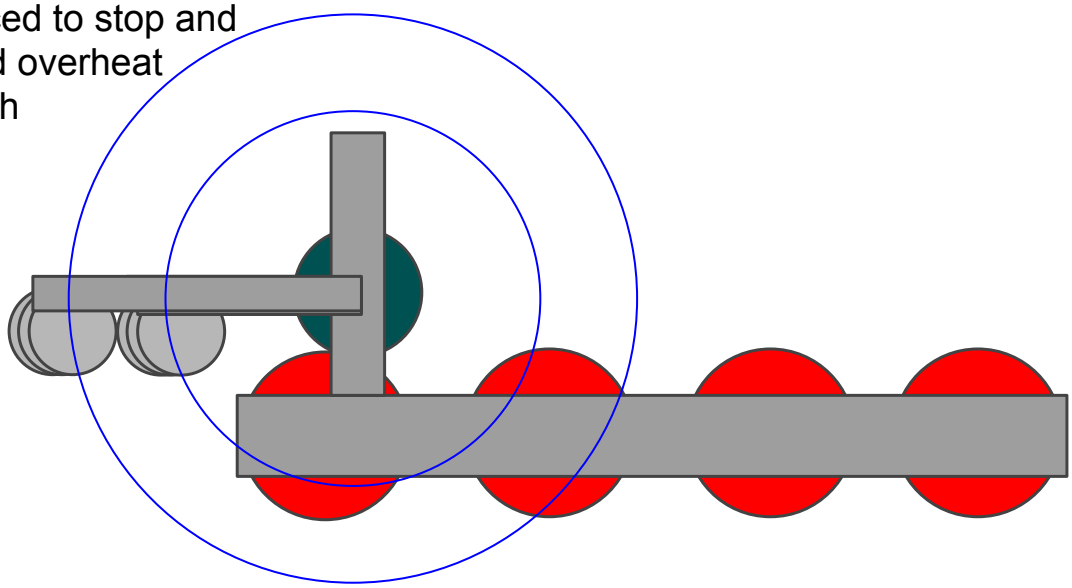
Building
Update 2



We added all the rubber bands and attached all the motors.
We have realised that the floating intake move up and down a little too much since the C channel that is pivoting is very short. But we also don't want to have it sticking to far out of the drivetrain virtual boundaries.

Diagram below showing the effect of having a longer floating intake.

We also added the aligner and attached a piston on to it and added all the intake motors.
We have chosen the 11W motor to go on the 2 rollers and the floating intake and the other 2 less powerful 5.5W motors on the other 2 sets of rubber band rollers. We think having the more reliable stronger motor on the floating intake is important as it is the entry point of the blocks and blocks can get jammed there and in pushing matches the floating intake might be forced to stop and a 5.5W motor would overheat really quickly at such resistance



Name: Tom

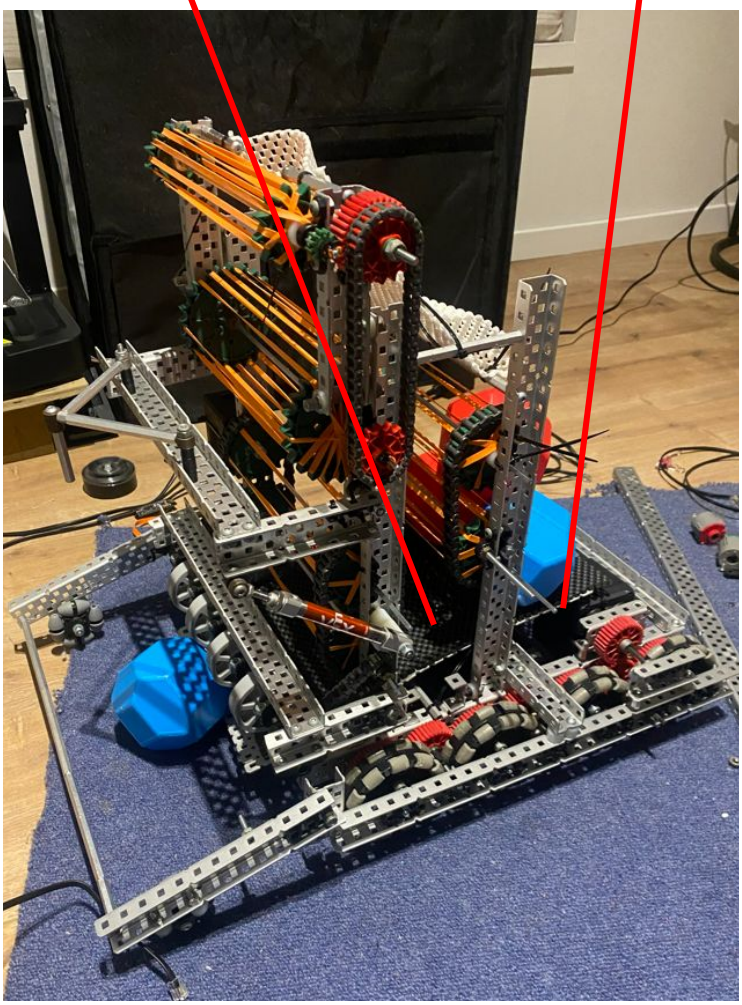
Building
Update 3

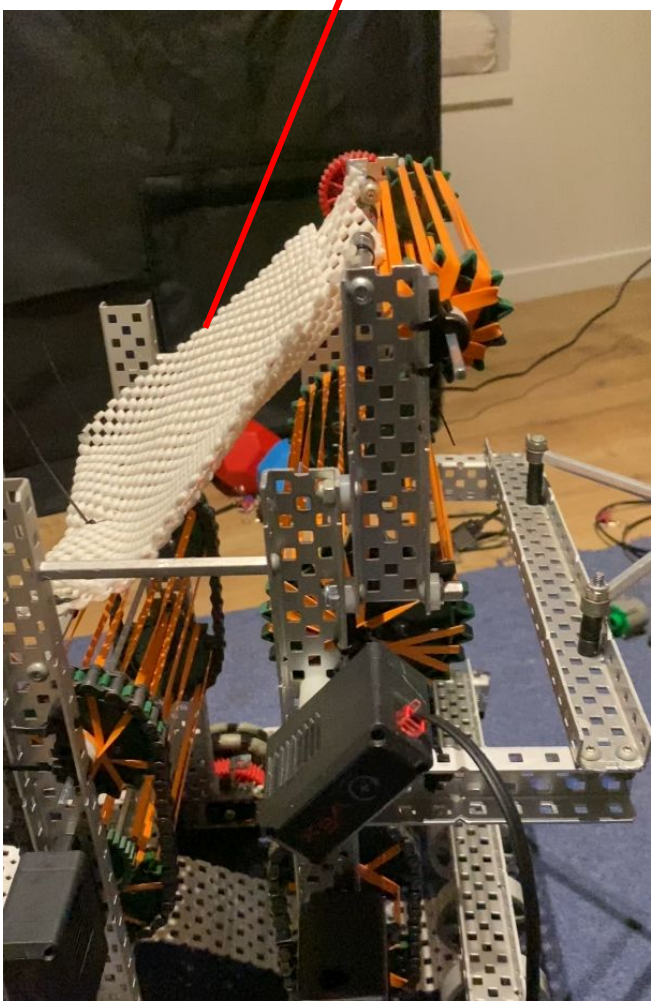
We have now added most the grip mat which will help guide and blocks through the intake and stop them from just spinning in place like polycarbonate plastic or plain flat plates would. We have also make preparations for where the future match loader mechanism could go but plan to take it off before the first tournament.

Gripmat to help keep pressure on the block and guide it up the intake to the long goal flat plate with grip mat on them to transport the blocks to the hopper storage

Space for the storage hopper

Gripmat to help keep pressure on the block and guide it up the intake to the long goal

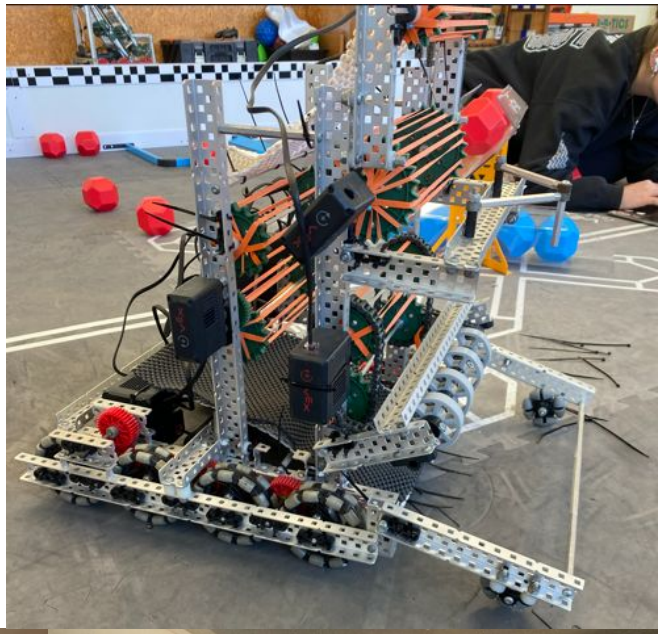




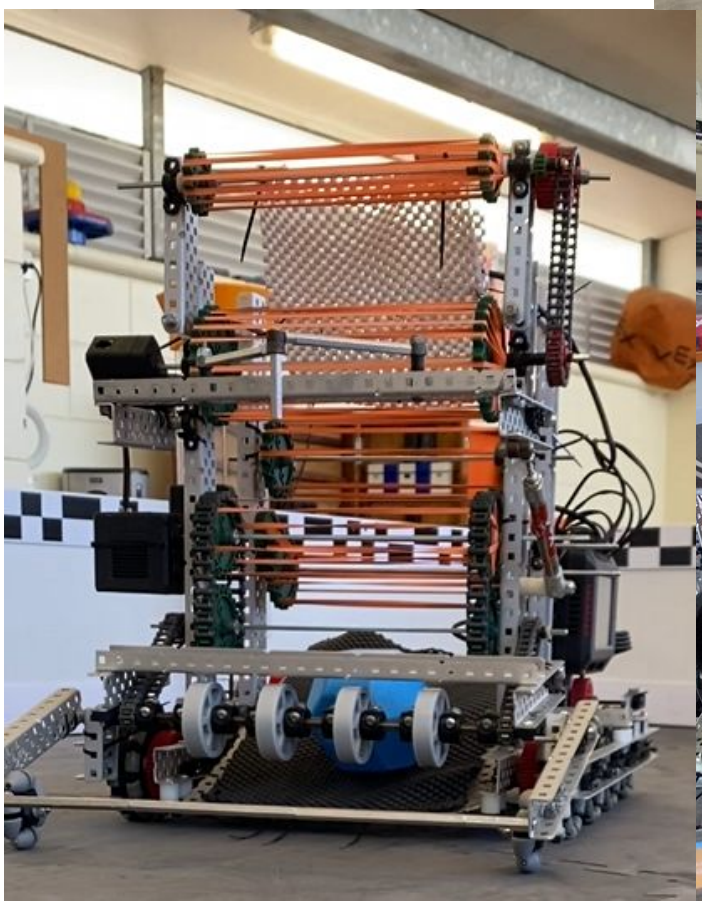
Name: Tom

Building
Update 4

We have finally brung the robot back to school and run it on the field. The drive feels very smooth and fast and can pick up the blocks nicely from the ground. The alignment remains unchanged and still lines up nicely to the long goals



In the bottom right corner is a picture of our intake scoring its first block in the upper middle goal

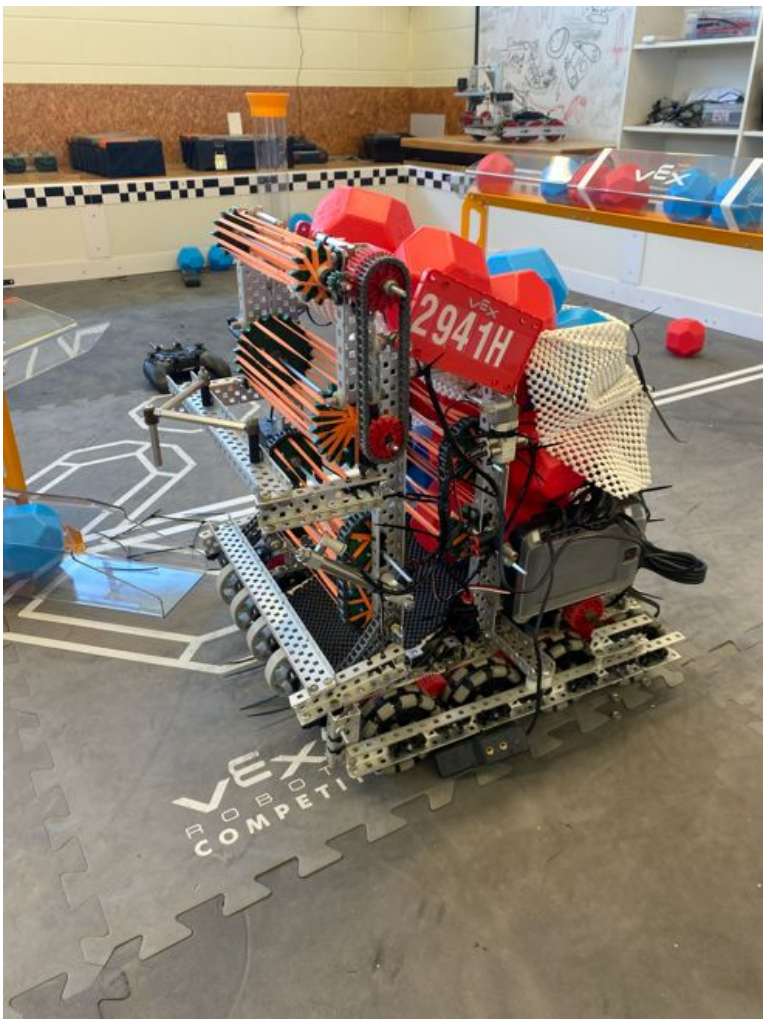


Name: Tom

Building
Update 4

We have added gripmat to the back of the robot to store all the blocks.

Picture of the robot scoring in the long goal



Name: Tom

Pre tournament

Pre tournament statement and strategy

We don't have many expectations for this tournament. We hope we can do above average and can get a good read on the game as well as having Rosa properly integrate into the drive team. We also hope Tom will be able to adapt to the faster drivetrain. We expect the game to be very fast and expect a lot of push bots and expect them to be relatively effective. We also don't expect a lot of descoring despite descoring being relatively easy since most people will be focused on building their robots to score blocks since the objective of the game is to score more points than the other alliance and not descoring the most points. Unfortunately we didn't have time to write an autonomous routine and don't expect many teams to have an autonomous routine and will be missing out on the easy 10 point bonus.

So essentially the 2 main objectives are to:
- Get a good idea of how the game is going to be played
- See how the drivetrain performs

Name: Tom

Post tournament

Results and thoughts

Qualification results for Auckland V5RC #3:

Qualifier #4	2915M	2915V	104	2921F	**2941H**	0
Qualifier #10	2900A	**2941H**	22	11044A	22020Z	40
Qualifier #12	70591A	22020X	31	2915Y	**2941H**	25
Qualifier #19	**2941H**	2915K	26	2921F	2915M	52
Qualifier #25	2918X	11044B	28	**2941H**	2921R	25
Qualifier #29	70591A	**2941H**	33	11044B	2941D	11
Qualifier #33	2915K	7031A	5	**2941H**	22020X	91
Qualifier #42	2915V	**2941H**	99	11044C	2915Y	15
Qualifier #47	2915G	11044X	36	2941A	**2941H**	40

Eliminations results:

QF #1-1	2915V	**2941H**	130	2921R	2921F	14
SF #1-1	2915V	**2941H**	76	2941A	2941G	20
Final #1-1	2915V	**2941H**	88	2915M	22020Z	31

Rank	13
WP / AP / SP	8 / 35 / 165

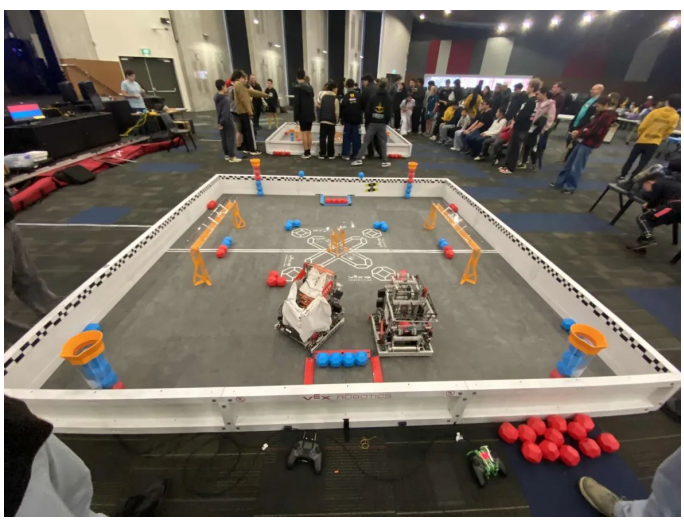
Wins - Losses - Ties
4 - 5 - 0

Rank: 13

Today's tournament was at Sacred Hearts college. We started the day 0-4 losing: Q4 due to our alliance partner not having legal license plates, Q10 and Q12 due to our floating intake shaft falling out. Thanks to 70591A for letting us borrow some parts we were able to get this under control. Q19 our battery came unplugged. After some practice at lunch and re-establishing some moral, we went into Q29 where we discovered our alliance partner didn't have any working code. Leaving us 0-5.

Determined to turn things around we convincingly won the next 3 matches and scraped together 1 more win in Q47 before going into alliance selection. The 1st seed, 2915V ended up settling on as as their partner because of our fast playstyle and ability to control the pace of the game. Despite our 0-5 start and not having the greatest scoring mechanism.

We finished the tournament by winning the elimination bracket and taking home our first ever tournament win.



Name: Tom, Indie, Rosa

Post tournament
Analysis

Autonomous
- We didn't have time to write any autonomous routines

Driver control
- Driver skills were good a little bit inconsistent but rapidly improving.
- Can still be improved
- Drive code performed as expected
- Controlled the pace relatively well but had trouble fending off other robots due to long intake cycles

Drivetrain
- Drivetrain worked flawlessly
- Drive speed exceeded most other robots
- Having exposed wheels at the back allowed us to park most times

Intake
- Floating section of the intake picked up blocks most of the time but having such a small floating intake radius really affected it
- The rubber bands we used are low quality and had to be replaced frequently
- Running chain over rubber bands severely shortens the rubber bands lifespan dude to the constant friction
- The long goal scoring worked but cycle time was too slow for comfort and the top rollers didn't really have the grip to push the block firmly into the goal and push the other 1-15 blocks along in the goal already and sometimes resulted the blocks falling out
- Middle upper goal scoring was very good and the rollers had a lot of compression which flung the blocks nicely into the goal but we had no aligner for the middle upper goal it was hard to score since other robots were trying to stop us
- Middle lower goal scoring was good as well but sometimes the floating intake would score the blocks too fast and they would roll out of the goal on the other side
- The intake is 2 blocks wide and at the funnel points when scoring 2 blocks would try to go out simultaneously and get jammed so we plan to add standoffs to guide the blocks and allow only 1 block to go through one after the other.

Post tournament
Analysis

Storage
-Storage jammed a lot and can only viably hold about 5-6 blocks not the 7+ we were hoping for
- We the gripmat hopper walls also stopped us from seeing into the hopper and making it unclear what exactly is in our hopper storage.

Aligner
- The aligner worked very well and helped us stick to the long goals a lot better and stop us getting pushed as much. But the flipped up descoring function needs some adjustment because it is missing the blocks sometimes in the long goal.

Match loader
- We didn't have a match loader

Post tournament
Analysis

Things we would like to change as a result of this tournament:

Autonomous
- Write a simple autonomous

Driver control
- Keep practicing and improving with and without live coaching

Drivetrain
- Keep unchanged

Intake
- Lower the flat plates close to the ground so it's easier for the floating intake to scoop things of the ground since we can't park forwards anyways it doesn't matter how low the robot is at the front
- Add standoffs all throughout the intake to stop 2 blocks trying to go through a funnel point at once and stop jamming

Storage
- Add funneling back into the intake so we can score blocks
- Stop blocks from going into spots they will get stuck in
- Remove the grip mat and replace with clear polycarbonate so we can see what color the blocks are in our hopper storage and the amount and if they are or aren't stuck.

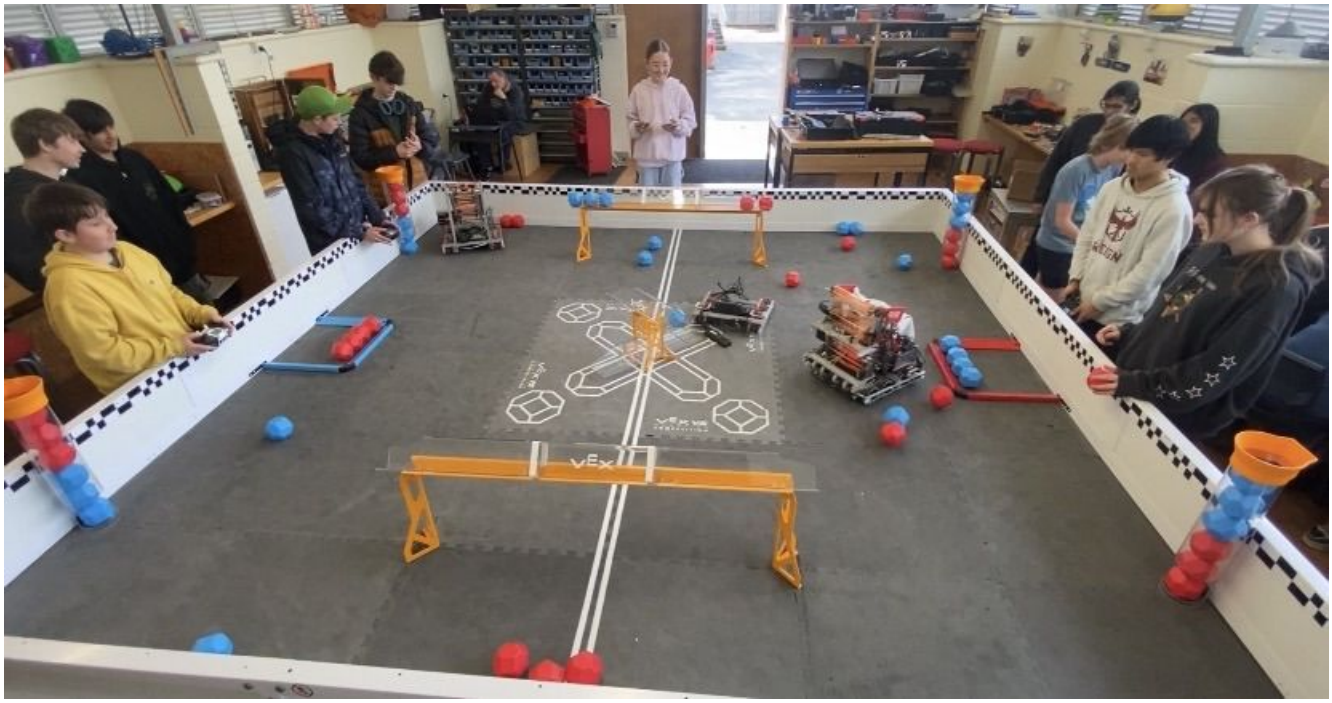
Aligner
- shorten the vertical standoff so that when it is flipped up it can push blocks on the edge of long goals.

Conclusion:
There are fundamental problems with our intake and hopper system but we want to persevere because in 2024 we rebuilt the robot right after the tournament instead of addressing the issues. This lead to us not getting good in match experience and falling behind in game knowledge. We don’t think our robot is extremely good but we can elevate it to a more consistent and reliable state where we are confident without experience we can do well at the next tournament and collect experience before we rebuild.

Practice

Update 1

Before making improvements we wanted to get some better footage of our robot to have a record and on demand analysis footage. This also doubled as some driver/drive team practice. Thankfully we have 5 sister teams to practice against and we 2v1ed our sister teams: 2941F and 2941G



Name: Tom

Monthly goals
September

1. Win a tournament
Completed on: 13th September 2025

2. Improve our current robot to a reliable state
Completed on: 12th September 2025

Note: These pages have been edited to add the dates the goals they were/were not completed on. These dates will have been added on the day they were completed on or in the case of non completed goals they will have been added on the last day of the month

Name: Tom, Indie, Rosa

Building/Improvements

Update 1

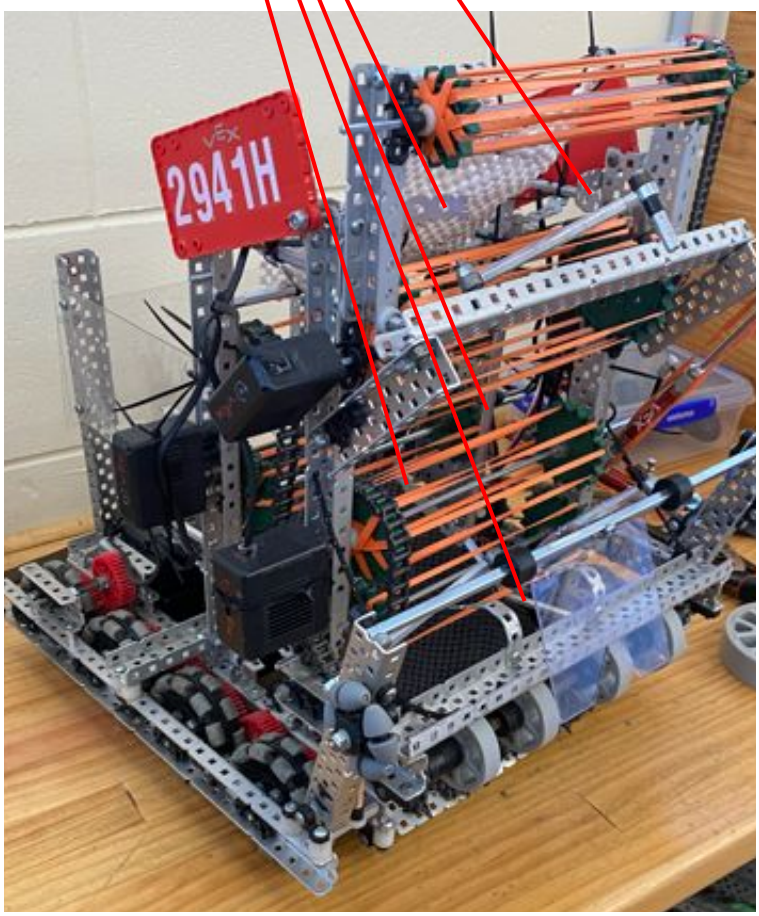
We already had framework setup for the match loader. Some points we made about 44252A's match loader was that the long standoff running across might bend and break and the standoffs were not optimised for tuning. We were also conscious of the damaging the bottom lip of the match loader. To address these problems we have drilled holes in a high strength steel shaft and used that in place of the standoff ensuring it wont bend or break. We used a heat gun to bend the polycarbonate and made it the perfect angle and curve to easily allow all the blocks to come out of the match loader. To address not damaging the bottom match loader lip we have added omni wheels to prevent the match loader from going down too far and hitting the lip while still allowing us to move around with it down.

Name: Tom

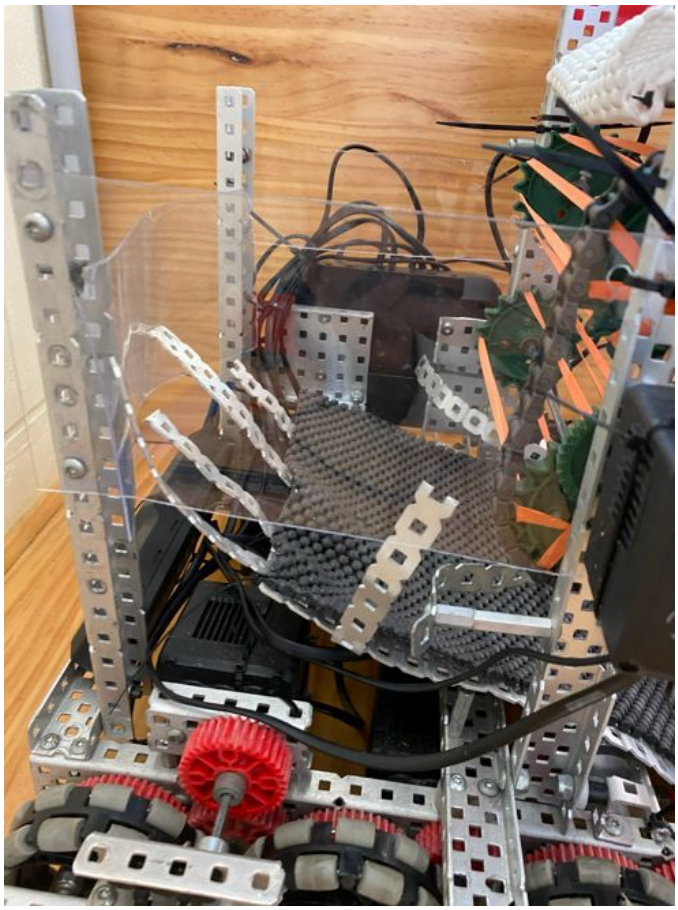
Building/Improvements

Update 2

We have added a series of bend 1 wide flats and standoffs that go all throughout the intake and prevent 2 blocks from being side by side in the intake and funnel the blocks into the hopper storage and out of the hopper storage.



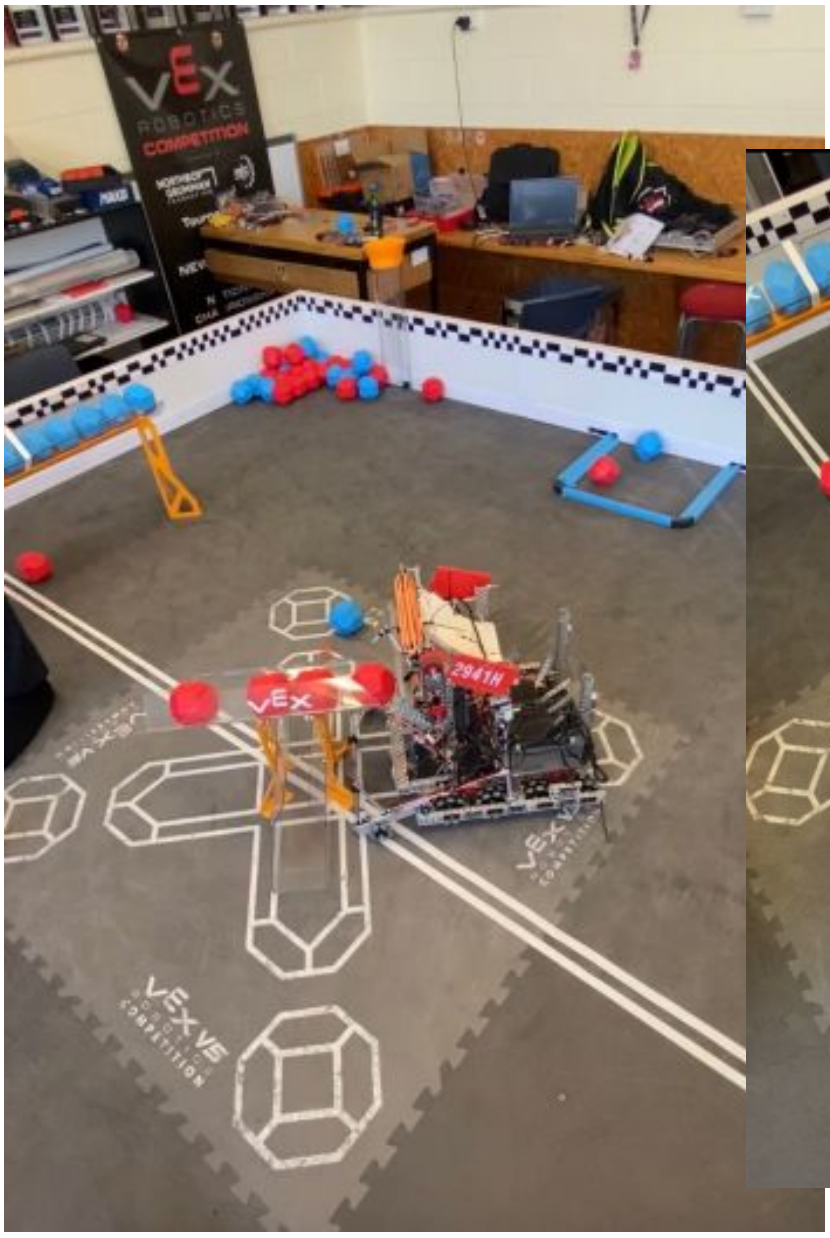
We have replaced all the gripmat on the hopper with clear polycarbonate so we can nicely see inside. We have also added a series of one wide to stop blocks from getting stuck on the sides and corners of the hopper. Our hopper can now hold around 8 blocks

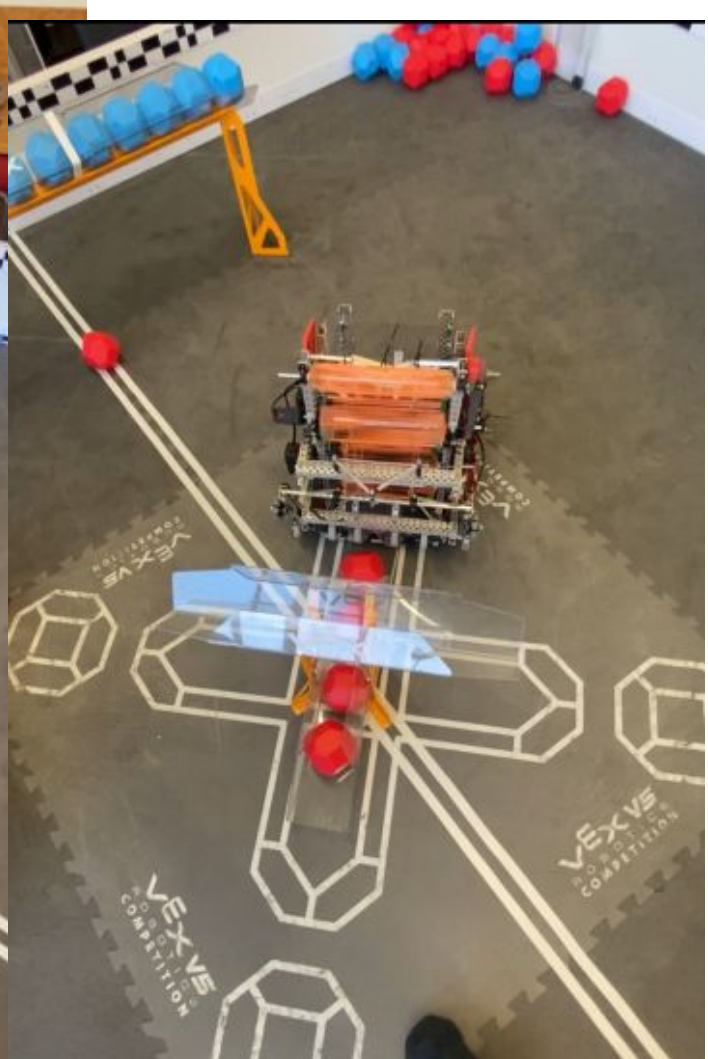


Building/Improvements

Update 3

We have also now made 2 simple autonomous which can be seen on the next few pages





Name: Tom

Pre tournament

Pre tournament statement and strategy

Our strategy for this tournament is to just play long goals and get them as full a possible. Currently in our region nobody has a descoring mechanism. We are aware lots of teams with less good robots will see more value in trying to stop us to score instead of scoring themselves. To defend against this strategy if we have it we will use our autonomous advantage of having blocks already in the middle goal to draw away attention from us scoring in the long goal. We also noticed in the last tournament we were struggling to get blocks. With the match loader we can now introduce up to 18 more blocks into the field. We plan to utilise this and have our teammate defend us while we collect the blocks out of the match loader.

We hope our robot will perform reliability and allow us to gather experience and knowledge about the game.

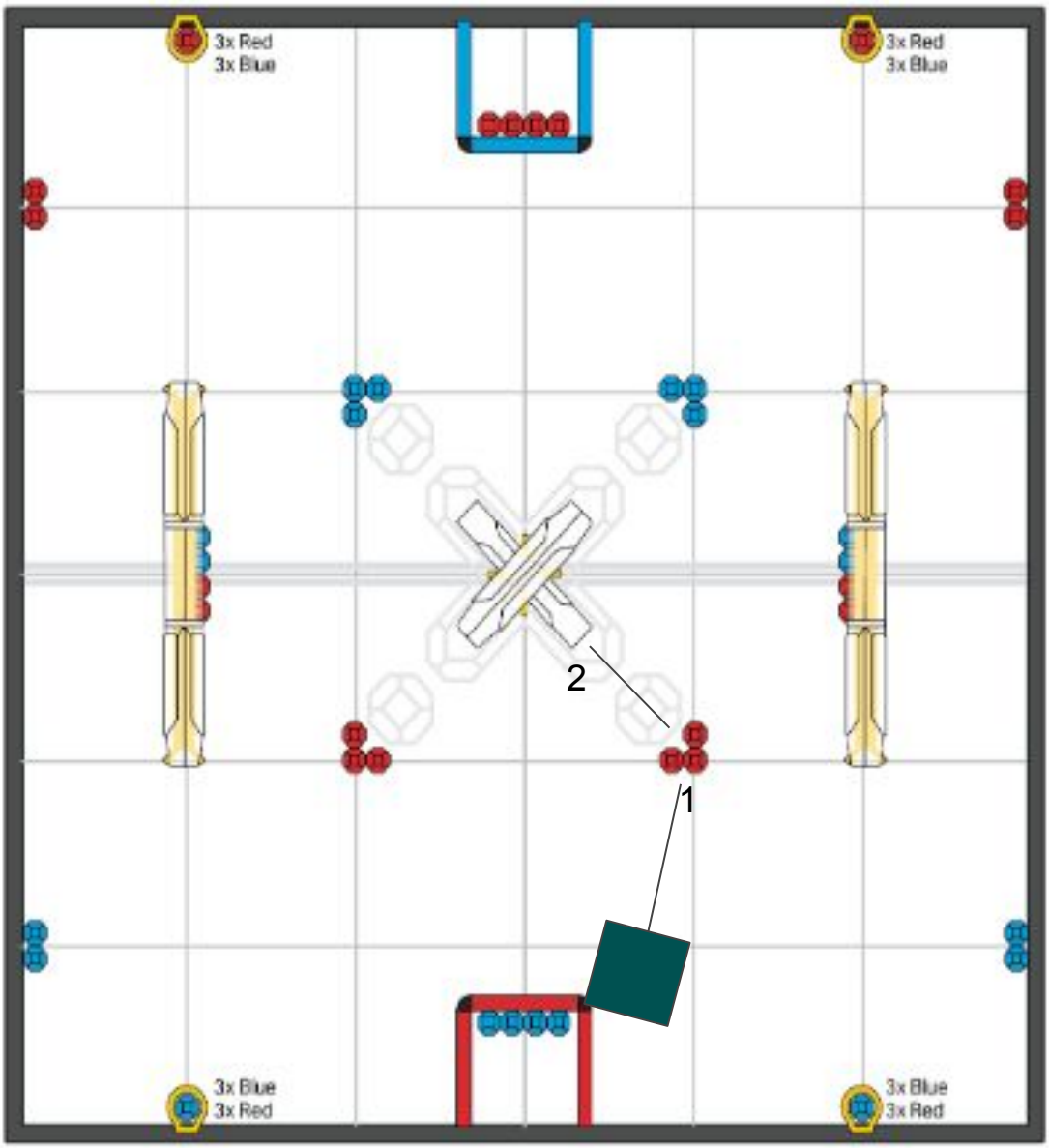
Pre tournament

Autons

In these diagrams we will be displaying the red auton since the field is mirrored in a diagonal line we only need 2 autons, one for each side.

1. The robot drives forward to grab the cluster of 3 blocks and stores them in the hopper
2. Robot turns and drives towards the lower middle goal and scores the 3 blocks + the preload into the lower middle goal

= Robot



Total points 12-18

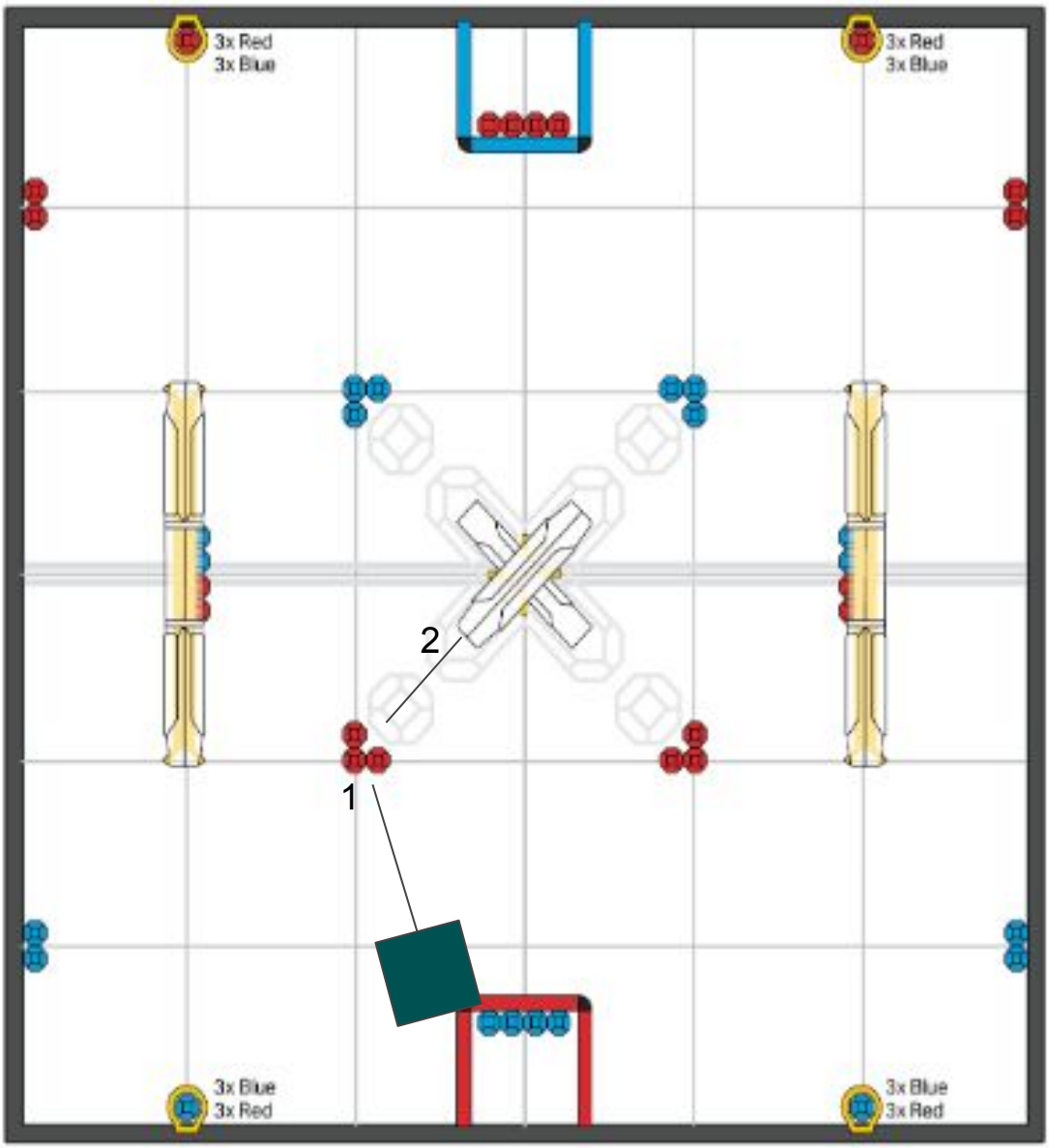
Name: Tom

Pre tournament

Autons

1. The robot drives forward to grab the cluster of 3 blocks and stores them in the hopper
2. Robot turns and drives towards the upper middle goal and scores the 3 blocks + the preload into the lower middle goal

= Robot



Total points 12-21

Name: Tom

Post tournament

Results and thoughts

Qualification results for Auckland V5RC #5:

Qualifier #4	2941G	2918X	31	78611Z	**2941H**	59
Qualifier #7	2941F	**2941H**	85	2915F	8757C	28
Qualifier #13	2915G	**2941H**	85	2915D	2915K	0
Qualifier #19	3168H	2941D	38	**2941H**	8757B	121
Qualifier #25	78611R	3168H	14	2915M	**2941H**	93
Qualifier #27	2941E	**2941H**	109	2915M	2915F	16
Qualifier #35	**2941H**	2915V	70	8757C	8757A	35
Qualifier #37	2915K	2915N	20	2941D	**2941H**	72
Qualifier #47	**2941H**	8757B	81	2915D	2941A	15

Rank	3
WP / AP / SP	18 / 70 / 197

Wins - Losses - Ties
9 - 0 - 0

Rank: 3

Eliminations results:

QF #1-1	2915V	**2941H**	121	8757A	2918X	15
SF #1-1	2915V	**2941H**	119	2915Y	8757C	0
Final #1-1	2915V	**2941H**	100	8757B	3168H	26

Today's tournament was at our own school: Otumoetai college. We started our day with Q4 where our autonomous was unfortunately blocked by our alliance partner who had selected the wrong code. Fortunately we still managed to get the win. We nicely won Q7, Q13, Q19, Q25 and Q27 going into lunch with a clean 6-0 record.

After a quick autonomous fix up at lunch we dove into Q35 continuing our no loss record. In Q37 our alliance partner selected the wrong code again and collided with our otherwise perfect autonomous routine. We finished the qualifications 9-0 ranking 3rd right behind 2941E. The 1st seed 2915V selected us as their partner because of our high scoring consistency and agility.

We went on to win the QF, SF and Finals very convincingly and won our second tournament of the season.

Name: Tom, Indie, Rosa

Completed Robot

Evaluation

Drivetrain: We really like the way our drivetrain turned out, its fast and responsive and still has a very good balance between torque speed and acceleration. Though towards the end we could feel the acceleration slowing down as we were adding more stuff and the robot got heavier. We do want to see if we can introduce using half cut gears instead of full high strength gears so we can squeeze our robot to be 2 holes thinner and give the robot a little more aggressive steering. We also want to see if we can change the drive to make it easier to go up onto the park barrier since at the moment if there are blocks in the park barrier we come up at such a steep angle it does not push the blocks out of the park barrier and instead rides up on top of them sometimes causing in a failed park. Overall we want to stay with the same ratio and wheel size.

Name: Tom

Completed Robot
Evaluation

Intake: Overall we have mixed feelings about our intake we think rubber band rollers are definitely the way to go for the majority of the intake since the rubber bands compress around the blocks very well. We want to keep the front flex wheels and our floating intake, though we want to make the mounting point further away from the rollers and bring the whole floating intake further into the robot to be within the virtual boundaries of the drivetrain. We also think making the places where the blocks are being scored being narrower like will help fling the blocks further into the goal. We also want to look towards decreasing the cycle time for scoring the blocks

Storage: While our storage was functional we don't think it was efficient at all and want to scrap having storage as a whole and want to look towards just storing the blocks in the intake this would increase our block scoring cycle times

Aligner: We want to move away from having our aligner being on a piston and having a fully passive aligner and a different passive descoring method.

Match loader: In the last tournament we noticed we weren't hitting that perfect sweet spot every single time. Simply because in an active match robots are constantly trying to push us and prevent us from match loading and there are lots of blocks in the way. We still think this type of match loader is very effective but want to look into ways we can refine it.

2941H

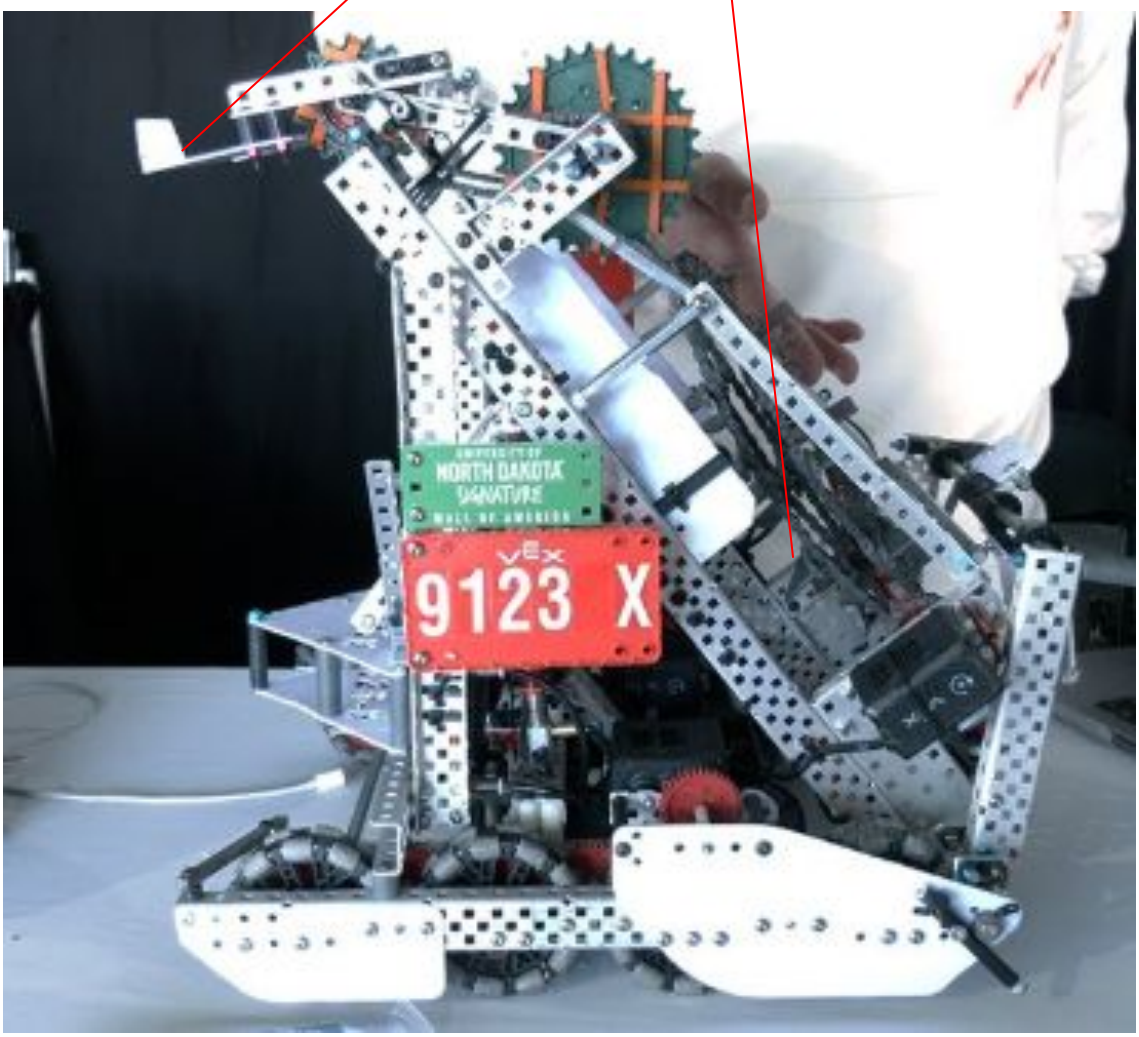
Design Cycle 3

Robot Concepts

Research

We are considering 3 different scoring ideas the first one is inspired by 9123X/C

9123X's design works by having a very wide intake where they can store about 7 blocks and works by intaking and having them funnel into the long goal. One very notable thing about 9123X's robot is the passive hood which helps push the blocks further into the goal but adding pressure onto the block and acts as a descoring mechanism. One major flaw in this design is the lack of upper center goal scoring. We have seen other similar designs with the same design philosophy where a trap door in the intake opens and lets the blocks out into the upper center goal. If we were to do a design like this we would add a floating intake and design a better middle goal scoring mechanism as well as try to find a way to have a slightly larger ball capacity



Name: Tom

Robot Concepts

Research

The next scoring idea is by VEXU team TNTN.
TNTN's robot features a C shape under goal design we think going under the goal this season could be very strong to evade other robots TNTN's robot can hold 8 blocks which is enough to comfortably get control zones in long goals.

If we were to make a C shaped intake under goal bot like TNTN we would want to stay with a similar drive as our 2nd robot and stay with a floating intake and match load piston mechanism. To save motors and allocate them towards the intake.

Name: Tom

Monthly goals
October

1. Decide on a design for nationals

Completed on: Not completed

Due to the team being all seniors we took a break to focus on school exams

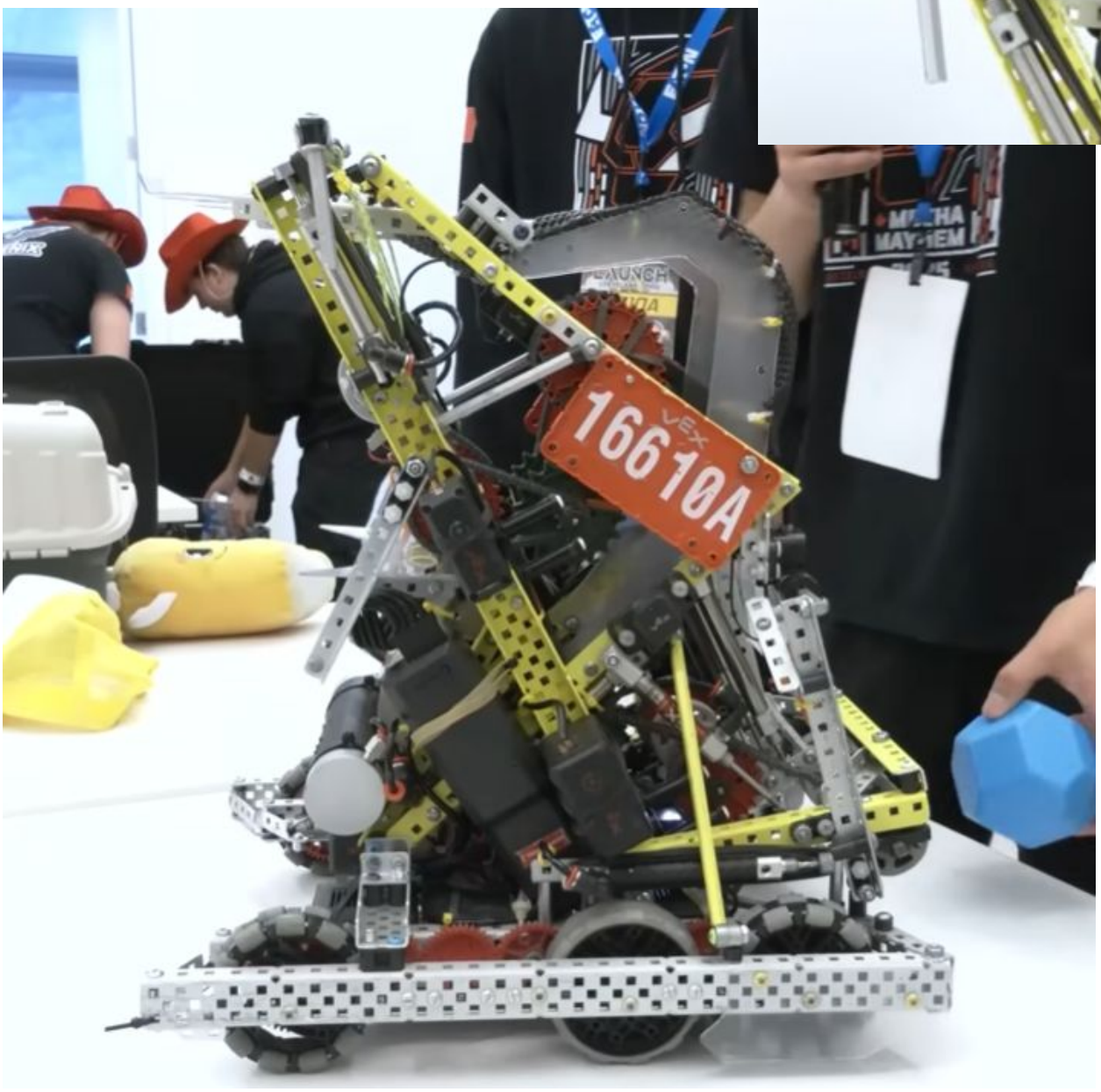
Note: These pages have been edited to add the dates the goals they were/were not completed on. These dates will have been added on the day they were completed on or in the case of non completed goals they will have been added on the last day of the month

Name: Tom, Indie, Rosa

Robot Concepts

Research

The last scoring idea is by 16610A. This intake is usually referred to as an S shape. It holds 8-9 blocks which is the most blocks out of all 3 of the researched designs so far. Like 9123X's design snacky cakes also has a front to back intake but unlike 9123X it does have a more developed middle scoring system. One feature we are really interested in is their descoring mechanism this allows them to reach into the top sections of the goals and descore Blocks. For robot 3 we would like to implement such a mechanism



Name: Tom

Monthly goals
November

1. Decide on a design for nationals

Completed on: 15th November 2025

Due to the team being all seniors we took a break to focus on school exams

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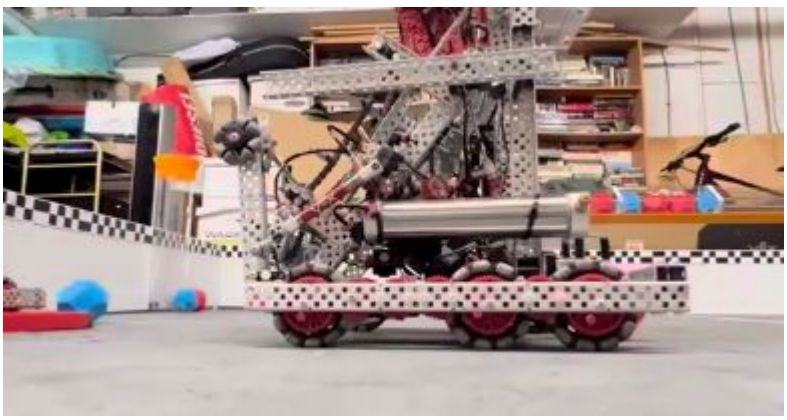
Name: Tom, Indie, Rosa

Robot Concepts

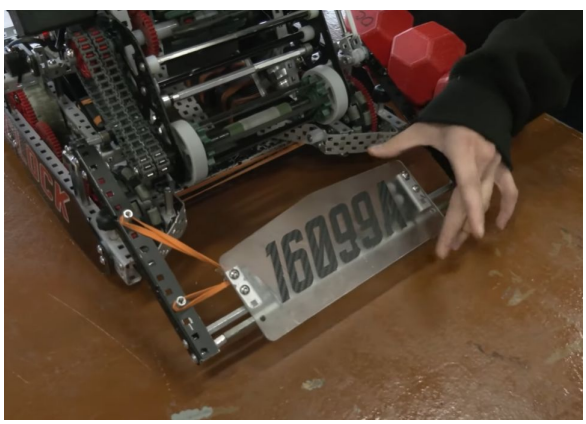
Research/Decision

We are deterred from an intake design like 9123X's because of its lack of support for the upper middle goal. To us 8 blocks seems like the sweet spot for comfortably getting control zones. So between TNTN's intake design and 16610A's intake design we can see 2 clear identities between them.
A C bot like TNTN is front to front scoring meaning going from the matchloader to the long goal will require the robot to do a 180 degree turn. While a S bot like 16610A's design is front to back scoring meaning we will be able to go directly from the match load to the long goal and score. But a S bot cannot go under the bar while the C can. Between the 2 we decided that having that better match load to scoring cycle is more important since there are other ways we can evade other robots.

There are also some other ideas we want to implement into our design. The first is an updated drivetrain. We aren't sure who came up with this specific drive setup but we want to get rid of one wheel and replace it with a 36T gear instead this should stop us from climbing up on top the blocks and failing our park



We have also really like 16099A's match loader design
Instead of having a stationary piece of plastic that goes into the match loader they Have a flexible piece on a hinge that slides Under the bottom block in the match loader And flexes to the shape of the back of the matchloader letting all the blocks slide out. This seems like a more reliable option to explore since
The matchloaders success is not reliant on The way the polycarb has been pre bent



Name: Tom

Monthly goals
December

1. Attend 22020X's invite scrimmage

Completed on: 19th december 2025

2. Finish most of robot 3

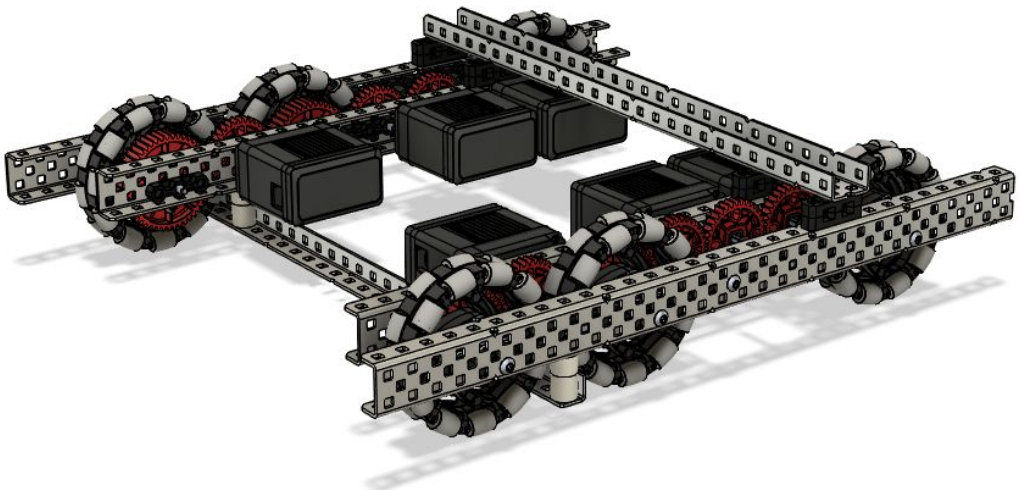
Completed on: partially completed on 19th december 2025

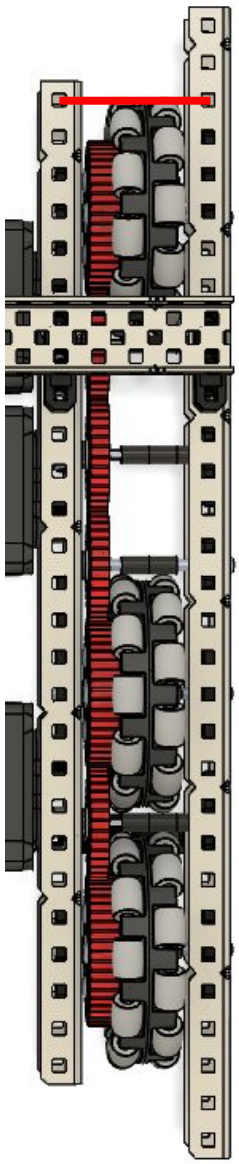
Note: These pages have been edited to add the dates the goals they were/were not completed on. These dates will have been added on the day they were completed on or in the case of non completed goals they will have been added on the last day of the month

Name: Tom, Indie, Rosa

CAD
Update 1

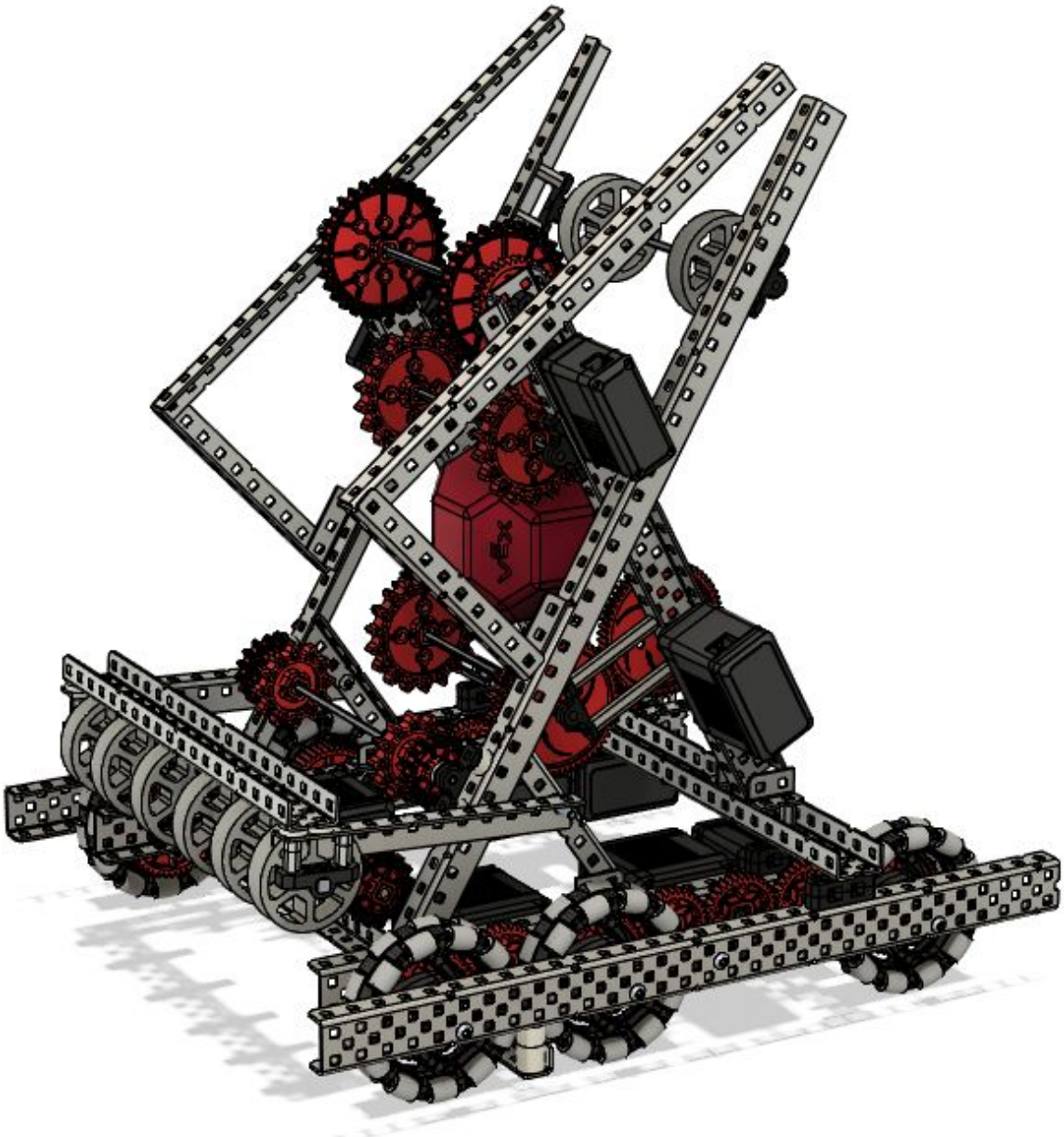
This is the drivetrain we have come up with. Some noticeable changes between this drivetrain and the last one:
- Only 6 wheels instead of 8 and not centered
This large wheel sized gap in the drivetrain should help us park in the parking barrier and stop us from coming up onto the barrier at such a steep angle and getting stuck on blocks in the park zone instead of pushing them out.
- Using half cut gears. This will allow us to squeeze our wheels and gears within 3 hole instead of 4 unlike the old drivetrain. This will result in a in the turn radius decreasing by 2 holes and will make our robot more aggressive and but also make the robot slimmer and allow us to fit between the wall and the long goals more easily without getting stuck.
- Motor placement we have chosen to place the motors lower Because at a lot of tournaments in the US we are seeing Robots tipping and get close to tipping so we think placing The motors and as much weight as low down as possible to lower our center of gravity and prevent us from tipping easily.





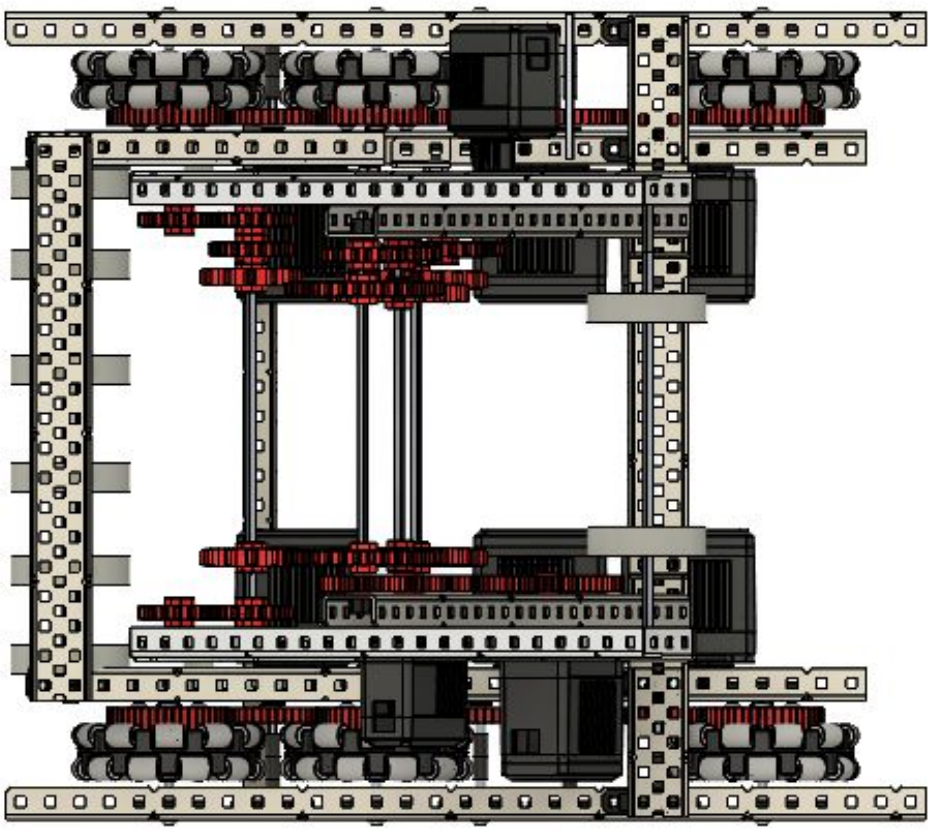
CAD
Update 2

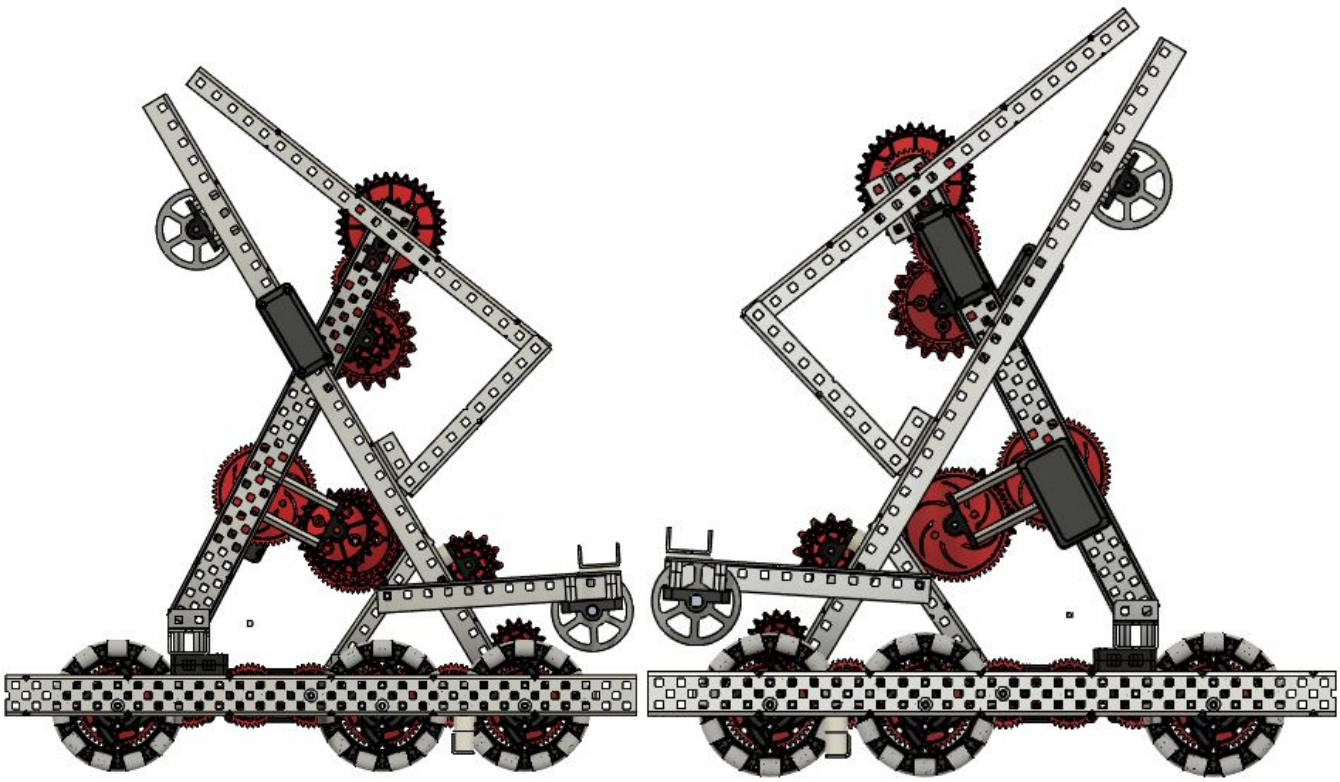
We have discovered that planning out of the the intake is going to be very hard since we cant CAD grip mat but the most important part: the fundamental intake structure and drivetrain can be CADed. The goal of using CAD was never to fully CAD the robot beforehand but to create and plan out fundamental structures like the intake which is very prominent in this design.



Name: Tom

CAD
Overview

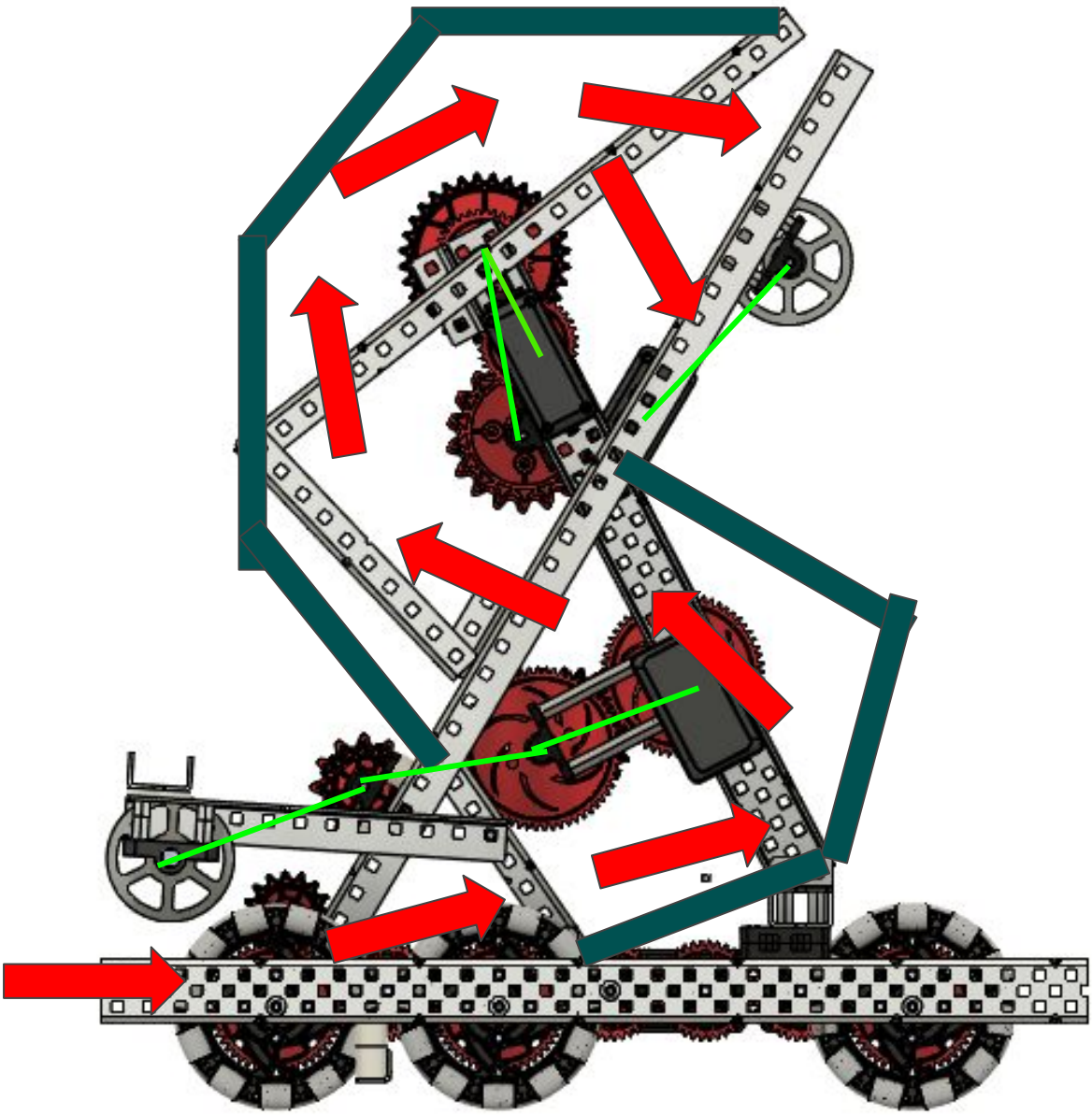




Name: Tom

CAD
Explanation

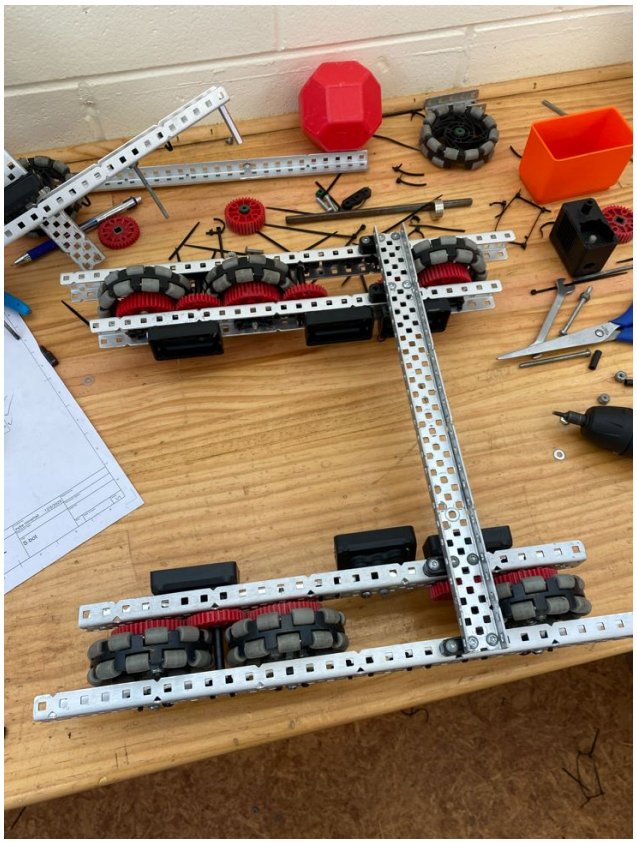
How the intake will work:
As shown by the **arrows** below is the travel path the blocks will take to the long goal and middle goal the **dark green is where the grip mat will go to hold the blocks on to the rollers.** The roller/**motor groups** are allocated as such because again we want to keep the 11W on the floating intake and the most rollers because the 11W motor has significantly more power and less prone to overheating. We have a 5.5W on the 2nd motor group because they will be less stressed and won't be constantly pulling blocks of the ground like the bottom motor group finally the last roller we wanted a dedicated 5.5 for 2 reasons Because if we reverse it it allows us to score in the middle goal and it will be under constant stress when scoring blocks due to the blocks being “forced” out of the intake to create the flinging effect.

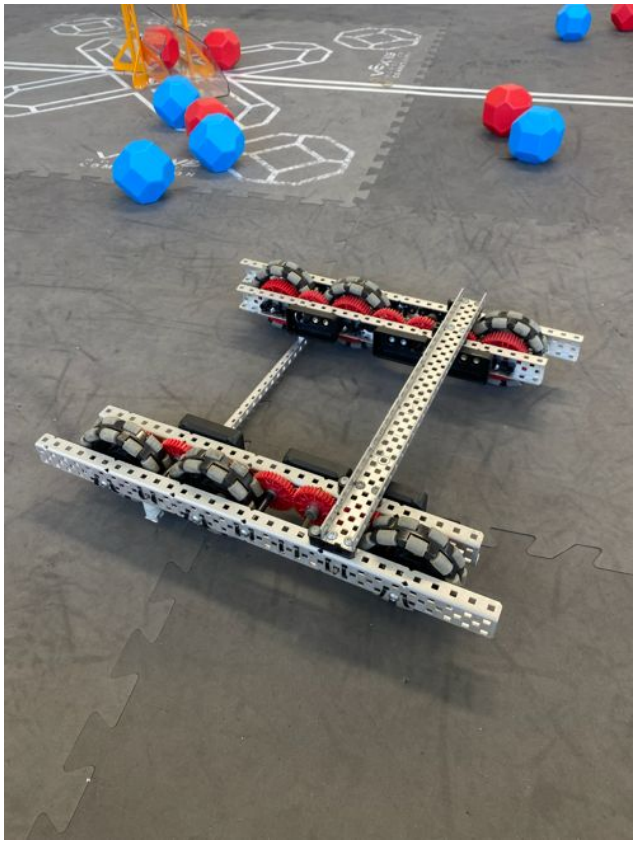


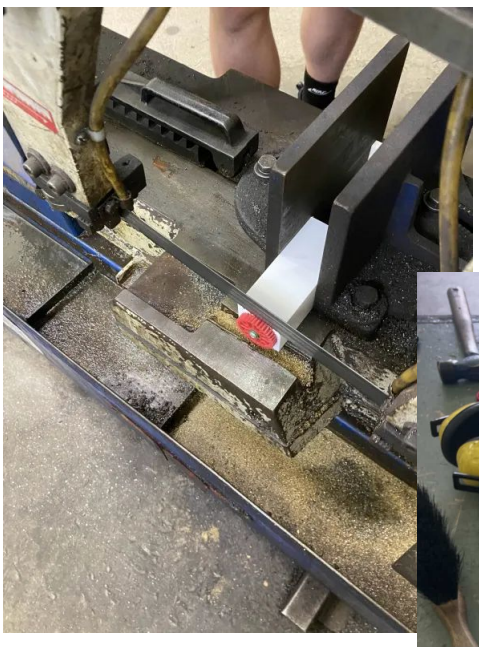
Name: Tom

Building
Update 1

Making the drivetrain was very challenging because it was very different from the 2 previous drivetrain we had made earlier in the season due to the sheer lack of space we had to work with due to it being so incredibly compact. We used a combination of a vertical band saw and a lathe to face down and cut our half cut gears.



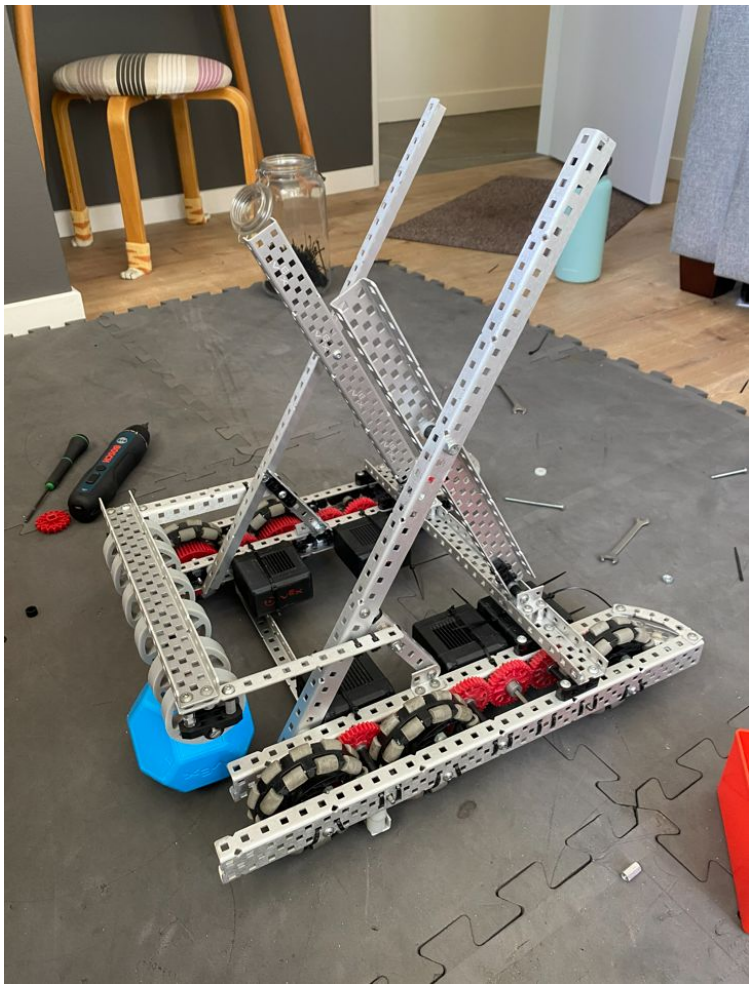


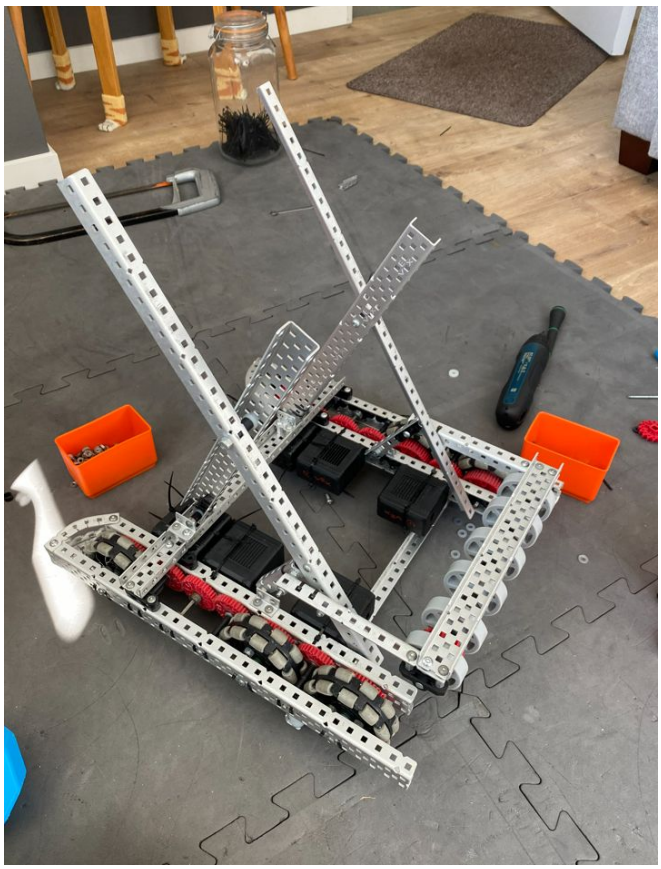


Name: Tom

Building
Update 2

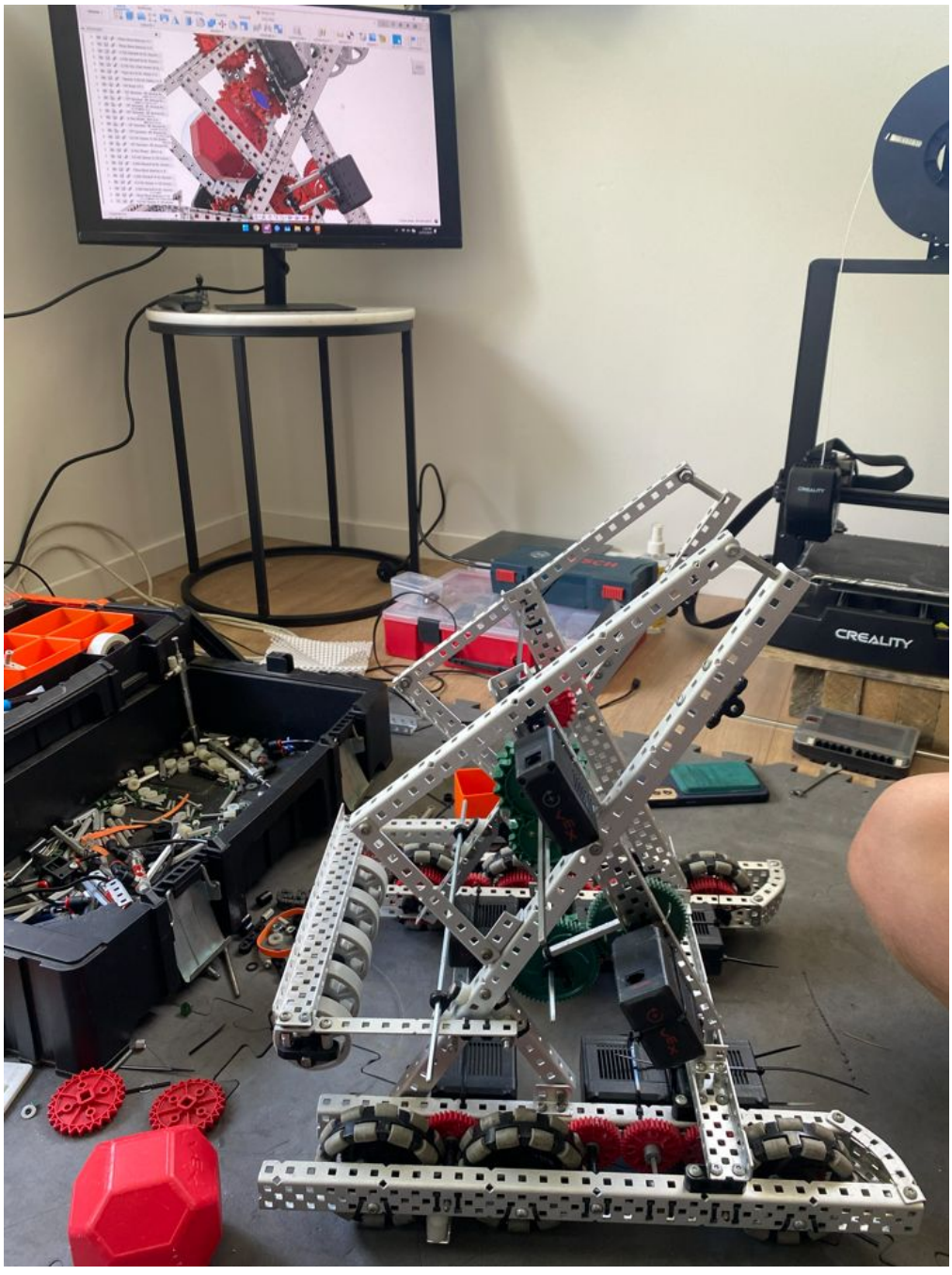
After constructing the drivetrain we moved on to the floating intake and the main intake structure thanks to our CAD this super crucial part of the build went smoothly and we were confident to use lock tight to lock these screws in place permanently since we were sure this structure would not change. To improve build quality we made sure to use flat bearings in places where crucial mounting screws would go to ensure both sides of the structure would be aligned with each other. If they were not it would result in a lot of friction in the multitude of rollers that we plan to run between them.





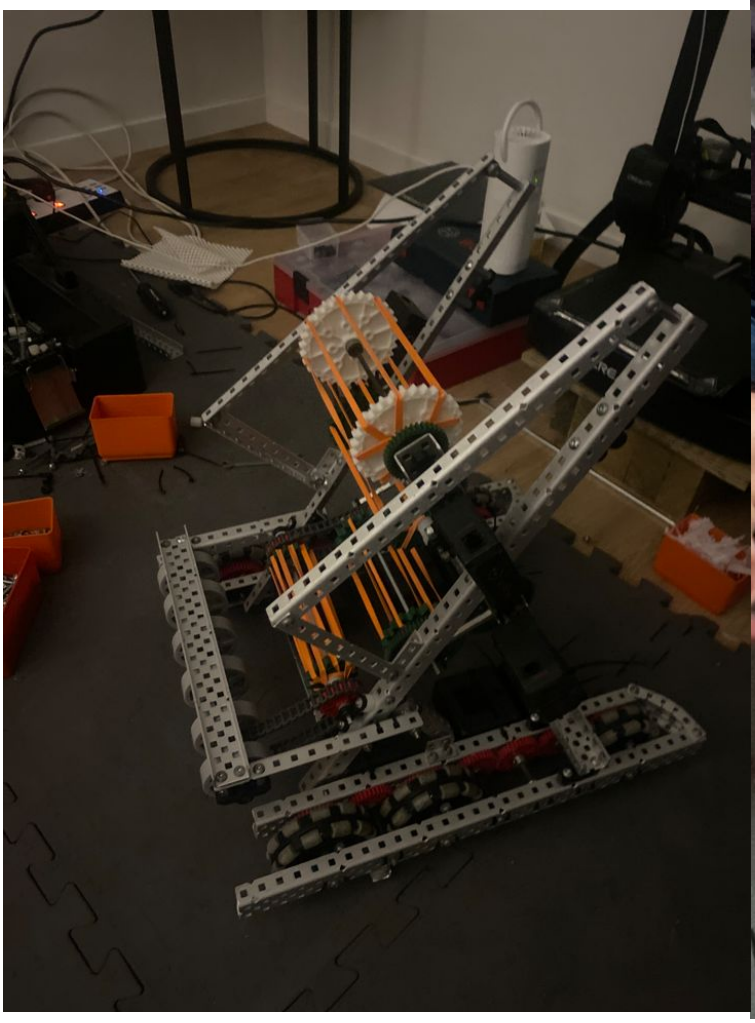
Building
Update 2

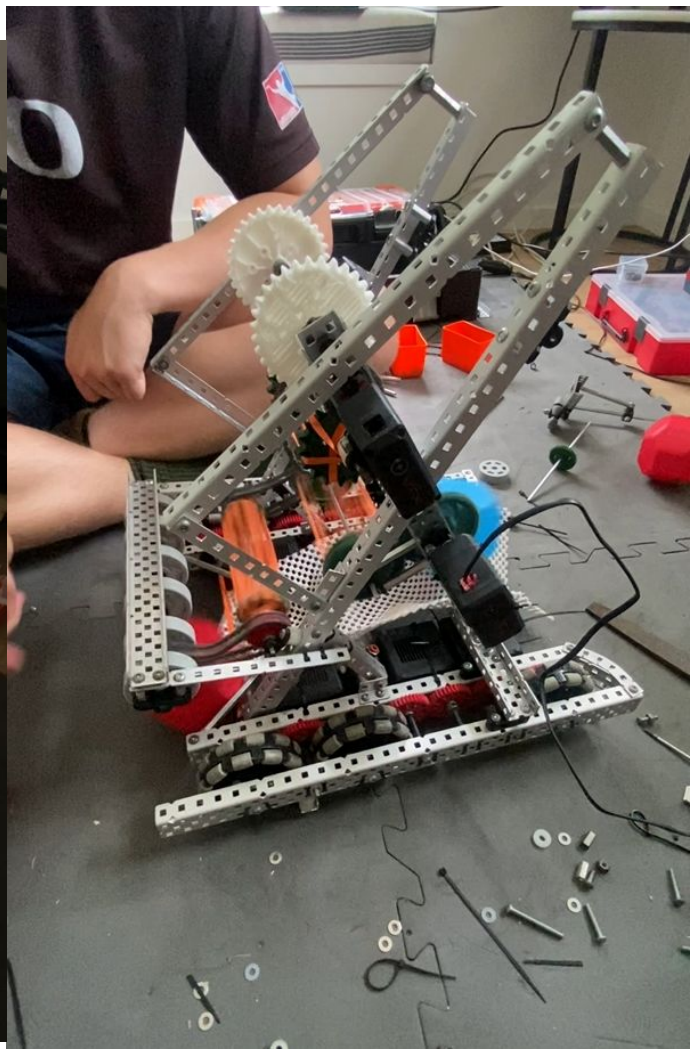
We have moved on to building the D shape that will serve as a major mounting points for the grip mat. We also plan to have a polycarbonate plastic curve mounted on top of the D to attach the gripmat to. This will create a nice curve for the block to travel round in the intake we have also mounted the motors and some of the sprockets/gears.



Building
Update 3

We have added the bottom 3 set of rollers and the rubber bands and gripmat to go with it we have also discovered we don't have the 24T 6P sprocket so we have had to temporarily 3D print some. Additionally we will be 3D printing our polycarbonate pieces out of PLA on a 3D printer to save time and money since cutting polycarbonate on a CNC router takes time and money. 3D printing allows us to easily prototype and find the perfect shape/curve. Once we are happy we will switch them out for the real thing.

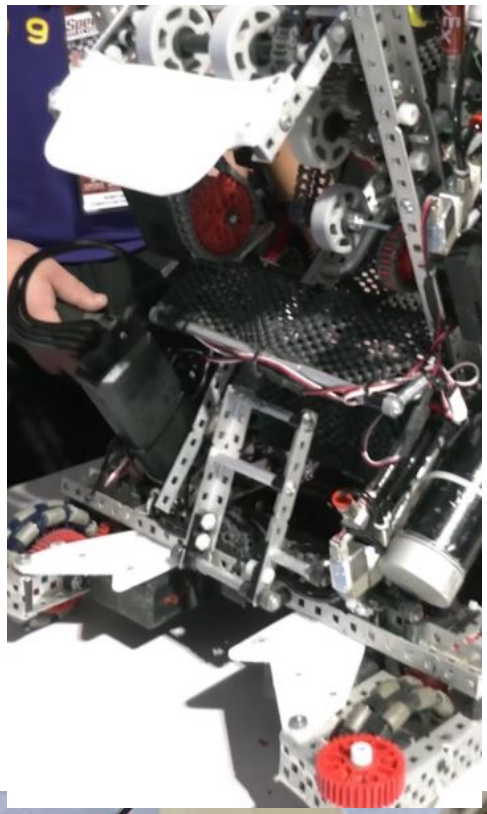


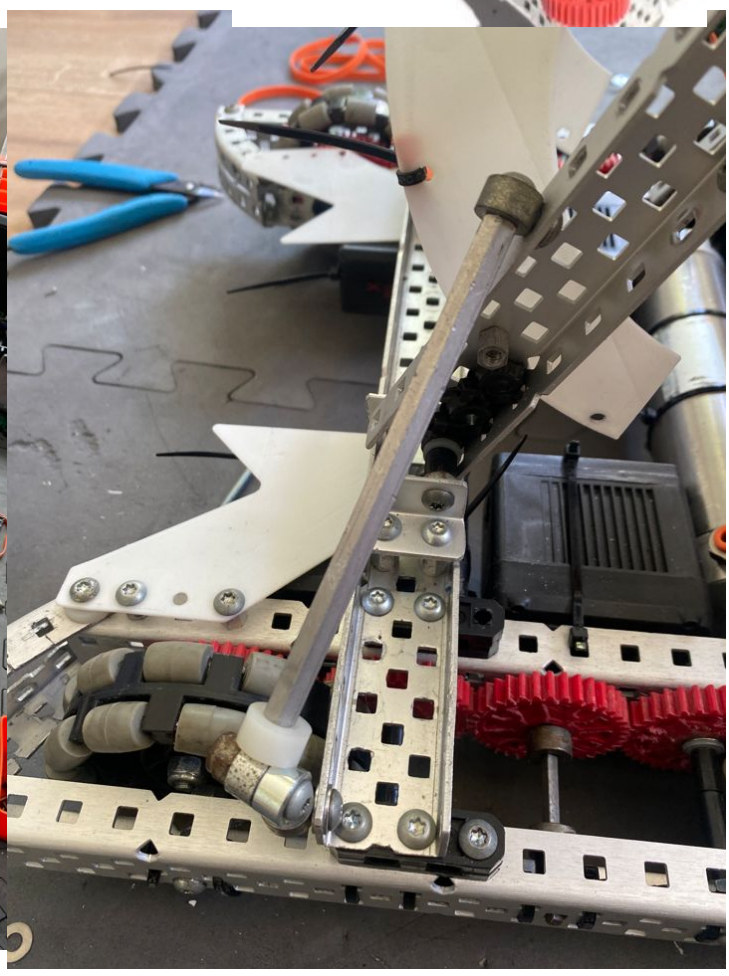


Name: Tom

Building
Update 4

We have come across this split aligner by 99904W which we have taken inspiration from and implemented for ourselves. We think this may be a better alternative than a triangle aligner since these take up much less space and might help us hold onto the long goals better. Either way we intend to just trial run them before we decide how we can improve them or if we want to keep them at all.

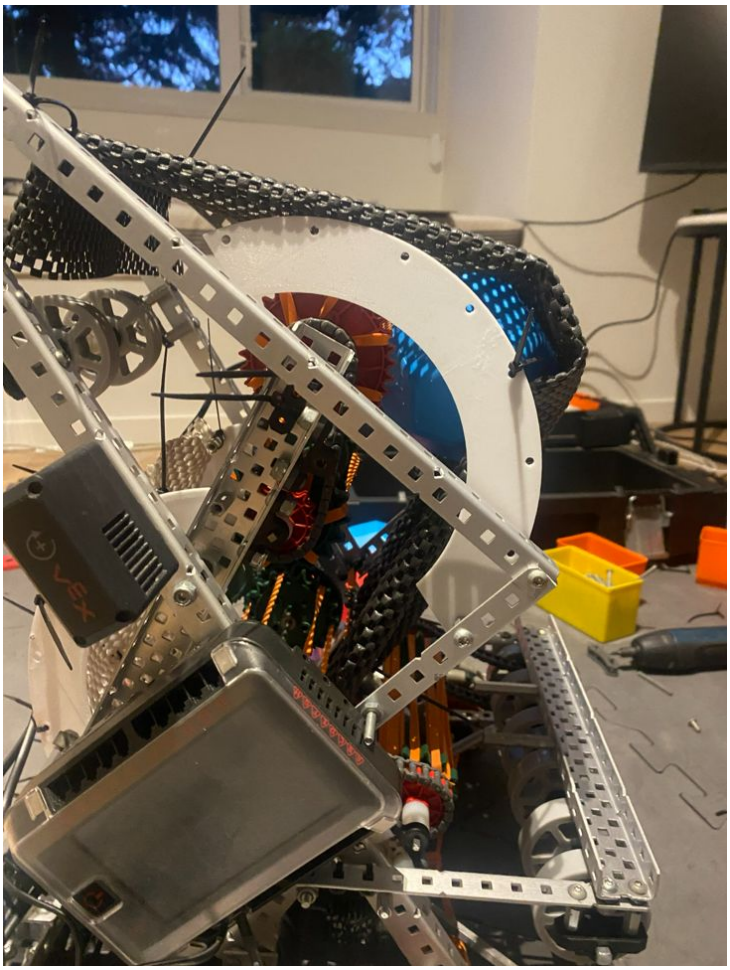


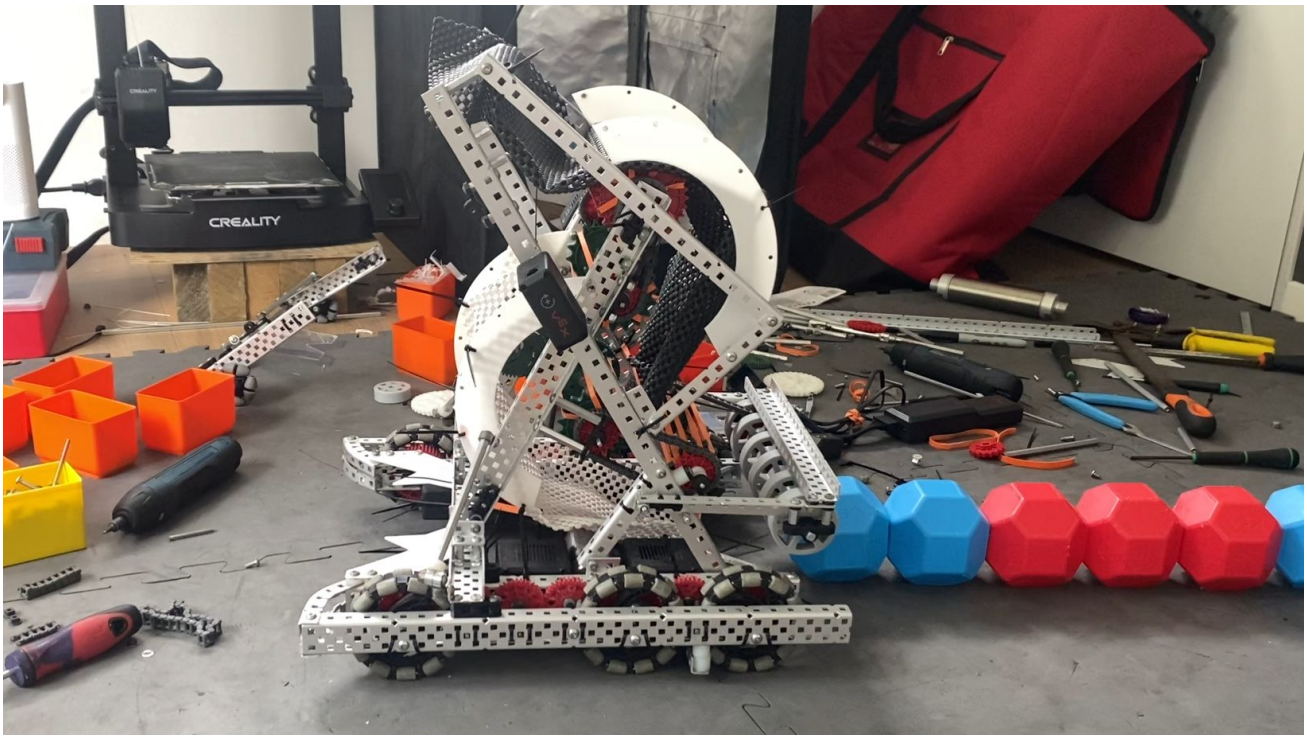


Name: Tom

Building
Update 4

We have started to add the rest of the Plastic, gripmat and intake rollers. But are still playing around with the shape of the plastic to minimise dead zones in the intake (where the intake rollers stop touching the blocks)



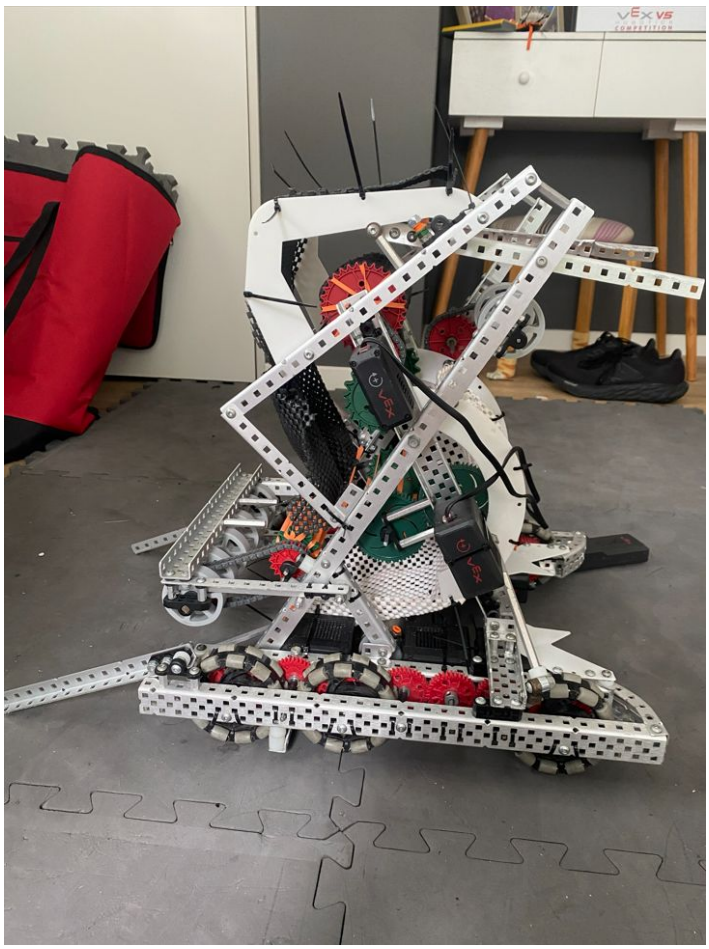


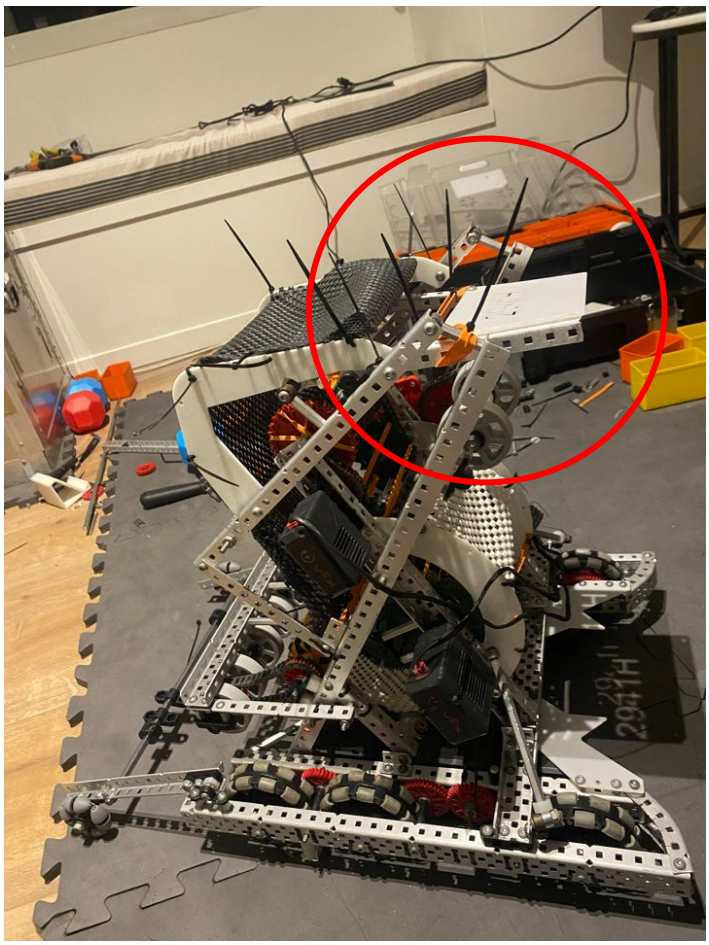
Name: Tom

Building
Update 5

We settled on this boomerang sort shape and have moved on to building the match loader and the hood

Hood explanation:
The **hood** is the thing that will allow the blocks to leave the intake and be scored i the long goal. It will be on a piston and will be on an hinge. Apart from letting the blocks go out the intake when the hood is down we hope that it will be able to push blocks on the ends of the long goals so we can push these blocks further into the long goal or descore blocks.





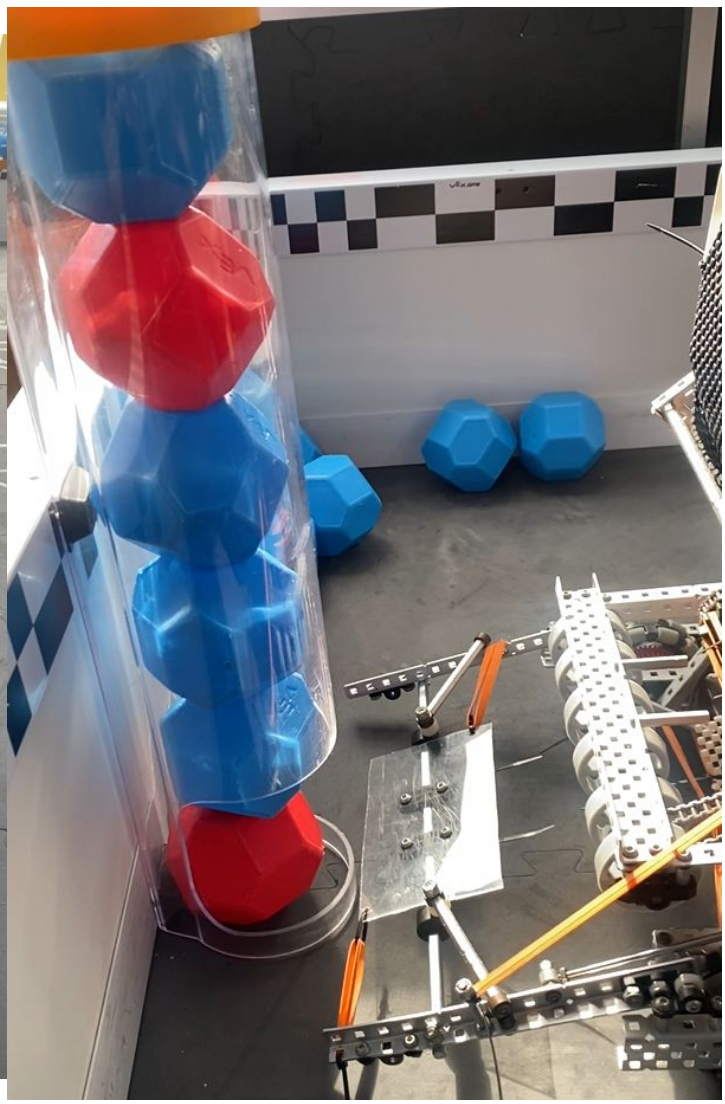
Name: Tom

Scrimmage

Analysis and takeaways

We were kindly invited by 22020X to come play practice matches on their field. We were also still missing some parts which they kindly lent to us to finish our robot:

Completed matchloader



Our main objective here is to see how the robot performs in match conditions

Name: Tom

Scrimmage

Analysis and takeaways

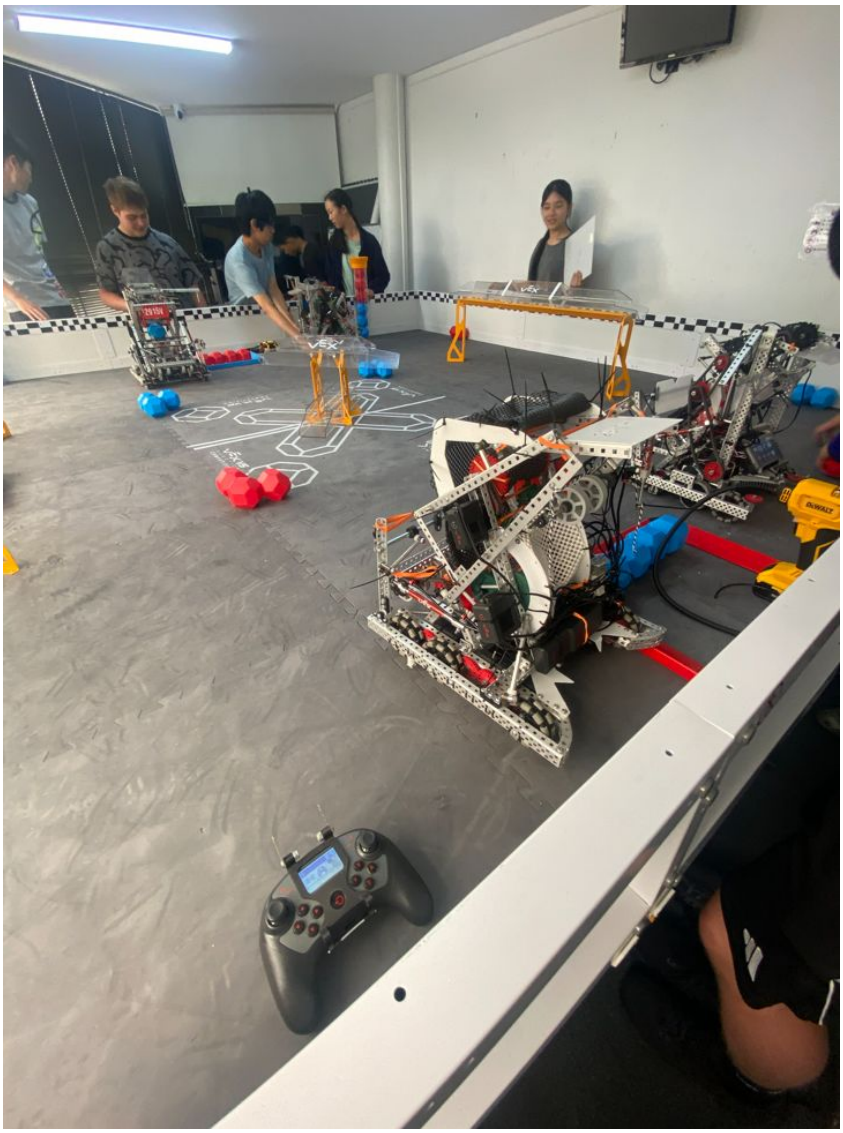
After scrimming we have some key takeaways about our robot and how the game has evolved since our last tournament in September.

Gameplay observations:
We notice with 4 very competitive robots on the field the game is very fast. Almost any block unattended will get descored by a wing. Unfortunately we did not have our wing on in time. We have also noticed that having good control over the robot is important as lining up for goals and matchloader and being able to do it first try is important since there is not a big window for these things.

Robot observations:
The drivetrain is very good we Have noticed that the zipties we use secure the flat bearings on The outside C channel of the Drive are breaking off because they are exposed. So we wil have to replace these with normal Screws.

The matchloader while it Actually worked really well and The concept is going to work It still needs refining.

The hood wasn't mounted very well to the piston and overall We are very whelmed with the Intake as it struggles to cycle And hold blocks properly

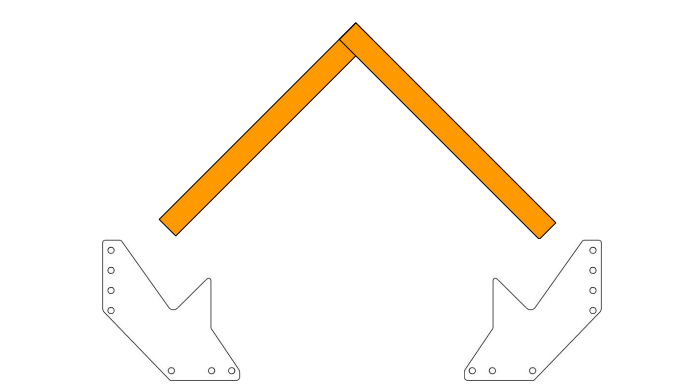


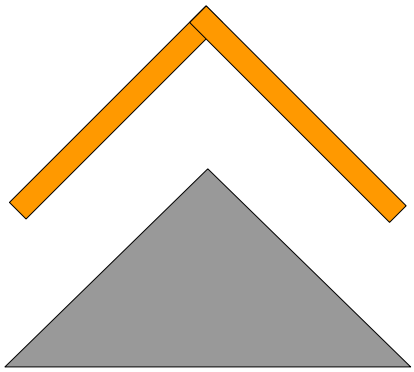
Scrimmage

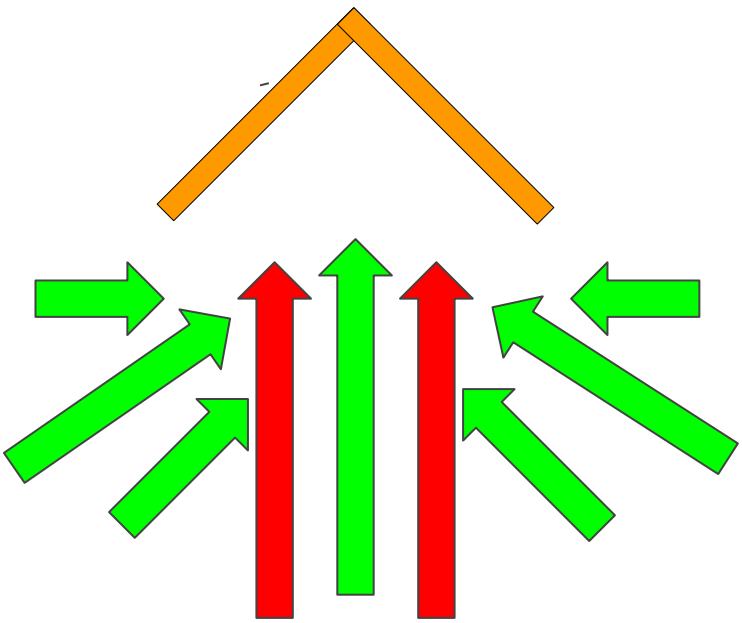
Analysis and takeaways

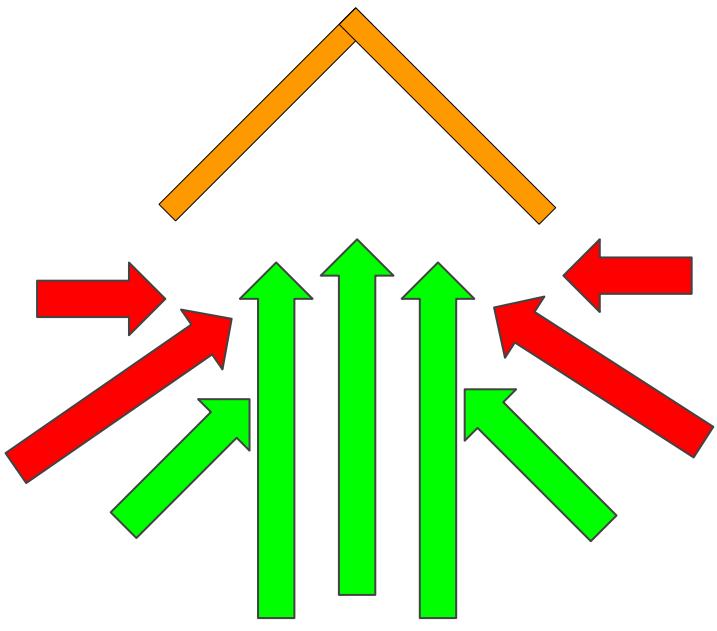
The aligners worked well initially but they broke off easily due to blocks getting stuck in between the aligners and the wall or long goal post. to solve this we want to either raise up the aligners to be higher than a block or lower than a block. this will stop them from breaking off the future. In the debate regarding if a triangle aligner is better we have a theory of how they work differently. Both should hold us in place once we are in place effectively but the difference is how they align.

If the arrows indicated the middle of the the diagram show all the different ways we can drive into the goal and **successful** or **unsuccessfully** align









As you can see with the split alignment we can approach the goal from very aggressive side angles. but when going straight back if your not in the middle it will miss.

For the triangle aligner you can't aligner from side angles like the split aligners but you can back up into it easier.

Name: Tom

Monthly goals
January

1. Improve the robot

Completed on: 31st Jan 2026

Note: These pages have been edited to add the dates the goals they were/were not completed on. These dates will have been added on the day they were completed on or in the case of non completed goals they will have been added on the last day of the month

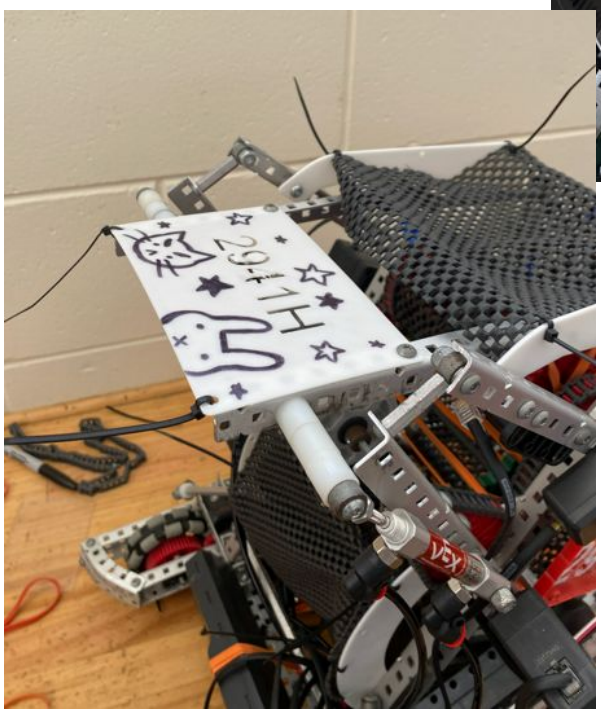
Name: Tom, Indie, Rosa

Building/Improvements

Update 1

The first 2 things we want to improve before we go to our 3rd official tournament Is the hood and match loader.

For the hood we just directly Mounted 2 pistons to the hood And this effectively held the Hood shut and didnt like any Blocks out additionally at this Specific point the hood Becomes slightly too narrow Creating that flinging effect To score the blocks further into goal

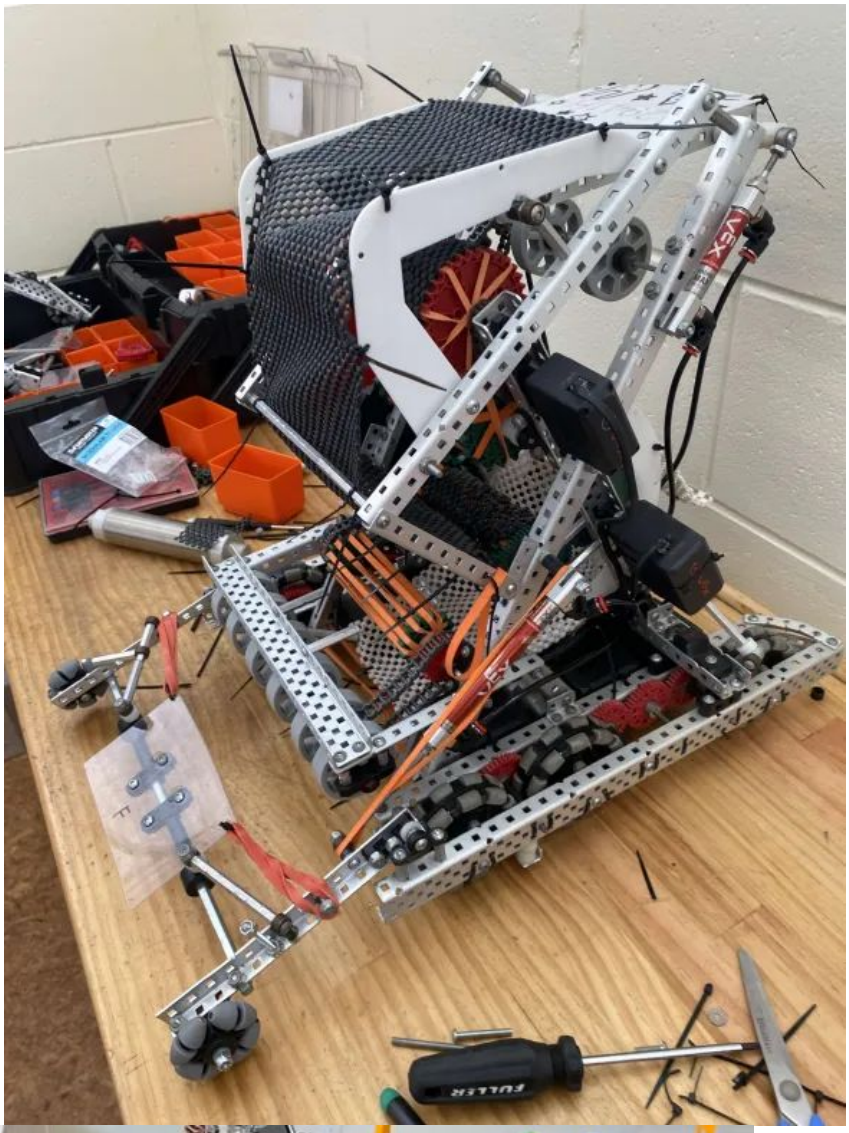


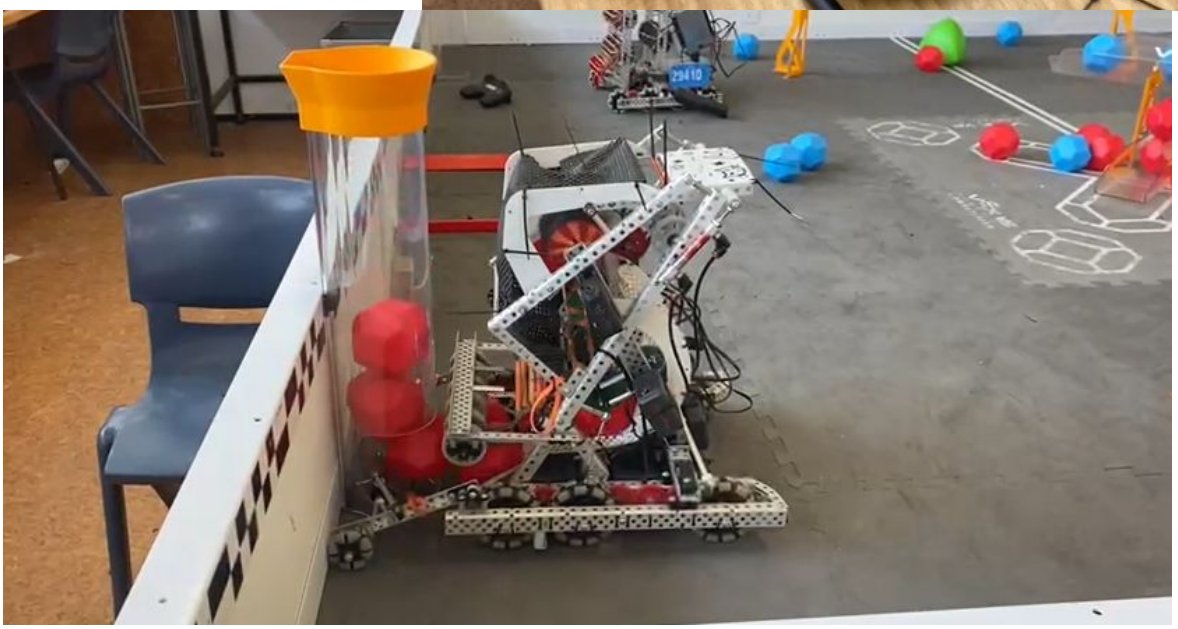
Name: Tom

Building/Improvements

Update 2

We feel like there is too much force required to drive into the match loader and get the blocks out so we are experimenting with rubber band placements. The rubber bands bring the polycarbonate to its original position after bending to the shape of the matchloader to get the blocks out. We are relatively happy with this rubber band setup but want to keep trying to improve it

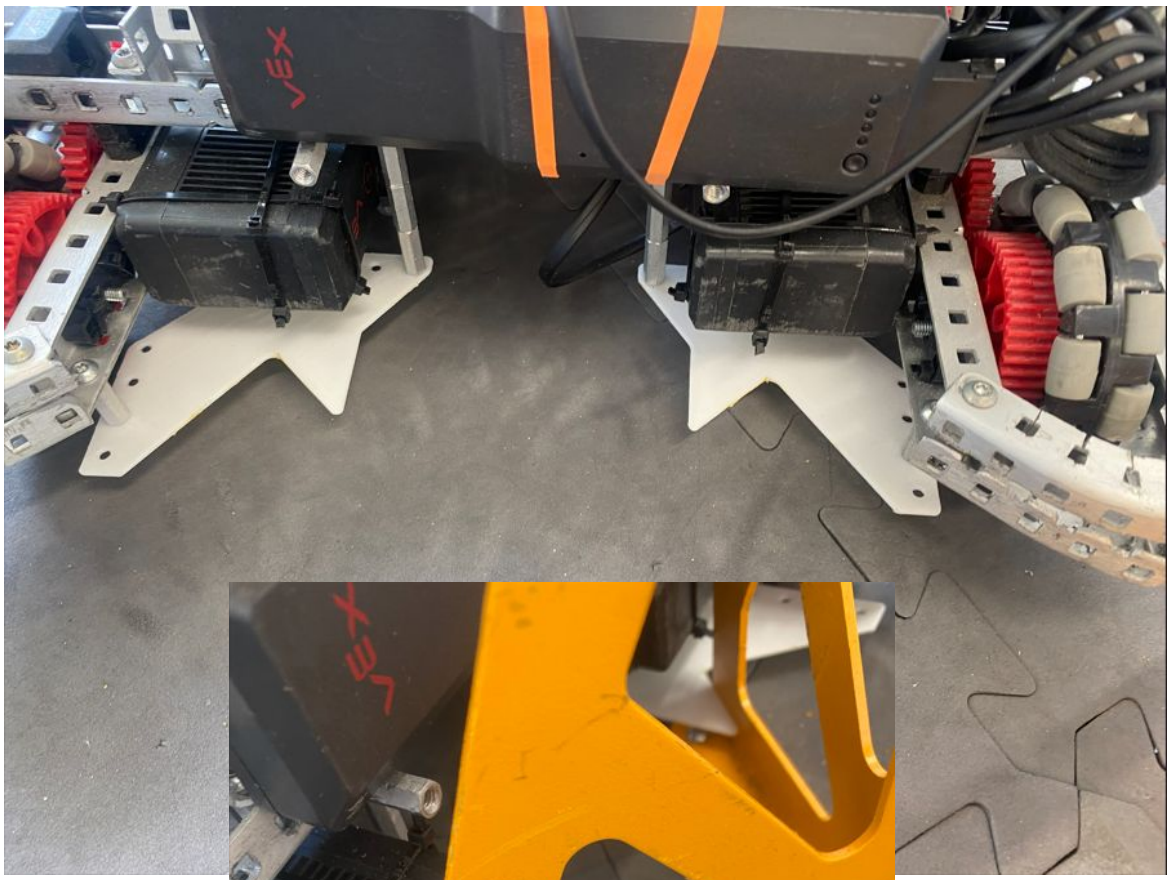




Building/Improvements

Update 3

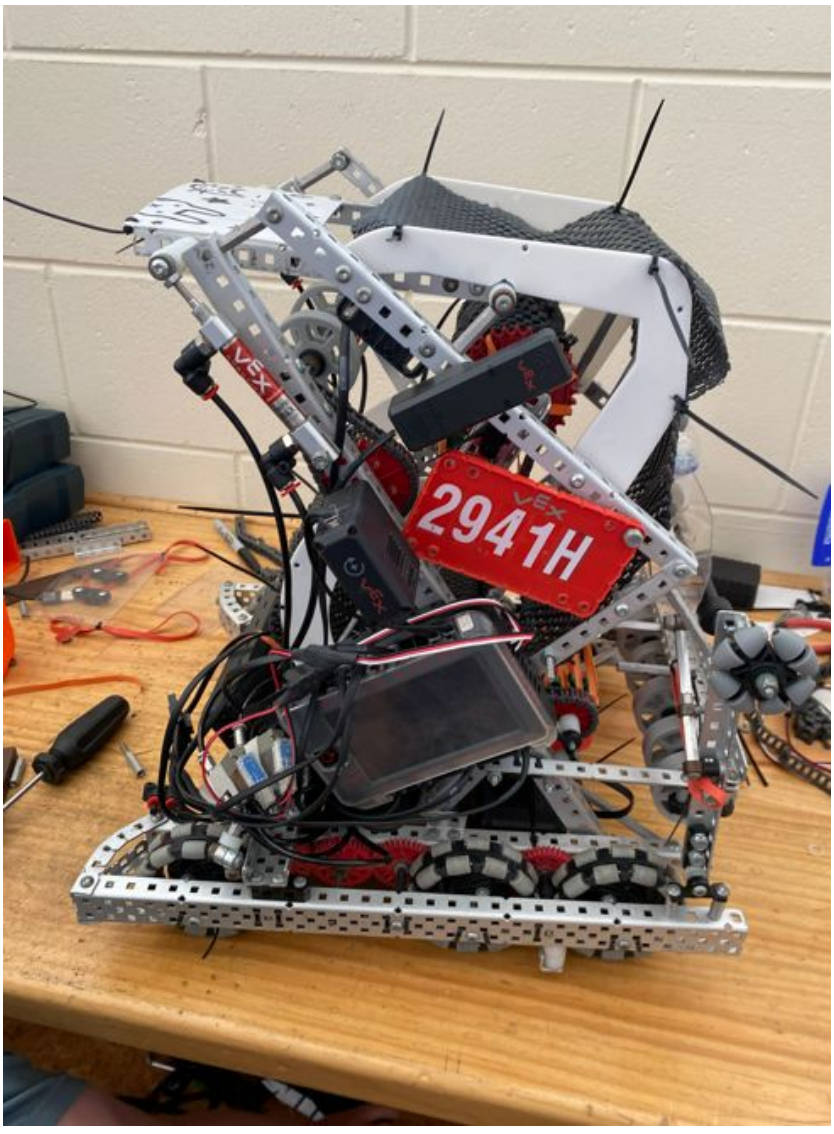
We have reprinted the aligners and mounted them very low on the robot. To avoid them getting broken and after rigorous testing and taking to break them in the most extreme scenarios they simply slide under the blocks. The risk of them breaking is always going to be there therefore we plan to make multiple copies. We have also modified them to make them sharper and longer and more angled. We believe this will give us a better alignment range.



Building/Improvements

Update 4

The intake is going to require a lot of work because of the fact that the intake path/cycle doubles as the storage. So when the hood goes down and starts blocking the blocks more and more blocks want to go up the intake but the hood is essentially stopping them from passing through. The rollers are still trying to push the blocks up further but can't since the hood is closed. Essentially the effect we are trying to create with the gripmat is where the gripmat puts enough pressure on the block to keep it in contact with the rollers as it goes up through the intake but have enough slip and slack to stop it from completely jamming when the hood is shut and it can't go any further we essentially want it to slip and spin in place. To find this perfect mid ground we have to adjust the grip mat until it hits that mid ground. We adjust the gripmat by changing where it is attached and how tightly its attached. This allows us to change the amount of slack/pressure that's being put onto the block.

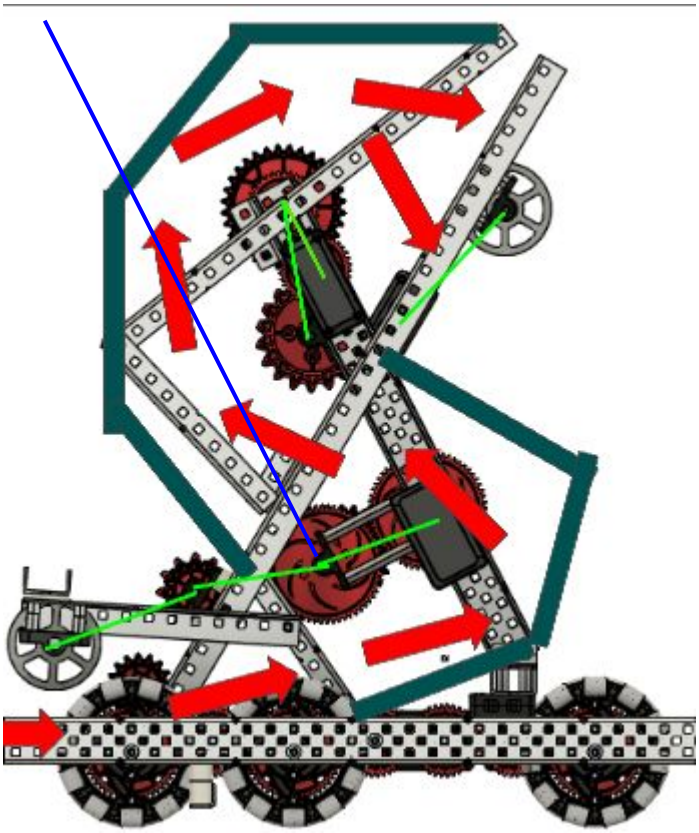


Name: Tom

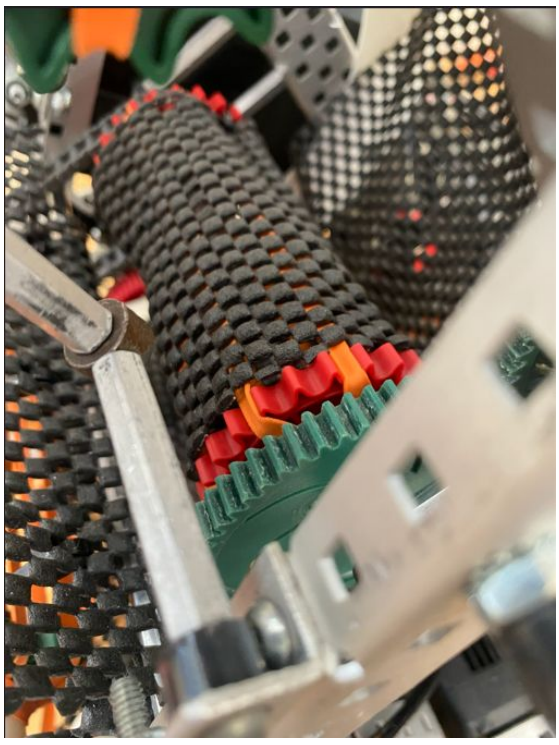
Building/Improvements

Update 4

We mastered the first 5 blocks pretty easily by just moving/tightening the grip mat. But we noticed the bottom center roller was too big and the blocks we being compressed to much and causing the last 4 blocks to jam the intake.



But after switching out the sprocket for a smaller sprocket and adding grip mat to increase slipping it worked perfectly and we were able to hold 9 blocks at a time and score them



Name: Tom

Monthly goals
February

1. Add a descoring wing mech

Completed on: 5 Feb 2026

2. Attend one more tournament before nationals

Completed on: 7 Feb 2026

Note: These pages have been edited to add the dates the goals they were/were not completed on. These dates will have been added on the day they were completed on or in the case of non completed goals they will have been added on the last day of the month

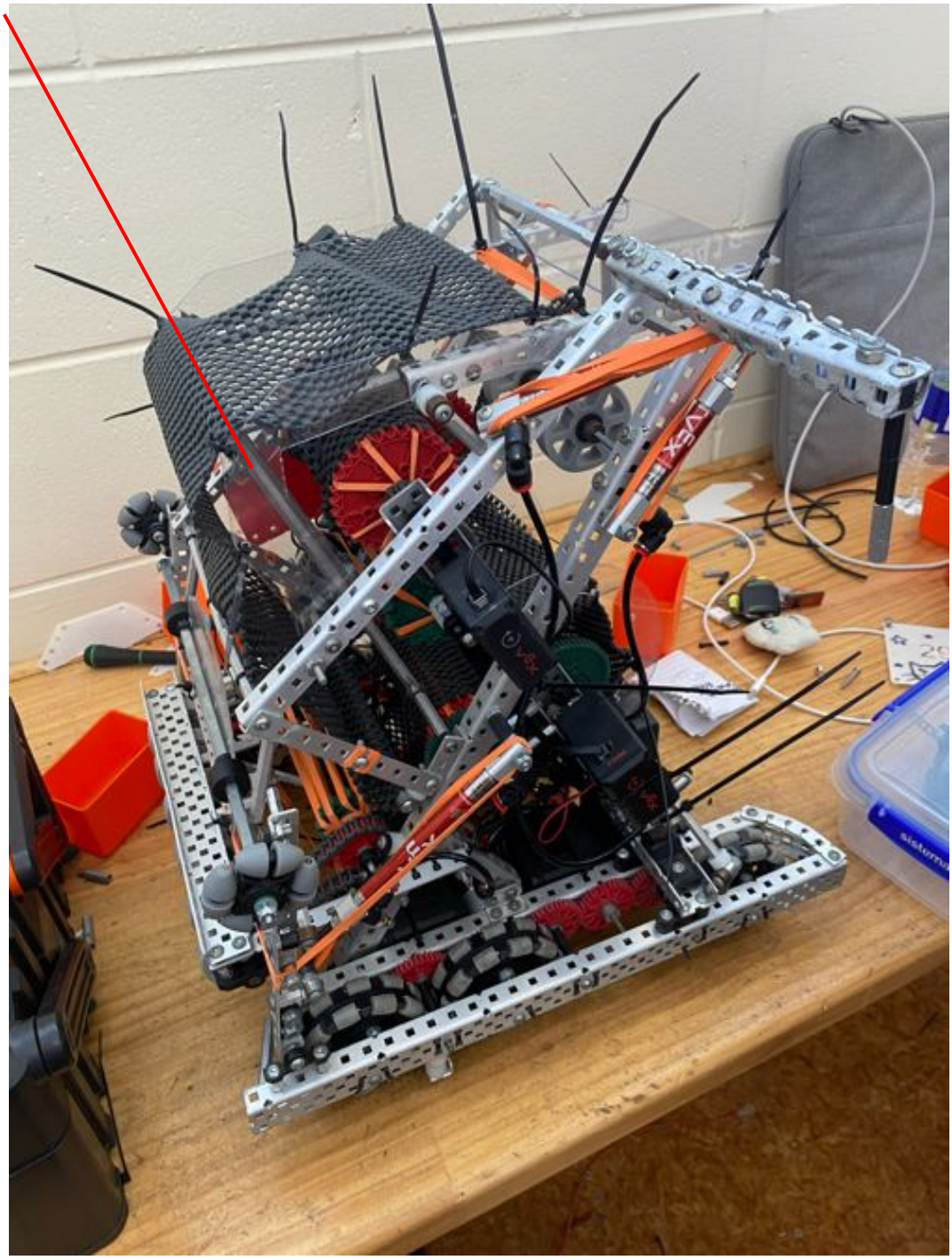
Name: Tom, Indie, Rosa

Building/Improvements

Update 5

This is our simple wing its just 2 pieces of boxxed L 1x1 with a screw on the end with spacers and a standoff. We have chosen to have spaces since they slide nicely in the goal. We have also twisted the wing so the hook faces directly down. So that we don't accidentally reach into the enclosed section of the goal

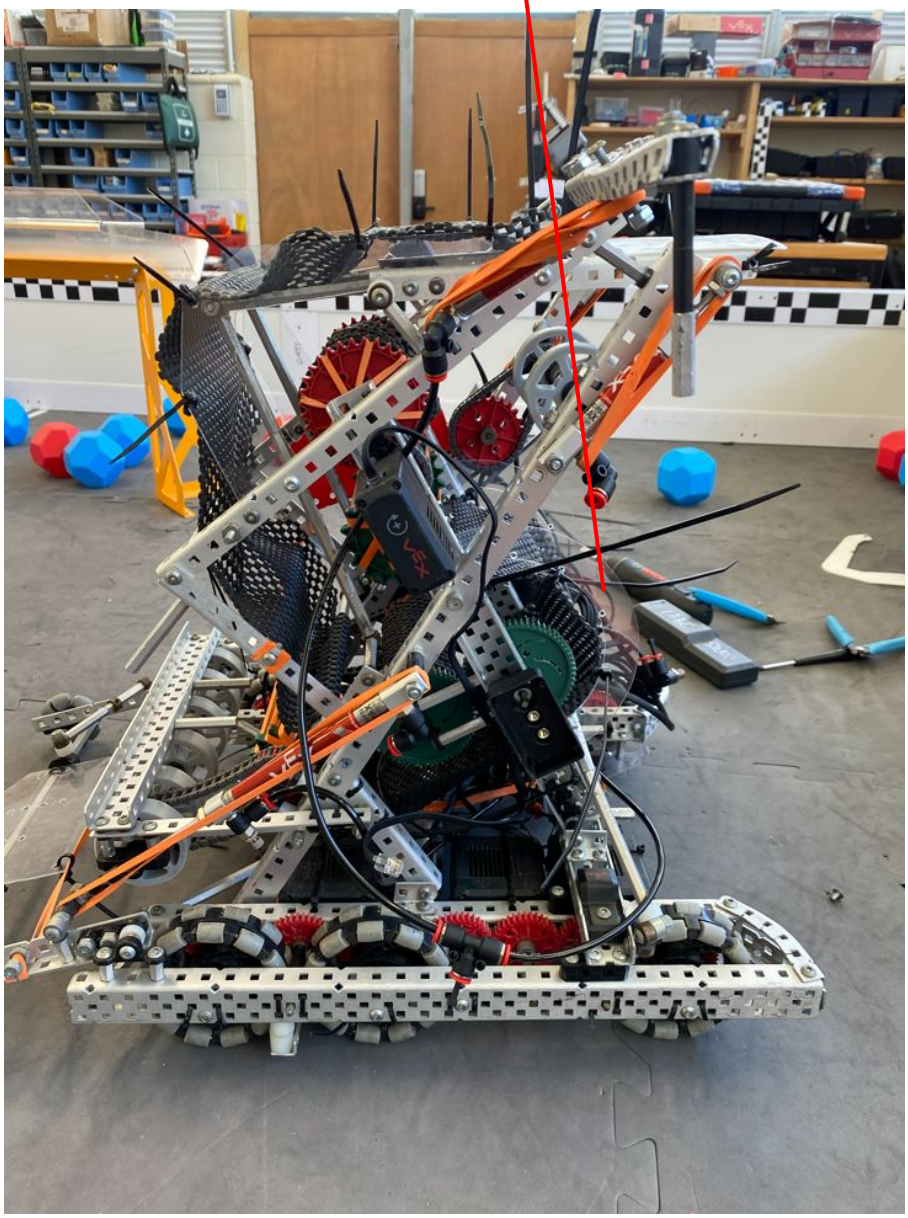
We have also added standoffs in the intake to guide the blocks and keep them in single file



Building/Improvements

Update 6

The second to last thing to do was replace our 3D printed polycarbonate plastic with real polycarb plastic since we are going to an official tournament
We have also make the back S poly a smaller radius since it was causing a deadzone in the intake



Pic of robot with legal clear plastic

Pre tournament

Strategy

Our strategy for this tournament is to just play long goals and if we cannot secure the long goals and we are unable to descore their blocks using our wing mechanism we will simply switch to scoring in the center goals or have both our alliance’s robots attack and try descore one long goal forcing them to give up their defensive position. We think it's also very important to recognise when we have won the game and we only have to play defense and defend out lead. Also overstocking the goals makes them easier to descore so scoring as little blocks in the long goal while still keeping control zone is ideal.

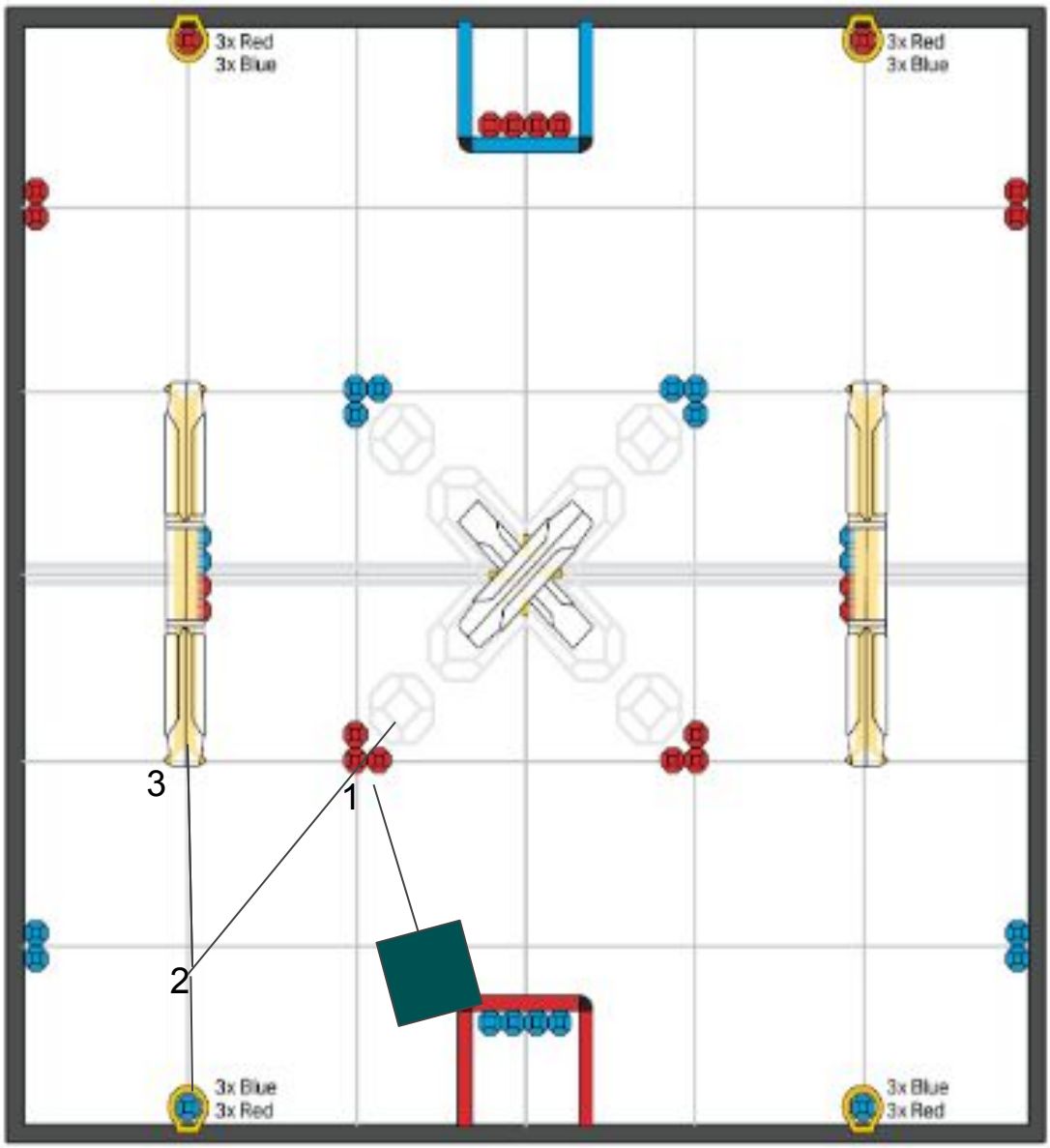
Pre tournament

Auton

1. The robot drives forward to grab the cluster of 3 blocks and stores them in the hopper
2. Robot turns around and drives to match loader, lowers scrapper and match loads blocks into hopper.
4.Robot drives backward to the long goal and scores the blocks in the long goal.

This auton is mirrored for the other side as well

= Robot



Total points 21-31

Name: Tom

Post tournament

Results and thoughts

Qualification results for Auckland V5RC #10:

Qualifier #7	**2941H**	2941D	39	22020Z	8115X	13
Qualifier #14	2918J	2941E	31	22020X	**2941H**	69
Qualifier #18	2918X	2996B	31	11044B	**2941H**	28
Qualifier #29	**2941H**	2941A	58	2921R	2941G	19
Qualifier #37	59833A	2915V	55	**2941H**	3168H	24
Qualifier #43	**2941H**	52392D	98	2918C	52392A	8

Rank	13
WP / AP / SP	8 / 20 / 123

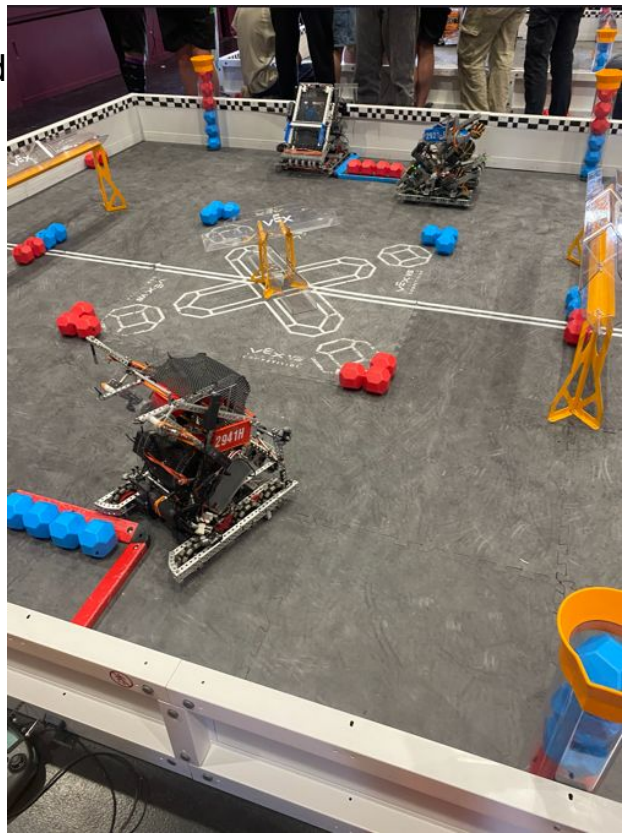
Wins - Losses - Ties
4 - 2 - 0

Rank: 13

Eliminations results:

QF #3-1	8115X	**2941H**	114	52392D	8757C	11
SF #2-1	8115X	**2941H**	70	22020C	2996B	3
Final #1-1	22020X	2915V	74	8115X	**2941H**	25
R16 #5-1	8115X	**2941H**	94	2921F	2941G	18

Today's tournament was at glenfield college we are actually really happy with our robot, there were a few inconsistencies overall our robot worked pretty well. We very unfortunately had some field controller issues that were out of our control. These issues involved when being plugged into the field us not being able to run our code and having to reset the controller and relink it first. Our autonomous routine performed as expected in the first 2 matches but after that started freezing mid routine. We tried to solve these problems by re-updating our brain, controller and factory resetting them. It resolved the code not running when plugged into the field controller issue but not the auton freezing issue. These issues caused us to lose a very winnable Q18 which would have bumped us to 6th place in qualifications.
Despite the field controller stopping our auton our driver skills and robot was still enough for the 2nd seed 8115X to alliance with us and win a series of calm clean matches. We did eventually fall to the 1 seed alliance in finals. Considering we lose our auton mid tournament to an issue beyond our reach being tournament runner should be considered a positive result.



Name: Tom

Post tournament
Analysis

Autonomous
- Our autonomous routine worked well the first 2 times before the field controller started freezing the auton mid routine

Driver control
- Can still be improved
- Drive code performed as expected
- Clung to long goals well and scored and de-scored blocks effectively

Drivetrain
- Drivetrain worked flawlessly
- We are happy with the weight of the robot and its correlation with the acceleration and responsiveness

Intake
- The floating intake picked up blocks very effectively the blocks cycled nicely through the intake.
- Very occasionally there would be a dead zone in the lower back part of the robot and would require another block to be picked up to push it further up the intake.

Hood
- The hood worked well and did its job

Matchloader
- The when the matchloader worked it worked well. Sometimes the rubber bands did bring it back to original position and couldnt get under the block.

Wing
- While the wing worked it was about a hole too short so we can to go at the long goal at a weird angle to get the wing in.

Post tournament

Improvements

Autonomous
- Replace our brain with a brand new brain to avoid any software issues with the field controller.

Driver control
- Can still be improved
- practice lining up for wing plays

Intake
- Fix these occasional dead zones by making the bottom polycarbonate circle radius even smaller.

Hood
- Add a lip so when the hood is down it can be used to push blocks from the ends of the goal

Matchloader
- Bring the rubber bands closer to the point of rotation

Wing
- Remake the wing 1 hole longer and add a slide to help align with the long goal

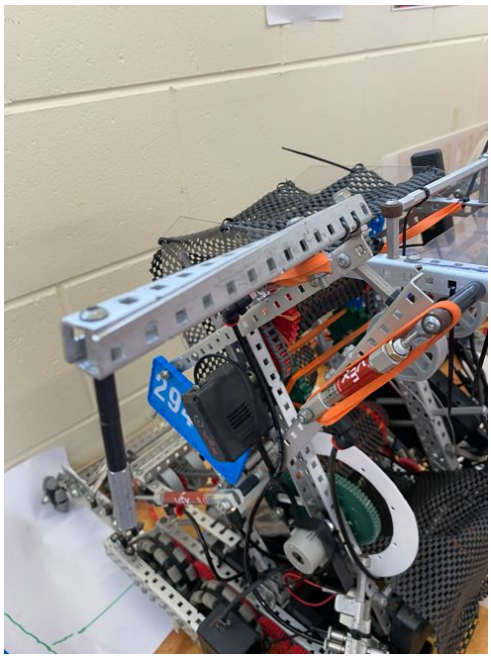
Final improvements

Update 1

We have acquired delrin plastic to replace some of our polycarbonate because it is stronger and flexes less this will help us fix the dead zones in the intake

We have also cut new L channel for the wing and made it one hole longer so it reaches in to the goal properly

We also switch our brain out for a brand new one and tested it on our own field controller and it works without problem now

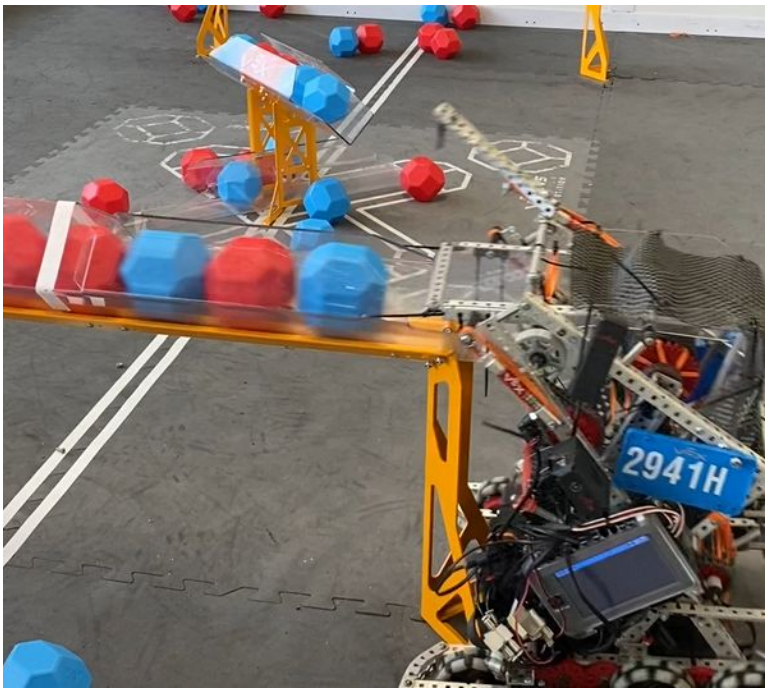


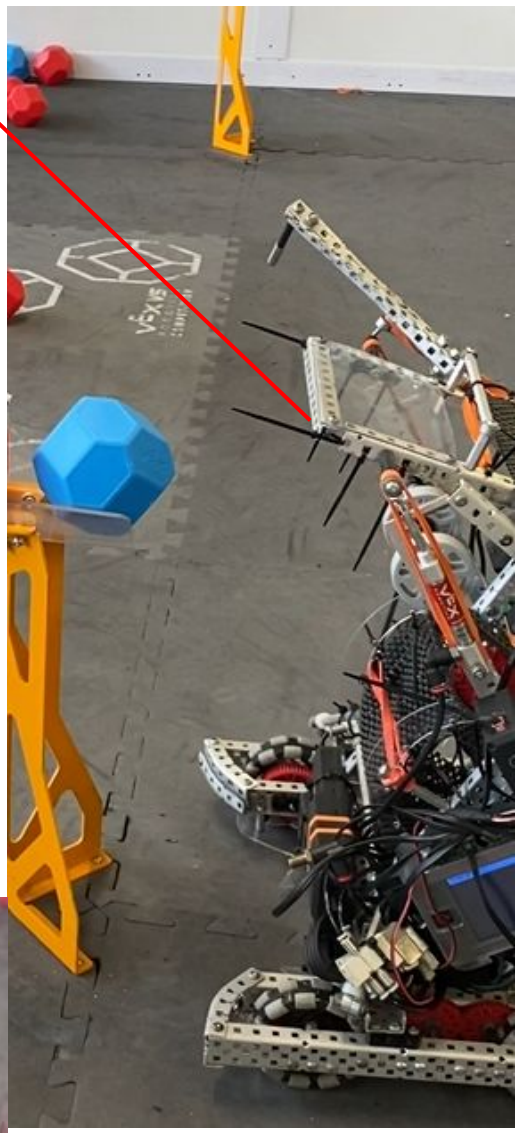
Name: Tom

Final improvements

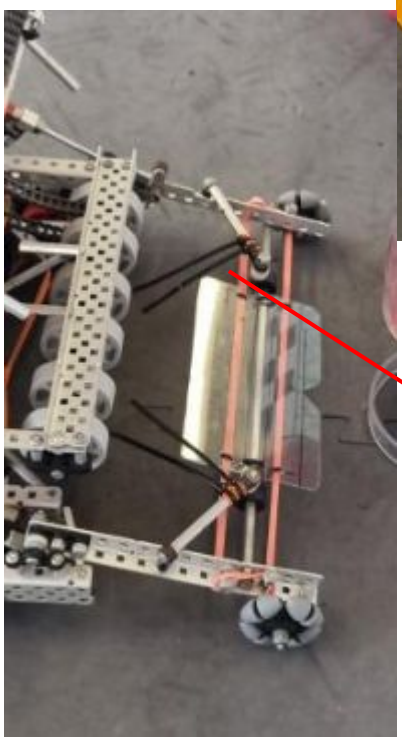
Update 2

We have also added a small L channel lip so we can push the blocks at the ends of the long goals





For the match loader we have moved the rubber bands closer the point of rotation so the poly bends nicely and returns to its original position properly

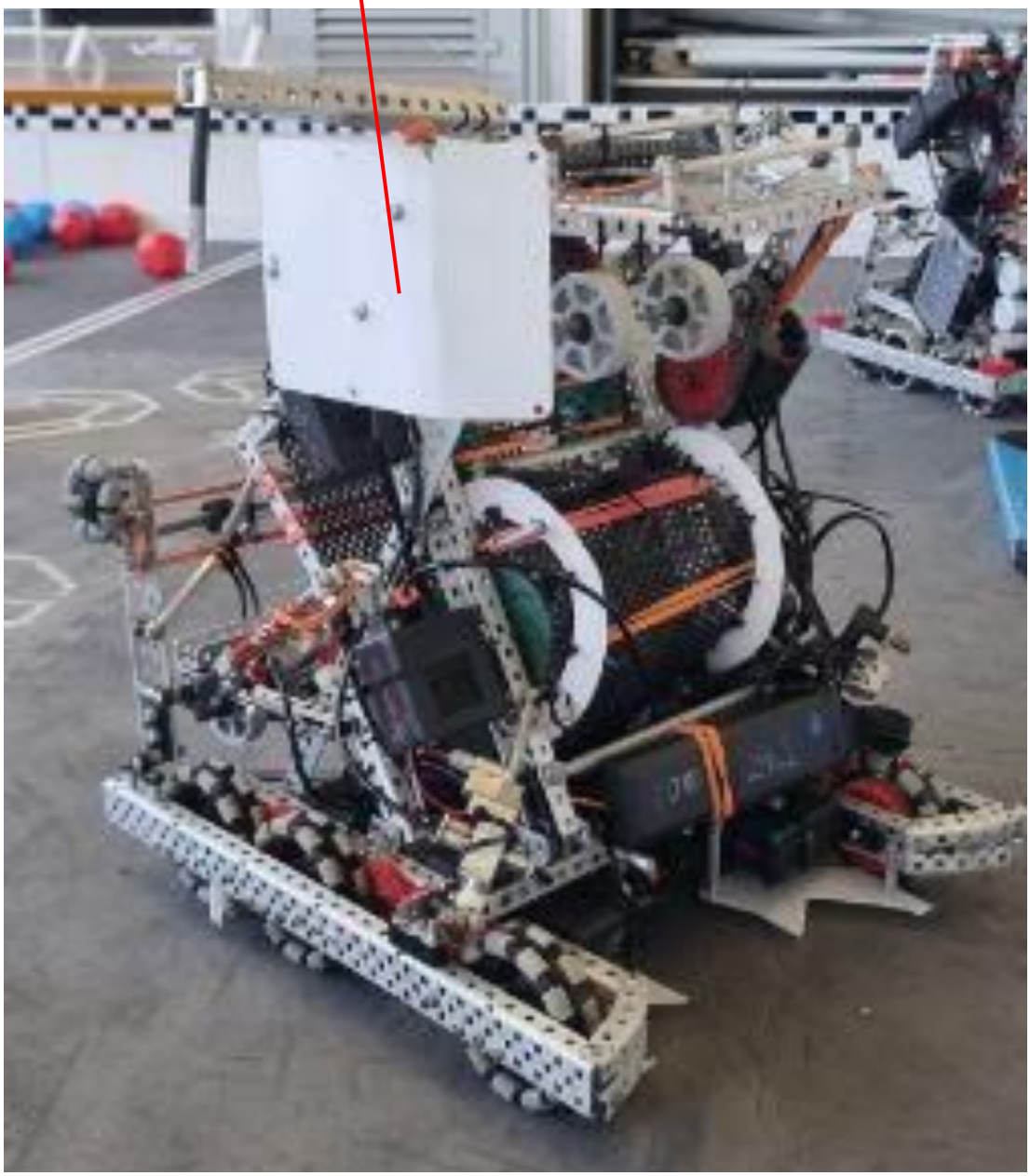


We also added these zipties to guide the blocks into a single file into the floating intake

Final improvements

Update 3

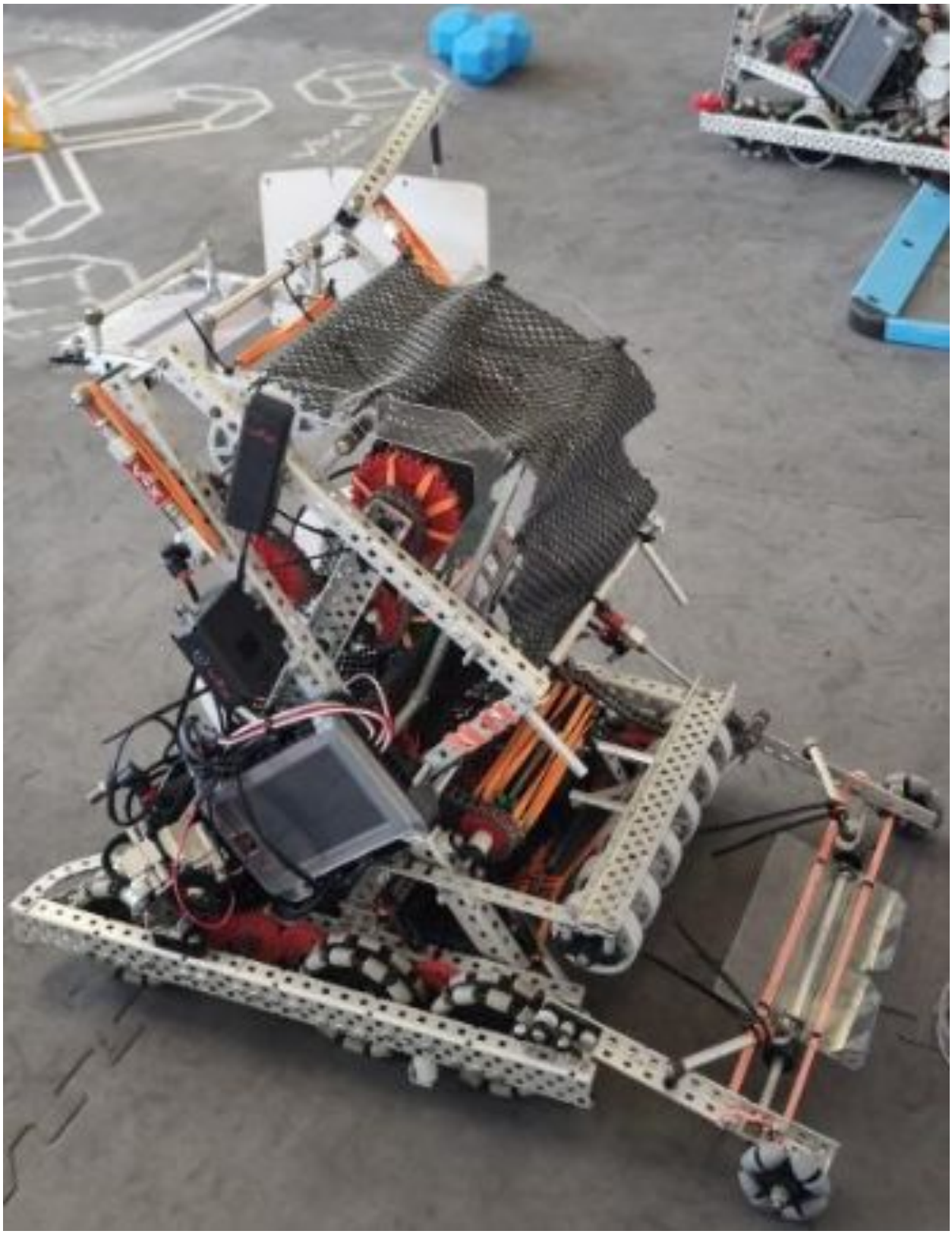
We have also added this alignment slider piece to help align with the long goal and help descore with our wing.



Final robot overview

Completed robot

This is our completed robot



Final robot overview

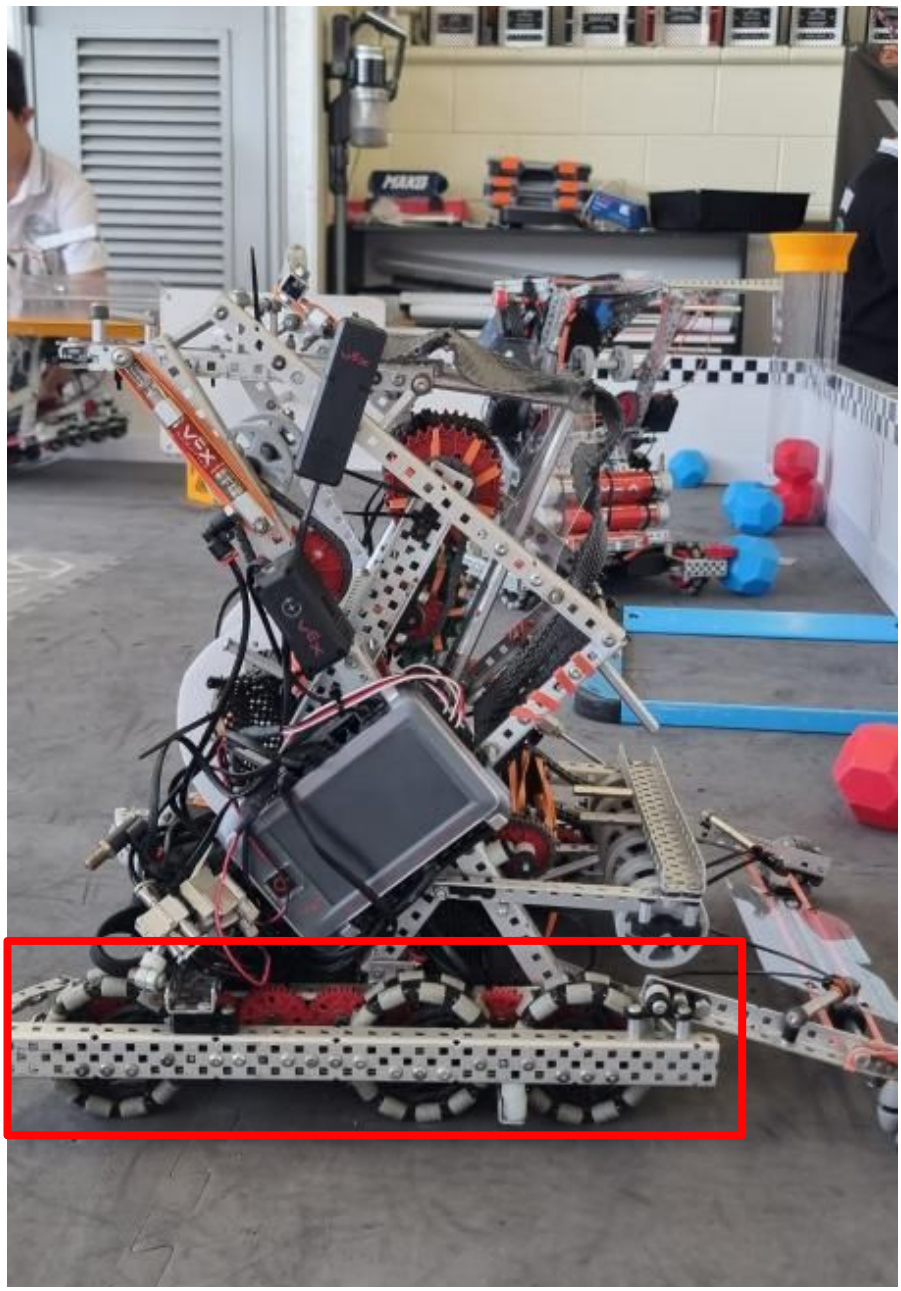
Completed robot overview

Through the engineering notebook we have explained our design process, ideas and philosophies. This final overview will skim over the robot and its main features and ideas behind them one last time.

Final robot overview

Drivetrain

The **red** box shows one side of the **drivetrain.** Starting with the wheel setup we are running a 6 wheel 3.75” full omni wheel setup with a non centered middle wheel. We have chosen this specific wheel setup because it allows us to effectively drive over the parking barrier. Have chosen to go with 6, 11W motor with 600 RPM cartridges because the drive is the most important part of the robot and we want to allocated as many motors to it as we can without compromising the option for other mechanisms. 6 motors allows us to use a 36T to 48T gear ratio this gives us an RPM of 450RPM. Our robot is 6.6kg’s according to the community 6.8kg’s or less is the ideal weight to maximise acceleration at 480 RPM with 6 motors



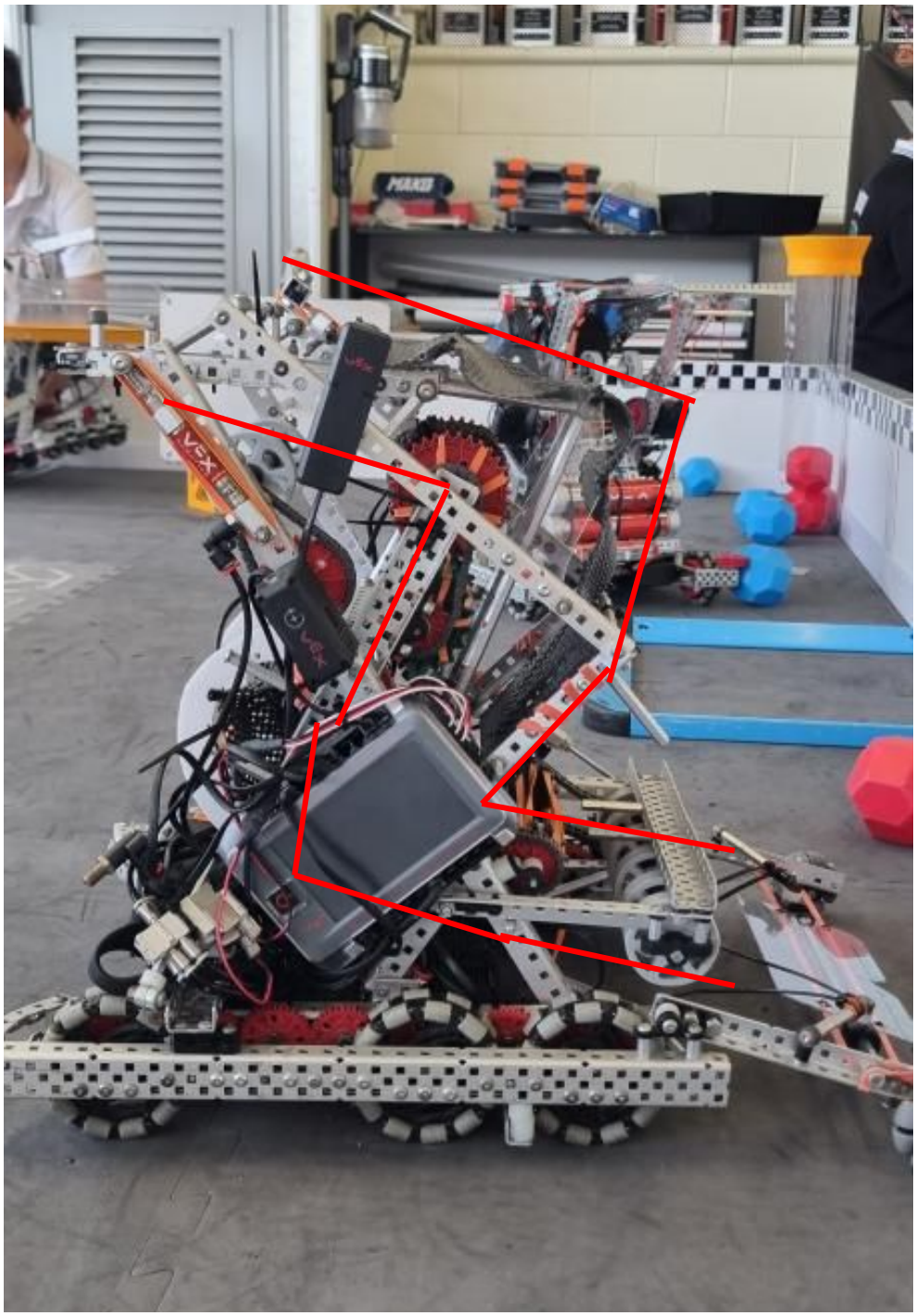
Another notable feature about our drive is that is we are using half cut gears instead of the standard high strength gears this allows us to squeeze into tight spaces like between the long goal and the wall.

Name: Tom

Final robot overview

Intake

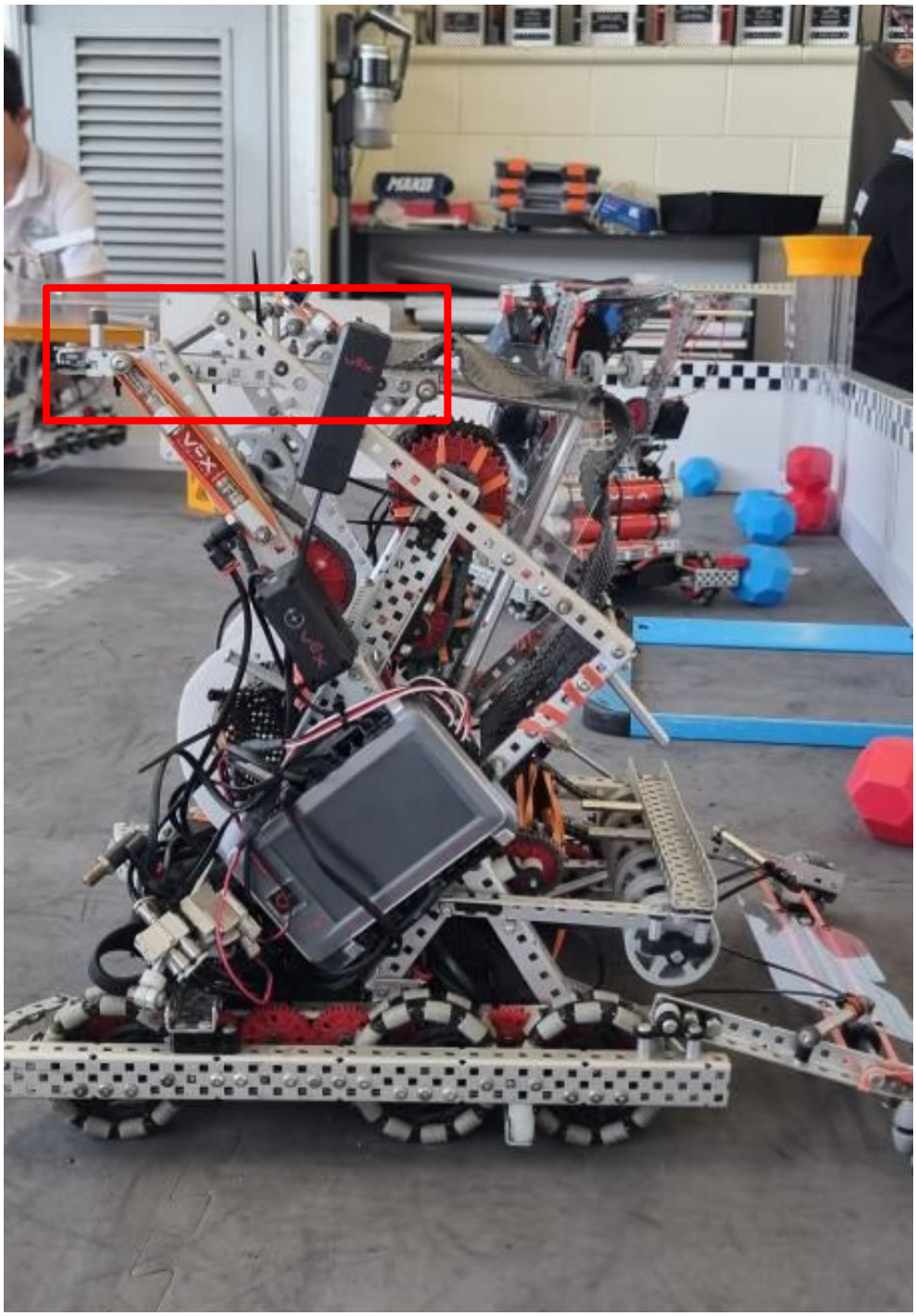
Our intake is powered by 1, 11W motor and 2, 5.5W motors the floating flex wheel intake on a hinge picks up the blocks from the ground and with the help of 3 different sets of rubber band or flex wheels and grip mat is guided up in a S shape and is cycled out into either the long goal or the middle center goal. The intake rollers spin at various different RPM's due to their different radiuses. RPM's range from 200-600 RPM. Our intake can hold up to 9 blocks at a time.



Final robot overview

Hood

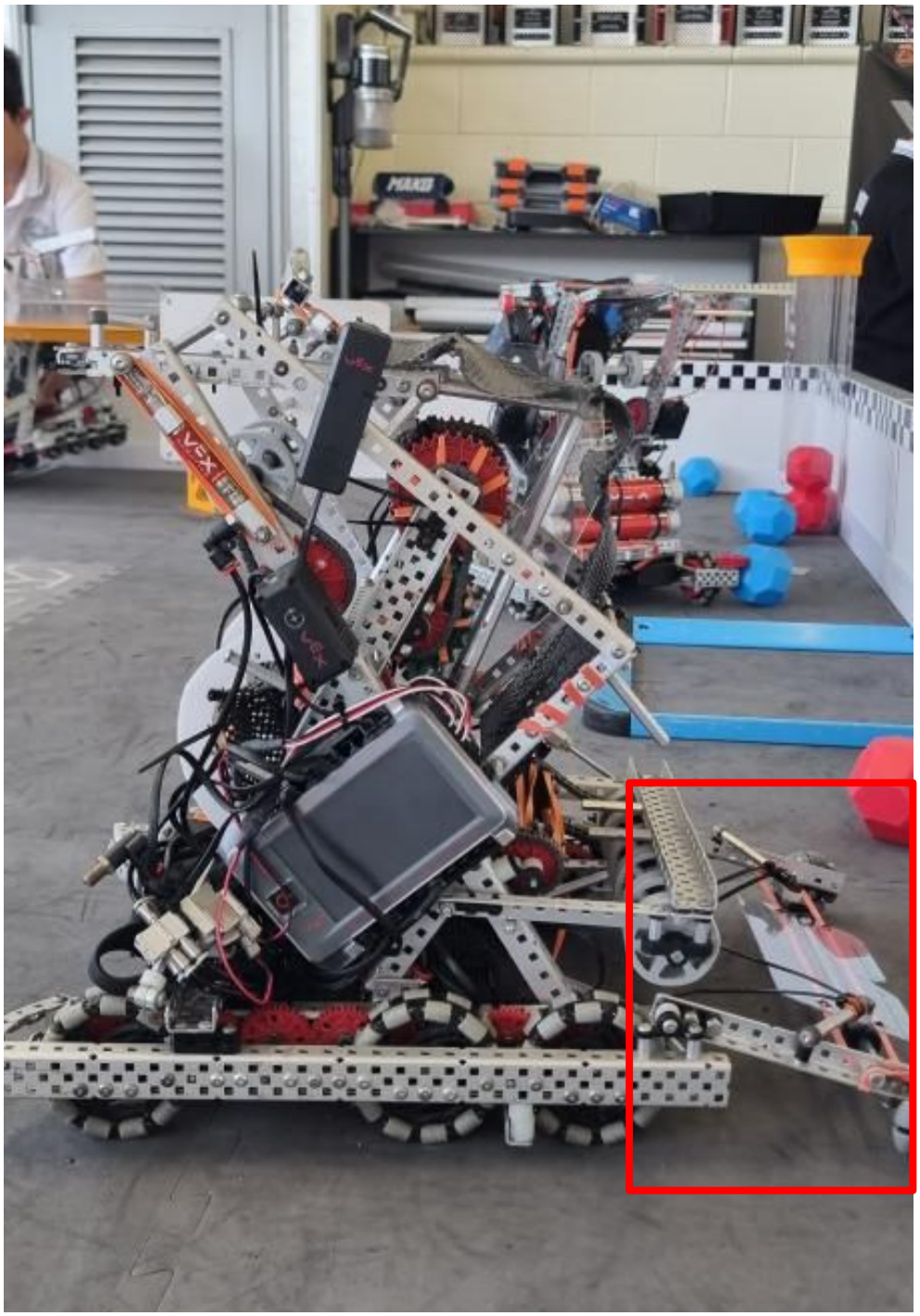
The hood is simply a piece of polycarbonate plastic on a hinge that stops the blocks from exiting the intake and allows our intake to store up to 9 blocks.
It is piston activated so when the piston is raised up the hood allows blocks to pass thru to the long goal. But blocks them when it is down the hood also had a small lip at the end so when the hood is down it allows us to push blocks from the ends of the long goals inwards.



Final robot overview

Matchloader mechanism

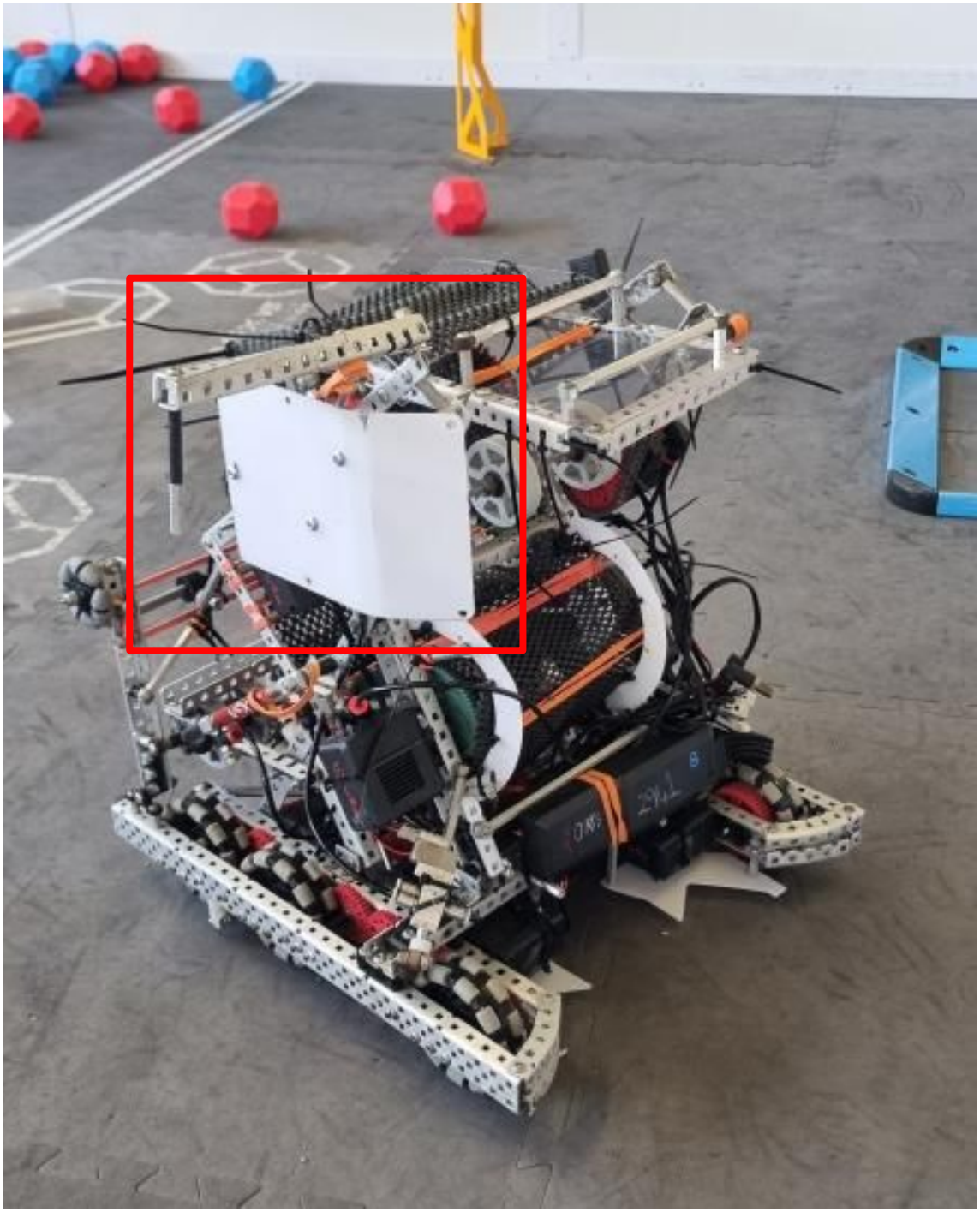
The match loader mechanism is essentially a piece of polycarbonate that's lowered down to match loader height and when pressure is applied and robot drives into the matchloader the polycarbonate bends to shape of the match loader and allows the blocks to slide out. This mechanism is on a piston and can be lowered and raised.



Final robot overview

Wing

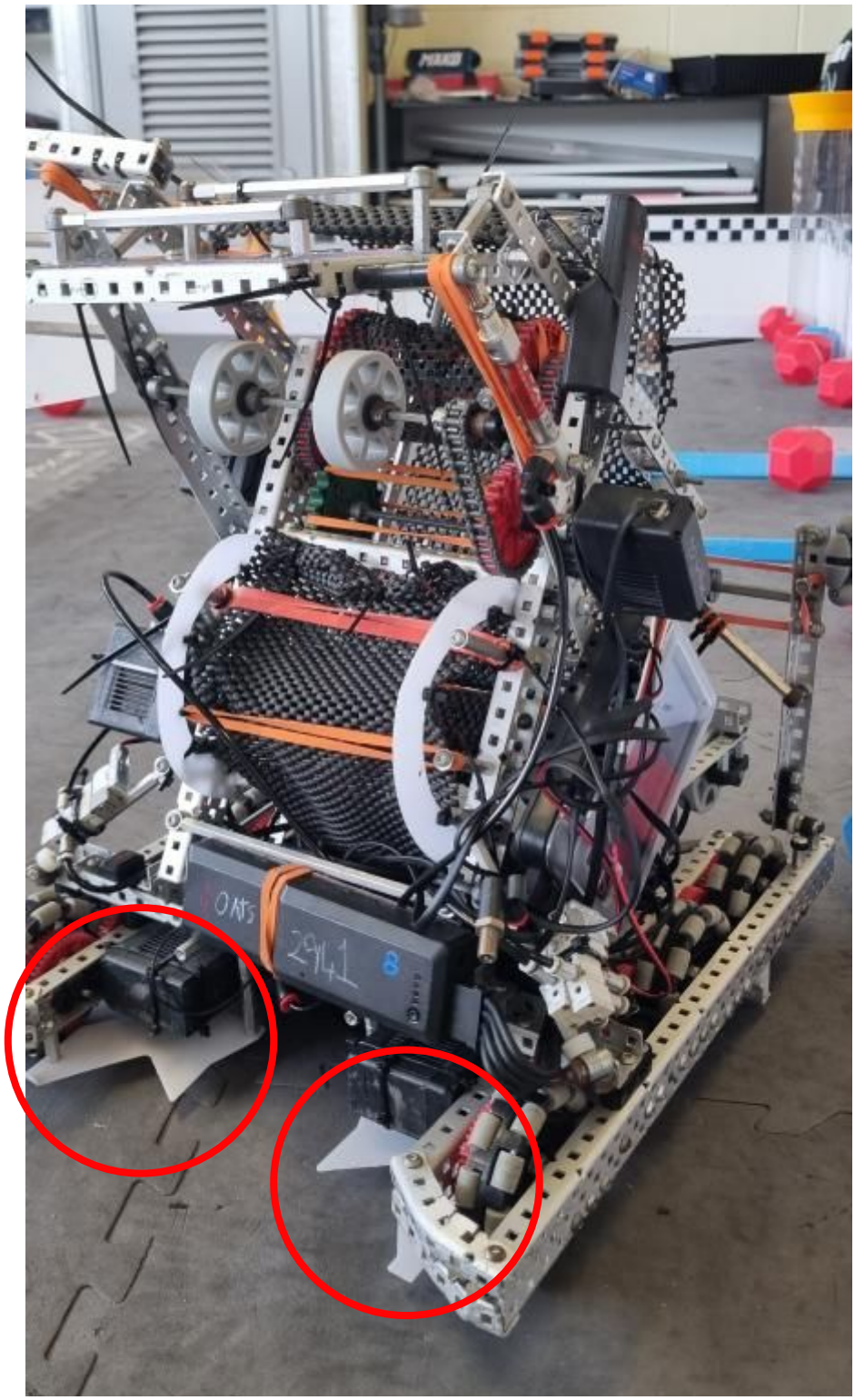
This wing or hook can be raised up and down out of the slit in the long goals using a piston this simple hook allows us to descore blocks from the long goal. To go with it we also have a piece of polycarbonate to help us align with the goal and easily descore blocks using this method.



Final robot overview

Long goal aligners

This last feature is a passive but very important one these alignment pieces CNCed out of Delrin plastic help us line up with the long goal and help keep us on the long goal even when being pushed by another robot.

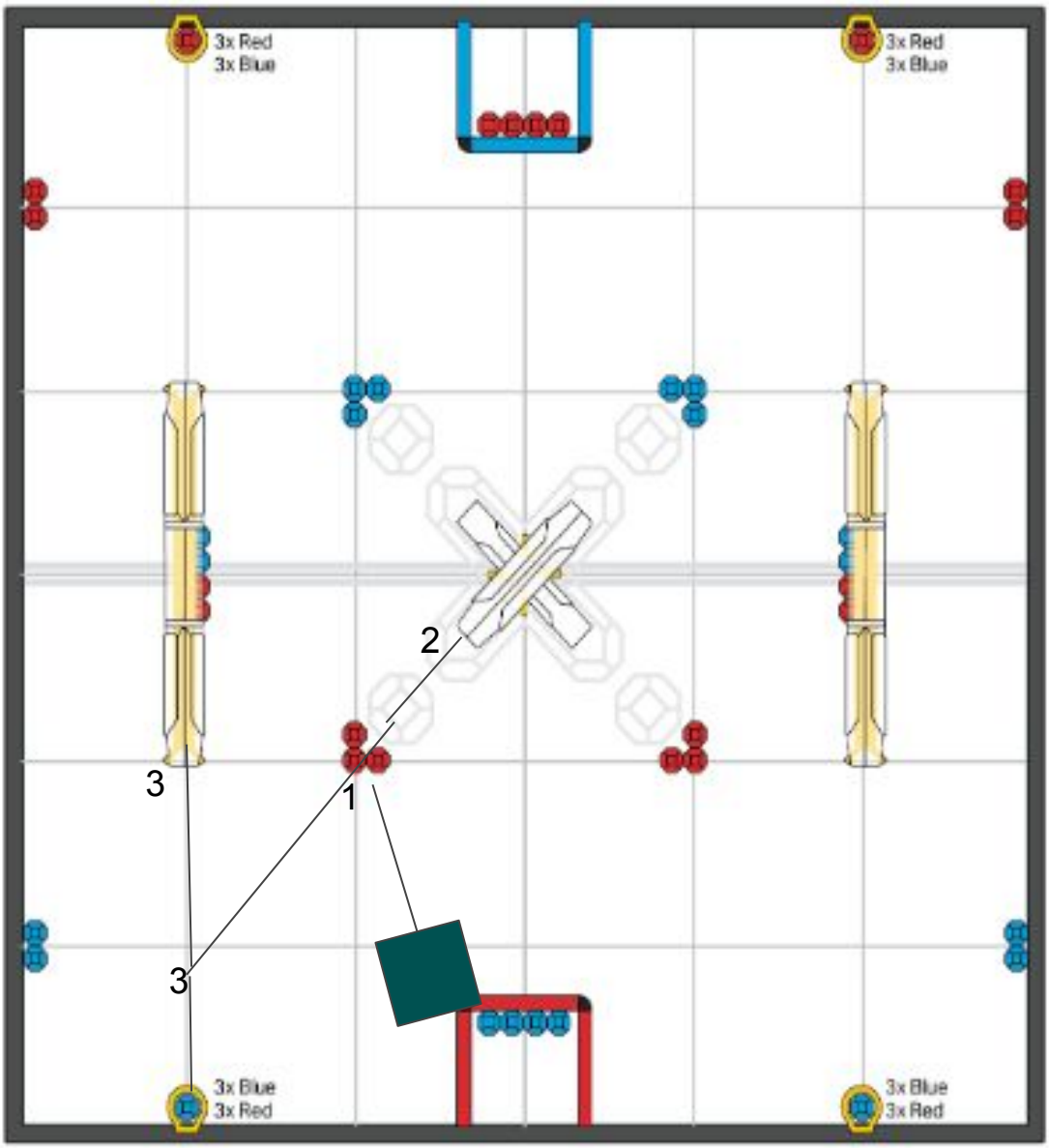


Pre Nationals

Auton 1

1. The robot drives forward to grab the cluster of 3 blocks and stores them in the hopper
2. Robot turns and drives towards the upper middle goal and scores the 3 blocks + the preload into the middle goal
3. Robot turns around and drives to match loader, lowers scrapper and match loads blocks into hopper.
4.Robot drives backward to the long goal and scores the remaining blocks in the long goal.

= Robot



We will use this auton for qualifications

Total points: 21-39

Name: Tom

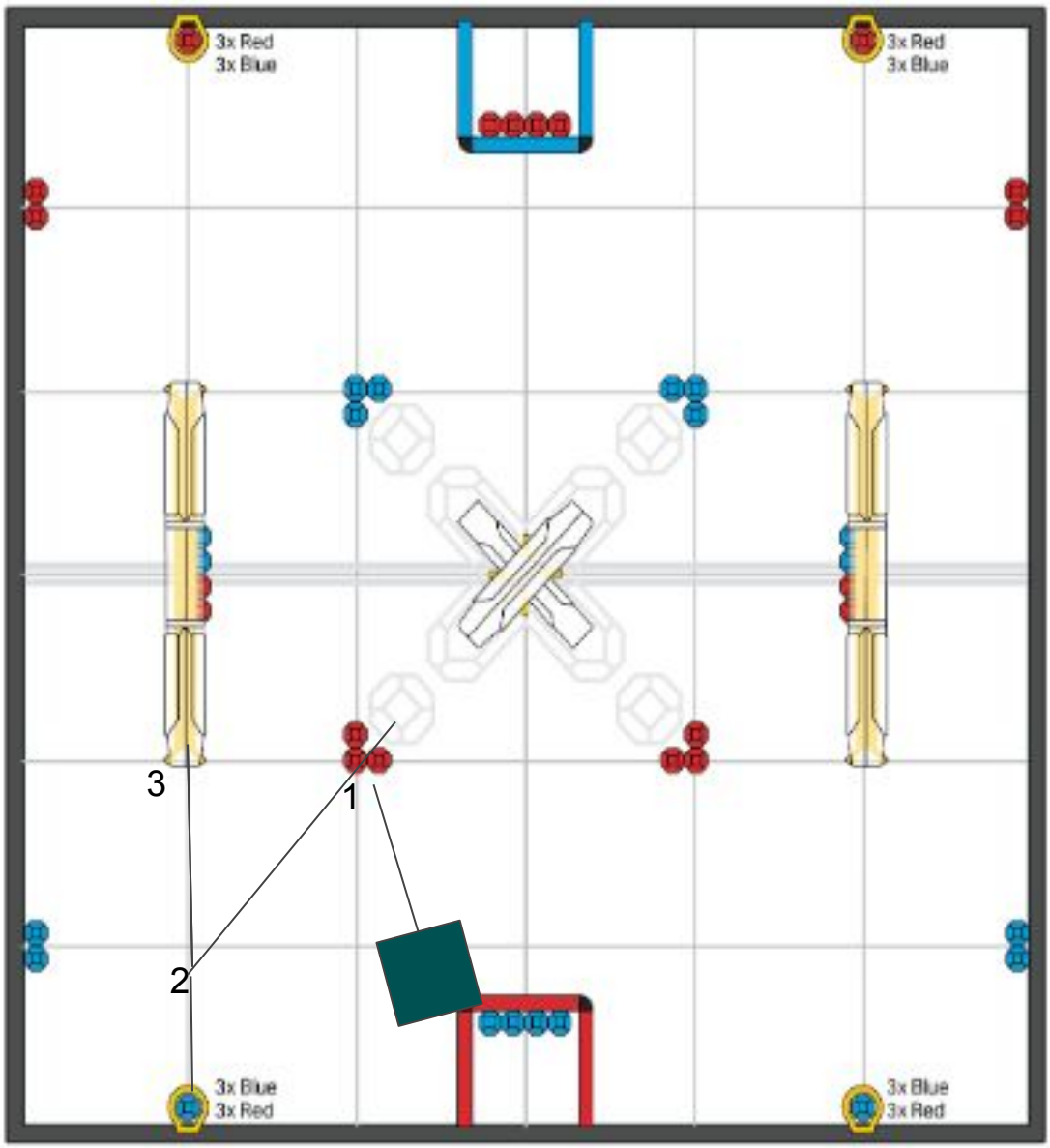
Pre Nationals

Auton 2

1. The robot drives forward to grab the cluster of 3 blocks and stores them in the hopper
2. Robot turns around and drives to match loader, lowers scrapper and match loads blocks into hopper.
4.Robot drives backward to the long goal and scores the blocks in the long goal.

We will use this auton for eliminations and its mirrored for the other side as well

= Robot



Total points 21-31

Name: Tom

Code

Intro

(**Important**) This has been written at the end of the notebook since code wasn't relevant enough throughout the first 2 design cycles to actually include. We have found it was more appropriate to not have these slides in chronological order since our code has been constantly adjusted and some things just don't make sense if not put next to other code related pages. The date for these pages will be set to 18th February 2026 when our notebook has to be handed in by for nationals.

I(Rosa) was the main coder for 2941H. It was my first year of robotics, and I have a background knowledge of Python and C++. Because of my base in C++, I decided to use PROS to code for the robot. PROS is an open source environment to code for Vex, that uses C/C++. Basically anything you can write in C/C++ can be applied in PROS for Vex. This is much better than the blockcode or python programming systems for vex, because it provides more autonomy and features. I chose PROS because it is open source and makes the code very customizable. It is a very well known runtime in Vex, meaning there is great documentation that I was able to refer to during the coding process.

Code

Hardware Setup

The beginning of the code is where the components are defined. Our bot has a 6 motor drivetrain, with each motor assigned to a port on the brain. These were named conventionally for clarity reasons when my teammates need to view the port numbers like when changing the motors or re-attaching the brain. The negative sign on some of the ports is an easy and fast way to reverse the motor direction. This is needed because some motor's orientation on the bot is backwards, so they need to be initialised as negative. They are members of the Motor class, which has built in functions for motor movements. The intake system of our robot also uses 3 motors for each part of the intake(low, middle, high), which is the same as the motors in the drivetrain.

```
#include "main.h"

// drive motors
pros::Motor left_front(-5);
pros::Motor left_middle(16);
pros::Motor left_back(-15);

pros::Motor right_front(19);
pros::Motor right_middle(-18);
pros::Motor right_back(12);

// intake motors
pros::Motor intake_low(8);
pros::Motor intake_middle(10);
pros::Motor intake_high(-11);



// pistons
pros::ADIDigitalOut piston_arm('H'); // hood
pros::ADIDigitalOut piston_2('G');   // scrapper
pros::ADIDigitalOut piston_wing('F'); // wing

// controller
pros::Controller master(pros::E_CONTROLLER_MASTER);

// state variables
bool piston_state = false;
bool piston_2_state = false;
bool piston_wing_state = false;
```

The pneumatics of our bot are in the ADIDigitalOut class, which means they are plugged into the ADI ports as they are digital output devices. They are binary output, so therefore, at the bottom, the boolean state variables are initialised so we can know if a piston is true or false and toggle it easily.

Code

Motion and calculations

```
const double WHEEL_DIAMETER_CM = 8.255;
const double WHEEL_CIRCUMFERENCE_CM = WHEEL_DIAMETER_CM * M_PI;
const double TURN_CONSTANT = 4.0;

void drive_forward(double rotations, int speed) {
  double target_degrees = rotations * 360.0;
  double tolerance = 4.0;
  uint32_t start_time = pros::millis(); // timer for time outs
```

In setup for the autonomous period, because we have no sensors like odometry or inertial, I relied on the motor encoders and therefore included calculations to convert the linear distance to rotations in degrees. The wheel circumference is the distance the bot travels in a 360 degree rotation of the wheel/motor. With Circumference = pi * wheel diameter formula, there is a relationship between linear and rotational. The target distance divided by the circumference shows the rotations needed and multiples by 360 to show how many degrees needed. This means I can measure the field for auton and put in degrees, but the calculations make the motors receive it in rotations.

The turn constant is a multiplier as to how many degrees the wheels have to turn because of other factors like friction on the field. To find this, I tested by rotating the robot and seeing how true it was to the input degrees, and adjusting the turn constant until it was accurate.

First the motor encoders are reset so they move from a clean slate, and then they move relative to their current position, rather than moving absolute. This is non-blocking, so below that you can see where it checks if the motors have meet the target position before moving into the next task to improve accuracy. There is also a timer using pros::millis(), which means that if the task isn't completed within the chosen time (2 seconds) from when it starts, it will move on. This avoids the robot getting stuck on a specific task which was a previous issue in our autons, where for some reason due to an inconsistency, the bot would just block and not continue, so this fixes that issue.

```
// reset
left_front.tare_position();
left_middle.tare_position();
left_back.tare_position();
right_front.tare_position();
right_middle.tare_position();
right_back.tare_position();

left_front.move_relative(target_degrees, speed);
left_middle.move_relative(target_degrees, speed);
left_back.move_relative(target_degrees, speed);
right_front.move_relative(-target_degrees, speed);
right_middle.move_relative(-target_degrees, speed);
right_back.move_relative(-target_degrees, speed);

// wait until motors finish
while (pros::millis() - start_time < 2000) {
  bool moving = false;
  if (fabs(target_degrees - left_front.get_position()) > tolerance) moving = true;
  if (fabs(target_degrees - left_middle.get_position()) > tolerance) moving = true;
  if (fabs(target_degrees - left_back.get_position()) > tolerance) moving = true;
  if (fabs(-target_degrees - right_front.get_position()) > tolerance) moving = true;
  if (fabs(-target_degrees - right_middle.get_position()) > tolerance) moving = true;
  if (fabs(-target_degrees - right_back.get_position()) > tolerance) moving = true;

  if (!moving) break;
  pros::delay(20);
```

End of notebook

Final message from 2941H (incase this is the end of our season):

To whoever is reading this thank you for taking your time to read this notebook.

IMPORTANT: (added on 23 Feb 26)

At the 2026 New Zealand nationals we successfully won tournament finalist and through that we have qualified for the world championship therefore we will be continuing the notebook.

Worlds qualification

Statement

Before we move forward with documenting our design process. We have to address the team situation. Because of the way the New Zealand education system works. Tom and Rosa are now undergraduates at Universities in a different city and will not be able to attend worlds without compromising their studies and will have to support the team remotely. Fortunately both William and Finn have recovered from their personal issues and are ready to step back into active positions on the team.