TODO

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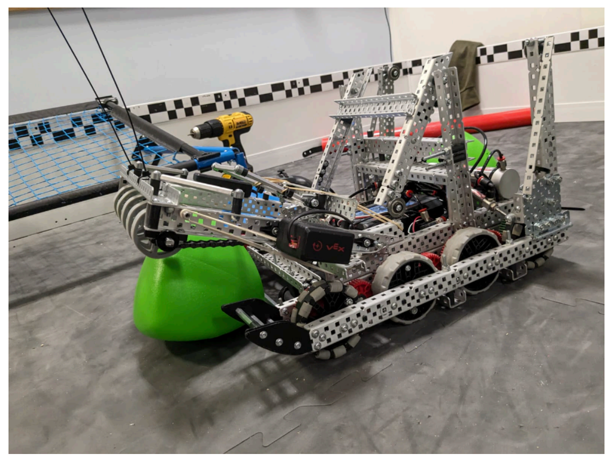
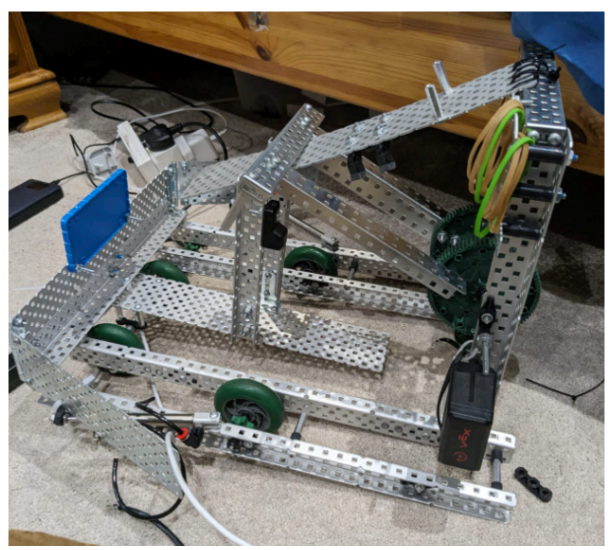
Team Introduction

Who are the Snowflakes?

We are the St Chris Snowflakes; we started out as a VRC team in september 2023, in our first season as a team in 'Over Under'. We set out to do our very best and we quickly found that we all loved the challenge of VEX and wanted to excell as far as we could; after a struggle, we qualified for UK nationals and siezed the oppurtunity to become the best we could. Our hard work payed off, and we went home with design award and a spot in the VEX World Championships; where we went in April and gained key experience to start this season.

Off of the back of Over Under we have acquired some very important skills necessary for competitive representation on both a national and global scale such as good building and coding practices which we hope to utilise in order to become even more competitive in all aspects of the V5RC competition where we weren't last year. We are also moving to a smaller team size as some of our members are moving on. This will mean we may have to work harder but also means a larger range of experience in other areas.





Team Introduction

The members

Jonah Fitchew
- Co-Head Builder
- Driveteam

Hello I am Jonah Fitchew and my role within the team is the physical construction of the robot, documentation and assisting the driver during matches.

Aubert Seysess
- Co-Head Builder

Hello I am Aubert Seysses and my role within the team is to help design and virtually CAD the robot, also, I aid with the physical construction of the robot.

Daniel Dew
- Head Programmer
- Driver
- Driveteam

My role within the team primarily resides in the programming of the robot's code including autonomous and driver control. I also aid with the design and CAD phases of building. I am also the primary driver.

Daniel DaSilva
- Programmer

Hi I'm Daniel da Silva and my role within the team is to support the development of the robot's software and to help organise it into the logbook.

Team Introduction

Thomas Robb

- Head Tactics
- Driveteam

My role within the team is to brainstorm tactics and communicate with the other members to ensure that designs and tactics align. During competitions I am also responsible for taking note of performances, both our's and other team's; to help find possible alliances.

How To Use This Notebook

About this Notebook

TL;DR

For this season, we decided to deviate from the standard process for making engineering notebooks. We decided that, with the loss of our main logbooker we would have to share the notebooking duties; this meant that formatting could become inconsistent and we immediatly found that it took too long to format everything to the desired (exceptional) standard. Therefore, to cut down on time and improve the notebook's readability and functionality, we decided to adopt the *Notebookinator* template, which is an extension of the *typst* markup language.

Why Typst?

Several ways of creating notebooks for VEX exist, wityh most adopting visual editors such as google slides or hand writing their notebooks.
When deciding what we wanted to use for this season, we quickly ruled out hand writing the notebooks as mistakes could take valuable time to correct; neatness and clarity is often sacrificed; and the need for online collabiration is great. We previously used google slides with good results, however the formatting (e.g. colour coding, table of contents etc.) takes a significant ammount of time to maintain and can be very difficult to keep consistent when we all share equal role in notebook creation (as opposed to 1 person overseaing all notebook formatting).
We then landed on the possibility of using a markup language; and with the lack of flexibility from LaTex, Typst seemed like the best option. We had also noted a few teams success with using Typst, especially when using Notebookinator alongside it - for example team 53E (also the creators of Notebookinator) had a great Over Under notebook[1] using Typst.

Features

- Uniform formatting
- Notebookinator template
  - Easy cohesion with engineering design process
  - Built in components i.e. pros/cons tables
- Code blocks
- Built in table of contents
- Fully Digital
  - Neatness
  - Modern tooling
  - Easy submission
  - Cohesion with version control

[1] *Link to notebook*

The Snowflakes' Enginnering Ethos

Our Engineering Ethos

At its core, VEX Robotics is nothing but an engineering problem. It provides a goal, and the materials to get there. We believe that the key to success in Robotics intrinsicly lies in how you approach each problem; with open-mindness and the willingness to learn but most importantly the deterination to find the best solution possible.

> Engineering: The art of organizing and directing men, and of controlling the forces and materials of nature for the benefit of the human race.
>
> — Henry Gordon Stott

Our Enginnering Design Process

For every new problem, we try to stick to an engineering method (similar to a scientific method) where different phases are used to maintain orginisation. The process applies to all forms of design, including programming and sometimes even tactics.

Phases of designs

For each of the phases in our EDP, a corresponding icon is provided, these are used throughout the notebook to label a phase.

Identify Problem[1]
Each solution starts with a problem, this ranges drastically – for example, from ‘We need a drivetrain’ to ‘this mechanism causes instability’. Problems can be raised by all members and, regardless of severity, it is something that must at least be addressed.

Brainstorm Solutions
Once the problem has been properly analysed, with root causes found, the team can move on to brainstorming solutions. Here, every team member can put forward possible solutions or fixes to the problem at hand, this is often accompanied with rough concept drawings. Additionally, finding use cases where each possible solution has been used effectively can be key to display a solution’s viability.

Decide Solution
Once all possible solution have been brought to the table, one possible solution is picked to move to the next phase; to ensure that the desicision is definitely the best one available, additional proceses can be used to decide the best (i.e. descision matrices). Ideally, all members offer their thougths on the solutions.

The Snowflakes' Enginnering Ethos

Implement Solution
With one solution in mind, the solution can be expanded, now taking into account the smaller details while creating a plan of action for the designing and implementation of the solution. The solution is then designed and built – either physically or as a program.
Note that both the build and program icons are used during this phase.

Test Solution
Once the solution has been implemented onto the robot, we can begin testing the solution to find out how effective it is. This is a key phase as it shows us how the solution up to different scenarios.
Depending on its effectiveness, the results of a test may prompt us to move back into the implement phase, as changes sometimes have to be made. This creates a feedback loop that iteratevly improves the solution until it meets our desired standards.

For our robot, we decompose the larger problem into a set of smaller, approachable problems. From there, each and every problem is approached using this EDP; this allows us to stay orginised and avoid descision paralasys.

[1]Sometimes, if the problem is obvious (i.e. the need for a drivetrain), this phase is skipped due to mutual understanding.

? Example Entry 2024/01/01

Here's some content in this entry.

Here's an example of how you'd create a pro-con table:

Pros	Cons
• pro number 1 • pro number 2 • pro number 3	• con number 1 • con number 2 • con number 3

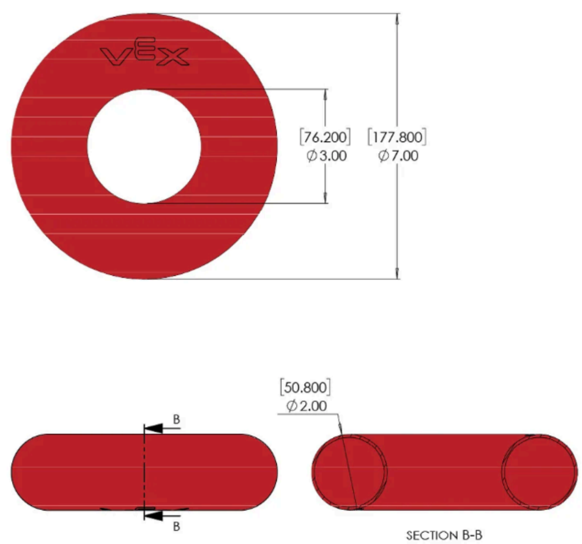
Now we'll generate 50 words of filler text!

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat voluptatem. Ut enim aeque doleamus animo, cum corpore dolemus, fieri tamen permagna accessio potest, si aliquod aeternum et infinitum impendere malum nobis opinemur. Quod idem licet transferre in voluptatem, ut.

Designed by:
Witnessed by:

The Game

Scoring & Game Objectives

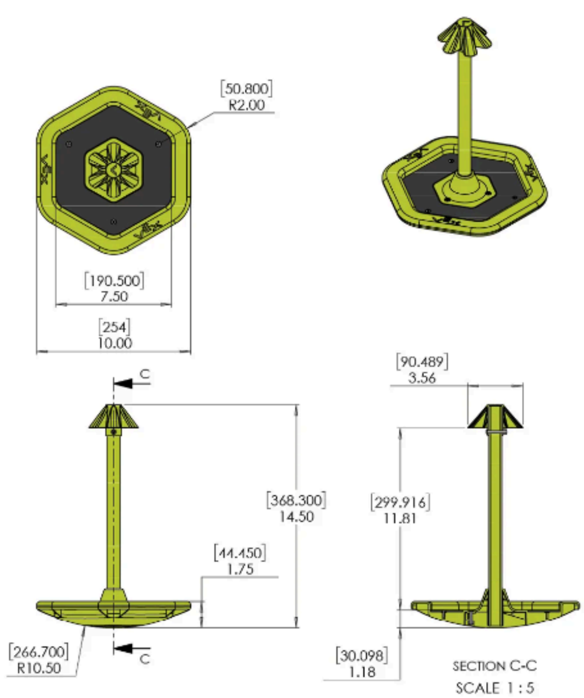


Game Elements: Rings
The majority of the scoring is done via these coloured rings.

- Outer diameter 7"
- Inner diameter 3"
- Height 2"

Potential Challenges

- Rings cannot roll on the floor, so manipulation is strictly contact based
- Large surface area in contact with floor so potential difficulty in manipulation

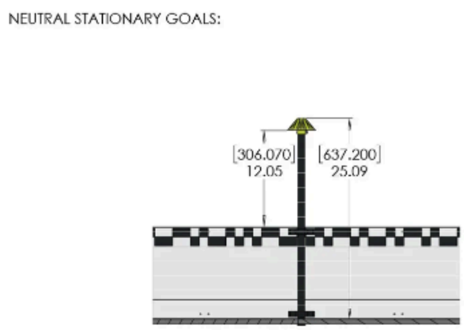


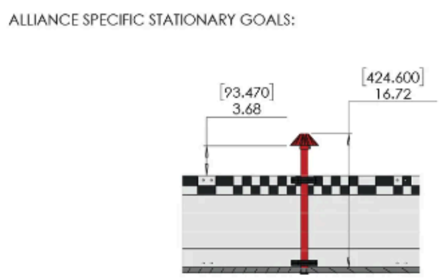
Scoring Object: Mobile Stakes/Goals There are 5 mobile goals ('mogos') on the field, and they can be freely manipulated by teams.

- 10" diameter hexagional bird's eye view profile
- 14.5" height
- Rubber cap to make descoring more difficult

Potential Challenges

- Weighted bottom could make manipulation difficult
- Scoring would require an elevated mechanism.
- Rubber caps mean force must be required to score/descore





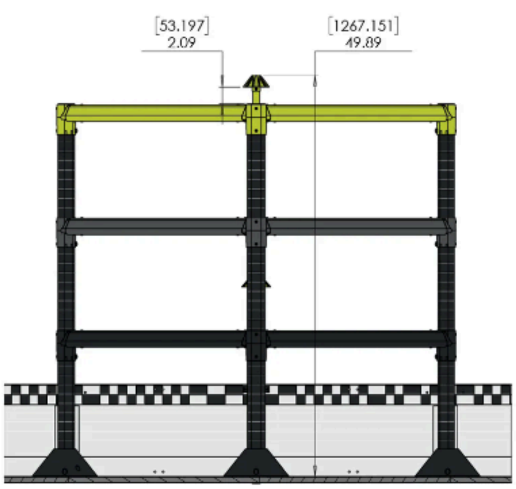
Elevated Stakes: Neutral and Alliance

There are 2 neutral stakes and 2 alliance stakes allowing for further scoring.

- Neutral stake 25.09" tall
- Alliance stake 16.72" tall
- Rubber caps (identical to mogo)
- Alliance stakes can only be scored by the corresponding alliance

Potential Challenges

- Stakes differ in height from eachother (also from the mogo) meaning different or morphing mechanism to score on all.
- Placement (field perimeter) risks throwing rings out of the field (risking S1 infringement)
- Rubber caps mean force must be required to score/descore



High Stake and Ladder

In the center of the field, there is a 4' ladder that teams can climb in the endgame to gain etra points. It also has a stake that can fit 1 ring at the very top.

- 49.89" (4.165') tall
- 3 tiers/rungs
- 4 sides

Potential Challenges

- Climbing structures requires lots of power and/or time
- High Stake would require extreme prescision

Scoring Takeaways

- All scoring requires vertical capability
- Employing multiple methods of scoring (mogo, neutral/alliance stake) would require a multiple – or one more complex, morphing – systems
- Emphasis must be put on prescision and reliability as there is little room for error

Designed by: Daniel Dew
Witnessed by: Jonah Fitchew

Rules analasis

Format

To avoid simply regurgitating the rules (to people who already understand them), we are going to simply list some rules with a paraphrased description; then how it affects us; then potential solutions – if a rule presents no problem, we will not cover it.

e.g.

<RULE NUMBER>

- *Paraphrased rule description*

Problems

- This rule affects us like this
- It also affects us like this

Potential Solution

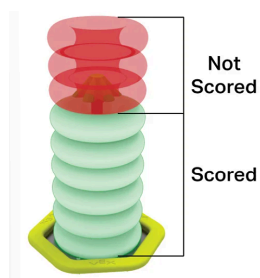
- This is one way we can mitigate the risk of infringement…
- This is another…

> **Note**
> Inspection, safety and general rules will not be covered, due to their relative simplicity.

Scoring rules

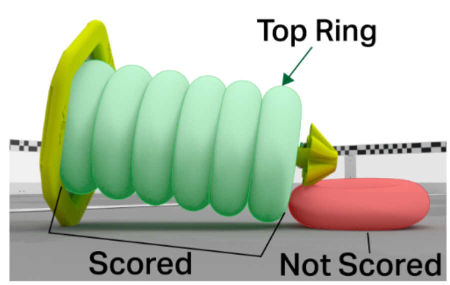
<SC3>

- To be considered scored on a stake, the ring must meet certain criteria:
  1. Ring must not be contacting robot *of same alliance*
  2. Ring is not contacting foam tile
  3. Ring is encircling the stake[1]
  4. Total ring count must not exceed max ring count of the stake (mobile: 6, neutral & alliance: 2, high: 1)



Problems

- Neutral/alliance stakes can contain more than 2, despite only 2 being counted
- Mogos with our rings on can be tipped to effectively descore some rings



Potential Solutions

- Driver may have to take care when scoring on neutral/ alliance stake
- Driver may have to guard or defend filled mogos

[1]Long description omited, see https://www.vexrobotics.com/high-stakes-manual#sc3

Designed by: Daniel Dew
Witnessed by: Jonah Fitchew

? The High Stakes Problem 2024/08/13

<SC5>
- A mobile goal is considered placed in a corner when it meets the following criteria:
  1. Mogo is contacting floor/foam tile
  2. Mogo is upright
  3. Contact with robot is irrelevant

> **Note**
> Only 1 mogo can be considered placed in each corner, even if 2 meet the requirements.

Problems
- Mogos can be knocked over do mitigate effect of corner

Potential Solutions
- Driver can guard/defend the corner, especially as robot contact is irrelevant.

<SC6>
- A mobile goal that has been placed in a corner will result in the following modifiers being applied to its scored rings:
  - Placed in **positive** corner:
    1. Values of all scored rings will be doubled
  - Placed in a **negative** corner:
    1. Values of all scored rings will be set to 0
    2. For each ring, an equilavent ammount of points will be effectively removed from that alliance's score
    3. Points scored from auton bonuses and climbing <u>cannot be removed</u>

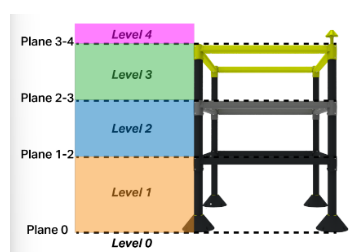
Examples included *here* .

Problems
- Opposing rings scored in a positive corner can drastically change outcome of game due to 2x multiplier
- Ring scoring can be easily countered by placing them in negative corner

Potential Solutions
- Once again, large emphasis must be placed on defending scored rings and preventing them from being placed in a negative corner
- Putting emphasis on scoring on the elevated stakes could mitigate dependance on mogo scoring and corner defence/offence

<SC7>

- A robot has climbed to a level when the following criteria is met:
  1. Robot is contacting the ladder
  2. Robot is not contacting any other field elements
  3. Robot is not contacting any mobile goals



4. The robot’s lowest point is above that level’s minimum height

Problems

- Climbing must be completely independant, it cannot rely on lower rungs or the floor

Potential Solutions

- When considering climbing, large power consumtion – due to independant climbing – must be considered, possibly with use of a winch and/or a PTO[2]

<SC8>

- **Autonomous Win point** is awarded to *any* alliance that have completed the following tasks (as long as they have not broken any rules):
  1. At least 3 scored rings of that alliance’s colour
  2. A minimum of two 2 stakes on the alliance’s side of the autonomous line with at least 1 ring of the alliance’s color scored
  3. Neither robot contacting or breaking plane of alliance’s starting line
  4. At least 1 robot contacting ladder

Problems

- Even if we can complete as many tasks as possible, AWP is still reliant alliance teammate, especially with no. 3

Potential Solution

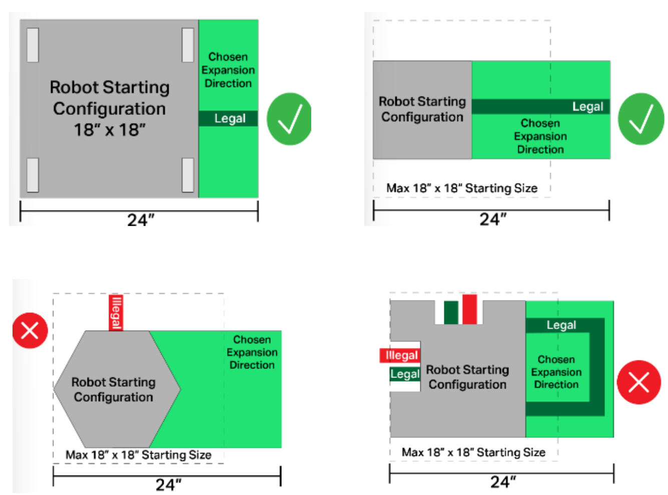
- Ensure prior coordination with teammate to ensure that they move off the line at the start[3]

Specific Game Rules

<SG2>

- Horizontal expansion is limited to an <u>additional</u> 6” on **one** side.

> **Note**
>
> 6” expansion is based on an 18” x 18” starting size, therefore robot can expand to the limit in **1** direction, then 6” in the same direction.



[2]PTO: Power Take-Off
[3]If the team does not have a (working) autonomous, advice/technical help can be given to simply move off the line, ensuring AWP

Problems
- Mechansims that rely on expansion must be contained within the footprint of the robot, or not expand over 6" on one side only

Potential Solutions
- Design all expanding mechanisms to expand on one side only
- Use as little space of the 18" x 18" to maximise expansion capability

<SG3>
- **Vertical expansion is limited**; vertical expansion cannot break 2 or more levels of the ladder

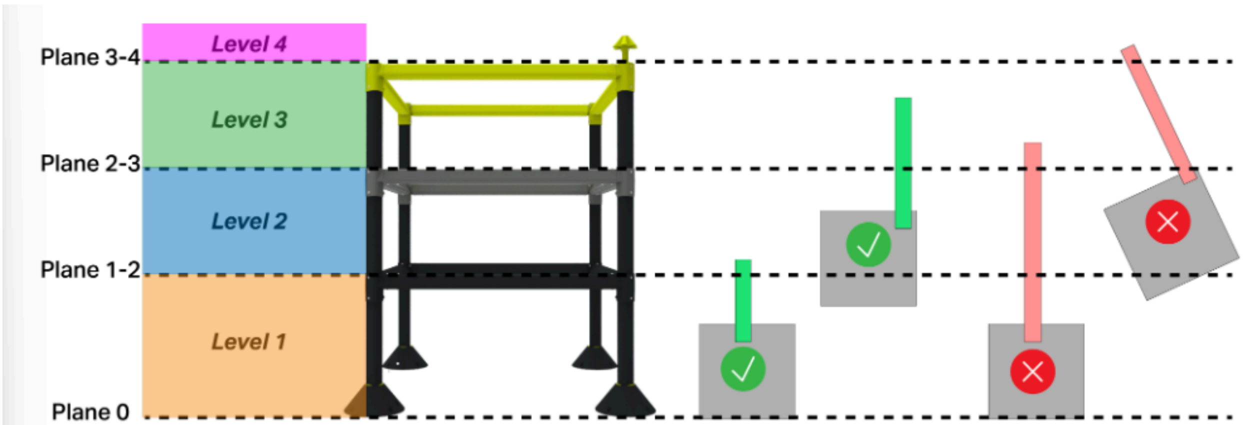


Figure SG3-1: Examples of legal and illegal vertical expansion.

Problems
- This rule makes climbing to the top with 1 movement impossible – unlike in Over-Under – instead teams have to climb the ladder like… a ladder, using each rung and not skipping levels

Potential Solutions
- When designing climbing mechanisms, multi-stage movements must be incorporated; making sure that the robot does not break 2 or more planes no matter the rotation[4]

<SG4>
- Keep scoring elements **in the field**, rings that exit the field will be given to the corresponding alliances to reintroduce into the game.

Problems
- Accidentally removing rings from when, for example, scoring on wall stakes results in a minor violation

Potential Solutions
- Driver can take extreme care when attempting to score on wall stakes
- Line-up guides can be designed to aid the driver
- Lots of time on tuning the mechanisms to ensure they are not too powerful

[4]This is because the planes are measured from the perspective of the field (see long explanation *here*)

<SG6>

- Possesion is limited to 2 rings and/or 1 mobile goal
  - Where rings scored on a stake do not count towards possesion count
  - Plowing multiple mobile goals is legal only when no mobile goals are possessed

Problems

- When attempting to rapidly score rings, this rule may be broken due to more than 2 rings being possessed
- Accidentally plowing a mogo while possessing one will result in a violation

Potential Solutions

- For both problems, driver care can be applied to avoid SG6 infringement
- A distance/colour sensor could be used in conjunction with an algorithm to stop manipulating rings once at the possesion limit
  - Using a coulour sensor could allow for a coulour sorting algorithm to only intake alliance's rings

<SG7>

- Dont cross the autonomous line during autonomous
  - Robots must not contact or break the plane of the autonomous line[5] during autonomous

Problems

- Accidentally crossing line due to lack of tuning or planning of the autonomous movements would result in the loss of ABP and AWP

Potential Solutions

- Extreme care and consideration must be used when planning out the autonomous movements

Primary Takeaways

Certain solutions appear more than once, meaning we can prioritise them to mitigate more risks at lower time/complexity costs.

Driver Skill

We have concluded that driving is a factor in nearly all the rules specifically targeted defence and offence, High Stakes is a skillful game that requires lots of practice from the driver. Putting emphasis on training our driver, using drills, friendly matches etc. must be a priority.

Control and Prescision

We have also concluded that prescicion is key to avoiding rule infringement and also to maintain effectivness. All mechanisms must be designed with extreme prescision with lots of time allocate for fine-tuning to a) maximise effectiveness of mechanism and b) avoid breaking rules such as SG4 and SG7.

[5] basically the halfway line

The Plan

This game and rule analasys has allowed us to form a plan on how we will approach the coming weeks as we organise ourselves to tackle the season.

Timeline Considerationss

- The emphasis on driver practice means we will try our best to allow for plenty of driver practice
- The further emphasis on autonomous tuning means we will have to make ample room for autonomous testing in the timeline

Careful Design

- We will also be making sure that all our designs our designed with strength, prescicion and effectiveness in mind during all stages of the design process – this is especially prominent during te CAD phase

Drivetrain Selection Process

The process of selecting a drivetrain is a teams first thoughts when considering the needs for a robot in any given VEX season. The benefits and drawbacks of all types of drivetrain are considered at this point of the design cycle, in the context of the current game of course, many different options are considered as the different parts that VEX provides can be combined in many different ways in order to give each drivetrain a different characteristic as it were.

Considerations for any given drivetrain

At the beginning of any season the needs of the three main aspects of a drivetrain are pitted against each other in the context of the needs of the current game, these three main features are:

- Torque
- Speed
- Size

Torque:

torque is defined as the force that causes rotation, the more torque that a specific drivetrain has the more power it will exert onto something it is pushing against, the more we have of this on our drivetrain which can be altered by the **gear ratio** the higher amount fo force we will be able to exert on another robot therefore being able to win pushing matches and achieve higher scores, the downside of having increased torque is the loss of speed as the relationship between the two is inversely proportional

Speed:

Speed is defined as the rate at which something moves or is able to move, as is quite obvious the higher speed that a drivetrain has the faster it will be able to move about the field, thereby increasing the rate at which we are able to score, however one of the drawbacks of increased speed is the relationship achievable with VEX parts of a manageable torque-speed relationship means that higher speeds where a significant edge is given in game also leads to a major drawback in the amount of torque exerted, therefore the tradeoff may not be worth it, also high amounts of speed can be difficult for the driver to control accurately

Size:

It is also necessary to consider the size of each drivetrain option when selecting as it can be the killing blow in relation to the rest of the mechanisms planned to be on the robot as the size of the drivetrain can affect the balance of the robot when it is completed, especially within this game where a good balance and centre of mass is necessary for efficient scoring and for a climb to be doable further down the line. However, a large drivetrain can affect the rest of the mechanisms through its own obstruction such as things like the intake which if forced to be too large can become jammed and remove the ultimate goal we have, scoring.

Designed by: Jonah Fitchew
Witnessed by:

Glossary

Example word

This is an example word which will appear in the glossary.