1511 BUILD SEASON

Who am I?

- Joined the team in 2012 (fall of 2011)
- Floated around, did some bits of design work, some fabrication and some assembly.
- As I got more familiar with the process, I often made suggestions and tried to encourage changes:
  - Start of the parts log
  - Changes in how we organized CAD files
  - Organization ideas for fabrication

- Asked to run robot build in 2014 after le son graduated).
- Attended MIT and Syracuse University for architecture.
- Worked in Boston, Syracuse and Rochester. Projects in MA, NH, VT, CT, NJ, NY, DC, VA, FL, MN, NE, CA.
- Own my own firm (Rhen Design) since 2006.

[redacted]

	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Champs	NA	51*	25*	28	30	55	67	36	**10**	12	35	**8**	?	?
FLR	**4**	47	**2**	9	**10**	40	9	11	**5**	**12**	29	30	?	
Midwest	17	**2****												
Greater Toronto			**2*****											?**
Montreal				7										
Tech Valley					**7**									
Boston						37**			**2*****			**5**	?	
Connecticut							14							
DC								16						
Chesapeake										12				
Philadelphia											**3**			
Buckeye														?

Regional alliance captain 6/10 times average ranking = 10.7	Regional alliance captain 3/10 times average ranking = 15.8
1 regional win, 1 regional finals, 2 Subdivision wins (4th bot), 2 Einstein (4th bot)	1 regional win, 1 regional finals, 1 subdivision finals

* = Selected for Einstein
** = Regional Winner
*** = Regional Finalist

Alliance 1	Alliance 2	Alliance 3	Alliance 4	Alliance 5	Alliance 6	Alliance 7	Alliance 8

1511 BUILD SEASON

- **2018**: FLR & Midwest Quarterfinalists
- **2017**: FLR Semi-finalists, Midwest Regional Winners, Curie Subdivision Winner
- **2016**: Greater Toronto Central Regional Finalists, FLR Quarter Finalists, Curie Subdivision Winner
- **2013** Boston Regional Winner
- **2005** Greater Toronto Regional Winner, Einstein Rookie of the year
- Regional Chairman's Award: 2017, 2016, 2015, 2014, 2011, 2010, 2009, 2007
- Regional Engineering Inspiration Award: 2017, 2014, 2012, 2010, 2008, 2006

1511 BUILD SEASON

The Starting Point: GOALS!

- **EINSTEIN – Our robot design group puts this on the board the first day of Build Season. This is our goal.**
- **We are willing to accept failure.**
  - **Fail Early and Fail Often**
- **If you never try you will never succeed.**

1511 BUILD SEASON

2018 Build Season Meeting Schedule

Work Times
A Days: 5:00 PM -10:00 PM
B Days: 10:00 AM – Midnight
C Days: 10:00 AM – 10:00 PM

Meal Times in G7
Lunch: 1PM
Dinner: 6PM

Note: Integration meetings should be attended by robot subteam lead mentors and students.
Rooms Reserved: G3, G4, G7, H21, and Cafeteria unless otherwise noted

January 2018

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2 Team Meeting Kickoff Travel Meeting	3	4	5	6 KICKOFF! 8 AM-4PM: All Team 4PM-12AM: Strategy
7 ~C Day~ 10AM-2PM: All Team 2PM-9PM: Proto	8 ~DAY OFF!!~	9 ~A Day~ Dinner in Cafeteria	10 ~A Day~	11 ~A Day~ 9:15PM: Integration	12 ~DAY OFF!!~	13 ~B Day~ 9:15PM: Integration 11AM-1PM: Strategy
14 ~C Day~	15 ~DAY OFF!!~	16 ~A Day~ 9:15PM: Integration	17 ~A Day~	18 ~A Day~ 9:15PM: Integration 6:30PM: Leadership	19 ~DAY OFF!!~	20 ~B Day~ 9:15PM: Integration 1:30PM-3:30PM: Strategy
21 ~C Day~	22 ~DAY OFF!!~	23 ~A Day~ 9:15PM: Integration	24 ~A Day~	25 ~A Day~ 9:15PM: Integration 6:30PM: Leadership	26 ~DAY OFF!!~	27 ~B Day~ 9:15PM: Integration 11AM-1PM: Strategy
28 ~C Day~	29 ~DAY OFF!!~	30 ~A Day~ 9:15PM: Integration	31 ~A Day~			

Rev. 10/11/2017 11:08 PM

1511 BUILD SEASON

2018 Build Season Meeting Schedule

Work Times
A Days: 5:00 PM -10:00 PM
B Days: 10:00 AM – Midnight
C Days: 10:00 AM – 10:00 PM
D Days: 5:00 PM – 11:00 PM

Meal Times in G7
Lunch: 1PM
Dinner: 6PM

Note: Integration meetings should be attended by robot subteam lead mentors and students.
Rooms Reserved: G3, G4, G7, H21, and Cafeteria unless otherwise noted

February 2018

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 ~A Day~ 9:15PM: Integration 6:30PM: Leadership	2 ~DAY OFF!!~	3 ~B Day~ 9:15PM: Integration 11AM-1PM: Strategy
4 10AM to 5:00PM	5 ~DAY OFF!!~	6 ~A Day~ 9:15PM: Integration	7 ~A Day~	8 ~A Day~ 9:15PM: Integration 6:30PM: Leadership	9 ~A Day~	10 ~B Day~ 9:15PM: Integration 11AM-1PM: Strategy
11 ~C Day~	12 ~D Day~	13 ~D Day~ 9:15PM: Integration	14 ~D Day~	15 ~D Day~ 9:15PM: Integration 6:30PM: Leadership	16 3PM to Midnight: Café	17 10AM to Mid 10AM – Mid: Cafe
18 8AM to Midnight RALLY	19 ~A Day~ BREAK WEEK SETUP FIELD IN CAFETERIA 2PM-Midnight	20 ~A Day~ BREAK WEEK USE FIELD IN CAFETERIA 2PM-12:30AM STOP BUILD DAY!	21 6PM to 10PM BREAK WEEK USE FIELD IN CAFETERIA	22 6PM to 10PM BREAK WEEK USE FIELD IN CAFETERIA	23 6PM to 10PM BREAK WEEK USE FIELD IN CAFETERIA	24 10AM to 10PM USE FIELD IN CAFETERIA
25 10AM to 10PM TEARDOWN FIELD IN CAFETERIA	26 ~DAY OFF!!~	27 6PM – 10PM	28 ~DAY OFF!!~			

Rev. 10/11/2017 11:08 PM

1511 BUILD SEASON

Team 1511 Build Season Robot Project Schedule
January 2018

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1 DAY OFF!!	2 Kickoff Travel Meeting	3 DAY OFF!!	4 DAY OFF!!	5 DAY OFF!!	6 **KICKOFF!**
7 Start Initial Prototypes Decide Drivetrain Design and Order Parts	8 DAY OFF!!	9 **Decide Strategy** Start Drivetrain Build	10	11 Initial Prototyping Complete Decide Robot Design	12 DAY OFF!!	13 **FIELD COMPLETE**
14	15 DAY OFF!!	16	17	18 Drivetrain Complete	19 DAY OFF!!	20 Controls Design Due
21 **Chairman's Draft Due** Robot Controls Design Complete	22 DAY OFF!!	23	24 Mechanism Design Complete	25 **All robot parts ordered and drawings submitted to Harris and Chamtek**	26 DAY OFF!!	27
28	29 DAY OFF!!	30	31			

1511 BUILD SEASON

Team 1511 Build Season Robot Project Schedule
February 2018

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2 DAY OFF!!	3 Receive all robot parts Start Robot Assembly
4	5 DAY OFF!!	6 Submit CHAIRMAN'S & Woodie Flowers	7	8 Chairman's Award & Woodie Flowers Due Robot Controls Complete Electrical Complete	9 DAY OFF!!	10 Assembly of Robots Complete
11	12	13 Submit Dean's List & Entrepreneurship Award Scouting Database Complete	14 Programming Complete	15 Dean's List & Entrepreneurship Award Due Driver Practice	16 RALLY FIELD SETUP IN CAFÉ Driver Practice	17 RALLY FIELD SETUP IN GYM Driver Practice
18 ROCHESTER RALLY!	19 Driver Practice	20 STOP BUILD DATE! BOTH ROBOTS COMPLETE!	21 Driver Practice Robot Code Refinement	22 Driver Practice Robot Code Refinement	23 Driver Practice Robot Code Refinement	24 Driver Practice Robot Code Refinement
25 Driver Practice Robot Code Refinement	26 DAY OFF!!	27 Driver Practice Robot Code Refinement	28 DAY OFF!!			

1511 BUILD SEASON

Kick-off has it's own detailed schedule that brings the team together at times, and separates into groups (Strategy and Robot).

- **Strategy focuses on Game play, game rules and maximizing point potential to arrive at a list of robot functionality priorities.**
- **Robot focuses on the gathering Information phase of design – which we'll get into more later.**
- **We come together at certain points to share information, keep the entire team engaged in the process and start building consensus.**

1511 BUILD SEASON

2017 Kickoff Weekend: Saturday Schedule Overview

Time	Room	Lead	Group	Description	Deliverable
10:30 AM	SHS	EB	Team	Kickoff stream and game reveal	KOP picked up
12:00 PM	Cafe	LL	Team	Lunch	
12:00 PM	Cafe	JG	Strategy	Small group reads The Tournament section of the game manual during lunch	List of ranking information and other important rules
12:30 PM	G3	TC/JD		KOP Inventory	
12:30 PM	C23	AA/JK	Field	Begin Rally field planning/prep	Home Depot shopping list
12:30 PM	Cafe	LL	Team	Begin reading the game section of the Manual and highlight rules / write post-it notes for the criteria below	Post-it notes of rules
2:00 PM	Cafe	LL	Team	Share post-it notes and discuss the following: • Ways to Score Points • Ways to Prevent Points • Way to Lose/Descore Points • Penalties • Interesting Rules • Questions for FRC Q&A • Potential robot and game strategies	Comprehensive, bulleted lists of the post-it topics
2:00 PM	Cafe	JG	Team	Share list of important Tournament Rules such as ranking, tie-breakers, format, etc	
3:00 PM	Cafe	LL	Team	Break Time and Split into Groups	

3:15 PM	G3	RK	Design	Read The Robot section in the manual. Use the post-it method to list robot design parameters:
				• Size Limitations
				  ○ Game Start
				  ○ Autonomous
				  ○ Teleoperated
				  ○ End Game
				• Extension Limitations
				  ○ Game Start
				  ○ Autonomous
				  ○ Teleoperated
				  ○ End Game
				• Weight
				  ○ Any Changes?
				  ○ Prepare preliminary weight chart
				• Bumper Limitations
					Lists of design parameters to share with the rest of the team

				• COTS
				  ○ Motors
				  ○ Pneumatics
				  ○ Wheels
				  ○ Other major changes
				• Unusual Restrictions
				  ○ Storage of Game Piece
				  ○ Human interaction	

3:15 PM	Cafe	JG/CE	Strategy	Split into smaller strategy groups. Determine relevant years for Legacy Strategy group.	
3:20 PM	Cafe		Strategy	**Group 1:** Tape down a full-sized field on the carpet in the cafeteria with wide masking tape. Include as many game elements as possible -- real scale. Will need to roll out both carpet in the Cafe.	Completed taped field
3:20 PM	G3		Strategy	**Group 2:** Begin legacy research on the years decided. Follow legacy research guidelines in the strategy powerpoint. Have group split into design subsystems (Ex: Intake, arm, shooter) to research separately. Try to get the photos as large on an 8.5x11" paper as you can without it getting grainy. Save this to the 1511 google docs.	-Large, good resolution photos for each chosen system. -Video links of the system in action

3:20 PM	G4	JG/CE	Strategy	**Group 3:** Analyze the point and scoring rules provided by the team.
				• Create a "match schedule". How much time for auto, teleop, endgame, etc
				• Draw out a quick sketch of the field on the smartboard. On this, note:
				  ○ Starting positions
				  ○ Number of game pieces and starting locations
				  ○ Identify any "safe zones" on the field (anywhere that contact is illegal)
				  ○ Identify any "hard stops" or easy places to line up a score.
				• List all the in-game actions that affect seeding/ranking (On Paper and Gdocs)
				• Create a list of finite vs infinite ways of scoring
				• Is there a max score to the game?
				• Make note of any finite scores that can be taken away by opponents (IE: RC or minibot race)
				• Make a chart of the ways the point value for the infinite and finite scoring values equal
					• Print out annotated field map
					• Bring down paper lists of reviewed topics and strategies to present

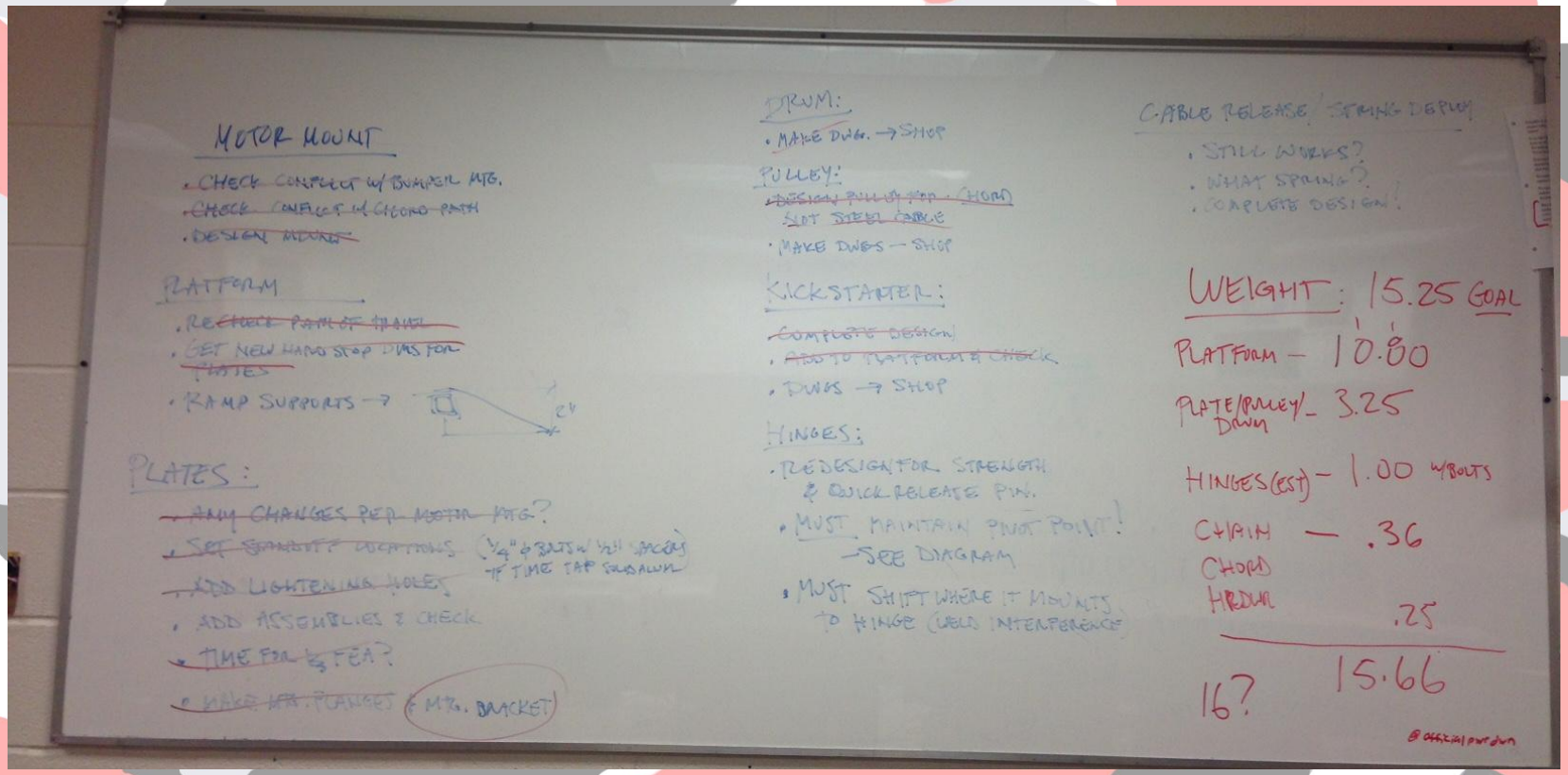
1511 BUILD SEASON

				c. Chain/Belt d. Pneumatically driven elements e. Electrically driven elements 5. Full prototype of idea using actual COTS a. Test contact materials b. Test speed c. Figure out how to control	
7:15 PM	Shop	RK/TC	Design	**Group 2:** Robot Component Design Scenarios (See steps 1-4 above)	A list of sketches, prototypes and ideas to share with team.
7:15 PM	G4	JG/CE	Strategy	Break into sub-groups.	
7:15 PM	G3		Strategy	**Group 1:** Research/watch/read up on how the Ri3D teams are coming along. Be ready to present your findings Sunday morning. This includes what strategies the teams decide to go with, what mechanisms the teams are using to achieve their strategies, each team's prototyping techniques and other interesting/useful information you think the team can benefit from.	Documentation of each team's strategy, design, prototypes, and other. Use pictures and video to supplement your data.
7:15 PM	G3		Strategy	**Group 2:** Continue legacy research based on the guidelines above (the 3:15 timeslot). Continue research until there is an overwhelming amount of pictures/videos and data. --Collect, compile, and print all research and color photos after showing a strategy mentor	-Large, good resolution photos for each chosen system. -Video links of the system in action -Make sure Carol or Josh has all of the research before group disbands.
7:15 PM	G4	JG/CE	Strategy	**Group 3:** In-depth strategic analysis. <u>Tele-Op Robot Movements</u> • List ALL possible robot movements in each of the teleop strategies provided • List ALL combinational robot movements • List ALL robot-robot interactions ○ Offensive ○ Defensive ○ Commit Penalties ○ Draw penalties from Opponent ○ With Field Elements *For Each Movement:* • Add an estimated time	
				• List ways to ensure movement can be operated with minimal "line up" time • Add a maximum time for this action to be considered viable. <u>End Game</u> • List all actions required to complete end game ○ Identify any "lining up" actions and how to minimize their impact ○ Locking action to ensure task remains complete after match conclusion • Create an end game timeline • Identify all possible points associated with end game task • Create a points comparison table between continue teleop scoring and the finite end game scoring. • Identify all strategic benefits of completing end game ○ Qualifications Ranking ○ Elimination rounds • Identify all situations where other robots might interfere with success of or decision to execute end game. <u>Autonomous Modes</u> • From the provided list of auto strategies, create a chart. For EACH strategy list: • Points • Starting Location • Game Pieces Interacted • Ways other robots could prevent success • Field features to sense • Difficulty Rank • Reliability Rank	
9:30 PM	G4	JG/CE	Strategy	<u>Cost Benefit Analysis</u> Use scoring info composed in earlier group session to create CBA. • Goal: Identify most valuable actions in a match. • Might need one table for Qualifications and one for Eliminations. • Calculate "match score potential" • Later, mechanical design difficulty can be added to identify what game actions can be done with the least amount of build season effort.	CBA
11:00 PM	G4	JG/CE	Strategy	Create Strategic Priority list, followed by Desired Robot Functionality Priority list based on the CBA. Be prepared for one student and one mentor to thoroughly explain this decision in the morning. ***"Critical Path Deadline"***	• Strategic Priority List • Desired Robot Functionality Priority List

LL = Larry Lewis
JG = Josh Goodman
CE = Carol Engelbrecht
RK = Roseanne Khaleel
AA = Amy Averill
JK = Jason Kuberka
TC = Tom Cavaliere
JD = Jeff Downs
EB = Eric Brewer

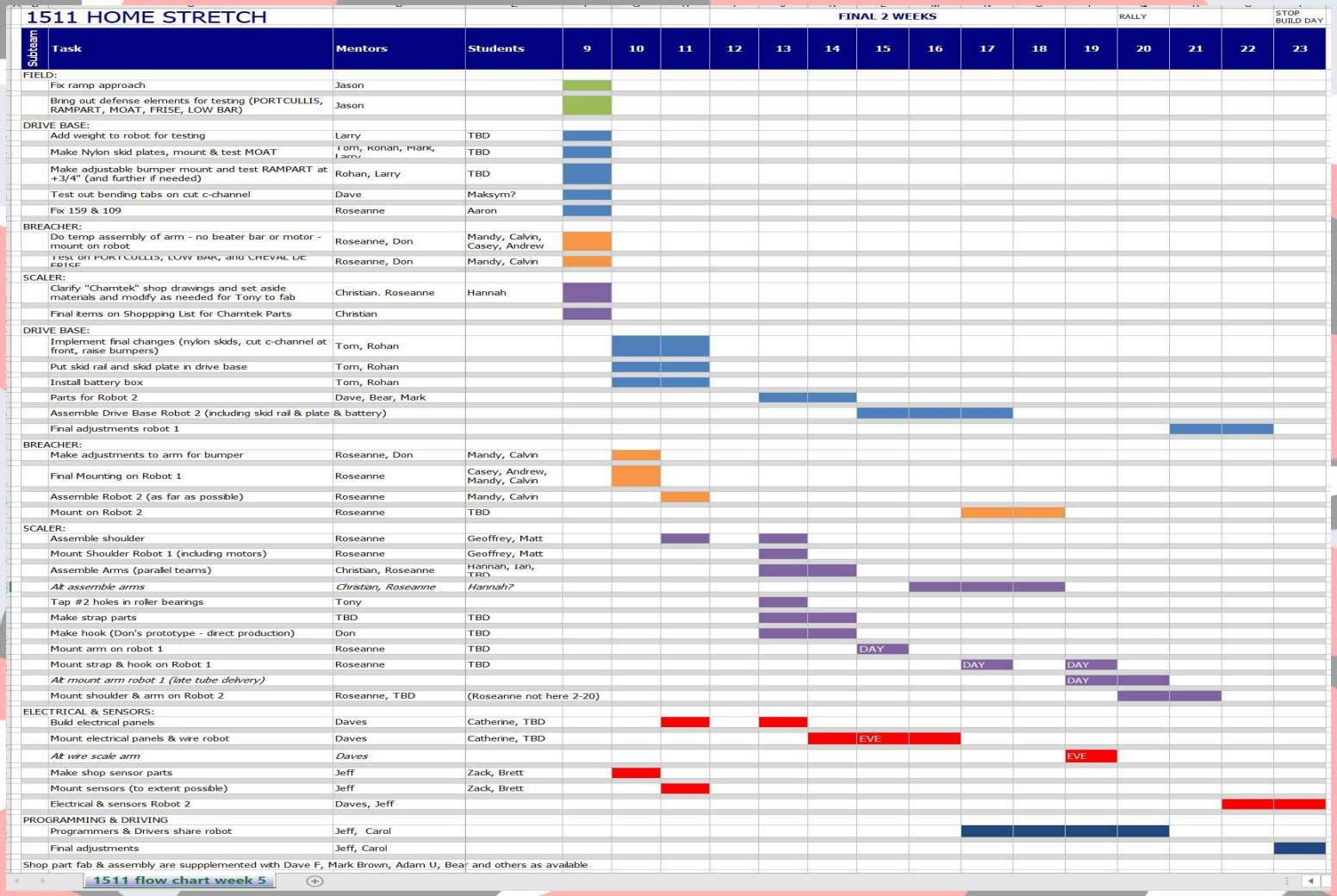
1511 BUILD SEASON

Beyond kick-off, the Robot Leads will should also produce task lists for each session with targets for subteams. Their role is to help subteams focus on design to the greatest extent possible.



1511 BUILD SEASON

Finally, the last 10 days or so of Build Season may also need a detailed schedule:



1511 HOME STRETCH

FINAL 2 WEEKS | RALLY | STOP BUILD DAY

Subteam	Task	Mentors	Students	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
FIELD:																		
	Fix ramp approach	Jason																
	Bring out defense elements for testing (PORTCULLIS, RAMPART, MOAT, FRISE, LOW BAR)	Jason																
DRIVE BASE:																		
	Add weight to robot for testing	Larry	TBD															
	Make Nylon skid plates, mount & test MOAT	Tom, Rohan, Mark, Larry	TBD															
	Make adjustable bumper mount and test RAMPART at +3/4" (and further if needed)	Rohan, Larry	TBD															
	Test out bending tabs on cut c-channel	Dave	Maksym?															
	Fix 159 & 109	Roseanne	Aaron															
BREACHER:																		
	Do temp assembly of arm - no beater bar or motor - mount on robot	Roseanne, Don	Mandy, Calvin, Casey, Andrew															
	Test on PORTCULLIS, LOW BAR, and CHEVAL DE FRISE	Roseanne, Don	Mandy, Calvin															
SCALER:																		
	Clarify "Chamtek" shop drawings and set aside materials and modify as needed for Tony to fab	Christian. Roseanne	Hannah															
	Final items on Shoppping List for Chamtek Parts	Christian																
DRIVE BASE:																		
	Implement final changes (nylon skids, cut c-channel at front, raise bumpers)	Tom, Rohan																
	Put skid rail and skid plate in drive base	Tom, Rohan																
	Install battery box	Tom, Rohan																
	Parts for Robot 2	Dave, Bear, Mark																
	Assemble Drive Base Robot 2 (including skid rail & plate & battery)																	
	Final adjustments robot 1																	
BREACHER:																		
	Make adjustments to arm for bumper	Roseanne, Don	Mandy, Calvin															
	Final Mounting on Robot 1	Roseanne	Casey, Andrew, Mandy, Calvin															
	Assemble Robot 2 (as far as possible)	Roseanne	Mandy, Calvin															
	Mount on Robot 2	Roseanne	TBD															
SCALER:																		
	Assemble shoulder	Roseanne	Geoffrey, Matt															
	Mount Shoulder Robot 1 (including motors)	Roseanne	Geoffrey, Matt															
	Assemble Arms (parallel teams)	Christian, Roseanne	Hannah, Ian, TBD															
	Alt assemble arms	*Christian, Roseanne*	*Hannah?*															
	Tap #2 holes in roller bearings	Tony																
	Make strap parts	TBD	TBD															
	Make hook (Don's prototype - direct production)	Don	TBD															
	Mount arm on robot 1	Roseanne	TBD							DAY								
	Mount strap & hook on Robot 1	Roseanne	TBD									DAY		DAY				
	Alt mount arm robot 1 (late tube delivery)													DAY				
	Mount shoulder & arm on Robot 2	Roseanne, TBD	(Roseanne not here 2-20)															
ELECTRICAL & SENSORS:																		
	Build electrical panels	Daves	Catherine, TBD															
	Mount electrical panels & wire robot	Daves	Catherine, TBD							EVE								
	Alt wire scale arm	*Daves*												EVE				
	Make shop sensor parts	Jeff	Zack, Brett															
	Mount sensors (to extent possible)	Jeff	Zack, Brett															
	Electrical & sensors Robot 2	Daves, Jeff																
PROGRAMMING & DRIVING																		
	Programmers & Drivers share robot	Jeff, Carol																
	Final adjustments	Jeff, Carol																
Shop part fab & assembly are suppplemented with Dave F, Mark Brown, Adam U, Bear and others as available																		

1511 flow chart week 5

1511 BUILD SEASON

Now let's talk about RESOURCES:

Money: Know your budget and track your budget. You will need to make key decisions about the robot design related to cost:

- **$ for raw materials? Inventory what you have.**
- **$ for COTS? Can you take COTS from previous robots? Can you afford new?**
- **$ for prototyping?**
- **$ for second robot?**
- **Control shipping costs**

1511 BUILD SEASON

1511 maintains a cost conscious approach in order to show our sponsors that we are not wasting funds:

- **We salvage materials and COTS from all of our second robots.**
- **We use new motors on our competition robot. We buy replacement gears to rebuild transmissions. We use old motors for prototyping and spares during competition.**
- **We salvage all of our unused aluminum. We reuse old parts for stock and for robot 2.**
- **We salvage all COTS.**
- **We use salvaged materials, including saved drive bases for prototyping.**
- **Our purchases are tracked and part of our aggressive schedule is an attempt to get long lead items quickly and limit shipping costs.**
- **We choose suppliers that have reasonable shipping policies whenever possible.**
- **We recycle anything we no longer have a use for, including wiring.**

1511 BUILD SEASON

Equipment and Space:

What are my available work areas and what equipment do we have access to. These are critical questions for both schedule and robot design:

- **CAD? How many stations? This will impact the number of subteams you can have, or if no CAD, the schedule may shift to provide longer prototyping and documentation by sketch, photo, etc.**
- **Shop? What equipment do I have? CNC? Break? Drill Press? Lathe? Mill? This will determine the basic approach to design.**
- **Outsourcing: Do I have any mentor shops available to use?**

1511 BUILD SEASON

1511 Equipment and Space:

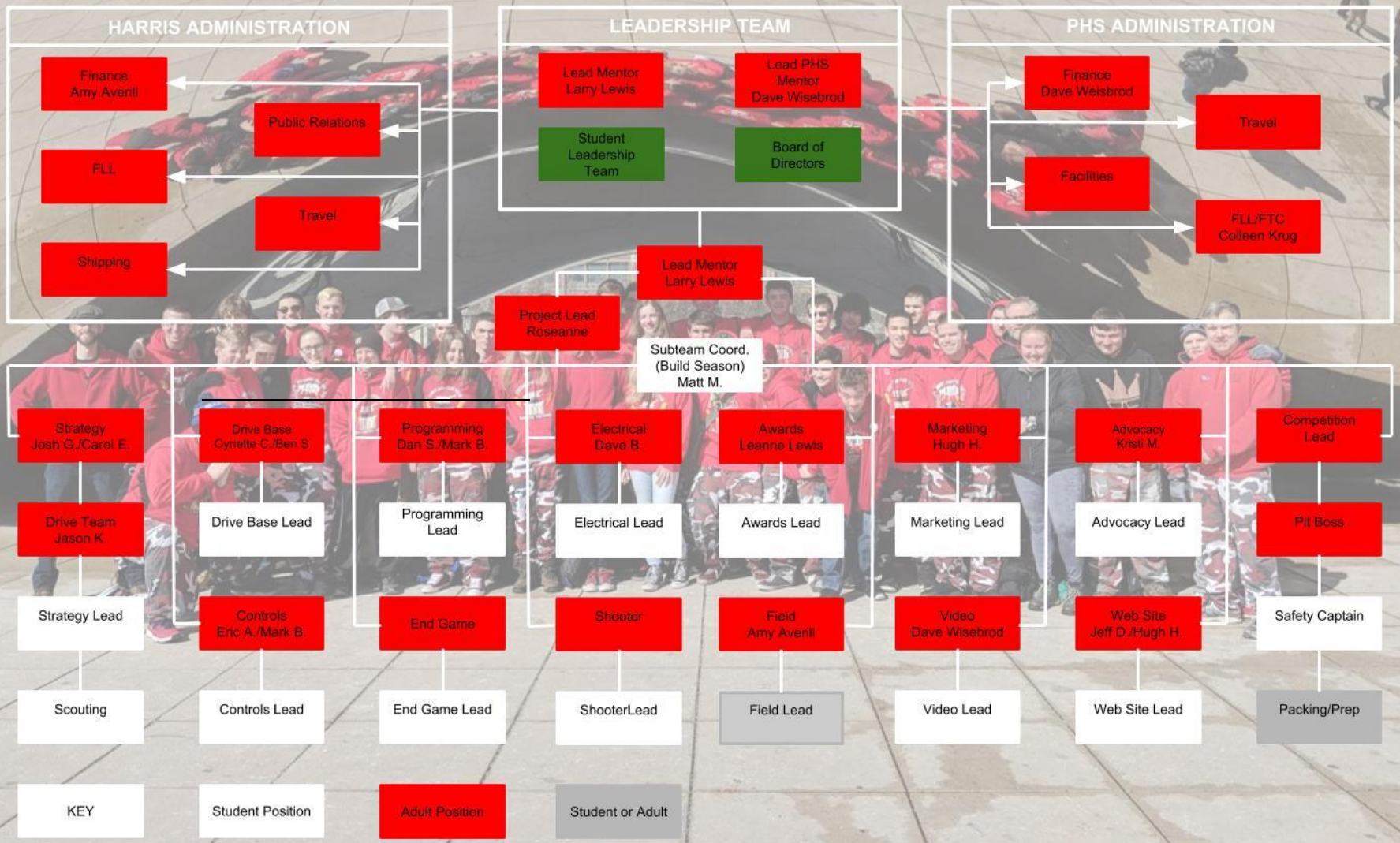
- **We use two high school tech classrooms with over 15 CAD stations each.**
- **We use Inventor because that is what the tech classes use.**
- **We use the high school metal shop that contains high school equipment as well as equipment the team obtained. We have a lathe, a mill, a break, drill presses, a band saw, a horizontal band saw, a sander, and many hand tools.**
- **We have access to the high school wood shop if needed.**
- **We have storage space to keep some completed robots for examples and for use in driver training and practice.**
- **We have storage space for all of our COTS supplies, raw materials, batteries, and toolboxes.**
- **We have access to mentor shops, our primary one being Harris where we can have sheet metal parts made.**

1511 BUILD SEASON

People: You need to determine who on the team is doing what during build season. I am going to focus on the robot build. However there are other things needing attention:

- **Our organized parents handle meals during build season**
- **Our parents, teachers and Leadership handle all aspects of travel.**
- **We have mentors and students dedicated to Chairman's and other awards.**
- **We have mentors and students dedicated to marketing throughout Build Season.**
- **We all work hard to honor and respect these contributions and acknowledge that they allow the rest of us to focus on the robot build.**

1511 BUILD SEASON TEAM STRUCTURE



1511 BUILD SEASON

Team Leader: Larry L.

Robot Project Lead: Roseanne K. (Mentor) Matt MO. (Student)

Final Robot Assembly: Rachel B., Matt D., Sophomore, Freshman

					Eric A.	Dave B.	Jeff D.
	Primary Mechanism: Game Piece 1			Extra (Game Piece 2)			
Drive Base & Frame	**Intake**	**Outtake**	**End Game**	**(Obstacles)**	**Controls**	**Electrical**	**Programming**
				STUDENTS			
Ethan P. (Co-Lead)	Matt D. (Lead)	Matt D. (Lead)	Rachel B. (Lead)	Kate M. (Co-lead)	xx (Lead)	Julia P. (Lead)	Josh L. (Lead)
Julia P. (Co-Lead)	Wherever Needed:			Joe MC. (Co-lead)	xx (Lead)	xx	xx
xx	xx	xx	xx	xx	xx (Lead)	xx	xx
xx	xx	xx	xx	xx			xx
xx	xx	xx	xx	xx			
xx	xx	xx	xx	xx			
xx	xx	xx	xx	xx			
				MENTORS			
Ben S. (Lead)	Tom C. (Lead)				Mark B.		Mark B.
	Dave B.						Dan S.

analytical and design support: Christian Stoeckl

Available Students

Shop Mentors	
Bear	
Tony DS.	
Dave F.	

1511 BUILD SEASON

- **Robot Project Leads (Robot Build Leads):**
  - Keep track of all parallel and overlapping processes from start of robot to finish (Einstein).
    - Subteam progress
    - Daily and weekly targets
    - To do lists for subteams
    - Documentation and tracking (robot weight, parts, assemblies, purchases, outsourced parts, etc.)
    - Student Robot build Lead conducts integration meetings.
  - Facilitate subteam coordination and integration.
  - Shift resources around when needed.
  - Maintain the schedule.
  - Report to the Team Lead and Student Leadership.
  - Coordinate with outside resources.

Must be willing to get yelled at and have a lot of "discussions" – must be able to stay COOL and EFFECTIVE in the face of team members who are concerned, upset, disappointed, frustrated, irate, and/or in full on panic!

1511 BUILD SEASON

- **Component Leads:**
  - **A solid mentor and a solid student lead for a component subteam will get you 80% there.**
  - **Look for the following traits:**
    - **Ability of the mentor to let the student come up with the design ideas and *guide* them – not tell them what to do.**
    - **Ability of the mentor and student to think specifically and globally *simultaneously*.**
      - **These leads will have to follow the schedule, provide direction for their component group, provide feedback to the Project Leads, coordinate with other subteams, and represent their subteam during Integration Meetings.**
    - **Ability of the lead student and lead mentor to break it down into parts and delegate.**
    - **COMMUNICATION SKILLS and CONFIDENCE: They need to do all of the above while doing their best to inspire their group.**

1511 BUILD SEASON

Only have as many subteams as you have strong willing students to lead and mentors to pair them with. This will limit what you do, but it will also ensure what you do is completed.

Do not base student leads on grade level or seniority. Choose based on design and communication skill. If you have an overabundance of qualified candidates, then grade level or seniority could be one factor in the decision.

Student lead is a voluntary position – it should not be assigned.

Long term, student lead for robot component design should be a desired position. If it is not, try to find out why students don't want to take on the challenge.

Do not discount alumni. While I would not advise giving alumni official positions when they are that transition period of not being full mentors due to age, they can still be added to subteams for support (even if it's only for the first week while they are on break).

1511 BUILD SEASON

Notice I said nothing about engineering experience yet! Knowledge of mechanical design is needed. But the level of knowledge needed is flexible.

- **What do I mean by that?**
  - **Look at what your resources are – not every team gets to have engineers on them:**
    - **Teachers**
    - **Architects & Contractors**
    - **Garage "mechanics", "inventors", "builders"**
    - **FIRST alumni**
    - **Professors**

There are tremendous design resources available through the FIRST community to allow for thinking outside the box when it comes to robot design mentors. Basic mechanical knowledge may be available through any of the above (and many more). Keep an open mind.

1511 BUILD SEASON

Now let's talk about design.

Phases:

1. **Gathering information (Saturday kick-off)**
2. **Ideas**
3. **Component Evaluation**
4. **Prototype, CAD, Calculate**
5. **Component Review**
6. **Whole Robot Review**
7. **Decision Time**

1511 BUILD SEASON

Robot Design Mantras

YOU MUST MAKE THE BEST DECISION YOU CAN WITH THE INFORMATION YOU HAVE *AT THE TIME YOU NEED TO MAKE IT!!!!!!!!*

Schedule is our most restrictive element. We must respect Larry's schedule – target dates are there for a reason!

If we take the time to vet, proto and test every idea we have we will not have time to build a competitive robot. We must quickly test, evaluate, and whittle down to 1. This is the purpose of prototyping.

If the entire team has to be involved in every step/decision we will not have a competitive robot. We must trust each other.

We must rely on the experience and judgement of mentors when making design decisions!

We must acknowledge and support what makes students enthusiastic about robotics in making design decisions!

When we work in subgroups, when a decision has been reached and documented, WE MUST RESPECT THAT AND COORDINATE WITH THAT DECISION. This includes Strategy decisions.

- A decision isn't made until Larry has been fully informed and ok'd the decision.
- A decision isn't documented until Roseanne knows about it. Documentation during design is located in the Robot Binder #2. Ideally it will also be on the WIKI.

1511 BUILD SEASON

The Starting Point: GOALS!

- Strategy sets robot function priorities
  - As much *useful* detail as possible
    - Speed goals
    - Timing goals
    - Acceleration goals
  - Discussed in an afternoon panel by students

1511 BUILD SEASON

Match Timing Analysis

Red= Must Make Clear To Ref

Action	Must Time(sec)	Want Time(sec)
Portcullis	3	1.5
Chevel De Frise	3	2
Moat	1	0.75
Ramparts	1	0.75
Drawbridge Front	5	4.5
Sally Port Front	4	3.5
Drawbridge Back	4	3
Sally Port Back	3	2
Rough Terrain	1	0.75
Rock Wall	1	0.75
Low Bar	1	0.75
Scaling	5	3
Low Goal	2	1
Acquire Ball	2	1
Top Speed	4.5 m/s	
Acceleration	3 m/s²	

Part of match	Action			Time(sec)
Autonomous	Traverse to Courtyard			5
Autonomous	Insert Ball Into Low Goal			10
Autonomous	Set Up to Countinue Breach			15
Tele-op	Time It will take to complete			20
Tele-op	a full breach with one			25
Tele-op	outer work being completed			30
Tele-op	during autonomous			35
Tele-op				40
Tele-op				45
Tele-op				50
Tele-op				55
Tele-op				1:00
Tele-op				1:05
Tele-op	DEF	Bring balls from Human Player To oponents courtyard ~5 balls	Score As Many balls as possible into the low goal ~ 4 balls	1:10
Tele-op				1:15
Tele-op				1:20
Tele-op				1:25
Tele-op				1:30
Tele-op				1:35
Tele-op				1:40
Tele-op				1:45
Tele-op				1:50
Tele-op				1:55
Tele-op				2:00
Tele-op				2:05
Tele-op				2:10
End Game	Hang/Cap			2:15
End Game				2:20
End Game				2:25
End Game				2:30

1511 BUILD SEASON

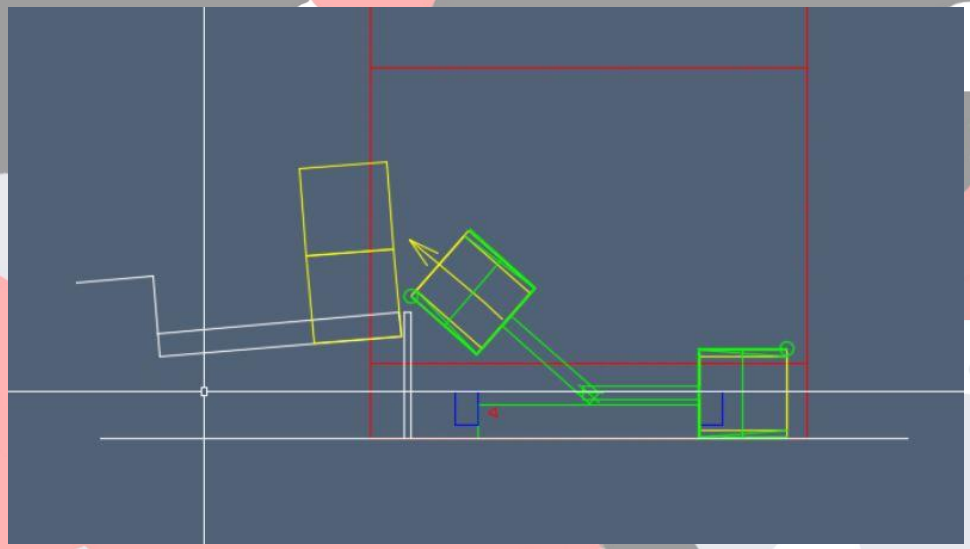
Strategic Priority	Desired Robot Functionalities
1 Drive	High Maneuverability: Turn on a dime quickly
	High Acceleration/Torque
	Able to traverse cable bump
	Able to climb platform
	Accurately accomodate complex auto modes that involve drive - turn - drive
2 Power Cube Ground Intake	Extremely quick "Touch it- own it" intake system
	Able to intake a cube in any cube orientation
	Able to intake with very low driver precision - majority of drivetrain side
3 Hold Cube Securely	Cube stays in place while hit or under high speeds/change in direction
	Cube must be loaded from the intake to a scoring mechanism as close to instantaneously as possible.
	Robot prevents second cube from accidently being intaked or placed anywhere on the robot
	Must be able to load and unload cube with robot powered off
4 Eject Cube into Exchange Zone	Eject cube quickly, powerfully, and accurately into the exchange with very little driver precision
5 Lift two robots so that their bumpers are 12" up while on the platform	Be able to reliably and safely deploy a lift system on the platform in 2 sec
	Lift system must be securely stowed into the starting configuration until
	Lift system must be accessible to any robot that can already climb the
	Lift system must hold 150lbs per lift for 40 seconds
	Lift system must elevate robot's drivebase to at least 11" off the platform
	Lift system must safely handle robots after robot has been powered off
	Lift actuation must be controlled one side at a time
	Lift actuation may be undone and redone
	Robot must be able to be moved onto cart in a timely manner at match end when lift has been deployed
6 Eject Cube into Switch	Cube must be able to be scored quickly into the switch platform in at least two layers
	Cube must be capable of being scored accurately during Auto
7 All robots cross Auto Line	Code a Auto Line Program in all available FRC programming languages
8 Vision for Auto Modes/Additional Auto Capabilities	Interpret FMS Data at t=2:30
	Sense switch proximity through Camera/Vison
	Sense Exchange proximity through Camera/Vision
	Sense Cube Location through Camera/Vision
	Acquire cube in Auto

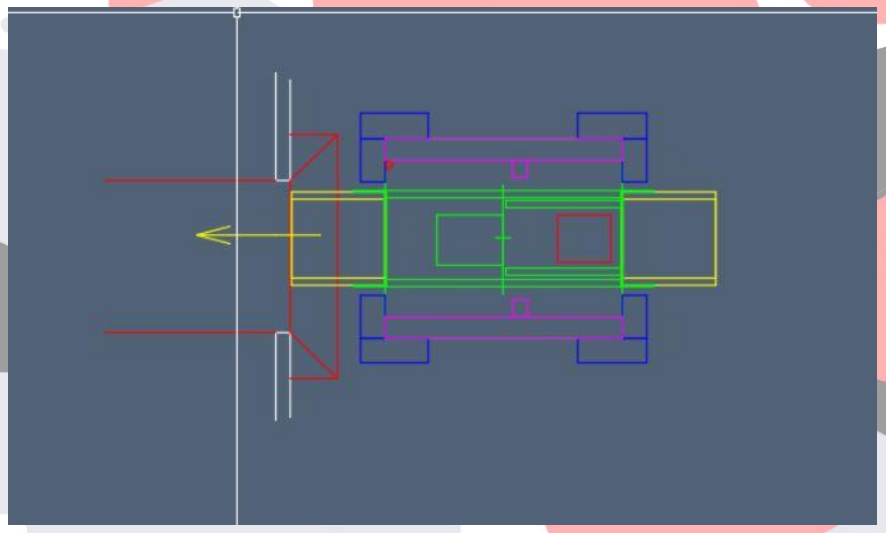
1511 BUILD SEASON

Gathering Information:

- **Robot Rules**
  - **Physical limitations:**
    - **Size or volume(s) of robot or drive base**
    - **Starting configurations**
    - **Travel configurations**
    - **Crate configurations**
    - **Extension planes**
    - **Bumper rules/constraints**
- **Additional Dimensional constraints**
  - **Field: terrain**
  - **Game pieces**

1511 BUILD SEASON



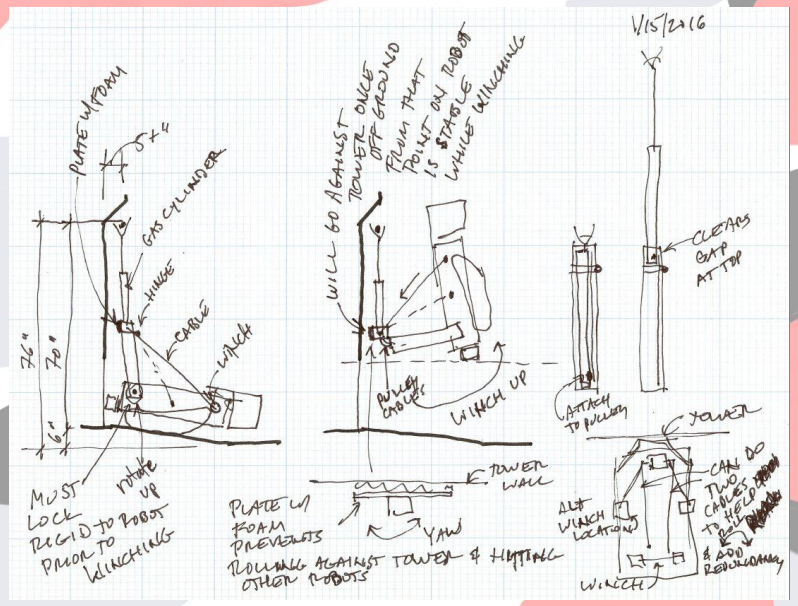


YOU MUST LOOK AT EVERY INTERACTION BETWEEN THE FIELD AND THE ROBOT!

1511 BUILD SEASON

Ideas:

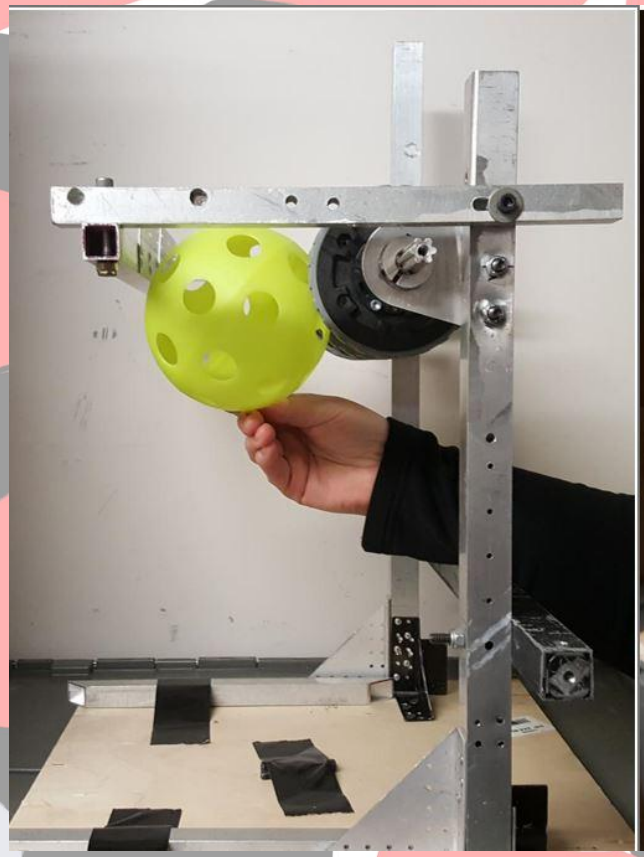
- **Quick sketches to convey ideas**
  - **Hand drawn**
  - **Legacy research**
  - **“Origami”**
  - **2D CAD**
- **Component Evaluation**
  - **Review all ideas**
  - **Narrow down to the number you can effectively prototype/develop in time frame**

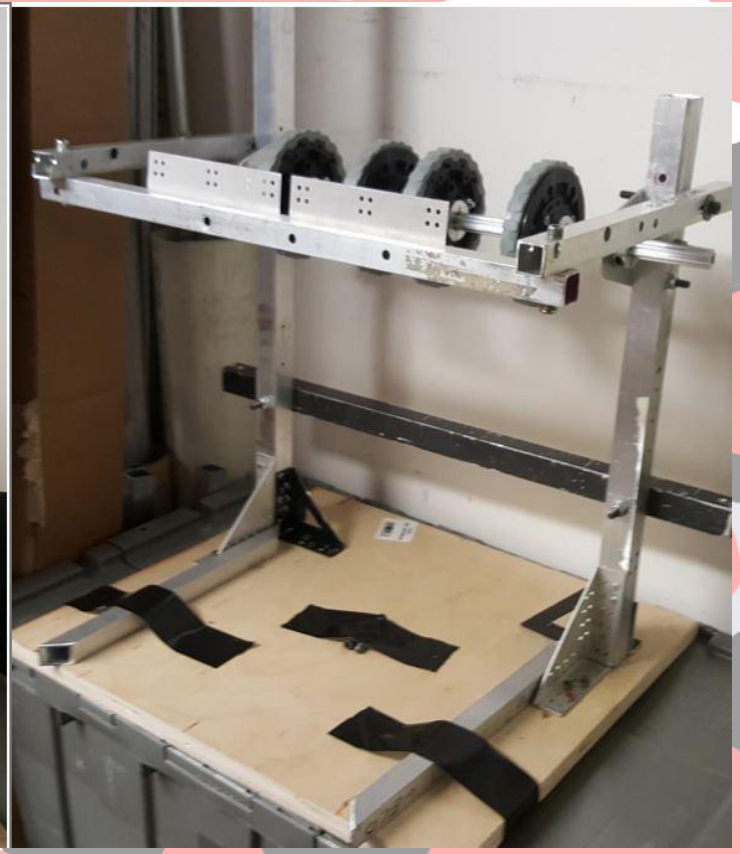


1511 BUILD SEASON

Prototype:

- **Limited time**



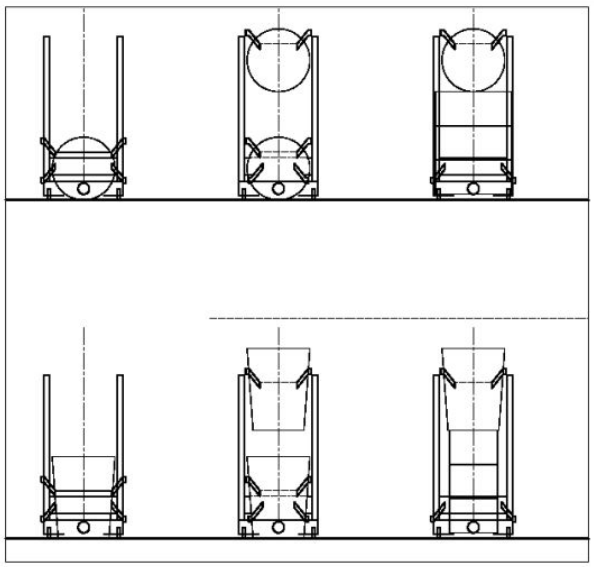


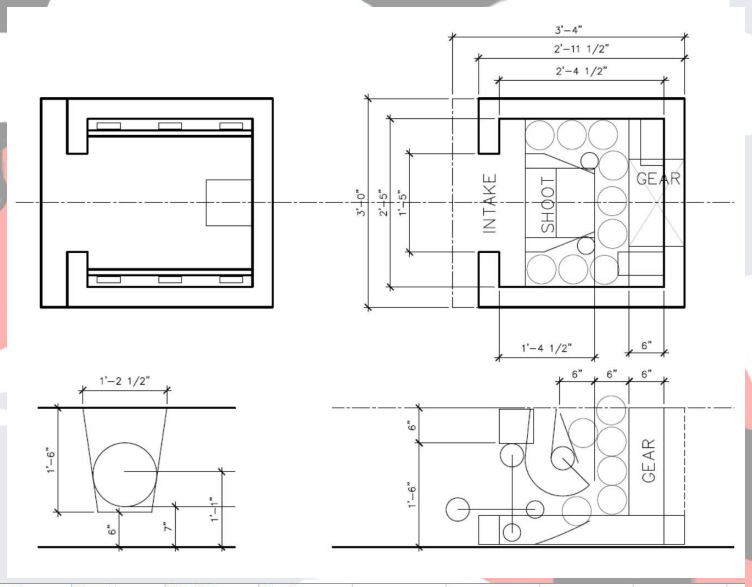
1511 BUILD SEASON

CAD & Calculate:

- **As much preliminary information as the subteams can put together in the time frame:**
  - **Strategy goals**
  - **Field interactions**
  - **Game piece movement**
  - **Motor calculations**
  - **Weight budget**

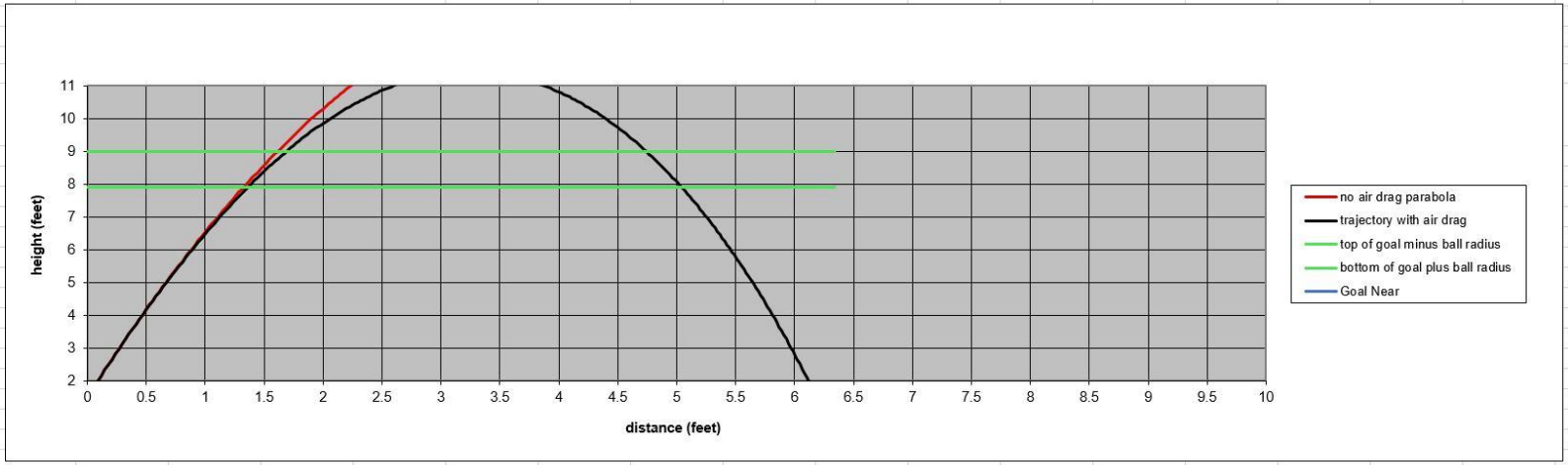
1511 BUILD SEASON





29	launch speed ft/sec	revC 3/4/2014 11am
80	launch angle degrees	
1.5	launch height (center of ball) feet	
37.5	terminal velocity of ball ft/sec	
32.174	g: gravity ft/sec^2	

Shot	Front	Middle	Back
Near End	1.5	2.5	3.5
Far End	3.5	4.5	5.5



1511 BUILD SEASON

Final component evaluation:

- Present any information you have for each idea selected for further study.
- Narrow down to proven viable ideas – no more hand waving, no more “I just need a little time”!
- Use weighted analysis if too difficult.

1511 BUILD SEASON

WEIGHTED ANALYSIS FOR SCALE ARM

1511 Stronghold Game 2016

	APPLICABLE TO ANY MECHANISM									SPECIFIC TO SCALE ARM				
Description:	Weight	Space Allocation	Design complexity	Assembly complexity	Controls complexity	No. of drivers	Repairability	Team Familiarity	Reliability of mechanism	Ability to maximize length of arm	Possibility of tangling/binding	Repeatability of motion path (aim)	Adaptability for future mods?	Totals:
Weight given to attribute:	4	10	7	5	8	6	8	3	8	8	8	10	5	
Scissors	4	3 partially deployed	5	3	4 no fine adjustment		5	1	3	3	2	1	1	250
Nested Cable	2	2	4	5	3		3	2	4	4	2	5	2 best if round	275
Nested Chain	1	1	4	4	3		4	3	5	4	4	5	5	306
Pulleys/Slide	2	1	4	4	3		3	2	4	4	3	5	5	283
Spring/Cable	3	3	3	1 always wants to open	3		1 get to the springs	1	3	2 overlap	2 Friction/spring	4	2	209
Fish Tape/Slide	2	2	4 two paths	4	3		3	2	3 no research	4	2 two paths	5	4	272
Folded/Spring	4	5	5	1 always wants to open	5		5	1	1	1	1	1	1	228
					all have to 1 - pivot, 2 - motor up, 3- motor down									0
														0

1/14/2016

1511 BUILD SEASON

Alternate weighted analysis:

WOT Table 2018 POWER UP

1511 Rolling Thunder

Cube Intake

Comparison Criteria	Weight	Outboard Side Roller Hand		Outboard Top Roller Open-Sided		Side Roller Feed to DB Intake	
		Score (1-5)	Weighted Score	Score (1-5)	Weighted Score	Score (1-5)	Weighted Score
Complexity of design	10						
Weight	4						
Ability to pick up CUBE from the ground in any orientation	10						
Tightness of grip (can hold without dropping if hit)	10						
Speed of grab	8						
Speed of CUBE ejection	8						
Total	50						

Cube Transport (arms, elevators, conveyors)

Comparison Criteria	Weight
Complexity of design	10
Weight	4
Ability to position CUBE at EXCHANGE	13
Ability to put position CUBE at SWITCH	5
Speed of positioning	9
Driver precision	9
Total	50

Ramp CLIMB

Comparison Criteria	Weight
Complexity of design	10
Weight	4
Driver precision	6
Ability for auto-deploy (as in no driver work required after initiating)	6
Amenable to all wheel types	12
Amenable to all drive base configurations (wide bot, long bot, narrow bot)	12
Total	50

1511 BUILD SEASON

Robot Build should pause at the end of this and determine whole robot configurations to evaluate:

- **Ability of components to share real estate:**
  - **And is the result a balanced robot with low CG?**
- **Negative interactions or cross purposes.**
- **Opportunities for shared weight:**
  - **Pneumatics?**
  - **Infrastructure?**
- **Overall use of motors and breakers.**

1511 BUILD SEASON

The final decision on robot design should be based on a "whole robot" review.

Once this decision is made it should not be changed for any reason – and I really mean that. This is the hardest part, but subteams should leave this session with clear direction on what they are doing and what their allocated area, motors, etc. are.

This is also the most difficult thing to do – 1511 has never been completely successful at following this rule and it has NEVER benefitted us when we broke it.

You are only at day 6-8!!!

1511 BUILD SEASON

Detailed design by subteam should commence after the whole robot decision is made:

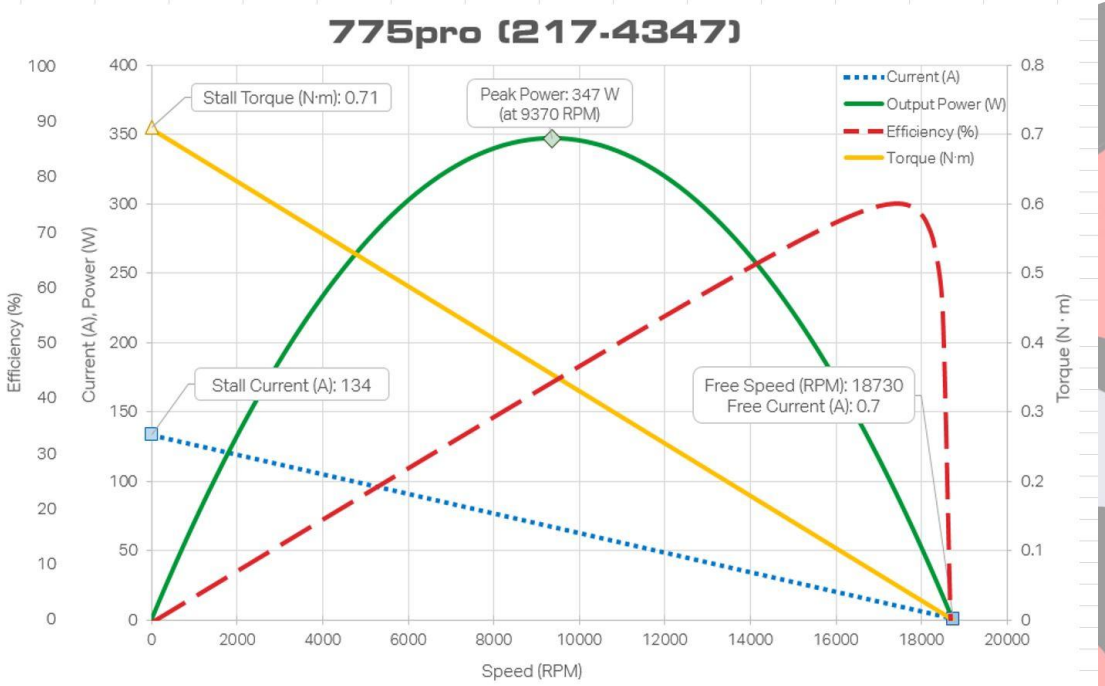
- **Detailed calculations – "Calculate don't speculate"**
  - **Use available calculators when possible.**
- **Employ protocols, protocols, protocols**
- **Begin Integration**

1511 BUILD SEASON

- **Detailed calculations – “Calculate don’t speculate”**
  - **Use available calculators when possible.**

Heavy Arm

Description	Symbol	Value	Units			
Length	L	22	Inches		in2m	0.0254
		0.5588	m		lbs2kg	0.453592
Mass	M	20	lbs		g	9.81 m/s^2
		9.07184	kg		lbf2N	4.44822
Force	Fg=M*g	88.9947504	N			
Torque	T=Fg*L	49.7302665	Nm			
Angle	a	120	Degrees			
Diameter	D	6	inches			
		0.1524	m			
Pull	p=∏D*a/360	6.28318531	inches			
Spring Const.	k	10	lbf/in			
Spring Force	Fs=kp	62.8318531	lbf			
		279.489906	N			
Spring Torque	T=Fs*D/2	21.2971308	Nm			
		28.4331357	Nm	we want Usable Torque to be as close as possible		
Stall Torque	Tmax	0.71	Nm			
Motor Torque	Tm	0.355	Nm			
Gear Ratio	R	98		(7:1 + 7:1 in versa w/ 2:1 on sprocket)		
Useable Torque	Tu	34.79	Nm			
Motor Speed		18800	RPM			
		313.333333	RPS			
Final Speed		3.19727891	RPS			



1511 BUILD SEASON

Detailed design

Air Usage Calculator

	System Pressure	Volume (in^3)	Rate (CFM)	Work (P_1V_1)	Min Press	Time (min)	Work (in-lb)
Accumulator	115	30.5		3956	60		1677.5
Compressor			0.36	9145		2	18289

Name	Cycles	Stroke	Diameter	Quantity	Tubing "	Pressure	Work
Transmission	25	1	0.75	2	12	30	2980
Latch	6	4	0.75	1	16	60	1764
Latch Small	6	2	0.75	1	16	60	1016
Intake Large	8	8	0.75	2	18	60	8692
Intake Small	8	3	0.75	2	18	60	3705
Stop	16	1	0.75	1	9	60	1710
							0
							0
Total Usage							19868
Capacity							19967
Surplus/Deficit						+0.5%	99

1511 BUILD SEASON

Integration: Integration meetings occur 2-3 times per week. They are an opportunity for ALL subteam leads (that includes electrical, programming, controls, strategy) to get together and address issues related to the integration of the entire robot.

- **It is not a design session – and should not devolve into one.**
- **It is intended to bring up issues needing resolution or answers and to delegate responsibility and set target dates for completing the task.**
- **It is also an opportunity to review weight as the robot progresses.**
- **It is a way to keep everyone informed and accountable.**

1511 BUILD SEASON

Status	Group	Person Responsible	Goal	Date Assigned	Goal	New Goal	Days Behind	Date Completed	Notes	Key
Complete	Drive Base		Put top of DB on the Wiki (4.5 in)	1/13/2018	1/14/2018	-	-	1/13/2018		
Complete	Everyone	Rosanne + Matt S	Put robot volumes in CAD	1/13/2018	1/14/2018	1/23/2018			move into detailed robot	
Complete	Drive Base	Jordan + mentor	Look at battery layout for the robot (back?)	1/13/2018	1/14/2018			1/20/2018	mechanisms	
Complete	Arm	Matt S/D + mentor	Establish the arm pivot point	1/13/2018	1/14/2018			1/16/2018	20" above ground plane	
Complete	Everyone	Leads	Determine actuators and motors and put it on the Wiki	1/13/2018	1/16/18	1/21/2018		1/23/2018	Ongoing, need ASAP	
Complete	Those Who Use Pneumatics	Student + Mr. Stoeckl	Check pneumatics supplies	1/13/2018	1/14/2018			1/16/2018	lacking devices	
Complete	Everyone	Michael N	Chart of motors/functions	1/16/2018	1/18/2018			1/18/2018		
Complete	Ramp	Dave V + Matt M	Resolve Dimensional Issue	1/16/2018	1/18/2018	1/21/2018		1/23/2018		
Complete	All Groups	Roseanne	Preliminary CAD Review	1/16/2018	1/18/2018			1/18/2018		
Complete	All Groups	Roseanne	Final CAD Review	1/16/2018	1/25/2018	1/28/2018				
In Progress	All Groups	Leads	Weight Estimate	1/16/2018	1/18/2018					
Complete	Drive Base	Jordan S + Ben S	U-Channel Drawings	1/16/2018	1/17/2018			1/21/2018		
Complete	Drive Base	Julia + Cynette	Locate Bumper Mounts	1/18/2018	1/21/2018			1/20/2018		
In Progress	Everyone	Leads	Coordinate Mountings to Drivebase	1/18/2018	1/21/2018	1/25/2018			waiting on ramps	
In Progress	Everyone	Leads	Preliminary Sensor Info	1/18/2018	1/21/2018	1/28/2018			chart on wiki/excel file	
Complete	Casey & Calvin	Larry	Color Coordination Committee	1/18/2018	1/20/2018					
Complete	Mechanism Groups	Leads	Calculate pneumatic usage	1/23/2018	1/25/2018	1/28/2018				
Complete	Mechanism Groups	Leads	total pneumatic components needed	1/23/2018	1/25/2018	1/28/2018				
Not Started	Drive Base	TBD	Robot Cart	1/23/2018	TBD					
In Progress	Everyone	Leads	Deciding where shielding is going	1/27/2018	TBD					
In Progress	Everyone	Leads	"keep out" areas for the cubes	1/27/2018	TBD					
In Progress	Drivebase	Ben	Check conflict with camera	2/6/2018	2/7/2018					
In Progress	Pneumatics	Jordan	order air tanks	2/6/2018	2/7/2018					

1511 BUILD SEASON

Weights		Estimates									
	Budget	1/17/2016	1/23/0206	1/30/2016		1/21/2016	2/2/2016	2/6/2016	2/7/2016		2/13/
General:											
Hardware (Nuts & Bolts)	5	5	5	5		5			5		
Pnuematics Infrastructure	8	1	1	1	tank only	1					
Electrical	17	17	17	17		17			17	(5 CAD)	
Paneling (Sponsors, Safety)	4	4	4	4		4			4		
Subtotal	**34**	**27**	**27**	**27**		**27**	**0**	**0**	**26**		
Specific:											
Drive Base	36	36	45	38		45.5			47	(actual)	
Breacher/Intake Arm	16	16	17	13		10			13	(CAD)	
Scaler	20	29	29	28	No Lightening no strap no brake	26			30	Estimate	
Category C	10	10		8		8					
Lights									0.5	(Budget)	
Skid Plates				3		3			4	(CAD)	
Future Improvements	4	4	2	3		3					
Subtotal	**86**	**95**	**93**	**93**		**95.5**	**0**	**0**	**94.5**		
Total	**120**	**122**	**120**	**120**		**122.5**	**0**	**0**	**120.5**		
Total Check	120			120							
Total Allowed	120										
Whole robot CAD						80.343					
Subtotal 3 subteams CAD						81.5					

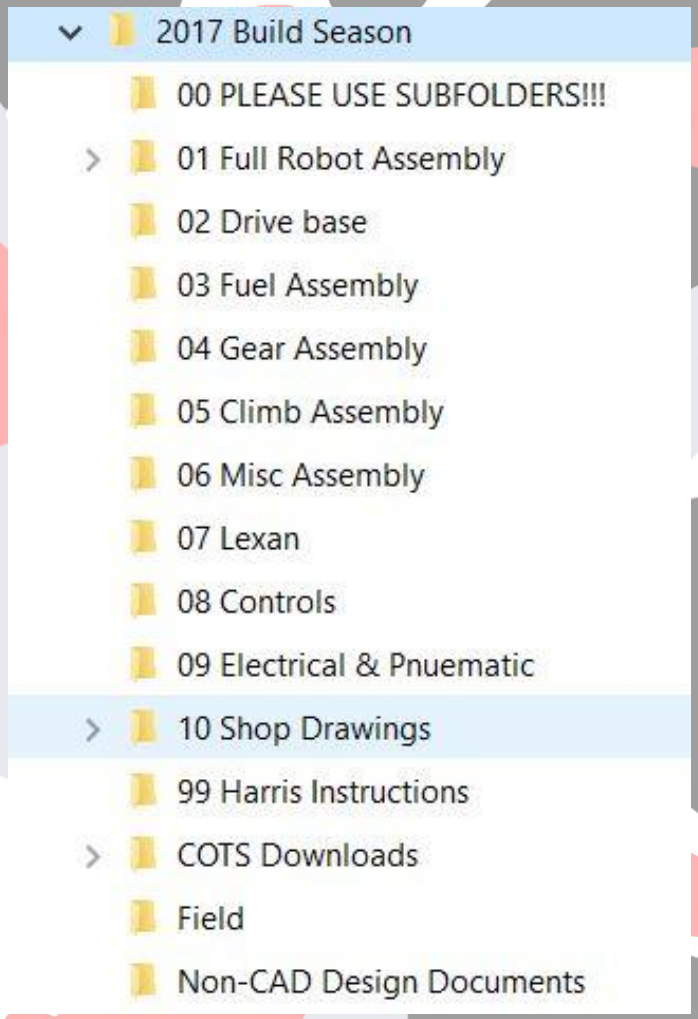
1511 BUILD SEASON

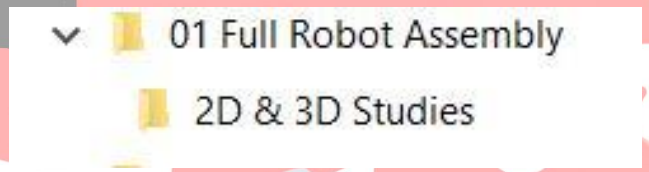
Protocols: For a consistent Robot Build you should have protocols for communication, design, manufacture, assembly, just about everything!

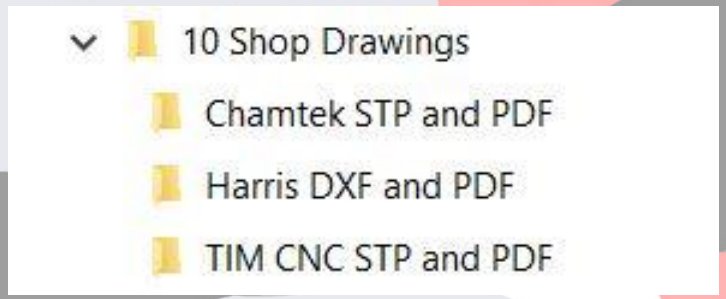
- Discussion: Slack "Robot Design" Channel
- Documentation:
  - School Drive: All CAD files, shop drawings and basic robot build work product.
  - Google Drive: Files that need to allow simultaneous editing:
    - Shopping List
    - Parts & Assembly Log
    - Integration spreadsheet
    - Detailed Schedules
  - Documentation of decisions and critical robot design elements:
    - WIKI
    - Robot Design Binder
  - Documentation of parts for fabrication:
    - Shop Binder
  - Documentation of Assemblies:
    - Shop Binder

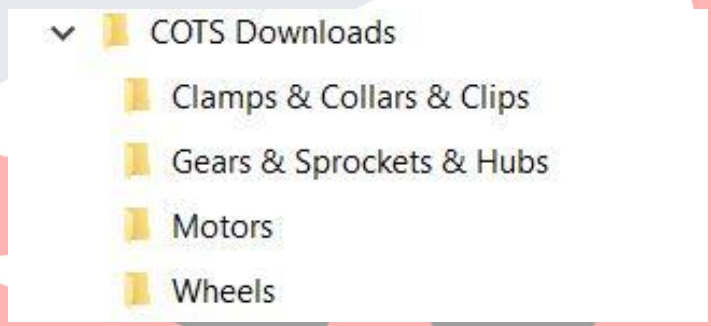
1511 BUILD SEASON

File Management on school drive : Organized based on subteam



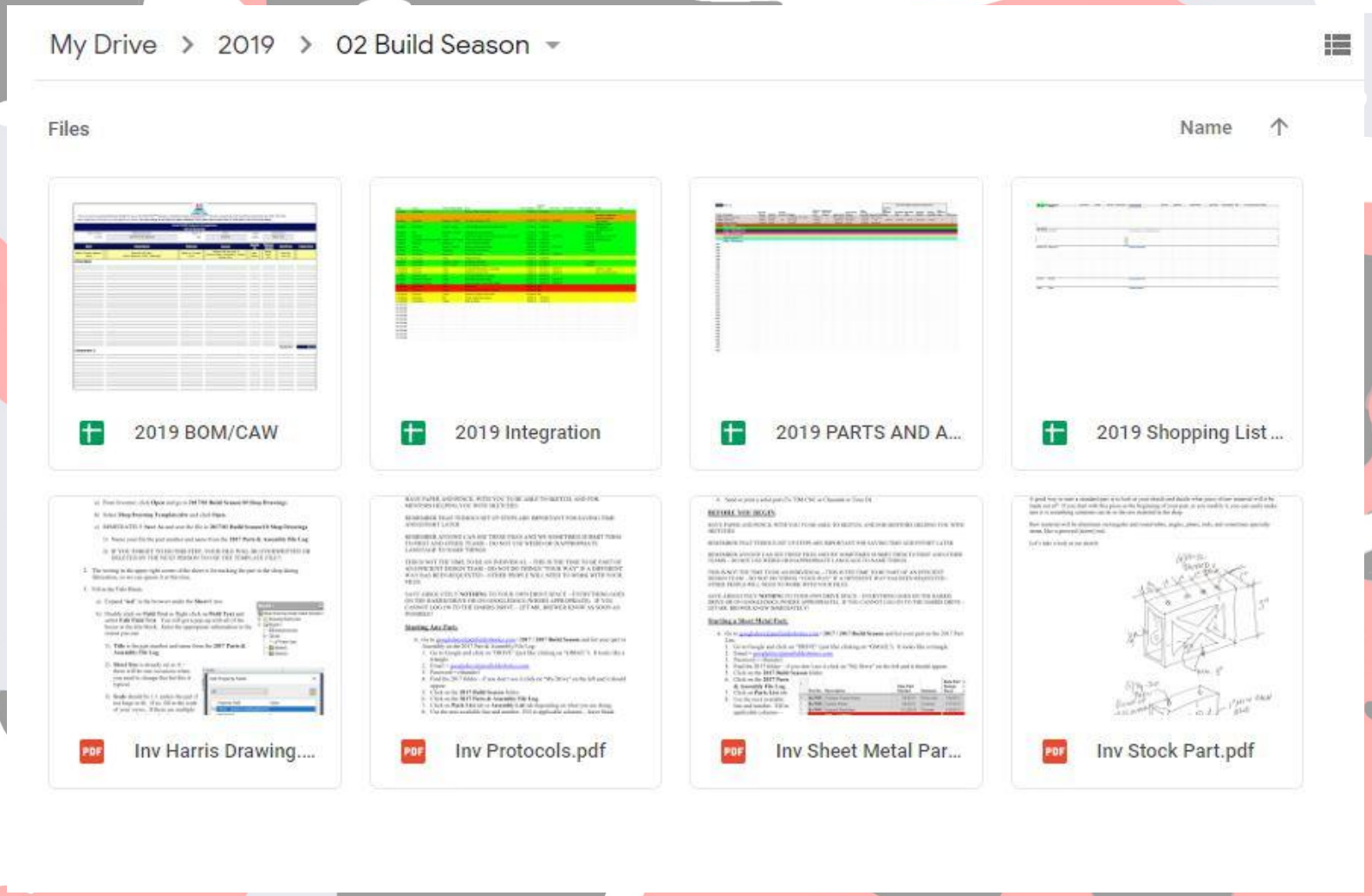






1511 BUILD SEASON

Google Drive:



1511 BUILD SEASON

Parts & Assembly Logs: Track each manufactured piece in the robot from design to assembly by assigning a part number and tracking progress on the log.

In addition, part tracking numbers are used by Robot Leads to:

- **Create priority lists for fabrication in the shop.**
- **Coordinate and track parts made by Harris and other mentor shops.**
- **Store parts on designated shelves so parts can easily be found during assembly.**
- **Check that all parts are in the BOM.**

1511 BUILD SEASON

Parts Log

Part No	Description	Date Part Started	Subteam	Quantity per Robot	Designer	Date Part Design Done	Approved to make shop drawing	Approved by:	Shop Drawing Made By	Shop Drawing Made Date	Status in Shop	FOR PARTS MADE OUTSIDE THE SHOP ONLY: STP Made Date (Chamtek Only)	PDF Made Date	DXF Made Date	Drawings Sent By	Drawing Sent Date	Part Arrived in Shop	Paint Color	STL File Made (for 3d printing)	Notes	BOM
Ex P001	Chassis Frame brace	1/4/2013	Drive train	4	Joe Schmoe, Tom Thumb	1/8/2013	Y	Tom Cavaliere	Joe Schmoe	1/10/2013	Robot 1 Done							b			
Ex P002	Control Panel	1/6/2013	Controls	NA	Tom Thumb	1/17/2013	Y	Mark Byers	Jim Cricket	1/18/2013	NA	1/27/2013	1/27/2013	1/27/2013	Mark Byers	1/27/2013	Y	r			
Ex P003	Support Stanchion	1/12/2013	Thrower	2	Tinker Bell	1/15/2013	y	Roseanne	Tiny Tim	1/16/2013	Not Started							b			
	RED = HARRIS																				
	GREEN = HIGH PRIORITY																				
	BLACK = OBSOLETE PART																				
	PURPLE = CHAMTEK																				
	YELLOW = 3D PRINTER																				
	CYAN = TIMS CNC																				
	WHITE = IN OUR SHOP!!																				
P001																					
P002																					
P003																					
P004																					
P005																					
P006																					
P007																					
P008																					
P009																					
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P020																					
P021																					
P022																					
P023																					
P024																					
P025																					

1511 BUILD SEASON

w **Parts Log**

Part No	Description	Date Part Started	Subteam	Quantity per Robot	Designer	Date Part Design Done	Approved to make shop drawing	Approved by:	Shop Drawing Made By	Shop Drawing Made Date	Status in Shop
Ex P001	Chassis Frame brace	1/4/2013	Drive train	4	Joe Schmoe, Tom Thumb	1/8/2013	Y	Tom Cavaliere	Joe Schmoe	1/10/2013	Robot 1 Done
P173M	Diagonal Brace Mirror	1/27/2018	Cube Arm		Matt Sowden						
P174	Arm Inside Support Plate Brake Side	1/28/2018	Cube Arm	1	Andrew Fabrizi	1/28/2018	Yes	Roseanne	Matt Sowden	1/28/2018	
P175	Cube Middle Lexan Alternate 1	1/28/2018	Cube Arm	1	Casey Stubblebine						
P176	Bimba Air Cylinder Mount	1/28/2018	End Game	2	Ethan Pendelberry	1/28/2018	Yes	Dave Vadas	Matt McOmber	1/30/18	
P177	Cube Top Lexan Alternate 1	1/28/2018	Cube Arm	1	Casey Stubblebine						
P178	Grabber Outer Spacer	1/28/2018	Transport	4	Matthew Darrer	1/28/2018	Yes	Roseanne	Tai Little	1/30/18	RB1+2 Done
P179	Grabber Pulley Spacer	1/28/2018	Transport	8	Matthew Darrer	1/28/2018	Yes	Roseanne	Tai Little	1/30/18	RB1+2 Done
P180	Lifter Brake Cable Mounting Block	1/28/2018	Cube Arm	1	Matt Sowden	1/28/2018	Yes	Roseanne	Zack Geoca	2/1/18	Robot 1 done
P181	Suspension screw Bracket	1/28/2018	End Game	2	Ethan Pendelberry	1/28/2018	Y	Dave Vadas	Aaron Kurtz	1/28/2018	
P182	Upper Hinge Spacer	1/28/2018	Transport	2	Matthew Darrer	1/28/2018	Y	Roseanne	Alex Bishop	1/30/2018	RB1+2 Done
P183	Arm Spacer .087	1/28/2018	Cube Arm	1	Casey Stubblebine	1/28/2018	Y	Roseanne	Casey Stubblebine	1/28/18	RB1+2 Done
P184	Mini CIM Plate	1/28/2018	DriveBase	TBD	Joe McCusker	1/28/2018	Y	C. Stoeckl	Joe McCusker	1/28/2018	
P185	CIM Shaft Simulator	1/28/2018	DriveBase	TBD	Joe Mccusker	1/28/2018	Y	C. Stoeckl	Joe McCusker	1/28/18	done
P186	Arm Spacer 1.414	1/28/2018	Cube Arm	1	Casey Stubblebine	1/28/2018	Y	Roseanne	Casey Stubblebine	1/28/18	RB1+2 Done
P187	Arm Spacer .571	1/28/2018	Cube Arm	1	Casey Stubblebine	1/28/2018	Y	Roseanne	Casey Stubblebine	1/28/2018	RB1+2 Done
P188	Arm Pully Alternate 1	1/28/2018	Cube Arm	1	Casey Stubblebine	1/28/2018	Y	Roseanne	Casey Stubblebine	1/28/2018	RB1 Done
P189	Brake Churro	1/28/2018	Cube Arm	1	Matt Sowden	1/28/2018	Yes	Roseanne	Alex Bishop	1/30/2018	R1 & 2 Done
P190	Motor Spacer Plate	1/28/2018	Transport	1	Matt Darrer	1/28/2018	Y	Roseanne	Aidan Hand	2/9/18	RB1 Done
P191	Arm Pivot Motor Mount Brace Front	1/28/2018	Cube Arm	1	Matt Sowden	1/28/2018	Y	Roseanne	Andrew Fabrizi	1/28/18	
P191M	Arm Pivot Motor Mount Brace Front M	1/28/2018	Cube Arm	1	Matt Sowden	1/28/2018	Y	Roseanne	Andrew Fabrizi	1/28/18	
P192	Arm Pully Alternate 2 (Hex)	1/28/2018	Cube Arm	1	Casey Stubblebine	1/28/2018	Y	Roseanne	Casey Stubblebine	1/28/2018	RB1 Done
P193	Lift Assembly Bracket support	1/28/2018	End Game	4	Ethan Pendelberry	1/30/2018	Y	Roseanne	Ethan Pendelberry	1/31/18	
P194	Arm Spacer 2.063	1/28/2018	Cube Arm	1	Casey Stubblebine	1/28/2018	Y	Roseanne	Casey Stubblebine	1/30/2018	RB1+2 Done
P195	Arm Spacer .125	1/28/2018	Cube Arm	1	Casey Stubblebine	1/28/2018	Y	Roseanne	Casey Stubblebine	1/30/2018	RB1+2 Done
P196	Optical Sensor Mount	1/28/2018	Cube Arm	1	Casey Stubblebine	1/28/2018	Y	Roseanne	Casey Stubblebine	1/28/2018	
P197	Lift Base Frame Center Members 36 Left	1/28/2018	End Game	1	Ethan Pendelberry	1/28/2018	drawing and	Roseanne	Calvin Morrison	1/28/18	needs nodified
P197M	Mirror			1			y	Roseanne	Ethan Pendelberry	2/6/18	needs nodified
P198	Lift Base Frame Center Members 36	1/28/2018	End Game	1	Ethan Pendelberry	1/28/2018	drawing and	Roseanne	Ethan Pendelberry	2/6/2018	needs nodified
P198M	Mirror	2/6/2018		1			Yes	Roseanne	Ethan Pendelberry	2/6/2018	needs nodified
P199	Motor Mount Bearing	1/28/2018	End Game	4	Rachel Benkovich	1/28/2018	y	Dave Vadas	Cameron Bradley	2/1/18	
P200	Lift Base Channel 36	1/30/2018	End Game	4	Ethan Pendelberry	2/6/2018	Yes	Roseanne	Joe McCusker	2/6/18	RB1+2 Done
P201	Lift Base Channel 32	1/30/2018	End Game	4	Ethan Pendelberry	2/6/2018	Y	Roseanne	Joe McCusker	2/6/18	
P202	Lift Base Channel 30	1/30/2018	End Game	4	Ethan Pendelberry	2/6/2018	Y	Roseanne	Joe McCusker	2/6/18	
P203	Lift Top Deck	1/30/2018	End Game	2	Ethan Pendelberry						
P204	Lift top Deck With Cutouts	1/30/2018	End Game	2	Ethan Pendelberry	2/6/2018	N				
P205	assembly)	1/30/2017	End Game	4	Rachel Benkovich	2/6/2018	y	Dave Vadas	Cameron Bradley	2/1/18	Robot 1 done

1511 BUILD SEASON

Shopping List:

	Requested Item	Part number	Quantity	Cost each	Cost extended	Supplier/hyperlink	Requestor	Justification	Mentor Review	Date Needed	Order By/Date	RX'd
McMaster-Carr						http://www.mcmaster.com/						
1/13/2018	Alloy Steel Shoulder Screw 8mm Diameter 45mm Long Shoulder, M6 x 1.0mm Thread	92981A250	6	$2.77	$16.62	http://www.mcmaster.com/	Julia Paille	Drivetrain Idler Part	Ben S	ASAP	Larry 1/15/2018	1/17/2018
1/20/2018	Oil-Embedded Flanged Sleeve Bearing	6338K413	18	$1.09	$19.62	https://www.mcmaster.com/#6338k413/=1b7kpm4	Andrew Fabrizi	Intake Pivot	Tom Cavaliere	1/27/2018	Larry 1/21/2018	1/23/18
1/20/2018	3/4"x1" 6061 Aluminum 3ft	8975K14	1	$17.40	$17.40	https://www.mcmaster.com/#8975k14/=1b7st93	Andrew Fabrizi	Intake Pivot	Tom Cavaliere	1/27/2018	Larry 1/21/2018	1/23/18
1/20/2018	3/4"x3/4"x1/16" Aluminum Tube 6ft	6546K52	2	$15.56	$31.12	https://www.mcmaster.com/#6546k52/=1b7sulg	Andrew Fabrizi	Intake Pivot	Tom Cavaliere	1/27/2018	Larry 1/21/2018	1/23/18
1/20/2018	1/2" Aluminum Shaft 6ft	9062K31	1	$35.81	$35.81	https://www.mcmaster.com/#9062k31/=1b7swsa	Andrew Fabrizi	Intake Pivot	Tom Cavaliere	1/27/2018	Larry 1/21/2018	1/23/18
1/29/2018	3/4" aluminum spacers	92510A767	16	$1.45	$23.20	https://www.mcmaster.com/#92510a767/=1bc7y6k	Matt D.	We could make these, but if okay, prefer precision of these (used in gripper hand between plates for spacing)	Roseanne	2/5	Larry 1/29/2018	1/30/18
1/29/2018	Steel Extension Springs 4" length 68.4 lbs/inch	9654K274	16	$6.54	$104.64	https://www.mcmaster.com/#9654k274/=1bc8i3z	Roseanne	Arm tensioner system (6 per robot plus some spares)	Roseanne	2/5	Larry 1/29/2018	1/30/18
1/28	Fast-Acting pressure relief valve **125 PSI version**	48435K714	2	$5.26	$10.52	https://www.mcmaster.com/#48435k71/=1bbtac2	Jeff	Relief valve for pneumatics	Dave	By Robot 1 start assembly	Larry 1/28/2018	1/30/18
2/1/2018	Linear Motion Shaft, Ceramic-Coated 6061 Aluminum, 3/8" Diameter, 48" Long	1031K78	2	$35.81	$71.62	https://www.mcmaster.com/#aluminum-rods/=1bdzkwo		Lift Jack	Dave V.		Larry 2/1/2018	2/6/18
2/1/2018	Lead Screw Nut 3/8-10	95072A127	6	$24.95	$149.70	https://www.mcmaster.com/#95072A127	Tai Little	Lift Jack	Dave V.		Larry 2/1/2018	2/6/18
2/1/2018	Lead Screw Clamp Collar (024 Aluminum Shaft Diameter 3/8" OD 7/8" Width 3/8" Clamping Screw Socket Head)	6436K133	18	$5.22	$93.96	https://www.mcmaster.com/#6436k133/=1bdspy0	Tai Little	Lift Jack	Dave V.		Larry 2/1/2018	2/6/18
2/1/2018	Lead Screw Die Spring (Blue Closed and Flat 1" OD 0.5" ID Length 6" Wire 0.100" Width 0.215" Flat Compressed 3.6" Maximum Deflection 40% Maximum Load 192 lbs. Load Rating Medium Deflection 25% @ 120 lbs. Rate 80 lbs./in.)	9573K61	4	$10.82	$43.28	https://www.mcmaster.com/#9573K61	Tai Little	Lift Jack	Dave V.		Larry 2/1/2018	2/6/18
2/3/2018	Surface-Mount Hinge, Self-Closing, Unfinished Steel, 5" x 1" Door Leaf	15205A12	1	$4.90	$4.90		Larry	Ramp Deployment	Roseanne		Larry 2/3/2018	2/6/18
2/3/2018	Surface-Mount Hinge, Self-Opening, Unfinished Steel, 5" x 1" Door Leaf	15205A78	1	$4.90	$4.90		Larry	Ramp Deployment	Roseanne		Larry 2/3/2018	2/6/18
2/1/2018	Jack Shoulder Screw	91259A175	40	$1.98	$79.20	https://www.mcmaster.com/#91259A175	Tai Little	Lift Jack	Dave V.		Larry 2/1/2018	2/6/18
2/1	Lead Screw 6 ft long bars	98940A010	4	$63.08	$252.32	https://www.mcmaster.com/#98940A010	Tai Little	Lift Jack	Dave V.		Larry 2/1/2018	2/6/18

Needed | Ordered | Received | 2018 Reference | 2017 (Summer) Reference | 2017 (Build) Reference | 2016 Reference | 2015 Reference | 2014 Reference | 2013 reference

1511 BUILD SEASON

CAD Protocols:

1511 Inventor Protocols

BEFORE YOU BEGIN:

HAVE PAPER AND PENCIL WITH YOU TO BE ABLE TO SKETCH, AND FOR MENTORS HELPING YOU WITH SKETCHES

REMEMBER THAT TEDIOUS SET UP STEPS ARE IMPORTANT FOR SAVING TIME AND EFFORT LATER

REMEMBER ANYONE CAN SEE THESE FILES AND WE SOMETIMES SUBMIT THEM TO FIRST AND OTHER TEAMS – DO NOT USE WEIRD OR INAPPROPRIATE LANGUAGE TO NAME THINGS.

THIS IS NOT THE TIME TO BE AN INDIVIDUAL – THIS IS THE TIME TO BE PART OF AN EFFICIENT DESIGN TEAM – DO NOT DO THINGS "YOUR WAY" IF A DIFFERENT WAY HAS BEEN REQUESTED – OTHER PEOPLE WILL NEED TO WORK WITH YOUR FILES.

SAVE ABSOLUTELY **NOTHING** TO YOUR OWN DRIVE SPACE – EVERYTHING GOES ON THE HARRIS DRIVE OR ON GOOGLEDOCS (WHERE APPROPRIATE). IF YOU CANNOT LOG ON TO THE HARRIS DRIVE – LET MR. BREWER KNOW AS SOON AS POSSIBLE!

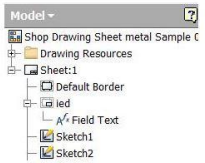
Starting Any Part:

A. Go to [redacted] **2017 / 2017 Build Season** and list your part or Assembly on the 2017 Part & Assembly File Log:
   1. Go to Google and click on "DRIVE" (just like clicking on "GMAIL"). It looks like a triangle.
   2. Email = [redacted]
   3. Password = [redacted]
   4. Find the 2017 folder – if you don't see it click on "My Drive" on the left and it should appear.
   5. Click on the **2017 Build Season** folder.
   6. Click on the **2017 Parts & Assembly File Log.**
   7. Click on **Parts List** tab or **Assembly List** tab depending on what you are doing.
   8. Use the next available line and number. Fill in applicable columns – leave blank columns where you do not have the info yet.

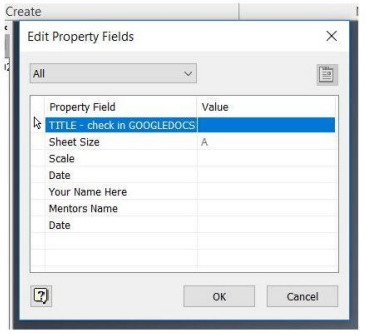
B. Sheet Metal file set up:
   1. Open Inventor
   2. **Open** file **Sheet Metal Starting Point.ipt** and immediately **SAVE AS** your part using the same number and name in you used in the parts log. Save it in the appropriate **2017 Build Season (ROBOT)** folder!!

Making a Sheet Metal Part Shop Drawing:

A. Let's make a Shop Drawing for Harris. Note – this info is also on the WIKI!
   1. We start by opening the template file.
      a) From Inventor, click **Open** and go to **2017/01 Build Season/10 Shop Drawings**.
      b) Select **Shop Drawing Template.idw** and click **Open**.
      c) IMMEDIATELY **Save As** and save the file in **2017/01 Build Season/10 Shop Drawings**.
         1) Name your file the part number and name from the **2017 Parts & Assembly File Log**.
         2) IF YOU FORGET TO DO THIS STEP, YOUR FILE WILL BE OVERWRITTEN OR DELETED BY THE NEXT PERSON TO USE THE TEMPLATE FILE!!
   2. The writing in the upper right corner of the sheet is for tracking the part in the shop during fabrication, so we can ignore it at this time.
   3. Fill in the Title Block:
      a) Expand "**ied**" in the browser under the **Sheet 1** tree.
      b) Double click on **Field Text** or Right click on **Field Text** and select **Edit Field Text**. You will get a pop-up with all of the boxes in the title block. Enter the appropriate information to the extent you can.



         1) **Title** is the part number and name from the **2017 Parts & Assembly File Log**.
         2) **Sheet Size** is already set as A – there will be rare occasions when you need to change this but this is typical.
         3) **Scale** should be 1:1 unless the part if too large to fit. If so, fill in the scale of your views. If there are multiple views on the sheet that have different scales, "**Varies**" or "**As Noted**" should be used.
         4) **Date** should be the current date it is being worked on.



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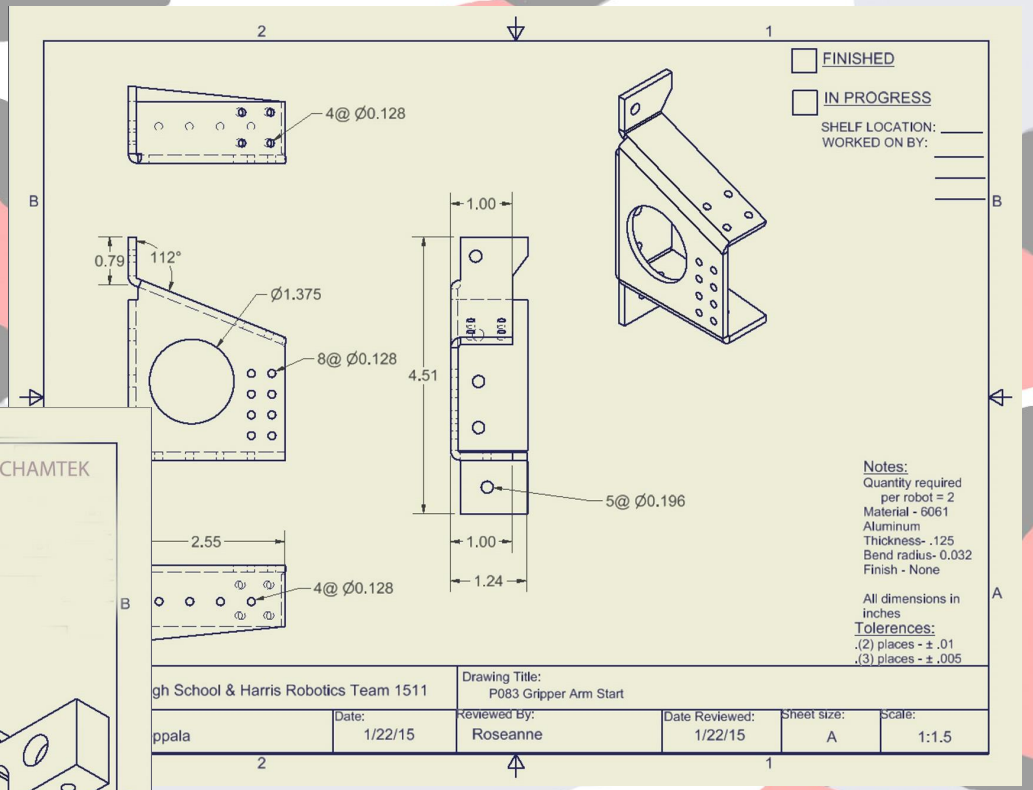

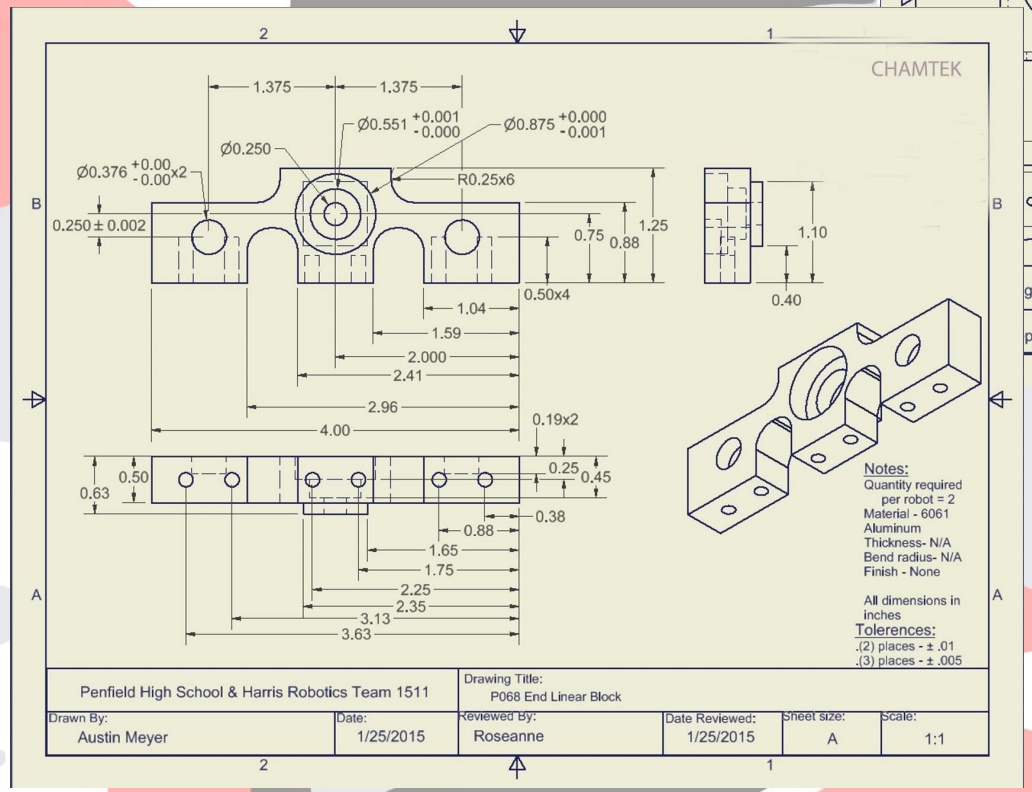

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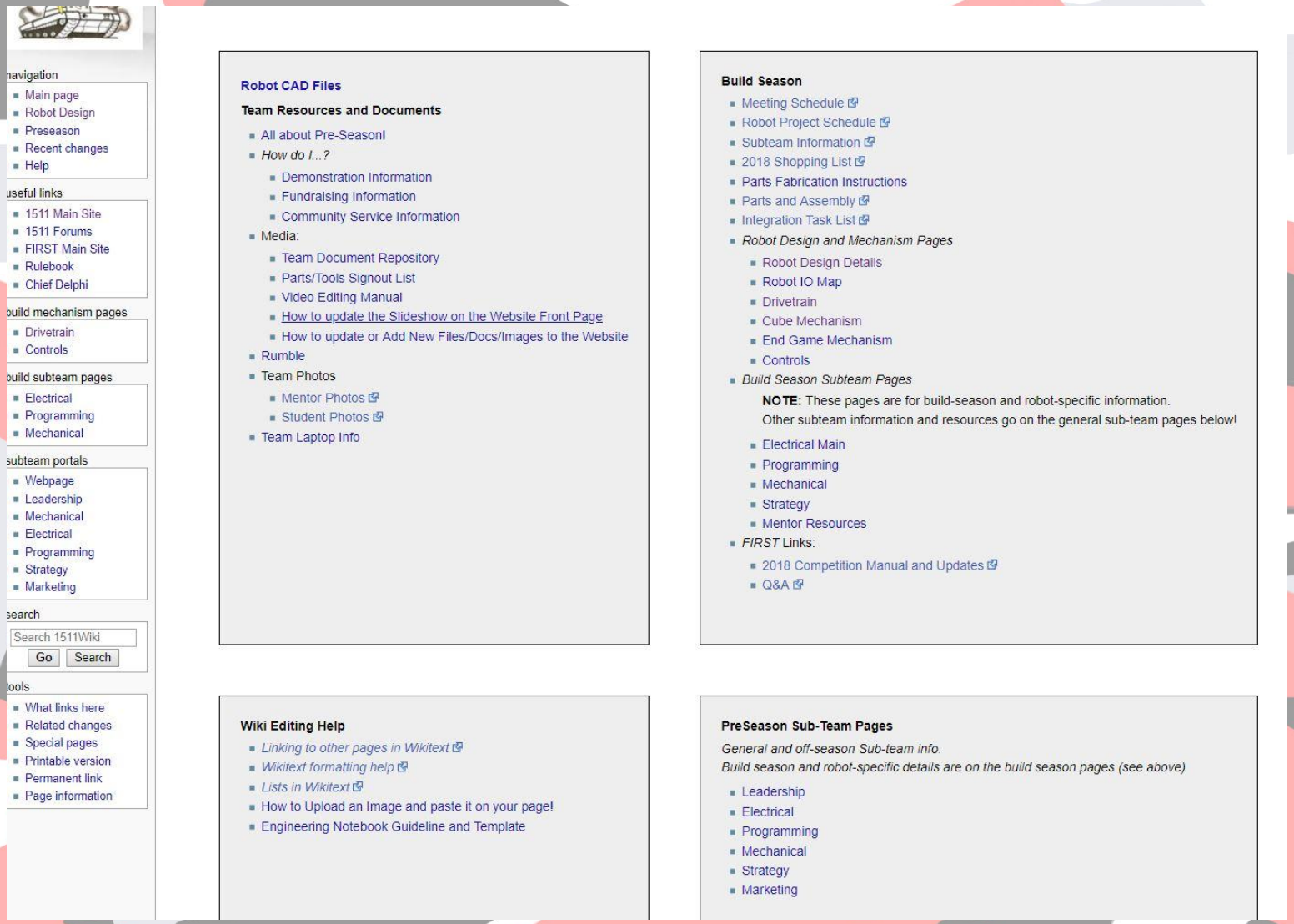
WIKI:



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Robot CAD Files

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Build Season
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- Subteam Information
- 2018 Shopping List
- Parts Fabrication Instructions
- Parts and Assembly
- Integration Task List
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  - Robot IO Map
  - Drivetrain
  - Cube Mechanism
  - End Game Mechanism
  - Controls
- *Build Season Subteam Pages*

  NOTE: These pages are for build-season and robot-specific information.
  Other subteam information and resources go on the general sub-team pages below!
  - Electrical Main
  - Programming
  - Mechanical
  - Strategy
  - Mentor Resources
- *FIRST* Links:
  - 2018 Competition Manual and Updates
  - Q&A

Wiki Editing Help
- *Linking to other pages in Wikitext*
- *Wikitext formatting help*
- *Lists in Wikitext*
- How to Upload an Image and paste it on your page!
- Engineering Notebook Guideline and Template

PreSeason Sub-Team Pages

General and off-season Sub-team info.
Build season and robot-specific details are on the build season pages (see above)
- Leadership
- Electrical
- Programming
- Mechanical
- Strategy
- Marketing

1511 BUILD SEASON

Actuators

This is preliminary and subject to change!

Motors

Mechanism	Action	*Minimum* Breaker Size	Motor Model #	Quantity	Notes
Intake	Grabs the cube and puts it in the hand	30A	775 Pro	2 - one left, one right	15"1 gear ratio - 5:1 and 3:1 in versa planetary gearbox
Arm	Pivots arm to robot/front back	30A	775 pro	1	50:1 gear ratio: 5:1, 5:1 in versa planetary, 18T timing pulley on motor, 36T timing pulley on axle. If belt fails, wil chane to 15T sprocket on motor, 32T sprocket on axle.
Hand	holds the cube as it moves around the robot and deploys the cube	30A	775 pro	1	Starting ration will be16:1 - (2) 4:1 in the versa panetary gearbox.
Lift/Ramp	Lifts the ramp/platform with another team's robots on top	30A	775 pro	4, 2 per lift	2 Lift systems (jacks) per ramp, 1 motor on each
Drive Base	Moves the robot	40A	CIM	6 (dropped to 4)	Gear ratio 14:64

Pneumatics

Mechanism	Action - Say what extend and retract do!	Cylinder	Extend Powered?	Extend Exhaust to Atmosphere?	Retract Powered?	Retract Exhaust to Atmosphere?	Working Pressure	Estimated Firings per Match (Sum of all powered directions!)	Notes
Intake	Extend = raise intake into robot Retract = lower intake to retrieve cubes	Bimba M-044-DP. Magnetic 3/4" bore 4" stroke, pivot mount	Yes	Yes	Yes	Yes	60 PSI	40	Assumes a defensive game (retract to prevent damage) RB1 on order RB2 on shelf
Arm Brake	Extend (spring loaded extension) = disengage brake Retract = Engage brake	Bimba 041-D. 3/4" bore 1" stroke	No	Yes	Yes	Yes	60 PSI	40 *(Review comment: Would expect this to be greater than # of intake firings even under severe defense due to uncertainty of how to use cube and putting in "up" position for any substantial movement)*	2 cubes auto, 8 cubes vault, 8-10 cubes switch @ 2 x per cube Rb1 & RB2 on shelf
Hand on Arm	Retract = "close" hand, tighten on cube Extend = "open" hand, loosen grip on cube	Bimba 042-D. 3/4" bore 2" stroke	No	Yes	Yes	Yes	?? PSI - 60 may be too high	20 *(Review comment: Thought the plan was this does not fire at all and acts as an "air spring"?)*	2 cubes auto, 8 cubes vault, 8-10 cubes switch RB1 & RB2 on shelf
Lifts/Ramps (One cylinder per platform/ramp but they are plumbed together on same solenoid)	Hold/Release ramp system. Extend = hold ramps up Retract = release ramps to ground level	Bimba 061.5-DXDE 7/8" bore, 1.5" stroke Double acting, double ended	Yes	Yes	Yes	Yes	60 PSI	1	Starts match under pressure Modifying mounting to use 3/4" bore, 2" stroke double acting on hand. Will cut off 1/4" pf threaded end and grind down remaining threads. RB1 & RB2 on shelf. Consider we may not need to start match under pressure - all loads lateral.

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Sensor Chart

Mechanism	Sensor Type	Function	Attachment Point	Notes
Intake	Magnetic reed switches (2) on pivot cylinder	Senses when cylinder has completed up and down motion	On cylinder	
Arm	Potentiometer	Absolute rotation position of arm.	On actual pivot/shaft.	
Arm	Limit Switch	Tripped at end of travel/at hard stop on **front** of robot	Left side A-frame top front	
Arm	Limit Switch	Tripped at end of travel/at hard stop on **back** of robot	Left side A-frame top back	
Hand on Arm	Retro-reflective beam sensor	Sense cube **all the way into** hand	Mounting is important! Must look "sideways" at the cube where it hits the backstop.	
Ramp	Integrated Versa Planetary Encoder	Sense travel and speed of lead screw on lift jacks One phase	4 total, 1 on each jack - Sensor should be at output stage of each gearbox	
Ramp	To be Determined	Sense when ramp jacks are fully reset (not used during match)	4 total, 1 on each jack - ADD MOUNTING DETAILS ONCE SENSOR IS KNOWN	
Drive	Shaft encoders	Travel of robot drive base. **One phase**	On center (traction) wheel shaft.	
Whole robot	Gyro	Sense rotation	**Must be center of rotation of robot** away from excessive vibration sources	
Whole robot	Camera	Visual feedback for lining up with exchange? MS LifeCam HD USB camera	On the back left corner of the robot in the area set aside in cad	

1511 BUILD SEASON

To Wrap Up:

- **Stay organized.**
- **Stay on schedule.**
- **Stay firm in your decisions – no matter how much extra time you take to make the design perfect, it WILL NOT work as intended the first time out. And you will have lost coding time (they can't test their code until they have a robot) and driver practice time!!!!**
- **Stay flexible – be willing to shift people resources around when needed or modify the schedule – because STUFF HAPPENS!**
- **Focus on the positive – don't focus on what was not done right, focus on moving forward and appreciating what has been achieved.**
- **Remember, although we are structuring this like an actual company project build, there is one really big difference: Everyone is a volunteer. If you cannot get buy-in to the process they will just ignore it or not show up. Always be building consensus!**

THANK YOU