Rick Hansen Robotics

Robot Playbook

2019 SEASON

THEORY6
FIRST TEAM 1241

1285 THE BIG BANG

Revision Block

Revision	Changes Made	Date Revised	Revised By
1.0	Initial Draft	Nov 25, 2015	Thuvishan R.
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Table of Contents

1.0 Introduction

The purpose of this document is to provide an overall understanding of the Rick Hansen Robotics design process pertaining to designing and building a robot for the FIRST Robotics Competition. This document highlights all important steps to be taken, gives a suggested timeline to complete these steps, and provides guidance on how each these steps should be carried out.

In each part of the design process, there are several best practices that have been developed over years of experience by the team. Some of these best practices have been highlighted throughout this document.

This document is to be used during the build season as a guide on how the robot should be designed and built. However, this document is simply a supplement to all other documents that may contain any technical information that may be required to design and build the robot itself. This document does not replace any reference documents, tutorials or workshops that may still be required to design and build an FRC robot.

2.0 Kickoff Weekend

FRC releases the game and competition for the respective year; usually on the first Saturday of January. This event is known as Kickoff. Kickoff involves watching a video that FRC releases depicting how the game for that year is to be played. FRC also releases several related documents such as the Game Manual. These documents give participating teams an idea of the rules and regulations pertaining to the field, game, and robot. Adhering to these rules and regulations helps the team understand the game and build a robot that complies with these rules.

The purpose of Kickoff weekend is to thoroughly analyze the game and to visualize how the team's robot will navigate on the field and perform all the tasks that the team agrees to. The team will also start brainstorming some preliminary design ideas for the robot and agree on which ideas to prototype in the coming week.

2.1 Kickoff Weekend Outline (Jan 5 – 6)

2.1.1 Saturday - Kickoff and Strategy Meeting Objectives

On Kickoff Saturday the following are the objectives for the team:

1. Read all Game documents and thoroughly analyze and understand the objectives of the game
2. List all possible Autonomous and Tele-operated Strategies. Hypothesize reasonable strategies for both teams
3. List all possible robot movements required to achieve the above discussed strategies
4. Determine which robot movements are absolutely required by the robot design

2.1.2 Saturday - Must Do's

Here are the trips and tricks for Saturday:

1. Try and keep everyone focused on the task at hand and stick to the allotted time
2. While selecting feasible strategies for the team, stick to the simplest possible method of achieving that strategy
3. Try and incorporate human intervention as much as possible while selecting feasible strategies
4. Try to find comparisons between past years with similar game pieces, and time needed to complete each action
5. Create a visual reference of the field with collection points. Have a human demo this
6. Use spreadsheets with embedded calculations to determine action times
7. Everyone must understand and agree on the selected role to play by the end of Saturday
8. While selecting requirements, make sure that they are easy to design and do not require too many additional subsystems
    a. Ideal number of subsystems is 4: Drivetrain, Intake, Tool and Endgame
9. Have chart paper ready with a pre-determined template so that the notes are organized and can be compiled easily
10. Obtain permits on Kickoff weekend for both Saturday and Sunday in order to have an efficient workspace

2.1.3 Saturday Schedule - Kickoff and Strategy Meeting

8:30am	Some students/mentors from all teams meet at Ontario Science Center or Quick Build
9:30am	Students meet at Rick Hansen Secondary School to watch the Kickoff stream
12:00 - 12:45pm	Lunch Obtain Kit of Parts and head to Rick Hansen Secondary School. Start reading Game Manual. This may be delayed if the Science Center presentation is extended
12:45 - 2:15pm	Inventory of both kits (1241 & 1285) Divide into 5 groups (Leads: TBD) Read Game Manual (this will start earlier as well, right after kickoff) • If possible, print out multiple copies of the Game Manual • Read Game, Tournament, Robot and Arena sections OUT LOUD • Create a summary sheet of all the key rules for this year's game as a quick reference • Every rule should be read and understood by all members present • Any questions should be listed to be asked in the Q/A
2:15 - 2:30pm	Break

2:30 - 4:00pm	Detailed Scoring Analysis and Strategy (Lead Students/Drive Team)
	
	Tele-operated Mode:
	• Create a visual reference of the field with collection points. Have a human demo them
	• Note Tele-Operated Mode time limit (minus end game)
	• Make a Tele-Operated scoring chart
	  ○ List scoring scheme
	  ○ List ALL penalties and associated points
	• Scoring Analysis:
	  ○ List theoretical maximum score during Tele-Operated mode
	  ○ List reasonable score during Tele-Operated mode
	  ○ List any special scoring circumstances or scenarios (e.g., do game pieces de-scored/stuck still count?)
	• List any conditions that affect seeding position (e.g., does difficulty of the match matter?)

2:30 - 4:00pm

- Robot Movements:
  - List ALL robot movements possible
  - Rank ALL robot movements in terms of priorities
  - List ALL combinational activities (more than one movement at a time)
  - List ALL defensive strategies
  - List ALL ways you can make the opponent commit penalties

Autonomous Mode:

- Note Autonomous time limit
- Note if human intervention is allowed (Hybrid Mode)
- Note starting position of robot
- Note the number of game pieces and their starting positions
- Make an autonomous scoring chart
- List ALL possible autonomous routines possible
- Rank ALL possible autonomous routines from easiest to most difficult (prioritize which routes you absolutely need vs. which you like to have)
  - Have a human demo the autonomous routines
- Determine maximum autonomous scoring possible within time limit
- Go through autonomous routines again and try to shave time for the next hypothetical level of auto scoring
  - e.g., One more power cube in 2018 Power-Up

End-Game:

- List time when end-game scenario should be initiated
- Make end game scoring chart
- List maximum score possible (qualifying and elimination rounds)
- List any conditions that help with seeding position

Einstein Tie Breakers:

- Go through Tele-Operated Actions and Autonomous modes and optimize for Einstein Tie Breakers
  - e.g., Hang points in 2018 Power-Up

4:00 - 5:00pm

Requirements/Preferences (MUST BE COMPLETED):

The goal of this portion is to clearly outline:

- All required goals for the robot, and preferred goals
- List must be approved and checked by lead students and mentors

8:00pm	Update people who attended Quick Build • Show required/preferred list, and game strategy for Autonomous, Tele-op, and Endgame • Preliminary drive-base configuration discussion (as much as possible) Requirements get split up into the following categories: • Intake/Game Piece Possession, Tool, Drive Train, Endgame

2.2 Kickoff Sunday Brainstorming Objectives

2.2.1 Sunday - Design Objectives and Must Do's

Here are the trips and tricks for Sunday:

1. Try and keep everyone focused on the task at hand and stick to the allotted time
2. Refine Drivetrain design
3. Take the concept chosen in brainstorming session and start deciding key parameters, materials and shapes for each of the parts for prototypes
4. Perform preliminary engineering calculations
5. Start developing basic 2D and 3D CAD models of prototypes
6. 1285 must complete their parametric study/ prototype design for intake/game piece possession category
7. Ensure any task/objective that requires obtaining a game piece is touch and go. (meaning it should be motor driven and either be in taken over the bumpers or through an opening in the chassis)
8. Keep style of scoring in mind when conceptualizing designs (e.g., Pick and place or shooting)
9. While selecting requirements, make sure that they are easy to design and do not require too many additional subsystems
    a. Ideal number of subsystems is 4: Drivetrain, Intake, Tool and Endgame

2.2.2 Sunday Schedule - Brainstorming Session

9:00 - 9:45am

Students/Mentors meet at location for discussing strategy/requirements list created from previous night

- List MUST be finalized and agreed upon by all lead students and mentors. This determines how robot design discussions take place today

9:45 - 10:30am

Introduce mentors/leads from each section

Play Kickoff Video

All the decisions from Saturday get presented

The following will be presented:

- Autonomous Strategy
- Tele-Operated Strategy
- End Game Strategy

15 minutes at the end of this meeting will be spent playing around with the game pieces to get a feel for the objects

10:30am - 12:30pm

Students/mentors are split into their respective teams (1241 & 1285) to discuss intake, tool and end game design. Drivetrain discussion can be optional depending on game field. All team members are encouraged to participate and provide ideas.

- 20 - 30 minutes is allocated per category for both brainstorming and discussion

Every member should present their ideas, and responses would be recorded as part of a complete list

12:30 - 1:00pm

Lunch

1:00 - 2:30pm

Mentors/lead students will discuss the presented designs for each category. The student group will rank each design by listing the advantages and disadvantages for each design **(45 Minutes)**

- Obvious choices should be eliminated quickly, and if decision between 2 designs is not made, both designs may move on to prototyping phase **(45 Minutes)**

2:30 - 4:00pm	Detailed decisions and plan of action for Week 1 must be completed (deciding on Prototype CAD model completion date, and prototype build/testing days) • Each category prototype will have a set of variables to be tested, while also making sure requirements can be met
4:00 - 5:00 pm	Mentor Meeting/Drivetrain detailed design • Discuss build schedule and availability of mentors • Create detailed design for drivetrain for all parameters including wheel configuration, gearbox, and overall size (with students)
5:00m - 7:00 pm	• Everyone leaves the school, lead mentors, and key lead students head out to start work on parametric studies/Physics Models/CAD models are to be started for each prototype. These prototypes must include detailed information/flexibility in order to test all variables • Parametrics made - outline every position on the field that robot will be in (including bumpers)

3.0 Week 1 Prototyping

3.1 Week 1 Objectives

- Prototyping is when the initial designs are tested for effectiveness and feasibility in real life
- Making an effective plan on what to prototype is crucial so that you can go in knowing what needs to be prototyped and not waste time on prototyping every possible idea
- Make sure to prototype possible variables that can only be tested to avoid doing them in the design phase. Make a list of these variables before beginning prototyping so the goals are clear
    - i.e., pinch, force of puncher, strength of catapult

3.2 Prototyping
Week 1 Monday – Wednesday (Jan 7 – 9)

- NO MANUFACTURING/BUILDING OF ANY PROTOTYPES ON THESE TWO DAYS
- Continuous CAD design of prototypes for systems decided
- Prototype must be powered and include critical sensors. It should also reflect the final design intent. Wood is preferred, but metal can be used if needed. Plastic can also be used
- Test process for prototype must also be created, and reflective of questions to be answered
- Tuesday: for any subsystems requiring multiple prototypes (e.g., catapult vs wheeled shooter), only one will be built during next few days. All other prototypes will be eliminated

3.2.1 Prototyping
Week 1 Wednesday – Friday (Jan 9 – 11)

- Design team will be paired with mechanical students to build prototypes based on designs created and decided upon on Tuesday
- Continue to question all the variables to be tested, and keep in mind number of mechanical components required. Keep note of any components that would change significantly on final design (e.g., linear sliders vs bearings)
- Testing spreadsheet should be developed. Criteria matrix for configuration choice should be made (e.g., 2-wheel vs 4-wheel intake, etc.) **(Appoint Student/Mentor to be in charge)**
- **Goals:**
    - Modular design, determine exact geometry of what the final CAD can be
    - Determining where the system is powered from and how, be it motor powered or passive. (Coil springs/Gas struts)
    - Mounting positions
    - Prototype MUST REFLECT what the final design will be. Power system should be identical, MAJOR CHANGE IS NOT ALLOWED
    - END OF FRIDAY ALL PROTOTYPES SHOULD BE BUILT WITH ROBUSTNESS AND QUALITY TO ENSURE NEAR REPLICATION ONTO THE COMPETITION ROBOT
    - Videos of successful prototypes' testing should be recorded and saved/archived

3.2.2 Prototyping/Integration
Week 1 Saturday – Sunday (Jan 12 – 13)

- *Saturday Morning:* Continued testing and refinement of the prototypes in order to improve their performance
- *Saturday Afternoon:* Physical integration of prototypes and obtaining an overall picture of the final robot design. If possible, all prototypes should be mounted onto a chassis in order to see how game piece interaction takes place between mechanisms
- *Sunday Morning:* Continued integration of prototypes
    - Questions for dimensions and problems during actual design should be answered
        - Integration/interference issues
    - Capabilities and room for improvement should be outlined
        - Reestablish strategic requirements and ensure we have met them
    - Determine parts to be ordered
- *Sunday Afternoon:* Final Robot design starts. If possible, have at least 3 - 4 hours of design work completed before this day ends
    - Drivetrain design should be completed by this time in order to start manufacturing on Monday
    - Videos of integrated prototype should be recorded and saved/archived
    - IF A PROTOTYPE DOES NOT WORK AS INTENDED, continue prototyping until successful
        - e.g., 2018 Intake, 2016 Shooter

3.2.3 Controls and Preliminary Code
Week 1 Saturday – Week 3 Tuesday (Jan 12 – 22)

- As final robot design starts, determine what sensors should be used for a specific system on the robot
- Once the final design has been chosen it is time to start writing pseudocode for how the robot is going to work, and how autonomous is going to work
    - Class diagrams should be used to setup templates for various subsystems on the robot. Each diagram should clearly show general descriptions of methods and variables. While using arrows to connect diagrams together to show how a class interacts with one another
    - A built partial field is an excellent way to envision the autonomous in relation to the field
- Working with the design team to integrate sensors and other controls components in can also be very useful as integration will be part of design and not an after-thought
- Once motors, pneumatics, and any other components that are needed to make the robot work are finalized, base code programming may start
- This will make it possible to have most of the code ready once the robot is built and all that needs to be done is to add on or modify the base code for Tele-op
- Keep most complex prototype system intact with sensors so programming people can play

4.0 CAD and Design

4.1 Week 1 Sunday – Week 2 Thursday (Jan 13 – 17)

- One week of CAD and design is crucial for a guarantee to have a successful robot
- CAD design should be completed by Thursday of this week in order to leave Friday/Saturday for drawings
- Midweek review will take place on Wednesday in order to reflect on any major problems, interference issues, or any conceptual questions. This review will also take place on Saturday while drawings are being created (Design and Strategy Mentors)
- Updates on Slack must be created every day, including pictures in the build blog
- Upload pictures and video into a Google Drive Folder
- Order for parts should be placed on Thursday in order to ship Friday, if it cannot be completed then Sunday evening, parts will be ordered

4.2 Week 2 Friday – Week 2 Saturday (Jan 18 – 19)

- If Friday needs to be a late night to meet the Saturday deadline, then designers must stay late, or at someone's house. Design will be locked on Saturday
- Drive-train subteam must move ahead and begin manufacturing if possible
- Aesthetics, lexan, and sponsor displays must all be completed as well
- Updates on Slack must be created every day, including pictures in the build blog
- Upload pictures and video into a Google Drive Folder

4.3 Week 2 Sunday – Final Design Review (Jan 20)

- Final design review will take place on Sunday Morning, with a design presentation created by the team. All major stakeholders including sponsors will be invited to this presentation
- **Goals:**
    - Organization of parts within the classroom needs to be completed
    - Zones with totes for drawing locations/zip lock bags/zip ties should be allocated
    - Order for manufacturing parts with timelines should be determined
    - Determine allocation of CNC between 1241 and 1285 throughout the next two weeks
    - Complete order list for parts and materials should be ordered before leaving. Each subgroup needs to make their own full order list to be approved by eng. lead
    - DXFs of the cad for CNC machining need to be done
    - MAKE THE FIELD ELEMENTS REALISTIC INCLUDING SPRINGS
    - ANY JIGS for manufacturing need to be designed, especially to hold complex pieces like sprockets or gears and extrusion for lightening

4.3.1 Design Tips and Tricks

- Follow team standards when it comes to:
    - 3 thou added to center to center distance for belts
    - 12 thou added to center to center distance for chain
    - 3 thou added to center to center for gears to ensure proper meshing
    - Retaining Ring Groove ½" Shaft: 0.468" DIA, or 0.016" depth, 0.040" width, outer edge of groove placed 0.060" from shaft end face
    - Round hex shaft end face to allow for easy access to retaining clips
    - Bearing blocks should have clearance fit into mounting holes on chassis
    - Most common bolt used should be 10/24 – socket head cap screws.
    - Bearing holes are to be 1.125" diameter with a new cutter *to be tested
    - 3/16" plates and gussets where possible
- Design for 100lbs, exceptions would be at the discretion of the lead design team
- Design the simplest solution that achieves all desired tasks in fastest way possible
- Decide on and control the LEAST number of variables to accomplish the given task (e.g., For shooting games- Shot positions, Hood Angle, Angular Velocity)
- For objects that only need to be orientated in two positions, use pneumatics (e.g., Up-righting containers)
- Use omni wheels to improve turning when necessary
- Sensor feedback at every joint of a linkage system, shooters require rotational speed to be tracked. Use optical sensors or Mag encoders for high speed shooters
- Take away as much load from the motor by using gas struts/coil springs when lifting heavy objects
- Intakes should spin faster than your drive train in order to grab objects while moving backwards and forwards.
- Never use pliable plastic for gearbox plates. They tend to separate gears over time
- Uniqueness is insignificant. Being the fastest, even if similar to others, is more important
- Design for possible flaws in field elements that may affect your robot's performance, only for the specified field tolerances detailed in the manual
- When designing with pneumatics, always design for further actuation if the mechanism is going to compress against a solid object
- Always check for interference with mounting and other hardware in CAD before manufacturing. Such things are easy to miss including interference with nuts or pneumatics fittings
- Surgical tubing/elastic bands have an exponential wear over time be weary when designing using them. Coil springs are a more consistent solution
- Have external eyes critique your design so that you minimize risk of failure
- Check all geometry in CAD through parametric studies before starting to 3D model
- Poly Cord isn't ideal compared to V belts or timing belts when trying to move objects through the robot. Belts should not be used to funnel objects

- Drive gearbox plates should have independent motor mounting holes while having proper clearances to access all the screws to allow for ease of maintenance
- When designing mounting holes, consider assembly process (e.g., Rivet holes in a corner)
- Design a proper center to center spacing for sprockets to allow for an even number of links
- When using pneumatics extension of cylinder provides more force when compared to retracting due to surface area available within the cylinder
- When designing an elevator carriage, bearings should be on the outside edges of the extrusion and not riding on the center of the tower
- Do NOT use nylon strap for cable routing on pulleys for elevators
- #35 Chain > 15mm Belts > #25 Chain for drivetrain. #35 chain for pneumatic wheels or wheels above 6" diameter is highly recommended. Due to the intense play for district system, we will be choosing #35 chain for drive for durability purposes
- Figure out degrees of freedom required to control for bracing
    - x, y, z axis (e.g., Elevator carriage riding up and down slider)
- For pick and place games, be able to let go of game piece without out taking. Also make sure that game piece is able to be held while driving. For irregular objects clamp with rollers
- If you can complete multi-axis machining on plates to eliminate extrusions, then complete it
- Electrical accessibility takes precedence
- Drive encoders placed on middle wheels

5.0 Manufacturing

Week 3 Monday – Week 4 Sunday (Jan 21 – Feb 3)

- Manufacturing starts as soon as design is finalized in CAD to avoid any errors
- If portions of design are completed earlier than foreseen, then those subsystems may begin the manufacturing process ahead of time. Manufacturing must prioritize the build schedule based on the schedule created on Sunday
- All manufactured parts must stay organized and accounted for. In plastic bags along with the working copy of the technical drawing
- As for CNC parts, DXFs must be made from the 3D model to be manufactured
- Keep manufacturing spreadsheet and drawings binder updated

5.1.1 Manufacturing Must Do's

- Whenever possible, limit the number of lightening holes on the drive train to simplify the manufacturing process
- Prioritize the order of which components are made, first ensure that all efforts are focusing around building two of each part starting with. Gearboxes, drive train, intake, tool and then endgame
- When considering lightening holes, circles are quicker and more efficient than any other pattern (i.e., diamonds and triangles)

- When large amounts of stress aren't being applied to the belly pan, it's ok to go with a polycarbonate plate as long as it's properly supported and is preventing sag. Aluminum corner gussets must be on bottom of chassis, as well as top, for strength purposes
- Having students in charge of documenting the Prototyping/Design/Build and testing of the robot is critical in engaging the entire team
- Organize parts that are ready to be assembled with a designated part drawing, with small parts placed in zip lock bags
- Each part drawing should be printed twice. One is placed in the design binder the other attached with the part to be manufactured
- Drawings for some CNC parts may be necessary if small differences are not easily spotted (i.e., different spacing for mounting holes)
- Bumper material on practice robot must be same as competition robot
- Record footage of parts being manufactured and team members of all subgroups at work

6.0 Assembly and Testing

Week 3 Thursday – Week 5 Wednesday (Jan 24 – Feb 6)

- Make sure all the parts are laid out before the start of assembly
- Ensure that the designer is present and reference the CAD to ensure the proper order when assembling components
- Ensure squares, alignment tools, and c-clamps are used to properly align components during assembly
- Measure all parts before assembling. If measurement is incorrect, then remanufacture the part (e.g., standoffs shouldn't be bigger or smaller than designed size). HAVE A NEW QUALITY CONTROL PERSON TO CHECK PARTS
- Notice any problems with assembly methods (e.g., Clearance issues/interference issues)
- If any issues are present from CNCing parts, talk to Mr. Lehman (Lead Teacher) (e.g., Gearbox plates not cut identically, bearing holes undersized)
- Record pictures and footage of assembly (e.g., Time lapse if resources are available)

7.0 Electrical

Week 4 Sunday – Week 5 Wednesday (Feb 3 – 6)

- The wiring and controls of the robot starts as soon as the drivetrain is complete. This must be done quickly as nothing else can be assembled until the full robot is wired
- RoboRIO must be insulated from any metal to avoid any shorting issues
- Make sure to wire everything as neatly as possible as it makes it much easier to trace problems or issues
- Create a map showing which components are wired together and to which ports

- Label wires at each end to make troubleshooting easier
- 12 AWG wires should be used for CIMs and mini CIMs
- 16 AWG wires should be used for bag motors or motors with similar current draw
- 18 AWG wires should be used for providing power to roboRIO, PCM, VRM and other electrical components
- All wire ends of PWMs and like connections should be covered with heat shrink to ensure wires will not break at the housings
- Try to avoid soldering wires that will be used for high load applications. Every bit of resistance can affect performance
- If possible, router needs to be mounted using a proper mount and placed highest point on robot
- Record pictures and footage of electrical wiring, lights, etc. (short time lapse if resources are available)

8.0 Iterations

Week 5 Thursday – Sunday (Feb 7 – 10)

- You will always need to iterate designs throughout the season
- Feasible solutions MUST be completed by week 5 Sunday. The iterations shouldn't go past the set date
- At this point, the competition robot should be finished in terms of manufacturing, and practice robot should be well on its way towards competition
- WEIGHT REDUCTIONS, LIFE CYCLE TESTING, and TELE OP TESTING are all forms of Iteration Practices
- Record practice robot footage (parts of storyboard that fit) as backup

9.0 Final Coding

Week 5 Friday – Week 6 Wednesday (Feb 8 – 13)

- Now that the practice robot is fully complete, the code for Tele-op can be polished or modified with the competition robot
- Competition robot must completed by this time as well so that there is no delay in terms of transitioning from competition robot to practice robot

9.1.1 Controls Tips and Tricks

- Must incorporate sensors into prototypes during prototyping phase
- Ensure electronics design is overlapped within design (e.g., routing holes within extrusion to ensure clean wiring)
- Prioritize Autonomous routines on the competition robot over practice robot

- Pseudo code should be generated after initial meeting where overall robot design is decided
- Record robot photoshoot

10.0 Autonomous and Practice
Week 6 Monday – Sunday (Feb 11 – 17)

- TBD later in season
- Autonomous practice requires proper field for exact distances (prioritize for Monday)
- Thursday and Friday are dedicated for Autonomous routine for competition robot
- Saturday and Sunday are dedicated for driver practice with competition robot
- Prioritize practicing with other teams to get a better understanding of the game

- Record comprehensive robot practice footage (e.g., stabilize pan shots, aerial drone shots if possible). Also record specific autonomous routines.

11.0 Preparation for Competition
(Feb 18 – 19)

- Design binder, posters, decals, bumpers
- Train pit crew and scouting crew
- Practice driving
- Reveal the practice robot/competition robot
- Create spare parts

12.0 Competition Season

- Back to back regionals/district events are ok, unless they are at the beginning of the season. Do NOT sign up for 3 in a row.
- Ensure a pit check list has been created and roles have been outlined for students
- Ensure all items are packed and ready to go, as per checklist, the night before the departure date to ensure a smooth transition
- Outline and implement a cross talk plan to improve communication throughout the season
- Organize all roles for mentors and students the weekend before attending the event
- Do system checks after every match for the mechanism you are responsible for
- System checks MUST be completed before the pit crew leaves for lunch

- Create a mentor buddy plan so that mentors are responsible for ensuring certain students leave/arrive and eat at the venue
- Organize food and rides for the venue up to a week in advance of the actual competition to minimize confusion
- Ensure full team's roster with consent forms have been signed and submitted along with bag and tag lockout form
- Day 0 of district events should also include helping teams get ready for matches to elevate the competition and make sure everyone is ready to go for Day 1
- Coaches during competition and off-season must be a mentor
- Dean's List students must be prepped for interview at least 1 week prior to their regional/district event

13.0 Preparation for World Championships

13.1 Einstein Field

- No pit rotations. Selected pit students and drive team will be trained to work on robot
- Organize lunch so that food arrives at the venue on time. Ensure a smooth transition from the division stands to the Einstein stands. Ask parents to help coordinate this
- Water and food delivery for pit crew and drive team
- Transfer all pit materials to Einstein area