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Hampton Roads Shipping Container Terminal Challenge

1. Introduction

"Roadstead" or "roads" is a body of water sheltered from rip currents, spring tides or ocean swell outside a harbor where ships can lie reasonably safely at anchor without dragging or snatching while waiting for their turn to enter a port of call; in maritime law, a "known general station for ships, notoriously used as such, and distinguished by the name". Charts and nautical publications substitute roadsteads for roads.

2. Objective

The IEEE SoutheastCon 2016 hardware competition is designed with the intention of simulating modern port logistics and its related traffic. This IEEE Roads port provides a challenging game of robotic skill and logistics. Each team has to successfully detect shipping goods on a barge (three types of shipping container) which are strategically placed in a harbor field. Correct shipping goods then have to be picked up and transported to the correct shipping zone, and they will be further transported by the rail, by truck or by air. Each team will have 5 minutes to complete the task.

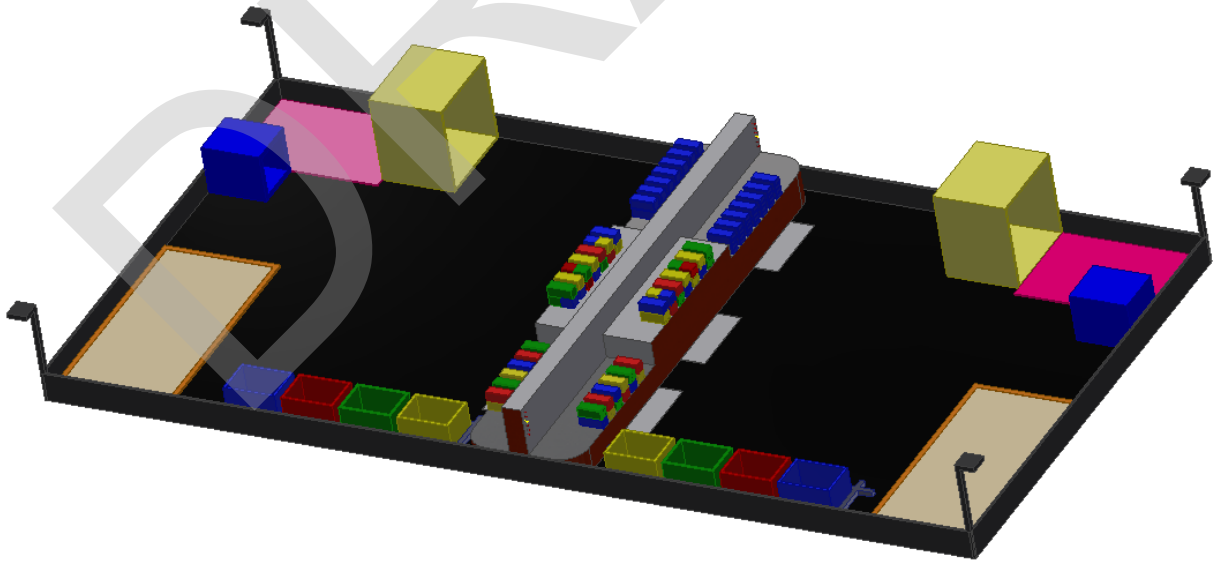


Figure 1: View of the Hampton Roads Terminal

3. Playing Rules

This will be a competition with two robots at the same time picking and moving shipping goods at the same time, with each match lasting five minutes. Each robot will start the round in the designated starting point on its side (either purple or pink). Shipping goods will be located in the middle of the court, on three different parts of a central barge. There will be three types of shipping goods: a) generic shipping containers which are located in the barge zone A; b) shipping containers with QR codes located in the barge zone B (see section 9. about the QR codes); and c) containers which have different colors located in the barge zone C. Different locations on each side of the court are designated as the "shipping goods boat, rail and truck dropping zones." A robot must travel to the central location - barge to collect more shipping goods.

The robots will be required to pick up shipping goods and to drop those shipping goods to the three available locations: boat, rail and truck to score, and then repeat the sequence. Shipping goods which have QR codes will have randomly assigned one of these two areas:rail (green), rail (blue), rail (yellow), or rail (red). See table below for the scoring.Goods can be stacked in the zones on delivery. They do not have to be placed flat, they can also be on edge (i.e. laying against the bin's walls). To be counted as points, the shipping good in the truck cannot touch the ground. If the shipping bin is between two separate buckets, the score is zero. If it falls on the floor,

Limited number of shipping goods are available and will be shared by both robots. The track is segmented into two playing fields. Robot is not allowed to reach to the other robot's side to reach out for extra shipping goods. Once these shipping goods are used, no more will be provided, so the two robots are in a race against each other as well as the clock.

When each team is called to participate in the competition, they will have 1 minute to place their vehicle in the designated starting area on the competition board and take all hands off the vehicle. The beginning of the competition will be signaled by a group of 4 red LEDs mounted in the center of the starting block. Each LED will be separated by 1 cm. Before each robot is placed on the board, the LEDs will be illuminated. The beginning of the competition will be signaled by the LEDs turning off.

Once the signal in shut off the timer is started and the vehicle will have a maximum of five minutes navigate and pick up shipping goods and transfer them to their appropriate locations. The game will end when the five minutes expire or when the robot crosses the finish line or if any part of the robot leaves the playing board. No robot can interfere with the operation of another robot. Any "offensive" strategies are not encouraged, such that one team intentionally degrades the performance of the opponent on the course.

The matrix with the scoring specifics will be released by August 15, 2015.

Judging will be done at the end. Any ruling of the judges is final.

4. Robot Specifications

The robot's dimensions cannot exceed 12" x 12" x 12" at the start of the match, however it can extend 8" in any one direction after leaving the starting point.

It must be self - propelled, autonomous and may not be remotely controlled in any manner, no tethers of any type. It cannot contain any flammable liquids, gases, or explosives. The vehicles cannot project any objects either in the playing field or out of the playing field, and all parts of the vehicle must remain attached (i.e. the vehicle may not split into multiple pieces). The vehicle may not present any danger to the judges, the spectators, or the playing board.Use of cylinders storing any liquid or gas under pressure at the start of a round is prohibited. Use of any flammable or hazardous substance which may pose a safety threat in a robot is prohibited.

5. IEEE Port Specifications

Full court will be 8 foot x 6 foot. The court will be enclosed by a 6" high, 0.5 in thick wall. For more specific dimensions, refer to the appendices or download the zipped folder with all CAD drawings from the link provided at Facebook page. Free version of Autodesk Inventor is available for download at Autodesk's website:
http://www.autodesk.com/education/free-software/all

There will be three separate zones for the scoring shipping goods delivery. These are:

- Boat shipping zone
- Rail shipping zone
- Truck shipping zone

Boat Shipping Zone will be made from: Office Depot's "Quartet® Economy Corkboard, 24" x 36", Natural Cork Board, Oak Frame", 24" x 36", Item # 489740.

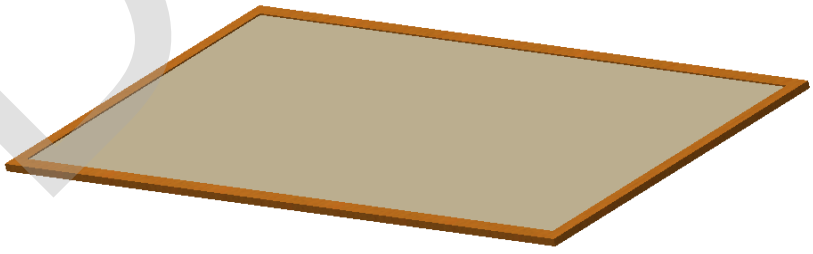


Figure 2: View of the boat shipping zone

Rail Shipping Zone: Dimensions of each bucket in the rail shipping zone: 10.75" L x 7.75" W x 5" H. The bucket position will be randomized. They will not always be at the same position. The buckets will have QR code on them with one of the appropriate words" "blue", "yellow", "red", or "green". The buckets will be fixed to the ground. They cannot be moved during the

competition. The walls are 0.5 in thick. They are made of plywood and painted with same colors as shipping goods: yellow, green, red, and blue.

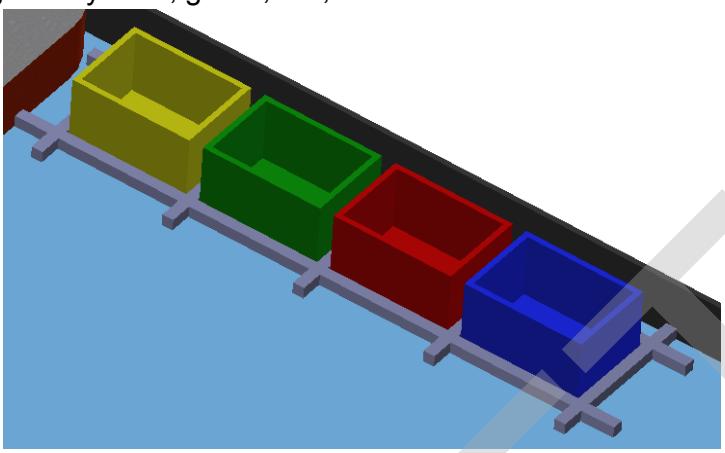


Figure 3: View of the rail shipping zone

- Green - Lowe's - "Rust-Oleum Stops Rust Quart Size Container Interior Gloss Hunter Green Oil-Base Paint"; Item #: 558151; Model #: 7738502
- Red - Lowe's - "Rust-Oleum Stops Rust Quart Size Container Interior Gloss Carnival Red Oil-Base Paint"; Item #: 558152; Model #: 7763502
- Blue - Lowe's "Rust-Oleum Stops Rust Quart Size Container Interior Gloss Royal Blue Oil-Base Paint"; item #: 558166; Model #: 7727502
- Yellow - Lowe's "Rust-Oleum Stops Rust Quart Size Container Interior Gloss Sunburst Yellow Oil-Base Paint"; Item #: 558162; Model #: 7747502

Truck Shipping Zone is shown in Figure 4.

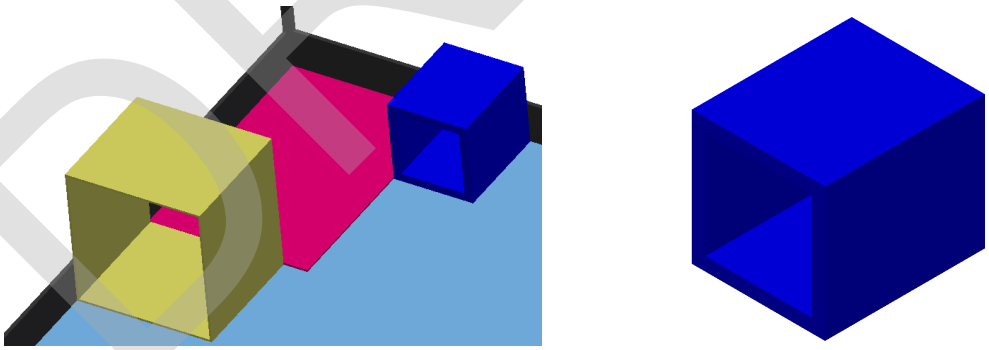


Figure 4: View of the truck shipping zone

The floor and walls of the court will be painted black using Lowe's "Rust-Oleum Stops Rust Quart Size Container Interior Flat Black Oil-Base Paint"; Item #: 558174; Model #: 7776502 black paint.

Start Areas: The start areas are located in the top corners of the playing field and are shown by a square painted in the team's colour (dark pink on the left, pale pink on the right, as seen by the audience). Before the start, the robots must be entirely contained within the start areas.

Start areas will be boards: Royal Brites 2 Cool Foamboard, 20" x 30", Pink; Item # 977958; OfficeMax # 24033662:
http://www.officedepot.com/a/products/977958/Royal-Brites-2-Cool-Foamboard-20/

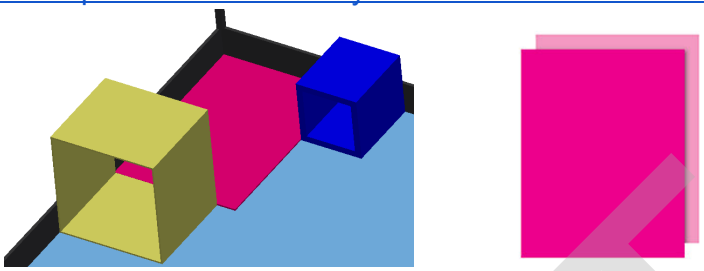


Figure 5: View of the start area

If a robot does not leave the start area before the end of the match, the match will be declared disqualified for that team and it will count as zero points.
The first obstacle through which robot has to navigate is the tunnel. The tunnel inside height is 16.5” by 16.5” width. Tunnel is show in the Figure 6. It is made by 1 / 2 in plywood. There will be no transition from the tunnel which is 1 / 2 in. Tunnel will be fixed to the playground, you are not allowed to move the tunnel away from the base position.

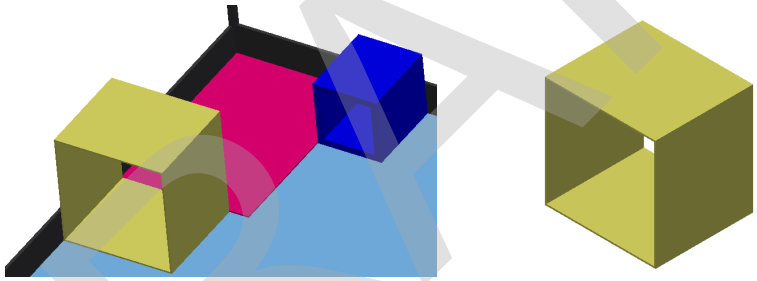


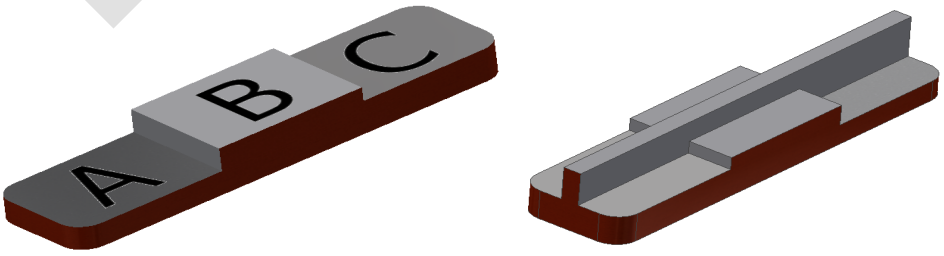
Figure 6: View of the tunnel and one tunnel with surroundings example (pink team)

Shipping goods will be located on the barge in the center of the field. The barge has three different zones: A, B, and C, as shown in Figures 7 and 8. These zones are:

A) color containers, same size;

B) containers with QR tag (different colors and different sizes)

C) generic containers, same color, same size



(a) (b)

Figure 7: Barge with three shipping zones

a) View of the barge and three shipping goods zones: A, B and C;
b) two robots are divided into two separate areas

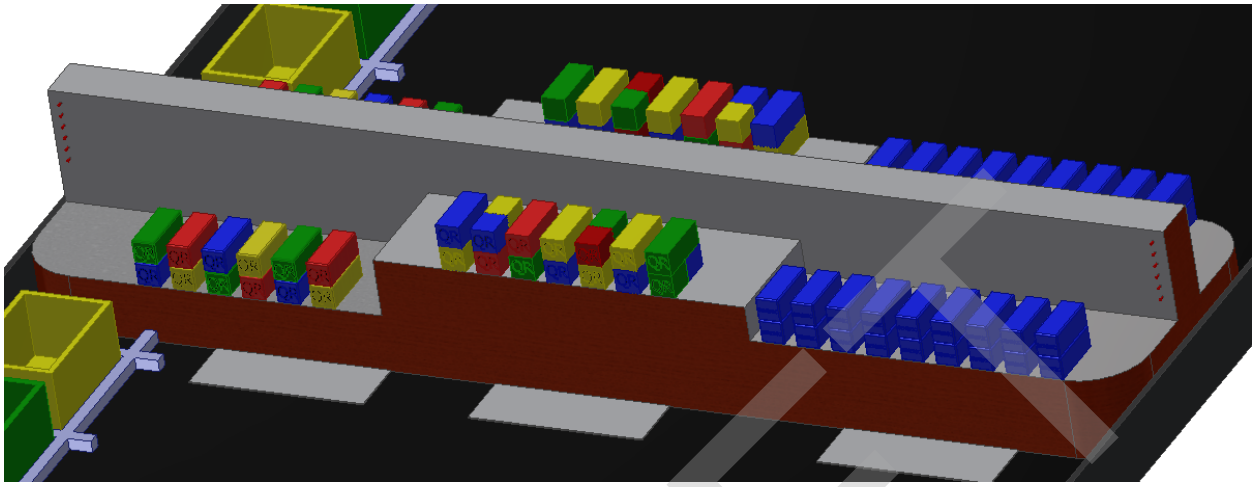


Figure 8: View of the barge and three shipping goods zones: A) color containers, same size; B) containers with QR tag; and C) generic containers, same color, same size

6. Shipping Goods Specifications

Shipping goods (containers) are scattered across the field and the barge. Their location will be randomized. Shipping goods cannot be damaged during the competition, they cannot be pierced, drilled, cut during the game. These shipping containers were in use and their paint might be scraped in some areas. You have to make sure to include that variability in your designs. Containers will be made from Lowe's "Spruce-Pine-Fir Furring Strip" (Common: 2-in x 2-in x 8-ft; Actual: 1.5-in x 1.5-in x 96-in) - Item #: 4513, Model #: 22PFUR.8

Containers with QR codes (green, red, blue, yellow) will be painted with the following colors:

- Green - Lowe's - "Rust-Oleum Stops Rust Quart Size Container Interior Gloss Hunter Green Oil-Base Paint"; Item #: 558151; Model #: 7738502
- Red - Lowe's - "Rust-Oleum Stops Rust Quart Size Container Interior Gloss Carnival Red Oil-Base Paint"; Item #: 558152; Model #: 7763502
- Blue - Lowe's "Rust-Oleum Stops Rust Quart Size Container Interior Gloss Royal Blue Oil-Base Paint"; item #: 558166; Model #: 7727502
- Yellow - Lowe's "Rust-Oleum Stops Rust Quart Size Container Interior Gloss Sunburst Yellow Oil-Base Paint"; Item #: 558162; Model #: 7747502
- Zone B containers will have random colors

Zone A: Shipping containers in this zone are all the same size, same material. However they have different colors: green, blue, red or yellow. See Figure 9.

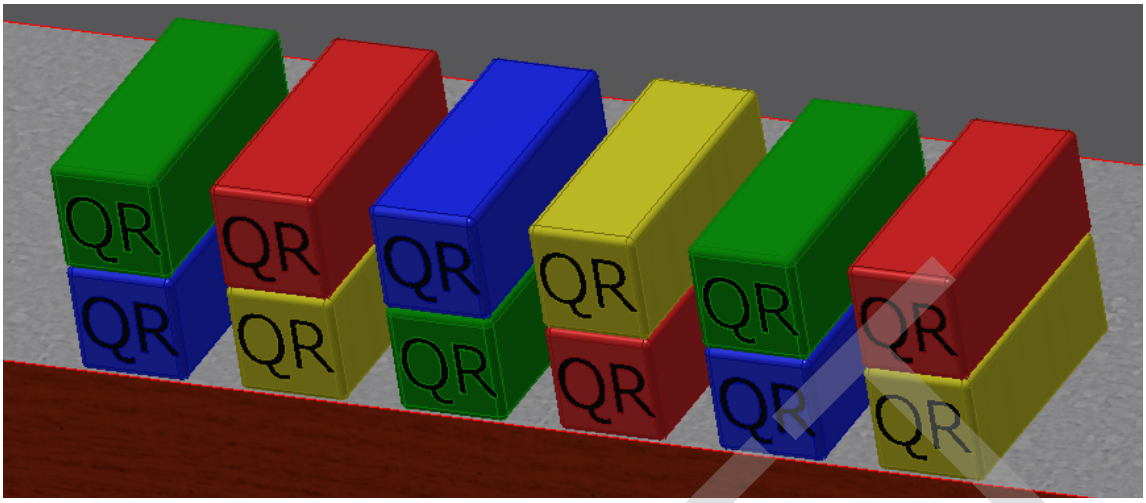


Figure 9: Shipping containers in zone A (same size: 1.5 in x 1.5 in x 5 in; different colors - green, blue, red or yellow)

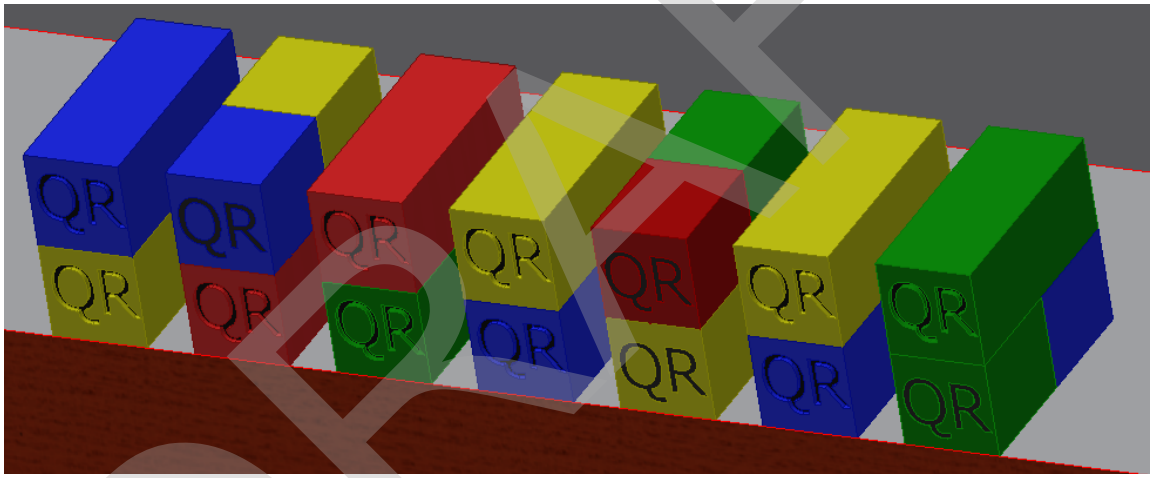


Figure 10: Shipping containers in zone B with QR codes (two sizes, various colors)

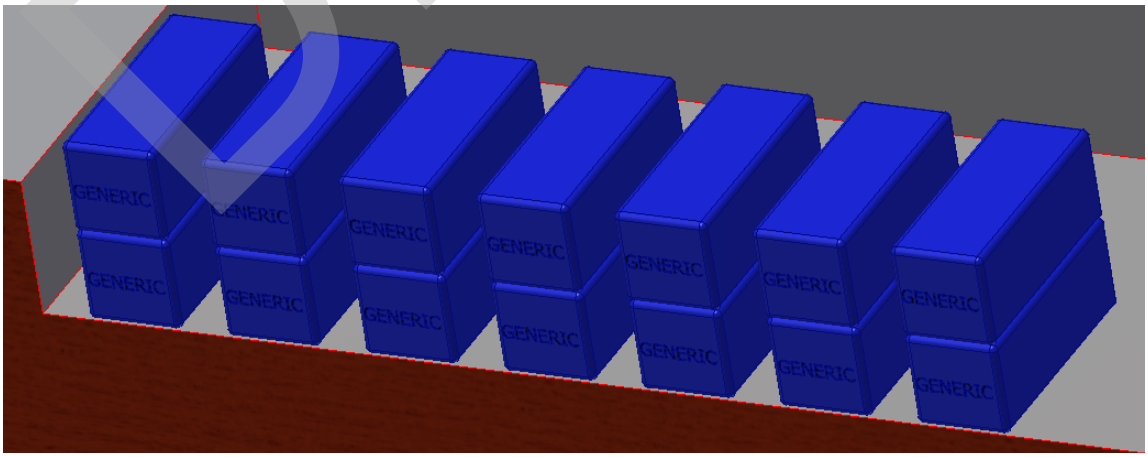


Figure 11: Shipping containers in zone C (1.5 in x 1.5 in x 5 in; same color)

7. QR Codes

There will be four types of QR codes, invented by Denso Wave, generated with color words: “yellow”, “red”, “green”, and “blue”. These codes are generated from text with the online generator: http://www.qr-code-generator.com/# . Their dimension will be 1.5 in x 1.5 in (one side of the shipping containers in zone B with QR codes will be covered with the code). QR codes will be facing forward but they can be in any orientation. More about QR codes find from here: http://www.qrcode.com/en/

Figure 12: QR code for the word “yellow”

Figure 13: QR code for the word “red”

Figure 14: QR code for the word “green”

Figure 15: QR code for the word “blue”

8. Navigation

Six LED will be placed at the frontal side of the barge, one set at the right side (visible from tunnel), one set at the right site. One set will be visible from the tunnel (at the starting location).

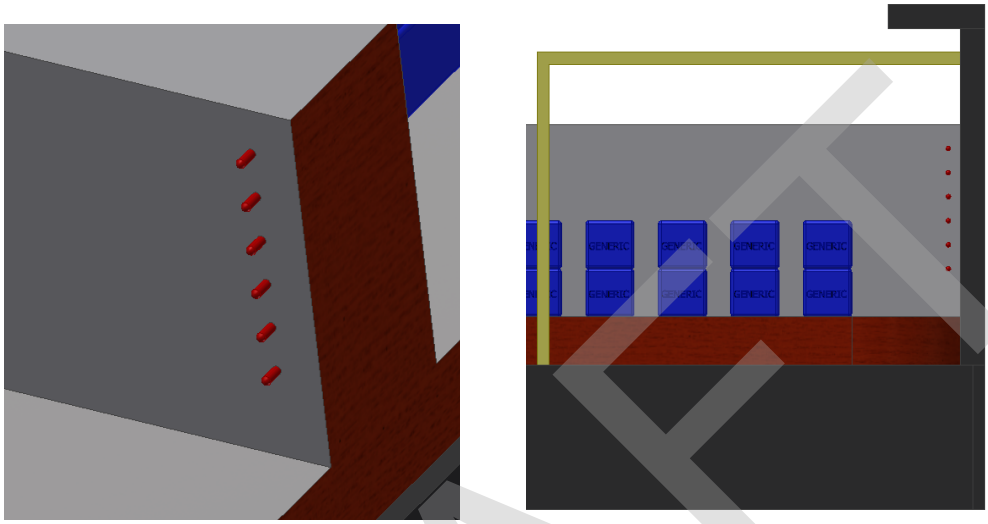


Figure 16: LEDs for navigation and the view through the tunnel from the base position

Three areas will be painted with lighter color in front of the Zones A, B, and C on the playground floor for easier navigation. See image below.

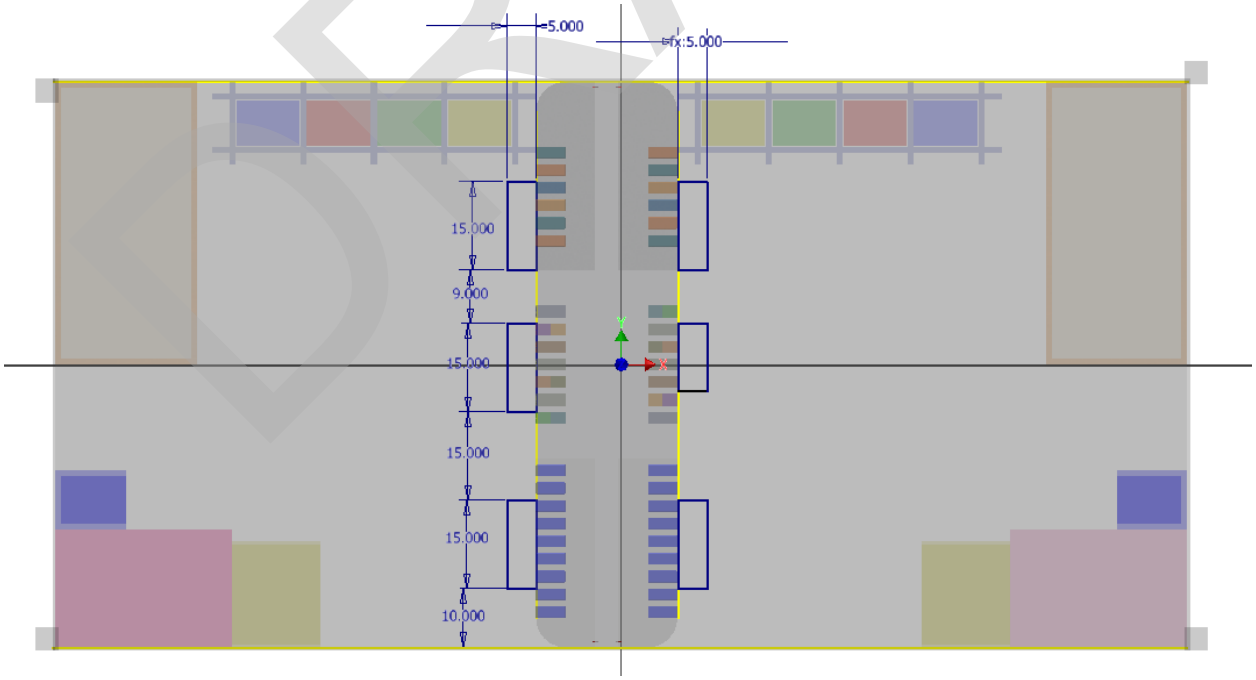


Figure 17: Dimensions of the navigation stripes

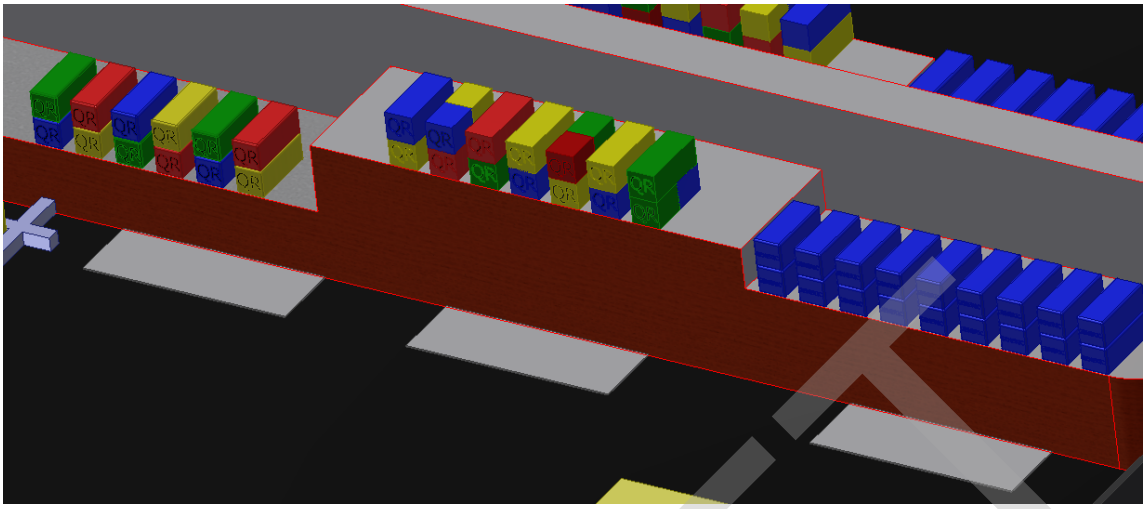


Figure 18: Brighter area for easier navigation

Important information: While the organizational team strives to be as accurate as possible while building the playing area, there may be deviations from the official dimensions because of manufacturing tolerances (+/- 0.125 in). No responsibility will be accepted regarding these deviations. If any modifications are made to the specifications, they will be made available in a complementary document on the website of IEEE SoutheastCon 2016 website. Please note that the surface finish of the painted areas may differ between each playing field, and may deteriorate over time. The rules, the specifications of the playing field and of the playing elements might be changed if problems are discovered. We strongly recommend that teams regularly check both IEEE SoutheastCon 2016 website http://sites.ieee.org/southeastcon2016 and the Facebook IEEE 2016 SoutEastCon page https://www.facebook.com/2016ieeesoutheastcon and the IEEE 2016 SouthEastCon Hardware Competition page https://www.facebook.com/groups/SouthEastCon2016HardwareCompetition/ to check for updates to the rules or specifications.

9. Qualification Round

The robot must completely leave the start area to be qualified for the competition.

10. Tournament Format

The competition consists of three rounds. Each team will have three rounds in which to base their final score. Scores will be summed up from each round. At the end of the three rounds, the final scores will be calculated. Final 4 teams will qualify for finals which will be held during the banquet. Each team will run one game, 5 minutes. The team which scores the most number of points is the winner of the competition.

If there are two teams which have the same number of points - remaining number of seconds will win (just in case of the tie breaker). The shorter time will be acknowledged at the moment when the team informs the judge about the completion.

If in the opinion of the judges and the host committee that time constraints require us to speed the completion of the competition after the second round, the host committee, at their discretion, can cut up to 1/2 of the lowest scoring teams.

Robots will be positioned to the location in the sequester A where they will stay until the the first round starts. After completion of the first round, the robots will enter the sequester B. Robots will stay in the sequester between Round 1 and Round 2. They will be released to the teams in between Round 2 and Round 3. Before Round 3, robot will be brought again to the sequester until the time for the final round comes.

If the team representative fails to appear for sequester after your team name is called twice, the team will not be allowed to play in that round. All teams must be sequestered prior to the start of the round. Two team representatives handles the robot during the competition. Each team representative has one minute from arriving at their competition course to set their games and robot. At the end of 1 minute, hands off, the start light goes out, and play time begins.Between rounds, all games will be lined up off the course at the starting end for your team representative to place.

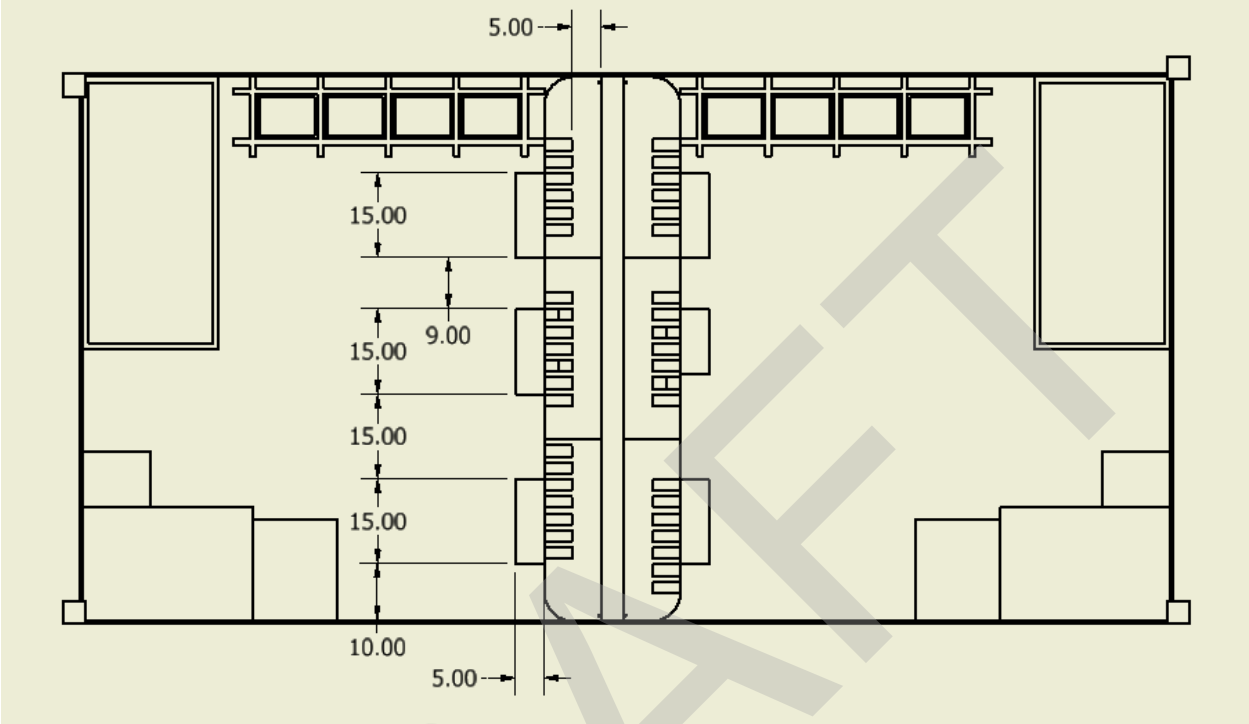
Flash photography will not be allowed. All designs should take this into account. Reasonable noise levels should be accounted for by teams during practice and competition. Every effort will be made to maintain courses between rounds, but in the interests of time minor scuffs (etc.) will not be addressed.

11. End of Timing (Game):

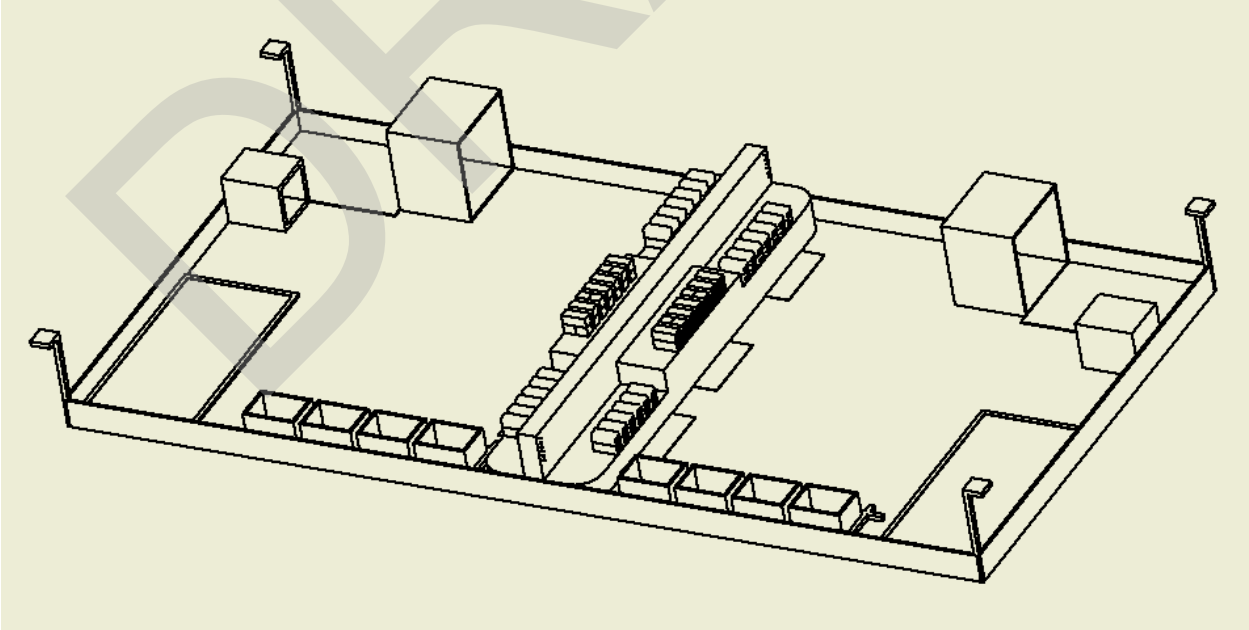
Once the robot has completely crossed the finish line the time ends, or at the 300 - second buzzer, whichever comes first. At either moment, judges will add points obtained.

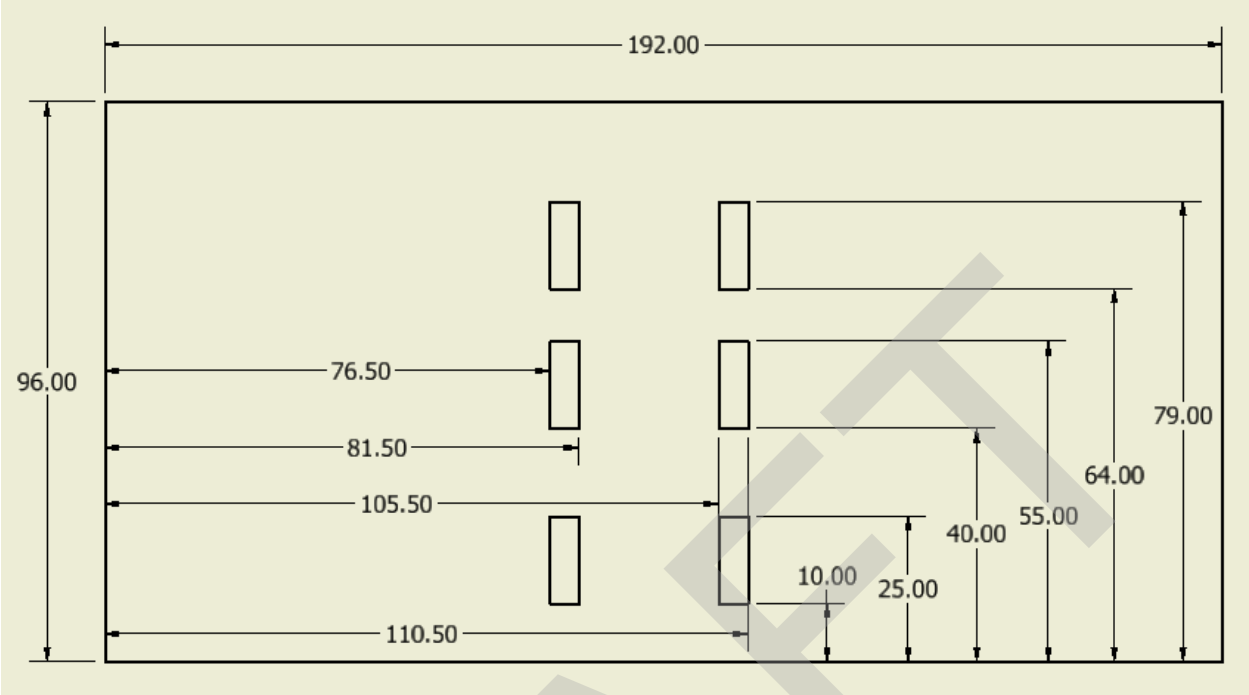
Team will remove robot from board.

Appendixes



Location of navigation strypes and distance behind the shipping goods





Drawing of a playing field (8 foot by 16 foot)

8 oz. Rust-Oleum Flat Black Protective Enamel Paint

Home Depot:

Model # 7776730

Store SKU # 448087

8-oz. Rust-Oleum Flat White Protective Enamel Paint

Home Depot:

Model # 7790730

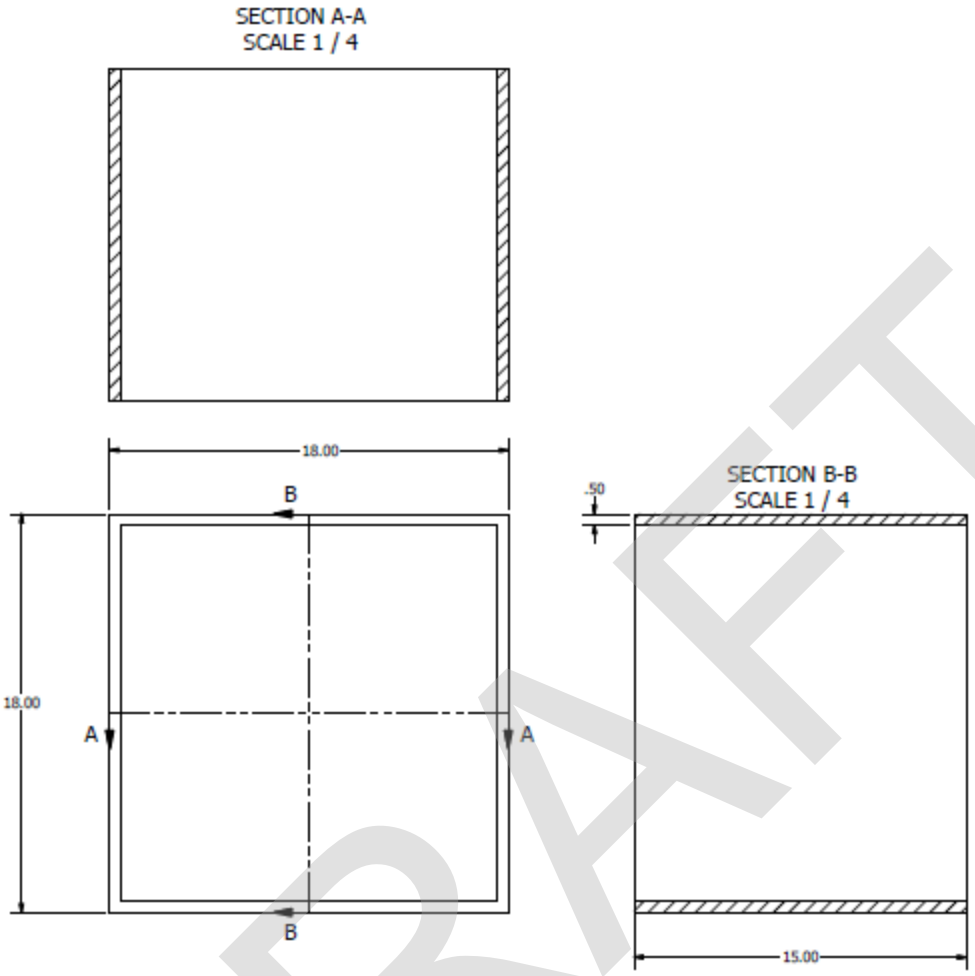
Store SKU # 448575

4 pieces of 5/8 in. x 4 ft. x 8 ft. Sanded Pine Plywood

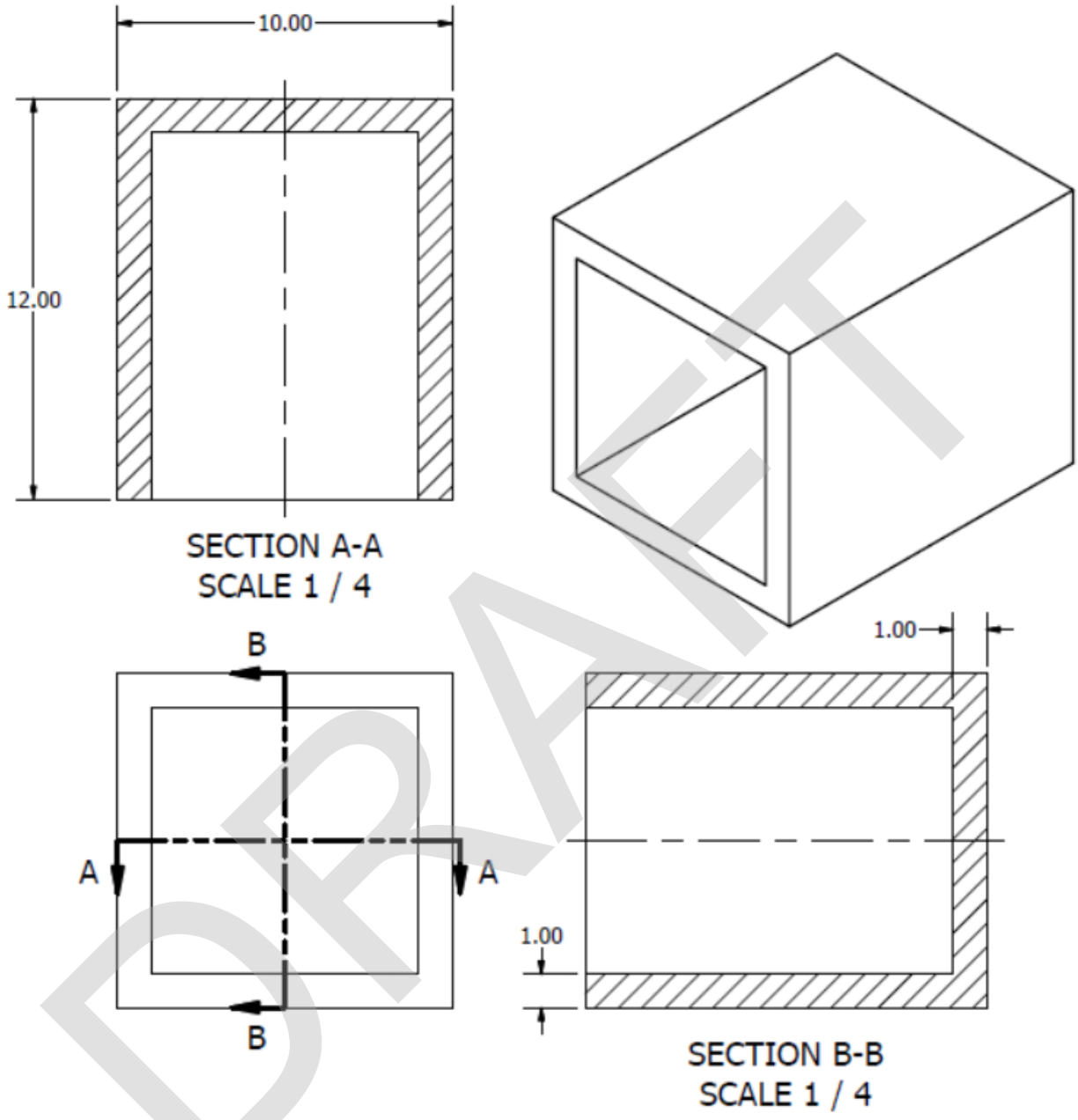
Home Depot:

Model # 326135

Store SKU # 326135



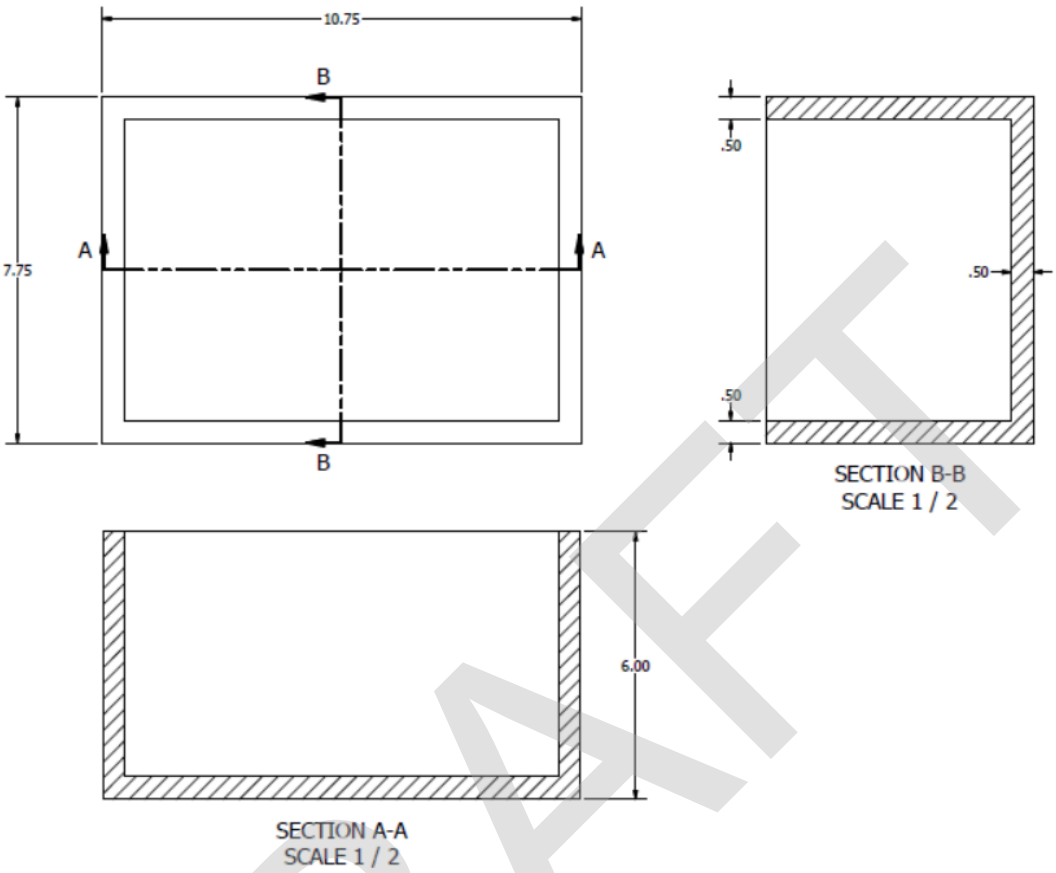
Drawing of a tunnel



Truck drawing

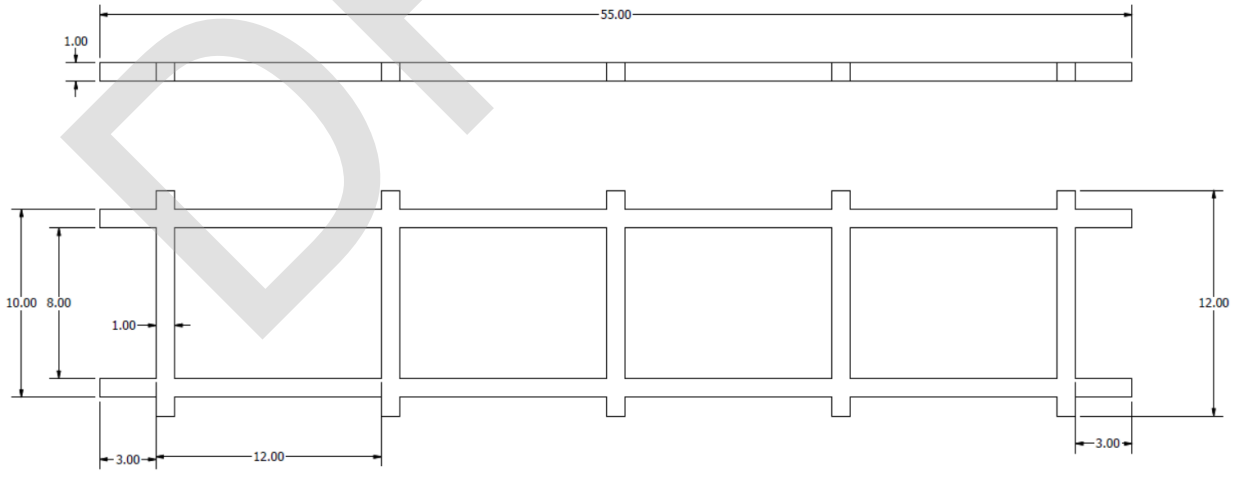
Drawing of a boat shipping zone (30”x 20 “or 2.5 ‘ x 1.67 ‘)

Boat shipping zone will be made from: Office Depot’s “Quartet® Rolled Cork”, 24" x 48", Item # 971676.

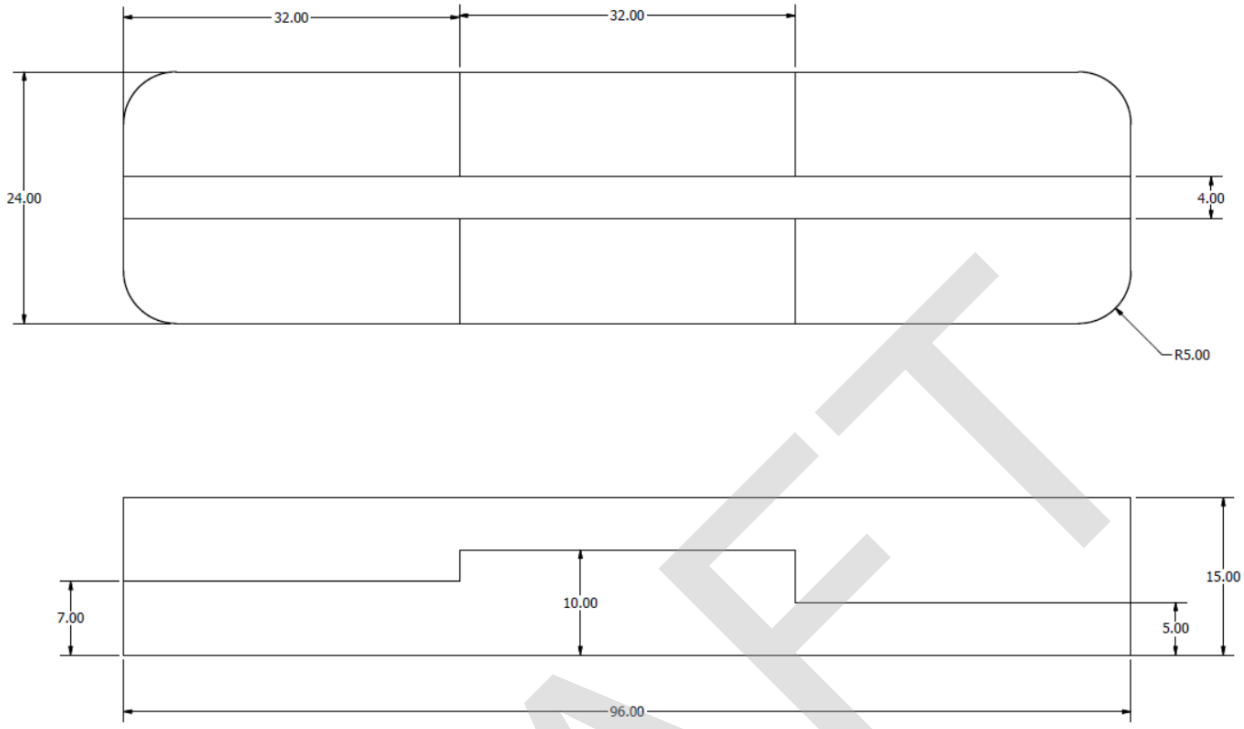


Rail shipping zone have four containers

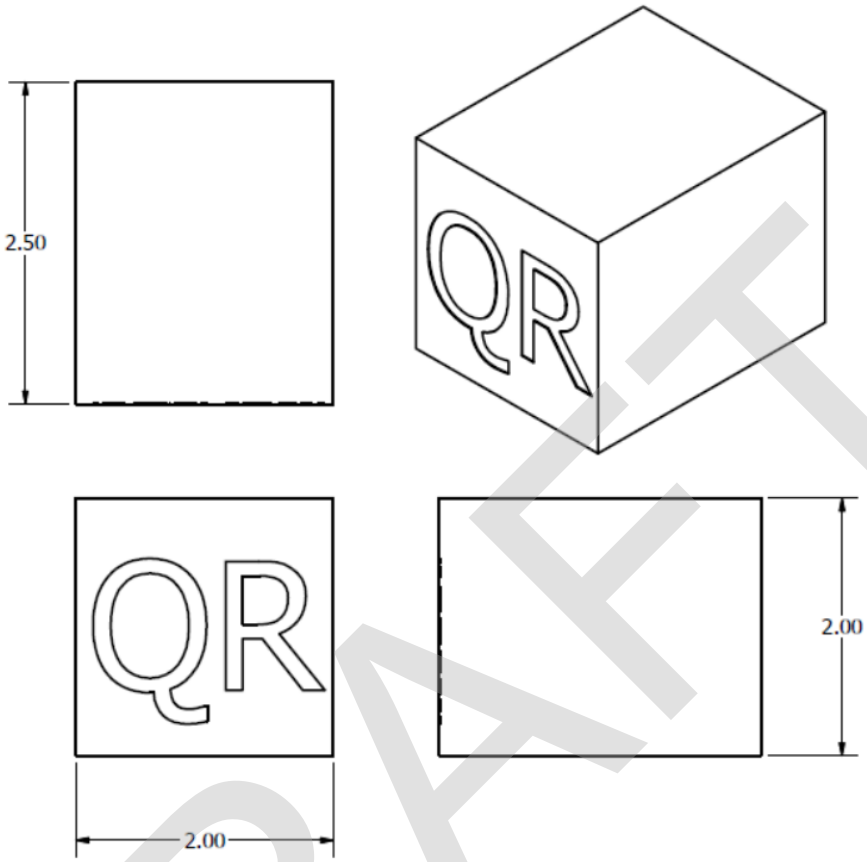
Dimensions of each bin: 10.75" L x 7.75" W x 5" H.



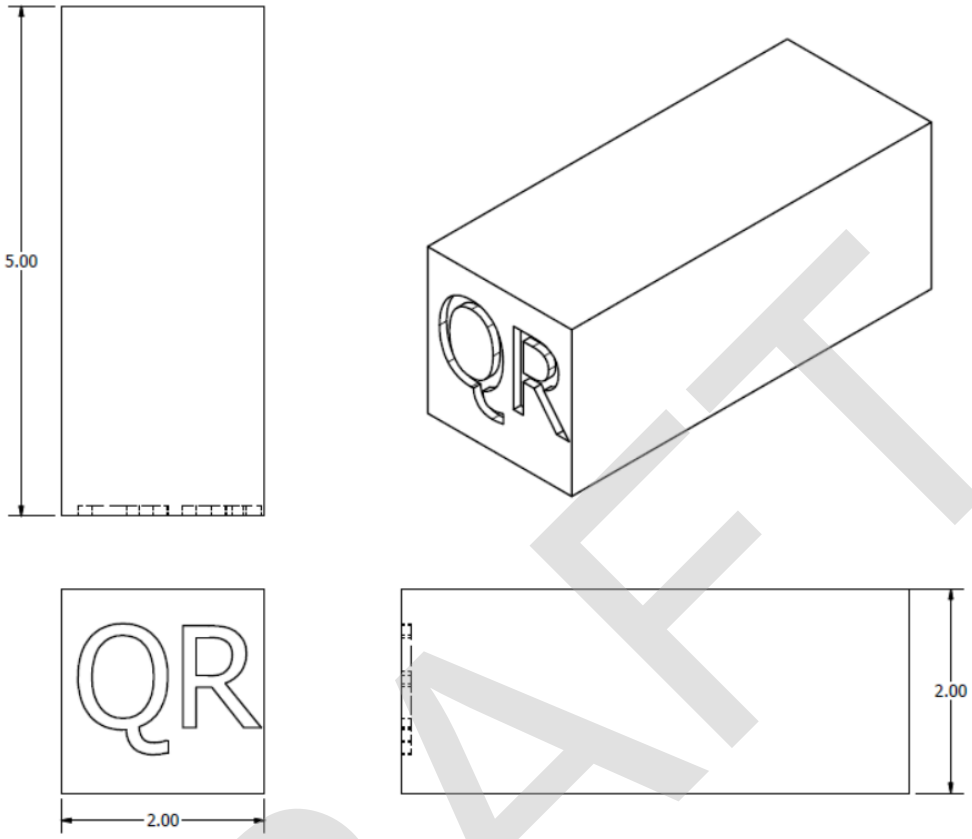
Drawing of a rail shipping zone



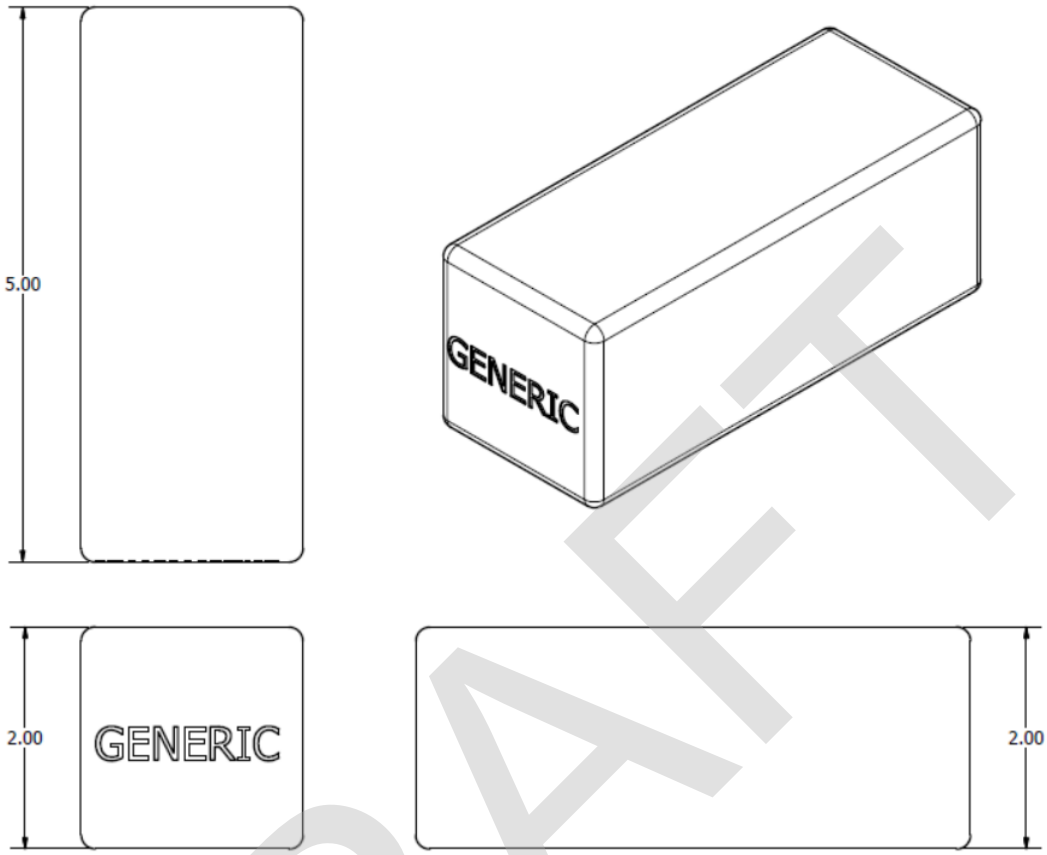
Drawing of a barge



Shipping containers in zone A -QR codes a) 2 in x 2 in x 2.5 in



Shipping containers in zone A -QR codes b) 2 in x 2 in x 5 in



Drawing of shipping containers in zone C (2 in x 2 in x 5 in; same color)

Questions and Answers

Q: How will the current contest/scoring information be displayed to the crowds?
A: LCD projector.

Q: How close do you allow team members/visitors to be to the course?
A: Everyone will be at least 4 feet from the board's edge.

Q: Will you be using liquid or spray paint and how will it be applied?
A: The paint will be rolled on liquid black & white paint.

Q: Will the playing surface be elevated?
A: No, it will be on the floor.

Q: Are base stations in the starting area allowed.
A: Yes. Base stations in the starting area are allowed.