Fire Fighting Robot Contest

Booklet

Definition:

Fire Fighting Robot Contest (FFRC) is a contest designed for only college and university students where each team's robot has to accomplish certain tasks within a predesigned track. The track is designed to test the ability of a rival robot to extinguish the fire and rescue people in some difficult situations that are laid out inside the track. The contest track is divided into eight (8) regions. In each region, there are several people (represented by ping-pong (table tennis) balls of 2.7 g weight and 4 cm diameter) to rescue and some fires (represented by small candles) to extinguish along with some challenges to overcome. In fact, the skills of the team in maneuvering the robot remotely would make a big difference in the performance. A certain score will be given to each task. The winning teams should have the highest score.

Robot Structure and Operation:

Each team can participate with a robot that is built using either (a) a microcontroller such as an Arduino controller, dc motors, sensors, communication module, power module, and other electronic components with a plastic/metal/wood material for the chasses or (b) an education robot kit such as the Lego EV3 or VEX IQ or Tetrix or any other similar kits.

Robot Dimensions:

Each team's robot can be of any dimension and weight but it is the responsibility of the team to design a robot that fits the track all the way. It should be noted that the robot can change its shape while running on the track. In other words, any parts or limbs or arms can be extended and distributed from the robot body after starting the contest.

Track Specifications:

The track will be 40 cm in width and covers a total area of 345 cm by 210 cm. It is divided into eight (8) regions (refer to Figures 1, 2, and 3 for illustration). In Regions (1) to (7), the robot can be operated manually and remotely controlled by the team. In Region (8), the robot must be operated autonomously. The robot has to choose between two routes at the end of the track; to end the track through Region (7) or Region (8). Of course, through Region (8), the robot will earn more points.

- **Region (1)**: There will be TWO hills at the entrance of the track to climb and descend. The first hill is with a width of 40 cm, height of 7 cm, and incline / decline of about 30º. The second hill is with a width of 40 cm, height of 5 cm, and incline / decline of about 20º. There will be one (1) ping-pong ball to be collected between them on the left side of the track.
- **Region (2)**: There will be three (3) ping-pong balls to be collected; one in a hole (i.e., depth is 2 cm and diameter is 6 cm) and two on columns (i.e., height is 12 cm and diameter is 3.5 cm). In addition, a fire on a building should be extinguished by ONLY air. The fire is represented by a small candle (i.e., height is 1.5 cm and diameter is 4 cm). The building's dimensions are illustrated in Figure 4.
- **Region (3)**: The ground will be an artificial grass (e.g., height is 2.5 cm) and there will be three (3) ping-pong balls to be collected. One of them is in a hole (i.e., depth is 2 cm and diameter is 6 cm) and another one is covered with a plastic cup (i.e., height is 8 cm, lower base diameter is 6.5, and upper based diameter is 4.2). The third one is on a building covered with the same aforementioned plastic cup. The building's dimensions are illustrated in Figure 4.

- **Region (4)**: There will be a tunnel with free-to-move roof and walls. Meaning that the tunnel is not fixed and can collapse and fell down if the robot does not manage to go through it smoothly. The tunnel's dimensions are illustrated in Figure 5. In addition, there will be one (1) ping-pong ball to be collected on the tunnel's roof.
- **Region (5)**: The ground will be covered with many small bumps. Along the way, there will be two (2) buildings on fire that need to be extinguished by ONLY air. The buildings and fire are as described in Region (2).
- **Region (6)**: There will be two (2) ping-pong balls to be collected. The first one is in a hole (i.e., depth is 2 cm and diameter is 6 cm) and the second one is on the tunnel's roof. The tunnel is not fixed and can collapse and fell down if the robot does not manage to go through it smoothly. The tunnel's dimensions are illustrated in Figure 5.
- **Region (7)**: There will be six (6) obstacles (i.e., thickness is 1 cm) to avoid. The obstacles' dimensions are illustrated in Figure 6.
- **Region (8)**: There will be a black line (i.e., width is 2 cm) to follow surrounded by white ground. Along the line, there will be five (5) stops represented by red and green squares (i.e., width is 4 cm and length is 4 cm). Refere to Figure 6 for distances between the squares. At the red squares, the robot must stop in order to extinguish the fire that is represented by a small candle (as described in Regions (2) and (5). At the green squares, the robot must stop in order to collect a ping-pong ball; one is in a hole (as described in Regions (2), (3), and (6)) and the other is on a base of height 2 cm.

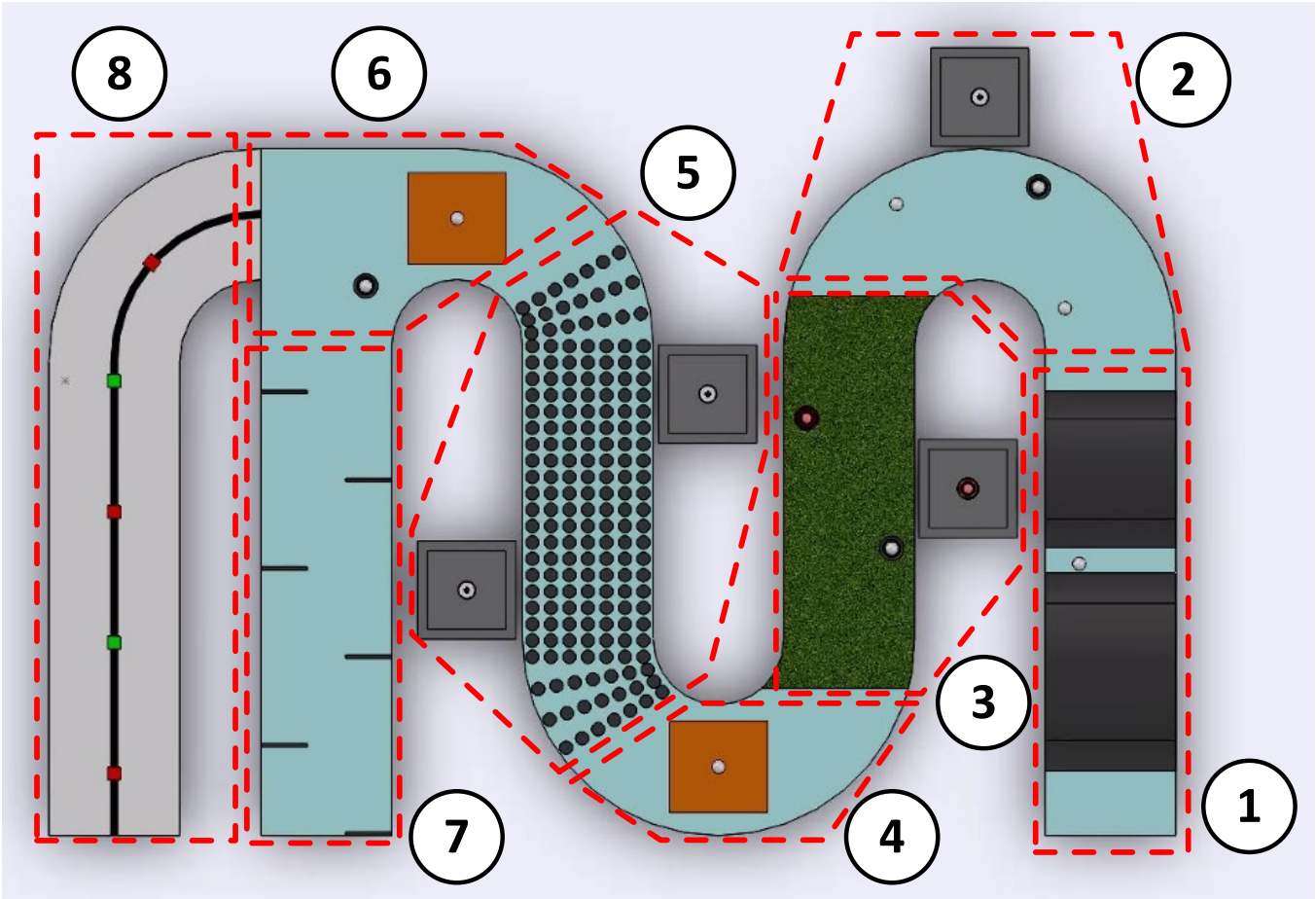

Figure 1. A top view of the FFRC track.

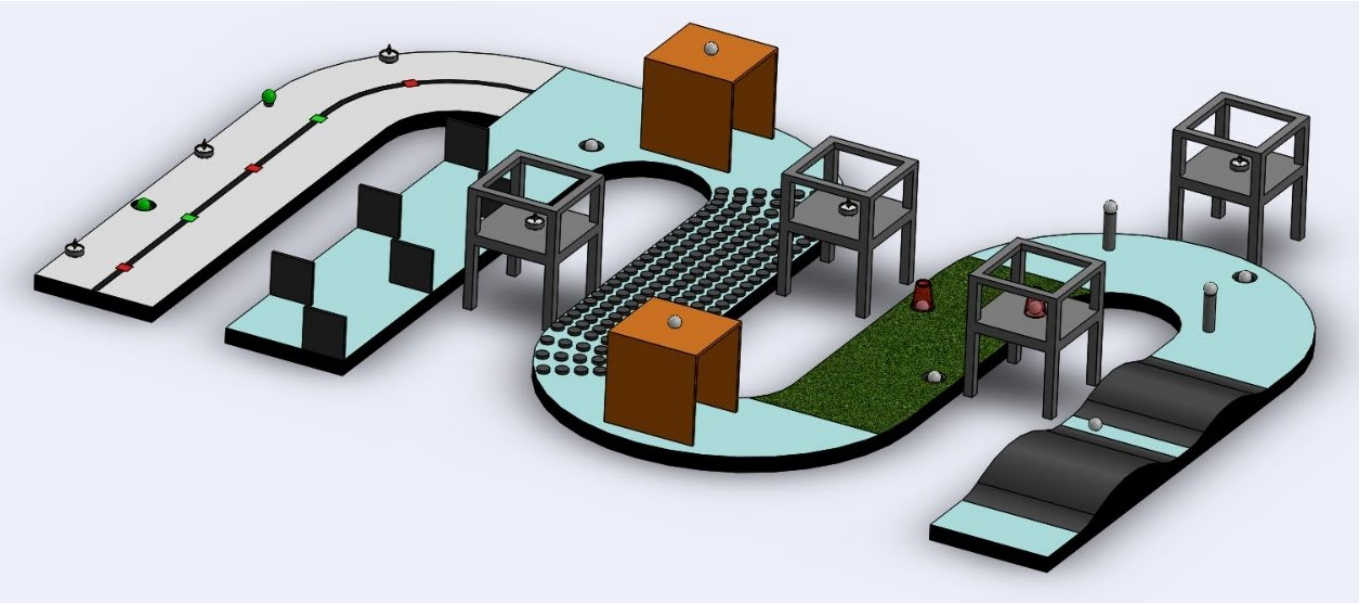

Figure 2. A 3D view of the FFRC track (east view).

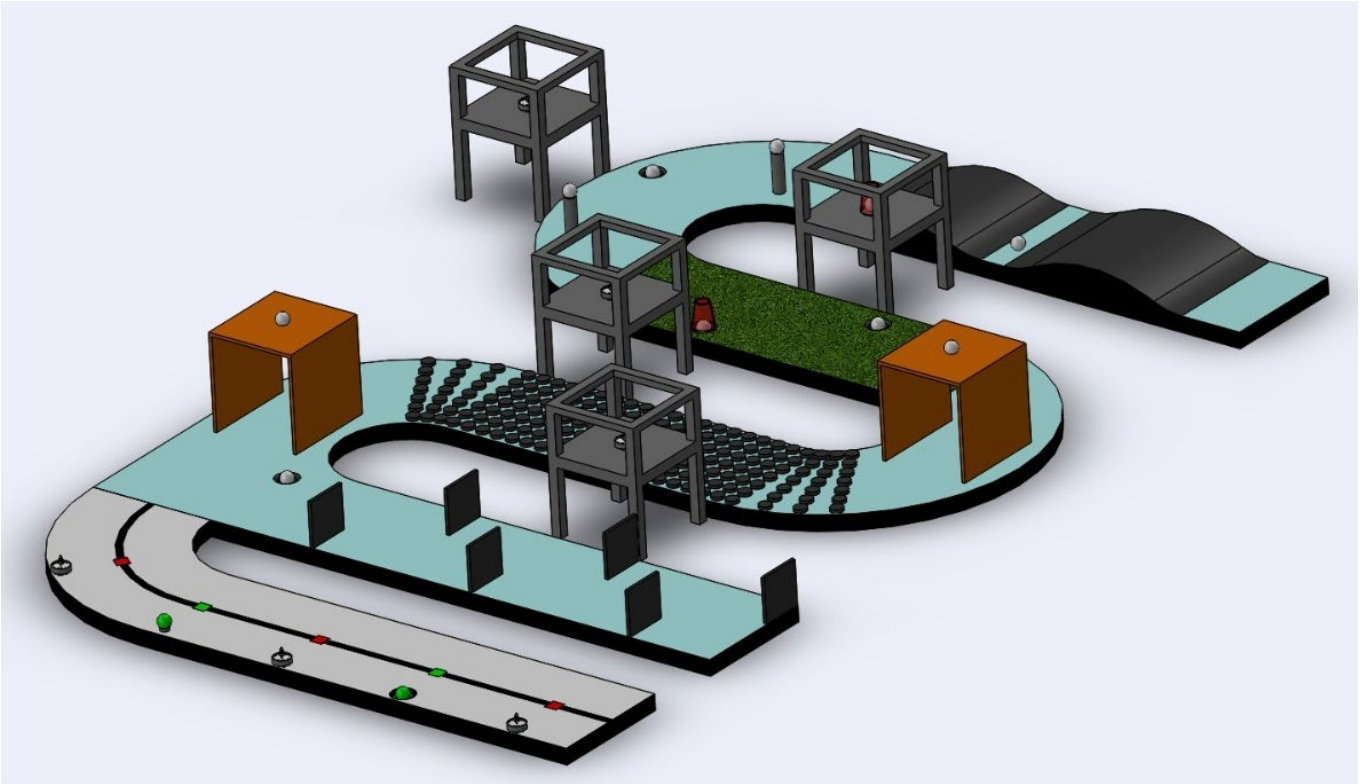

Figure 3. A 3D view of the FFRC track (west view).

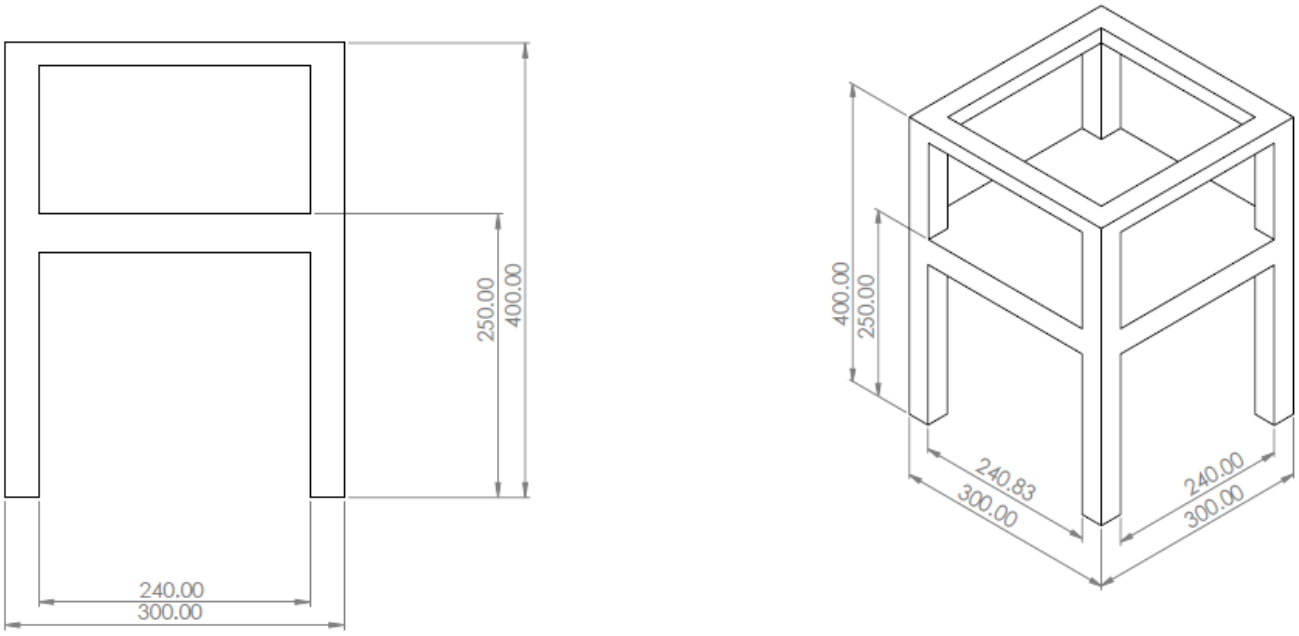

Figure 4. Building dimensions in mm.

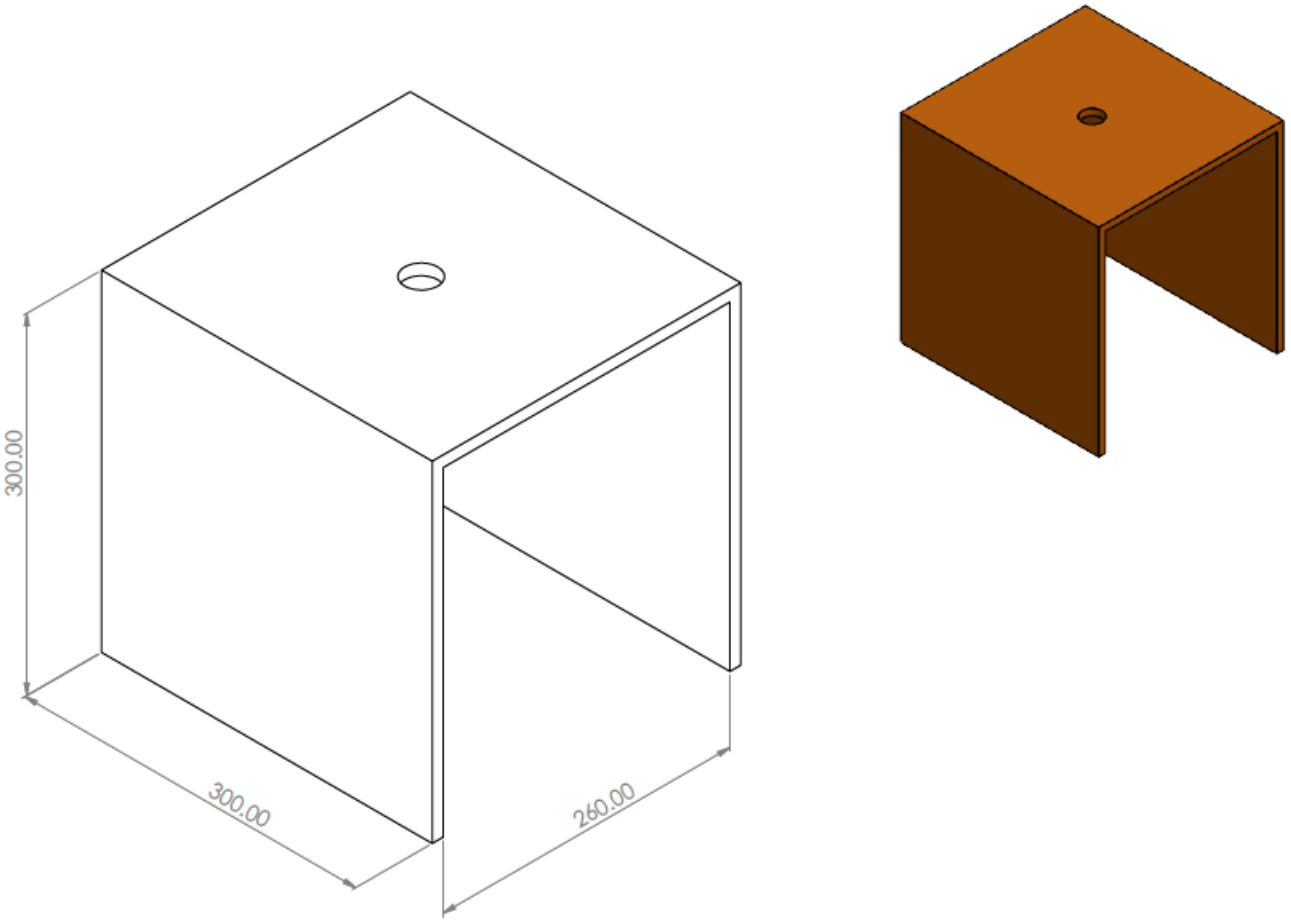

Fig. 5. Tunnel dimensions in mm.

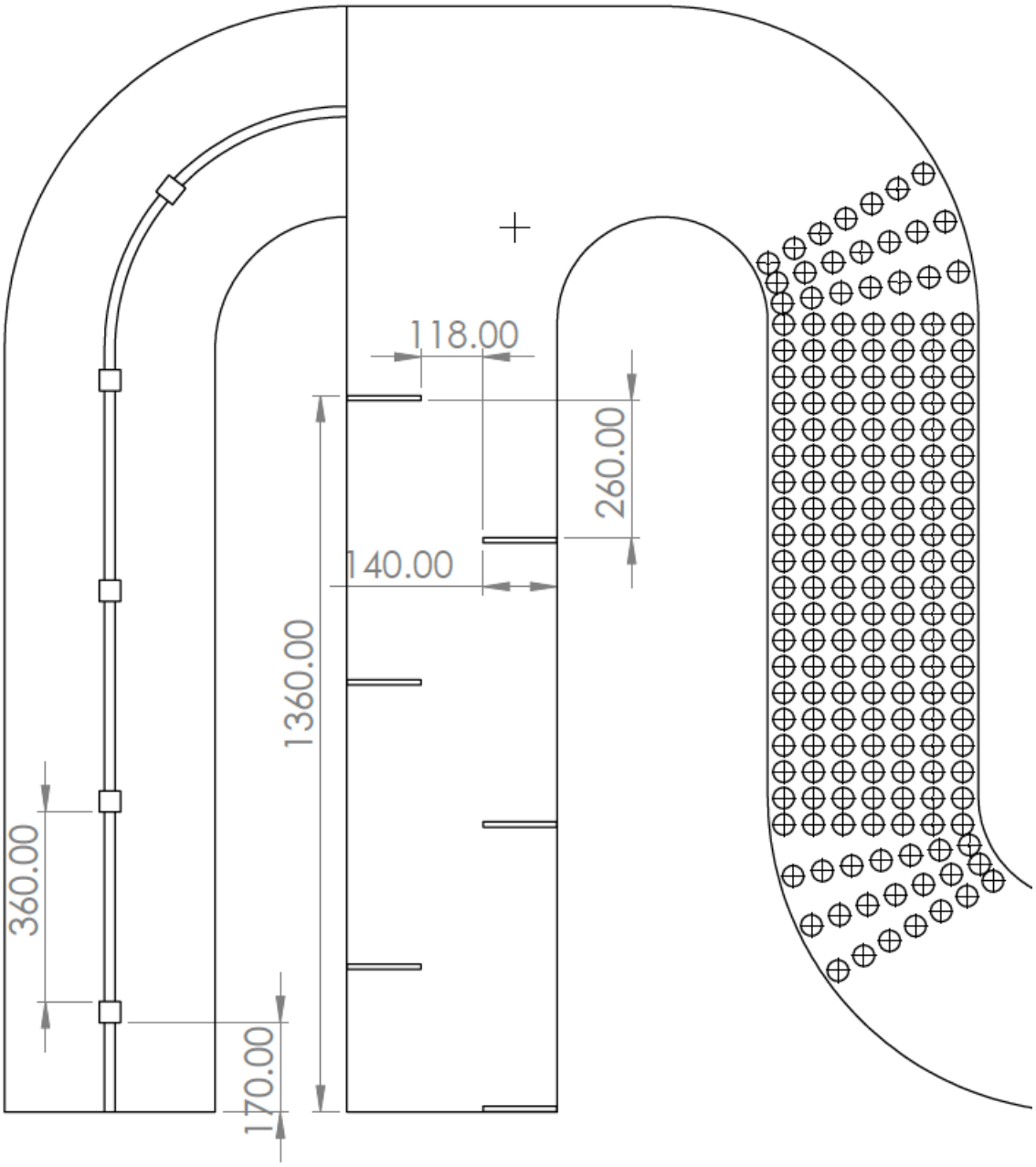

Figure 6. Ends of the FFRC track. Dimensions are in mm.

Performance Evaluation:

Each team's robot is evaluated based on the accomplishment of the task shown in the table below.

Region	Task	Score	Region Score
1	Climbing two hills	10	15
	Collecting the ball between the two hills	5	
2	Collecting the balls on two columns	10	30
	Collecting the ball in the hole	10	
	Extinguishing the fire	10	
3	Collecting the ball under the plastic cup	10	40
	Collecting the ball in the hole	10	
	Collecting the ball in the building under the cup	20	
4	Collecting the ball on the tunnel's roof	10	25
	Passing the tunnel	15	
5	Extinguishing the fire	20	20
6	Collecting the ball on the tunnel's roof	10	35
	Passing the tunnel	15	
	Collecting the ball in the hole	10	
7	No points	0	0
8	Extinguishing the fire	30	50
	Collecting the balls	20	
	Time needed to finish the track (refer to the details)	35	
	Total	**250**	

General Rules of the Contest:

- The robot is allowed to be remotely controlled (i.e., manually) in Regions (1) to (7) and must be autonomous in Region (8).
- The robot can end the track through either Region (7) or (8).
- Any member of the team can use the remote control unit and navigate the robot while it is running within Regions (1) to (7). In Region (8), it is prohibited to control the robot manually. The navigation should be autonomous.
- All teams must control and maneuver their robot (manually or autonomously) within a certain area. Not doing this will cost the team to lose points.
- The team is not allowed to touch the robot or change anything in it while it is on the track. However, the team may change the robot design or any components before the start of any round.
- If something wrong happened with the robot in the middle of the competition such as a shut down in the battery, the round will stop and the team will be given the collected points with the time score equal to ZERO.
- All the ping-pong (table tennis) balls collected during the round should be kept inside the robot until the end. Losing any ball along the way will cost the team to lose points.

- If the team's robot could not pass a certain region, accomplish a certain task, or the robot gets out of track and could not come back, the team can move their robot by hand to the next region but they will lose the points of that region in addition to (5) points from the time score. However, if this is done in Region (7), (5) points will be lost for each obstacle.
- If the team decides to finish the FFRC track through Region (8), the robot should be stopped at the beginning of Region (8) and then manually (i.e., by hand) or remotely switched to the autonomous mode.
- The total time allowed for the robot to finish the track is (20) minutes. If not, at the minute (20), the robot operation and round will stop and collected points will only be counted.
- The teams with the first three highest scores out of (250) will be considered the winning teams.
- In case two teams scored equally at the finals, they compete between each other again in one more round.
- It should be noted that not doing any of the listed tasks would cause losing points.
- In general, teams do not have to accomplish all tasks if they think a certain task will delay them too much. They may think to trade off some tasks with others.

Violations:

- Any unethical behavior (i.e., words or actions) will cause the team to lose (50) points.
- In case the team goes out of the region from which they remotely control its robot, (50) points will be lost (refer to Figure 7).
- In case the team interferes with the robot's motion by hand, (10) points will be lost in addition to the region score.
- In case any of the collected ping-pong (table tennis) balls falls down or goes out of the competition track, (10) points will be lost for each ball.
- In case any of the obstacles, in Region 7, falls down due to the collision with the robot, (5) points will be lost for each obstacle.

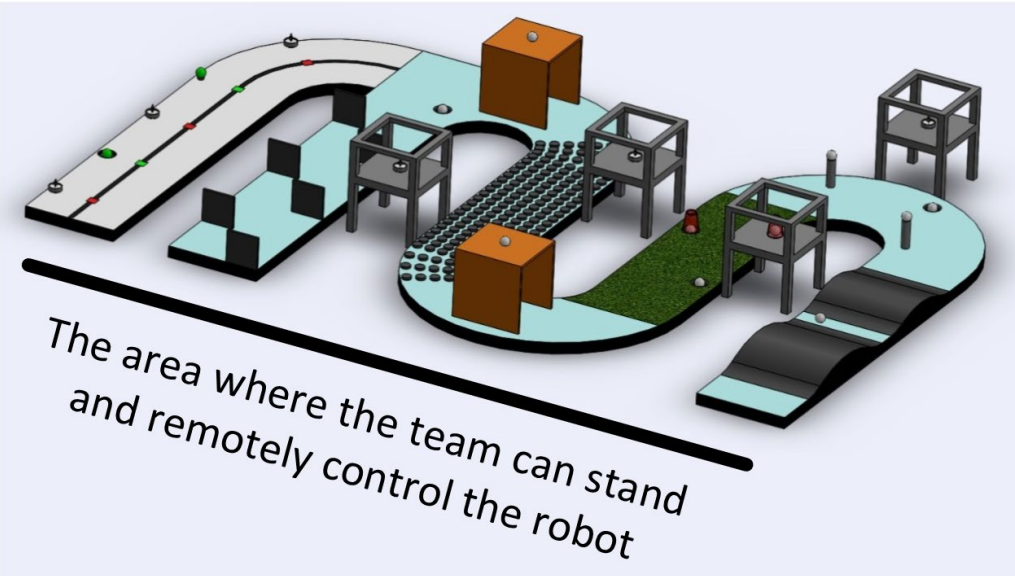

Figure 7. The area where the team can stand and remotely maneuver and control the robot.