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## Battle for Middle Earth

### 1. INTRODUCTION

Peace, that seemed everlasting after the destruction of the ring, has once again been shattered. Tales of Dark Forces, foul alliances between Orc and Goblin Armies drift to the peacelands from the South. Despite this, the Peace of Middle Earth is threatened by the interracial tensions, stirred up by cunning diplomats, who seek out war to profit themselves.

You are the last hope; you are a group of rebels, who seek to unite the three races again and face the menace brewing in the South. To re-engage the Alliances of old, you should reignite the doused fires of Minas Tirith. These shall, like the flames themselves, put fires in the bellies of Men, in the eyes of the Elves, and in the arms of the Dwarves. But the Darkness, all knowing in its nature, hunts you down. It has rallied its armies in your pursuit, and has cornered you around the gates of Minas Tirith.

### **CAN YOU IGNITE THE FLAMES AND UNITE THE FREE WORLD?**





which is an annular section with inner radius 1150mm and outer radius 2750mm. Zone B3, Zone R3 and Zone G3 constitute the inner zone which is the inner circular section of 1150mm.

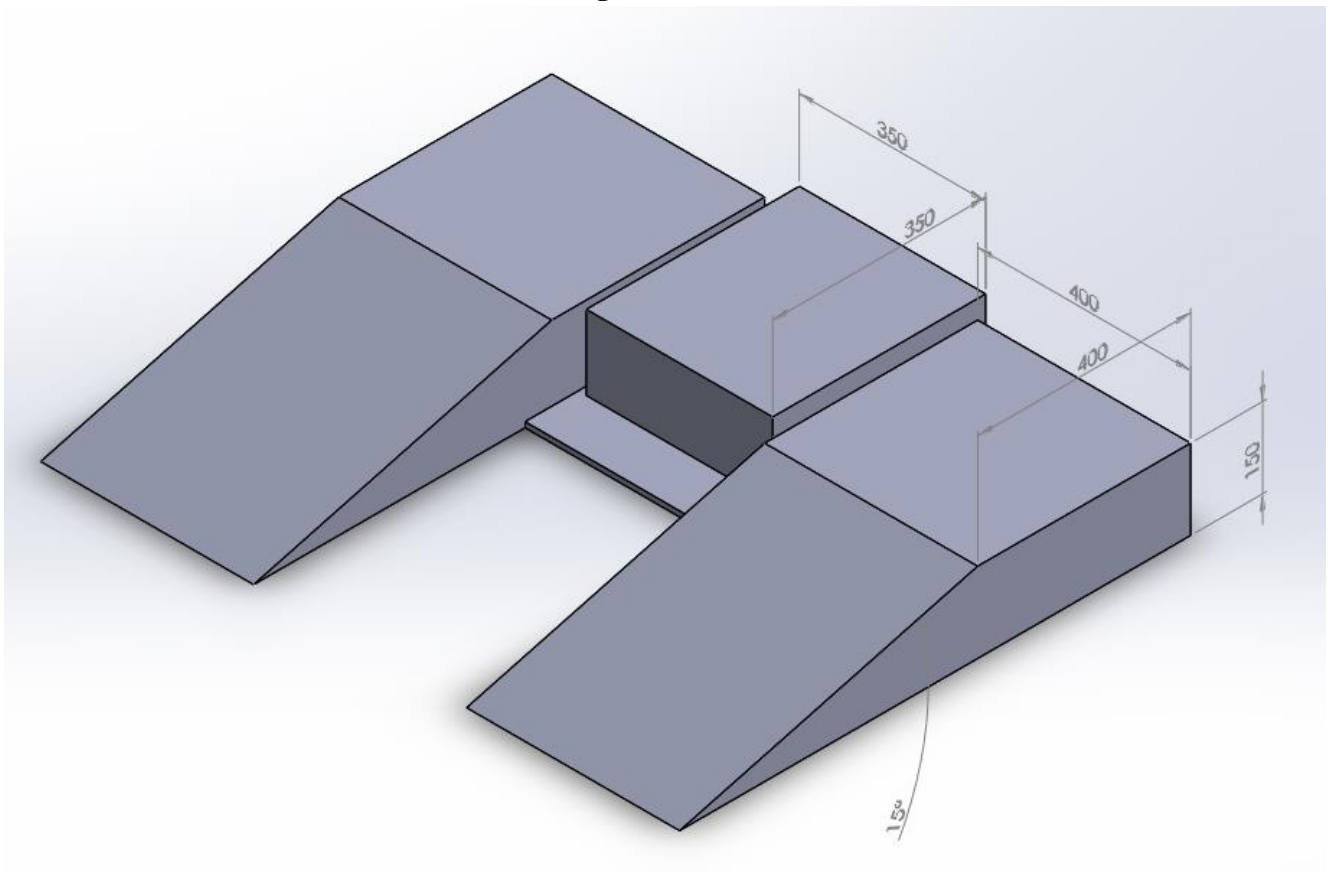
2.4 Zone B(B1,B2,B3), Zone G(G1,G2,G3) and Zone R(R1,R2,R3) are separated by a wall of height 50mm.

2.5 Starting zone for robot A in Zone B, Zone G and Zone R is denoted by SZ B, SZ G AND SZ R respectively. The check point for robot A in the outer zone will be its starting zone itself.

2.6 Starting zone and check point for robot B are both same and are denoted in Zone B, Zone G and Zone R is denoted by CP B, CP G and CP R respectively.

2.7 The outer zone and intermediate zone are connected by path P as shown in the fig.1.

**Fig.2 (Path P)**



#### 2.8 Description of Path P:

This dynamic obstacle consists of two ramps of inclination 15 degrees and a height of 150mm.

Two moving platforms of size 350\*350mm each are placed between the ramps.

The ramps and the moving platforms are at same elevation.

2.9 The check-point for robot A in the intermediate zone is the base of the ramp (in the intermediate zone) of Path P.

#### 2.10 Loading zone:

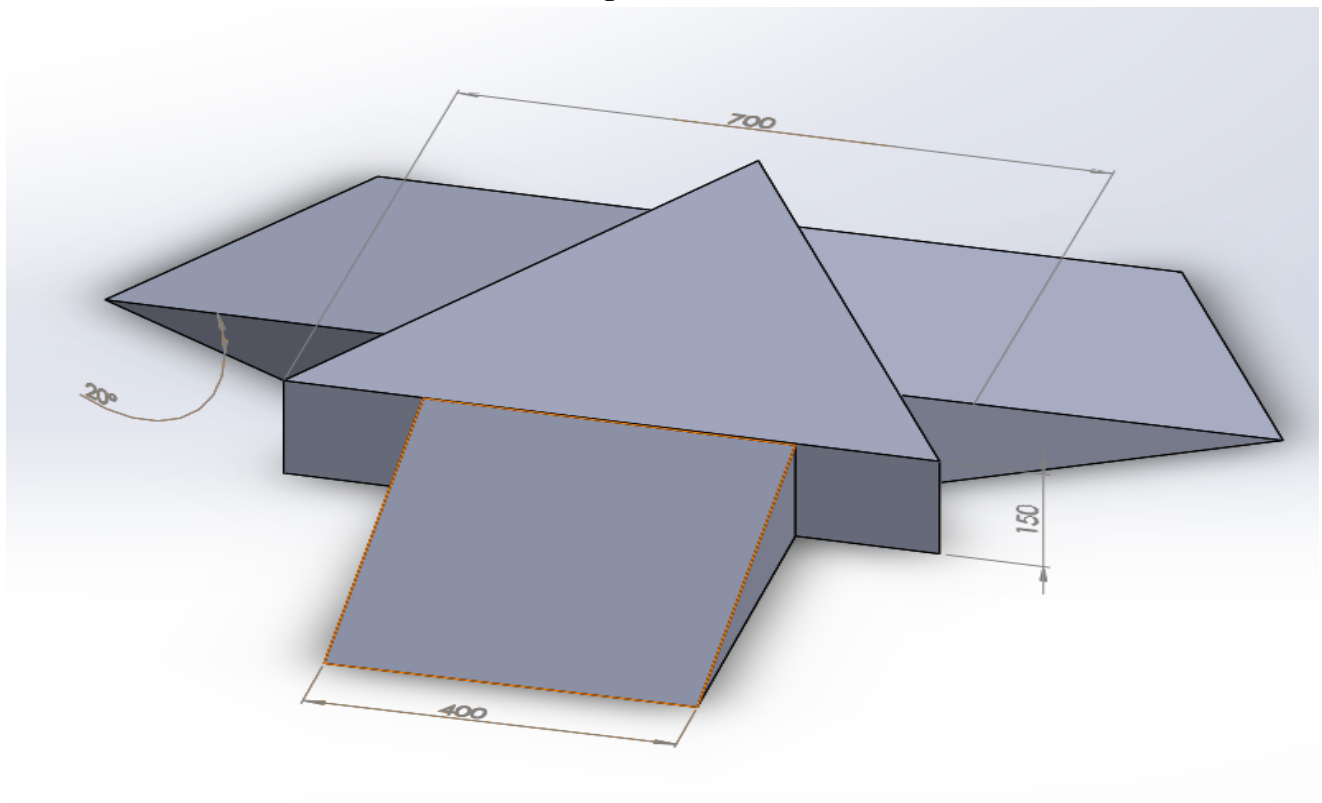
The ball is transferred from inner zone to intermediate zone between the robots in the loading zone. Each loading zone consists of a funnel of height of 100mm and the tip of the funnel at height of 250mm above the ground level. The diameter of the funnel at the top is 195mm and at the bottom is 80mm.

2.11 The targets are arranged in triangular fashion as denoted in Fig.2. Throwing zone is denoted in Fig.2. The minimum distance between the throwing zone and the first target is 500mm as shown in Fig.3. Each target is a plastic bottle (coke bottle) of 600ml volume containing 250 ml water.

2.12 Pick-up zone for every color zone consists of 5 balls of diameter 67mm of weight 120 grams are placed above PVC pipes of height 15mm.

2.13 Core zone is represented by the yellow colored circular region in the inner zone in Fig.3. The flame cubes of dimensions 100\*100\*100mm are placed in the core region between the ramps as denoted by the colored rectangular region in Fig.3.

**Fig.3 (HILL)**



#### 2.14 Hill (in the Core Zone):

It consists of three ramps one for each robot which ascend into a triangular platform of length of all sides 700mm. Each ramp has an inclination of 20 degrees and height of 150mm and a width of 400mm.

### **3. MISSION**

Mission is to finish at top of Minas Tirith (the Hill ) completing certain tasks/challenges along the way.

3.1 Each team has to build two Manual Robots Robot A and Robot B for completing the challenge.

#### **3.2 Tasks of robot A:**

3.2.1 The robot must navigate to the entrance to the intermediate zone

3.2.2 The robot must proceed to the intermediate zone from its respective home zone via the specified respective path.

3.2.3 In the intermediate zone, the robot A must progress to the ball loading sub-zone.

3.2.4 It must load the ball falling from the channel placed in the ball loading sub-zone.

3.2.5 The loaded ball should be used to knock over targets placed in the throwing zone.

#### **3.3 Tasks of robot B:**

3.3.1 The robot B must enter its respective pick up zone and pick up the balls placed.

3.3.2 The robot B must transfer the balls it picked, to robot A using the transfer funnel.

3.3.3 Following the successful transfer of all balls in its home zone (the 120 degree sector corresponding to its color), the robot must pick up balls from the foreign zone (opponents' home zone), and transfer balls to robot A, in order to gain bonus points.

3.3.4 Once all the balls (total 15 in number) leave the elevated zone, then the robot is to enter the core zone (sub-zone of the robot's home zone) and take the flame cube.

3.3.5 The flame cube should then be taken up the hill and placed above the hill plane.

3.3.6 The bot must also ensure that all its wheels rest atop the hill plane at the end of the challenge.

### **4. PROCEDURE**

#### **4.1 Tasks for robot A**

4.1.1 The robot must navigate from its starting zone to the intermediate zone by crossing the Path P.

##### **Path P:**

- The robot must climb a ramp.
- The robot must move across mobile platforms which translates to and fro in the direction perpendicular to the path.
- The robot must get down a ramp to enter its intermediate zone.

4.1.2 In case the robot skips the path P, a time penalty of 60 seconds will be imposed. The robot can resume only after 60 seconds from its check point in the intermediate zone.



4.1.3 After the successful entry into its intermediate zone, the robot A must proceed to the ball loading sub-zone (400mm\*400mm) of its intermediate zone.

4.1.4 It must successfully obtain a ball falling from a tube at a height of 100mm and may load it for the next task of throwing the ball.

4.1.5 The ball obtained from the ball loading area must be used to knock over bowling pins placed in the bowling zone in order to gain extra points. The robot must not leave its intermediate zone while doing so.

#### 4.2 Tasks of robot B:

4.2.1 The robot B must enter the pick-up sub-zone in its home-zone.

4.2.2 The robot B must pick up balls placed on its holder.

4.2.3 The robot B must coordinate with robot A so as to transfer the balls from the inner zone to the intermediate zone via the transfer funnel.

4.2.4 Once all the 5 balls of its own zone is transferred, only then the robot is permitted to pick up balls in the foreign zone (opponents' home zone) and transfer balls from it to maximize its points.

4.2.5 The wheels of the robot must not enter the foreign zone in any case. The robot must devise a way to pick up foreign zone balls without its wheels entering the foreign zone.

4.2.6 If any parts of the two robots touch each other in a foreign zone, then both the robots must be reset to their corresponding starting point in its inner zone.

4.2.7 Once all the balls leave the inner zone (elevated zone), then the robot is permitted to enter the core zone (sub-zone of the robot's home zone).

4.2.8 In the core zone the robot must pick up the flame cube, climb the ramp and place the mystery cube on top of the hill.

4.2.9 After the flame cube is loaded on the robot, it is considered to be a part of the robot.

4.2.10 If there is a robot already present on top of the hill, then no other robot is permitted to enter the top of the hill.

4.2.11 A robot will be considered to be on the top of the hill if all parts of the robot are above the hill plane.

4.2.12 If two robots touch each other when none of them are on top of the hill, then they must be reset from the location where its flame cube was placed.

4.2.13 The robot can climb the ramp only if it possesses the flame cube.

(Note: In case while picking up the ball from holder, the ball happens to fall out of the pickup zone towards the core zone. The coordinators will place the ball **on the same holder from which it was picked up**. This rule is designed as the ball cannot be easily picked up from that region due to space constraints.)

## 5. SCORING

Task Completed	Points awarded
<b>Robot A</b>	
Boarding the dynamic part of the path P	10
Leaving the dynamic part of the path P and descending the ramp in the intermediate zone	20
Loading of the ball into the robot	10
Launching of the ball into target zone (only if no target is knocked during that launch)	5
For each pin knocked	10
<b>Robot B</b>	
Picking up balls from holder in its home-zone	5
Picking up balls from holder in foreign-zone	15
Pushing the ball into the funnel successfully (only if the ball is not loaded into robot A)	5
Collecting the mystery box and carrying it till the base of the hill	20
Placing the mystery box on the top of the hill	40

## 6. VIOLATIONS

- 6.1 At any point during the match, the bot should not purposely hit the funnel in the intermediate area.
- 6.2 Bots are not allowed to cross over the walls or damage them.
- 6.3 The operator shouldn't disturb the arrangement of the balls in the ball zone.
- 6.4 The operator should not enter into the core zone (elevated zone).
- 6.5 For every Violation, the team responsible shall have to take a restart from the last checkpoint.
- 6.5 Operator must not enter the inner (elevated) zone.
- 6.6 Operator shouldn't disturb the arrangement of ball in the ball zone.
- 6.7 Operator should not touch robot other than at the time of retry.

## **7. PENALTIES**

7.1 Any damage to the dynamic obstacles will yield 10 negative points.

7.2 Time penalty of 60 seconds when skipping Path P (dynamic obstacle)

	Points Penalty	Time Penalty(seconds)
Skipping Dynamic Obstacles		-60
Damage to arena/Dynamic obstacles	-10	
Operator hits the balls intentionally	-10	
Operator pulling the bot intentionally using wires	-10	
Robot going outside the arena	-10	

**NOTE:** Penalties will be given by coordinators and coordinator's decision will be final.

## **8. RETRIES**

8.1 In case of any technical issues in any of the robot, the robot can be taken to the previous checkpoint with the consent of coordinators.

8.2 A retry can be opted at any time in the match. This retry can be opted for as many times as necessary without any penalty.

8.3 The referee needs to be informed before going for a retry.

8.4 All retries should be from the last checkpoint.

## **9. ROBOT SPECIFICATIONS**

9.1 Each team shall use only two manual robots.

9.2 Maximum dimensions of the robots at the start of the game are **300mm x 300mm x 300mm**.

9.3 The robots can extend after the start of the match.

9.4 Maximum allowable weights of the robots combined are **20 kg**.



- 9.5 The robots must not use ready-made parts and shall be designed and constructed by the students themselves, failing which the team will be disqualified.
- 9.6 Manual robots have to be operated by means of cable connection. The length of the cables should be at least 2 m. Wireless radio control is also permitted.
- 9.7 The manual robots can be powered with eliminator or a DC battery. The maximum voltage between any two points should not exceed 12V.
- 9.8 Hydraulics or chemical energy should not be used for any mechanism.
- 9.9 Pneumatics can be used and in case of use the pressure should be less than 6 bars.
- 9.10 If a team is using LiPo or Li-ion batteries, it is the team's responsibility to make sure there is no risk involved in its usage.
- 9.11 The bots shouldn't exceed the dimensional and weight constraints mentioned above.

## **10. RULES AND REGULATIONS**

- 10.1 The Game is three way match in which three teams compete simultaneously.
- 10.2 Each trial lasts for 6 minutes.
- 10.3 At the end of 6 minutes game will be ended by a blow of whistle.
- 10.4 1 minute shall be provided for setting up of Robots before the match.
- 10.5 Only two members of each team will be allowed to enter the game arena. Only in the case of reset, 3/4 members of a team will be allowed to enter the arena.
- 10.6 Only one team member is allowed to control one robot.
- 10.7 The robots shall be placed in their respective starting zones at the beginning of the match.
- 10.8 A robot cannot split into two or more subparts. Subpart implies a robot which has a drive mechanism of its own.
- 10.9 The manual robot operator can walk on the arena but should not disrupt any part of the arena and other the opponent team.
- 10.10 The two operators are allowed to touch their corresponding robots only during a retry & before the match starts.
- 10.11 All the statements written in this Problem Statement form the official framework of the rules to be followed by the teams. Violation of any statement in the Problem Statement may lead to disqualification.
- 10.12 Damage to arena is unacceptable and will lead to instant disqualification.
- 10.13 The robot exceeding the weight constraints shall be disqualified.
- 10.14 Referees have all rights to ask the teams to produce the additional explanations on design issues. Also the referees can ask for additional explanation on the safety of the bots if required anytime during the event.
- 10.15 Participating robots will be checked and tested, according to these rules and regulations.

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**NOTE :**

- 1) Game field dimensions are subject to a tolerance of  $\pm 5\%$ . No tolerances will be given in case of maximum bot dimensions.
- 2) The authenticity of any action not provided in this problem statement shall be subject to discretion of Coordinators.
- 3) Problem Statement, rules and regulations, and scoring pattern may be changed and the changes will be updated on Shaastra website. Participants are responsible to keep themselves updated about the changes. Keep visiting Shaastra website [www.shaastra.org](http://www.shaastra.org) for any updates regarding the event.
- 4) For any queries please mail to [robotics@shaastra.org](mailto:robotics@shaastra.org) with the subject 'Manual\_Query- <query description>'