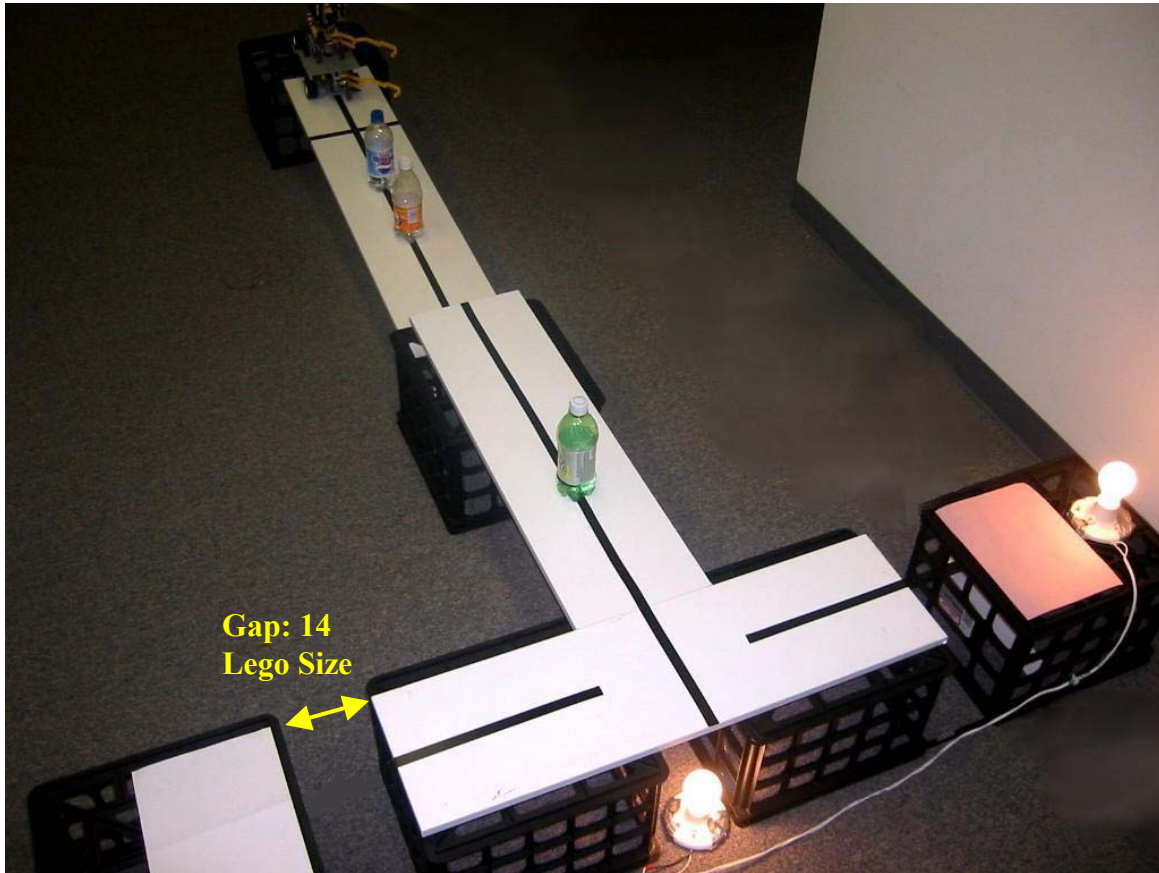


Robofest 2004 Earthquake Challenge

Feb. 21, 2004 Official Version



A sample playing field

I. Introduction

A Richter scale 7.9 earthquake hit a city (The famous San Francisco earthquake of 1906 was 7.8 on the Richter scale). Because many people, including rescuers themselves, are injured and trapped due to fires and collapsed buildings, it is impossible to send traditional ambulances to rescue people. Now it is time to send our intelligent mobile robots to extinguish fires, search and rescue people.

It has been reported that many people are trapped inside a burning building, but they cannot get out because of a huge crack in front of the building caused by the earthquake. A bridge to the building could be the only way to save many lives.

Your robotic mission is to send a robot, while removing debris with a ladder, to a burning building. The carrier (1st robot) must help the second robot (rescuer robot with a ladder) to reach the flat area. Then the rescuer robot must find the burning building while removing a concrete block on the road and make a bridge to the building to rescue people. Then the robot is supposed to do some unknown remaining missions, which will be unveiled on the day of the competition.

II. Game Objectives

The main goal of this robot game is to complete the entire mission without human aid in the shortest time.

III. Game Missions in Detail

The start zone is the only area where two human players can touch their robots. If human players touch the robots outside the start area, the robot must be re-started and the team will lose time. In general, the next mission can be attempted only if the previous mission is completed (except for the mission number 5 explained below). The following is the sequence of detailed missions:

1. **Waiting for the start signal:** Two robots are to be stacked at the starting base. Every part of the robots (except the ladder) must not cross the starting line. When the audible start signal is given, two human players can press the green buttons to start the robots. It is fine to start the second robot first, before the game start signal, if the second robot is activated with sensor inputs. *No remote control can be used to start robots.* If the stacked robot passes the start line, **5** points will be awarded. If the robots start before the game start signal, they have to restart their robots. As a result, they will lose time. Details about how to construct the ladder are described in section VI.
2. **Removing the first block:** Before reaching the flat road, there are two concrete blocks (Plastic soft drink bottles with 6 oz or 175 ml water; specs of the bottle can be found in section VIII) at unknown locations on the collapsed bridge. If the first one is dropped off the road, **10** points will be given. If failed, the game must be restarted from the beginning and the block(s) will be reset on the board by the referee.
3. **Removing the second block:** If the second block is dropped off, **10** points will be given. In case of any failure, the game must be restarted from the *beginning* by resetting two blocks on the collapsed bridge by the referee.
4. **Reaching the flat road:** If any of the two robots touch either the crate or the second board, then the team will get **5** points. If there is any failure, which requires a human's help, the team must restart the game from the beginning.
5. **Sending the 2nd robot onto the road:** If the second robot is placed on the second board safely at least for three seconds, then **15** points will be awarded. If unsuccessful, the game should be restarted and two blocks should be reset. However, it is also allowed to start the second robot manually from the start position of the road by selecting a different robot program for **2** points. This strategy will be helpful for the team to earn more points when the remaining time is short.
6. **Removing the third block:** There is another concrete block before reaching the end of the road. **10** points will be given if this is dropped off *the board where the bottle was placed*. If unsuccessful, the second robot should be restarted from the start of the road (second board), not from the beginning of the game.
7. **Reaching the end of the road:** There will be a bright lamp under the board as shown in figure 1 to indicate the end of the road. If the robot reaches the end of the continuous black line and it does not fall off, then **3** points will be given. If unsuccessful, then the second robot must be restarted from the start of the road (second board).
8. **Finding the right direction:** When the second robot is started successfully on the flat road, the referee will place a lamp on either the left or right side crate. If the robot finds the correct direction and start to follow the line toward the bright lamp then **10** points will be awarded. It

is all right to rotate to find the right direction, however, it must not go over the wrong black line. Otherwise (for example, it follows the wrong line), it must be restarted from the start of the road.

9. **Making the bridge:** If the ladder is dropped and placed successfully to make a bridge to rescue people over the cracked road, then **15** points will be given. The ladder must ***touch*** both the last board and the crate (any part of each). If the ladder is dropped but did not make the bridge, then 5 points will be given. If either this mission was a total failure or the team got only 5 points, the team may restart the 2nd robot from the start of the road.
10. **Unknown mission 1 and 2:** After rescuing trapped people from the building, there will be two unknown missions for 7 points, which will be announced on the day of the competition. These missions will require only additional programming if the robot has a light sensor to follow the line.
11. If all missions are completed in a sequence from the beginning till the end without *any* human help, then 5 points will be given.

IV. Game Rules

- The brightness of the competition area is unknown. Students should be able to adjust their programs or write programs to self-adjust on the fly for the light changes.
- 2 minutes per game are given
- There will be two rounds for every team. For each round, if a team is ready to compete, two members must bring the scoring sheet to referees and must be sitting on the chairs, which form a line. The official team package has one scoring sheet for the first round; and one sheet for the second round. Teams will compete on a first come first served base without using a predetermined order.
- If a team misses the final call for a round, the team loses the chance to run for that round.
- If there are more than 20 teams for a division at the competition site, the top 6 to 8 teams, based on the performance the ***average*** of two scores, will advance to the semi-finals. The tiebreaker in this decision will be (1) the average total *time* taken, (2) the best total time out of two runs, and (3) the best total score out of two runs
- Based on the results of two semi-finals, the best three (or four) teams will advance to the final match. The final match will decide the champion team.
- If the number of teams for a division for a site is less than 20, there will be only one final match for three or four teams.
- The performance score from the final matches of all the Robofest 2004 sites will decide a national champion team.

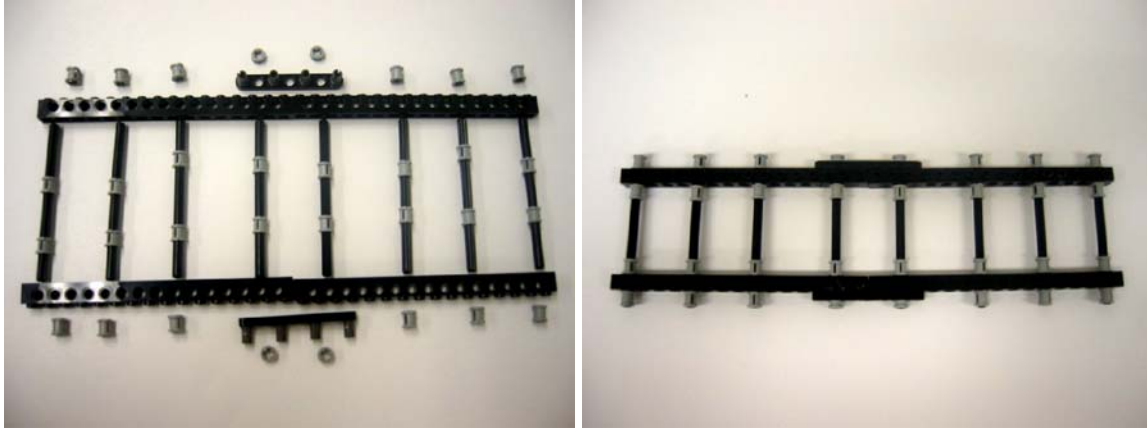
V. Robot Qualifications

- The robot must fit inside a box of these dimensions: width 9.5" and length 12" (No height limitation). However, during the game, the robot may extend its dimensions.
- You may use any number/type of sensors
- You may use any number/type of motors
- You may use ***only*** standard Lego blocks
- You may ***not*** tape/glue Lego blocks
- You may use only one RCX brick (robot controller) for each robot.

VI. Playing Field Instructions

Ladder

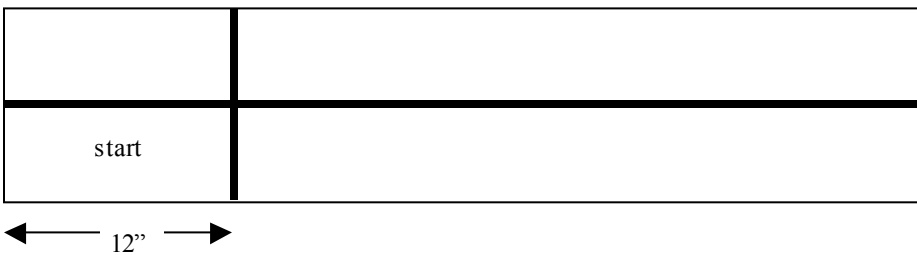
Four 16-size beams and 8 10-size axles are to be used.



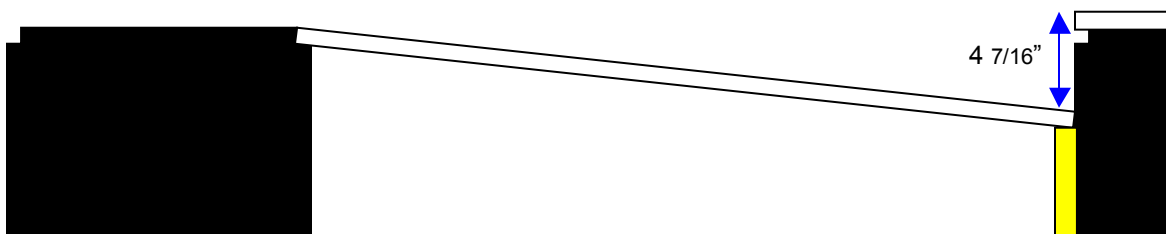
Tracks

Multipurpose white shelves with black lines as shown below are to be used. Note that the actual width of the 10"x48" and 10"x36" bookshelves you can buy from local stores is slightly less than the specified size. The thickness of the bookshelves is about 5/8". Black standard electrical tape (width of 0.75") will be taped approximately in the middle of each shelf.

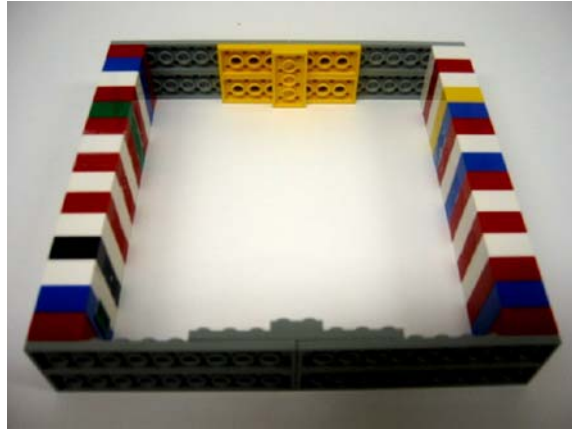
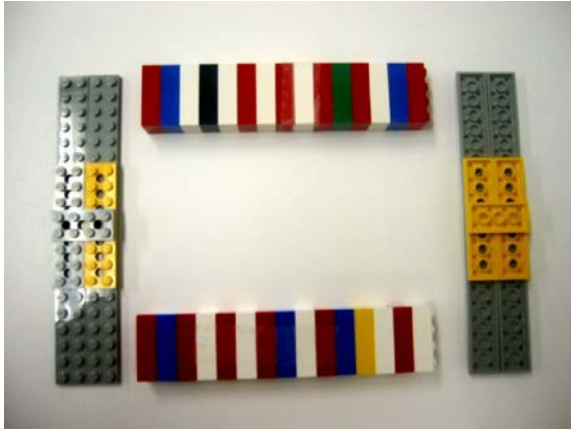
First track (10x48")



It will be placed on the Sterilite crate as shown below.



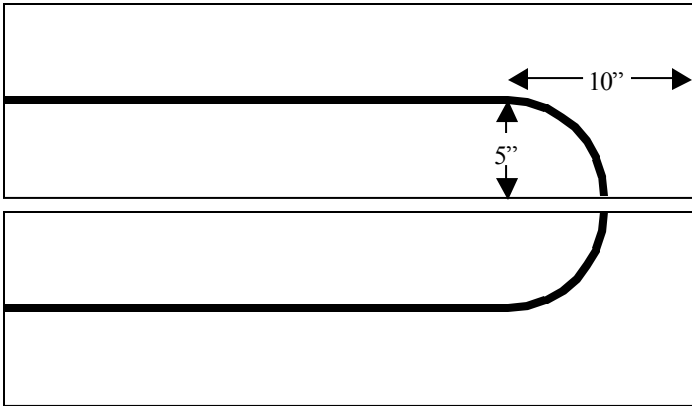
The collapsed bridge supporter shown in yellow in the picture above is built using standard Lego blocks as shown in the following:



Second track (10x36")

One of the following shapes will be used. The left side of the board (straight line) is connected to the first board.

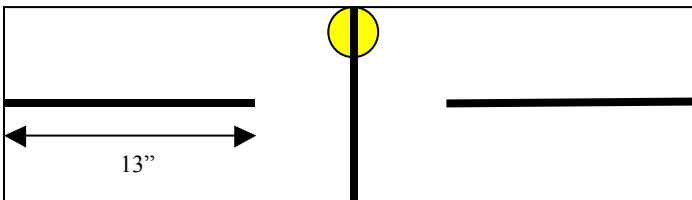




Middle tracks (10x36")

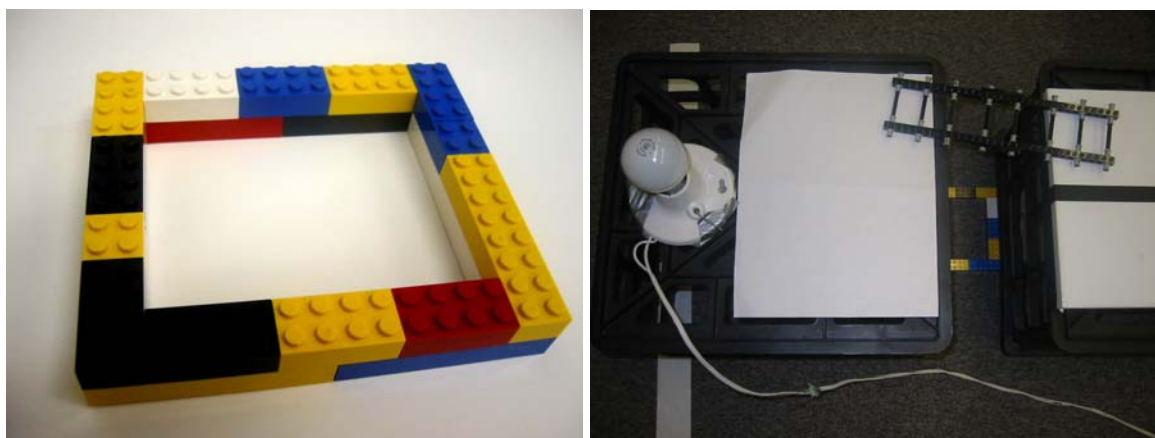
Zero to two boards will be used chosen from the above three shapes, which means the length of the total path is unknown. The photo on the first page is an example of using no middle tracks. The left side (straight line) of the above boards will be connected to the centerline of the last board.

Last track (10x36")



The above board is placed on crates as shown in the photo on the first page. Note that the last board is placed in the middle of two supporting crates. Also note that the location of the lamp below the end of the line is shown in yellow above. For safety reasons, in case the robot drops, the bulb will be placed inside of the board, but it is still bright enough to be detected by Lego sensors.

The distance between a supporting crate and a crate representing the building is 14 in Lego size. The photo below shows the Lego structure that will be placed between two crates. Only Sterilite crates will be used for the official playing field. On the crate, a letter-size piece of white paper will be placed. The paper does not cover the “rib”, but it is placed inside of the rib as shown in a photo below. The exact location of the lamp is also shown in the photo. There will be a wall behind the lamp for the official competition arena with multiple tracks in order to prevent it from being seen from other fields.



Misc. Info

All the edges (not the center area) of the shelves will be taped together using transparent packaging tape (2" width). If your robot is using Lego skids, make sure they can slide over the tape.

The color of the floor where the shelves will be placed should be dark, but unknown. (For example, LTU site's floor color is dark blue). You may use this knowledge for your navigation method. Team members are responsible for catching the robot if it falls off.

VII. Advanced Robot Competition Division Rules

Every thing is same as the above. The only difference is that the number of concrete blocks *for the 2nd robot* is unknown until each game is started.

VIII. Purchase list for one playing field

Item	Spec. / Description	Quantity	Estimated Unit Price	Estimated Price
Plastic pull chain lamp holder *2	Leviton	2	\$2.96	\$5.92
Easy-to-wire plug *2	Leviton	2	\$1.87	\$3.74
Electrical wire *2		20ft	\$0.13	\$2.60
All purpose white shelf*	5/8 thick, Approx. 10"x36"	3 (or 4)	\$6.29	\$18.87
All purpose white shelf*	5/8 thick, Approx. 10"x48"	1	\$7.89	\$7.89
Storage Crate*, *3	Sterilite, 15 1/4"L x 13 3/4"W x 10 1/2"H, 1692, www.sterilite.com	7 (or 8)	\$2.00	\$14.00
40W Bulb *2	GE Softwhite x 4	1	\$1.48	\$1.48
Standard electrical tape *	Black, PVC tape	1	\$1.19	\$1.19
Plastic bottles from Pepsi Co. (vending machine)	20 oz (591 ml), height: about 8.5"	3	\$1.00	\$3.00
			Total (w/o tax)	\$58.69

*- purchased at Meijer *2- purchased at HomeDepot *3- True Value hardware store: www.truevalue.com

The following extra Lego items may be needed for this challenge

- 9V geared motors (Lego item number: 775225, \$16.25)
- Light Sensors (Lego item number: 779758, \$14.99)
- Additional Lego Pieces
- Rotation (angle) sensor (Lego item number: 979891, \$16.99)

Where to purchase Lego RCX and parts

- <http://www.pitsco-legodacta.com/>
- <http://shop.lego.com/>
- Lego Dacta: 1-800-362-4308; 1-877-371-8709
- Lego Shop: 1-800-453-4652

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