



RULES 2018

25th edition of robotic contests



NOTE: all images in this document are provided as a guide to illustrate the various paragraphs. In no case they can serve as a reference. Only the dimensions, colors and materials indicated in the appendix shall be taken into consideration.

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A.NOTICE

WARNING!

This document presents the **Eurobot^{Open}** and **Eurobot^{Open} Junior** 2018 rules. To distinguish between them, you will find the information dealing with Eurobot^{Open} in **blue** and Eurobot^{Open} Junior in **yellow**. Information common to both rules is in **black**.

This block is an example of Eurobot^{OPEN} rules.



This block is an example of Eurobot^{OPEN} Junior rules.



WARNING!

General remarks are also annotated in the document. Please pay special attention to these points.

This text is an example of remark to all participants.

Good reading

B.CONTEST PRESENTATION

Eurobot^{Open} and Eurobot^{Open} Junior are two events open to young robotics teams of amateurs. These teams can be composed of students involved in Eurobot^{Open} in the frame of a school project, group of friends, or independent clubs. Eurobot^{Open} and Eurobot^{Open} Junior share the same goal: to allow young people to be involved in an active-learning process and put into practice their knowledge and know-how by participating in a fun and friendly event.

About Eurobot^{Open}

The age limit for participating in the Eurobot^{Open} final is 30 years old. Each team may have a supervisor to whom the age limit does not apply. Teams that do not respect this age limit will not be allowed to participate in the Eurobot^{Open} final. The technical challenge is to build an autonomous robot as well as an optional secondary autonomous robot.

About Eurobot^{Open} Junior

The age limit for participating in the Eurobot^{Open} Junior final is 18 years old. Each team may have a supervisor to whom the age limit does not apply. The technical challenge is to build a remote controlled robot as well as an optional autonomous robot.

Be careful, according to your country's educational system, this age limit may be slightly different. Check the registration requirements stated by your National Organizing Committee.

A team is a group of young people who have built one or two robots for the event.

One young people can be part of only one team, even if several teams can belong to the same organization. However, we encourage teams to share their expertise.

The project can be supervised by someone over the age limit (teacher, parent, group leader, etc.), but all elements of the robot(s) must therefore be designed by the young. In this context, robots manufactured from a commercially purchased chassis or rolling base will not be accepted.

The objective of the secondary robot is to allow young people to experiment with programming. It is tolerated to use a commercial robotic base for this robot unlike the main robot. As the work is mainly on programming, it will be asked during the registration that the young people present the program and are able to explain it to the referees.

One organization (club, school, etc.) can supervise and register several teams, if allowed by the registration requirements set by your National Organizing Committee. The acceptance of these requirements is compulsory to validate your registration and your entry.

Eurobot^{Open} and Eurobot^{Open} Junior are intended to be held in a friendly, sporting and fair-play spirit. As for every sport events, refereeing decisions are pronounced with no possible recourse, except if an agreement between each participant is met.

Eurobot^{Open} and Eurobot^{Open} Junior European finals gather teams which are selected on national finals. These final events take place in Europe, but remain open to all other countries. Countries where more than three teams are registered must organize a national qualification, in order to select teams among registered teams that will attend the international final.

As usual, some parameters can vary from one year to the next. Accordingly, please read the rules carefully even if the chapters may seem familiar to you (playing field dimensions, robots dimensions, starting area dimensions etc.).

The rules for both events (Eurobot^{Open} and Eurobot^{Open} Junior) are similar. The aim of this approach is to provide an almost common platform for the Eurobot^{Open} event, dedicated to autonomous robots, and for Eurobot^{Open} Junior event, dedicated to wire-guided robots. Thus, a Eurobot^{Open} organizer also has the ability to organize a Eurobot^{Open} Junior contest, and vice versa. Think about it when you will organize an official or friendly event.

Robotics contests are held at mass events. Therefore, we ask the teams to respect the rules of decency and safety (electrical, sound level, know how to live...). These rules apply to the persons and equipment they bring.

C.THEME PRESENTATION

75 years ago, Isaac Asimov created the 3 laws of robotics:

- A robot may not injure a human being or, through inaction, allow a human being to come to harm.
- A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
- A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

Today, robots need new laws to build new cities even as the preservation of the environment is a major issue of the coming decades. These new laws are:

- a robot must preserve its environment;
- a robot may use the natural resources available around it unless such orders conflict with the first law;
- a robot can build comfortable houses for the use of its inhabitants so long as it does not conflict with the first or second law.

It is by following these new laws at best that your robots will have to evolve.

Your missions will be:

- **Provide drinking water to the city.** Water is an important resource and its recycling is essential to preserve it.
- **Build buildings.** We must build housing for the inhabitants of this new city.
- **Power its home automation panel.** To control your city well, you have to take care of your home automation panel.
- **Foraging a flower.** Pollination and the survival of bees are important for biodiversity in the city and the maintenance of the ecosystem.
- **Evaluate its performance.** As with any project, it is also important to know what has been achieved.

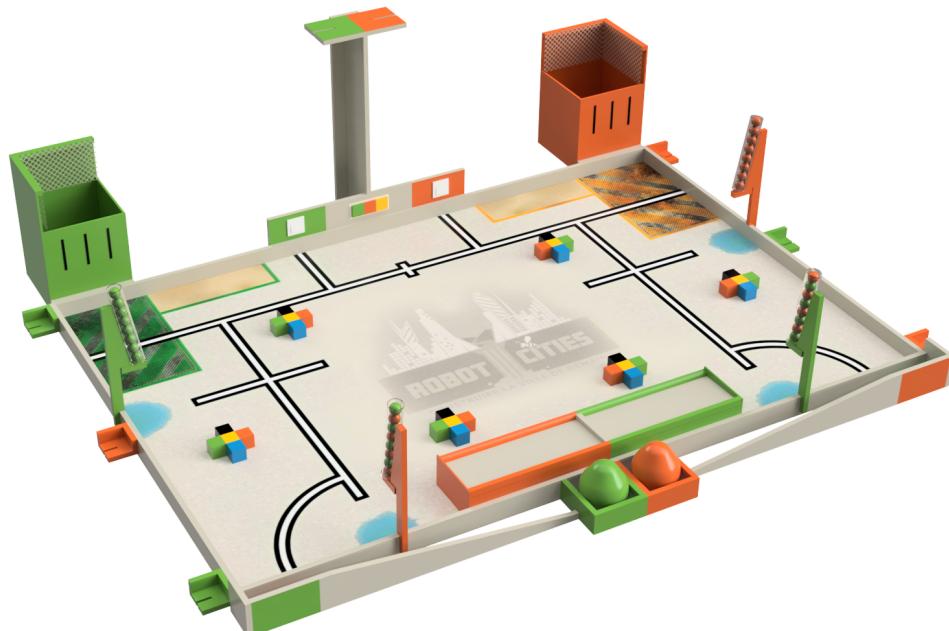
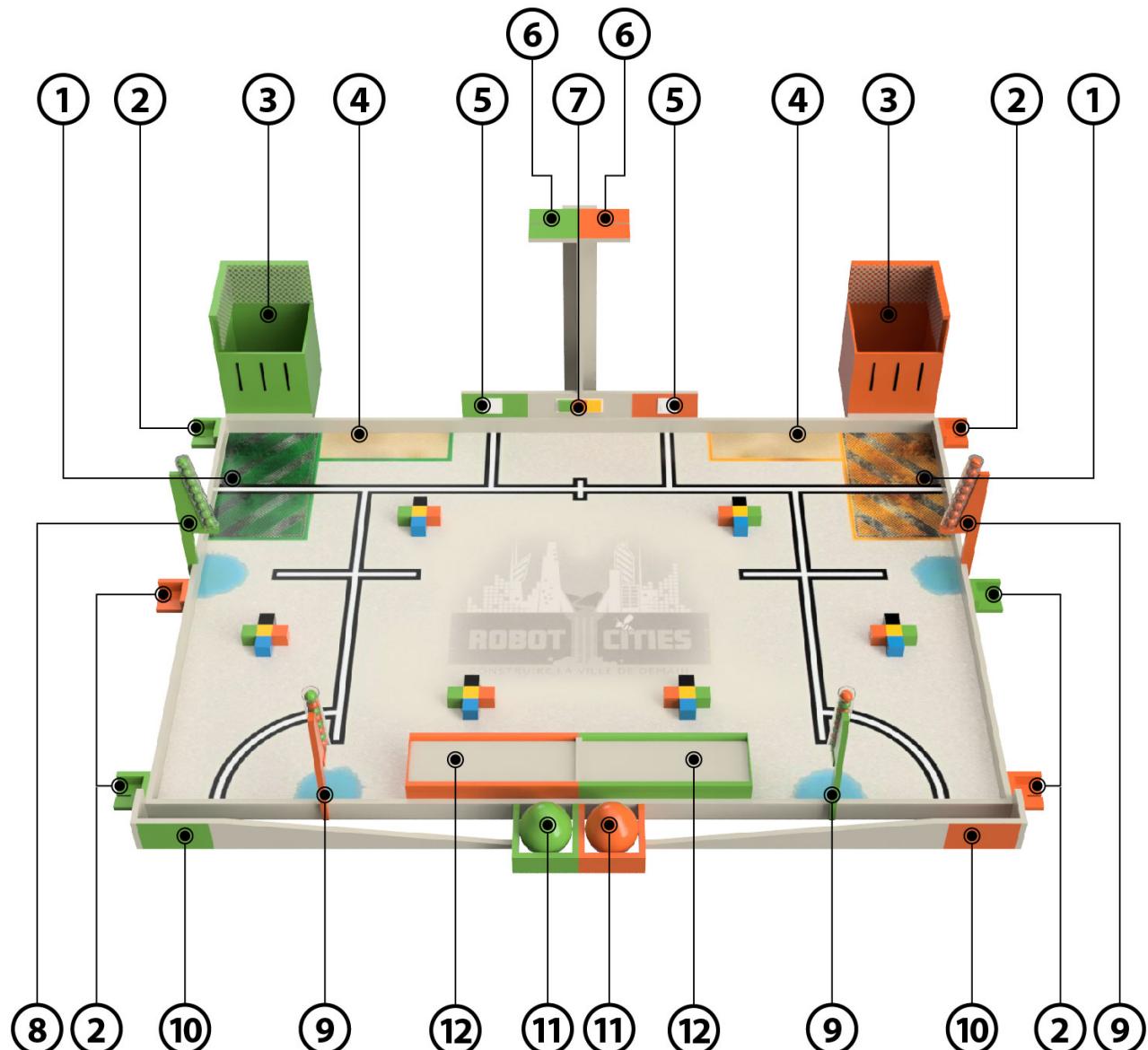


Figure 1 - Overview of the playing area with game elements

Watch out:

All actions are independent from one another and no specific sequence is imposed whatsoever.

No single action is compulsory. Give careful thought to your strategy. It is strongly recommended to focus on designing simple and reliable systems over a limited number of actions.



1 – Starting areas

2 – Fixed beacons

3 – Water towers

4 – Construction areas

5 – Home automation switch

6 – Central tracking device

7 – Construction plan

8 – Wastewater recuperators (singled color)

9 – Wastewater recuperators (multicolour)

10 – Bee starting areas

11 – Flower

12 – Wastewater treatment plant

D.PLAYING AREA AND ACTIONS

D.1. IMPORTANT INFORMATION

Organizers commit themselves to build the playing area with as much accuracy as possible. Nevertheless, they reserve the right to some modifications if they think it is necessary.

No objections regarding differences in dimensions will be taken into account.

Possible changes of the technical specifications will be announced on the Eurobot website, (<http://www.eurobot.org/>) or on the website of the National Organization Committee (NOC) in your country.

Teams are advised that the quality of the painting on surfaces can vary from one table to another, and can deteriorate as time goes by.

If any problem regarding the rules occurs, the specifications of the playing area and its elements could be changed during the year. We therefore strongly encourage the participants to check our website regularly (<http://www.eurobot.org/>) as well as your NOC's own website for news. You can also follow the discussions and get further information in the forum (<http://www.planete-sciences.org/forums/>).

The answers in the forum are provided by an official referee and are taken into account during match plays and approvals rounds.

D.2. PLAYING AREA

The playing area is a **horizontal** rectangular plane of 3 000 mm by 2 000 mm with borders on each side. Depending on the carpenter, it may consist of one or more pieces (eg 3 pieces of 1 000 mm per 2 000 mm). References and plans are provided in the appendix.

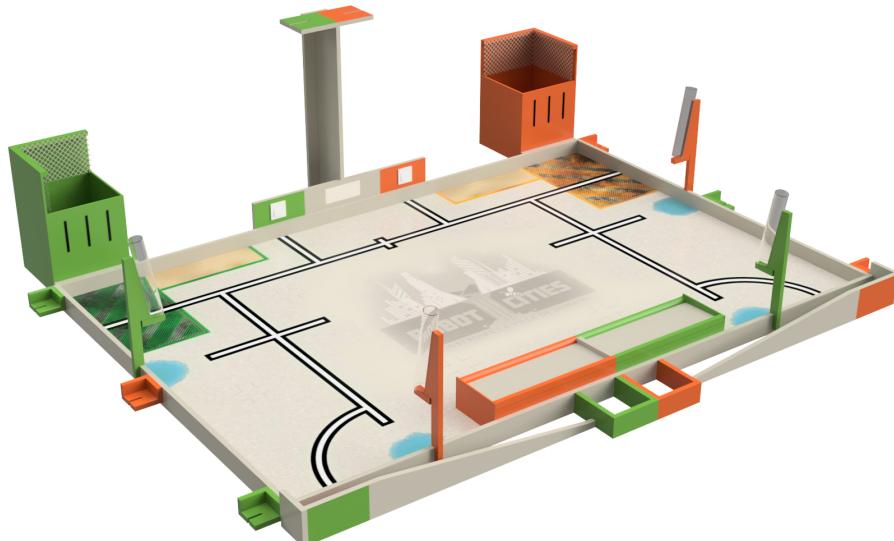


Figure 2 – Overviewing of the playing area without any elements

Full specifications of the playing area and game elements (dimensions, positions at the beginning of the match, colors and other references) are listed in the appendix.

In the rest of this document, horizontal and vertical directions are stated relative to the playing area. Notions of "left", "right", "front", and "back" are stated with respect to the spectator's point of view.

D.3. STARTING AREAS

D.3.a. DESCRIPTION

Each robot has a construction hut, which will serve as a starting point. Each starting area is the color of the team.

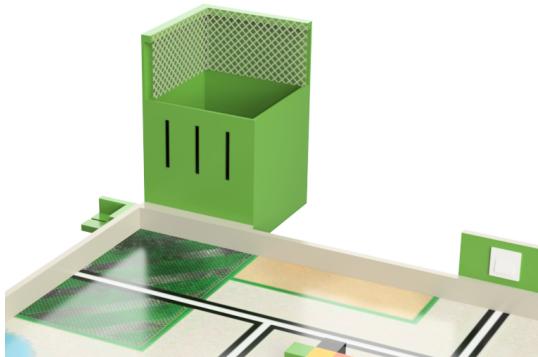


Figure 3 - A-team starting area



Figure 4 - B-team starting area

D.3.b. CONSTRAINTS

Before starting, the robots must not exceed the limits of the starting area in vertical projection. Make sure your robots can enter the starting area completely. Be careful, the edges of the playing area are excluded from the starting area.

The robots are not allowed to enter the starting area of the opposing team during the entire match.

D.4. FEEDING THE CITY WITH DRINKING WATER

Water is a precious resource without which no one can live. Knowing how to treat wastewater and reuse it for city food is very important to preserve this resource. The task of the robots will be to collect and treat the waste water of their color in the water tower and to deposit the others (water of the color of the opposing team) in the appropriate wastewater treatment plant.

D.4.a. DESCRIPTION AND LAYOUT OF THE GAME ELEMENTS

The water to be treated: these are 44 mm diameter foam balls of the color of each team.



Figure 5 – Wastewater balls

Wastewater recuperator: these are four transparent inclined tubes containing the water to be treated, closed in their lower part by a latch in the color of one of the two teams. On each side of the ground there are two recuperators:

- one in the vicinity of each starting zone containing 8 balls of the color of the nearest starting zone and whose latch has the same color; a mixture of 4 balls of each color and whose latch color is that of the near start zone;
- the other, located farther to the front of the table, containing a mixture of balls of the two colors alternately. The color of this recuperator and of the lower ball is that of the furthest away zone.

The wastewater treatment plant: it consists of two raised areas. It is located at the front and middle of the table. Each team has its own storage bin.

Water towers: each team has one. They are represented by a basket in height behind the starting area, in the corner of the table. An opening at the top allows the treated water to be sent to the upper part of the water tower.

D.4.b. ACTIONS AND CONSTRAINTS

Actions:

- The robots must first "open" the access to the water to be treated contained in the waste water collectors by actuating the latch.
- They must then recover the water to be treated (balls) and can:
 - deposit the balls of their color in their water tower,
 - deposit the balls of the opponent color in their storage tank of the treatment plant.

Constraints:

- Robots can retrieve waste water from the oppressor's sewage treatment plant if they are used as part of their own removal action.
- It is not allowed to open the latch of the opponent.
- Points marked by the deposition of water in a water tower will be counted if only if no ball of the opposite color pollutes it.
- It is forbidden to send water to the opponent's water tower.
- A latch is said to be "open" when at least one ball is completely removed from the recuperator which contained it by passing through the opening created in its lower part. It is obviously not allowed to take the balls out of the recuperators by any other means.

D.5. BUILDING HEQ BUILDINGS (HIGH ENERGY QUALITY)

The city of the future will need housing made from materials that are found on the ground. If the robot respects the construction plan, the environment will be protected optimally.

D.5.a. DESCRIPTION AND LAYOUT OF THE GAME ELEMENTS

Construction cubes: these are the stages of constructions, the color of which represents the type of material. They are arranged at the beginning of the match by a pack of 5 cubes (one of each color) according to the diagram given in the appendix.

- yellow: straw construction
- green: plant construction
- black: industrial construction
- blue: solar panel construction
- orange: brick construction



Figure 6 – Construction cubes

Golden cubes: these are white "joker" cubes and can have colorful decorations.

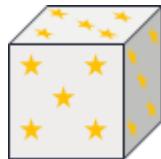


Figure 7 - Golden cube

Construction plan: This is the plan of 3 consecutive floors of a building that will be defined after the preparation of the robots. The plan is selected by random drawing from a set of cards offering multiple combinations.

Each plane consists of three squares of different colors. They represent three floors of a building. The plan is installed on a vertical support located behind the construction area.

Construction area: Buildings must be built on the building area reserved for them. These areas are located against the large border at the back of the playing area near the starting area.

D.5.b. ACTIONS ET CONSTRAINTS

Actions:

Report building materials to build buildings in construction areas. The higher the building, the more housing it can hold, the more points it will earn. A construction containing consecutively the 3 floors described by the construction plan will be more environmentally friendly and will also yield more points, for this the colors of the building must be in the same order as those of the plan (in the direct or reverse direction).

Constraints:

- One stage is valid if and only if:
 - it is at least partially in the construction zone in vertical projection;
 - One of its faces is horizontal and in contact with either the ground or another valid floor.
 - The three floors described by the construction plan can start at any level of the tower.
- A floor can be part of at most one combination representing the construction plan. In the case where several configurations are possible, the most favorable case will be taken into account.
- Two "golden cubes" are put at the disposal of each team by the organization to be embedded in the robots during the preparation time. They may replace any building material, but a succession of floors conforming to the plan may contain at most one golden cube.
- The buildings are limited to five floors. Any floor above will not be taken into account.
- Robots are not allowed to enter the construction zone of the opposing team. Consequently, it is forbidden to destroy a building or to remove cubes already installed in the adverse construction area.

D.6. FEEDING ITS HOME AUTOMATION PANEL

D.6.a. DESCRIPTION AND LAYOUT OF THE GAME ELEMENTS

Home automation panel: this is a panel, to be designed by the teams, which will be positioned in front of the water tower.



Figure 8 – Home automation panel example

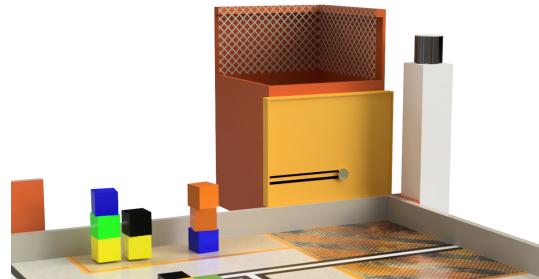


Figure 9 - Home automation panel example

Home automation switch: it is a fixed part located at the back of the table that the robot must activate to activate the home automation panel. Each team has a home automation switch.

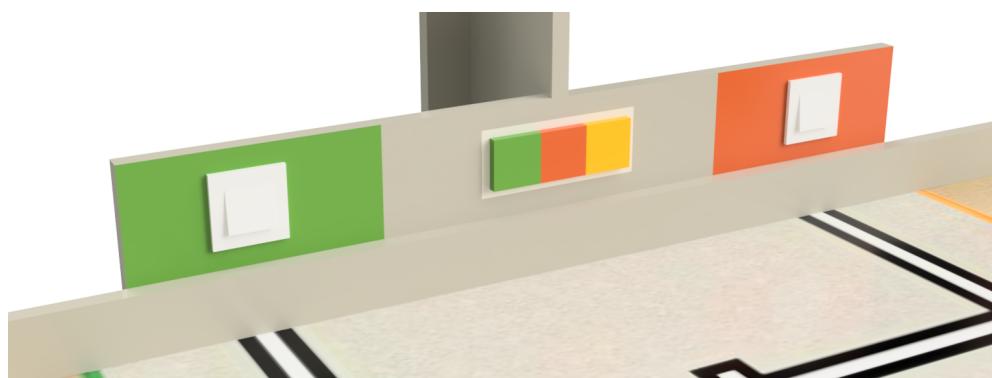


Figure 10 – Home automation switch

D.6.b. ACTIONS ET CONSTRAINTS

Actions:

Deposit the panel in front of the water tower during the preparation time. The front of the water tower is equipped with Velcro hook side according to the diagram provided in appendix.

Push the switch to power the home automation panel. The switch closes when pressed down.

Constraints:

- The panel may contain one and only one power source. The ground switch must switch the power supply to the panel directly. To do this one of the wires of the power source must be connected to the switch of the playground.
- It is not allowed to act on the switch of the home automation panel (to open or close it).
- The home automation panel must be equipped with:
 - of cables of at least 1.5 meters to be connected to the home automation switch via male and secured plugs of the "banana" type of 4 mm during the preparation time. The bases connected to the switch and provided by the organizers will be of the female type;
 - velcro side velvet back, so as to secure with the front face of the water tower;
 - an internal battery.
- In addition to its Velcro fastening to the water tower, it must rest on the edge of the playing area
- The home automation panel must not extend beyond the perimeter of the playing area, except its cables connecting it to the switch.
- The activated panel must be visible to the public. It may be lighting, mechanical or other action. The public must be able to easily notice if the panel is activated or not even after the end of the match.
- The width of the panel must be between 400 mm and 1000 mm, its height between 297 mm and 400 mm and its thickness not more than 80 mm. The weight of the panel must not exceed 2 kg.

The use of a screen as display is allowed only to display home automation information related to the current game. It will not display any video, images, photos or advertisements.

For Eurobot^{Open} Junior, it is tolerated that the power supply of the panel is connected to the power supply of the robot control panel.

Exception. During the final stages of the Eurobot^{Open} meetings, it is permissible to switch off the power to the home automation panel by opening the switch.

D.7. FORAGING A FLOWER

D.7.a. DESCRIPTION AND LAYOUT OF THE GAME ELEMENTS

Beehive: this is the starting area of the bee. It is located at the front of the ground in each corner, on a specific border. Each team has a hive in its color on the same side as its starting area.

Flower: this is a ball located on the front and center of the playing area. Each team has a flower in its color.

Path of honey: This is a straight track materialized by a beam between the hive and the flower. This track (one per team) contains a slope to bring the bee to its flower.

Bee: an additional mini robot with purely mechanical action made by the teams.

D.7.b. ACTIONS ET CONSTRAINTS

Actions:

Each bee will have to go foraging the flower of its color. This action is materialized by the bursting of the ball of the color of the team.

Constraints:

- The bee will have the following maximum dimensions:
 - 15 cm wide;
 - 20 cm in length;
 - 20 cm high.
- The bee will be devoid of electricity (no battery, capacitor, battery, coil, etc.).
- It must be visible to the public.
- A robot will have to touch the bee so that it leaves its hive to go to fetch the flower.
- The ball must have exploded at the end of the match so that the action is validated.
- It is forbidden to prevent the honeybee from reaching its flower.
- It is not allowed to forage the flower of the other team.
- The action must not be dangerous for the public, the playing field or the robots in the presence. Appropriate protection should be provided when using a sharp element during transport.
- At no time should the honey beat, in vertical projection, on the horizontal game board dedicated to the robots.
- The bee must remain in contact with the ramp.

D.8. EVALUATE ITS PERFORMANCE

D.8.a. DESCRIPTION AND LAYOUT OF THE GAME ELEMENTS

The device for displaying the score estimation made during the match must be present on one or more robots:

- it can be static (sheet of paper, slate, ...).
- be dynamic (electronic display) and located on a robot or on the home automation panel (making sure that it is activated).

D.8.b. ACTIONS ET CONSTRAINTS

- The team must evaluate the number of points made in the match by its robot(s). For this, two exclusive options:
 - Pre-match evaluation on a static display: the team records by hand the score it intends to make during the match.
 - Evaluation during a match on a dynamic display device.
- The display area and its sense of reading must be easily visible and identifiable by the referees.
- The estimated score must be expressed in decimal.
- It is allowed for a team with two robots to design a display for each robot. In this case, his score assessment will be the sum of the values of the two displays.
- In the case of dynamic displays, the scores must not change after the match is finished, otherwise the bonus will be 0. In addition, these dynamic displays must continue to display the estimated score after the end of the match, without changing the value once the match is over.

E. PROJECT PRESENTATION

Both Eurobot^{Open} and Eurobot^{Open} Junior encourage you to practice science through entertainment. One of the fundamental objectives is to assist and value your work and projects of this year. To achieve this, we require you to make a Technical survey and a Poster.

It is demanded to create attractive robots and, if possible according to the rules theme. To be creative and original will add value to your effort as much as the performance of your robot(s) is (are) during the matches. That will increase the value of your project communication and visual effect of your robots, for both the public coming to the events and for your own satisfaction of having created something aesthetically and functionally completed.

E.1. EUROBOT^{OPEN} TECHNICAL POSTER

Each team is required to provide a technical poster. This poster should present information related to the design of the robot (drawings, technical references, design specifications, etc.). It should be at least DIN A1 (594x841 mm) in size, and should ideally be printed. The poster is intended to promote exchange and communication between teams.

Special vulgarization effort should be made to render the contents of the poster accessible to a novice audience. The poster should ideally include pictures and charts to explain the concepts.

The poster must also include:

- *The name of the team,*
- *The names of team members,*
- *The country of the team*

This poster will be posted on the team booth at the venues. For the international final, an English version will be requested. The chosen resolution must guarantee the readability of all texts. The resulting PDF file must not exceed 25 MB. The PDF version of the poster may be sent to the organization prior to the meeting via your national organizing committee.

In general, the organization encourages teams to communicate around their projects, on the Internet, via forums, etc.

E.2. EUROBOT^{OPEN} JUNIOR

As for previous years, the presentation of your team's project (through project management on the long-term, tasks distribution ...) as well of your robots (technical systems implemented, chosen strategies ...) is an integral part of the event. Teams should present their projects in a way that is easily understandable and visible for the public and the other participants.

E.2.a. CONSTRAINTS

This presentation must be made on a panel size A1 (594 x 841 mm) at least. If you want to use other visual media than paper it is quite possible. Let your imagination be free!

On the other hand, we propose to the teams to hold a blog explaining progressively the progress of the realization of the robot ("logbook"). The creation of this blog will be done automatically when the teams register on the Poolzor software, and the procedure to be followed will be explained in detail. A blog is not mandatory to validate the registration, but we strongly encourage the teams to do so in order to promote the exchange around their projects.

E.2.b. EVALUATION

The project must be exposed to the referees and / or guardian angels during the homologation of the robot to allow the teams to show all their work. This presentation will be taken into account in the homologation sheet.

During the meetings, a jury will pass through each panel and discuss with the teams to award a special prize for the best presentation.

F. THE ROBOTS

F.1. FOREWORDS

Each team is allowed to register a maximum of two robots which are referred to as the “main robot” and the “secondary robot”. The secondary robot has different dimensional constraints.

For EurobotOpen Junior, the main robot is wire-guided and the secondary robot is autonomous.

For EurobotOpen, both robots are autonomous.

The construction of a secondary robot is optional. The aim is to allow teams with a large number of members to work on a second project. Beginning teams are also recommended to concentrate on building a single functional machine. Better is a robot that works well than two that do not move.

A secondary robot can compete only with the main robot with which it was designed and approved. However it can compete alone if the main robot cannot participate. It cannot be re-homologated with another main robot.

A team's main or secondary robot must not block the other team's robots. In the event of a voluntary action of this type signaled by the referee, the team may be penalized.

A robot must not intentionally cause damage to the opposing robots, or to the playing area and its elements.

Only two members of the team are allowed to enter the backstage and on the stage. They transport all the equipment (robots, home automation panel, etc.). The path to the playground may include stairs, especially when entering the stage. It is therefore recommended to design easily transportable equipment.

The main robot and the secondary robot must be composed of elements that are integral with one another (and therefore cannot contain and deposit parts or elements on the playing area) except for the play elements.

Robots must not attach to the playing area (e.g. a suction cup).

A robot must not prevent the opponent from scoring points. If the robot remains static (e.g. if it has finished an action), it must move as far as possible to a location that does not disturb the opponent.

A game element can be moved:

- for the purpose of scoring points with;
- if justified by performing another game action (e.g. if a common game element is located on the robot's path). The number of elements then moved (especially from their starting position of the match) must remain reduced.

Deliberately vibrating the table or any other irregular action exposes the team to a refusal of homologation. If in doubt, contact the arbitration committee.

Be imaginative! For example, as an innovation, but also to offer the public and the media an attractive show, your robot can use sounds, display expressions, etc.

F.2. DIMENSIONS

Warning: the dimensions of the main robot and the secondary robot of Eurobot^{Open} are identical to those of Eurobot^{Open} Junior. Eurobot^{Open} Junior participants can more easily access the Eurobot^{Open} meetings. The Eurobot^{Open} Junior robot will only need modifications to make it stand-alone.

Dimensions of the main robot and the secondary robot:

The perimeter of a robot is measured by surrounding it as shown in the illustrations below:

| Dimensions of the main robot: | Dimensions of the secondary robot: |
|---|---|
|  Not deployed $\leq 1200\text{mm}$ Deployed $\leq 1500\text{mm}$ |  Not deployed $\leq 850\text{mm}$ Deployed $\leq 1050\text{mm}$ |

The perimeter of the main robot must not exceed 1200 mm at the time of departure. The perimeter of this fully deployed main robot shall not exceed 1500 mm during the match.

The perimeter of the secondary robot is independent of that of the main robot. It must not exceed 850 mm at the time of the start and 1050 mm when it is fully deployed during the match.

At any time during the match, the height of the main robot and the secondary robot shall not exceed 350 mm. However, it will be tolerated that the emergency stop button exceeds this limit height to reach 375 mm.

For Eurobot^{Open}, this height excludes the mast of the beacon support, any sensors and associated electronic circuits integrated under the mast of the beacon support.

When manipulating an object by a robot, the height of this object cannot exceed 350mm in order not to disturb the use of the beacons.

At the beginning of a match the vertical projection on the playing area of both robots in the start configuration shall fit inside the starting area and may not exceed its limits.

F.3. ENERGY SOURCES

All potential sources of energy stored in the robot are permitted (batteries, springs, compressed air, gravitational energy, etc.), with the exception of sources of energy using chemical reactions such as combustion or processes pyrotechnics, which are prohibited for safety reasons and the use of living things.

In addition, the use of corrosive products is prohibited and liquid splashes are not permitted.

If you have any doubt about an unusual energy source, ask the arbitration committee as soon as possible, providing the corresponding datasheets.

In order to avoid any risk of fire, attention should be paid to the choice of the conductors, depending on the intensity of the currents passing through them. It is also strongly advised to protect the electrical installation with a fuse, wired closest to the batteries.

Battery:

If the team chooses a battery power supply, we recall that only sealed batteries can be used.

Teams must be able to play three games in a row. Note that this includes the time required to set up, during which the robot will be powered and awaiting the start.

As a result, we strongly recommend teams to carry several sets of batteries and provide easy access to the batteries in the robot for their change. The teams are reminded that it is essential to have a set of spare batteries, fully charged and available at all times.

Note on the use of Lithium-based batteries:

Lithium batteries are known for their lack of stability and can easily ignite when certain precautions are not taken. This type of battery is therefore authorized under the following conditions:

- Charger suitable for presenting approvals,

- Batteries permanently in certified and unmodified fireproof bags (either in the robot or on the stand, even in storage),
- a system for detecting underloads is highly recommended.
- exception in the case of the following batteries, authorized without the conditions listed above:
 - Lithium batteries for LEGO Mindstorm / laptop / mobile phone provided that they have not been dismantled and are used for the intended purpose of the manufacturer;
 - Lithium-Iron batteries (LifePo4)

For Eurobot^{Open} Junior:

Warning! The supply systems must be easily transportable. Teams may have to go up and down the stairs on their way to the stage where the matches take place.

The power source transmitted to the robot by the cable is only electric. The maximum permissible voltage is 13.8 V (measured between any two wires of the cable and the robot). This voltage source is not provided on the day of the meeting. On the other hand, the teams have access to the standard (230 V 50 Hz standard) and can use batteries.

The terminals of the cables must be insulated.

F.4. OTHER DESIGN CONSTRAINTS

F.4.a. COMMON TO BOTH EVENTS

i. Visibility

A rectangular space of 100 x 70 mm per robot must be left free on one of the side faces. As far as possible, this space must be visible from a camera located at the level of the playing field. This space must be visually accessible during the majority of the match. Teams will receive stickers printed by the organization (number of teams, sponsors of the event), which they will place on these open spaces.

Teams are strongly encouraged to make all manipulation of elements visible from the outside. The purpose of this advice is to allow the public and the other participants to see how the transport of the elements in the robot works.

ii. Starting cord of autonomous robots

The robots must be equipped with a starting device easily accessible on the robots. This device will be triggered by pulling the end of a cord at least 500 mm long. This cord will not remain attached to the robot after the start.

No other starting system (remote control, manually activated rocker switch, etc.) will be approved.

The start of a robot can launch the other robot.

iii. Emergency stop button of autonomous robots

Autonomous robots must be equipped with an emergency stop button that is at least 20 mm in diameter and red in color. It shall be placed on the top of the robot in a visible position and in a non-hazardous area and immediately accessible by the referee at all times.

The button, in its rest state, may exceed the prescribed height of the robot by 25 mm.

The emergency stop button must be able to be operated by a simple downward movement (for example, by striking it with the fist).

Pressing this button must cause all robot actuators to stop immediately.

iv. Automatic shutdown

Each robot will be equipped with a system that stops the movement of the robot as well as all its actuators, automatically at the end of the 100 seconds that a match lasts. The dynamic displays that may be present on the robots may remain on.

The automatic shutdown of the robot (s) is optional for Eurobot^{Open} Junior participants.

v. Obstacles avoidance system (optional for Eurobot^{Open} Junior)

The teams are required to equip their robot with a robot detection system.

The system is designed to prevent collisions between robots during a match. This will be systematically verified at the time of approval. Referees will pay particular attention to non-fair play teams who deliberately disable their avoidance systems after passing the approval stage.

Voluntary deactivation of robot avoidance systems may result in complete disqualification of the team.

The avoidance systems of the robot (s) are (are) optional for EurobotOpen Junior participants.

Warning: most events are filmed, so you must adapt your avoidance systems so that they are not disturbed by autofocus cameras and cameras.

F.4.b. EUROBOT^{OPEN} SPECIFICITIES

On-board beacon support

In order to make it easier to spot robots in the field, robots must integrate an on-board beacon support to accommodate the beacon of the opposing team. This support must at all times respect the following points:

- be of cylindrical shape (vertical cylinder), with a diameter of between 80 mm and 100 mm. The cylinder wall must be solid and opaque.
- have its top surface positioned at a height of 430 mm from the level of the playing area and allowing the positioning marker of the opposing team to be placed.
- the platform surface will be fully covered on the Velcro™ top (hook side);
- the on-board beacon support must be located as close to the center of the robot as possible in vertical projection, and must be in a circle 20 cm in diameter around the center of the robot.
- the on-board beacon support can only accommodate sensor systems. In this case, the beacon support should be as short as possible: in particular, teams using rotating devices should ensure that the removed cylinder portion is less than 2 cm (exception to the minimum envelope size convex)
- the on-board beacon support must be stable and must be able to support a minimum weight of 300 g (opposing beacon).

However, a team may choose not to equip its on-board beacon support robot. In this case, if the opposing team requires a beacon support, and has the utility (either to detect the mast or to place a beacon), the team or the robot concerned may be declared forfeit.

F.4.c. EUROBOT^{OPEN} JUNIOR SPECIFICITIES

i. Control system

Each team must have, for the main robot, a console, operated by a single pilot.

The control system is a casing for controlling the robot's electrical devices. It is connected to the robot only by the electric cable. Any other communication system of the robot with the outside during the matches is forbidden.

ii. The cable

The electric cable connecting the robot to its control system is not provided: it must be designed and produced by each team, according to its needs.

However, the cable must have a minimum length of two meters between the electrical socket and the power supply and a minimum of 5 meters between the robot and the control unit for reasons of mobility of the robot on the playing field.

The rope of the robot must come out from the top of the robot in order not to drag on the playing field.

It is held in the air by the co-pilot with a pole supplied by the organizers.

iii. The control system of the autonomous robot

Teams can use any kind of control system for the robot (analogue, based on microprocessors, microcontrollers, embedded computers, programmable logic, etc.)

These systems must be fully integrated into the secondary robot.

The control system must allow the robot to play a match with either of the forecasted colors. Ideally, this should be configured just before the game.

F.5. SAFETY

F.5.a. GENERAL

All systems (robots and beacons) are obliged to respect the regulations in force in Europe and in the organizing countries of the meetings. Among other things, they must respect the safety regulations and must in no way endanger the participants, the organizers or the public either during the matches or behind the scenes or in the stands.

Robots shall not have protruding or pointed parts that are likely to be dangerous or to cause damage.

The use of liquid, corrosive, pyrotechnic and living products is prohibited.

All robots must comply with the standard "low voltage" regulations. Therefore, **the on-board voltages must not exceed 48 V.**

Potential differences greater than 48 V may exist, but only within closed commercial devices (e.g. lasers, backlighting of LCD screens, etc.) but only if these devices have not been modified and if they are themselves compliant with national and European regulations.

In general, any system considered by the Referee Committee to be dangerous will not be homologated and must be removed from the robot before the game in order to play.

F.5.b. LASERS

Only the **laser class** definitions (defined according to the international standard IEC60825) will be considered. Teams using lasers will **have to** provide a document from the manufacturer indicating **the class of the device** (this information is normally systematically available on the system itself).

On the basis of this classification, class lasers:

- 1 and 1M are accepted without restriction
- 2 are tolerated if the laser beam is never projected outside the playing area
- 2M, 3R, 3B and 4 are formally prohibited.

CAUTION: Removing or modifying devices using laser sources often results in a change of class. Laser devices must therefore be used in the state of their commercialization (lasers = source + optical + electronics).

F.5.c. HIGH POWER LIGHT SOURCES

When using a high intensity light source, the light intensity should not be hazardous to the human eye in the event of direct illumination. Note that some types of LEDs have warnings. Be responsible! Your machines evolve in front of an uninformed audience!

In the slightest doubt, the organization reserves the right to request the manufacturer's specifications in order to check the non-hazardous nature of the lighting system used. If the system is found to be potentially hazardous, it may be denied homologation in the same way as class 2M lasers and above.

F.5.d. COMPRESSED AIR SYSTEMS

No compressed air system shall exceed 4 bar.

G. BEACON TRACKING SYSTEM (EUROBOT^{OPEN} SPECIFICITIES)

G.1. GENERAL POINTS

The rules provides for a beacon-type pre-equipment allowing teams who wish to develop an absolute beacon location system and a central platform located above the ground along one of the borders for placing a device of central location.

If the opponent so requests and really has the utility, the robots will have to be equipped with a flagpole to fix an opponent's beacon above (see E.4.b).

The beacons (fixed beacons, embedded beacons and central tracking device) must remain in place on their supports throughout the duration of the match. All robot safety instructions apply equally to beacons.

Fixed beacons, center marker, beacons, embedded beacons and their respective supports are described below.

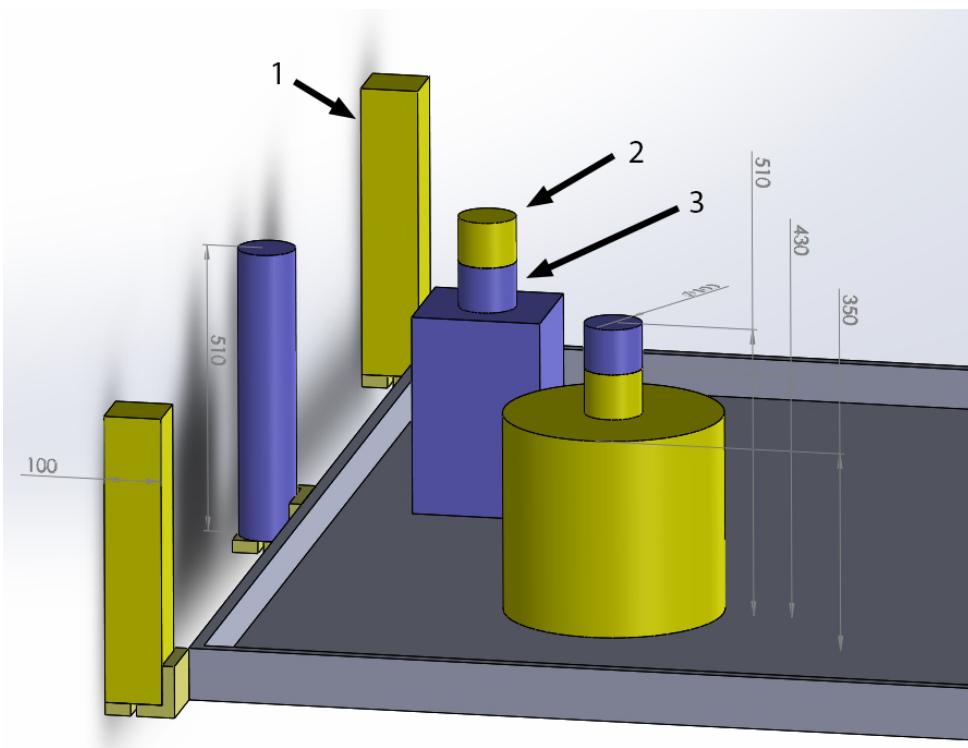


Figure 11 - Example of positioning beacons on robots

Caption:

- **1: fixed beacons** (maximum dimensions $W \times W \times H$: 100 x 100 x 510 mm)
- **2: embedded beacon** (maximum dimensions $L \times W \times H$: 100 x 100 x 80 mm)
- **3: mast of the support** (cf. G.4.b)

G.2. BEACON ON THE ROBOT

A beacon can be placed on each adverse robot, in order to locate the latter. It is placed on a dedicated mast, at an altitude with respect to the playing area of 430 mm. The maximum size for an on-board location beacon is a square base parallelepiped 100 mm and 80 mm high.

The upper side of the on-board beacons must be covered with Velcro™ on the hook side in order to receive the identification mark of the robot, in the color of the team.

The underside of the beacons must be covered with velvet Velcro™.

It is recommended that the color of the beacons be mainly white or very clear, so as to favor their detection on a dark background.

In the name of fair play, the elements used for this beacon must have real utility. Any "useless" or weighted beacon may be refused by the organization.

A localization beacon must not exceed 300 g.

G.3. FIXED BEACON

Each team can place up to three fixed beacons on fixed supports, allocated to the team, placed around the playing area.

Action-cams not useful for the course of the game are prohibited in fixed beacons.

G.3.a. DIMENSIONS

The fixed beacons shall be integrally contained in a square rectangular parallelepiped of 100 mm side and height 510 mm.

A fixed beacon shall not exceed 1.5 kg.

G.3.b. FIXATION

Given the potential height of the fixed beacons, they must have a solid fixing system.

The plane of the fixed beacon supports is at the level of the playing area.

The horizontal plane of the fixed beacon supports is pierced with a 10 mm wide groove from the center of the beacon support to the middle of the rear side. This groove allows the passage of a threaded rod of 8 mm diameter fixed vertically on the underside of the beacon. A butterfly nut placed on this threaded rod makes it possible to locate the beacon on its support in a reliable and fast manner from below.

The absence of this fixing system will prevent the homologation of fixed beacons.

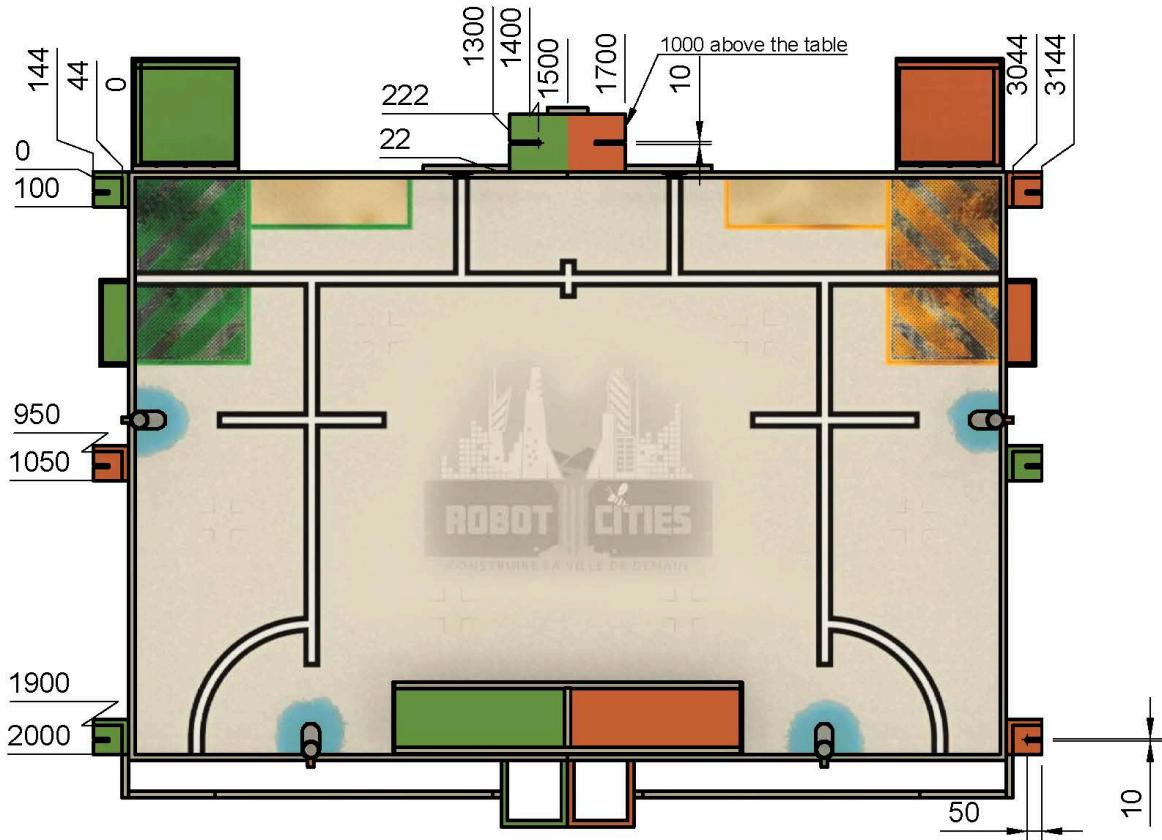


Figure 12 - Beacon positions on the playing area

G.4. CENTRAL TRACKING DEVICE

In order to facilitate the identification of robots on the ground, a shared platform located on the central axis of symmetry of the long side of the ground (see plan) is placed 1 m above the plane of the playing area in order to ability to place a robot tracking device in top view.

The central registration device should be placed on the part of the platform of the color of the team. It shall not extend beyond a horizontal plane 6 cm above the upper surface of the platform and shall not descend below a horizontal plane 6 cm below the lower surface of the platform. On the sides, an offset of 6 cm is allowed forward, the edge not shared with the opponent and the back. The offset allows to place sensors above the ground, to connect the part situated above the platform and the part located underneath, and to allow a setting on three sides of the central locating device and a solid fixing. Its weight must be less than 2 kg.

It is forbidden to pass on the platform part of the opponent.

It should be noted that the central registration device can be subjected to vibrations due to the movements of robots on the table to which it is fixed.

Fixation:

The thickness of the fixing platform of the central marking device is 22 mm.

The fastening device must surround the fastening platform from above, underneath and on all three sides so that it can be assembled and positioned quickly and without the risk of falling.

The mounting platform has a 10 mm wide groove from the center of the beacon support to the middle of the side. This groove allows the passage of a threaded rod of 8 mm diameter fixed vertically on the locating device. A butterfly nut placed on this threaded rod enables the locating device to be locked reliably and rapidly on its support.

The absence of this fastening system will prevent the homologation of the locating system.

For safety purposes, a ring secured to the central registration device must be present so that it can be fixed to a chain or a safety cable located on the platform and supplied by the organization. This chain holds the central tracking device in case of a fall. The ring is part of the central tracking device and must have a minimum inside diameter of 15 mm and a maximum thickness of 10 mm.

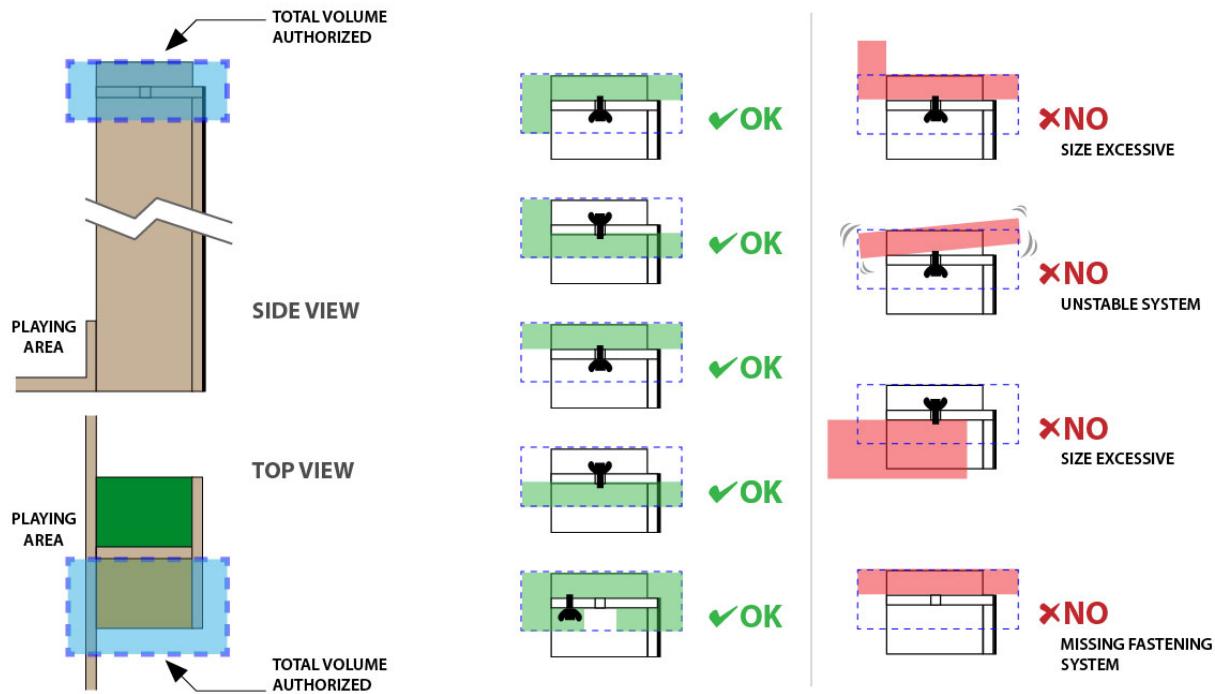


Figure 13 - How to install a central tracking device?

G.5. CONNECTIONS

The fixed beacons and the central platform can be connected by a wired link. This connection must not under any circumstances disrupt the smooth running of the match. The installation of the whole system must be able to be carried out during the three minutes allowed for the preparation of the match, and this without disturbing the opposing team.

During the preparation of the match, a temporary wired link may be established between the robot and one or more tags, but only on condition that this does not constitute any embarrassment for the opposing team.

G.6. COMMUNICATION SIGNALS

To avoid interference between teams, it is recommended to encode the communication signals. We strongly recommend teams using infrared devices to take into account the strong ambient light used during the encounters. In addition, this luminosity may vary during encounters, in time and according to the location of the playground in the room.

We also recall that the organizing team uses high-frequency radio devices and that under no circumstances can they be held responsible for the malfunctions encountered by the robots.

CAUTION: Beyond the edges of the playing area, there may be elements that may interfere with color detection or communications signals such as:

- elements of the decoration of the playing area
- people (referees, teams, etc.)

- *electronic systems (microphones, cameras, etc.) »*

In no case can people and elements of decors around the playing area be asked to deviate from them.

G.7. ROBOT IDENTIFICATION

During each match, the robots are assigned a color marking in the form of a small colored module. This marking is intended to help the public to recognize which robot belongs to which team at any time.

The mass of the marker module is negligible. It is placed on the beacon support of the robot if it has one or on the onboard beacon.

H.MATCHES

The matches have a duration of 100 seconds.

Only two people per team are permitted to go backstage and on stage to play the matches.

To ensure that the contest runs smoothly, we ask you to be present on the stand with the robot (s) and ready to go in a match 30 minutes before the start of the series and until that your game is played.

In case of a problem, it is tolerated by the organization to ask for a delay to go to the match but this delay can never exceed the end of the current series. At the end of the series, a package will be applied. In case of abuse, a warning will be applied, and if the problem recurs in a subsequent series, a penalty may be awarded.

In any case, you must be present on your stand when the organization comes to pick you up for a game. In the event of non-compliance with this rule, an official may initially give you a warning, and if the absence is repeated on a subsequent series, a penalty may be awarded.

H.1. PREPARATION PHASE

At the start of a match, the elements of the playing area and the playing area itself are installed as indicated in the diagrams in the appendix.

Upon arrival on the playing area, each team has a maximum of three minutes to proceed with the placement of the robots, the bee, the home automation panel and the external beacons.

A robot who is not ready at the end of this period exposes the team to a package for the match.

The other team's robot will still play their own game on the playing field. They will have to score points to be declared the winner.

When both teams are in place, the referee asks the participants if they are ready. From this moment, teams are no longer allowed to touch their robots. No dispute can be made on the disposition of the elements of play after the beginning of the match.

H.2. THE MATCH

At the signal of the referee, each robot is switched on. In no case may robots, play items and playgrounds be allowed to touch during the match. In case of absolute necessity, the arbitrator may however authorize such action. Any manual intervention on a robot, an element of play or the playing area, without the explicit authorization of the referee, may justify the application of a fixed price for the match.

No elements taken out of the playing area can be handed over before the end of the game and the validation of the scores.

At the end of the match, the robots must stop and turn off all the robot's actuators. It is permissible to keep any dynamic displays giving the rating of the score on.

At the end of the match, no one except the referee can touch the robots and the game elements unless expressly indicated by the latter. The referees count the points; they give the result of the match, including the points to the teams. If they both agree, they sign the match sheet, they can then take back their robot (s) and join their stand. If the teams do not agree, they refer calmly to the referees. The robots remain in place until the dispute is resolved. Arbitration decisions are final.

In case of difficulty judges, the referees reserve the decision to replay the game or not.

The referees are allowed to pronounce the end of a game in advance, before the end of the regulation time if both teams agree (if the robots are blocked for example).

A team is considered to be **forfeit** for the match:

- if none of the robots have completely left the starting area during the match,
- if one of the two robots had the emergency stop button pressed during the match,
- following arbitration decisions.

H.3. COUNTING POINTS

At the end of the match, the referees count the points of each team according to the following scale.

H.3.a. FEED THE CITY WITH DRINKING WATER

- 10 points for each recuperator at least emptied of a ball by the team to which it belongs;
- 5 points for each ball of the right color in the water tower. Be careful, a ball of the wrong color cancels all the points of the water tower
- 5 points per ball of the opponent's color in the treatment plant

H.3.b. BUILDING HEQ BUILDINGS (HIGH ENERGY QUALITY)

- Floor (cube) valid in the construction area. Points awarded according to floor level:
 - 1 point for the first level (ground);
 - 2 points for level 2;
 - 3 points for level 3;
 - 4 points for level 4;
 - 5 points for level 5;
- 30 points for a combination of cubes corresponding to the construction scheme.

H.3.c. FEEDING ITS HOME AUTOMATION PANEL

5 points for the deposit of the panel in front of the water tower

25 points for a powered panel (switch closed) at the end of the match

H.3.d. FORAGING A FLOWER

5 points for the deposit of the bee on the hive

50 points for a foraged flower (bursting balloon)

H.3.e. EVALUATE ITS PERFORMANCE (BONUS POINTS)

The assessment is based on all the previous actions (water, buildings, panel and foraging of the flower).

The following scale will be applied:

| Score \ Delta | 0 to 2 | 3 to 5 | 6 to 10 | 11 to 15 | 16 to 25 | 26 to 35 | 36 to 50 | 51 to 100 | 101 to 150 | 151+ |
|----------------------|---------------|---------------|----------------|-----------------|-----------------|-----------------|-----------------|------------------|-------------------|-------------|
| 1 to 10 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 to 20 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 to 40 | 10 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 41 to 60 | 17 | 10 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 61 to 80 | 23 | 16 | 9 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 81 to 100 | 30 | 23 | 16 | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| 101 to 130 | 37 | 30 | 23 | 16 | 6 | 0 | 0 | 0 | 0 | 0 |
| 131 to 160 | 43 | 36 | 29 | 22 | 12 | 2 | 0 | 0 | 0 | 0 |
| 161 to 190 | 50 | 43 | 36 | 29 | 19 | 9 | 0 | 0 | 0 | 0 |
| 191 to 220 | 57 | 50 | 43 | 36 | 26 | 16 | 4 | 0 | 0 | 0 |
| 221 to 260 | 63 | 56 | 49 | 42 | 32 | 22 | 10 | 0 | 0 | 0 |
| 261 to 300 | 70 | 63 | 56 | 49 | 39 | 29 | 17 | 3 | 0 | 0 |
| 301 to 340 | 77 | 70 | 63 | 56 | 46 | 36 | 24 | 10 | 0 | 0 |
| 341 to 380 | 83 | 76 | 69 | 62 | 52 | 42 | 30 | 16 | 0 | 0 |
| 381 to 420 | 90 | 83 | 76 | 69 | 59 | 49 | 37 | 23 | 0 | 0 |
| 421 to 500 | 97 | 90 | 83 | 76 | 66 | 56 | 44 | 30 | 7 | 0 |
| 501+ | 103 | 96 | 89 | 82 | 72 | 62 | 50 | 36 | 13 | 0 |

A score of zero cannot give right to any bonus.

H.3.f. THE PENALTIES

A penalty is a **loss of 20 points** on the result of the match. Several penalties can be applied.

A negative score will be reduced to 0.

An element controlled by a robot, does not yield points. An object is considered to be controlled by a robot, if by moving the robot along its natural axis of movement it is moved.

RECALL:

The penalties are intended to compensate for damage after a possible incident during the course of the game. A penalty situation is considered as non-respect of the rules of the game, this type of situation must remain exceptional!!! A penalty may result in the team's forfeit. The arbitration committee will also be attentive to the penalties distributed between several levels of meeting (region-national-Europe).

H.3.g. BONUS POINTS

10 bonus points are awarded to all teams that are not "forfeit".

H.3.h. FORFEIT CASES

The score of a forfeit team is reduced to zero.

I. THE CONTESTS

I.1. GENERAL

The Eurobot^{Open} and Eurobot^{Open} Junior events can be organized on three levels:

- **regional**: when they exist (e.g. in France for Eurobot^{Open} Junior), qualify a number of participants for the national final,
- **national**: it allows to qualify the teams for the European finals,
- **european**: this last stage brings together, in the same friendly spirit, teams from different countries in Europe and elsewhere.

I.2. APPROVAL

I.2.a. PRE-APPROVAL

Before the start of the matches, the robots are subject to the supervision of an arbitrator who verifies their compliance with the rules. Robots must be able to easily show all their mechanisms.

The ancillary systems (beacons, central tracking device, etc.) will also be subject to static control (size, mass, presence of mandatory elements).

I.2.b. APPROVAL

The robots must, in 100 seconds, validate **at least one action**. The robots are put in a game situation but without the presence of the opposing team. Certain specific features provided for in the regulation can also be verified (timer, avoidance of opponents, etc.).

If the assembly consisting of the main robot and the optional secondary robot fulfills these conditions, it is declared homologated. If one of the two robots is not homologated, the other robot can play the match alone.

I.2.c. SIGNIFICANT TECHNICAL MODIFICATION AFTER THE APPROVAL

It is essential to inform the referees of any significant modification (functional, structural, dimensional ...) brought to the robot after its homologation. The referees will then check the modifications made and re-approve the robot if they deem it necessary. In the event of a breach, the team may be declared disqualified from the contest.

I.3. QUALIFICATION PHASES

During the qualification phase, the registered teams will have the possibility to play at least three games (often more, depending on the local organizers).

A ranking is established according to the accumulated points in order to select the qualified teams for the final phase.

The tied teams are tied by comparing their scores without taking into account the bonus points. Organizers may also use additional matches. Pairs of teams competing for the same place will be drawn and the resulting matches will be played by knockout. In case of an odd number of teams, an extra match will be drawn at random and played on the same bases.

I.4. THE FINALS

At the end of the qualifying phase, the 4, 8 or 16 first teams (according to the matches) constitute the table of the matches of the final phase.

According to the meetings, only the teams composed of members less than 30 years of age will be able to enter the final stages.

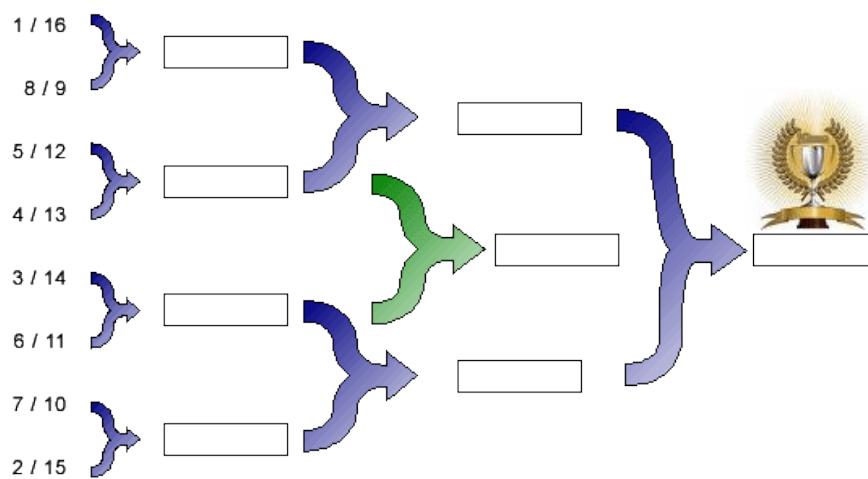


Figure 14 - Example of final phase diagram

The matches of the final phase are with knockout, unless otherwise organized on some meetings. In the event of double forfeit, double defeat or tie, the match is replayed immediately; if this second match is still a case of double forfeit, double defeat or equality, the winner will be determined according to the points acquired at the end of the qualifying phases.

The final will be played in two winning games. Be careful to provide batteries accordingly for autonomous robots.

I.5. QUALIFICATION FOR THE NATIONAL FINALS

When there are regional meetings (e.g. Eurobot^{Open} Junior France), the number of teams qualified per regional meeting is proportional to the total number of teams registered at the national level.

The best teams in the ranking established at the end of the qualifying phase of each regional meeting, as well as at least one team chosen by the organizers from the special prizes (e.g. creativity, fair play, presentation, etc.).

I.6. QUALIFICATION FOR THE EUROPEAN FINAL

Each country participating in Eurobot^{Open} and/or Eurobot^{Open} Junior organizes a national competition to determine the qualified teams for the international contest. The top teams in the final rounds (and not the qualification rounds) as well as the team who receives a special award will qualify for the European finals.

For Eurobot^{Open}, the first two teams and a special award will qualify to go to the European final.

For Eurobot^{Open} Junior, the number of qualified teams per country is proportional to the total of international registered teams.

**For questions and comments, feel free to visit the forum on Planete Sciences Forum.
A volunteer from the arbitration committee will answer your question there.**

<http://www.planete-sciences.org/forums/>

**News and more information about Eurobot^{Open} et Eurobot^{Open} Junior are available on our website
www.eurobot.org
(It also contains links to your local organizations)**

The whole organization team of d'Eurobot^{Open} et d'Eurobot^{Open} Junior whishes you a lot of fun and success for the coming months, and looks forward to seeing you soon around a playing field!

Robotic Regards,

The Eurobot^{Open} & Eurobot^{Open} Junior organization committee.

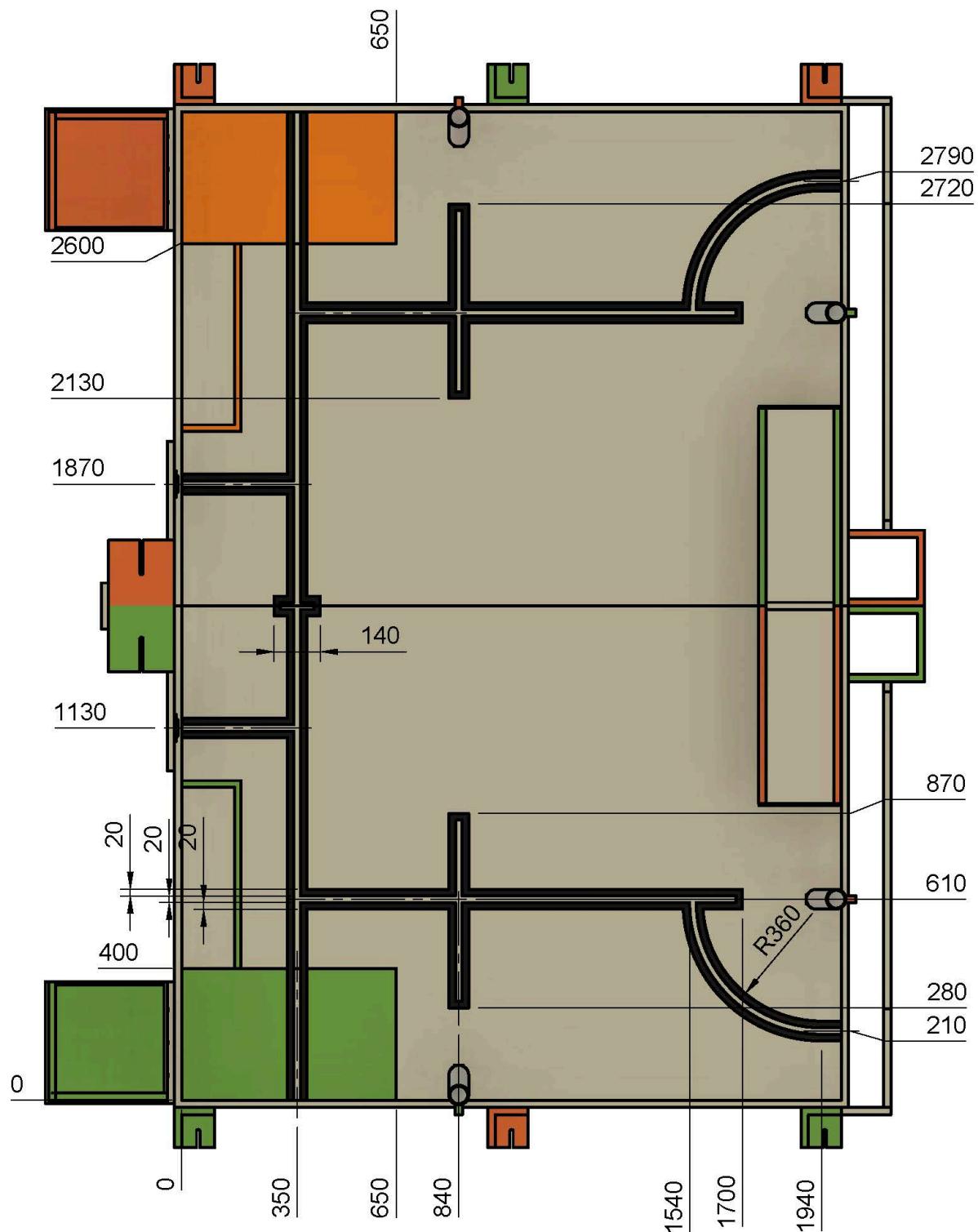
J. APPENDIX

J.1. CONSTRUCTION PLANS

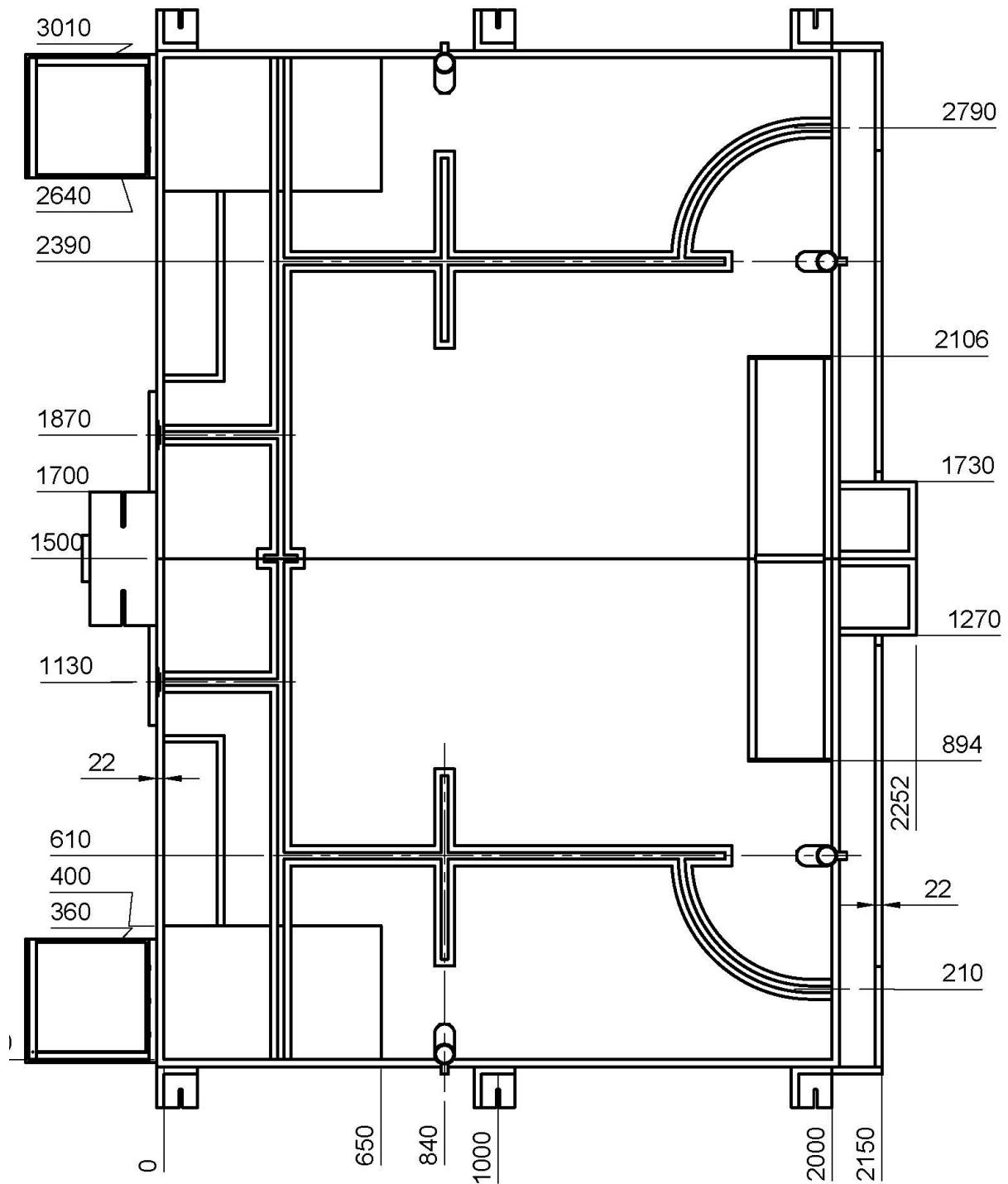
The construction schema is fixed to the vertical, in the thickness of the edge of the playing area on a dedicated support. This schema can be put in both ways. The following is a list of possible combinations:



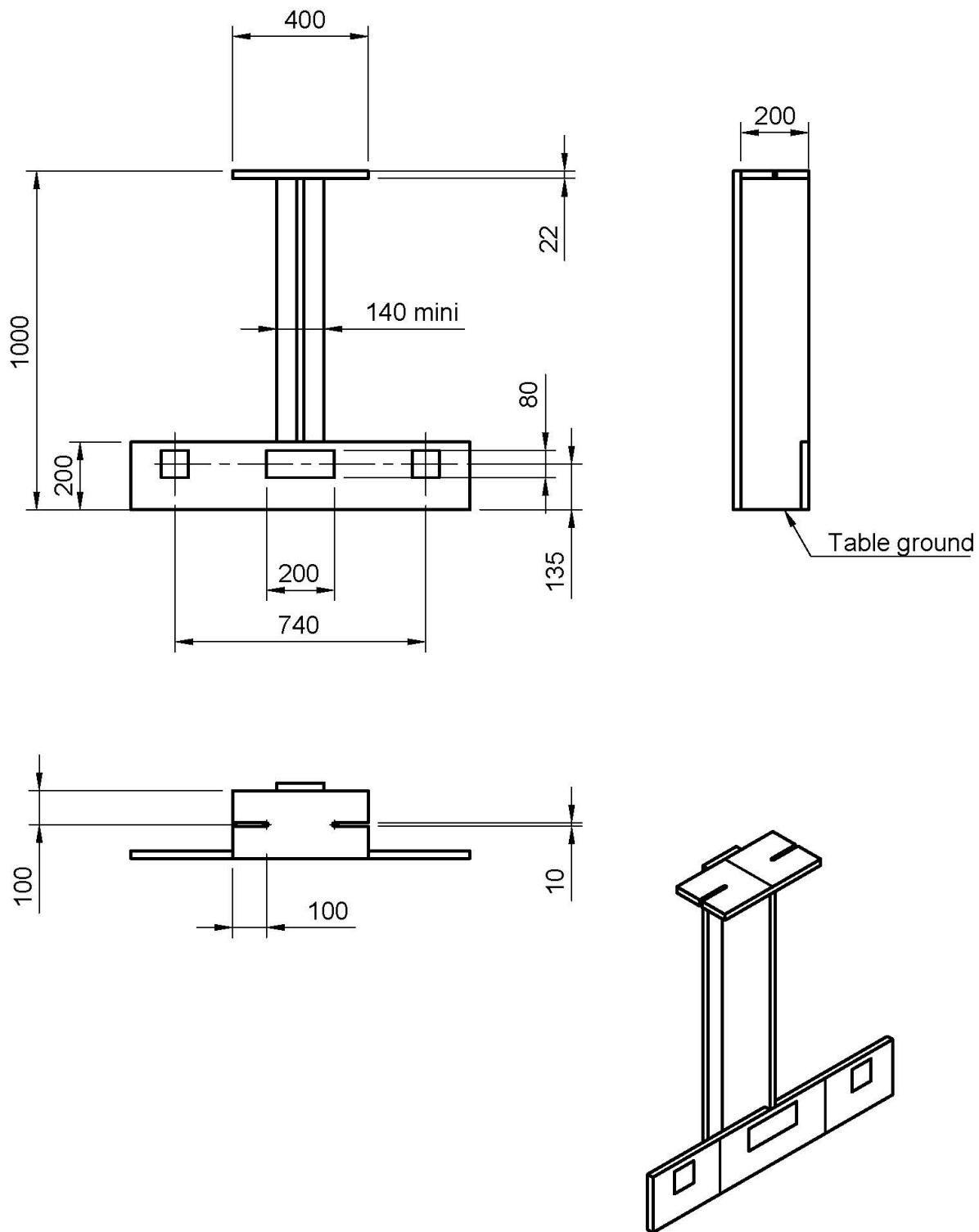
J.2. PAINTING



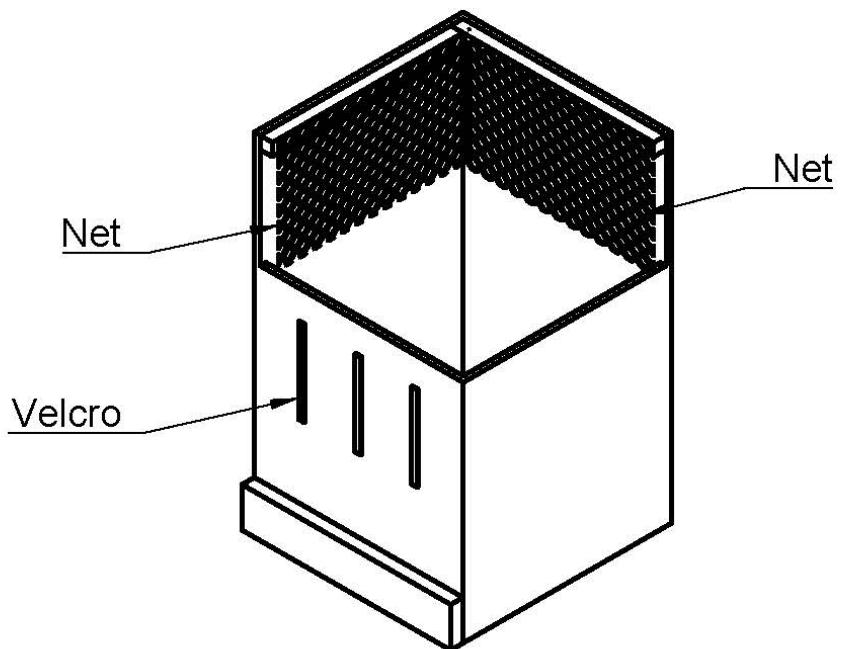
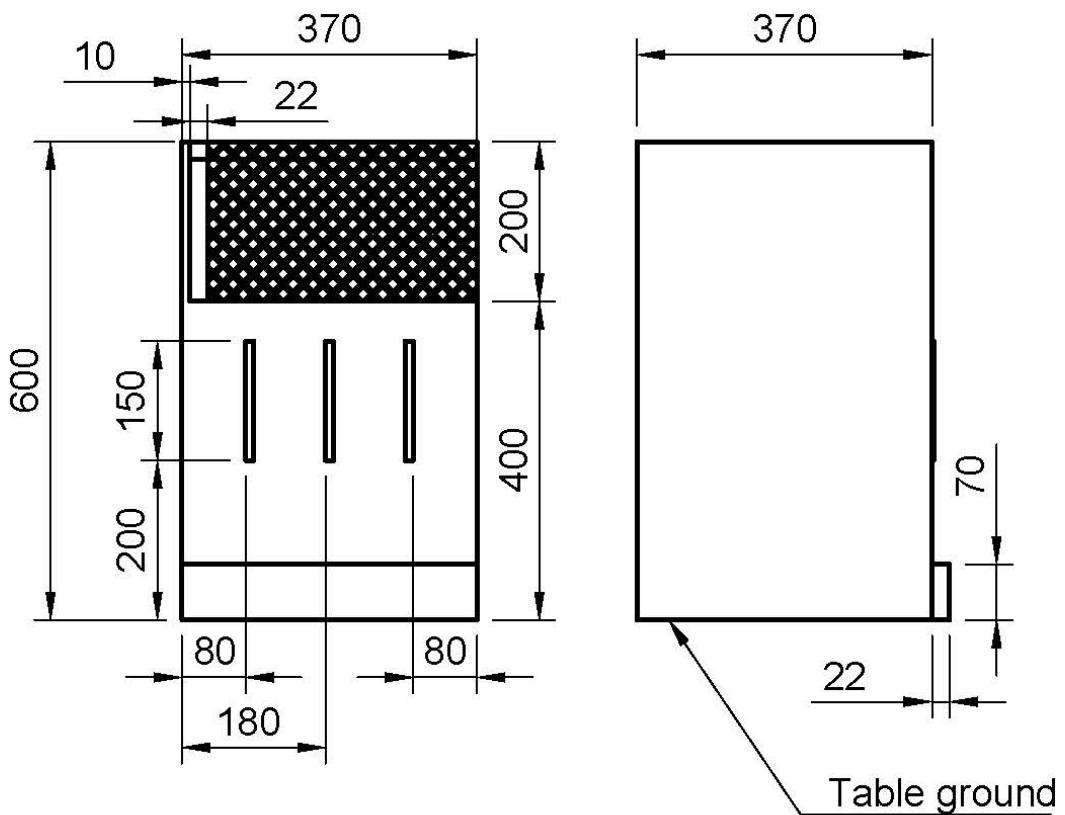
J.3. GENERAL DRAWINGS



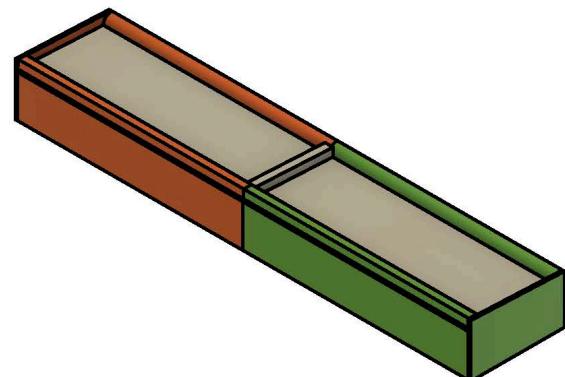
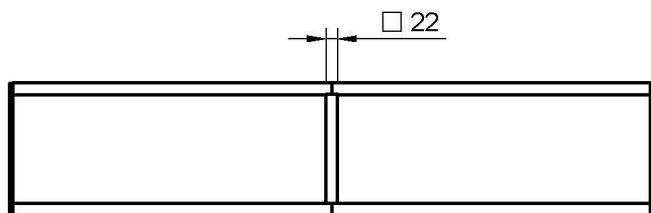
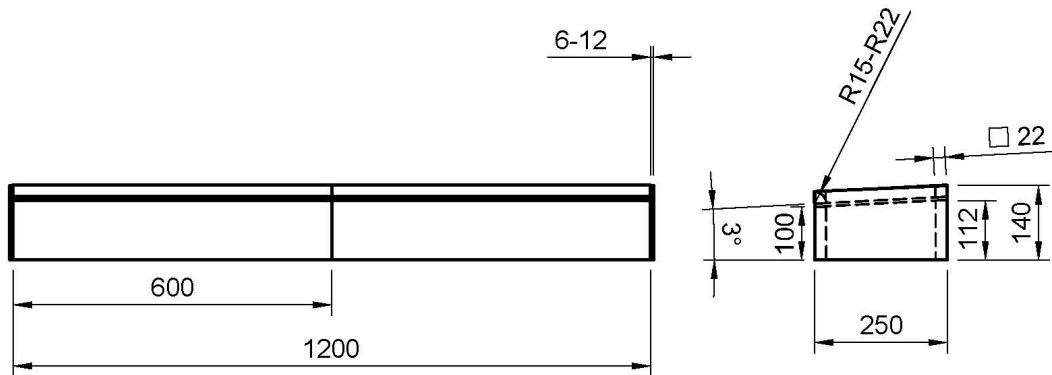
J.3.a. CENTRAL TRACKING DEVICE PLATFORM



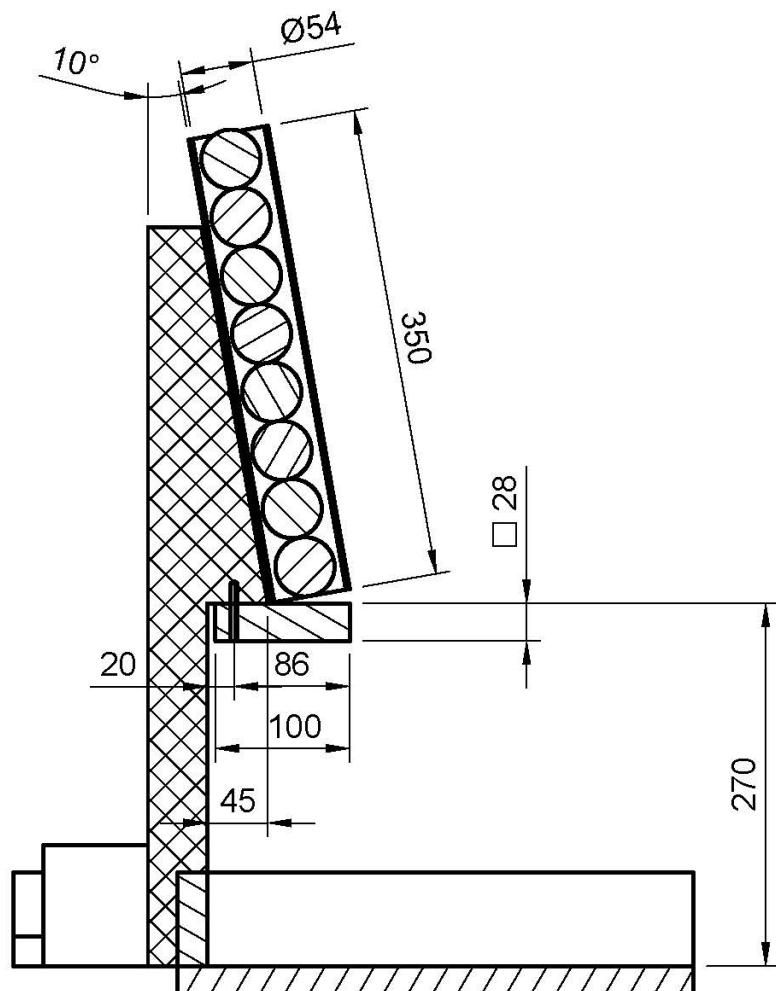
J.3.b. WATER TOWER



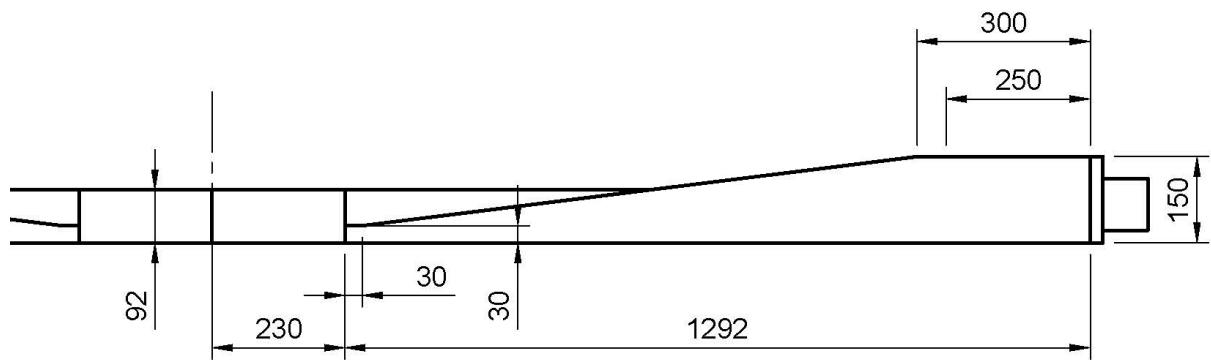
J.3.c. WASTEWATER TREATMENT PLANT



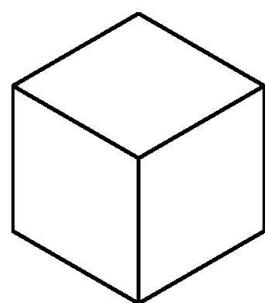
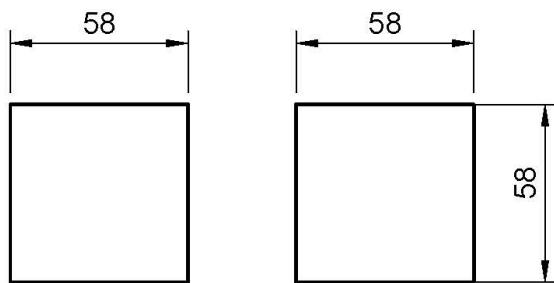
J.3.d. WASTEWATER RECUPERATOR



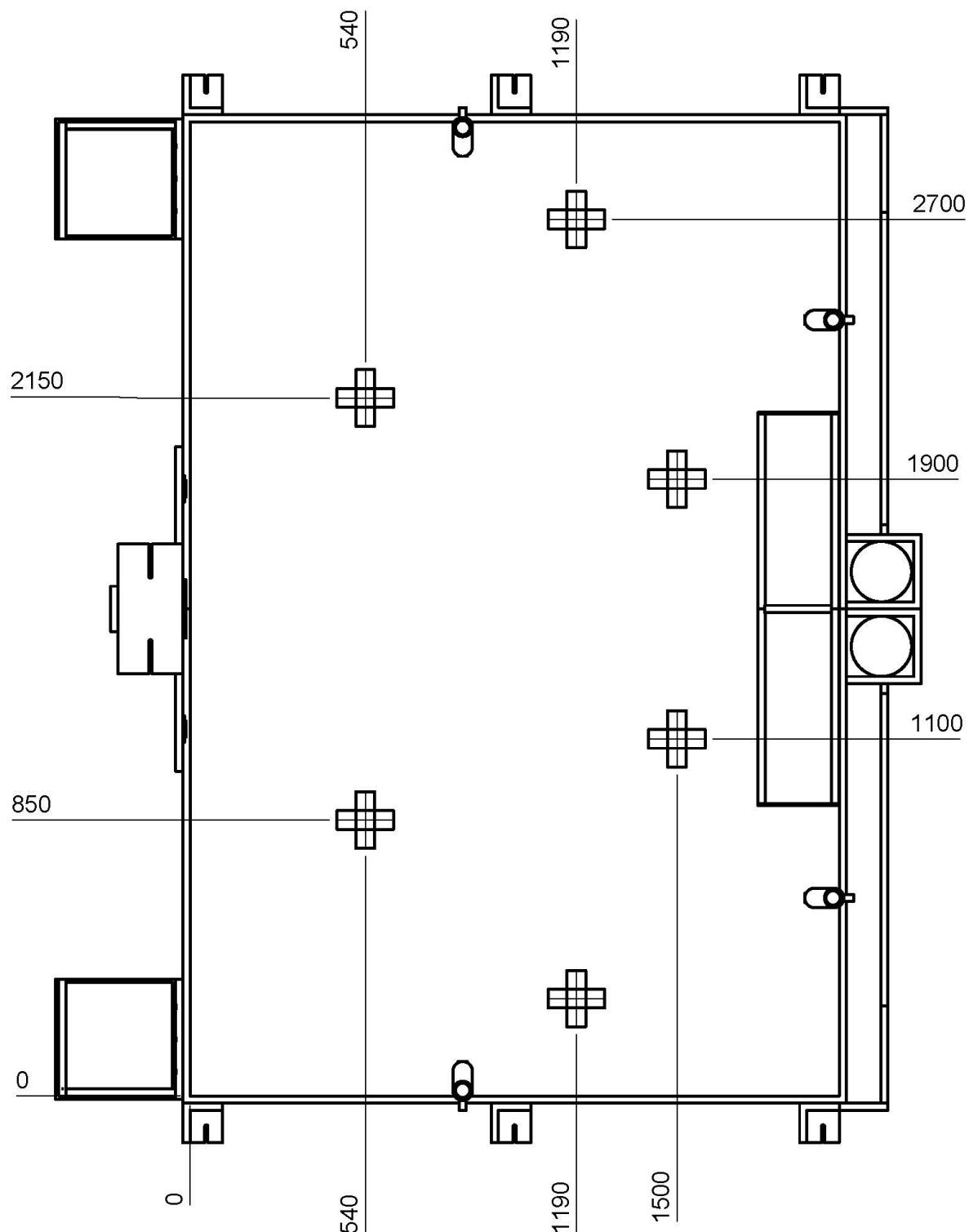
J.3.e. FORAGING A FLOWER



J.3.a. CONSTRUCTION CUBE



J.3.b. LOCATION OF THE GAME ELEMENTS AT THE BEGINNING OF THE MATCH



J.4. MATERIAL REFERENCES

| Elements | Material or reference | Comments |
|------------------------|---|--|
| Construction cubes | Wood (pine) | Significant variations in weight due to knots and moisture in wood |
| Wastewater | Polyurethane Decathlon Artengo FB700 | |
| Switch | Legrand MOSAIC (REF. 0 996 91) | |
| Wastewater recuperator | Acrylic or polycarbonate | Transparent |
| Game floor | Printed monomeric gripping vinyl | Ordering information will be provided by Planète Sciences |
| Water tower | Net | Mesh size must be smaller than 22mm. |
| Path of the bee | Wood | |

No objections regarding differences in dimensions will be taken into account.

The material's density can change from one country to another. It is highly recommended that the team tries different types of wood since the weight may differ significantly.

J.5. MANUFACTURING TOLERANCES

All dimensions are in millimeters (or mm). Manufacturing tolerances shall comply with the following rules, unless otherwise specified directly on the drawings.

| Dimensions | General tolerances |
|------------------------------|--------------------|
| ≤ 20 | ± 1.50 |
| $> 20 \text{ and } \leq 70$ | ± 2.50 |
| $> 70 \text{ and } \leq 150$ | ± 4.00 |
| > 150 | ± 5.00 |

J.6. PAINTING REFERENCES

| | Color | Reference |
|-------------------------------------|----------------|--------------|
| A-team | Signal orange | RAL 2010 Mat |
| B-team | Yellow green | RAL 6018 Mat |
| Borders and cleats in starting area | Pebble grey | RAL 7032 Mat |
| Straw construction cube | Traffic yellow | RAL 1023 Mat |
| Vegetable construction cube | Yellow green | RAL 6018 Mat |
| Industrial construction cube | Jet black | RAL 9005 Mat |
| Solar panel construction cube | Traffic blue | RAL 5015 Mat |
| Brick construction cube | Signal orange | RAL 2010 Mat |
| Golden cube | White | RAL 9010 Mat |

RAL hues can vary from a printed soil mat to another.