

ASME Hong Kong Section Student Design Competition 2024

Harvesting the Sun and Wind

(Updated on 10 December 2023, key changes are highlighted)

Nearly twenty percent of the energy consumed around the world for heat, power, or transportation comes from renewable sources. Renewable sources generate a quarter of global electricity, projected to rise to 45 percent by 2040. Much of the increase will likely come from solar, wind, and hydropower. The ability to generate these advances in technology will require the efforts of skilled engineers who appreciate the challenges involved in both collecting and utilizing renewable energy.

The theme of ASME Hong Kong Section Student Design Competition 2024 is to collect renewable solar and/or wind energy and move weights around a game surface. It requires teams to design and build a remotely controlled vehicle with the following goals:

- The device should be as small as possible, with a maximum internal size of 350 *mm* by 350 *mm* by 350 *mm* (a Sizing Box bonus is awarded)
- The device must be capable of collecting and using solar and/or wind energy to power its operation. Each device starts the round with one charged AAA battery for propulsion. A bonus is awarded for devices that use both solar and wind power
- The device transports as much weight as possible from a loading area onto a raised platform within 10 minutes. Teams determine the amount of weight carried per trip and number of trips made during the given time
- Weights will be manually loaded onto the device, and may either be manually or automatically unloaded on the raised unloading platform (an Automated Unloading bonus is awarded)

General Rules:

1. Students participating in the competition must be undergraduate engineering students.

Number of teams from a school: At most 3.

Number of students on a team: No more than 5.

2. The device, controls and all weights to be used during the competition must fit within the box, which is 350*mm* x 350*mm* x 350*mm* (internal dimensions). Teams should minimize the box dimensions to get the Sizing Box bonus

$$\text{Sizing Box Factor} = \sqrt[3]{\frac{(350\text{mm})^3}{\text{interior box width} \times \text{length} \times \text{height}}}$$

3. The demonstration field is a 2400*mm* by 2400*mm* space marked on the floor by tape (see Figure 1). Devices must stay within the taped outer boundary during demonstration. The field will have one 500*mm* x 500*mm* (external) Starting/Charging Zone marked by tape on the floor. A 600*mm* x 600*mm* Weight Unloading Area platform is indicated in the playing surface

that is elevated approximately 50mm and fabricated from wood. Two ramps are used to connect with the Unloading Area platform. Both ramps are be uniform and the horizontal length of the ramp will be approximately 250mm.

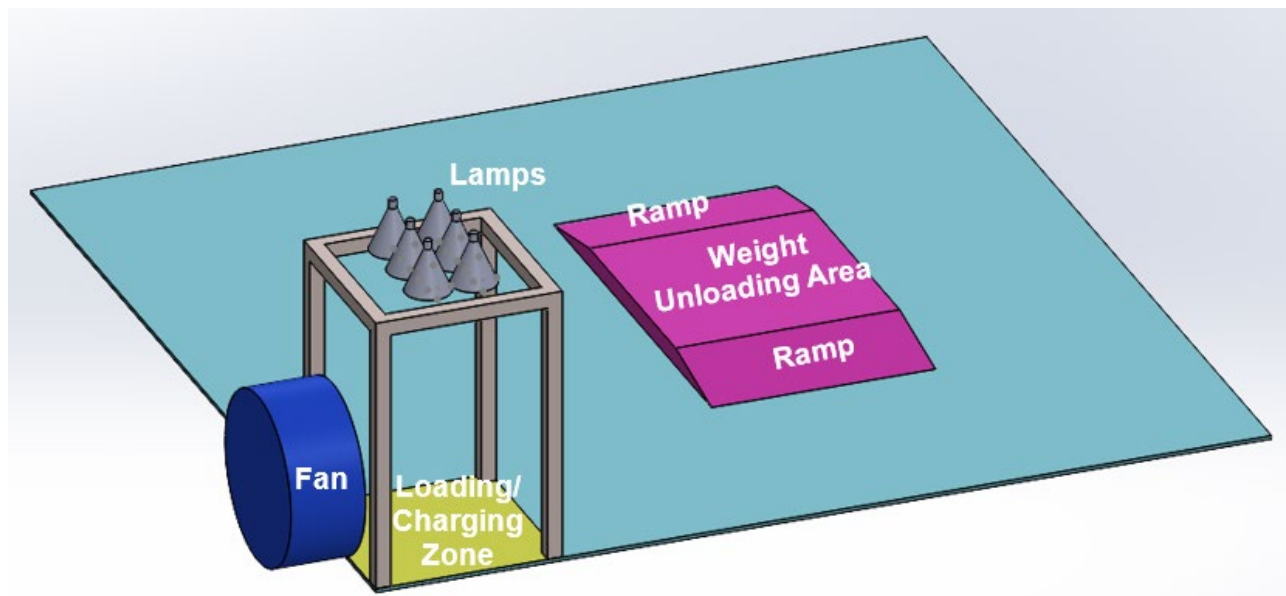
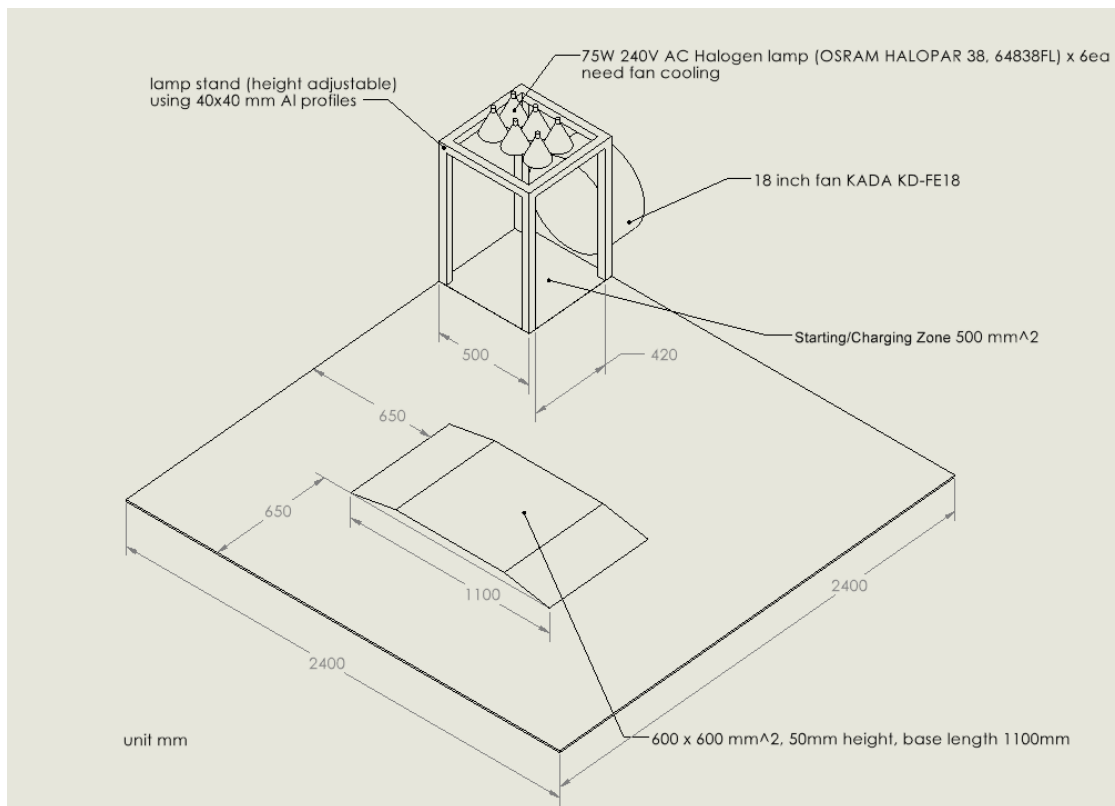


Figure 1: Competition Playing Field
(2400mm x 2400mm overall size)

At the competition, ASME Hong Kong Section will provide the solar energy and wind sources at the Starting/Charging Zone (see Figure 1):

- The solar energy will be simulated by 6 75W 240V AC Halogen Lamps (See Figure 2 for the model: OSRAM HALOPAR 38) arrayed in 2 by 3 (set up as the source of solar energy for the Charging Zone at the competition). The solar energy source will be positioned on the top of supporting profile in the Charging Zone, and the height of lamp stand can be adjusted.



Figure 2: The model of 75W 240V AC Halogen Lamp

- The wind energy will be simulated by a “KADA” 18” 240V AC fan 地台风扇 (KD-FE 18, See Figure 3) set up as the source of wind energy for the Charging Zone at the competition. At the competition, the wind energy source will be positioned near the edge of the Charging Zone and may not be moved, but teams will be allowed to manually set the desired fan speed.



Figure 3: The wind fan

- During the competition, a team member may activate either/both energy sources while their device is in the Charging Zone, and then deactivate all energy sources when the

device leaves the Charging Zone.

4. Teams must build a device propelled by energy collected from the solar and/or wind sources. Teams must decide how collected energy will be stored within the device (capacitor, mechanical storage, etc. **but rechargeable battery is not allowed**). **In addition, one non-rechargeable AAA battery (Duracell Alkaline cells (AAA) or equivalent) will be provided by the Organizing Committee to propel the device. At the start, teams must show that devices contain no stored energy to propel the vehicle other than the provided non-rechargeable AAA battery.**
5. The use of mechanical energy is allowed for vehicle propulsion if it is generated by the solar/wind energy collected, however teams may not use pre-loaded springs or weights (including the weights being carried to the unloading platform), or initially compressed gas to propel the device.
6. A remote controller operated by one team member will control the movement of the device. **Additional batteries may be used on the device for control purposes only, i.e., not for propelling the vehicle.**
7. All devices **must be capable of collecting, storing and using** either solar and/or wind energy sources. Before the competition each team will explain this capability to the judges – teams must prove that power is being collected from the solar/wind sources. An Energy Source bonus will be given for devices that use energy from both sources:

Energy Source Factor = 1 for one source used; = 1.2 for two sources used

8. Each round will begin with the device in the Loading/Charging Zone. One team member may manipulate the device as long as it remains within this zone (no part of the device is **touching the ground** outside of the taped area), and will manually load the desired weights onto the device for transport to the Weight Unloading Zone. Teams must supply all weights themselves for each trip to the Unloading Area. The weights can be reused for each trip, and different weight totals can be used for different trips.
9. After a device has been loaded, it must traverse the Playing Field and travel up either ramp to the Weight Unloading Area, but should travel down along the other ramp. Once the entire device is off the ramp and only touching the Unloading Area platform surface (shadow of the device on the ramp is allowed), the weights can then be deposited onto the raised Unloading Area to earn points. Weights can be manually or automatically removed and the device must return to the Loading Zone under its own power to complete the trip and earn points.
10. If a device becomes stranded without power on the Playing Field, a team member will be allowed to manually place the device in the Charging Zone, however the team will not score any points for any weights carried during this run.
11. An automated weight removal bonus will be applied to scoring in the competition. Teams that can deposit weights from the device onto the Unloading Area Platform remotely receive an ***Automatic Weight Removal Bonus = 1.2***. Devices using manual weight removal

receive no bonus. In either case, devices may not be adjusted or repositioned in the Unloading Area other than to remove all weights.

12. For each team, two rounds will be completed during the demonstration. For each round, the setting time is 20 minutes, and the competition time is 10 minutes. The highest score from either round will be counted as the final score. The team can give up the 2nd round and the score in the 1st round will be counted as the final score. The sequence of teams for competition will be determined by lucky draw on site.
13. Two identical demonstration fields as described in Item 3 above will be prepared for the competition. One round of the competition will take place on one of the demonstration fields while the second round will be on the other field.
14. When the device requires recharging during competition, teams must position their device completely within the Charging Zone. Within the Charging Zone one team member is allowed to position the device. The Solar and/or Wind power sources will then be turned on, and the device recharged. The recharging time is counted in the 10-minute competition time.
15. The type of testing area surface will be announced once the venue of competition is confirmed.
16. At the end of the round, the team will get a total score based on the following:

$$\textit{Trip Score} = (\textit{Automatic Weight Removal Bonus}) \times (\textit{Energy Source Factor}) \times (\textit{mass of weights deposited in Unloading Area})$$

$$\textit{Total Score} = (\textit{Sizing Box Factor}) \times (\textit{Sum of Trip Scores})$$

Note: Mass of weights deposited in Unloading Area will be measured by ASME.

17. The Section reserves the rights to revise the rules and regulations of the competition anytime, and will be responsible for answering questions raised by the participants and other relevant parties. The decision of the Section will be final.