International Core Journal of Engineering Volume 7 Issue 8, 2021
ISSN: 2414-1895 DOI: 10.6919/ICJE.202108_7(8).0046

# The Design of Non-powered Environmentally Friendly Car

Junmeng Lyu, Qin Fu

School of Guangdong University of Science and Technology, Dongguan 510000, China.

## Abstract

**The unpowered environmentally friendly trolley uses its own gravitational potential energy to gain power on the prescribed slope. The energy required to complete all actions during the walking process of the trolley is obtained by the conversion of the gravitational potential energy when it is sliding,so no other energy source can be used to drive the trolley. The design is a three-wheel structure, and there are strict requirements for the specific design, material selection and processing. Standard parts such as bearings, washers, screws, bolts, pins, etc. can be used in the production of the trolley. There are requirements for the quality and size of the car. The performance evaluation is based on measuring the length of the car's sliding distance. From design to production, the mathematical model of the car is first established with the help of the software UG to analyze the structure, and then the specific parameters of the car are obtained. Then, the solid modeling of the trolley is carried out, and the material properties, processing technology, and cost of the parts are comprehensively considered.**

## Keywords

**Unpowered Environmentally Friendly Trolley; The Design of the Trolley; Material Selection; Process Analysis.**

## 1. Introduction

The unpowered inertial linear sliding trolley obtains power by releasing its own gravitational potential energy on the prescribed slope, and the trolley completes all actions by inertia during its walking. Because the trolley has a three-wheel structure, it consists of two rear wheels and one front wheel.

We manufacture unpowered inertial linear sliding trolleys, which enable the trolley to gain power by releasing its own potential energy on a prescribed slope, traveling as long as possible, and converting gravitational potential energy into kinetic energy. To use the potential energy of gravity, because it is released on the same starting line on the slope, the higher the center of gravity is the better, so trying to move the center of gravity of the entire car back. Considering these factors comprehensively, we focus on studying how to increase the inertia of the rear wheels, while reducing the friction between the rear wheels and the ground, increasing the mass of the rear wheels and the inertia wheels as much as possible, using steel wheels and aluminum inertia wheels. Because there are weight requirements for the production of small cars, and the density of aluminum inertia wheels is much lower than that of steel and copper, aluminum inertia wheels are used under weight control requirements. When they are rotated, the density is small and the radius is large and the moment of inertia is large, so that the rotation is not easy to stop, and the trolley can be driven for a period of time [1]. To reduce friction with the ground, the smoothness of the wheels is very important, and the wheels need to be turning, milling, planning, grinding. Ensuring the sliding direction, avoiding the trolley rollover or the direction deviation, there must be a common axis between the wheels to restrain each other to ensure the direction. The bearing seat is needed, and it must be made into a stepped hole to prevent it from slipping out from the other side [2].

ISSN: 2414-1895 DOI: 10.6919/ICJE.202108_7(8).0046

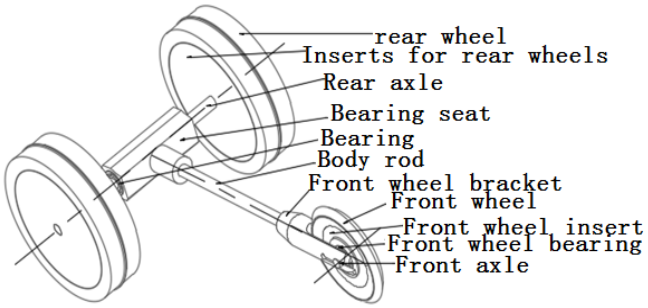


Figure 1. Schematic Diagram of The Structure of The Trolley

## 2. Material selection

For the production of the trolley, we must first consider its material. The material is extremely important. If the material density is too high, the trolley will be overweight and not meet the requirements. If the material density is small, the trolley is too light, and the power obtained by the release of gravitational potential energy is small, which shortens the sliding distance and causes the trolley to not reach the best condition. Therefore, it is very important to select the appropriate materials [3]. The trolley gains power by releasing the potential energy of gravity on the prescribed oblique wave, so the center of gravity of the trolley is behind, and the front wheel is as small as possible to reduce the weight. In order to increase the moment of inertia, the front wheel radius should be as large as possible. Taking these two factors into consideration, the most suitable material for the front wheel is metallic aluminum. Metal is used for the selection, instead of plastic, because the metal is harder and not easy to deform; After considering the factors of density and hardness, the material selected by the theory of inertia is aluminum.

## 3. Design ideas

The "inertial car" mechanical comprehensive ability training program requires participants to design and manufacture an unpowered inertial linear sliding car, so that the car can obtain sufficient power with its own potential energy release on the prescribed slope, and the car can travel a longer distance [4]. We designed this car and analyzed the car's gravitational potential energy, kinetic energy, moment of inertia, wind resistance, car body mass and inertia wheel mass according to physics, and obtained the best solution we think. We made a three-wheeled unpowered trolley, so that the trolley can use its own potential energy to obtain sufficient power on the prescribed slope, and the trolley can travel a longer distance. The middle of the front and rear wheels is hollowed out to insert inserts made of aluminum, and the wheels are distributed into one front wheel and two rear wheels. The trolley is mainly connected by rod-like parts. The main design components are the rear wheel and the front wheel. The design of the rear wheel mainly considers the gravitational potential energy, the moment of inertia, the friction between the wheel and the ground, and the ability to continue to walk in a straight line after slipping from a slope. In order to make the trolley get the maximum weight potential energy on the slope, most of the weight is concentrated on the rear wheels. In order to ensure that the trolley can slide in a straight line after falling to the ground, the maximum diameter of the rear wheel is designed to be close to the maximum height. The design of the front wheel is similar to that of the rear wheel. According to the design idea, the front wheel should also be designed to be close to the maximum height. But we take into account that the car should obtain the greatest gravitational potential energy, and the weight is mainly concentrated on the rear wheel, so the thickness and diameter of the front wheel must be considered according to the overall mass of the car, and at the same time, in order to obtain a larger moment of inertia for the front wheel , and the front wheel also adopts the form of hollowing out and inserting aluminum blocks in the middle to obtain a larger moment of inertia.

ISSN: 2414-1895 DOI: 10.6919/ICJE.202108_7(8).0046

## 4. Analysis of turning process

The processing technology plays an important role in the processing of parts. It brings great convenience to the entire processing process and greatly improves the accuracy of the parts. The processing technology scheme adopted by this inertial trolley conforms to the general principles of process design. The process route is composed of first rough and then refined, near first and then far, the main and then the second, the inside and the outside, and the unified benchmark. In this plan, we have determined the different processing methods for each side. Basing on the understanding of the characteristics of various processing methods and the surface roughness [5], in the processing process, the processing method will be flexibly adapted to meet the technical requirements of the processed parts and help improve work efficiency while reducing processing costs.

## 5. Debugging and driving of the trolley

In the process of debugging the car, in order to reduce the friction between the parts, drip lubricating oil on the axle, the trolley should be handled gently, and the correct way is to hold the bearing seat with two fingers. Taking the car to the track, due to the requirements of the track, the rear wheel of the car cannot leave the slope. In order to get the full kinetic energy of the car, the rear wheel of the car is at the top of the slope, and the car is in the middle of the slope, grasping the rear wheel, adjusting it, and gently put both hands at the same time.

## 6. Conclusion

Through this design and production research, we have gained valuable knowledge and ability improvement from theory to practice. For example, how can the trolley minimize the energy loss in the process of converting the gravitational potential energy into kinetic energy; How to reduce the wind resistance of the trolley during driving, and how to make the trolley obtain the maximum rotational inertia and so on. After sufficient design and production discussions and the teacher's patient guidance, we came up with the best design plan. After a rigorous process, we also had the car we wanted.

## References

[1] "University Physics" edited by Luo Yuanyuan [K] (Volume 1) Chapter 5 "Basics of Rigid Body Mechanics", 2010/01(1).

[2] Pu Lianggui, Ji Minggang. Mechanical Design [M]. Eighth Edition. Beijing: Higher Education Press, 2010.

[3] Liu Hongwen. Mechanics of Materials [M]. Fourth Edition. Beijing: Higher Education Press, 2009.

[4] Li Yongzhuo, Liu Beineng, and Xiao Zhuoye formed the "Thunderbolt Lightning Team" process report[R].

[5] Gan Yongli. Geometrical tolerances and testing [M]. Eighth edition. Shanghai: Shanghai Science and Technology Press, 2009.