

## Calculation and design the automotive maintenance station

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**Abstract:** The repair and maintenance station is the place where repair and maintenance work is carried out in accordance with the plan to repair the damaged vehicle. Therefore, the basic requirement for maintenance and repair stations is to maintain and repair quickly and promptly according to plan, ensuring the technical requirements. There is enough capacity, meeting the requirements of ensuring safety for laborers, fire safety. To perform the requirements on the maintenance station - the repair must be fully equipped with facilities, equipment for maintenance, repair, especially specialized equipment, construction of sufficient number maintenance, repair.

**Keywords:** design, maintenance station, automotive maintenance, calculation method

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### 1. Introduction

In the latest report, although there have been some results, the domestic automobile assembly and assembly industry has not yet met the real automobile industry (most new in assembly). The main production line consists of 4 main stages: welding, painting, assembling, testing. Vehicle prices are still high compared to other countries in the region. The reason for automobile prices in Vietnam is higher than other countries, according to the Ministry of Industry and Trade, due to high taxes and fees and low domestic production. In particular, the quality of vehicles manufactured and assembled domestically, though improved, is still not equal to imported vehicles. The difficulties for Vietnam's automobile industry lie in both inputs and outputs. Specifically, to make a car requires technical standards must be very standard. In fact, no one wants to make a car, the business must make 100%. Even corporations, big companies now only make a few dozen%, what is their strength they promote. There are big brands, even they do not, but just buy new technology to make their products and sell to the market. The technical team can be built according to the investment thinking of each government. And supporting industry is very important, even if we already have a technical team, want to design their products, but the supporting industry market is not very difficult to develop the car industry.

Another barrier to Vietnam's automobile industry is the need to create a brand that guarantees its credibility. Considering the strategic vision for the automobile industry, Vietnam has had to change its policy, because it has not met the target. If the automotive industry is developed, most other industries have to follow because they are interrelated, especially when the world has turned to new energy sources. However, this is not a good thing for Vietnam because if we buy the old technology to make products cannot keep up with the trend of technology development. According to the above analysis, the expert emphasized that Vietnamese people want the country to have a product that affirms its name in the market, but to make a quality product, there Branding is not simple at all. The difficulty here is in thinking users, whether the people of Vietnam are willing to spend money to buy a car "made in Vietnam" or want a car importer brand name?

As for automobile technology today, Vietnam lags far behind in the world in both technical and industrial support for the automobile industry. For example, in Germany, a corporation wants to make cars with modern technology, around it is the company, the factory makes the equipment, details with the modern technology that the corporation requires. In Vietnam, it seems impossible. Countries such as Malaysia, Thailand and Indonesia have been developing their strategic vehicles and trying to keep the domestic automobile industry alive. If Vietnam follows that way properly, then we are left behind because the countries have gone ahead.

The automotive sector holds an important place in the operation and development of society. Automobiles are commonly used to serve the national economy and in defense. The economy of our country is on the development momentum. Currently, many modern vehicles are being manufactured and assembled in Vietnam, with technical parameters suitable to the climatic conditions and topography of Vietnam. In our country today, we mainly exploit the generations of vehicles manufactured abroad with many different types. But in practice, the exploitation of vehicles in domestic companies has shown many limitations. The investment for the construction of facilities for maintenance and repair is still low and the station system is not complete.

There are many factors that affect the vehicle's technical condition. Apart from subjective factors, people in the observance of technical regulations also consider objective factors.

#### a. Objective factors

\* The effect of air humidity.

Our country is in a humid tropical climate, so the air with high humidity will cause metal rusting due to electrochemical corrosion. At the same time when large water vapor will penetrate grease or damage. lubricity. The water is deposited on non-metallic materials such as wood, rubber, leather.

\* Influence of temperature conditions.

When the outside temperature is high, the engine cooling performance and clusters such as clutch, gearbox, suspension system, etc. will be greatly reduced, resulting in engine power, transmission efficiency of the clusters. reduced fuel consumption, increased lubrication and reduced cooling capacity.

### b. Subjective factors

\* Impact of maintenance quality - repair.

Technical maintenance is a combination of technical organization management measures to maintain a good state of the vehicle and extend the life of the vehicle. Through technical diagnosis will detect in time and anticipate the damage to maintenance - repair. Regularly carry out inspection, adjustment, tightening, lubrication, sanitation.



Figure 1. The automotive maintenance station

Our country is in the process of changing with the strong development of the economy, especially since we are a member of the World Trade Organization (WTO). In order to meet the needs of the economy in the field of transportation, travel, many modern vehicles with many different types have been imported from abroad or assembled in factories in the country. In Vietnam, there are currently over 1.6 million cars in circulation, of which about 40% are cars of 9 seats or less, along with the amount of new cars put into use every year from (15 - 20)%. Understanding the importance of maintenance work, the company has built a system of maintenance - repair to meet the actual needs of maintenance - repair of vehicles. The design of a maintenance station - repair must be based on the maintenance tasks and the technical specifications of the vehicle, the characteristics of the situation where the company works and the capabilities of the company. From the analysis above we choose the layout as shown in Figure (c) as the station layout plan as it is more reasonable. (The bridge method combines bridge and bridge). The station is designed to include maintenance areas with maintenance bridges and surrounding areas that are necessary for repair and maintenance. Due to the basic area and small capacity, parts of the same nature will be allocated an area.

## 2. Method of planning and technical calculation

Maintenance and repair service center for technical maintenance of 01 and 02 for automobiles, small and medium repair and specialized maintenance works.

The center consists of maintenance area - general repair, professional repair rooms and rooms for daily life and organization and production management. All parts are in a building.

**a. Common maintenance area**

This is where technical maintenance and repairs are carried out, in the area where maintenance bridges are located. The number of bridges depends on the number of vehicles for maintenance - repairs.

**b. The repair room**

- Engine repair area;
- Mechanical room - cold;
- Car Body Repair Section;
- Room for modifying and repairing the fuel system;
- Department of electrical equipment repair;
- Engine room;



Figure 2. The rule of design of the automotive maintenance station

**Calculation of maintenance needs - repair**

In theory, the need for maintenance - repair of vehicles is usually determined by the following method: Determine the maintenance needs - repair according to the monthly vehicle use plan of the enterprise, organizations and fish human. This method is difficult, due to the company's monthly vehicle use plans or changes.

Determine vehicle number for maintenance - repair.

Select worker level.

The selection of maintenance workers - repair is conducted based on the following factors: the amount of maintenance work - repair, the complexity of the work, the type of equipment, the ability to work each technician and must match the actual situation of the center. For maintenance work - small repair without the technician good technician of the center only need a technician certificate issued by Toyota.

**Calculate the area of the rooms under the maintenance and repair center**

The purpose of calculating the area of the rooms is to ensure sufficient space for layout of equipment and facilitate the maintenance - repair, but also to ensure the economic and technical indicators to avoid causing wasted materials for construction, avoiding excess or lack of use area.

Second method: Determine the plan based on the planning, equipment size, size, number of vehicles, draw the layout of them at the set ratio to ensure the requirements of the distance. between vehicles and between devices, between the device and the wall, to ensure the convenience of travel, the work of workers.

Work area for cold room and shell repair

Calculate the area of the paint area.

Paint rooms include specialized paint rooms and surface preparation rooms before painting. The surface area of the surface preparation before painting is calculated on the basis of the following principles: The distance between vehicles on bridges or vehicles with walls is 1.2 m, this distance ensures technicians easy operation, unobstructed view of space. The distance between the car's tail and the wall is 1.2 m. The distance between the body and the house is not less than 0.5 m, the distance between the vehicle and the fixed device is not less than 1.2 m.

#### **Calculation of industrial hygiene and labor safety**

This is a very important and essential issue for the daily life of workers in the station. The level of lighting and quality of lighting will directly affect productivity, quality of work and safety for workers. Therefore the lighting needs to meet the following requirements: Lighting must be adequate, uniform for all rooms, do not cause blinding, not shiny, safe and economical. To ensure all the above requirements in the design we use two types of lighting: natural and artificial lighting for the station.

The purpose of the ventilation is to ensure good working conditions of the workshop personnel, change the air and bring out the toxic, dust generated by the machine. Ventilation may be provided by natural ventilation or artificial ventilation. Natural ventilation through the area of doors, windows, shutters.

#### **Determination of CO<sub>2</sub> and CO**

In the process of human activity always emits toxic gases and vapors (carbon monoxide from the respiration process, other gases produced by the process) which increases to a certain limit, endangering people. To reduce the amount of vapors and gases one of the solutions or solved is ventilation for the building. The allowed concentration of CO<sub>2</sub> in the room is 1% by volume. The process of respiration. The amount of CO<sub>2</sub> emitted by the person is depending on the size, age, and activity status.

Resting state, quiet 20 [liter / h-person];

Light manual labor of 30 [liter / h-person];

Normal manual labor 50 [liter / h-person];

Located quietly 10 [liter / h-person];

The amount of air required to discharge CO<sub>2</sub>: The concentration of CO<sub>2</sub> allowed 1%, so the amount of air needed to remove CO<sub>2</sub> is:

#### **Planning site maintenance, repair**

The bridge is built on the basis of the most appropriate organization of the process of maintenance, repair and best use of the area and do not interfere with other work. The arrangement of the main components must be in line with the general sequence of technical maintenance of automobiles. Arrangements for sub-components should be technologically relevant to the main components.

Determination of maintenance methods - repairing vehicles: At the center of basic maintenance methods is the method of maintenance of the bridge. The essence of the universal bridge method is that all work in a particular type of repair and maintenance is performed on a bridge and is carried out by a group of technicians with different expertise. One of the forms of maintenance organization - repair by the universal bridge method is the establishment of specialized groups of mobile technicians. The essence of this organizational form is that parallel to the construction of the bridge, one organizes a group of technicians who specialize in a number of tasks.

### **3. Conclusion**

The results of design of the automotive maintenance station are evaluated versus the conclusion as: Evaluation of station capacity is calculated according to the average intensity of us

Based on actual data: vehicle performance, vehicle usage, company vehicle utilization plan and maintenance organization - vehicle repair unit as the basis for calculation. The capacity of the station allows timely and sufficient content maintenance periodically, quickly overcome the damage of the car, while also creating conditions for good exploitation of the equipment of the company, improve the level organization of technical staff.

#### **On the area of space used**

Space used must meet the needs of the company in that space, on the other hand if the area through the wide will cause waste and increase the cost of construction so when the construction area of history It must be derived from the following two points: To meet the demand for use of the unit, to ensure the economy. For the repair and maintenance station as designed above, it is reasonable to make full use of the exploitation capacity

of each area, not to waste space and at the same time to meet the demand for maintenance - repair one optimal way.

### **On the general layout of the station**

The general layout of the selected station is optimized. It allows the car to be repaired and repaired easily and conveniently. Equipment for maintenance - repair of vehicles is arranged around the bridge maintenance to help the maintenance - repair cars are more convenient and efficient, easy and fast moving.

#### *Maintenance equipment*

The repairing and maintenance equipment of the above design company is equipped with a number of equipment to improve labor productivity and quality of maintenance - repair and reduction of human labor.

#### *Grade and placement of workers in maintenance and repair rooms*

When arranging people on maintenance bridges - repair and repair rooms, service rooms are paid attention to how the layout of the number of people is reasonable, the level of workmanship and the professional field of workers to ensure. Using the equipment, bringing into play professional technical skills of workers, improving productivity and product quality to ensure the time in the station is the most reasonable.

### **References**

- [1] Ben-Gal, I and Bukchin, J. 2002. The ergonomic design of workstations using virtual manufacturing and response surface methodology. *IIE Trans.*, 34: 375–391.
- [2] Gürkan, G. 2000. Simulation Optimization of buffer allocations in production lines with unreliable machines. *Ann. Oper. Res.*, 93: 177–216.
- [3] Huang, MG, Chang, PL and Chou, YC. 2002. Buffer allocation in flow-shop-type production systems with general arrival and service pattern. *Comput. Oper. Res.*, 29: 103–121.
- [4] Hwang, HS and Cho, GS. 2001. Assembly performance evaluation using factor/AIM for the automobile body assembly line. *J. Korean Inst. Ind. Eng.*, 27: 95–102.
- [5] Law, AM and Kelton, WD. 2000. *Simulation Modeling and Analysis*, 3rd, Singapore: McGraw-Hill.
- [6] Noh, SD, Hong, SW, Kim, DY, Sohn, SY and Hahn, HS. 2001. Virtual manufacturing for an automotive company (II)—Construction and operation of a virtual body shop. *IE Interf.*, 14: 127–133.
- [7] Okulicz, K. 2004. Virtual reality-based approach to manufacturing process planning. *Int. J. Prod. Res.*, 42: 3493–3504.
- [8] Park, SC. 2005. A methodology for creating a virtual model for flexible manufacturing system. *Comput. Ind.*, 56: 734–746.
- [9] Qin, SF, Harrison, R, West, AA and Wright, DK. 2004. Development of a novel 3D simulation modeling system for distributed manufacturing. *Comput. Ind.*, 54: 69–81.
- [10] Spieckermann, S, Gutenschwager, K, Heinzl, H and Voß, H. 2000. Simulation-based optimization in the automotive industry – A case study on body shop design. *Simulation*, 75: 276–286.
- [11] Ulgen, O, Gunal, A, Grajo, E and Shore, J. 1994. “The role of simulation in design and operation of body and paint shops in vehicle assembly plants”. In *Proceedings of the European Simulation Symposium, Society of Computer Simulation International* 124–128.