



# Design and research of automatic carpet laying machine

Jun Zhe Cao<sup>a</sup>, Nan Qin<sup>a\*</sup>

<sup>a</sup>School of Mechanical Engineering, Dalian University of Science and Technology, Liaoning Provincial

\*Corresponding author:99365204@qq.com

**Abstract.** Under the stimulus and promotion of socialist market economy, various large space architectural forms gradually increase. In such as workshop, workshop, exhibition, hotel and other large space occasions, often need to lay carpet on the ground. Most large space occasions, directly using manual carpet laying work, low efficiency, high strength, high labor cost. In addition, artificial carpet is a labor-intensive industry, the industry is difficult to recruit people, difficult to maintain people, difficult to keep people and other difficulties increasingly prominent. How to innovate and introduce an automatic carpet laying machine to improve laying efficiency and reduce labor cost is an important issue that needs to be solved in this paper. This paper aims to analyze the status quo and problems of traditional carpet laying technology, and take the automatic carpet laying machine as a case, to discuss the design technology and concept of automatic carpet laying machine.

**Keywords:** Automation; Carpet laying machine; Design technology; Analysis and research

## 1 Introduction

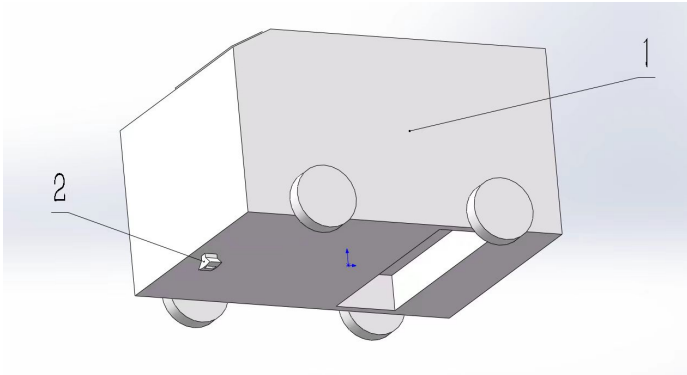
In the large hotel exhibition hall and large exhibition space, carpet is a necessary basic material. In large area carpet laying, often need a lot of manpower construction. Workers need to prepare scissors, irons, ironing belt and other tools, squat on the ground for construction operations. In the face of oversized scenes such as hotels, more workers are needed to help each other to complete the carpet laying, which takes a long time and occupies a lot of human resources. In the traditional manual laying method, when facing the rolled carpet, it needs to hammer the special tool with the knee, which is easy to cause harm to the workers' body. The design and application of automatic carpet laying machine has greatly solved the above problems and has good practicability. The purpose of this paper is to discuss the design technology and ideas of modern automatic carpet laying machine, only for the reference of related design units.

## **2 Current situation and problems of traditional carpet laying technology**

Before the modern automatic carpet laying machine design technology appeared, the traditional carpet laying machine technology has been applied for a long time. Compared with automatic carpet laying machine, traditional carpet laying machine has more problems and difficulties. Traditional manual paving, for example, takes more time than mechanization; For example, in the face of oversized scenes such as hotels, a large area of carpet laying is needed, and several workers need to help each other at the same time to complete the laying of manpower; For example, in the traditional manual paving method, when facing the rolled carpet, it needs to hammer special tools with knees, which is easy to hurt the body and cause labor loss. It is also because of the above reasons that the traditional carpet laying technology is gradually eliminated by the society, and ushered in a new era of automation in the design and application of modern automatic carpet laying machine <sup>[1]</sup>.

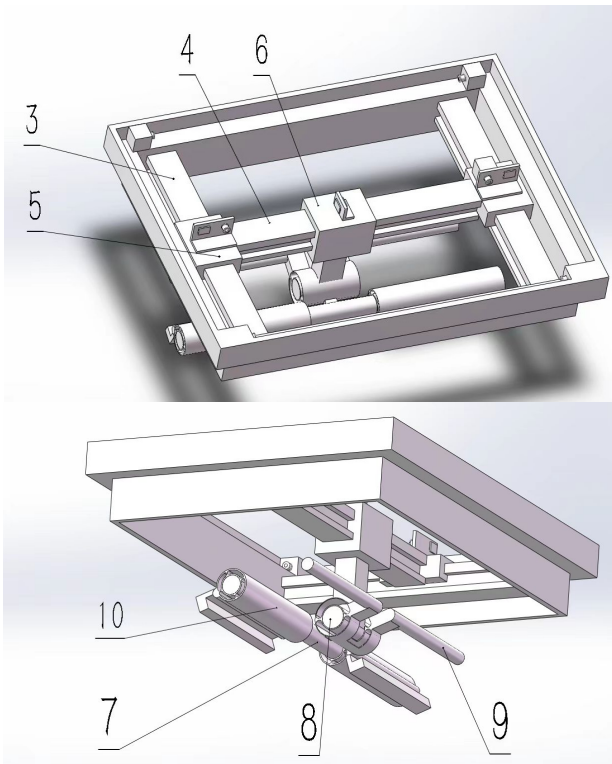
## **3 Automatic carpet laying machine overall working scheme**

The designed automatic carpet laying machine is shown in Figure 1, which mainly includes a laying vehicle and a laying module, and the laying module is arranged in the laying vehicle. The structure of the laying module is shown in Figure 2, which mainly includes a positioning mechanism, a grasping mechanism and a flattening mechanism. The positioning mechanism is a two-axis driving device driven by the motor. A rotating structure is arranged between the grasping mechanism and the flattening mechanism. The grasping mechanism and the flattening mechanism are connected with the two-axis driving device through the rotating structure. The grasping mechanism comprises a rotating barb device and a rotating device, as shown in Figure 3. The rotating barb device is arranged on both sides of the rotating device. The rotating barb device is a cylindrical structure with an L-shaped barb structure, and the L-shaped barb structure can rotate along the installation point, and the rotating device is connected with the rotating structure. In this case, the new automatic carpet laying machine mainly uses rotating barb coordination, glue spraying device and flattening device to lay the carpet in the same process, so as to improve the working efficiency and reduce the error rate, as well as reduce the labor demand <sup>[2]</sup>.



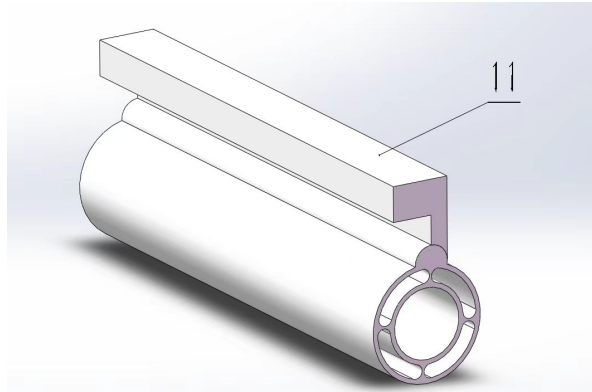
1- Laying car 2- Nozzle

**Fig. 1.** Automatic carpet laying machine laying car



3- longitudinal guide rail; 4-horizontal guide rail; 5-Longitudinal slide block; 6-Transverse slide block; 7-Rotating device; 8-Rotating structure; 9- Flattening mechanism; 10-Rotating barb device.

**Fig. 2.** Structure of automatic carpet laying machine



11-L-shaped barb structure

**Fig. 3.** Rotating barb device

## 4 Design technical points and functions of automatic carpet laying machine

### 4.1 Structure and composition of automatic carpet laying machine

The design of automatic carpet laying machine adopts modular design, the whole is divided into three modules, the front end is the central control module, the workers input scene for analysis, provides a variety of laying schemes for workers to choose, but also workers can design their own laying schemes. At the same time, use the remaining space to add the spray module and spray glue on the cleaned floor with the pump. The middle part is the extraction and lowering module, which uses a rotating barb device to hook the required carpet out of the carpet pile and lower it to the ground that has been sprayed with glue. Finally, for the flattening module, the heavy press wheel is used to flatten and compact the already laid carpet [3].

### 4.2 Working principle of automatic carpet laying machine

The working principle of automatic carpet laying machine is as follows: (1)The rational use of pump body and nozzle makes the laying of glue more uniform. (2)The positioning system realizes the movement of x axis and y axis through three groups of motors, three groups of synchronous belt, three groups of belt wheel and splint. (3)The design of the rotating barb device, through the barb structure will hook the carpet from the carpet pile, through the electromagnetic force rotation action to pull out the carpet, at the same time the device into the lock state. The unpositioned system sends the carpet along with the barb device to the desired location, which releases the lock by electromagnetic force and lowers the carpet to the desired glue-sprayed floor [4]. (4)The design of the automatic carpet laying machine can pull out the carpet from the carpet winding cylinder through the opening mechanism, the carpet is pressed flat on the ground through the flattening mechanism, the tensioning mechanism plays a tensioning

role in the laying process of the carpet, the glue mechanism to the back side of the carpet sticky double-sided adhesive, so that the carpet can be firmly fixed on the ground, at the same time for the stripping of paper tape recovery. The carpet machine realizes a series of operating procedures such as pulling out, laying, flattening, bonding and cutting of carpets through the reasonable arrangement and cooperation of various institutions, thus realizing the automatic laying of carpets, greatly improving the efficiency of carpet laying and saving labor costs<sup>[5]</sup>.

#### **4.3 Function description of automatic carpet laying machine**

(1) In the automatic carpet laying machine, the empty space in the middle of the box is the place where the carpet is stored, the carpet is put in, and the carpet is laid through the rotation of the mechanical equipment. In the process of laying, if the carpet is stuck and other problems are encountered, it will use its own unique transmission mode to quickly re-level the carpet<sup>[6]</sup>.

(2) Automatic carpet laying machine is automatic and does not require human involvement all the time. It can replace the decorator for fully automated carpet laying, and his work efficiency is higher than human work efficiency. The automatic carpet laying machine in this case is completely in some simple ideas, an extension of the new fully automatic working machine. In this case, the automatic carpet laying machine has the same working value as other commonly used machines<sup>[7]</sup>.

(3) Automatic carpet laying machine, not only can lay carpet, but also can smooth the laid carpet, the machine can press the carpet back and forth, so that the carpet is more smooth.

### **5 Automatic carpet laying machine design innovation**

(1) The design of automatic carpet laying machine is novel. At present, there is no carpet laying machine in the market. Based on the grass laying machine, it is improved to carpet laying machine<sup>[8]</sup>.

(2) The designed automatic carpet laying machine internal connecting rod mechanism and transmission mechanism, internal mechanism of high freedom, can better realize automatic work.

(3) The designed automatic carpet laying machine has a smooth appearance without edges and corners. At the same time, it is equipped with an ultrasonic induction device to detect obstacles, which is more conducive to the automatic carpet laying machine to operate in a narrow room<sup>[9-10]</sup>.

### **6 Conclusion**

The design of the automatic carpet laying machine has a reasonable structure, its positioning device, grasping device, barb device and spray glue device, flat device to complete the laying of the carpet with the same process, in order to achieve the

liberation of the manual, to achieve the purpose of automatic carpet laying. Solid Works is used to complete the simulation of mechanical structure, which shows that the automatic carpet laying machine has reasonable structure, can meet the design requirements, and has good promotion value.

## References

1. GUO D. (2020) Research on Carpet Pattern Recognition and Motion Trajectory Planning of Carpet Machine. Tianjin Vocational and Technical Normal University.
2. Guo D, Li H, Wang L. (2019) Research on Motion Path Planning of Carpet Machine Based on Image Recognition. Journal of Tianjin Vocational and Technical Normal University.
3. Huang R. (2019) High-speed carpet tufting machine needle - hook mechanism design and analysis. Donghua university.
4. Peng Ch, Ji Ch. (2019) Modeling and Analysis of Electronic CAM Horizontal Jacquard System for Carpet Machine. Machinery Design & Manufacture.
5. WANG W. (2012) Research on Integration Technology of Tufted Carpet Machine Control System Based on CAN Bus. Donghua University.
6. LI X. (2008) Research on Multi-loop High Carpet Machine Control System Based on CAN Bus. Donghua University.
7. Zhao H, Yan Ch, Yan J. (2014) Application and Development Prospect of Mechanical Automation Technology in China. Journal of Anyang Normal University.
8. GUO L, SHANG Y, CAI F. (2020) Application of Automation Technology in Mechanical Design and Manufacturing. China Equipment Engineering.
9. WANG Sh, Yang W, et al. (2004) New Technology, New Structure and Development Trend of Foreign Construction Machinery.
10. Chen L, Yu B. (2014) Mechanical optimization design method. Metallurgical Industry Press. Bei Jing.

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

