

# Design and Practice of Laser Machining Comprehensive Training Project

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**Abstract:** Laser processing with its simple and convenient processing means, more and more widely used, as an engineering training project is also popular among students. But learning equipment operation is not the fundamental purpose of engineering training, more attention should be paid to the cultivation of engineering quality, to carry out engineering training based on product design and processing is an inevitable requirement. Therefore, this paper discusses the characteristics of the comprehensive project, the source of the comprehensive project, the design and practice of the comprehensive project, so as to further enhance the scientific design of the laser processing training comprehensive project, and better achieve the education and teaching objectives.

**Keywords:** Laser Processing; Training; Project; Practice

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## Introduction

The national medium and long-term education reform and development plan outline (2010-2020) ", in 2018 the Ministry of Education "about to speed up the construction of a high level of undergraduate course education, improving talent training ability of opinions" and other relevant documents, points out that universities should "to establish an open, three-dimensional practice teaching system", "perfect curriculum system, update teaching content, Improve teaching methods "and" enhance students' sense of social responsibility, innovative spirit and practical ability ". Constructing a new system of practical teaching in colleges and universities is one of the important ways and tasks for colleges and universities to cultivate morality and cultivate people and strengthen the connotation construction of higher education. The new economy characterized by new technologies, new industries, new forms of business and new modes is developing vigorously. The existing practical teaching system of engineering education is difficult to meet the new needs of higher engineering education put forward by the new round of scientific and technological revolution and industrial transformation. Mainly reflected in the lack of practical teaching project design, not enough relevance with life, difficult to find the feeling of immersive;The training project is independent and single, lacking of comprehensive, and lacks training of engineering system thinking and engineering literacy <sup>[1-7]</sup>. Taking laser machining training as an example, this paper tries to solve the above problems encountered in engineering training practice teaching from the perspective of design and practice of comprehensive projects.

## 1. Characteristics of laser machining training comprehensive project

Comprehensive practical training projects take products as the final goal of practical training. Products can be formulated according to students' interests, and teachers can make independent propositions according to teaching requirements to complete a product during practical training and teaching. In this process, students from design to processing, parts with specific size and matching requirements can establish the concept of product production, improve students' enthusiasm for processing. In addition, students have experienced the whole product production process in the learning process, which not only completed the teaching content stipulated in practical training, but also cultivated students' engineering literacy.

The comprehensive practical training program enables students to experience the whole life-cycle production process of conception, design, material selection, production and assembly, and the teaching process immersing students in it. The comprehensive practical training project must be the task moving type, with the task running through the practical training

teaching, the teaching content and the operation training content are closely combined, forming a systematic practical teaching process from point to line, from line to surface. The product needs students to make comprehensive use of several kinds of equipment to complete, will greatly stimulate students' interest in learning, improve learning initiative and creativity, will get a sense of accomplishment. Therefore, the comprehensive project has the characteristics of comprehensiveness, systematicness and whole-life periodicity.

## **2. Design of laser machining training comprehensive project**

The design of comprehensive projects mainly focuses on actual combat projects, such as interdisciplinary innovation and entrepreneurship projects, the theme projects of mechanical innovation design competition, such as old-age assistance and agricultural picking assistance, and the carbon-free car, energy car, UAV, underwater obstacle removal, etc. , in the comprehensive ability competition. The introduction of enterprise resources, the integration of industry and education collaborative education, the needs of enterprises and projects into engineering practice, to ensure that the training of talents to meet the needs of the industry, industry. The design of all comprehensive projects must flexibly use at least three sets of equipment to complete the processing and production of works. From the simple operation of equipment to the flexible use of equipment, from a single equipment, to the combination of use, more importantly, several kinds of equipment can complete some parts of the processing task, but from the perspective of economic benefits learn to choose the use of the corresponding processing equipment, training engineering analysis ability.

The source of the project can be multi-channel, multi-layered and multi-dimensional. From life, to solve the problems encountered in life, such as storage and sorting, hygiene tools, beautify life, etc. ;From production, to solve the problem of increasing production and improving efficiency. Such as the improvement of forming equipment, workshop logistics auxiliary equipment, intelligent security equipment and so on. From innovation and entrepreneurship, to fill the gap in the industry, to solve the national bottlenecks. Such as microforming technology and equipment, quantum communication technology and equipment, big data collection and use, etc.

Design drawings, select materials, determine the process, choose the means of processing. According to the requirements of the comprehensive project, CAD and corresponding software are used to complete the design of the drawing, determine the size and tolerance, and form the pattern of laser processing equipment identification. The material and thickness of the material determine the selection of processing parameters of laser processing equipment. From conception to the completion of the production of products in accordance with the strict process can be realized, and the right choice of processing equipment. Assessment is divided into process assessment and structure assessment. Process assessment, including drawing design, material selection, process determination and processing method selection, etc. The results of the assessment, including the functional, aesthetic and structural rationality of the work.

## **3. Practice of laser processing training comprehensive project -- creative bookends**

Customized products have become a popular mode of production, and productive labor is developing from simple repetition to innovative productive labor and creative development. At present, there are a variety of book products, as shown in Figure 1, and they are still mainly formed products of plate reinforcement, which are processed through design-cutting, blanking, bending, polishing, coloring, decoration and packaging.



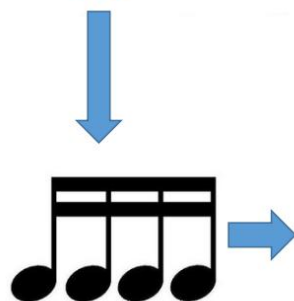
Fig.1 Bookends of plate forming

### 3.1 Conception and design

First of all, it is necessary to master the design software, such as AutoCAD, Solidwork, CAXA, etc. , and combine personal preferences and relevant elements to form a personalized design, as shown in Figure 2.

Fig.2 Personalized design ideas

Ex.1a



Taking the sixteenth note as an example to carry out the following design. The commands needed include the drawing of

points, lines and shapes, graphic editing commands, size annotation, etc. The drawing should be an expanded drawing of the design for later processing and blanking. The height of the side elevation of the book file is 158mm according to the finished size of the large 16K paperback book (297\*210mm) and the 32K hardcover book (184\*130mm), and the length of the bottom surface is 112mm, about the thickness of 7-8(about 300-page) books (each book's thickness is about 12-14mm), and the radius of the corner is about 2mm. Therefore, the length direction of the expansion diagram is 270mm;Width direction 136mm;The hollow sixteenth note is taken as the side facade, and the plane is taken as the bottom surface to form the sixteenth note creative book file, as shown in Figure 3.

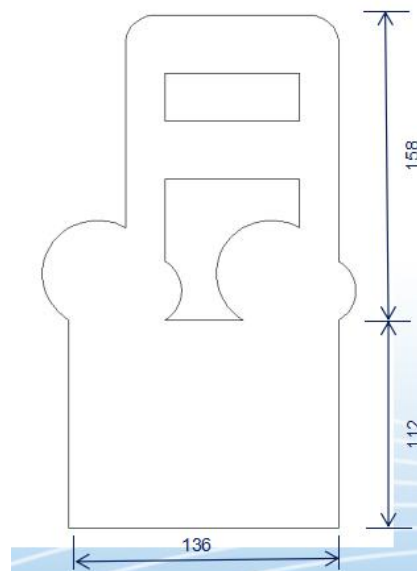


Fig.3 Bookends expansion diagram

## 3.2 Blanking

The traditional blanking method used in mass production is stamping blanking. This method is not suitable for the production of personal customization, because the mold cost is large, the mold design cycle is long, and the supporting equipment occupies a large space. So the new processing blanking method is laser metal cutting method, flexible and convenient, more suitable for small batch, personalized product processing. Transfer the graph, remove the annotation line and the center line, as shown in Figure 4; Adjust cutting parameters to appropriate values according to material and effect requirements, as shown in Figure5 and 6.

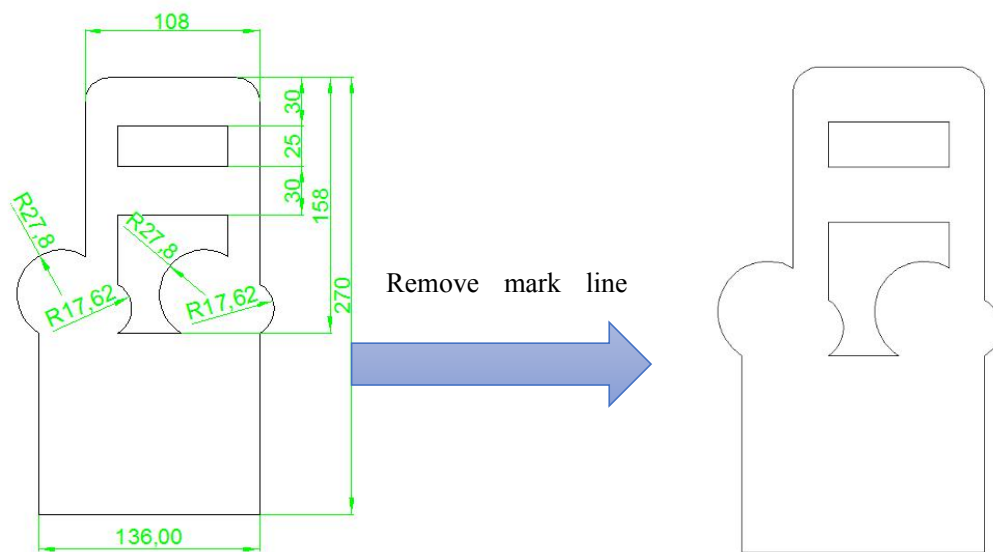


Fig.4 Processing of graphics

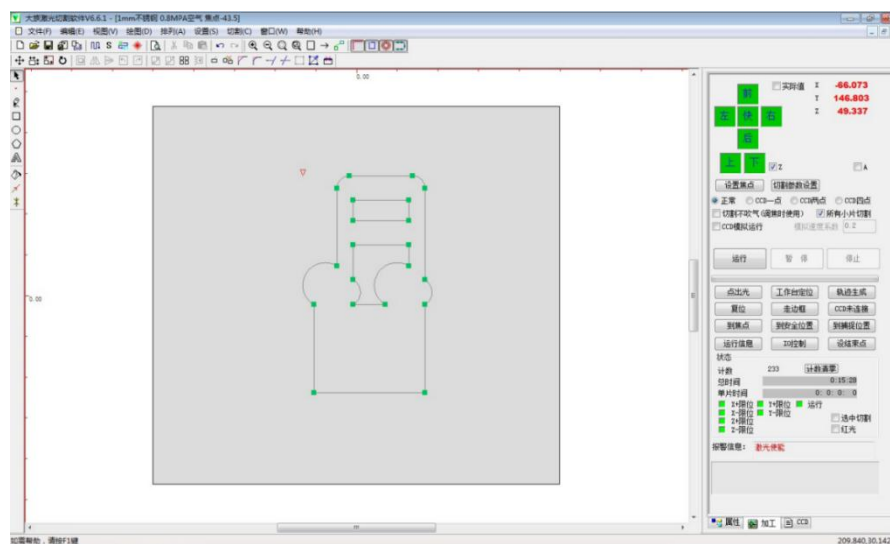


Fig.5 Operation interface of laser metal cutting

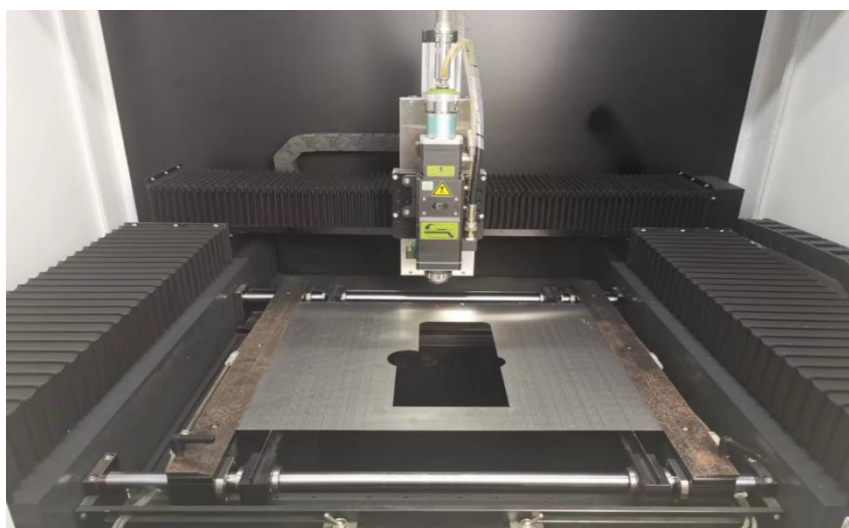


Fig.6 Laser metal cutting blanking

### 3.3 Bending processing

Next, the bending process. Bending equipment is a manual bending machine, in bending to fully consider the problem of material bending rebound, according to the different material, the same material thickness is different, the amount of rebound is different, generally use many adjustments to bend to the desired Angle, our book is a right Angle of 90 degrees. Firstly, the falling parts are fixed on the bending machine with a pressing plate, and the position should be aligned with the bending line, as shown in Figure 7. Slow moving rod bent bending to the location of the  $90 + 5$  degrees, for 5 seconds, slow down bending rod, such as meet at the end of the bending Angle, can in the case of not loosen the clamp, to repeat the above process, if the corner is greater than the bending Angle, the revision will be more difficult, unqualified products will also increase the risk of produce, so applying pressure when bending must be slow, When approaching the target Angle, the speed should be slowed down to ensure that it does not exceed the target Angle. This is shown in Figure 8.

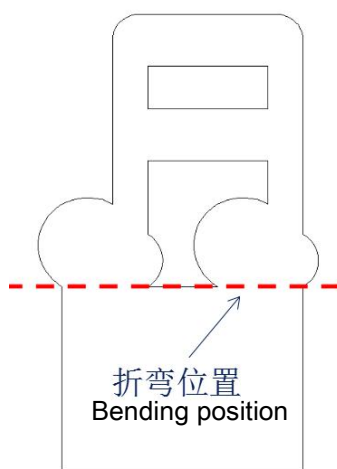


Fig.7 Bending position of bookends



Fig.8 Bending forming

### 3.4 Follow-up Procedure

Compared with the metal color, most people prefer the color of the book file, the use of hand spray painting for painting, after drying, so that the paint film and the substrate binding more firmly; If you want to continue to increase decorative

patterns, you can carry out laser marking processing, or more advanced wood grain transfer technology. I don't need to list them here. Finally, plastic film packaging to avoid surface wear or scratching.

## 4. Conclusion

The design of laser processing comprehensive training project has the characteristics of comprehensiveness, systematicness and whole-life periodicity. Based on the comprehensive project as the carrier, the training process not only pays attention to the teaching of laser principle and laser processing equipment usage knowledge, but also pays more attention to the cultivation of practical operation ability and engineering analysis ability. The comprehensive practical training project is carried out in the form of task completion, and the whole process of creative sixteenth note books from conception to design and then to the production of creative products of processing and decoration is completed in the way of immersive learning. Stimulate students' interest in learning, enhance students' self-confidence and sense of achievement in learning.

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