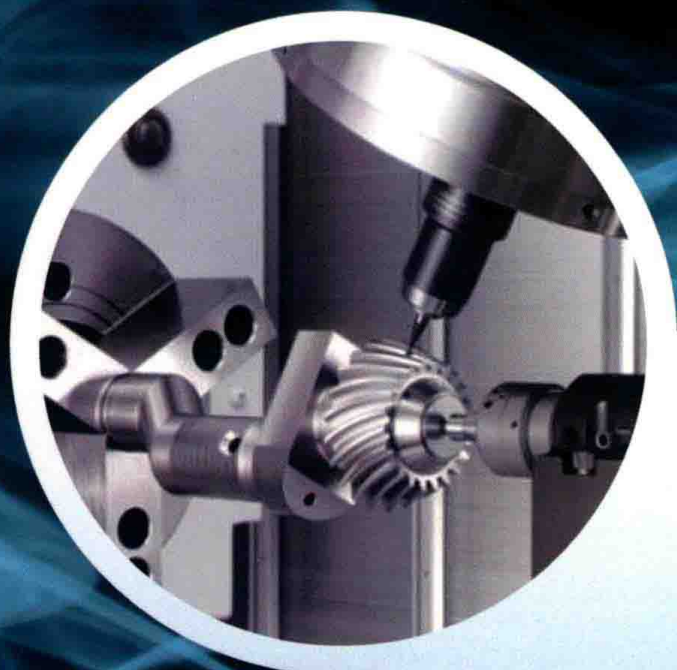


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MECHANICAL MANUFACTURING BASIC ENGINEERING TRAINING



机械制造 基础工程训练

曾艳明 主编
(Zeng Yanming)

 江苏大学出版社
JIANGSU UNIVERSITY PRESS

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机械制造基础工程训练

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 江苏大学出版社
JIANGSU UNIVERSITY PRESS

镇江

图书在版编目(CIP)数据

机械制造基础工程训练 = Mechanical
Manufacturing Basic Engineering Training : 英文 /
曾艳明主编. — 镇江 : 江苏大学出版社, 2018. 11
ISBN 978-7-5684-0962-9

I. ①机… II. ①曾… III. ①机械制造—教材—英文
IV. ①TH

中国版本图书馆 CIP 数据核字(2018)第 228284 号

机械制造基础工程训练

Mechanical Manufacturing Basic Engineering Training

主 编/曾艳明

责任编辑/吴蒙蒙

出版发行/江苏大学出版社

地 址/江苏省镇江市梦溪园巷 30 号(邮编: 212003)

电 话/0511-84446464(传真)

网 址/http://press. ujs. edu. cn

排 版/镇江市江东印刷有限责任公司

印 刷/镇江文苑制版印刷有限责任公司

开 本/787 mm×1 092 mm 1/16

印 张/20.5

字 数/685 千字

版 次/2018 年 11 月第 1 版 2018 年 11 月第 1 次印刷

书 号/ISBN 978-7-5684-0962-9

定 价/58.00 元

如有印装质量问题请与本社营销部联系(电话: 0511-84440882)

PREFACE

This book is compiled on the basis of the “Basic Requirements for the Teaching of Mechanical Manufacturing Courses” formulated by the Guiding Subcommittee of Mechanical Basic Courses of the Ministry of Education for colleges and universities. It acts up to the spirit of the “excellent engineer training plan”, and absorbs the achievements and experience of Jiangsu University in the exploration, reform and practice of basic engineering training system and model in recent years.

This book follows the principles of science, practicality and versatility, takes engineering ability and comprehensive quality training as fundamental. This book is mainly focused on practical teaching. It aims at cultivating students' basic skills, comprehensive application of process knowledge, engineering quality and innovation consciousness. During the compiling of the book, the author emphasizes the teaching idea of “modularization of basic knowledge and skill training, tamping foundation and strengthening application ability, project-based comprehensive ability and innovation, highlighting innovation and improving quality”, and determines the guiding ideology and the characteristics of the textbooks, which are mainly reflected in the following aspects:

1. The basic theoretical knowledge in this book achieves the requirement of necessity and sufficiency, focusing on the analysis and training of engineering examples;

2. Organize and write according to the idea of “propose a problem—analyze the problem—solve the problem”;

3. This book based on the project-driven instructional model, using the actual parts processing as the carrier, to achieve the goal of improving engineering quality and professional ability by the technology analysis and processing of typical examples.

The book is divided into 11 chapters, the main contents include: Introduction, Engineering Materials and Heat Treatment, Casting, Forging and Stamping, Welding, Turning, Milling, Bench Work, CNC Machining, Non-traditional Machining, Comprehensive Process Design

and Innovation Practice.

The chief editor of this book is Zeng Yanming. The associate editor is Xie Zhiyu, Ma Weimin. The reviewer is Wang Weixin. There are many teachers who participated in the compiling of the book, such as Fang Zhuoya, Hu Jianmin, Wang Yifang, Ye Xin, Du Yanjin, Ying Tao, Chen Yanjun, Ma Pengfei, Zhao Yuchun, Aamir Nazir.

A large amount of relevant teaching material, manual and literature at home and abroad was consulted and cited during compiling. I would like to pay my respects and thanks to the authors concerned.

Due to the limited level of editors, this textbook inevitably might have some errors, peer and readers rectification is accepted!

Editor

August, 2018

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Chapter 1

Introduction

1.1 Description of Engineering

Engineering takes advantage of scientific principle, technology, management theory, humanities and arts and practical experience to transform and use nature. It is used to develop and produce useful products for human and its core task is to design and implement the target object which does not exist yet to directly or indirectly serve the human society. Engineering originated from the basic necessities of human survival, including the most basic needs for food and clothing, and it originated from the eager of human to the artifacts, tools, residence and other items of daily life. The aim of the human activity is making and building these useful items. The human activity from birth to today has a long history.

With the development of science and technology, social progress, the scope of human engineering activities continue to expand, the complexity of it constantly deepens, and the technical content constantly improves. The discipline fields of engineering change from the traditional civil engineering, mechanical engineering, materials engineering, electrical engineering and other traditional range, to the development of modern communication engineering, aerospace engineering, biological engineering, nuclear engineering and other high-tech fields. However, no matter how human activities change, how the basic disciplines develop, the property of engineering has not changed, namely, innovation, practice, quality, cost, social security, and so on.

Since ancient times, the processing of human practice performs as dynamic. We can understand the characteristics of the engineering from the engineering process, and grasp the essence of engineering to understand the engineering behavior. In general, plan, design, manufacture, use and end form a complete life cycle. The plan contains two parts about proposal and decision of engineering idea, and it mainly solves the



problems of the necessity and feasibility of engineering manufacturing. After the engineering plan is approved, the design of the project will start, including design ideas and concepts of engineering, and determine the concrete construction plan design. The third step of engineering is manufacture, including engineering, assembly, commissioning and acceptance, and it is based on the process of engineering design for the transformation and reconstruction of nature. The use of the project refers to the period during which the project is formally put into operation after the completion and acceptance of the project, and the project realizes its own economic or social benefits. After the engineering end, it needs to be scrapped, that is the end stage of the project. These five steps are closely related and interact with each other, which constitute the complete life cycle of the project.

The purpose of understanding the project from processing is to refine the factors that play a core role throughout the engineering process and thus better to understand the essence of the engineering. In this aspect, it has formed two kinds of complementary views on the engineering process: one is to understand engineering as the process of design. The idea that the “design” is the essence of engineering and the implementation of the engineering is only according to design to product or manufacture. Therefore, the design is the soul of the engineering, the real engineer is a designer. Another idea thinks engineering as a process of manufacture. It depends on the design but is beyond the design. Eventually, artificial objects reflect the value and significance of the engineering.

1.2 Engineering Culture

1.2.1 The concept of engineering culture

Culture is a complete complex that reflects the characteristics of a society or a social group. The engineering culture refers to the cultural phenomenon of engineering characteristics which occurs, is reflected and transmitted in the field of engineering. Engineering cultural education is a new kind of educational idea. It aims at cultivating the engineering culture quality of engineering cultural education. It also includes the education of engineering values, the education of engineering ethics, the aesthetic education of engineering and the cultivation of engineering thinking mode. It is necessary to establish a brand—new idea of engineering cultural education, reform the curriculum system, strengthen the construction of teachers' teams, enrich the teaching content and reform teaching methods.

Engineering culture is the fusion of “engineering” and “culture”. In a broad sense, engineering culture is the sum of material and spiritual achievements formed by human beings in designing, producing, managing and consuming activities for the survival and development of society. The narrow sense of engineering culture refers to the cultural



phenomenon involved in the process of actual engineering activities, that is, the cultural phenomenon with engineering characteristics that occurs, reflects and spreads in the field of engineering, in various links of engineering activities. It is the sum of material and spiritual achievements produced by human beings in engineering activities. That is to say, the main body of engineering culture is a variety of engineering communities, including engineering decision makers, managers, investors. Engineers, workers, and other social groups, these social groups due to different origins, social status and cultural literacy, may have different world outlook, outlook on life, values, but in engineering activities. They want to take the engineering activity as the common target behavior, and must obey the common engineering activity behavior rule. Therefore in the long-term engineering practice, they not only create the rich material and cultural achievement, but have a common value, common belief, common mode of thinking, common language, common style, and common spiritual style, and common code of conduct. This has formed a special culture-engineering culture, engineering cultural education is a new educational concept, its purpose is to cultivate the engineering cultural quality of engineering college students, and it emphasizes people-orientation. Based on the relationship between human and engineering and the attitude of human towards engineering, this paper organically combines science education, humanities education and engineering education, so that students can receive basic knowledge of science. The edification of engineering culture, including engineering professional knowledge, realizes the comprehensive and coordinated development of knowledge, ability and quality, and gives full play to the function of university culture in educating people.

1.2.2 Connotation of engineering culture

Engineering culture includes four aspects: engineering values, engineering aesthetics, engineering thinking and engineering ethics.

Engineering values are a special value created through engineering activities. It reflects that engineering activities and their achievements meet some human need to some extent, and it is the soul engineering of engineering culture. The education of engineering values is to help the educates to set up correct engineering values. Based on the harmonization and sustainable development of human, nature, and society, people should not only pay attention to the present interests of the project but also pay attention to the long-term interests of the project. They should not only pay attention to the utilitarian value of the project but also pay more attention to the non-utilitarian value of the project, which is the humanistic value of the project. The utilitarian value of the project indicates the practicability of the project. The humanistic value of engineering reflects the humanistic connotation of engineering. It means the taste of the project, the care of the people themselves, and the humanistic care embodied in the project.



Heidegger used to borrow the poem of the Netherlands, saying that man poetically lives on the earth. The two words of poetry express the nature of humanity. People are not only realistic, rational but also romantic and ideal. The pursuit of beauty is human nature. Now our land, the environment of our lives, has been wrapped by our high tech. Surrounded by our various works of engineering, we live in a space built by engineering. The quality, structure, and function of the project are of course important, but the spiritual style, the cultural value and the aesthetic value of the project cannot be ignored, because it is the requirement of the higher level of the project, and it is also the ultimate concern to the person concrete embodiment. It's the ultimate concern that is woven into the poetry. With the charm of culture and the beauty of art to tap into the hearts of people, it inspires people's life ideals and makes people enjoy life in poetic love. Engineering beauty is the harmonious, orderly and stable factors that are included in the engineering activities and the engineering effects. The engineering beauty can bring harmony and joy to the engineering community and even the project participants. Engineering beauty should not only be the goal of engineering designers but also should be the goal of all members of the engineering community. The engineering beauty needs to reflect the structural rationality of the project in every link of the engineering activity, and the overall operational effectiveness and perfection, the harmonious relationship between the project and the surrounding environment, etc.. As a measure of whether the project is successful or not, it is also a concrete manifestation of engineering beauty. Those projects, which can fully meet the functional utility of the project, and reflect the perfect form, must be in conformity with the aesthetic requirements. The functional utility of the pursuit project is consistent with the pursuit of perfect form. Only when the two are organically combined can the overall concept and ultimate goal of engineering design be achieved better.

With engineering practice, there is a thinking activity about engineering practice. Engineering thinking is a kind of thinking mode which is closely related to engineering practice in engineering practice. Engineering activity is a kind of creative activity, and it is a kind of activity that remodels the world. And the activity of this transformation world is artificial scale, which determines that the engineering practice is the unity of the law and the purpose. To achieve this goal in engineering practice, engineering designers and engineers must cultivate their engineering mindset. What are the main characteristics of engineering thinking? First, engineering thinking is scientific. On the one hand, scientific thinking provides some theoretical guidance and methodological revelation for designers and engineers. On the other hand, scientific laws set strict limits on the "impossible goal" and "impossible behavior" existing in engineering activities for designers and engineers in engineering thinking. Second, engineering thinking is artistic. The artistry of engineering thinking not only is reflected in the imaginative need of engineering thinking because engineering thinking is a kind of creative thinking, but also shows that engineering thinking often requires engineering



decision-makers, designers and engineers show “thinking individuality” and “engineering beauty”. Third, engineering thought has the ability to logistics and integration. Thinking is a basic content of engineering to consider how to reasonably use the various tools, machinery, equipment and other means of reasonable technological process to realize the purpose. This is the face of engineering thinking strategy, because the engineering activity is technical factors, economic factors, management factors, social factors, aesthetic and ethical factors such as the integration of various factors, which determines the engineering thinking must be based on integrity as a fundamental characteristic way of thinking. The principle, nature, and characteristics of engineering thought are mastered, which is the precondition of being educated to form a mode of thinking.

Ethics is a subject that explores what is good, what is bad and discusses moral responsibility and obligation. It answers questions such as “how a person should live” or “how a person should act”. The main research of natural science is the “real” state of things. Ethics studies the “should” state of things. The aim is to point out what is true or evil. Without the grasp of “real”, there will be no judgment of “should”. This is why we seek the truth. Similarly, without the judgment of “should”, the grasp of “real” is meaningless. Because of this, we should educate the students in ethics.

Engineering activity is one of the most basic social practice activities, which involve many complex ethical issues. Engineering ethics education is to ask the educated (future engineer) to define the whole project, especially the responsibility and obligation of the engineer to the society. Such responsibilities and obligations mainly include: the engineer should place the public safety, health, and welfare in the paramount position; to ensure the quality of the project, as this is the premise of ensuring public safety, health and welfare; to be honest, engineers must be honest, just and fair. Engineering activities are driven by a multitude of social forces. Since engineers have multiple roles in society and assume multiple responsibilities and are often in a conflict of interest. In the face of the temptation of interests, engineers should be able to continuously accept the test of morality and “conscience”, and resist the temptation. Since engineers are mostly employed by businesses, it is their duty to be loyal to their employers. But when there is a conflict between loyalty to the employer and a commitment to society, the engineer has to make a decision: Loyalty to society and profession should be greater than and beyond the narrow interests of direct employers. In conclusion, through the engineering ethics education, it is required that the educators (the future engineer) in future engineering activity should follow social moral, social, ethical and social fairness and justice principles, adhere to the people-oriented, and promote the coordinated development of human and nature, human and society.

1.2.3 Cultivation of engineering culture

According to the connotation of engineering culture and the needs of educators in



engineering colleges, engineering cultural education should include education and training in the following aspects besides basic knowledge and professional knowledge.

I . Honesty and trustworthiness of the occupation ethics

Engineers shoulder the responsibility to create a better life for human society. The moral ethics of their own behavior need make the right choice. The purpose and significance of engineers are not only in order to make money for profit, but should be to develop themselves, social services and the benefit of mankind.

II . Humanistic feelings of people-oriented

Humanism is the embodiment of human wisdom and spirit. From a large aircraft to a small screw, the design and production of the products are for the people, thus engineers must be people-oriented in the first place. Today, engineers not only create material wealth and pursue the maximum interests of enterprises but also contribute to increasing human well-being. Therefore, engineering education must pay attention to the people-oriented concept during the whole process of cultivating engineer.

III . Rigorous and pragmatic professionalism

Activity and process of engineering have the objectivity and reality, which requires the engineer has a rigorous and pragmatic spirit, adhere to everything from reality, and oppose fraud and instant gains. At the same time, in the specific engineering practice, details determine the success or failure of a project from system design, equipment installation, commissioning and operation to the actual operation, engineers should have a high sense of responsibility to each link in the production process, and any carelessness will affect the overall situation, or even do damage to the producers and consumers, causing losses to the enterprises and the country.

IV . The pioneering spirit of innovation

Innovation is the essential requirement of the project, and the eternal theme of engineering construction project. Through the creation to create a world that does not exist, the outstanding works at all times and in all countries all shine with the light of innovation. But it can not be denied, the mediocre phenomenon caused by the lack of individuality and innovation in engineering construction still exists. In the face of complex and difficult engineering environment, engineers need to have innovation, and the courage of the persistent quality.

V . Seeking the rational spirit of truth-seeking

Any engineering activities must respect the objective facts and objective laws, and engineering design, construction, use should be carried out under the guidance of science and rationality, which is rational. When an engineer is faced with engineering problems, he should not rely solely on books, but also on practice. In practice, engineers should not be obsessed or blindly respond to existing theoretical and technical authority. Seeking truth from facts, the truth is the basic attitude of engineers should uphold, and the rational spirit of doubt and criticism is the inherent nature of the engineer should have. In fact, that is the process of the discovery process, problems

