



# Research and Practice of New Form Textbook Construction for Engineering Mechanics

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**Abstract.** In order to improve the quality of personnel training and promote the high quality development of military academies, it is necessary to deepen the reform of teacher, textbook and teaching method. The construction of new form textbook is the need and development trend of textbook reform. This paper introduces the background and characteristics of the new form textbook construction. Taking the Engineering Mechanics as an example, it analyzes the construction content and the resource type of the new form textbook. All teaching resources are integrated together to form a cloud textbook by using blue ink cloud platform. The new form textbook promotes the integration of information technology and education and teaching, which can enhance the efficiency and convenience of teachers and students to acquire knowledge.

**Keywords:** new form textbook · Engineering Mechanics · curriculum politics · military cases · cloud textbook

## 1 Introduction

With the development of information technology, the state pays more and more attention to the education informationization and digital resource construction. The deep integration of internet and education has become the main trend of education development in the new era. Since 2019, the state has successively issued National Primary and Secondary School Textbook Construction Plan, Administrative Measures for Teaching Materials of Ordinary Universities, and Construction Specification of Digital Campus in Colleges and Universities. In order to change the traditional teaching model, adapt to the needs of the new era of teaching reform and development, these documents advocate the use of three-dimensional, loose-leaf, manual-style and new form textbook integrating of modern information technology. China Education Modernization 2035 also proposed to strengthen the construction of curriculum and teaching material system, scientifically plan the curriculum of primary and secondary schools, classify and formulate curriculum standards, make full use of modern information technology, enrich and innovate curriculum forms. The guidance and support of the national macro-policy is an important driving force for the continuous improvement of textbook construction in higher education. The new form textbook combined with traditional paper textbook and digital resources has become an inevitable trend in the future [1].

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## 2 Characteristics of New Form Textbook

The new form textbook is based on paper textbook and takes the learners as the center. It makes full use of the Internet, VR/AR technology, virtual simulation and two-dimensional code technology. The new form textbook integrates paper textbook with digital resources, teaching resource libraries and online courses. It provides all-round and three-dimensional learning services which can meet the needs of teachers' teaching and learners' learning to the greatest extent [2, 3]. Comparing with traditional paper textbook, new form textbook has obvious advantages:

(1) The contents of the new form textbook are more abundant. Traditional paper textbook mainly describes the content with words, pictures or charts, which is flat, one-way and static. The new form textbook breaks through these limitations and integrates rich curriculum resources, such as micro-video, teaching cases, multimedia courseware, mind map, exercises online, discussion online, testing online and other digital resources. It means that the textbook changes from single to comprehensive, from static to dynamic. The new form textbook presents the teaching content vividly and intuitively, which conforms to the cognitive law of learners, enhances the interaction of teaching, improves the learning effect of learners, and realizes the effectiveness of teaching.

(2) The update speed of the new form textbook is real-time and fast. The traditional paper textbook needs a certain time period from writing, proofreading to publishing, so the update speed is relatively slow. If problems are found in the use process, it is difficult to be revised in time. In the process of using the new form textbook, once problems or new discoveries and new ideas are found, teachers can quickly update the digital resource through the network platform in time. The new technology, new norms and new requirements of the industry can also be integrated into it timely. The new form textbook can solve the shortcomings of traditional paper textbook, keeps up with the development of times and meets the needs of learners.

(3) The organization of the new form textbook is conducive to personalize. With the development of modern information technology, the network communication tools provides students with a convenient learning platform. Relying on the new form textbook, students can use mobile phones or mobile terminals to scan two-dimensional codes, learn autonomously anytime and anywhere. They can check and fill vacancies through the resources and tests online to meet their needs of personality development. Teachers can use the network teaching platform to carry out personalized teaching methods, such as flipped classroom, autonomous learning, discussion, and so on. They can also use flexible and diverse assessment and evaluation to detect learners' learning situation. So personalized learning programs for students can be customized to improve the learning effect and efficiency and the quality of teaching [4, 5].

## 3 Construction and Practice of New Form Engineering Mechanics Textbook

The new form Engineering Mechanics textbook conforms to the requirements of textbooks construction. It is consistent with the school's 2025 textbook planning goals, and has passed the textbook project. The construction of Engineering Mechanics is guided by the military education policy in the new era that is 'moral education, education for war'.

### 3.1 Construction Contents

(1) Contents of course. The course of engineering mechanics is one of the general and basic courses for many engineering majors, which usually includes theoretical mechanics and material mechanics, and some also include structural mechanics. Because of the time limit, the total class time of three mechanics is not much. The course of engineering mechanics is very difficult and has a lot of contents. If we choose the national planning textbook, it is impossible to explain all the contents one by one, which will inevitably result in a great waste of resources. Students will be intimidated even if they only see three thick textbooks, which will reduce their interest in learning. To solve these problems, the new form Engineering Mechanics textbook combines the three major mechanics into one textbook, which makes the teaching contents more concise and the chapters more reasonable.

(2) Teaching objective. The teaching objective is the starting point and the end result of the teaching activity, which decides the determination and arrangement of the teaching content and the choice and application of the teaching method [6]. For setting the teaching objectives of the new form Engineering Mechanics textbook correctly, we understand President XI's requirements deeply about the strategy of strengthening the army with talents, and think about the military education policy in the new era 'Who to train, how to train and for whom to train'. The teaching objectives are made clearly from three aspects: knowledge, ability and quality. For example, the knowledge objectives of 'Displacement calculation of statically determinate structure' is described as: understand the concept of structural displacement, explain the purpose of displacement calculation, and describe the principle of virtual work, understand the steps and principles of unit load method to calculate the displacement of statically determinate structure; use graph multiplication to calculate displacement skillfully; describe four reciprocal theorems of linear elastic system. The ability objective is to calculate the displacements of military floating bridges, rigid frames and military tent trusses by the unit load method. The quality goal is to train the students' courage of exploring and innovating the scientific spirit.

(3) Curriculum politics. In order to implement the military education policy in the new era, a large amount of ideological and political information is integrated into the textbook. They can be divided into four aspects: cultivating students' feelings of home and country through the stories of scientists and celebrities; cultivating students' philosophical thinking, dialectical thinking and experimental thinking through seminar teaching; cultivating students' safety awareness and responsibility through engineering accident cases; cultivating the spirit of great country craftsmen through the breakthrough and innovation of science and technology in the heavy equipment of the country [7, 8].

(4) Case application. The classroom is linked to the battlefield, teaching is about winning. In teaching, we should always insist on teaching what is needed in war and training what the army needs. We should encourage students to study the mechanism of winning, carry out scientific research on new technologies, new weapons and new equipment, and be ready to win an information-based war by relying on science and technology. New form Engineering Mechanics textbook adds professional military cases into the course to meet the needs of students post. It establishes the link between theoretical knowledge and engineering practice. Here is an example.

**Question:** In order to make the force on the bridge deck more reasonable, how should the bearing of the military floating bridge be arranged?

**Answer:** Taking a four-span statically determinate beam as an example, a mechanical model is established and a bending moment diagram is drawn in Fig. 1.

$$M_C = \frac{1}{2}qlx, M_I = \frac{1}{8}q(l-x)^2, M_H = \frac{1}{8}ql^2 - \frac{M_C}{2}, M_G = \frac{1}{8}ql^2 - M_C.$$

When the maximum positive moment and the maximum negative moment are equal, the force is the most reasonable.

Let  $M_C = M_I$ , we can obtain  $\frac{1}{2}qlx_1 = \frac{1}{8}q(l-x_1)^2$ .

The solution is  $x_1 = 0.1716l$   $M_C = M_I = 0.0858ql^2$ .

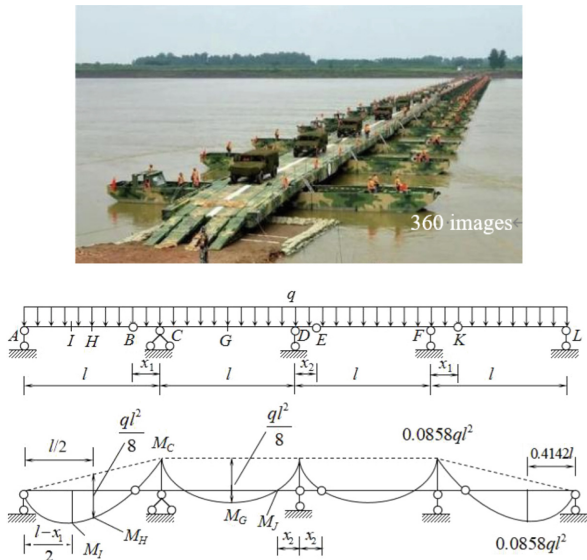
For  $F_{D\ddot{x}} = 0.5ql, M_J = 0$ ,

According to the equilibrium of JD, we can obtain  $0.0858ql^2 + 0.5qx_2^2 - F_{D\ddot{x}}x_2 = 0$ .

The solution is  $x_2 = 0.22l$ .

Compared with the internal force of simply supported multi-span beam, the maximum bending moment of the multi-span statically determinate beam is reduced by 31.36%, so the force of the multi-span statically determinate beam is more reasonable. It is the most reasonable position to take the hinge point at the distance of 0.22l from the support.

(5) Strengthening and upgrading. Engineering Mechanics course is one of the general and basic courses in the major of machinery, civil engineering, transportation, aviation and aerospace. It is the bridge between the basic courses and the specialized courses and is widely used in many engineering fields. It is also one of the professional courses for students to further their Postgraduate Admission Test. In order to make the textbook



**Fig. 1.** Floating bridge

more widely applicable, the teaching material exercises are very rich, including fill-in-the-blank questions, multiple-choice questions, judgment questions, thinking questions and calculation questions.

### 3.2 Resource Types

The resource types of the new form Engineering Mechanics textbook mainly include picture, animation, video, micro-lesson literature and procedure.

(1) Picture. Engineering Mechanics course is closely related to the actual engineering structure. Most of the traditional paper textbooks only give the picture of the actual structure, such as bridge, building, machinery, and so on, but do not give the detailed information. In the new form Engineering Mechanics textbook, not only the picture, but also the background and type of the actual structure will be introduced.

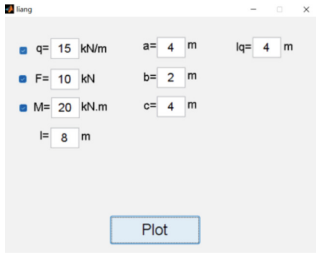
(2) Animation, video and micro-lesson. According to the characteristics of the course and the learning rules of the learners, the abstract and difficult knowledge in the teaching contents are organized. They are designed to short and concise video resources which are presented in the form of animation, video or micro-lesson. So the abstract contents become more intuitive and easier for students to understand.

(3) Literature. The new form Engineering Mechanics textbook includes many cases, which can be divided into three parts: some cases are summarized by the teacher according to their teaching experience and teaching research, some cases are military cases extracted from professional knowledge, the others are found from references which are researched by other people. These resources will be classified according to different teaching contents, so that each chapter has actual application corresponding knowledge.

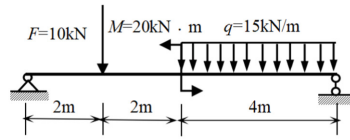
(4) Procedure. Some applications and workable interface are compiled using MATLAB in the new form Engineering Mechanics textbook. On a computer with MATLAB, you can open the operating interface and input relevant information, the internal force diagram will be drawn. It can save a lot of time and improve the human-computer interaction experience. The shear diagram and bending moment diagram of the simply supported beam can be drawn by inputting the information as shown in Fig. 2(a) in the operation interface.

### 3.3 Publishing Service Carrier

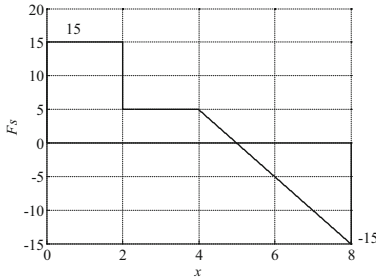
When all the teaching materials and resources are finished, they need to be aggregated into a service platform. Cloud textbook is a knowledge service carrier suitable for new publishing. The cloud textbook integrates the cutting edge technology in three fields of mobile reading, Rich Media Digital Publishing and cloud service. According to the reader's situational, dynamic and visual reading needs, the traditional paper books are re-designed with rich media and interactive design. For each end of the new design presentation (mobile phone, Pad, PC), it can provide readers with rich, extensible, interactive, progress can be tracked, refined new reading and learning experience.



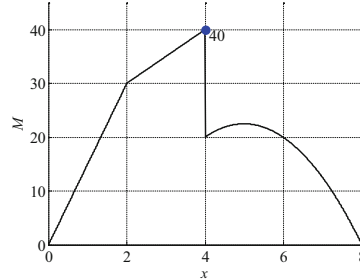
(a) Workable interface



(b) Force diagram



(c)  $F_S$  diagram



(d)  $M$  diagram

**Fig. 2.** MATLAB results

The new form Engineering Mechanics textbook plans to use the blue ink cloud platform. It will design a chapter catalogue that is easy to read. The layout, style, color and contents are more free and rich. Many videos, animations, bubbles, network links, two-dimensional codes are inserted in the textbook. Readers can click on bubble to read and network links to see relevant expansion content, and can scan two-dimensional codes to obtain relevant online knowledge resources directly (such as video, pictures, VR real-life interaction). Through the cloud platform, you can see the teacher’s key annotations, you can also record the knowledge you have learned into notes. After interactive learning, you can strengthen the knowledge by fill-in-the-blank, select, and answer questions in the form of instant interaction, and test the learning effect. Whether it is using a tablet, PC or mobile phone, the behavior of readers’ interactive learning and experience will be recorded. The creator can understand the use of textbooks by learners instantly, and can add or replace better teaching resources (such as new theories, new ideas, new phenomena, etc.) at any time. So the contents of the textbook can always keep in step with the times. The application interfaces are shown in Fig. 3 [9, 10].

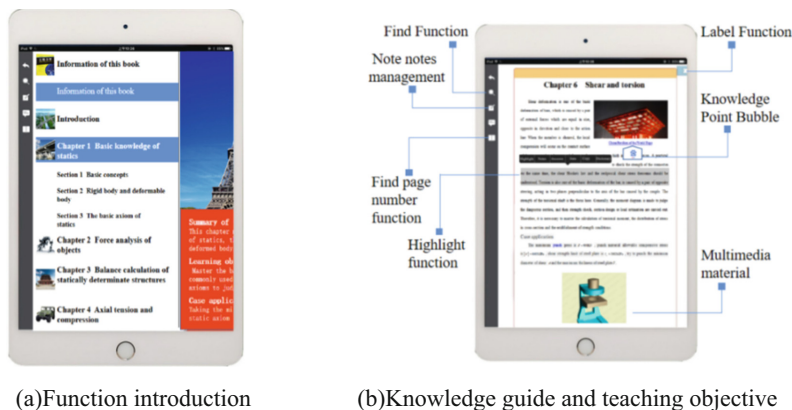


Fig. 3. Cloud textbook of Engineering Mechanics

## 4 Conclusions

The new form textbook is the inevitable outcome under the background of “Internet +”. Through the research on the new form Engineering Mechanics textbook, we found that the cloud textbook make the traditional textbook present in a new form, and make the information technology and education and teaching integrate deeply. It is of great significance to enhance learners’ learning interest, improve learning efficiency, test learning effect, and make rational use of fragmented time. It overturns traditional educational methods and promotes the reform of textbook and teaching methods actively.

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