

Brief Discussion of the Teaching Reform Research in Application-Oriented Colleges

—A Case Study of Introduction Class of Structural Mechanics

Chuanteng Huang

School of Engineering and Technology
Zunyi Normal College
Zunyi, China
huangct@yeah.net

Shuang Pu

School of Engineering and Technology
Zunyi Normal College
Zunyi, China
pushuangss@yeah.net

Abstract—In order to respond to the strategy of “Industry Strengthen Province” in Guizhou Province, to achieve the goal of transformation and upgrading of the college and training applied talents for local economy and society, teaching reform is imperative. According to the requirement of application-oriented development, taking the introduction class of Structural Mechanics as an example, this paper analyzes the existing problems in the course teaching and puts forward the viewpoint that “introduction class is the key and difficult point of entire course teaching”. On the basis of higher education theory and teaching practice, this paper defines the teaching objectives, shows the key points and methods and points out the precautions in the introduction class. The conclusions of this paper can provide reference for the colleagues.

Keywords—teaching reform; teaching method; Structural Mechanics; introduction class

I. INTRODUCTION

Guided by the guidance of the Ministry of Education, the National Development and Reform Commission and the Ministry of Finance on guiding the transformation of local general undergraduate colleges into application-oriented ones [1], and under the background of accelerating the transformation of general undergraduate colleges and universities in Guizhou Province, Zunyi Normal College was collected as the pilot college in transition.

The way of development of application-oriented local undergraduate colleges lies in the characteristics: develop with its own features, teaching with its specialty, strengthen schools with its own characteristics; the core is to establish the concept of applied talents [2], to cultivate the students’ ability to combine theory with practice and the ability of practice and innovation. Civil Engineering also emphasizes both theoretical and practical abilities. In particular, under the strategic planning of transformation of our college, this puts forward higher requirements and goals for the disciplinary construction and personnel training mode of Civil Engineering major. Curriculum construction is the basis of disciplinary

construction, and directly determines whether the goal of personnel training can be achieved. Teaching reform is the source driving force and booster of curriculum construction.

Structural Mechanics is a branch of solid mechanics. It mainly studies the response of the member structure under load and non-load factors: internal forces, reaction forces and displacements, as well as the reasonable compositional rules of structures, structure dynamic characteristics and structural stability. Structural Mechanics is an important basic course in Civil Engineering and related majors. It is not only the development and deepening of math course group (advanced mathematics, college physics) and mechanics course group (material mechanics and theoretical mechanics), but also the foundation of the specialized courses. Structural Mechanics occupies an important position in the entire Civil Engineering course system [3]. And Structural Mechanics is also the professional courses in graduate entrance exam of Civil Engineering in China.

In teaching practice, the authors deeply realize the importance and criticality of a good introduction class to the entire course, and deeply feel the difficulty of the introduction class. This paper focuses on how to carry out introduction class of Structural Mechanics, and provides reference for the colleagues; this paper is an exploration of teaching reform.

II. THE IMPORTANCE OF INTRODUCTION CLASS

Introduction class is the beginning of Structural Mechanics, describes the subject, the research content, the research purpose, the research method and the research significance of this course, as well as the difference and connection between this course and other courses, and also needs to clarify the role and status of this course in the entire Civil Engineering course system. At the same time, students should be taught about the learning methods, teaching arrangements and assessment standards, as well as to arouse the students’ interest and enthusiasm in learning [4,5]. Therefore, the authors believe that the introduction class is not only the key point of the entire course, but also the difficulty point of the entire course.

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III. EXISTING PROBLEMS IN THE INTRODUCTION CLASS

A. *The textbook*

Throughout the mainstream textbooks of Structural Mechanics, the first chapter (introduction chapter) contains the following contents: objects and tasks of Structural Mechanics, structural calculation diagram. Among them, only "research object and task" is regarded as the introductory content of the course, and "structural calculation diagram" is the professional knowledge of Structural Mechanics. In general, there are too few introductory contents in the introduction chapter in each textbook, which cannot reach the goal of introducing the background of the course, the connection between previous and subsequent courses, and the general summary of the main contents of the course. In addition, the introduction chapter is also a lack of learning requirements and learning methods of Structural Mechanics.

B. *The teaching method and arrangement*

According to the communication with teachers and the lecture attendance, the introduction class fails to receive sufficient attention. The main problems in teaching method and arrangement are as follows:

- Regarding the mechanics solutions as the core issues while neglect the Structural Mechanics conception. Under the guidance of the Ministry of Education, the period of Structural Mechanics has been drastically reduced; take my college for example, from the traditional nearly 120 periods reduced to 96 periods now, which also includes 16 periods of practice courses. In order to complete a large number of teaching tasks, teachers tend to cut down the conceptual chapters represented by the introductory class, while focusing on the chapters that are mainly based on the calculation method. In fact, the mechanics concept is the basis of calculation; an outstanding introduction class is a long-term benefit for the course.
- Some teachers do not stand on the perspective of students about how to explain the knowledge in simple terms, or even take the courseware provided by the publishers, "reading" instead of "teaching".
- There are also some teachers plans seriously and steadfastly, while; there are few thoughts on the renewal of teaching ideas, the use of new media and in-depth teaching reform.

IV. TEACHING OBJECTIVES OF THE INTRODUCTION CLASS OF STRUCTURAL MECHANICS

According to the requirements of "Civil Engineering Undergraduate Education Syllabus" promulgated by the Civil Engineering Professional Steering Committee of the Ministry

of Education and with the author's understanding of the introduction, the goals of the introduction class include:

- Understand the object and task of Structural Mechanics.
- Understand distinction and contact between Structural Mechanics and other courses, as well as the course status and role in the Civil Engineering curriculum system.
- Understanding the knowledge hierarchy of Structural Mechanics and the relationship between the various parts.

The key points of the introduction class:

- Stimulate students' interest of this course.
- The object and task of Structural Mechanics.
- Distinction and contact between Structural Mechanics and other courses as well as the status and role of Structural Mechanics in the Civil Engineering curriculum system.

The difficulties of the introduction class:

- Stimulate students' interest in learning and curiosity.
- Build the understanding of the main contents of Structural Mechanics.

V. TEACHING POINTS AND METHODS OF INTRODUCTION CLASS OF STRUCTURAL MECHANICS

According to the characteristics (generalization, abstraction and rationality) of introduction class [6], combined with the academic foundation psychological characteristics of the college student, the generally teaching method is: to ensure the logic of the teaching; maintain full attention and mobilization of students' attention; cultivate students' emotion and values timely and subtle.

A. *Definition of "structure"*

The definition of "structure" is the essential question of the introduction class. "Structure" = characteristic + object, Fig. 1 is the connotation map of "structure". By contrasting the majors of Architecture and Civil Engineering, leads to the differences of function and safety in the two majors, which shows that the "structure" must has characteristic of load transformation; by divided the Civil Engineering into three professional direction for specialized learning, leads to the concept of building and architecture, and showing the object of "structure" refers to either building or architecture. Finally, the teacher should make the summary: all the buildings and architectures which have the capacity of sustaining and transferring loads can be referred to as "structure".

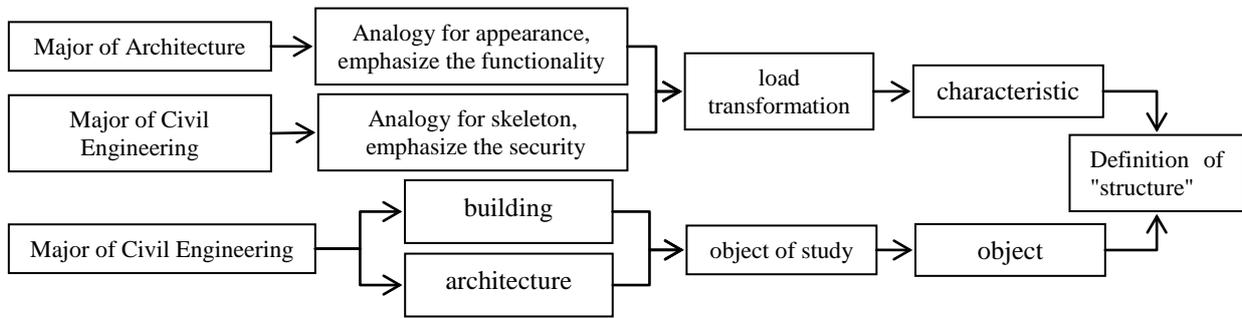


Fig. 1. Definition of "structure"

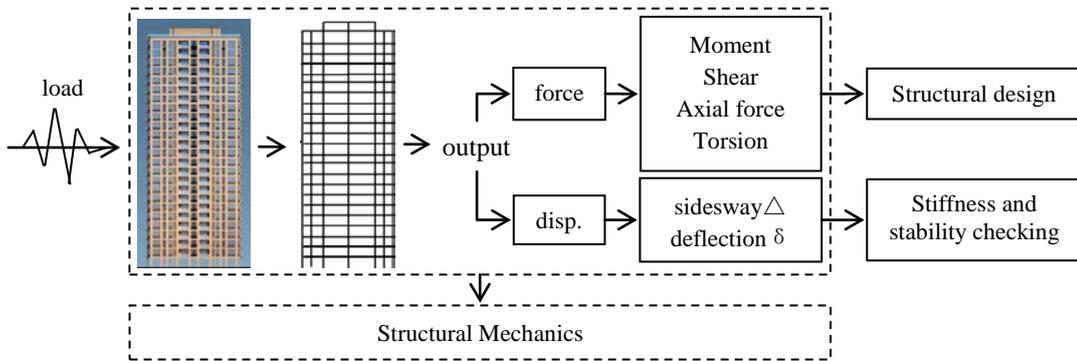


Fig. 2. Status and role of the Structural Mechanics

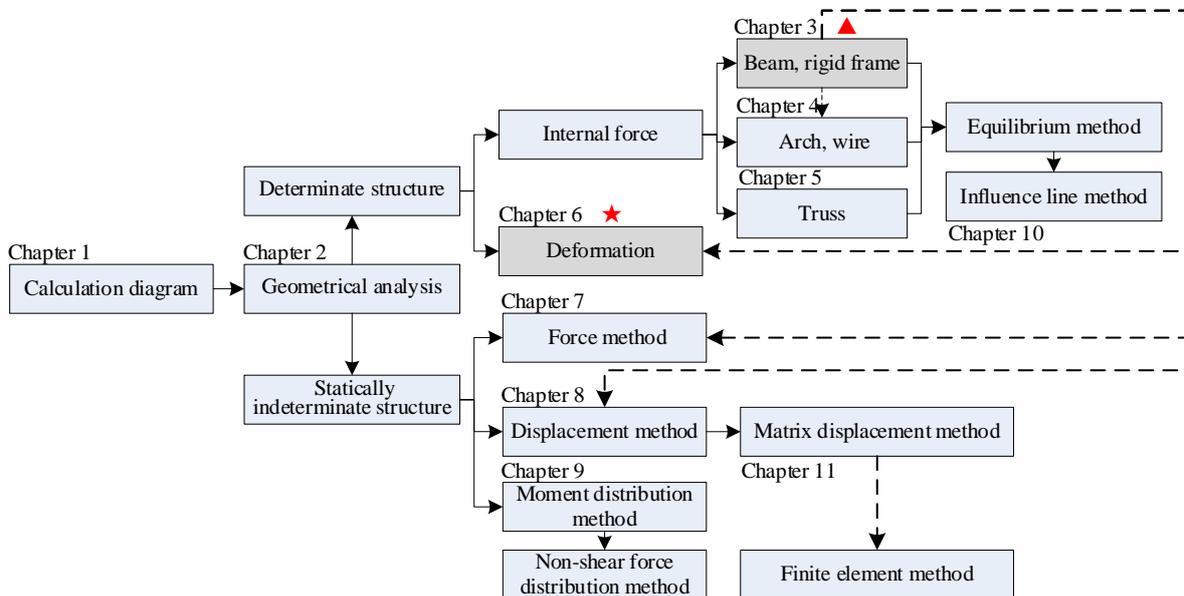


Fig. 3. The main contents of Structural Mechanics and chapter relations (take the contents in reference [7] as an example)

B. Status and role of the Structural Mechanics

The status and role of Structural Mechanics as well as the connection between previous and subsequent courses are another essential question of the introduction class. In order to break through the key points, as shown in Fig. 2, the mind map describes the ideas and core processes of structural problems in Civil Engineering detailly, and points out the role of Structural

Mechanics. The figure clearly shows the relationship of Structural Mechanics previous and subsequent courses.

C. The main contents of Structural Mechanics and chapter relations

The main contents of Structural Mechanics and the relationship between the chapters are the core and difficult point of the introduction class. In order to break through the

difficulties, the key is to clearly describe the internal logic among the chapters. As shown in Fig. 3, the 3rd chapter is the core chapter and the 6th chapter is the most difficult chapter of the course. The 3rd chapter (the internal force calculation of static structure) is the base of structural displacement calculation (Chapter 6) and the indeterminate structure internal force calculation (Chapter 7, Chapter 8). And Chapter 8 is the foundation of Chapter 9 and Chapter 11. The content of Chapter 3 is the core and focus of the whole Structural Mechanics course, which directly affects the effect of the whole course learning. The introduction class should clarify the importance and help the students developing the mode of thinking of Structural Mechanics.

D. Practice and assessment methods

In order to improve the comprehension, application and engineering practice ability, the practical training such as structural design contest and bending moment diagram competition are introduced in extra-curricular teaching [8, 9]. For the structural design contest, students are required to use the specified materials to make structure according to the requirements of the proposition. Secondly, the bearing capacity and stability of the structure are verified by the static load and the dynamic load. In order to test the learning, a bending moment map competition is held during the half period, which mainly inspected the bending moment diagram of statically-determined beams and statically-determinate rigid frame. Because this part of knowledge is the core and focus of Structural Mechanics, through the way of competition, it will help students keeping enthusiasm for learning and encouraging students' passion.

In order to change the examination method from single paper examination, to reflect the diversified assessment methods and highlight the evaluation of learning process, in the new evaluation system of the Structural Mechanics course, the degree of participation in the classroom study, attendance, bending moment map contest, structural design contest, etc. [10]. are all considered and dividing the final test scores into two phases: the mid-term and the finals: Course Final scores = $30\% \times \text{mid-term} + 60\% \times \text{final test} + 10\% \times (\text{homework} + \text{classroom performance}) + \text{bonus}$ (1st, 2nd and 3rd place in structural design competition and bending moment diagram contest will plus 5 points, 3 points, 2 points on the final scores, respectively).

VI. SUMMARY

Teaching reform is not abstract, nor a random attempt. Educational reform should follow the basic educational theory

and psychological cognition of the students. From the students' perspective, the knowledge should be explained in a simple way. The teaching reform needs innovation, and encourages the teachers using the new teaching concept, new information technology, different teaching organizations and implementation programs. The only standard testing teaching reform is students, through the meticulously preparation to implement the concept of teaching reform in the actual teaching, then get reflection and correction by students' feedback, this is a spiral process, and finally find the appropriate teaching methods.

In this paper, the introduction class of Structural Mechanics is regarded as the entry point of teaching reform, talking about the authors' ideas and perspective. In the future, the authors will apply these concepts in the whole class and the entire mechanics course group to promote discipline construction and the transformation of our colleges to the application type.

REFERENCES

- [1] The Ministry of Education, the National Development and Reform Commission and the Ministry of Finance on guiding the transformation of local general undergraduate colleges into application-oriented ones[EB/OL]. Ministry of Education of the People's Republic of China. 2015-10-23. <http://moe.edu.cn/>. (In Chinese)
- [2] Yan T, Wang X L, Tong W S. Research on the developmental approach of the newly-founded four-year institutions[J]. *Journal of Higher Education*, 2007, 28(17): 60-65. (In Chinese)
- [3] Maiorana C, Sgarbossa L, Salomoni V. New methodologies in teaching e - structural mechanics using WWW[J]. *Computer Applications in Engineering Education*, 2008, 16(3): 189-210.
- [4] Tang W, Li C, Liang Z Q. The importance of introduction class to basic courses in colleges and teaching practice[J]. *China Adult Education*, 2008 (12): 124-125. (In Chinese)
- [5] Yang Z J, Yang X D. Reflections on introduction class in colleges and universities[J]. *China University Teaching*, 2011, 12: 39-41. (In Chinese)
- [6] Zhou L. Some experiences in introduction courses teaching[J]. *Occupation*, 2008(3): 54. (In Chinese)
- [7] Xiao Y W, Zhang L Y. *Structural Mechanics*[M]. Beijing: Chian Machine Press, 2013. (In Chinese)
- [8] Qu S Y, Hu T, Wu J L, et al. Experimental Teaching Centre Platform" New Engineering" Practice Teaching Mode[J]. *EURASIA JOURNAL OF MATHEMATICS SCIENCE AND TECHNOLOGY EDUCATION*, 2017, 13(7): 4271-4279.
- [9] Tsutsui W, Loui M C. The Effectiveness of Weekly Supervised Homework Sessions in an Aerospace Structural Mechanics Course[C]//*ASEE 2016 Annual Conference & Exposition*, New Orleans, LA. 2016.
- [10] Phillips A T M. Engineering Education, Research, and Design: Breaking In and Out of Liminal Space[J]. *Journal of Professional Issues in Engineering Education and Practice*, 2017, 143(4): 02517002.