THE APPLICATION OF CASE STUDY IN ENGINEERING DRAWING COURSE

Zhang Wenying, *Zhejiang Ocean University, People's Republic of China, wyzhang@zjou.edu.cn,*
Yuan Yuefeng, *Zhejiang Ocean University, People's Republic of China, yfyuan@zjou.edu.cn; yuanyuefeng@126.com*

The paper describes the case study in engineering drawing course in the process of assembly drawing by using customized software. The process is reflecting three steps of an engineering case solving: design, processing and installation. Using case study for design drawings students can master the main components of assembly drawing, understand assembly drawing and learn the AutoCAD software. All this can improve the quality of teaching.

Keywords: engineering drawing; case study; assembly drawing.

Engineering drawing is a specialized basic compulsory course for students with major in engineering [1]. The course on Engineering Drawing consists of three parts: descriptive geometry, mechanical drawing and computer-aided design. It course is designed to train skills related to engineering and to be the basis for other specialized courses [1]. The course is mainly concerned with the composition of structures in engineering, so it is a practical subject for engineering students. The course aimed to develop the students' ability of space thinking and of design by utilizing modern design technologies [2]. A teacher realizes these goals through a variety of methods and means. One of the key means is to implement a method of case study into education content through multimedia activities. Solving real engineering cases can arouse the students' interest and learning enthusiasm in this course. In the teaching process, students are guided to deal with the engineering cases as practical projects, so they can clarify the objectives of the projects and know how to finish the tasks with their knowledge of engineering drawing. By completing the projects, students can learn and master the knowledge related to drawing, and to the software of computer-aided design.

The solving of a real engineering case involves the three steps: design, processing and installation. These steps are finally reflected in the drawings, because the engineering drawing is a sort of engineering language. The designers show their own design ideas through drawings. The workers responsible for processing complete the processing of actual objects by selecting processing technologies via drawings. Workers responsible complete the installation of the spare part while drawings. Each step must be completed with account to the knowledge about the science of engineering drawing. As a result, the teaching of each part of the engineering drawing course can be focused on an engineering case. This can both enable students to get a good understanding of the so-called engineering and fully embody the practical significance of the engineering drawing course for students with a major in engineering [3].

1. Brief introduction to an engineering case

Two different engineering cases are described in this paper, which allow students to grasp the knowledge about the science of engineering drawings.

Engineering Case 1: A spectator stand on the field for canoeing games during 2008 Beijing Olympic Games. In 2008, the field for canoeing games was planned to be located in Beijing Shunyi Water Park where there were no stadium bleachers. Thus, the Beijing Organizing Committee for the Games of the XXIX Olympiad (BOCOG) required a spectator stand to be built surrounding the game filed. The spectator stand should be temporary, safe, reliable, and easy to disassemble. The following diagrams are drawings on site before and after the spectator stand was installed.

Engineering Case 2: coin boxes of the automatic slot machine on self-service ticketing buses in the city. Usually an automatic slot machine is composed of three parts: a box body, a coin slot and a coin box. The coin slot and the coin box are connected with each other, so the coins thrown into the slot will all fall into the coin box. The box body and the slot can be seen by everyone, but the coin box cannot be seen. The passengers are required to throw the coins in such a way that the coins fall into the coin box. After a working day is over the coin box with the coins is taken out by the worker responsible for it.

(a) Picture before installation

(b) Picture after installation

In order not to lose the money from the coin box it must be designed to be closed firmly when the worker takes it out. Then another coin box is installed inside the automatic slot machine so the bus can work again.

2. Application of engineering cases to the teaching of assembly drawing

Assembly drawing is the comprehensive use of all the content of Engineering in drawing. The assembly drawings for mechanical products are technological documents for technological exchange. They show the overall structure and shape of product components, the assembly relationships between the parts, the working principle of each part and their respective technical requirements in the assembly process [4]. The assembling of all the parts must be completed based on the specific requirements of assembling draft. When the lecturer delivers this chapter, he should present students the drawings about the project, which were drawn by himself with the AutoCAD software. According to the design drawings of engineering cases, the students analyze the assembly drawings and master the content of the assembly drawings.

(1) Firstly, an assembly drawing should be prepared. At present, the CAD software is applied to the teaching of engineering drawing at colleges and universities. The examples in this project have been drawn by using AutoCAD. The size of the drawing must be in accordance with accordance of the design requirements, and the frame of the drawing should be made in accordance with the requirements of standard drawings. When you design drawings using CAD interface, as the requirements of different companies vary, the boundary of the drawing can either be marked or not, but the frames are required to be marked out clearly with thick lines. Compare Fig. 1 with Fig. 4, which show the frame formats used by the author in designing two different products for a company.

(2) Secondly, the assembly drawings include specific views showing the whole structure of all the components as well as the connection and the assembly relationship between the components. Fig. 1 shows the assembly drawing of the temporary spectator stand for the canoeing game. The on-site installation should be carried out according to this drawing, in which the structure, assembly and interconnection of different sections of the spectator stand, including its façade, rear, left, right and the middle are shown in a clear and detailed way in the five views: the front view, the vertical view, the left view, the right view and the mid view. The means of the expression of assembly drawings vary with different products. Fig. 4 shows the assembly drawing of the coin box of the automatic slot machine on a self-service ticketing bus. The working principle, assembly and interconnection of the components are indicated in one front view and one cutaway view on the figure.

(3) Thirdly, the assembly drawings should also clearly describe such key dimensions as the total size, the assembly size and the installation size. Following the standards shown on Fig. 1, we can see such key sizes as the total length, width and height of the spectator stand, fixed mounting distance between the compartments and connecting fixed distance between the key parts. The specific dimensions of the standard method should be accurate, comprehensive, clear and reasonable according to the requirements of international standards.

(4) The assembly drawing should also cover words or symbols describing the technical requirements of compartments in installation and usage. In comparison, we can see that no technical requirements are mentioned in Fig. 1, but

detailed technical requirements are mentioned in Fig. 4. As an engineering drawing is a very flexible technical document, it is feasible that no words or symbols describing the technical requirements are added in the drawing if all the comprehensive data including views, dimensions and title columns in the drawing can clearly describe the specifications of the components.

(5) The assembly drawing should also cover the title column. The basic format of the title column should be consistent with the requirements of national standards, like the length of the title column and the spacing between each line inside the title column. In actual engineering environments, different companies have different requirements for the specific format of the title column. In comparison between Fig. 1 and Fig. 4 in the title column, the contents in the title column of Fig. 1 is easier while the format of the contents in the title column in Fig. 4 is almost the same as the requirements mentioned in the book. The location of the specific projects is different in two title columns. No matter how the title column is drawn, it should cover such basic contents as pattern names, unit name, code, material, weight, ratio, design and audit, which cannot be omitted.

(6) The serial numbers of the components should be marked clearly in the assembly drawing. When reading the drawing, you can know intuitively the total number of components in the assembly parts from the serial numbers of the drawing. The format of the serial numbers generally including lead wires and figures has also been standardized. The lead wires are marked out with fine lines and cannot cross with each other. The serial numbers should be numbered in clockwise or counter-clockwise order, horizontally or vertically, and the numbers are required to be parallel in the horizontal or vertical direction, just as shown on Fig. 1 and Fig. 4.

(7) Lastly, the assembly drawing should also cover several subsidiary columns matching with the serial numbers of the components. In the subsidiary columns, such information as the serial number, name, code, quantity, materials and proportion of all the components in the assembly drawing must be given. When the drawing is designed, the subsidiary columns are required to be listed above the title column, corresponding to the serial numbers of the components marked out in the views. In the subsidiary columns, the serial numbers should be filled in from down to up. In case of insufficient space in the box, the sections of the subsidiary columns can be on the left of the title column, as shown on Fig. 4. If the components in the assembly drawing on Fig. 1 are too large, and there are so many components that the selected assembly drawing cannot cover all the subsidiary columns, the subsidiary columns are unnecessary to be drawn in the assembly drawing. Instead, they can be drawn on other drawing subsidiary columns independently. As shown on Fig. 2 and Fig. 3, the author has drawn the corresponding subsidiary columns in the assembly drawing on two drawings.

At the lecture a teacher uses CAD software (such as AutoCAD) to teach the students how to complete the assembly drawing based on what

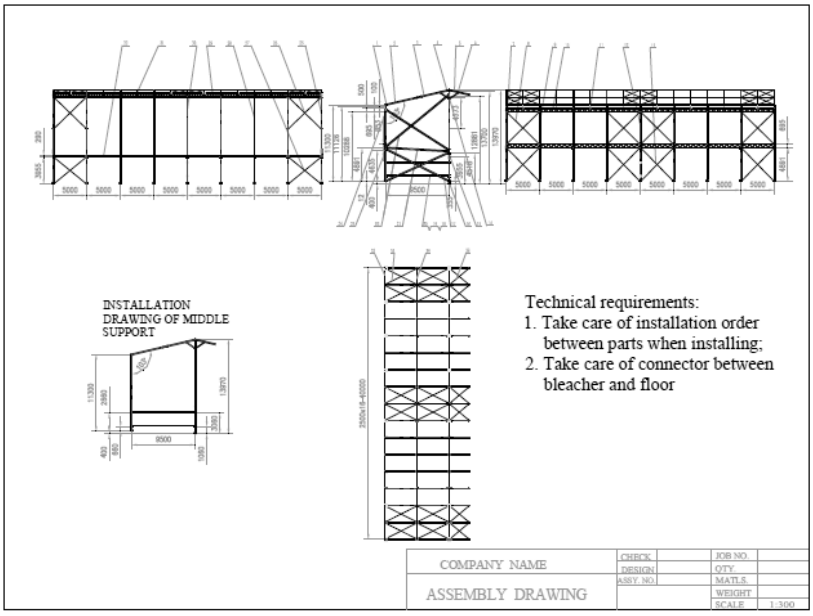

Fig. 1

NO	NAME	QTY.	MATLS.	SIGLE WEIGHT (kg)	GROSS WEIGHT (kg)	DWG. NO.	REMARKS
32	BEAM OF FRONT LEG	8	WELDING PART				
31	FRONT AND SHORTER LEG	8	WELDING PART				
30	FRONT LEG 3	1	PART				
29	UP LANTERN SUPPORT OF FRONT LEG	8	WELDING PART				
28	FRONT LEG 2	6	PART				
27	DOWN WIREROPE OF FRONT LEG	4	PART				
26	UP WIREROPE OF FRONT LEG	4	PART				
25	FRONT LEG 1	2	PART				
24	DOWN CROSS SUPPORT OF BACK LEG	2	WELDING PART				
23	UP CROSS SUPPORT OF BACK LEG	2	WELDING PART				
22	SIDE AND UP CROSS SUPPORT	2	WELDING PART				
21	SIDE MIDDLE BRACE	2	WELDING PART				
20	CONNECTOR BETWEEN MIDDLE SUPPORT AND BACK LEG	2	WELDING PART				
19	CONNECTOR BETWEEN MIDDLE SUPPORT AND FRONT LEG	2	WELDING PART				
18	MIDDLE SUPPORT	2	WELDING PART				
17	SIDE DOWN CROSS SUPPORT	2	WELDING PART				
16	CONNECTOR BETWEEN SIDE DOWN CROSS SUPPORT AND FRONT LEG	2	WELDING PART				
15	DOWN CROSS SUPPORT OF FRONT LEG	2	WELDING PART				
14	UP CROSS SUPPORT OF FRONT LEG	2	WELDING PART				
13	BHIND WIREROPE OF BACK LEG	8	PART				
12	BACK LEG 3	1	WELDING PART				
11	BACK AND SHORTER LEG	8	WELDING PART				
10	BACK LEG LAMP HANGER	16	WELDING PART				
9	BACK LEG 2	6	PART				
8	WIREROPE OF BACK LEG	8	PART				
7	BACK LEG 1	2	PART				
6	SHORTER BRACE	16	WELDING PART				
5	SHORTER BEAM	17	PART				
4	U-SHAPE OF FRONT LEG	9	WELDING PART				
3	LONGER BEAM(RIDGE)	17	PART				
2	LONGER BEAM(EAVE)	17	PART				
1	*U-SHAPE OF BACK LEG*	9	WELDING PART				

COMPANY NAME	CHECK		JOB NO.
	DESIGN		QTY.
ASSEMBLY DRAWING	ASSY. NO.		MATLS.
			WEIGHT
			SCALE 1:1

Fig. 2

NO	NAME	QTY.	MATLS.	SIGLE WEIGHT (kg)	GROSS WEIGHT (kg)	DWG. NO.	REMARKS
	BASE OF BACK TENSION BAR FOR THE TOP CLOTH(SIDE)	2	PART				
	BASE OF BACK TENSION BAR FOR THE TOP CLOTH	15	PART				
	BACK TENSION BAR OF THE TOP CLOTH(SIDE)	2	PART				
	BACK TENSION BAR OF THE TOP CLOTH	14	PART				
	BASE OF FRONT TENSION BAR FOR THE TOP CLOTH	17	PART				
	FRONT TENSION BAR OF THE TOP CLOTH	16	PART				
36	SHORTER WIREROPE OF ROOF	12	PART				
35	PURLIN(BETWEEN)	16	PART				
34	LONGER WIREROPE OF ROOF	24	PART				
33	PURLIN(SIDE)	32	PART				

COMPANY NAME	CHECK		JOB NO.
	DESIGN		QTY.
ASSEMBLY DRAWING	ASSY. NO.		MATLS.
			WEIGHT
			SCALE 1:1

Fig. 3

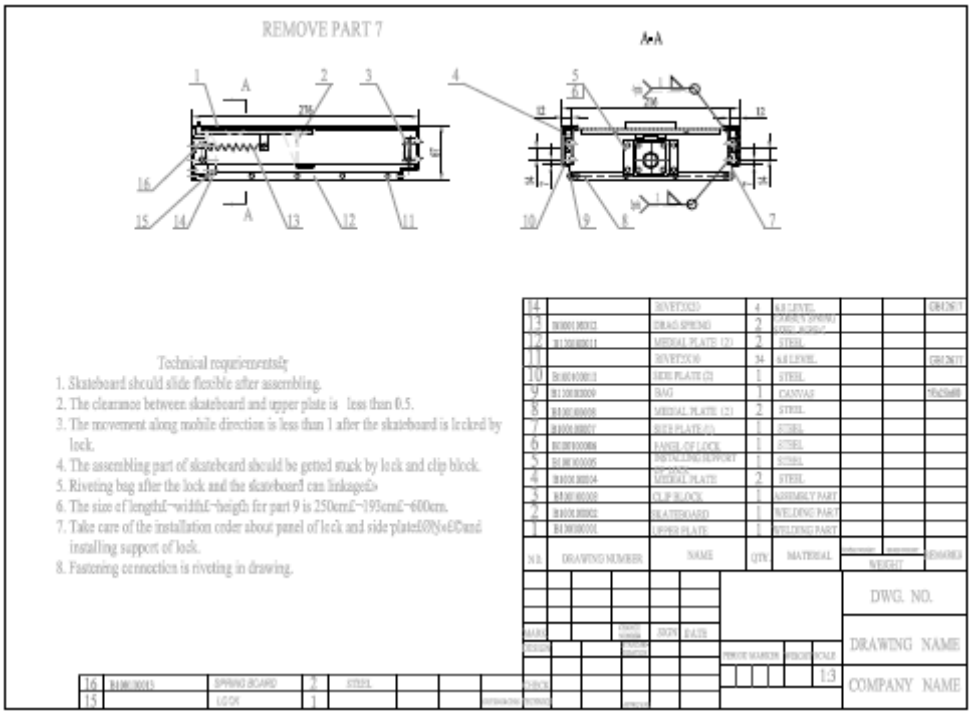

Fig. 4

they have learnt before, such as how to label the serial numbers of the components and how to draw the fine lines using AutoCAD interface. The students are asked to complete the assembly drawing of the project by themselves after the class.

3. Conclusion

While focusing on the basic knowledge, basic concepts, basic methods concerning descriptive geometry and engineering graphics, the course of engineering drawing has integrated computer drawing, geometric modeling, science research and common techniques dealing with graphics in actual engineering. This course enables engineering technicians to master the engineering language, learn how to solve problems in engineering and modern digital design technologies, etc. By introducing engineering cases into the teaching of engineering drawing, on the one hand, the increase of engineering information can enrich the education content, greatly stimulate the enthusiasm of students to learn their special courses. It can also improve the quality of teaching as it enables the students to get to know the engineering environment, cultivate their ability to solve the practical problems about engineering and to master modern computer-aided technologies. In this way, the course can become a good foundation for the students' future study and work.

References

1. Zhu Shimin, Hu Huarong. Application of Physical and Virtual Models to Teaching of Engineering Drawing. *Journal of Xiangtan Teachers College*, 2006, 28 (4), pp. 133–135.

2. Yang Guang, Huang Yuyu, Liu Jinghua, Ma Sheng, Wang Yun Qiao. Highlighting the "Design" and "Three-Dimensional" Ideas in the Reform of Teaching of Engineering Drawing. *Journal of Engineering Graphics*, 2002, pp. 150–156.

3. Tan Jianrong, Zhang Shuyou, Lu Guodong, Shi Yueding. Fundamentals of Graphics Tutorial. Beijing: Higher Education Press, 2006. 231 p.

4. Wang Dongming, Yang Xiaodong, Chen Ying, Li Lianzhi. Application of Pro/Engineer to Teaching of Engineering Drawing. *Journal of Jilin Teachers Institute of Engineering & Technology*, 2008, 24 (10), pp. 76–78.

Received 5 February 2015

УДК 378.016:004.92
ББК Ч448.026

ИСПОЛЬЗОВАНИЕ МЕТОДА «CASE-STUDY» В КУРСЕ ИНЖЕНЕРНОЙ ГРАФИКИ

Юэфэн Юань, Чжан Вэньин

Чжэцзянский океанический университет, Чжоушань, Китайская Народная Республика

В статье описывается использование метода «case-study» в процессе преподавания инженерной графики, в частности, при создании рисунка сборки объекта с помощью специализированного программного обеспечения. «Case-study» позволяет отразить три шага реального инженерного взаимодействия с объектом: проектирование, создание и установку. Использование метода «case-study» при построении чертежей позволяет студентам освоить основные компоненты и этапы построения чертежа, понять основы чертежного проектирования и изучить программное обеспечение AutoCAD. Все это положительно влияет на результаты обучения.

Ключевые слова: инженерная графика, метод «case-study», чертеж сборки.

Юэфэн Юань, доктор философии, старший преподаватель, факультет военно-морской архитектуры и океанической техники, Чжэцзянский океанический университет (Китайская Народная Республика), yfyuan@zjou.edu.cn; yuanyuefeng@126.com.

Чжан Вэньин, магистр, инженер, факультет военно-морской архитектуры и океанической техники, Чжэцзянский океанический университет (Китайская Народная Республика), wyzhang@zjou.edu.cn

Поступила в редакцию 5 февраля 2015 г.

БИБЛИОГРАФИЧЕСКОЕ ОПИСАНИЕ СТАТЬИ

Zhang Wenying. The application of case study in engineering drawing course / Zhang Wenying, Yuan Yuefeng // Вестник ЮУрГУ. Серия «Образование. Педагогические науки». – 2015. – Т. 7, № 2. – С. 16–21.

REFERENCE TO ARTICLE

Zhang Wenying, Yuan Yuefeng. The Application of Case Study in Engineering Drawing Course. *Bulletin of the South Ural State University. Ser. Education. Educational Sciences.* 2015, vol. 7, no. 2, pp. 16–21.