APPLICATION OF CAD TECHNOLOGY AND EDUCATION OF ENGINEERING GRAPHICS IN CHINA

TONG Bing-shu
Tsinghua University, Beijing, China

1. APPLICATION OF CAD TECHNOLOGY IN CHINA

1.1 CAD Application in China

CAD application in China can be divided into four levels.

Level one: “Computer Aided Drafting”
- 1991: Present “throw over drawing board”
- 1992: Start project of “CAD Application Engineering”
- 2002: 100000enterprises throw over the drawing board and the rate of using 2D CAD reached 90% in main mechanical industry.

Level tow: “3D Design”
- One mode is “Non-paper design /having-paper manufacturing”, i.e. 3D modeling→2D paper drawing→manufacturing.
- Another mode is “Non-paper design /Non-paper manufacturing”, i.e. 3D modeling→manufacturing.
At present, 3D design reached 100% in aeronautical industry in China.

Level three: “Digital Design”
Digital design means to simulate the whole process of product design, engineering analysis, assembling, manufacturing, etc. by computer.

Level four: “Lifecycle Management”

1.2 MIE (Manufacturing Infomatization Engineering) in China

The contents of MIE:
- Digital design and manufacturing: To develop 3D CAD system, PDM system, virtual manufacturing system
- Process automation: To develop MES (manufacture execution system) and process control system
- Enterprises management and electric commerce: To develop ERP, SCM, CRM, etc.
- Numerical apparatus: To develop NC machine, high-tech equipments
- Network manufacturing: To develop supporting platform, PLM system, SCM;
- Database management: To develop large general DB system
- Test bed: To implement in some provinces, cities, industries, enterprises

The achievements (by the end of 2006):
- Using 2D CAD systems: 95.8%
- Using 3D CAD systems: 57.7%
- Using CAE systems: 65.5%
- Using CAPP systems: 50.0%
- Using CAM systems: 61.3%
- Using ERP systems: 51.0%
- Using PDM systems: 22.7%
- Using finance systems: 63.8%
- Using office automation: 54.6%

1.3 CAD Research in China

(1) Research on modern design theories and methods
Such as concurrent design, collaborative design, virtual design, mass customization design, green design, reverse design, etc.

(2) Research on the technologies of design environments
- Supporting technologies for network collaborative
design

- Integration technologies, such as enterprise application integration, PLM, product data exchange, etc.

(3) Research on the design tools

- Core of 3D digital innovation design tools
- Special design tools for special products
- Tools of Product Lifecycle Management
- Integrated tools of CAx & DFx

2 EDUCATION OF ENGINEERING GRAPHICS IN CHINA

2.1 Situation of EG course in China (at 2006)

The situations, such as the organization, the amount of EG teachers, teacher's workload, teaching hours, etc., are introduced.

2.2 Course system reform

As the achievements of reform in recent 10 years, four modes of course systems are described.

(1) Merged-integrated mode

Sample of curricula: “Mechanical Design Drawing” by Beijing University of Science and Technology (Figure 1)

Reform idea: To merge four courses, i.e. engineering drawing, fundamentals of mechanism, machine elements, and CAD, into an integrated one course lectured in Material Specialty. The new system contains five stages, i.e. primary drawing, machine introduction, common parts and assemblies design, engineering design, and innovative design.

Characteristics: (a) Re-organizing teaching contents; (b) Emphasizing the ability training of engineering design and innovation design

(2) Stage-cooperative mode

Sample of curricula: Engineering Graphics for Mechanical Engineering by Shanghai Jiaotong University (Figure 2)

Reform idea: Re-planning and re-constructing the original series basis courses of mechanical engineering into several modules; then defining the position and function of each module and the teaching semester.

Characteristics: (a) Enhancing design thinking; (b) Training student's four abilities, i.e. the ability of space thinking; the ability of transforming space thinking to graphics; the ability of transforming graphics to modeling; the ability of transforming modeling to drawing; (c) Creating new forms for practice.
(3) Common platform mode

Sample of curricula: “Engineering graphics” by Zhejiang University (Figure 5)

Reform idea: Establishing a common platform for training “graphics diathesis” which has no difference for any specialties; meanwhile building some professional modules on this platform for needs of different specialties.

Characteristics: (a) using common platform to train graphics diathesis, such as space thinking, graphic representation and engineering feelings; (b) training three abilities: space thinking, graphic representation, and visual thought; (c) building three concepts: product information, shape configuration, and engineering standardization.

(4) 3D skeleton mode

Sample of curricula: “Representation of Product Design” by Beijing University of Science & Technology, South China University of Technology, Xi’an Jiaotong University (Figure 7)
Reform idea: Introduce the principal, methods and skills of 3D modeling into EG course to form new teaching system, new teaching contents and new teaching methods.

Characteristics: (a) 3D modeling is put through the whole course; (b) sketching is enhanced; (c) Set design activity as assignments to boost up practice.

2.3 Reform of teaching methods

(1) Introducing the development of CAI for EG courses in China

(2) Introducing various teaching aided means
   - Multimedia courseware
   - Electronic teaching plan
   - Network course
   - Test question library

(3) Introducing EG course on network
Aims: Put course learning, assignment, test, question and answer, etc. on the network

Example of types: Course learning system; assignment system; exercises solution system; virtual model library; test sheets library, etc.

(4) Building teaching resources libraries
Contents of libraries: animation library; 2D & 3D model library; video library; text library for knowledge points; optimized teaching case library.

ABOUT THE AUTHOR
Tong Bing-shu is a Professor in the School of Mechanical Engineering at Tsinghua University and vice president of the China Engineering Graphics Society (CEGS). His research interests are in CAD Technology and Graphic Science. He can be reached by e-mail: by fax: 86-1062784691, or through postal address: Dept. of Precision Instruments, Tsinghua University, Beijing, 100064, China.