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The *Engineering Design Graphics Journal* is the official publication of the Engineering Design Graphics Division of ASEE. The scope of the Journal is devoted to the advancement of engineering design graphics, computer graphics, and subjects related to engineering design graphics in an effort to (1) encourage research, development, and refinement of theory and applications of engineering design graphics for understanding and practice, (2) encourage teachers of engineering design graphics to experiment with and test appropriate teaching techniques and topics to further improve the quality and modernization of instruction and courses, and (3) stimulate the preparation of articles and papers on topics of interest to the membership. Acceptance of submitted papers will depend upon the results of a review process and upon the judgement of the editors as to the importance of the papers to the membership. Papers must be written in a style appropriate for archival purposes.

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. . . from the EDGE

Engineering • Design • Graphics • Editor

I must be getting older, because as we finish another school year (Purdue finishes Spring Semester, earlier than most schools), I have spent some time looking back. When I started as a graduate student at Purdue University in 1980, we were housed in the old Michael Golden Facility. It was a grand, old three-story building. Naturally, the only women's bathroom was in the basement, and, of course, most of the classrooms were on the top floor. At that time we were 'Engineering Graphics' and part of the Civil Engineering Department, and had a two-year Associate degree program in Industrial Illustration Technology. We used t-squares with the drawing tables, because the tables not only were without drafting machines, they didn't even have tilt tops. We had great windows that overlooked the spacious lawn, and in the spring, the windows were open and Friday afternoon classes were tough because of all the student noises we could hear from the lawn below. Sometime around 1982 or 83, we got our first computer, an Apple IIe, and Dennis Short was so excited he could hardly stand it.

Looking around me today, I know that we have traveled more than one lifetime in the interim. The Michael Golden building no longer exists, it was torn down and replaced by Knoy Hall of Technology. I know that the architect was tall, because the bottoms of the windows that surround the perimeter of the building are at five foot, and require a window wrench to open. I have become adept at climbing chairs to see out. We started with 10 manual labs and one computer lab which were the top of the line technology for 1984.

Between 1984 and 1996 we have constantly changed and upgraded our technology and our program. We now offer a bachelor's in Technical Graphics and have grad students with TG as a speciality. This semester we have six computer labs, next fall we will have seven or eight. Soon, our last drafting machine will be sold to the highest bidder. Most of our students have never owned or used a t-square. These days, they carry around disks, zip drives, and labtop computers. They are interested in animation, virtual reality, web publishing, cd roms, and parametric modeling. We still use a pencil to sketch, but most of the manual skills consist of mouse movement and keyboard skills.

We have struggled and continue to struggle with the elusive 'body of knowledge' which we feel each of our students need. Just as promotion and tenure have become moving targets for new faculty members, so has program, course, and curriculum design. We are constantly finding something new that must be added, which leads to the dilemma of what to delete.

This is not a complaint, rather an observation. Sometimes I look longing at disciplines with a tried and true curriculum which does not change as the technology advances. Then I realize how lucky I am to be part of the Technology Revolution. Will things stabilize as they did after the Industrial Revolution and allow us to catch our breath? I sincerely doubt it. Those of you who are just now entering the race will do more technology travel in your career than most of us have ever imagined. My hope is to hang on for dear life and not get lost in the scuffle.

Mary A. Sadowski

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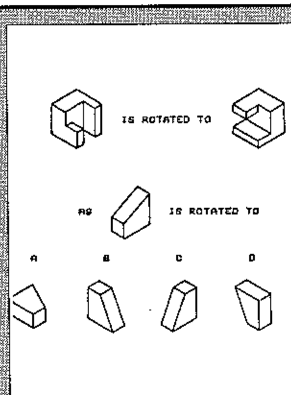

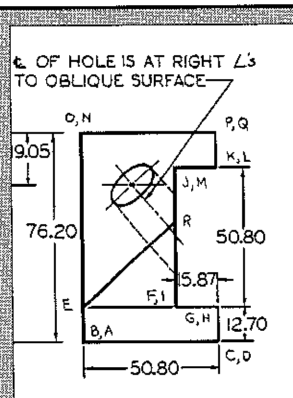

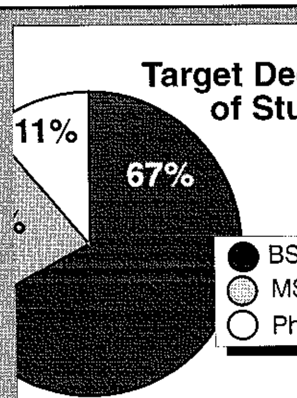

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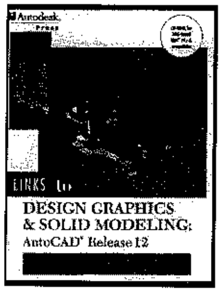

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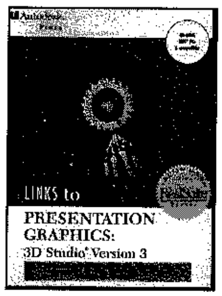

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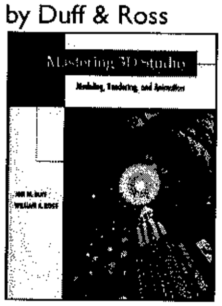

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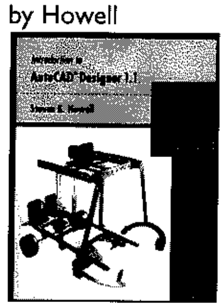

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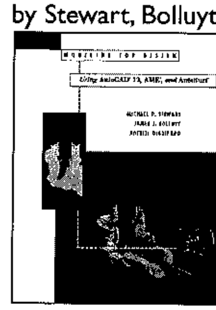

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Requirements for Successful Completion of a Freshman-Level Course in Engineering Design Graphics

Oppemheimer Award Recipient

Presented at the 50th Annual Engineering Design Graphics Mid-Year Meeting
Ames, Iowa
November 6. 1995

John Barrett Crittenden
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Blacksburg, Virginia

Abstract

A study of typical examinations given to freshman students of engineering design graphics revealed topics which instructors feel students must thoroughly understand for successful completion of the course. Although the content of most examinations included coverage of both visualization and conventional practices used in engineering design graphics, approaches for testing varied widely. Examination requirements ranged from freehand sketching to the exclusive use of modern graphics software. Although multiple choice and true-false type questions were often included, many examinations required constructions using drawing instruments.

Introduction

An analysis of a small number of examinations given by instructors of engineering design graphics in colleges and universities in the United States and Canada indicated that most instructors of freshman-level courses continue to emphasize the need to develop three-dimensional visualization skills and to understand the conventions used on engineering drawings. But unlike courses taught before the use of computer graphics software, less emphasis is now placed on topics dealing with descriptive geometry. The instruction in the use of computer software packages seems to have overshadowed that area of coverage.

descriptive geometry	orthographic proj. theory
developments	reading of enineering drawings
dimensioning	scales
drafting skills	sectional views
geometric construction	sketching
geometry	software use
graphing	solid modeling
intersections	threads and fasteners
kinematics	tolerances
lettering	visualization
mathematics	

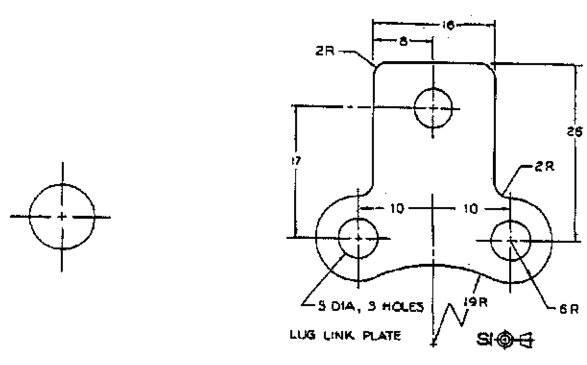
Figure 1. Major topics covered in Freshman level engineering design graphics courses

Some examinations were exclusively multiple choice while many included both multiple choice and true-false questions. Most required the completion of views of objects illustrating various principles, such as orthographic projection theory (involving both principal and auxiliary views), sectional views, dimensioning, and visualization (construction of the missing view or completion of the partially complete views). Examinations often required the use of drawing instruments and a few required the use of computer software. Most required sketching; some used sketching exclusively. As has been the case for years, the ubiquitous "mutilated block" was used when addressing the various topics.

Typical Problem areas included on Engineering Design Graphics Examinations

Examinations given this past academic year illustrated coverage of the major topics in freshman-level engineering design graphics courses. These major topics are shown in Figure 1 in alphabetical order.

Figures 2 through 11 show examples of some of the more interesting or challenging problems.

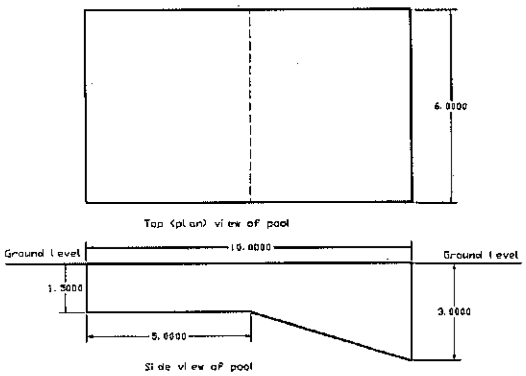


In the space provided, layout the outline of the lug link plate shown to the right using triple size millimeter dimensions.

Select a convenient starting point so that the entire outline fits nicely in the space provided. Use compass, dividers, scales, and triangles as needed to complete the outline in light construction line format. Leave all construction lines intact and do not go over the outline with dark freehand sketches.

(75 points)

Figure 2. Geometric construction problem using drawing instruments



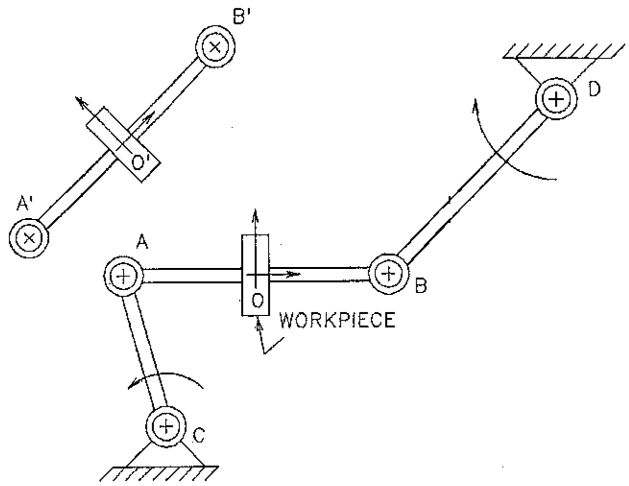
A homeowner decides to install a family swimming pool. The dimensions of the pool are shown in the figure below in units of meters. Consider the following problems:

a. How many cubic feet of soil must be excavated to make this pool?
b. Using MathCAD, create a plot volume (m^3) vs. depth for this pool.
c. How many gallons of water will be required to fill the pool to 0.1 meter below the ground level?
d. If the owner moves the water in pails from a nearby lake, how many tons will be carried? (Density of water is 62.4 lb./ft3.)
e. If he carries two 5 gallon pails per trip and makes 20 trips per evening, how many days will it take to fill the pool?

Use MathCAD to solve this problem. For full credit completely document your work (including units) according to the problem solving format presented in class. Note: You may have to use other references (math or physics book or library to get the conversion factors and geometrical formulas for this problem.

Turn in BOTH a printed output of your solution in addition to your MathCAD file on a disk.

Figure 3. Take home exam problem - A mathematics - graphics problem



It is required to build a small manipulator to carry a workpiece from 0 (0.0) to 0' (-10,10). The bearing of A'B' is 45° NAz.

Locate the correct coordinates of C & D and specify the correct link lengths AC & BD.

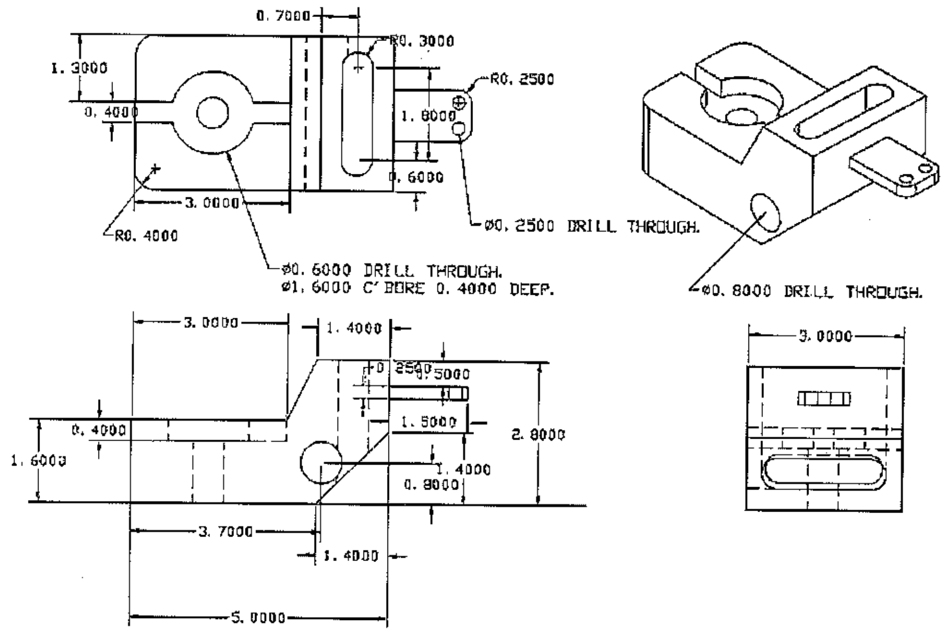
The task must be carried out by rotating CA 45° CCW & rotating DB 45° CW.

The drawing is to scale, but axes C & D are misplaced.

X_c = ________
Y_c = ________
X_d = ________
Y_d = ________

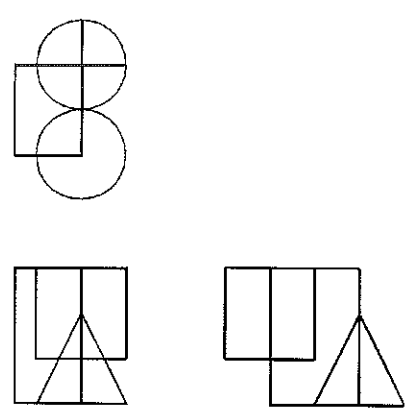
AC = ________

Figure 4. A kinematics-related problem



Using AutoCAD Designer, create three orthographic views and an isometric view of the following part. Use the dimensions given on the drawings. For full credit, you must include all necessary dimensions and annotations. You must also dimension the views according to standard practices for dimensioning. Be sure to include a title block and border. Turn in both the AutoCAD plot (showing all 4 views) and disk containing your file.

Figure 5 A problem requiring computer use



GIVEN:

The H, F, and P_R views of block, cone, and cylinder primitive

REQD:

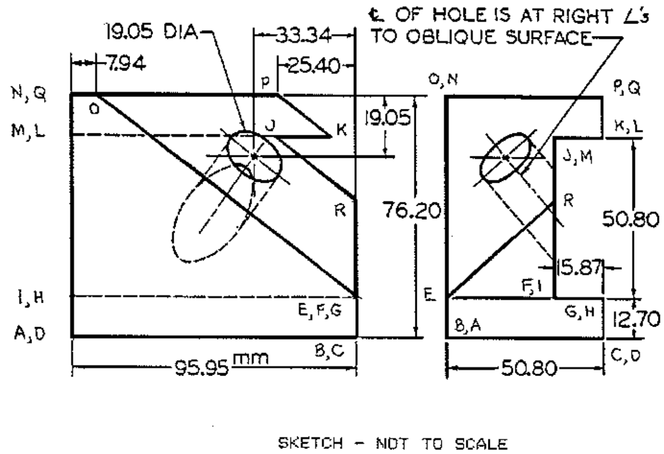
Sketch a single isometric pictorial of the object resulting from the following Boolean (set) operations on the given primitives.

a. Union - block and cone (the result is called a blone)
b. Difference - blone minus cylinder

Figure 6 A solid modeling problem using only pencil and paper

For the object shown, use AutoCAD to:

1. Create a solid model of the object.
2. Print an isometric view of the solid; include center lines.
3. Create a complete working drawing of the object. The horizontal and frontal views must be displayed as well as an auxiliary view showing the oblique plane in edge view and an auxiliary view showing the oblique plane true shape.
4. Create a full sectional view of the object resulting from a vertical frontal cutting plane located 20 mm behind the frontmost plane of the object.
5. Determine, using AutoCAD, the:
   a. distance from a line from A to C to line JR
   b. distance from point D to plane OER
   c. angle between line AD and Plane OER
   d. angle between plane ABE and plane OERJKP



Submit at the beginning of your in-class portion of the examination the following:

a. Your diskette containing the file ExamOBJ
b. Four sheets of hardcopy as indicated in steps 1-4
c. This sheet containing the answers to question 5.

Figure 7 The take-home portion of an examination requiring computer usage exclusively

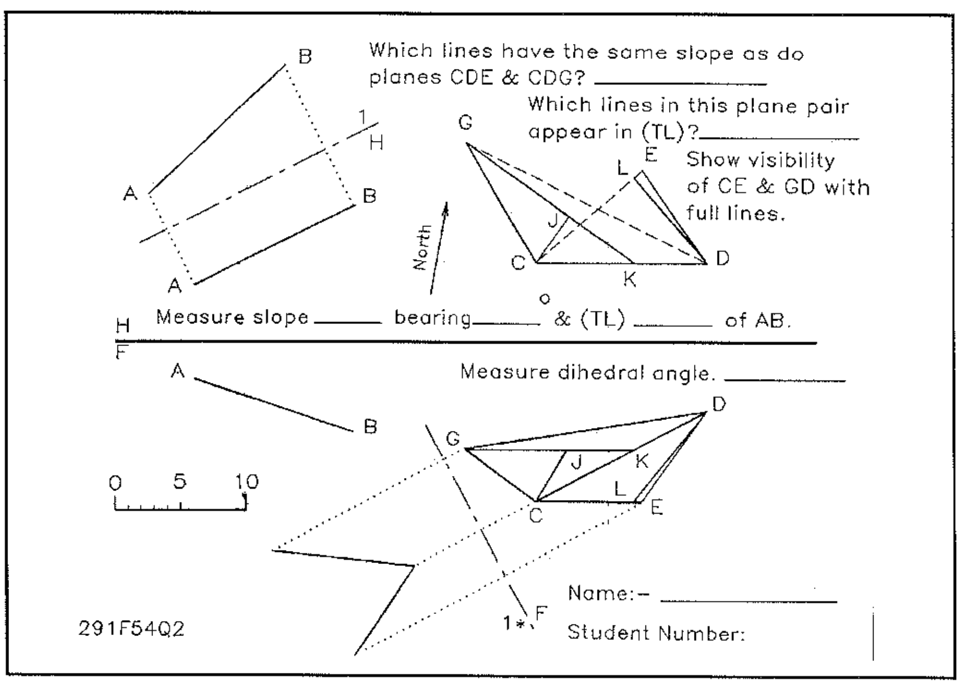
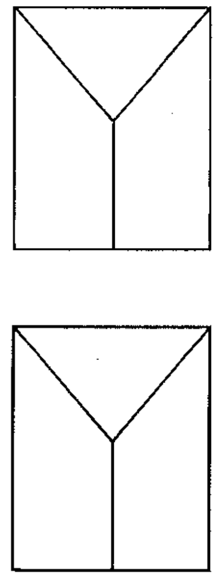


Figure 8 Two descriptive geometry problems

3. When you use ZOOM, are you changing the actual size of the drawing? yes/no
4. When moving an object, must the base point of displacement be on the selected object?
5. Can entities of different types be filleted (i.e., Line and an Arc) or must they be alike?
6. Where is the absolute 0,0 located on your screen?
7. Can you snap to the midpoint of an arc? yes/no
8. Explain each of the following POLYGON options: EDGE, I-SCRIBE, C-SCRIBE
9. If you erased an object by mistake, how can you get it back?
10. What is the name of the feature that forces the lines to be drawn only vertically or horizontally?

Figure 9. Examples of questions related to computer software usage.



Given the horizontal and front views, sketch an isometric view and the right profile.

Figure 10 A challenge for most students.

Significant Changes from Examinations of Years Past

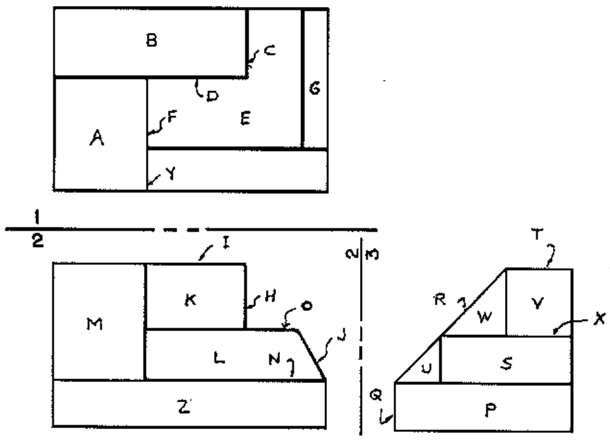
A few basic descriptive geometry topics were covered on approximately fifty percent of the examinations. Questions typically addressed the true length view and point view of a line or the true shape view and edge view of a plane. Only one examination addressed the strike and dip of a plane and only a few examinations required the determination of an angle between two planes, the distance from a point to a plane, the distance between two skew lines, etc.

Examinations of years past often included a complete engineering drawing requiring students to analyze components of the drawing in order to address various questions. Reading engineering drawings is only rarely included on today's examinations.

Although many questions allowed the use of a drawing board and T-square, it was obvious that the instructor intended that only triangles be used to complete the drawing. No use of the irregular curve was required.

Reproduction techniques for engineering drawings were only occasionally included on multiple choice examinations. References to drawing sizes were seldom seen. The various lead types and lead widths for mechanical pencils were rarely mentioned.

Perspective projections, still often used by architects, were not included. Though sketching was widely employed in the examinations, perspective sketches were not.



44. Surface (A) in the Top View corresponds to surface (___) in the Side View.
(1) (2) (3) (4) (5)
R S W X V

45. Surface (H) in the Front View corresponds surface (___) in the Side View
(1) (2) (3) (4) (5)
R S P U V

46. Surface (C) in the Top View corresponds to surface (___) in the Side View
(1) (2) (3) (4) (5)
R T S U V

47. Surface (B) in the Top View corresponds to surface (___) in the Side View
(1) (2) (3) (4) (5)
R S P T U

48. Surface (S) in the Side View corresponds to surface (___) in the Front View
(1) (2) (3) (4) (5)
L O M I J

49. Surface (Q) in the Side View corresponds to surface (___) in the Front View
(1) (2) (3) (4) (5)
L O M H Z

50. Surface (F) in the Top View corresponds to surface (___) in the Side View
(1) (2) (3) (4) (5)
R P W U S

51. Surface (E) in the Top View corresponds to surface (___) in the Front View
(1) (2) (3) (4) (5)
R V W S O

52. Surface (D) in the Top View corresponds to surface (___) in the Front View
(1) (2) (3) (4) (5)
H P J K N

53. Surface (M) in the Front View corresponds to surface (___) in the Top View
(1) (2) (3) (4) (5)
C A G Y B

Figure 11 A type of visualization problem not often used

Unexpected Discoveries

Although the use of computer software and computer techniques is widespread in the instruction of engineering design graphics, its use on examination's is limited. Though several examinations included multiple choice questions related to one of the typically used graphics software packages, only rarely did an examination require the use any of the commonly used software packages, such as AutoCAD, CADKEY, SilverScreen, etc.

As a result of the lack of computer usage, questions dealing with solid modeling were rarely included. The few examinations that did require an understanding of solid modeling tested this through computer usage or by sketching the results of various Boolean operations on overlapping solid primitives.

Despite the fact that many present-day engineering graphics courses include coverage of engineering design, few examinations had questions relating to engineering design. The few questions that may be considered related to design did not involve the steps in the design process.

Most educators would define an examination as a means of determining at the end of a course the knowledge gained by their students during the course. It is not only used by the instructor as a means of testing the level of knowledge gained on the most important topics covered during the quarter or semester, but also as a means of conveying to the students the instructor's opinion of the relative importance of topics. Surprisingly, many graphics programs do not give final examinations; instead, a series of tests or quizzes are used in determining students' progress.

Conclusions and Recommendations

Uniformity of coverage is questionable except with regard to visualization skills and conventional practices associated with engineering drawings. The Engineering Design Graphics Division should therefore continue its educational efforts and must be aggressive in initiating and establishing uniform standards for educational institutions.

If modern computer software is to be the primary medium for design graphics education, it should be the primary medium for testing. This may require design graphics programs to utilize unconventional testing times to ensure that all students use laboratory facilities for examinations and even ordinary tests and quizzes.

Is it any wonder that we Engineering Design Graphics Educators "*GET NO RESPECT?*"

Engineers and engineering technologists are typically classified as problem solvers. Therefore, more problem solving (i.e., descriptive geometry) must be incorporated into freshman-level courses using modern graphics software. This software can be used to solve problems of centroid location, volume, surface area, as well as the determination of various distance and angle measurements.

If engineering design graphics is to be considered a part of the design process, reference to design should be included on examinations. This might require that a small design be completed during the examination or that an essay question be included relating to the steps of the design process.

Examinations in engineering design graphics courses should be required. It is critical that the content and the level of difficulty of graphics classes be equated with that of conventional engineering courses. If tests or quizzes are given during normal class periods as a replacement for a final examination given during the normal examination period, engineering and engineering technology colleagues will relegate the course to the level of a laboratory class (typically not carrying the normal 3 credit-hour rating and typically not requiring an examination).

Notes to EDGD Members

Members of the Engineering Design Graphics Division of the American Society for Engineering Education often voice the opinion, individually and as a group, that we as design graphics instructors "get no respect" for educating our students in this important area. Having reviewed the examinations of many of my fellow members, I offer the following retorical question:

If we, as engineering design graphics educators, don't give true end-of-semester or end-of-quarter examinations as do most college and university-level courses (except laboratories);

If we don't require the use of computers on our examinations even though we use them in our instruction and expect our students to know how to use efficiently one of several graphics software packages available;

If we ask questions on our examinations that do not require original and creative thinking, while most engineering courses emphasize the ability to think rather than memorize;

If we don't require problem solving on our examinations, which is the primary responsibility of practicing engineers;

And if we don't ask questions related to engineering design, even though many of us claim to be teaching courses in engineering design graphics,

Is it any wonder that we Engineering Design Graphics Educators "GET NO RESPECT?"

A Course for the Development of 3-D Spatial Visualization Skills

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Department of Civil and Environmental Engineering

Beverly J. Baartmans
Department of Mathematical Sciences

Michigan Technological University
Houghton, MI 49931

Abstract

In January 1993, the authors of this paper received NSF funding to develop a pre-graphics course for freshman engineering majors who are weak in 3-D spatial visualization skills. A text and computer lab manual utilizing I-DEAS software were written specifically for this course. The course is 3-credits (quarter system) with two hours of lecture and two hours of lab each week. It was offered at Michigan Technological University (MTU) for the first time during the 1993 Fall term. The Purdue Spatial Visualization Test: Rotations (PSVT:R) was administered during freshman orientation and those students who scored less than 60% correct were counseled into the course. The objective of the course is to provide the prerequisite spatial skills needed by students to succeed in their subsequent engineering design graphics courses. For students enrolled in the experimental course, gain scores on the PSVT:R were analyzed and shown to be statistically significant ($p<0.0001$).

Introduction

Visualization of problems is critical for success in engineering education. In most cases, it is an essential ingredient for student understanding. According to research conducted on learning processes, Treichler (loc. cit. Sexton) concluded that people learn new information based on the following percentages:

People Learn...	
1.5%	Through Touch
3.5%	Through Smell
11%	Through Hearing
83%	Through Sight

Although some may disagree with the exact numbers suggested here, clearly the majority of learning takes place through visual means. It is also recognized that the ability to visualize is an important tool

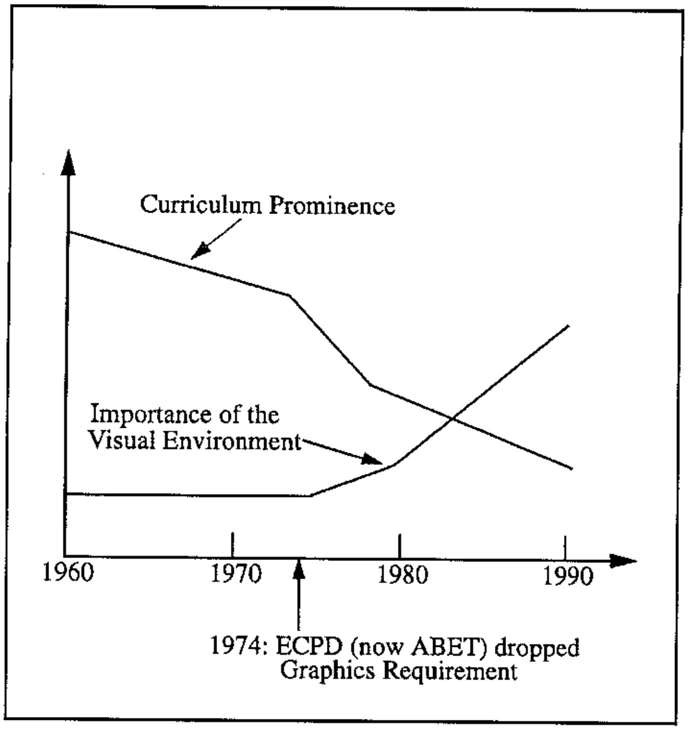

Figure 1 Trends in Graphics Curriculum

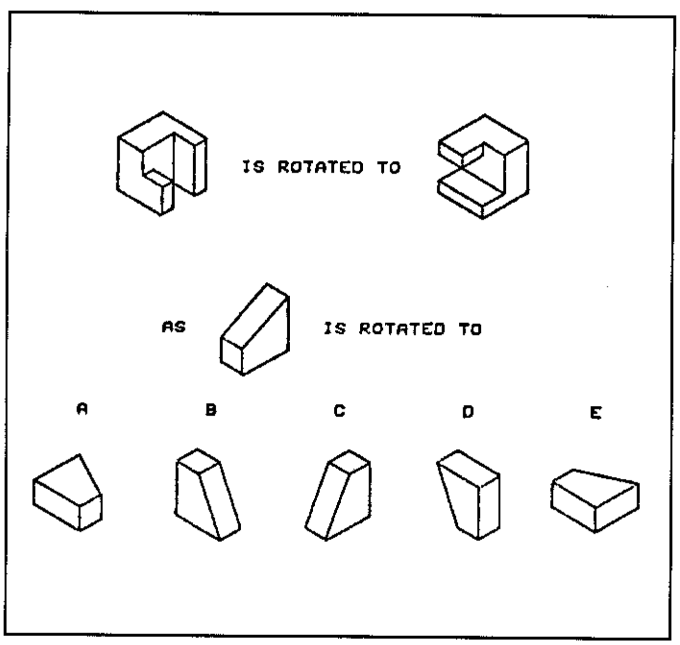

Figure 2. Sample Problem from the PSVT:R

required of engineers in order to function effectively (Miller, 1990; Pleck, 1991; Deno, 1995). In addition to the traditional visualization tasks associated with engineering design, enhanced visualization skills are necessary to function in this new age of computer aided design. In fact, Norman (1994) found that a person's spatial ability is the primary factor which explains differences in performance in fully utilizing computer-based technology. Unfortunately, at a time when visualization skills are increasingly important to engineering students, engineering graphics (the primary course where students first learn visualization concepts) has been de-emphasized, and in many cases, dropped from the engineering curriculium as shown qualitatively in Figure 1 (Pleck, et al., 1990).While some may argue with the specifics of this graph, few will argue with the general trends as depicted in the graph.

The Development of 3-D Spatial Ability

According to Piagetian theory, an individual acquires spatial visualization ability through three distinct stages of development. In the first stage, children learn topological spatial visualization where they are able to discern an object's topological relationship with other objects—i.e. how close the objects are to one another, an object's location within a group of objects, the object's isolation, etc. In the second stage of development, projective representation is acquired. At this stage, people are able to conceive what an object will look like from different perspectives. In the final stage of spatial visualization development, a person learns to combine projective abilities with the concept of measurement. There are standardized tests which are available to measure a person's ability across the first two stages of spatial development. The Purdue Spatial Visualization Test: Rotations (PSVT:R) was devised by Roland Guay (1972) to test a person's ability at the second stage of spatial development. A sample problem from the PSVT:R is shown in Figure 2. The reliability coefficient of the PSVT:R using the Kuder-Richardson 20 in a sample of 492 MTU freshman engineering students in September of 1995 was r=0.82. This testing instrument was used during the project described in this paper to identify students who have a weakness in spatial visualization skills and to partially assess the impact of the experimental course.

Previous Research at MTU

It is well-documented that the 3-D visualization skills of women lag behind those of their male counterparts (Stafford, Heir & Crowley, Fenema & Sherman, Deno). Studies conducted at MTU by Gimmestad (now Baartmans) support these findings. It has been our experience that women are two to three times more likely than their male counterparts to be deficient in 3-D spatial skills. A course such as the one described in this paper can help women students address a deficiency in their background so that they are more likely to succeed in their engineering studies (and in particular, their design graphics courses).

In 1985, one of the authors (Gimmestad, 1990) conducted a research study at MTU. The sample used in the study included 365 entering freshmen (65 women and 300 men) who had declared Mechanical Engineering as their major. During freshman orientation, the students were given the PSVT:R. A multiple regression analysis established that a student's score on the PSVT:R was the most significant predictor of success in the freshman graphics course (ME105) out of the eleven predictors studied. Two other factors were found to be significant in predicting student success in ME105:

1. math ACT test score, and
2. a combination of prior experience in shop, drafting and solid geometry

Mean scores for women lagged behind mean scores for men on two of the three significant variables—spatial visualization as tested by the PSVT:R and prior years of experience in drafting, shop and solid geometry. The mean score for women on the spatial visualization (20.9 out of 30) was significantly lower than that for men (24.2 out of 30). Furthermore, it was expected that students would improve their spatial visualization ability as a result of instruction and other activities in the freshman graphics course. In this study both genders did improve their performance on the spatial visualization test; however, the mean post-test score for women (23.3) was still significantly lower than that for men (25.6). These results are shown in Figure 3.

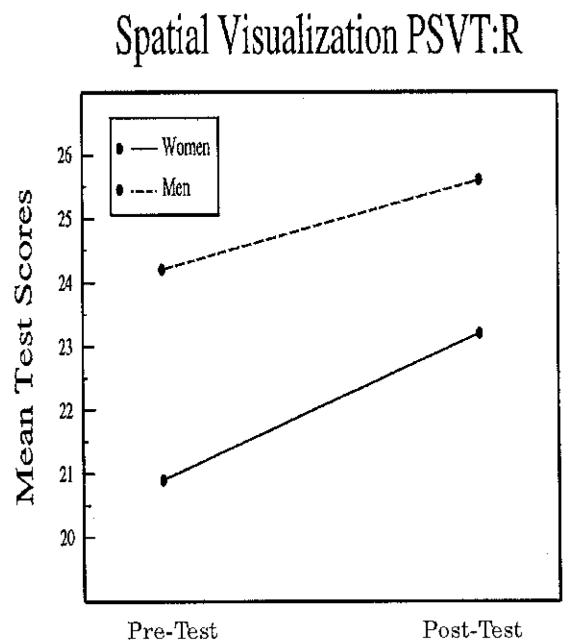

Figure 3 Pre- and Post-Test Results from Engineering Graphics Course

Project Description

During the Spring and Summer of 1993, the authors wrote a textbook to be used in an introductory 3-D spatial visualization skills course (GN102 - *Introduction to Spatial Visualization*). This course is viewed as a pre-graphics course at MTU. The textbook topics include hands on construction activities, paper and pencil activities, and computer activities and are sequenced in a logical order for the development of 3-D spatial skills. The topical outline for the ten-week course is shown in Figure 4.

Course Outline

Week 1 Course Introduction. Students are introduced to the need for visualization skills in fields such as engineering, medicine, architecture, chemistry and mathematics. The three stages of spatial visualization development are discussed.

Week 2 Isometric and Orthographic Sketching. Students are given a set of snap cubes so that they can construct buildings according to coded plans. Then they learn how to make isometric and orthographic drawings of the buildings using grid paper. The use of the snap cubes enables the students to hold a concrete model in their hands as they are making the sketches.

Week 3 Orthographic Drawings and Applications. Objects which contain inclined surfaces are demonstrated and orthographic and isometric drawings are made of these objects. Students are also instructed how to set up an engineering drawing in a standard layout.

Week 4 Pattern Development. Flat patterns which can be folded into 3-D solids are studied. Students are also introduced to a sheet metal application.

Week 5 Two- and Three-Coordinate Drawing. Students are shown the principle involved in locating specific points in space. Then they use a table of coordinate data to draw wireframe geometry. A surveying application using traverse data is introduced.

Week 6 Translation and Scaling. Object transformations in 3-space are introduced. Students are required to draw objects after translation and scaling.

Week 7 Rotation of Objects. Students work with objects created from snap cubes and sketch isometric views of the objects as they are rotated about one or more axes. These objects are rotated first about one axis and then about two or more axes.

Week 8 Reflection of Objects and Applications. Students use Miras in class to construct reflected views of objects. The concept of a plane of symmetry for an object is also introduced. Applications from organic chemistry involving reflected molecules are investigated.

Week 9 Cross-Sections of Solids. Students are taught to graph planes in 3-space. Cross-sections for cubes, cones and cylinders using cutting-planes of different orientations are discussed.

Week 10 Surfaces and Solids of Revolution and the Intersection of Solids. Students are required to sketch the surface/solid which would be formed by revolution of a planar figure/region about an axis. Conversely, given the surface/solid of revolution, they sketch the shape of the planar figure/region which was revolved. The intersection of solids and its use in Computer Aided Design is discussed.

Figure 4 Ten Week Course Outline

Computer Lab

As a part of this project, computer exercises were developed which utilize I-DEAS software as a visualization tool. The exercises were written to adhere closely to those topics covered in the text book. For example, during Week 9, the computer lab exercise instructs the students to create basic primitives (cones, cylinders and blocks) and then to pass cutting planes at various orientations through them in order to observe the resulting cross-sections.

Evaluation and Assessment

Assessment of the project consists of three primary areas of interest:

1. post-test scores on the PSVT:R for students enrolled in the course,
2. student comments regarding the course and text, and
3. comparison of student performance in subsequent graphics courses for the experimental class and the control group.

Post-Testing with PSVT:R

Incoming students who were enrolled in the fields of mechanical, civil, environmental, geological and general engineering were administered the PSVT:R and a background questionnaire as part of their freshman orientation. A total of 535 students took the test, 418 males and 117 females. The average percent correct for male students taking the test was 79.6% compared to an average of 68.1% for the female students. Furthermore, of the 45 students who received perfect scores on the exam, only 3 (about 7%) were women. Conversely, of the 96 students who received scores of 60% or lower, 50 were male and 46 were women. In other words, only 12% of the male students failed the exam; whereas, 39.3% of the females failed the exam. This is shown in Figure 5.

Although women made up only 22% of the group being tested, they were almost 50% of the group failing the exam. Further statistical analyses of the data from the background questionnaire and the PSVT:R test scores revealed four significant predictors of success on the PSVT:R (Parolini) out of eleven factors studied. They were:

1. play as children with construction toys such as Legos™, Lincoln Logs™, Erector Sets™,
2. gender,
3. math ACT scores, and
4. previous experience in design-related courses (like drafting, mechanical drawing, CAD, and art).

Furthermore, male/female differences on predictors 1, 3 and 4 were tested for statistical significance. Play with construction toys and previous experience in design courses were found to be gender-biased (i.e., average scores for women on these variables were significantly lower than for men on both of these two predictors). Average scores on the ACT Math subtest did not differ significantly for men and women. The predictors which were not significant for a person's PSVT:R score were:

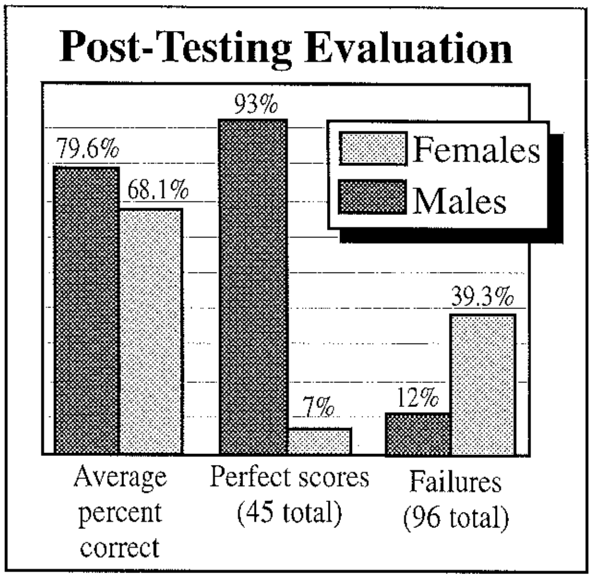

Figure 5 Post-Testing Evaluation

1. age,
2. right vs. left handedness,
3. previous experience in high school geometry courses—nearly all of the students had taken high school geometry,
4. participation in industrial arts courses in high school,
5. playing video games,
6. previous work experience involving spatial skills, and
7. participation in sports which involved placing an object in a specific location (e.g., basketball, hockey, etc.)

Students enrolled in the experimental course were given the PSVT:R as a part of their final exam. The average score on the PSVT:R during freshman orientation for these students was 51% correct; whereas, at the end of the course, the average score was 86% correct. A dependent t-test was used to analyze the students' gain scores on the PSVT:R. Statistically significant gains were made ($t=12.53$, $p<0.0001$) by students enrolled in the experimental course. In fact, not one student failed the PSVT:R when

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1995 Graphics Salary Survey Report

Jon M Duff
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Purdue University
West Lafayette

Abstract

Recent history has seen dramatic changes in graphics instruction, equipment, and applications. Once the purview of engineers and computer scientists, curricula across the university now teach courses in design, documentation, presentation, visualization, and information distribution based on computer graphics technology. The identification of a peer group of faculty teaching these courses and the collection of salary data establishes a level of marketability for future salary considerations.

Background

This salary survey, conducted in the spring of 1995, was actually the outgrowth of an earlier salary survey conducted to ascertain the status of salaries of Technical Graphics faculty within the School of Technology at Purdue's West Lafayette campus.

It was the position of the university's administration that comparisons between departments or schools could not, by themselves, demonstrate salary equity or inequity. The university adheres to a *market model* for determining the relative level of compensation, both of individuals and of academic areas. That is, salary is not based ultimately on productivity in terms of teaching, scholarship, and grantsmanship. Instead, it is based on what subject is taught, in which school, and the perception of the university as to its (your) marketability. Marketablity as explained later may differ with ones perception of the hiring process.

As background, the Technical Graphics Department has 13 full-time faculty and approximately 350 full-time students pursuing Associate of Science and Bachelor of Science degree programs. Faculty work with

FACE VALIDITY OF SURVEY DATA

To determine a measure of whether the salary data is within expected ranges, the differences between rank as determined from the data were compared with the differences reported in aggragate salaries of the general faculty population on the Purdue West Lafayette campus. The measures used were the average salaries of Assistant and Associate Professors as a percentage of average Full Professor salaries.

The differences in these data may be attributed to the decidedly Associate Professor bias of the faculty in the peer group. Because many long-term graphics teachers retired in the period 1975-1985, faculty represented in the peer group may not have the rank or years in rank as does the faculty in general. For example, Full Professors make up but 29% of peer group faculty with an average of 13 years in rank, well below Purdue's institutional average.

Rank	Purdue Campus	Peer Group
Full Professor	100%	100%
Associate Professor	67%	77%
Assistant Professor	57%	66%

Figure 8. Salaries as a Percentage of Average Full Professor

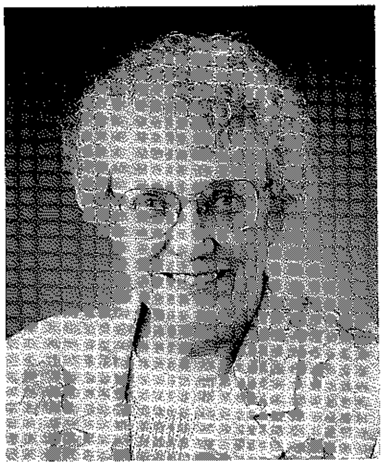
Conclusions

The results of this survey were presented to the administration with a direct comparison with salary data for the Technical Graphics department. Based on this, salary adjustment monies could be appropriated and distributed. It was stressed that the need and validity of such adjustments is the responsibiltiy of the faculty and must be an on-going program. Peer group norming should be a regular departmental activity.

Based on the comparison of salary differences within and between ranks, these adjustment monies can be distributed with the goal of more closely matching peer group data. To do this, department salaries can be adjusted to:

- close the gap with peer group averages within each rank
- maintain similar range differential of peer group within each rank
- maintain similar peer group differential between ranks

Divison News and Notes



Chair's Message

Mary Jasper

A leader is best when people barely know that he exists.
Not so good when people obey and acclaim him,
Worst when they despise him.
Fail to honor people,
They fail to honor you.
But of a good leader, who talks little,
When his work is done, his aim fulfilled,
They will all say "We did this ourselves."

Witter Bynner, *The Way of Life According to Lao-tzu*

As teachers of the graphic language, we have a lot in common with our community college colleagues. In fact, most graphic communication is taught at the community college level, whether or not we would like to admit this. How many of these folks are members of our division and how many feel that they are teaching in that proverbial vacuum?

At Mississippi State, we have undertaken to open dialogues with all 16 public community colleges in the state. Two of our staff make regular visits to each of these and talk to the instructors who teach engineering graphics to students who will transfer to MSU and other state universities. They share our syllabi and teaching practices and also find out how the academic side interacts with the graphics instruction on the technology side of each community college campus. (This latter information is material in and of itself for another complete column!)

Our colleagues at the community colleges in each of our states are important to the overall engineering education thrust in our nation. I know that each one of you reading this has experienced students in your classes who have transferred from two-year institutions in your state and have been among the best and the brightest in your class. If we believe that all of our children deserve a quality education, it is our duty and opportunity to create alliances with our counterparts in the two-year programs in our respective states. These alliances should not be one-way pipelines in which we "teach" these colleagues the "correct way" to impart knowledge, but rather, a sharing of information and knowledge from both ends of the pipelines.

This week, (the first week in April), I am sending ASEE applications to all of the engineering graphics teachers at the Mississippi community colleges. The application will include a cover letter which encourages their participation in the ASEE, and the benefits which will derive therefrom. I hope that I will at least receive some letters or phone messages of inquiry from this correspondence. I challenge each of our members who read this, to do the same for their colleagues in two-year institutions in their state. ASEE Headquarters will be thrilled to send extra applications, and all you have to do is call!

If any of you have already started a dialogue with your colleagues at two-year colleges, please share your information with me. My last column will be devoted to this subject again, and I will include your letters, phone calls, faxes, or email missive about the results which you report.

I look forward to hearing from you, so write me at

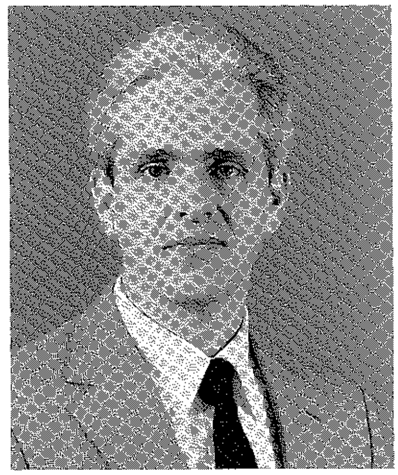
Mary A. Jasper
Dept. of Industrial Engineering
Mississippi State University
Box 9542
Mississippi State, MS 39762

or phone me, 601-325-3923;
or FAX me, 601-325-7618;
or email me,
jasper@engr.msstate.edu

Mary A. Jasper
Chair, EDGD

edgd

Vice-Chair



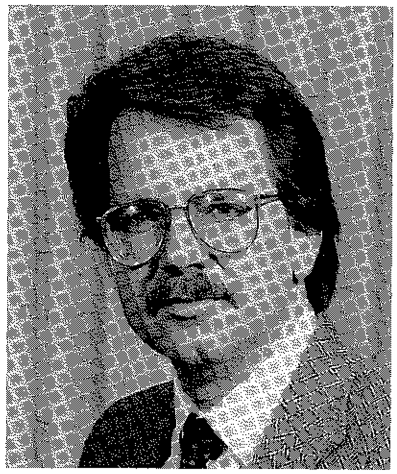
Jon M. Duff

Jon M. Duff is Professor of Technical Graphics in the Department of Technical Graphics at Purdue University's School of Technology in West Lafayette, Indiana. He received his Ph.D. from The Ohio State University, where he was a faculty member in Engineering Graphics in the college of Engineering for seven years. Author of nine textbooks on technical graphics and over forty technical papers on a variety of technical topics, Dr. Duff worked on electronic graphics technology as a Battelle Memorial Institute Research Scientist with the Department of the Navy. In addition to his writing, Dr. Duff consults with a number of clients including IEEE and the National Opinion Research Center. He served as Director of Publications and Editor of the Engineering Design Graphics Journal over a period of six years, and has been active in the Engineering Design Graphics Division since 1978. At Purdue, he is active in the design and evaluation of curricula and has developed an interest in interactive authoring and multimedia for training.

Tim Sexton

Tim is an associate professor if Industrial Technology in the Russ College of Engineering and Technology at Ohio University in Athens, Ohio. His responsibilities at Ohio University include teaching courses in engineering graphics, architectural drawing, computer applications in industry. His research interests include: measuring and fostering abilities in spatial visualization, developing instructional material using CAD for entry-level engineering graphics courses, and designing and developing presentation graphics. He has authored *Hands-On CADKEY: A Guide to Versions 5, 6, and 7* (1996) published by Irwin Publishing Company. Tim has been a member of EDGD since 1987, presented numerous papers at ASEE and ASEE-EDGD meetings, is currently on the Review Board for *The Engineering Design Graphics Journal,* and was the facilities chair for the ASEE-EDGD's 1993-94 midyear meeting. In addition to ASEE, he is a member of the National Association of Industrial Technology (NAIT) and Epsilon Pi Tau (EPT). He received a B.S. in Architecture from the University of Illinois (1973), an M.S. in Industrial Technology from Western Illinois University (1977), and Ph.D. in Instructional Technology from Ohio University (1991).

Director of Professional & Technical Committees



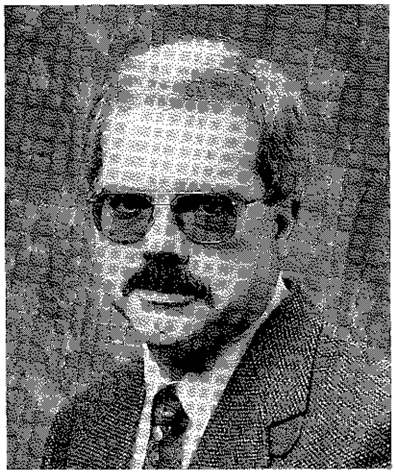
Pat McCuistion

Pat is an assistant professor of Industrial Technology in the Russ College of Engineering and Technology at Ohio University in Athens, Ohio. At Ohio University he teaches engineering drawing, geometric dimensioning and tolerancing (GDT), quality assurance, and technical writing. He is co-author of *Geometric Tolerancing* published by Glenco. He is contributing author to *AutoCAD Instructor* by Jim Leach and *Mechanical Drawing* by Jay Helsel. Pat has been a member of EDGD since 1989. In addition to presenting papers at the regular meetings, he has presented a one-day GDT workshop at the ASEE annual conference for the past three years. He is chairman of the Standards Committee and as chairman of the new National Design Graphics Competition, is primarily responsible for reviving the competition. In addition to ASEE, he is an active member of the National Association of Industrial Technology, and the Society of Manufacturing Engineers. As a member of the American National Standards Institute Codes and Standards, he serves on five different subcommittees; Y14.3, Multiview and Section Drawings, Y14.5, Dimensioning and Tolerancing, Y14.35, Revisions, Y14.36, Surface Texture, and B89.3.6, Functional Gages. Pat earned his B.S. in 1977 and his M.S. in 1981 from Pittsburgh State University, and his Ph.D. in 1989 from Texas A & M University.

Audeen W. Fentiman

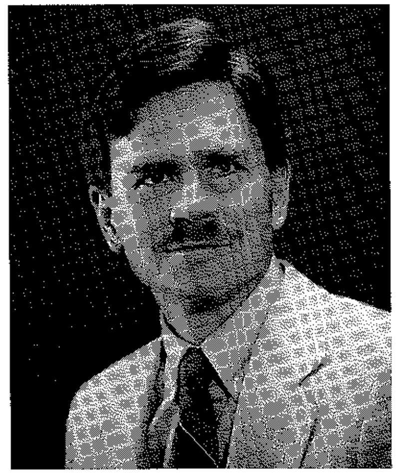
Audeen Fentiman joined the Engineering Graphics faculty at The Ohio State University in 1990. She was part of a team that conducted a survey of industry to learn what basic engineering skills were most valued and has helped to modify courses to emphasize those skills. She has taught several pilot sections of the modified courses. Dr. Fentiman has worked with other Engineering Graphics faculty to obtain NSF funding for a workshop to introduce fundamental graphics concepts to incoming freshman women engineering students. She is an active member of ASEE and currently serves as Secretary of the North Central Section. Dr. Fentiman is a nuclear engineer, and has worked in industry holding technical and management positions.

Director of Zone Activities



J. Douglas Frampton

Doug is an Associate Professor and coordinator of the Drafting and Computer Drafting Technology program at The University of Akron. He received his B.S. in Industrial Technology and M.A. degrees from The Ohio State University. Doug has been teaching at The University of Akron since 1989 and prior to that, he taught for nine years as a Lecturer and Graduate Teaching Assistant with the Department of Engineering Graphics at The Ohio State University. Dough has been a member of ASEE and EDGD since 1987 and is currently serving as Best Paper Chair for the North Central Section. He has also served as Technical Program Chair for the 1992 ASEE Annual Conference and the 1993 EDGD Midyear Conference. In addition, Doug has made several presentations, and has co-authored an AutoCAD textbook published by MacMillan Publishers.



Steve Howell

Steve is an Associate Professor if Mechanical Engineering at Northern Arizona University. He received his Ph.D. degree from the University of British Columbia in 1983. His M.S. and B.S. degrees in mechanical engineering were received from Southern Methodist University in 1977 and 1976. Prior to joining the engineering faculty at NAU, Steve taught various mechanical engineering courses at University of the Pacific' beginning in 1983. From 1986 to 1987 he worked with the College of Engineering at the University of Zimbabwe under a U.S. Agency for International Development grant. While in Zimbabwe he helped install and implement the first computer aided learning lab in Sub-Saharan Africa. Steve has been active in the EDGD of ASEE since 1991 and active in the ASEE since 1987. He has presented numerous papers in the field of computer aided learning and computer graphics. He has authored a book Engineering Design and Problem Solving and has recently completed an AutoCAD Designer book. He twice won the Oppenheimer Award for best paper at the EDGD Mid-Year Meeting.

Calendar

The new address for the EDGD web page is
http://www.tech.purdue.edu/tg/edgd_division.htm

National Museum of Photography, Film & Television Conference
April 16-18, 1996

Bradford, United Kingdom
Conference Secretariat:
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Electronic Imaging and Media Communications Unit
University of Bradford
BRADFORD BD7 1DP
United Kingdom
Tel: 01274-385463
International: 44-1274-385463
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International fax: 44-1274-383727
Email: W.M.Taylor@bradford.ac.uk

1996 Annual ASEE Conference
June 23-26, 1996

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International Conference on Engineering Computer Graphics and Descriptive Geometry
July 18-22, 1996

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1996-97 EDGD 51st Annual Mid-Year Conference
October 27-29, 1997

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Phone: 919-328-4146
Fax: 919-757-4250
Email: itchin@homer.sit.ecu.edu
General Chair: Eric N.Wiebe
Graphic Communications Program
Department of Occupational Education
College of Education and Psychology
North Carolina State University
Box 7801, Raleigh, NC 27695-7801
Phone: 919 515-2234
Fax: 919 515-7634
Email: eric_wiebe@ncsu.edu

Accreditation Board for Engineering and Technology 1996 Annual Meeting

October 31-November 1 1996

San Diego, California
Contact: Dr. Stanley I. Proctor
ABET
Education & Information Services
111 Market Place, Suite 1050
Baltimore, MD 21202-4012
FAX: (410) 625-2238
For more information contact ABET at (410) 625-2238

COMPUGRAPHICS '96

Fifth International Conference on Computational Graphics and Visualization Techniques
December 15-19, 1996

Nogentel Nogent-sur-Marne
Paris , FRANCE

Topics include: Technical Drawing, Engineering Graphics, Descriptive Geometry, Theoretical Graphics and Classical Geometry, Computational Geometry, Geometric Modeling, CAGD, Computer and Computational Graphics, Image Synthesis and Processing, Art, CADD, CAI, CAD/CAE, CAAD, GIS, Industrial and Engineering Design, Finite Element and other Numerical Methods, Artificial Intelligence and Expert Systems, Scientific Visualization, Standards, Systems/Software, Human-Computer Interface, Physically-based Modeling, Animation, Natural Scene Simulation and Fractals.
Contact: Harold P. SANTO
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Tel. + AM + Fax :+351-1-439-2571
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1997 ASEE IL-IN Section Conference

March 14-15, 1997

IUPU - Indianapolis
Call for Papers deadline September 15, 1996
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Conference Chair: V. Raju
Purdue School of Engineering and Technology, Indiana University Purdue University Indianapolis, IN
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Indianapolis, Indiana 46202
RAJU@TECH.IUPUI.EDU
phone: 317-274-3429
FAX: 317-274-4567

WSCG'97

The Fifth International Conference in Central European Computer Graphics and Visualization 97
February 10-14, 1997 in Czech Republic in cooperation with IFIP working group 5.10 on Computer Graphics and Virtual Worlds.
Contribution deadline: October 30, 1996
Contact:Vaclav Skala
Computer Sci.Dept.,
Univ.of West Bohemia
Univerzitni 22, Box 314,
Plzen, Czech Republic
e-mail: wscg97@kiv.zcu.cz Subj: INFO
http://yoyo.zcu.cz/~skala/wscg97.html
Information on previous conferences:
http://yoyo.zcu.cz/cg_group

1997 Annual ASEE Conference

Milwaukee, WI, June 15-18, 1997
Frank Croft, EDGD Program Chair
email: croft.3@osu.edu

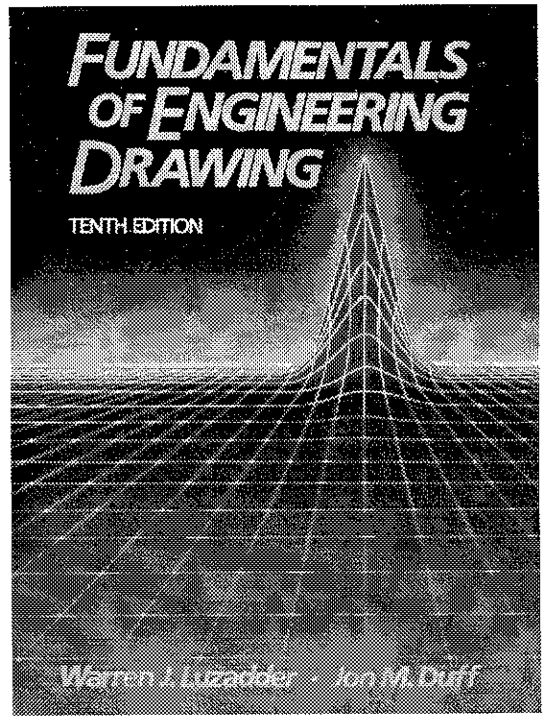
Warren J. Luzadder

1904-1996

Journal Editor-1952-55

Division Chair-1957-58

EDGD Distinguished Service Award-1964



Warren J. Luzadder, 91, of West Lafayette, Indiana, died at 8:15 a.m. Monday, Feb. 5, 1996, at his home. He had been ill for three months.

He was the34 author of *Fundamentals of Engineering Graphics* and 10 other textbooks. Mr. Luzadder, who taught at Purdue 51 years, was designated professor emeritus in 1970.

Born in Indianapolis on Dec. 31, 1904, he graduated from Arsenal Technical High school, attended Butler University and graduated from Purdue University in 1929 with a degree in civil engineering. He completed his master's degree at Purdue in 1933.

He married Jeanette Palmer on March 27, 1932, in Indianapolis. She died in 1982.

A year after earning his undergraduate degree, he joined the Purdue faculty as an instructor in engineering drawing and descriptive geometry. He became a registered professional engineer in 1935. His first textbook, *Fundamentals of Engineering Drawing*, was published in 1943, and it became the third best-selling textbook on any subject during the next five decades.

Mr. Luzadder was a draftsman for the Indianapolis Street Railway from 1920 to 1925 and served as a design engineer for the Indiana State Highway Commission form 1929 to 1930. He was a chief surveyor for the Indiana Highway Planning in 1936 and an Army ordnance research draftsman at Purdue in 1944.

Since 1956, Mr. Luzadder had served as an adviser for the Alpha Gamma Chapter of Alpha Phi Omega service fraternity and the Purdue chapter and national organization honored him on several occasions for his work with students. He received the Dean Beverly Stone Award at Purdue in 1984 for outstanding contributions to student life.

He was a member of the American Association of Military Engineers, American Association of University Professors, National Society of Professional Engineers American Standards Association's Screwthreads Committee, Elks Lodge 143, American Society for Engineering Education and was chairman of the Engineering Drawing Division in 1957-58.

Mr. Luzadder was the editor of T-Square Page in the Journal of Engineering Education from 1948 to 1950, the Journal of Engineering Drawing from 1952 to 1955, and contributing author to the Encyclopedia of Science and Technology.

Surviving are two sons, Robert Luzadder of Fort Wayne and James Luzadder of Bloomingdale, Ill.; three sisters, Nellie Theising of Indianapolis, Laurabelle Tompkins of Muncie and Frances Morgan of Newark, Ohio.

51st Annual

American Soicety of Engineering Education
Engineering Design Graphics Division

October 27-29, 1996

EDGD Midyear Meeting
RALEIGH, NC

"Exploring the *Next* 50 Years"

CALL FOR PAPERS

The North Carolina State University Graphic Communications Program is pleased to host the 51st Annual Midyear Meeting of the Engineering Design Graphics Division of the American Society of Engineering Education.

Meeting Date and Place

The meeting will be held October 27-29, 1996, at North Carolina State University in Raleigh, North Carolina. Papers will be presented throughout the conference along with a social activity and industrial tours.

This announcement is a call for submissions to the conference. Topics may include, but are not limited to, the following:

- Simulation and Animation
- Visualization
- Instructional Innovation
- Theoretical Graphics
- Parametric Modeling
- Internet Graphics
- Alignment of Secondary & Post-Secondary Curriculum in Graphics

Submissions Dates and Location

Submissions are encouraged from both industry and academia. Abstracts must be received by **July 15, 1996**. Acceptance notices will be mailed by August 15, 1996. Please submit two copies of a one page abstract (350 words) to:

Robert A. Chin
Flanagan Building, ECU
Greensboro, NC 27858-4353

Phone: 919-328-4146
Fax: 919-757-4250
email: itchin@homer.sit.ecu.edu

Papers accepted for presentation will be published in the conference proceedings. The deadline for completed papers is September 30, 1996. Details regarding preparation of completed papers will be provided in the acceptance notices. For more information, please contact Eric Wiebe (e-mail: eric_wiebe@cos.ncsu.edu).

Graphic Communications—Department of Mathematics, Science and Technology Education
College of Education and Psychology—North Carolina State University

Enhancement of Faculty Design Capabilities

Enhancement of Faculty Design Capabilities is a two-week workshop offered fromJjuly 28 to August 9, 1996 at Southern Methodist University in Dallas, Texas. This workshop is offered for all engineering disciplines and faculty who intend to or are presently teaching design in engineering courses to undergraduate students. This workshop strives to address needs of faculty from two-year and four-year institutions who teach non-design, or engineering science, courses and desire to include design into the course work.

The workshop addresses topics in design methodologies, design content, design constraints, design tools, and teaching design through a multi-faceted format using lectures, laboratory sessions, discussion session, work sessions and industrial tours. Participants are expected to develop a design plan, design problems, design projects, and design case studies. Workshop participants will work individually, in single discipline teams, and in in multi-discipline teams to design materials for use in incorporation into their courses at their home institution. Faculty leaving this workshop will have a design plan, design materials for courses, a plan of implementation at the home institution, and a network of design faculty with whom to interact.

This workshop will guide faculty to a different way of thinking, a freshened approach to processes and procedures of design synthesis as opposed to highly analytical skills generally emphasized in research activities and engineering science courses.

For information, contact:
Dr. Charles M. Lovas
Southern Methodist University
214-768-3207.

Engineering Design Graphics Division

51st Annual Mid-Year Meeting

Exploring the Next 50

October 27-29, 1996
Raleigh, North Carolina

ENGINEERING DESIGN GRAPHICS DIVISION
ASEE

For information contact
Eric Wiebe
Graphic Communications Program
P.O. Box 7801
510 Poe Hall
Raleigh, NC 27695-7801

Phone: 919-515-1753
Fax: 919-515-7634

Awards

Congratulations to Dr. Gary R. Bertoline, who was named the first recipient of "The Steve M. Slaby International Award for Outstanding Contributions to Graphics Education," at the EduGraphics/CompuGraphics 95 Conference in Faro, Portugal, December 11-15, 1995. The Slaby award is given for accomplishment and life achievement for outstanding, leading, and influential stature in the Graphics Education field.

Dr. Bertoline, who was chosen to head the Technical Graphics Department in July 1995, has an outstanding record of achievement in the area of engineering graphics. He has served on the faculty of Wright State University, The Ohio State University, and Purdue

Gary has received a number of awards and honors for his work in engineering graphics education.

Gary has published over 32 academic papers in the graphics education area and is author or co-author of ten textbooks. As series editor for Irwin Publishers, he has launched a new engineering design graphics series. He has also assumed active leadership roles in national and international academic and professional societies.

Gary spoke to the membership of the Edugraph/CompuGraph conference on the role of graphics in many disciplines, and encouraged an international effort to define and validate an emerging discipline of graphic science. He is an able communicator and leader in the practice and teaching of modern engineering and technical graphics.

Submission Guidelines

The *Engineering Design Graphics Journal* is published by the Engineering Design Graphics (EDG) Division of the American Society for Engineering Education (ASEE). Papers submitted are reviewed by an Editorial Review Board for their contribution to Engineering Graphics, Graphics Education and appeal to the readership of the graphics educators. By submitting a manuscript, the authors agree that the copyright for their article is transferred to the publisher if and when their article is accepted for publication. The author retains rights to the fair use of the paper, such as in teaching and other nonprofit uses. Membership in EDGD-ASEE does not influence acceptance of papers.

Material submitted should not have been published elsewhere and not be under consideration by another publication. Submit papers, including an abstract as well as figures, tables, etc., in quadruplicate (original plus three copies) with a cover letter to

Mary A. Sadowski, Editor
Engineering Design Graphics Journal
1419 Knoy Hall / Technical Graphics
Purdue University
West Lafayette, IN 47907-1419
FAX: 317-494-0486 PH: 317-494-8206

Cover letter should include your complete mailing address, phone and fax numbers. A complete address should be provided for each co-author. Use standard 8-1/2 x 11 inch paper, with pages numbered consecutively. Clearly identify all figures, graphs, tables, etc. All figures, graphs, tables, etc. must be accompanied by a caption. Illustrations will not be redrawn. All line work must be black and sharply drawn and all text must be large enough to be legible if reduced. The editorial staff may edit manuscripts for publication after return from the Board of Review. Upon acceptance, the author or authors will be asked to review comments, make necessary changes and submit both a paper copy and a text file on a 3.5" disk.

Page Charges

A page charge will apply for all papers printed in the *EDG Journal*. The rate is determined by the status of the first author listed on the paper at the time the paper is received by the Editor. The rates are as follows:

$5 per page for EDGD members
$10 per page for ASEE, but not EDGD members
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