Marine and Related Mini Design Problems Presented in an Introductory Engineering Graphics Course

Eric W. Hansberry, Associate Professor,
Francis A. DiBella, Assistant Professor,
And
Guido W. Lopez, Assistant Professor

Northeastern University
School of Engineering Technology
360 Huntington Avenue, Room 120 SN
Boston, MA 02115-5096
Tel: (617) 373-4852, Fax: (617) 373-2501
e-mail: ewh@coe.neu.edu

Abstract

First-year students at the School of Engineering Technology and the Lowell Institute School at Northeastern University are directly involved in multifaceted projects that have practical applications. This paper will discuss how Mini Design problems are used to develop students' design abilities and understanding of the design process. They are an ideal teaching tool because they are short and allow for immediate feedback to students. This paper will include examples of projects used at the School of Engineering Technology and the Lowell Institute School at Northeastern University. The problems encompass architectural, mechanical and electrical/electronic engineering based graphics, with an emphasis on marine design.

I. Introduction

Mini Design problems are an ideal method for instructing design skills to engineering students. First and foremost, they provide students with an opportunity to gain invaluable experience doing precisely the type of work they will be responsible for, when they enter the workforce. Preparation with Mini Design projects sets them up to 'Hit the deck running.' The goal of this paper is to highlight the important features and benefits of Mini Design problems. Actual projects will then be presented to exemplify how they may be used in the classroom. These projects were developed through years of instructing students with these methods.

First-year engineering design projects are an integral part of the education process in engineering and engineering technology. According to Gerard Voland, the design process includes need

Proceedings of the 2002 American Society for Engineering Education Annual Conference & Exposition

assessment, problem formation, abstraction, synthesis, and implementation. Mini Design problems incorporate all of these levels of learning. They are presented to students in an order of increasing complexity, to ultimately incorporate each of the essential levels of design described by Voland. Because each individual project is designed to be completed within one class period, students acquire these skills in a practical manner, and develop an appreciation for their inter-relationship within the design process.

Mini Design problems are particularly effective in teaching design because they expose students to 'real world' design projects, all the while fitting into the limitations of the classroom. Constraint on time is a limitation every instructor must overcome to teach students effectively. Mini Design problems can be completed within one class period. Since they are completed in a short period, students who miss a class are not behind on a problem, as a new problem is introduced each period.

As a problem-based learning approach, the design problems incorporate skills such as computer aided design and technical language with the creative process, all the while developing technical engineering knowledge.

Because of their convenient format, Mini Design problems can be tailored to suit the individual needs of the students, their instructors, and the demands of the engineering field. For example, a project can easily reflect regional industrial problems. If students attend school in a maritime location or program goals wish to cater to the needs of marine design, Mini Design problems can easily reflect this focus.

In addition to being convenient, Mini Design problems allow for immediate feedback. This feedback improves students' confidence and competence. Because students have an opportunity to use design concepts immediately after they are taught, Mini Design problems promote understanding and retention, the goal of education.

A typical Mini Design problem is developed so that it can be completed within a fifteen-to sixty-minute period. They are created with an emphasis on the most recent design concept presented to the class. For example, if the instructor has just discussed orthographic projection and how the views are drawn using the computer, the Mini Design problem for that day would include making a drawing (developing a database) of a basic civil, mechanical or electrical part or component. It is the responsibility of the instructor to ensure that the Mini Design problems implemented always reflect current, useful design.

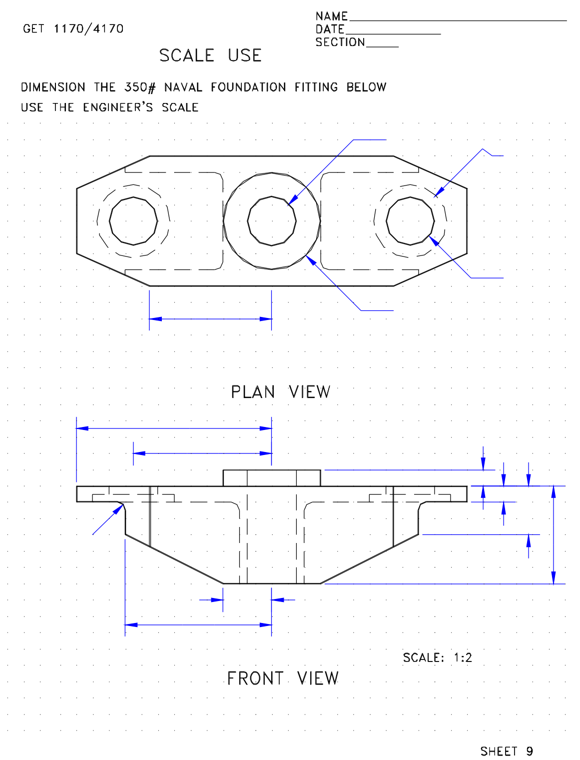
Mini Design Problems

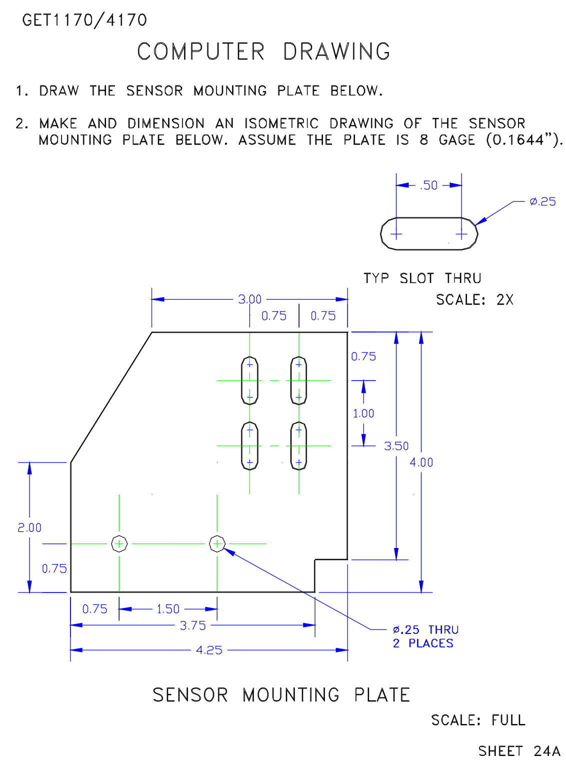
The following are examples of Mini Design problems implemented in the School of Engineering Technology and the Lowell Institute School at Northeastern University.

Problems 1 and 2

These examples of an initial Mini Design problems were created to familiarize students with orthographic projection, use of engineering scales and computer aided design (CAD) software.

The Software used in these sketches and engineering graphics is Autocad 2002. The first drawing sheet 9 shows how the engineer's scale may be used.





In making the second drawing, sheet 24A above, students use full size and double size scales. The mounting plate is full size and its slot detail is double size. Students become familiar with making a CAD drawing as they learn basic commands including grid, offset, line, circle and text. Students realize the importance of dimensioning and how that relates to object and centerlines. In this basic drawing students are not required to know how to dimension. In completing this drawing students will have made their first CAD layout drawing utilizing the principal orthographic view and calling out its depth by the metal gage.

Problem 3

The following is a more complex Mini Design problem. The students are given an isometric sketch for which they develop plan and elevation working drawing of the frame foundation below.

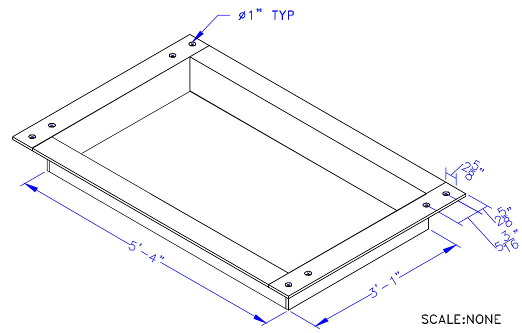
GET 1170/4170

COMPUTER DRAWING

WRITE YOUR NAME, DATE, AND SECTION IN THE UPPER RIGHT CORNER OF THE DRAWING SHEET. DRAW THE FRONT, TOP, AND THE RIGHT SIDE VIEWS OF THE FRAME FOUNDATION BELOW. DIMENSION THE VIEWS.

SET THE FOLLOWING LAYERS (DO NOT USE THE 0 LAYER):

NAME	ABB	COLOR	LINETYPE
OBJECT	OBJT	BLACK (WHITE)	CONTINUOUS
CONSTRUCTION	CONST	RED	CONTINUOUS
CENTERLINE	CL	GREEN	CENTER(.5x)
HIDDEN	HIDE	GREEN	HIDDEN(.5x)
TEXT	TXT	BLUE	CONTINUOUS
DIMENSION	DIM	GREEN	CONTINUOUS



FRAME FOUNDATION

NOTE: FRAME FOUNDATION CONSTRUCTED OF 6X4X1/2 ANGLES, 6" TOE DOWN.

SHEET 26

To make their working drawings students must create drawing layers utilizing abbreviations, colors and associated linetypes. In this drawing, as in the previous example, students improve their use of scales and layout skills. Students also become acquainted with angles as structural elements, and how they are used to create a machine foundation.

Conclusion

The use of Mini Design problems is an essential training method in preparing students to enter the workforce. Because problems are designed to be completed within a class period, professors are able to provide students with the structure they require. An environment is created in the classroom that encourages students to develop both their skills and self-confidence. In addition, Mini Design problems prepare students for real-life situations that occur on the job. The problems presented in this paper illustrate how students can gain invaluable exposure to the industrial format.

Mini Design problems also provide an ideal opportunity for students to be exposed to a variety of engineering disciplines. It is crucial that students develop the ability to work and communicate across discipline. Cohesion among the different engineering fields eliminates a great deal of inefficiency, redundancy, and error in any design problem. In short, Mini Design problems are a necessary element in the education of competent engineers.

Because Mini Design problems can be tailored to meet the individual needs of the instructors and students, they are ideal for introducing students to marine design. The current global conditions have resulted in an increased demand for engineers with skills in the marine field. Mini Design problems are an effective method for exposing students to this career. The problems prepare students to enter the marine field with a solid background and instill students with the enthusiasm that accompanies a solid appreciation and understanding of a new concept.

References

1. Voland, G., Engineering by Design, Addison-Wesley Longman, Inc., 1999, pp. 4-8, 14-16.
2. Bertoline, G., Wiebe, E., Miller, C., Mohler, J., Technical Graphics Communication, McGraw-Hill Companies,1997, pp. 41.

ERIC W. HANSBERRY
Eric Hansberry is Professor of Design Graphics in the School of Engineering Technology at Northeastern University where he is the coordinator for the Mechanical Engineering Technology program. He served as Acting Department Head at the Franklin Institute of Boston. Professor Hansberry holds a number of professional registrations, including civil engineering (MA, NH), and mechanical engineering (NH). He is a founding member of the National Society of Architectural Engineers and an Honorary Member of Tau Alpha Pi. Professor Hansberry holds B.S. and M.S. degrees in Civil Engineering from Tufts University and Northeastern University respectively.

FRANCIS A. DiBELLA
Francis A. Di Bella, PE is an Assistant Professor, Northeastern University, Boston, MA.; College of Engineering , School of Engineering Technology. Mr. Di Bella's professional engineering research interests involve the practical, engineering applications of Thermo-fluid and Machine Design sciences within the Mechanical Engineering discipline.

Specific areas of interest include all aspects of energy systems including generation, storage, conservation and a variety of innovative applications of wind, solar and hydropower. Such systems and their application include gas and steam engines (reciprocating, gas and steam turbines) with steam generation and steam turbine cogeneration of ancillary power. Engine power augmentation including turbo compounding, micro-turbine power generation using turbo-charger machinery for stationary electric power generation and use. Interest extends to the thermodynamic modeling of cogeneration systems and their size vs. cost optimization. This interest is exhibited in course instruction in heat transfer, thermodynamics, fluid dynamics.

GUIDO W. LOPEZ.
Guido Lopez is a Professor of Thermofluids Science, Mechanics, Engineering Design and Engineering Laboratory in the School of Engineering Technology, at Northeastern University, Boston. Before joining NU's faculty, he served as Department Head of the Engineering Math and Science Division at Daniel Webster College, Nashua, NH, and taught engineering and science at the National Polytechnic School in Quito, Ecuador, Daniel Webster College in New Hampshire, and the Lowell Institute of Technology at Northeastern University. He performed research at the NASA John Glenn Research Center on alternative solar dynamic systems for power generation for the international space station alpha. Lopez received his M.S. degree and, Ph.D. degree in engineering from Northeastern University.