AC 2007-743: USE OF THE MACHINERY'S HANDBOOK IN A MANUFACTURING DESIGN COURSE

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Use of the Machinery's Handbook in a Manufacturing Design Course

There are many ways in which to teach a manufacturing design course. The focus that this university took was to look at process development as well as general equipment and tooling design. This would not be a course in general manufacturing processes. Rather the principles in designing the process as well as the tooling and fixturing would be developed. This course would then be attractive to manufacturing engineering technology students as well as to mechanical engineering technology students interested in design.

The textbook that was decided on for this course was the Machinery's Handbook. This is a different strategy than is normally used for a course. Using a trade reference book will allow the students to solve problems as they would in a real situation. The thought was that it will teach them not only how to solve problems in the classroom, but also that they could see the benefit of using this book in their careers.

This paper will explore the thoughts behind using this strategy. Also it will detail how the book is used in a non-traditional manner in the classroom.

Goals of the Course

This course called Manufacturing Design concentrates on some various design principles in the manufacturing field. Machining process design involving Merchant's Diagram, force analysis, tooling design, fixture design, machine design, and process design are analyzed. Then die design for the sheet metal industry is taught. Gage design for measurement of various tolerances and

products is then introduced. Finally design for manufacturability is used in relation to product development.

The purpose of this course is to graduate engineers who can do some design. Being in Engineering Technology practical applications of design are taught in order to show students how to use tools in industry over traditional engineering science. Project based learning is used to allow the students to explore topics in a form that will enhance their work experience and give them the information needed to be valuable to employers. Project based learning is a popular way to develop design principles for engineering students.[1]

Graduates of a Manufacturing Engineering Technology Program must …." understand the design of products and the equipment, tooling, and environment necessary for their manufacture"[2]. The U. S. Department of Commerce has recognized the need for manufacturing education in responding to the challenges of the manufacturing industry in the United States.[3] Employers have a need for engineers to have some project and design knowledge when entering the workforce. It is these reasons that a class in manufacturing design is offered in order to teach students the process of design for the manufacturing of a product.

Challenges

The National Science Foundation recognized the need for project based learning as well as close interaction with industry.[3] So the needs of industry must be taken into account when looking at the structures of classes. With a class that emphasizes design how do the students get a flavor

for solving a real problem? The solution is to allow them to use the tools that they would use in the workplace. A trade handbook is a very good solution to this dilemma.

The ultimate goal in this course is to prepare the student for the workplace. So this course is constantly being analyzed for continuous improvement in the skill sets manufacturing engineers need in the workplace. This is a huge question being constantly asked in many colleges and universities around the country. What was decided was that not only the traditional skills such as knowing traditional manufacturing processes are needed, but knowing where to get information and how to use it in the workplace was also needed. This led to looking at a trade handbook for a possible textbook in this class. The Machinery's Handbook states that it is a "comprehensive and practical tool, combining the most basic and essential aspects of sophisticated manufacturing practice."[4] So it was decided to pursue using this a textbook rather than a traditional textbook for this design class.

Structure of the Course

Previously traditional textbooks were used in this class to introduce these topics. This functioned adequately but there was a thought process that involved in looking at preparing students to better enter the workforce. Project based learning was introduced. To do this a new way of looking at the traditional textbook was introduced. The question was asked as to what references the student would need. The course involved lectures on various topics to introduce the students to them. Example problems were then worked, using the reference tables in the Machinery's Handbook. Some design problems and case studies were used as in class assignments as well as outside of class team assignments. Tests were given to get some student

evaluation. A final project instead of a final examination was used to incorporate all of the student's knowledge in the course. This project was to take a product chosen by the professor and come up with the manufacturing design. This included tooling design, gaging, machine design, fixturing, and plant layout. A set of parameters were given to the students and they were asked in teams to develop the plan. A presentation was given on their results.

Use of the Machinery's Handbook

Not usually used as a textbook the Machinery's Handbook presented some challenges incorporating it in the classroom. The book was written for informational and reference purposes, rather than teaching. So the language was difficult. The book was written with many charts and calculations for a wide variety of different conditions. So the quantity of information was almost too much. For this course only certain sections were relevant. Therefore time was also spent on how to use the book as a reference.

There were three sections in the 27th edition that were relevant for this class. These were the sections on Tooling, Machining, and Manufacturing. In Manufacturing we only used the Punches, Dies, and Press Work sub-section.

One of the sections that we discuss is tooling design. In the Tooling section there is a reference to cutting tools. This section is used in concert with websites and vendor material to discuss the various designs of cutting tools. The terms are defined for the student so they know what is being discussed in the literature. They are then given a couple of different assignments. One type of assignment is to design a tool for a particular application. This application is given by

myself to the students with some background. They are then to solve this application by using the Machinery's Handbook and other literature as a reference. They must cite where the information for the solution has come from. What is evaluated is the process, not the answer. This is very open ended so the solutions vary. The other type of assignment is to develop a training guide for single point cutting tools and tool materials to a worker that does not have a degree in engineering. This must be concise, accurate, and show some creativity in the way it is presented. The thought behind this is that the student must learn the material from the handbook to be able to train someone else in the material. What is important in this section is that the student becomes comfortable with the design of cutting tools and where this information is found.

There is a section on estimating machining power. Again case studies are used to develop what will be needed for that application. The charts in the handbook are estimates, so some real applications in industry are discussed also to give the students even more references. The speeds and feeds sections that are used in the book give great insight into modeling machining systems.

In Machining Econometrics we discuss tool life equations and how they relate to cost structures. A lot of the material is too detailed for this class, but it does give the students some background on where cost structures come from. So a small portion was used in reference to taylor's Tool Life equations.

Fixture and die design are developed by defining a process in which a part is looked at. Some real part prints are shown from local industry and the student is asked to look at the design

principles established in class. The student is asked to reference the handbook in developing a gross design.

Automation and numerical control are introduced at a very high level. There are other courses in our curriculum that go into much more detail. But a basic understanding of these processes can be taught with the use of this handbook. Finally how does geometric tolerancing effect manufacturing design is looked at. The basic symbols and terminology are based in the handbook.

With all of this material outside sources from local industry are used to supplement. Also used are vendor information obtained form local and international tooling and machining companies. But the main references are contained within this handbook.

Results

The results for this course have been very positive. Students have given positive feedback in the fact they are using a book they see as useful when they graduate. Also a couple of students have stated they learned things that were very useful in their coop experiences. Using real case studies and projects and forcing them to reference the handbook has helped them understand which references to use when. We have just implemented this book for the past year so I have not been able to gather any graduate data yet. This will be interesting for a future project. The advisory board for the department also expressed its approval of using the handbook in teaching students how to deal with real problems and case studies.

In Table 1 the student evaluations are listed. Semester 1 was taken before implementing the Machinery's Handbook. Semester 2 was taken after implementing. The value of the textbook to the students went up in score. A scale of 0-4 was used with 4 being strongly agreed with the statement.

Table 1 - Student Evaluations

Question	**Score Semester 1**	**Score Semester 2**
	90% responded	87% Responded
I learned a great deal from this course	3.3	3.3
I would recommend this course to other students	3.4	3.4
The textbook was an asset to this course	2.9	3.0

Conclusion

In conclusion using the Machinery's Handbook as a textbook for a Manufacturing Design course has been very beneficial. It is very rewarding for the students and encourages them to use references they will use in industry. It takes work from the professor to develop the materials in class to give good real examples to have the students work them in a way that they might in industry. The handbook could also be used in many other courses, for example manufacturing processes, materials engineering, and mechanics. Using something that a student sees as rewarding will help them be excited about the courses and see what benefit it will have when they graduate.

Bibliography

1) Dym, Clive L., Agogino, Alice M., Eris, Ozgur, Frey, Daniel D., Leifer, Larry J. 2005 *Engineering Design Thinking, Teaching, and Learning* Journal of Engineering Education

2) www.abet.org

3) National Science Foundation, *Systemic Engineering Education Reform: An Action Agenda*, NSF98-27, www.nsf.gov 1997

4) Machinery's Handbook 27th Edition 2004 Industrial Press Inc. New York

Machinery's Handbook book. Read 14 reviews from the world's largest community for readers. NAME ON THE EDGE IN MARKER *** Please Read This *** Slight she...Â Start by marking â€œMachinery's Handbook: A Reference Book for the Mechanical Engineer, Designer, Manufacturing Engineer, Draftsman, Toolmaker, and Machinistâ€ as Want to Read: Want to Read savingâ€¦ Want to Read. Falkowski, S. (2007, June), Use Of The Machineryâ€™s Handbook In A Manufacturing Design Course Paper presented at 2007 Annual Conference & Exposition, Honolulu, Hawaii. 10.18260/1-2--1887. Download Citation. Ã—. APA - LaTeX bibitem. \bibitem{asee_peer_1887} Falkowski, S. (2007, June), \emph{Use Of The Machineryâ€™s Handbook In A Manufacturing Design Course} Paper presented at 2007 Annual Conference \& Exposition, Honolulu, Hawaii. 10.18260/1-2--1887. Download Citation. @inproceedings{Dong2007AC2M, title={AC 2007-1005: MECHANICS, PROCESS, AND DESIGN SIMULATION OF FIBER-REINFORCED COMPOSITE MATERIALS - A NEW COURSE DEVELOPMENT}, author={Y. Dong and J. El-Sayed}, year={2007} }. Y. Dong, J. El-Sayed. Published 2007.Â Composite materials are widely used due to their advantages in high strength to weight ratios, high corrosion resistance, high fatigue life in cyclic loading, and great potential in styling design. This paper presents a new composite course development focusing on the properties, mechanics, manufacturing aspects, and design simulation of fiber-reinforced composite materials. Together with Properties of Polymers (MECH-580), Polymer Processing (IME-507), and Plastics Product Design (MECH-584â€¦ His book on "vibration analysis and design of foundations for machines and turbines" published in 1962 (translated from Hungarian) had been a very useful tool to deal with machine foundation problems.Based on the scientific investigations carried out in the last few decades it has been established that it is not enough to base the design only on vertical loads multiplied by a.Â Simple methods of calculation were used for strength design of the foundation by multiplying static loads with an estimated Dynamic Factor. This resulted in consideration of increased static loads without any knowledge of actual safety factor. Even with these so-called excessive loads, harmful effects were observed during operation. Machinery's Handbook Collector's Edition: 1914 First Edition Replica by Erik Oberg Industrial Press, Inc. #textbook In commemoration of our 125th Anniversary, we are proud to present the Collectorï¿½s Edition Replica of the original first edition of the Machineryï¿½s Handbook, published in January, 1914. It's the perfect gift for your favorite machinist or to add to your own collection. Own the book that helped industry build! For virtually its entire life in print, Machineryï¿½s Handbook has beenâ€¦ Machinery's Handbook Reference Book English Book Used Tools Book Title Book Format