

Design and Ethics Problem 1
Due: One week after Test 1

General Instructions: All submissions must be neatly typed. Exceptions to this include calculations which may be neatly done by hand on Engineering Paper. Any EXCEL spreadsheet or other software programs used to solve this problem, must be neatly labeled and included with the solution. All references must be cited and provided in a references section at the end of the problem solution. Both a technical and ethical solution must be provided. The seven steps for ethical reasoning and ABET code of ethics must be explicitly applied for the ethical solution. Absolutely no late submissions will be accepted. Solutions may be turned in early.

This problem adapted from Testing by a Co-Op Student. Website reference available through Instructor.

Problem:

Project leader, Brad Kenyon was being sorely pressed to complete the development of several engineering prototypes for a field test of a new appliance model for the Ziglar Appliance Company. One particular plastic component of the new model had given difficulty in laboratory tests as it failed repeatedly before reaching the stress level of 60 MPa necessary for successful operation. Brad had directed a redesign of the component using a tough new engineering plastic recommended by the Research Laboratory's Material Science Department. Tensile tests and fracture toughness tests needed to be run on the material, but Brad was running short of time and needed to get on with building the prototype.

Brad sought out the manager of the Material Science Department for help in running the tests on the material samples. With this assistance he could go ahead with the prototype building and conduct the tests concurrently. The prototypes, of course, would not be released to field test until the coupon tests on the new material proved the material substitution/redesign to be satisfactory.

Keri Hines, manager of the Material Science Department, was willing to assist because she knew how critical completion of the development was to Ziglar's future. However, this was also a busy time for Keri's department. Keri suggested to Brad that she could assign the test work to one of the engineering co-op students. Keri was also coordinator of the engineering co-op students and she liked to use the co-op students in demanding situations to give them practical experience.

Keri assigned the test work to Jake Miller, an engineering co-op student from a local university who was completing his second work session at Ziglar. Jake was familiar with the test equipment and had done similar test work. Jake was an excellent student and his co-op work had usually been very well done. Keri commented to Jake that he would need to work diligently to complete the tests before he had to return to school.

Jake completed the tests on schedule and turned in a report to Keri indicating the material had successfully passed the tensile tests (strength > 60 Mpa) and had superior fracture toughness over the previously used material. Upon completion of the test report, Jake returned to school. Keri gave Brad the good news. The prototypes were completed and the field test of these prototypes got underway on schedule.

A few weeks later, Brad rushed into Tom's office to tell him that most of the prototypes were out of operation because of a catastrophic failure of the component using the material tested in Keri's lab. Brad wanted to discuss the test immediately with Jake, but since Jake had already returned to the university, Brad and Keri settled for studying Jake's laboratory notebook.

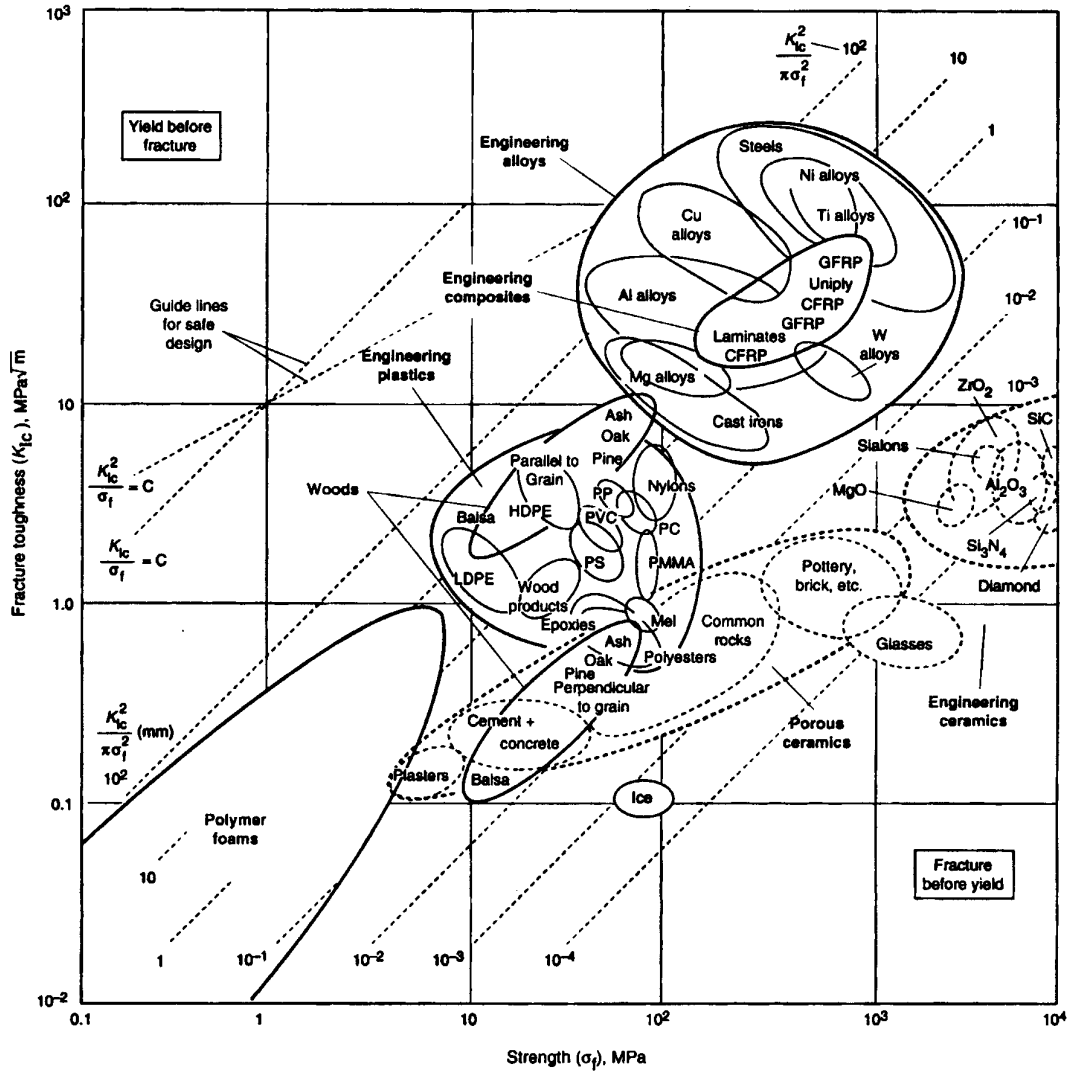
After review of the notebook, Keri said, "Brad, I hate to say this, but the data looks too good. I know the equipment and there should be more scatter in the measurements that Jake took. I think some, if not all of the measurements are in error or they have been faked! At best, Jake probably took a few points and extrapolated the rest!"

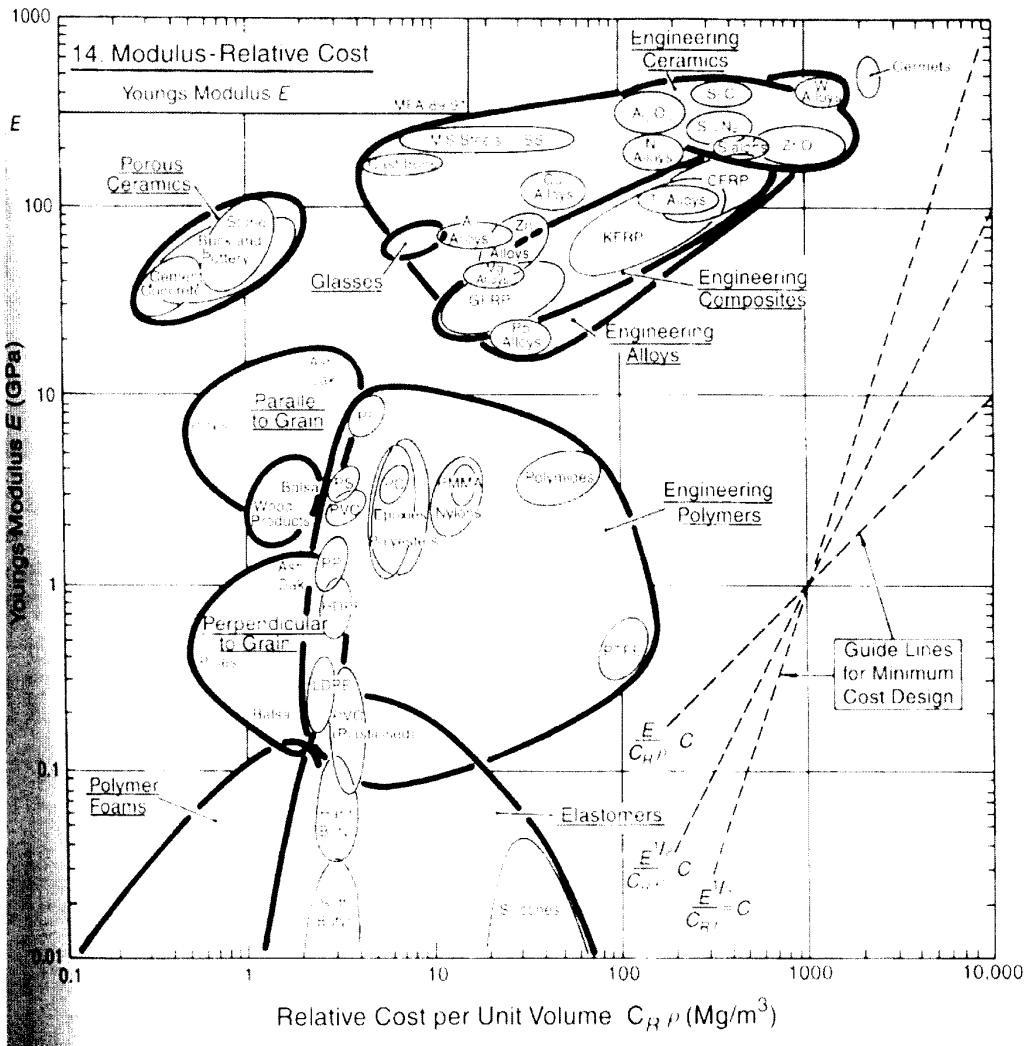
Technical Discussion:

The current type of plastic that had been used for the part was a PMMA plastic. The material tested by Jake and picked for the material substitution was a PVC material. Use the material selection charts provided to discuss which plastic should have been used for the application. The requirements are that the $\sigma_f > 60$ Mpa, the new material should have improved fracture toughness and have the lowest possible cost and must be a polymer. Was the PVC material a good choice for the application? Why or why not. Describe the general characteristics of PMMA, PVC and your suggested material. Using some of the knowledge gained in lab class, describe some of the potential pitfalls in using coupon type test data (such as tensile test data for small samples). What would you suggest to avoid these "pitfalls."

Ethical Discussion:

What ethical issues, if any, does this scenario raise? Pretend you are Keri and use the seven steps and ABET code of ethics to solve this dilemma. Generate a list of at least five possible options (ethical not technical) to solve this ethical dilemma and test each option using the code of ethics. Make sure you explicitly address each of the seven steps. Make sure that you clearly identify the people involved in this dilemma.





Design and Ethics Problem 2

Due: One week after Test 2

General Instructions: All submissions must be neatly typed. Exceptions to this include calculations which may be neatly done by hand on Engineering Paper. Any EXCEL spreadsheet or other software programs used to solve this problem, must be neatly labeled and included with the solution. All references must be cited and provided in a references section at the end of the problem solution. Both a technical and ethical solution must be provided. The seven steps for ethical reasoning and ABET code of ethics must be explicitly applied for the ethical solution. Absolutely no late submissions will be accepted. Solutions may be turned in early.

This problem is a modified version of Case 1022 in the Applied Ethics Case of the Month Club. Website reference available through course instructor.

Problem:

You are a design engineer for the Materials Consulting Firm. You have been with the firm for several years. Generally the firm assists metal suppliers with the development of specialty alloys for various projects after the contract has been awarded to the metal supplier or during the contract bidding period to aid the metal supplier in developing the specialty alloys concepts. Additionally your firm helps determine the associated costs for bid purposes to the metal supplier.

A few years ago, you were retained by Allswell Metal Supplier to assist them in developing a low density metal alloy for a unique engineering problem. The material you “devised” worked very well for the application and Allswell made an excellent profit on the project. Your firm was paid a fee of \$25,000 based on your time and administrative costs in accordance with your agreement with Allswell.

Currently, a very similar project is out for bids in the local area. Zeiferts Specialty Metals Inc., a company whom you have not worked before, is aware of the work you did for Allswell and would like to have you help them with a solution to a materials problem virtually identical to the one you worked on previously for Allswell. In fact, Zeifers says the situation is so similar that you could simply modify the recommendation paper to fit the new project.

You hear through the grapevine that Allswell is also planning to bid on the project but they have not contacted you for your assistance so far.

Technical Problem:

The technical information given to you is as follows: the density of pure aluminum calculated from crystallographic data is expected to be 2.6995 g/cm^3 . You were asked to design an aluminum alloy that has a density of 2.6450 g/cm^3 and one that has a density of 2.7450 g/cm^3 . Please indicate how the properties might be affected by the addition of the alloying element (compared to the pure metal).

Ethical Problem:

Please identify any ethical problems with this scenario and use the seven steps and ABET code of ethics to determine how your company should handle this situation.

Design and Ethics Problem 3

Due: One week after Test 3

General Instructions: All submissions must be neatly typed. Exceptions to this include calculations which may be neatly done by hand on Engineering Paper. Any EXCEL spreadsheet or other software programs used to solve this problem, must be neatly labeled and included with the solution. All references must be cited and provided in a references section at the end of the problem solution. Both a technical and ethical solution must be provided. The seven steps for ethical reasoning and ABET code of ethics must be explicitly applied for the ethical solution. Absolutely no late submissions will be accepted. Solutions may be turned in early.

This problem has been adapted from Case No 83-3 of the NIEE. Website reference is available through the instructor.

Problem:

You work for an engineering company, Building Materials, Inc. Your company had not initially wanted to submit a proposal to an architecture firm looking to solve some rivet problems. However, you play golf with several of the member of the architecture firm and they really wanted your company to submit a proposal. Your golf buddies casually mentioned to you that they would really like to work with you on this project and that their firm had an established and trusted working relationship with Building Materials, Inc. Amanda Huggins of Materials Solutions, Inc. submitted a proposal for this work to the architecture firm. The proposal included technical information and data that the firm requested as a basis for the selection. Jenkins (a person that you do NOT golf with), a staff member of the architecture firm, made Amanda's proposal available to you. Using Amanda's proposal as a guide to develop your own proposal that you could submit to the architecture firm would greatly increase your chances of winning the contract. Award of this contract would greatly help our your company as well as help out your chances of getting a promotion. Your golf buddies made it very clear that they did not want to work with Amanda nor did they want to work with Materials Solutions, Inc.

Technical Problem:

The architecture presented the following technical problem. They need to attach aluminum sheet to the frame on the 24th floor of a skyscraper. They plan to use rivets made of an age hardenable aluminum, but the rivets must be soft and ductile in order to close. After the sheets are attached, the rivets must be very strong. The architecture firm wants your company to design a method for producing, using and strengthening the rivets, then execute this procedure during the construction of the building. Please suggest a method to satisfy the design requirements.

Ethical Problem:

Please identify any ethical problems with this scenario and use the seven steps and ABET code of ethics to determine how you should handle this situation.

Design and Ethics Problem 4

Due: One week after Test 4

General Instructions: All submissions must be neatly typed. Exceptions to this include calculations which may be neatly done by hand on Engineering Paper. Any EXCEL spreadsheet or other software programs used to solve this problem, must be neatly labeled and included with the solution. All references must be cited and provided in a references section at the end of the problem solution. Both a technical and ethical solution must be provided. The seven steps for ethical reasoning and ABET code of ethics must be explicitly applied for the ethical solution. Absolutely no late submissions will be accepted. Solutions may be turned in early.

This problem has been adapted from a case study provided in *Ethics in the Field*. Reference is available through the instructor.

Problem:

A new engineer, Jason Young, is assigned by his company, Ladders R Us, to design the rung on a ladder. Jason's superior, Francis, looks over Jason's calculations and, without checking them closely passes the drawings on to the drafting department. The plans are drawn and sealed by Francis and the shop is set-up to manufacture the rungs via a cold working process. Several months later, after the ladders had been on the market for several weeks, another member of the company, You, discovers a serious error in the ladder design that would not meet the design requirements of being able to hold a 300 lb person. Francis notes that the rungs seem to be holding and instructs you to have the drafting department and design department to just change the design requirements initially given to Francis (then given to Jason) to accommodate Jason's design.

Technical Problem:

The material to be used for the manufacture of the ladder rungs was an aluminum alloy, 5182-H19. The ladder rungs were to be 12 in long and must accommodate a 300 lb person. Jason's design indicated the rungs to be 0.25 " thick and 1" wide. What is wrong with Jason's design? Suggest another design for the rungs using the same material and length of the rungs. Assuming there to be only 12 rungs. How much would the rungs only on the ladder weigh. Assume the density of the alloy to be the same as pure aluminum (which is NOT true).

Ethical Problem:

Please identify any ethical problems with this scenario and use the seven steps and ABET code of ethics to determine how you should handle this situation.