ENGINEERING ETHICS

Chapter 2

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Engineering Ethics

- Engineering is a profession

Team Exercise #1

- In 1 minute, list as many professions as you can.

Team Exercise #2

- In 3 minutes, list as many traits of a profession as you can.

PART 2

Interaction Rules of Behavior

- *Etiquette* - rules of acceptable personal behavior and courtesy when interacting with others in a social setting.
- *Laws* - a system of rules and punishments clearly defined and established by a society to maintain a safe and orderly social environment.

Interaction Rules of Behavior

- *Morals* - personal rules of right and wrong behavior derived from a person's upbringing, religious beliefs, and societal influences.
- *Ethics* - a code or system of rules defining moral behavior for a particular society.

Professional Ethics

- Ethics is the study of the morality of human actions.
- Professional ethics guide the conduct of a professional.
- Most technical societies have written codes of ethics.

Code of Ethics

- As professionals, engineers have a code of ethics

Team Exercise #3

In two minutes, explain why is it important for engineers to have a code of ethics?

Fundamental Principles

Published by the Accreditation Board for Engineering and Technology (ABET)

Preamble and Four Parts

Fundamental Principles

- Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:
  - I. using their knowledge and skill for the enhancement of human welfare;
  - II. being honest and impartial, and serving with fidelity the public, their employers and clients;
  - III. striving to increase the competence and prestige of the engineering profession; and
  - IV. supporting the professional and technical societies of their disciplines.

Fundamental Canons

1. Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
2. Engineers shall perform services only in the areas of their competence.
3. Engineers shall issue public statements only in an objective and truthful manner.
4. Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.

Fundamental Canons

5. Engineers shall build professional reputation on the merit of their services and shall not compete unfairly with others.
6. Engineers shall act in such a manner as to uphold and enhance the honor, integrity and dignity of the profession.
7. Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional development of those engineers under their supervision.

Case Study Example

Actions Affecting Human Life:

- A leather manufacturer disposes of dangerous leather-cleaning chemicals in the river causing the city's water to be contaminated with carcinogens. Eight children died by leukemia.
- SOUNDS FAMILIAR?

  "A Civil Action" starring John Travolta.

  A perfect case of professional ethics.

Case Study Example

What should the owner of the plant do?

1. Say nothing about the problem. If challenged, claim that it is impossible to prove that the plant discharge caused the leukemia.
2. Work out a cleaning system that would rectify the problem.
3. Admit that he made the error, clean the discharge, clean all contaminated areas, have the Environmental Protection Agency (EPA) inspect the cleaned areas, and pay a settlement to the families of lost children.
4. Other?

Case Study Example

Do Ethical Canons Apply?

Ethical Canons

- Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.

Team Exercise #4

- Discuss case studies based on material published by the American Institute of Chemical Engineers

Resource Allocation

- Engineers are often responsible for allocating limited funds to projects.
- These projects may affect the general health and safety of the public.
- These projects may have detrimental effects on some segments of the population.

Team Exercise #5

Identify three situations in which an engineer must make resource allocation decisions that may affect the public.

Three minutes

Professionalism and Ethics

Engineering Profession

- Engineering is...

"the **profession** in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind".

Accreditation Board for Engineering and Technology (ABET)

Professional

- specialized knowledge gained by

  study

  experience

  practice

- comprehensive education
- motivated by a strong desire to serve humanity

Engineering As a Profession

- Satisfies indispensable and beneficial need
- Discretion and judgment, not subject to standardization
- Knowledge and skill not commonly possessed by the general public
- Group consciousness promotes knowledge, professional ideas, social services
- Legal status
- Well-formulated standards of admission
- Code of Ethics

Exercise: PAIRS

Why should engineers follow a code of ethics?

Two minutes

Engineers as Professionals

- Unlike other professionals (e.g., attorneys, physicians), engineers seldom deal directly with those who benefit from their services.
- Unlike other professionals, engineers can practice with only a BS. (Note: MS is increasingly important.)

Interaction Rules

- ***Etiquette*** - rules of acceptable personal behavior when interacting with others in a social setting.
- ***Laws*** - a system of rules and punishments established by a society to maintain a safe and orderly social environment.

Interaction Rules

- ***Morals*** - personal rules of right and wrong behavior derived from a person's upbringing, religious beliefs, and societal influences.
- ***Ethics*** - a code defining moral behavior.

Professional Ethics

- Ethics is the study of the morality of human actions.
- Professional ethics guides the conduct of a professional.
- Most technical societies have written codes of ethics.

Professional Ethics for Engineers

- Accreditation Board for Engineering and Technology (ABET) defines:

Fundamental Principles - defines ethical behavior

Fundamental Canons - expands Fundamental Principles with a set if rules

Fundamental Principles

Accreditation Board for Engineering and Technology (ABET)

Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

I. using their knowledge and skill for the enhancement of human welfare;

II. being honest and impartial, and serving with fidelity the public, their employers and clients;

III. striving to increase the competence and prestige of the engineering profession; and

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Settling Conflicts

Must determine the source of conflict:

Moral Issue

Conceptual Issue

Applications Issue

Factual Issue

Increasingly Abstract

Moral Issue

- An issue that can be resolved only by making a moral decision.

Should drivers be allowed to speed?

Conceptual Issue

- An issue that can be resolved by a clear definition.

Speeding is...

Without adverse driving conditions:

speed > 70 mph

With adverse driving conditions:

speeds that will cause an accident

Application Issue

- Questions resulting when a definition is applied to an actual case.

The road is slick from a light rain. Is John speeding when he skids off the road when traveling 55 mph on a highway posted for 70 mph?

Factual Issue

- A morally relevant issue that can be resolved by gathering more facts.

I got stopped for speeding. Which was out of calibration, the police radar gun or my speedometer?

Moral Theories

Tools for resolving moral issues:

- Ethical Egoism
- Utilitarianism
- Rights Analysis

Ethical Egoism

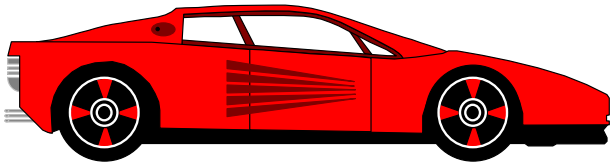
- Act in your enlightened self interest

It's okay to kill an attacker in self-defense.

It's okay to compete aggressively in the business world, provided you do not break the law or ethical codes.

Utilitarianism

- Do the most good for the most people



Brakes fail.
Which way to turn?

Rights Analysis

- Golden Rule

  Do unto others as you would have them do unto you.

- Rights Hierarchy

  1. Life, physical integrity, mental health
  2. Maintain purposeful fulfillment
  3. Increase purposeful fulfillment

Resource Allocation

- Engineers often must allocate limited funds to projects that may...
  - affect the general health and safety of the entire public.
  - detrimentally affect segments of the population.

Exercise: TEAM

As a team, take 3 minutes to...

- Identify three situations in which an engineer must make resource allocation decisions that may affect the public.

Case Studies

- In your group, discuss the three cases described in Section 2.6 of *Foundations of Engineering*

PROPORTIONS

Learning Objectives

- Define proportionality and apply it to problems

Relational Notation

Mathematics often describes relationships between two quantities using ***relational operators***.

Relational Notation

- Examples:

  $A < B$ ("A less than B")

  $X \geq Y$ ("X greater than or equal to Y")

  $V \propto r^3$ ("V proportional to radius cubed")

- See Table 2.2 of *Mathematics Supplement* for other relational operators.

Direct Proportionality

- The operator $\propto$ indicates ***proportionality*** between quantities.

Example:

$C \propto r$ (circumference directly proportional to circle radius)

$C = 2 \pi r$ (2π is the proportionality constant)

Direct Proportionality

Example:

$A \propto r^2$ (circle directly proportional to radius squared)

$A = \pi r^2$ (π is the proportionality constant)

Inverse Proportionality

Example:

$$y \propto \frac{1}{x^2}$$ (y is ***inversely proportional*** to x squared.)

$$y = \frac{k}{x^2}$$ (k is the **proportionality constant**)

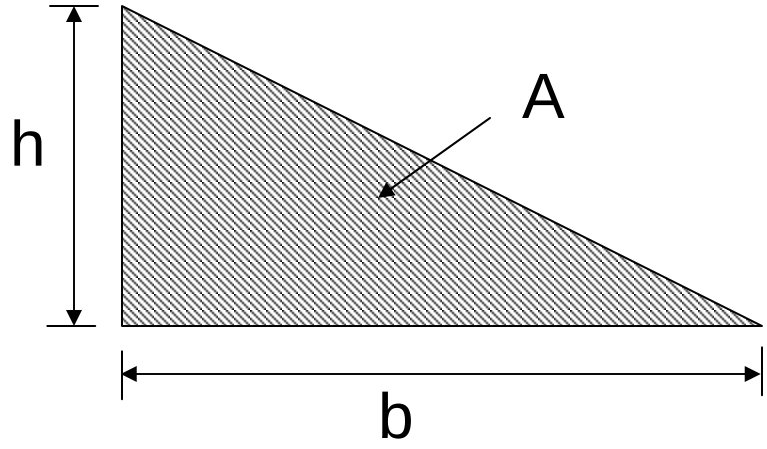
Other Relational Notations

Example:

$$A = f(b,h)$$

or

$$A = A(b,h)$$



"The area **A**, is a function of the base, **b**, and the height, **h**."

Mathematically, $$A = \frac{1}{2}bh$$