Ethics and Floodwater Engineering – 1

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Couse Description

This course is the first hour of a 4-hour course on engineering ethics and floodwater engineering.

This course satisfies 1-hour of engineering ethics continuing education requirement for Professional Engineer license renewal.

The course in engineering ethics and floodwater engineering is intended to encourage the engineer to consider the big-picture result of decisions using real-world examples from a licensed Professional Engineer with extensive experience in Floodwater Engineering.

The engineer's duty is to make things work. Following instructions, complying with the law, and using current best practices are usually good enough for the present. But the engineer's task to make things work in the future. This requires making projections about future conditions and use. While engineers prefer hard facts, we are sometimes forced to work with "soft data" that require evaluating many possible options. During this evaluation, we use legal requirements and best technology as tools. Ethics can be used as a third tool to make decisions. "Ethics and Flood Water Engineering" contains many examples of using ethics in real-world situations to make engineering decisions.

Objectives

At the conclusion of this course, the student will have read and evaluated:

- Considerations for the long-term implications of design decisions beyond code requirements
- Considerations and implications when forced to work with "soft data" that require evaluating many possible options
- Use of legal requirements and best technology as tools
- Consideration of the use of ethics as a third decision making tool
- Review many examples of using engineering ethics in real-world situations to make engineering decisions

How to Read this Course

The student is required to thoroughly read and comprehend the course material and examples

In order to complete the course, the student must pass the quiz in the final chapter of the course. It is recommended that the student keep these questions in mind as the course is read.

Topics Covered

Introduction, Engineering Ethics, Floodwater Engineering, Real-World Examples of Engineering Ethics in Floodwater Engineering Applications.

Grading

Students must achieve a minimum score of 70% on the online quiz to pass this course.

The quiz may be taken three times.

The student will be asked at the end of the quiz to attest that he or she has personally and successfully completed all chapters of instruction.

The quiz may be viewed in the final chapter of this course.

Couse Inquiry

This course is designed to be interactive. The student is encouraged to contact us to discuss any questions that arise while taking this course. All inquiries will be answered within two days or less. The reader can contact PDH*Now* as follows:

By Email: info@pdhnow.com

By Phone: 1-833-PDHNOW9

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Ethics and Floodwater Engineering - First Hour

Introduction

This 4-hour course (4PDH) discusses engineering ethics as applied to many situations involving floodwater.

My name is Don Soards. I am a register professional civil engineer. I had a 31-year career as a civil engineer with the US Army Corps of Engineers and have been active in many phases of engineering dealing with floodwater.

All the examples used in this course are from my own career.

In order to avoid any vulnerability to governing bodies, projects, or individuals I have omitted names of places and people.

Floodwater engineering is a less precise field of technology than most other forms of applied science. However, all forms of engineering involve some degree of error tolerance when estimating variations in materials, variations in manufacturing or construction technique, formulas not exactly matching conditions found in nature, variations from estimated design inputs, end-user behavior deviations from expected use, and most importantly unique site requirements beyond those considered by design code.

It is the engineer's job to make the system work in spite of "error tolerances". Ethics can greatly aid the engineer with this task.

The gap between the black and white world of "by the book" and system reality is a gray area. One aid to successfully traverse this gray area is to ask the question, "What is the *right* thing to do?"

Ethics enables us to balance error tolerance, code inadequacy, and system sensitivity. Ethical solutions are more functional products and in the long-run save our society money and time. In many cases applying ethics allows the engineer to quickly grasp the right qualitative solution – one that gets the job done and is supported by the people involved.

Definition

Ethics are moral principles that govern the behavior of an individual or group. "Principles" means "rules" and "moral" means behavior that is consider right or at least acceptable in society.

Engineering ethics sets the obligations by engineers to themselves, their clients, society and to the engineering profession.

Society means all people who will use or be affected by your work.

"Situation ethics" is a judgment based more on the context of a situation rather than absolute moral principles.

The concept of ethics and situation ethics is somewhat analogous to statutory law and case law. As a practical matter it is impossible for legislators to consider all possible situations when making a law, so society depends on case law to furnish context specific judgments.

Essentially, ethics is a battle of ideas about "good".

Unfortunately, moral principles can conflict with one another. For example, when we talk about good, we have a contextual reference about "who" it is good for.

Is it good for the engineer personally?

Is it good for the engineer's client?

Is it good for society?

Is it good for the engineering profession?

Frames of reference answer the questions who, what, where, when, why and how. "Who" may be divided into categories of "what" (handicapped) or "where" (residents of a particular city or state) and "when" (present or future residents). "Why" may refer to funding considerations and "how" may be a selection of the best technology or cheapest alternative.

Given 4 entities and 6 frames of reference creates a matrix of 4x6 = 24 possible perspectives. No wonder answering the question about "What is ethical?" is so confusing!

My first ethical work consideration on an engineering project (chip seal road repair) occurred when I was in college.

I was given a 35-lb bucket of oil and told to put it into the road cracks. I was followed up by a "sander" who dumped sand on my oil. I was immediately confronted with the ethical dilemma caused by traffic. It was easy to pour oil in cracks off the edge of the road, but more difficult where there was danger of being hit by a car. At this point there was a question of "who is this good for?" The sander was scared too and suggested that once the chip seal went down no one would know the difference.

I developed my own ethical policy for danger areas of just repairing the neediest spots very quickly with more of an eye for traffic than workmanship. I used this road a year later and didn't notice any defects. Problem solved.

I was fortunate that a solution that was "good enough" for all four players existed. In this case I stayed alive and on the payroll; the company got their product to work without the mess of filing insurance claims for a worker hit by a car; society got a good road; and our profession can once again be respected for service rendered.

Applied Engineering Ethics

Applied engineering ethics consists of finding a solution that will satisfy all.

Unfortunately, as game theory teaches us: We can only maximize one variable at a time.

For example, consider the case of dollars in your pocket, gas in your car's gas tank, and food in your tummy. These are three variables. If you try to maximize any one, it will be at the expense of the other two. Say you stay home and save your money, then your car will not have gas and your stomach will be empty. If you get gas you will lose money. If you buy food, but no gas your car may stop before you get home.

The solution to this problem is to write a combined function containing all three terms like:

My happiness = f(dollars) + g(gas) + h(food)

Now you have one variable "My happiness" to optimize. However any solution must satisfy the requirements for each term separately. Your solution must allow enough gas to get back home, enough food to stay alive, and enough money so you know where your next meal is coming from.

This leads to solutions that are "good enough" for all players rather than optimal for any one player at the unethical expense of others.

Ethical concept: Select solutions that are "good enough" for all parties, rather than optimal for any one party.

Corollary: "Better" is sometimes the enemy of "Good".

The quality we put into our work is at a cost to ourselves. It takes more time and other resources to do a better job. If we are lucky we can find a balance among all four of the players (you, client, society and profession).

However, sometimes we are not in control of the work.

One day our crew was assigned to install a corrugated metal pipe. The culvert was to lie directly on the bottom of a small wash. The pipe was rolled off a flatbed truck and into the wash. Then we started shoveling dirt at the bottom of the pipe. One husky lad had a hand compactor and jammed the dirt under the pipe. This process continued until our foreman left. Quickly, the guy with the hand compactor put it down, grabbed a shovel and started shoveling furiously. He said no one would ever know. Some of the others followed his lead. We were now placing uncompacted fill under a floodwater conveyance structure and putting it at risk to failure by piping through the uncompacted fill.

Personally I was surprised. We weren't getting paid anymore and would just go back on the road crew as soon as the culvert was finished. Then I realized that holding the hand compactor at an angle was very hard work and maybe even hard on the worker's body. So the worker made a decision that was good for him. However, this wasn't good for his client (the firm we were working for) or for society (including our firm's customer) if the pipe and gravel road washed out. The worker was clever, but unethical. He tamped the last few lifts to make it look good. What he should have done is ask someone else to take a turn with compactor. I was curious and would have liked the opportunity myself.

Ethical concept: Unethical behavior eventually tarnishes the purveyor's reputation.

Our society acknowledges this with famous quotes like the one from Abraham Lincoln: You *can fool all* the people some of the time, and some of the people all the time, but you cannot *fool all* the people all the time.

In this example what the unethical worker didn't know was that my dad's group was the customer our firm was installing the culvert for.

I had a construction option on my civil engineering degree and my first job after college was working as a construction superintendent for a residential home builder. I was in charge of 100 homes being constructed by 26 subcontractors. The housing firm was strictly management with a focus on sales. All work was accomplished using "subs" and I was the interface between them and the firm. This was on the east coast during the early 1970's and there was a huge mistrust of management by labor. Getting everyone to work together was the longest six weeks of my life. 19 of the 26 subs "fell in line" quickly. The others required special handling.

My dad was a carpenter before he became a civil engineer. I learned about house construction by helping him build a retirement home for him and my mom. This knowledge helped me to get along with the subs.

My first big break came when the state sent a crusty old inspector to our site. He pointed out construction flaws that I hadn't noticed. I then pointed these out to the subs. *I was surprised that I didn't a single negative reaction!*

Each sub had a personal ethical dilemma. If they did a crappy job, they did it slightly quicker and easier. A crappy job was optimizing their money at the expense of society (the people my firm sold the houses to) and didn't make any profession look good.

Ethical concept: However, what I observed was that no craftsman likes to do substandard work. Deep inside of most of us is an ethical person.

My inspection of their work gave them an excuse to "do the right thing" (which is really what almost all of us want to do anyway).

Almost all workers want their work to be "*good enough*" for society.

Gaining money by unethical means is frowned on by society and is illustrated by sayings like "easier for a camel to get through the eye of a needle than for a rich man to get into heaven".

Ethical concept: Almost all of us want to do right by society.

Unethical Workers:

I worked personally with the foremen of 6 of the last 7 subs I was having difficulty with. This was during a wage-price freeze and some of the subs were losing talented workers to other firms who had slightly higher wages before the freeze. I was in an awkward position because I was competing with our firm's other housing development for scarce workers. Eventually, these 6 subs started giving our development proper support. I now had 25 of 26 subs supporting our development.

The last group I couldn't get proper support from was the painters. I even had to settle a house and have people move in when we hadn't painted their steps. The new homeowners were gracious, but I knew this wasn't right. When I talked to the painters I didn't sense any camaraderie. I never could arrange a meeting with the paint foreman.

The lesson I was about to learn was:

When faced with normal work requests evasive people are generally less ethical – much less ethical.

I am not talking about avoiding some stalker or crazy person. We all must do that for our own safety. We tell kids not to open the door to strangers. Nor am I criticizing reticence when someone asks us for trade secretes or classified information. I am specifically talking about devious behavior being substituted for honest information.

I got a break dealing with the painters. One problem our salvage sub was having was that someone was stealing "overages" of cinder block. Cinder block is delivered on pallets of a fixed number. The masons always order a few extra blocks in case of breakage. Then those few extra blocks are left along with other trash to be picked-up by the salvage sub. Those few good blocks are part of the salvage subs compensation for picking-up the construction debris. A few extra blocks per lot can add up to a significant amount after 100 lots.

I couldn't find out who was doing it. (No one wanted to be the rat.) So, I stayed after work. I didn't have to wait long. A white van was already there. I watched from the shadows of a partially constructed house. I recognized some of the painters loading good cinder blocks into their van. I stepped out of the shadows and they saw me. I didn't say anything. They closed the rear doors and tried to drive away but got stuck. I just stood there while they got unstuck and eventually tossed the cinder blocks out the door.

The next morning, I got to work at 7:30 a.m. and went to the house where I couldn't get the painters to finish the steps. I met the smiling husband coming out of the house. The painters had showed up at 6:30 a.m. that morning and painted their steps!

After that I never had to ask the painters for anything. They just did their jobs in a timely manner. Also, the theft of cinder block stopped. Problem solved.

Personally, I don't like doing business that way. I try hard to avoid doing business with unethical people. Unfortunately, when I have been forced to deal with marginally ethical people I have had the most success when I was a threat to their economic well-being. Unless, you are a threat to their well-being, they think there are no consequences to abusing you for their own personal fun and profit.

Bait and Switch:

I much prefer to deal with honest people, even if they seem harsh or abrasive. Even if I don't like what they have to say, I at least know where I stand.

As far as identification of evasive types goes, I can offer the following observations. Every Meyers-Briggs personality type has the ability to be ethical or unethical. However, two groups stand out. The entrepreneurial ENTP (extraverted, intuitive, thinking and perceiving) is highly manipulative and is prone to unethical behavior like "Bait and Switch". These fast talking "wheeler-dealers" (think oil man JR Ewing on the famous TV show "Dallas") can display little respect for conventional rules in pursuit of their goals.

For example, during the first year I was a college math tutor, I had four young female student's try to get me to do their homework. All four were ENTP's who were more than capable of doing the math assignments (NT's are the best at math). They just wanted to see if they could "bat their eyelashes" at some old man and charm him into doing their work for them. The only golfer I have ever seen drop a club when another golfer was putting was an ENTP. Most ENTP's are ethical, but there is a greater tendency for their imaginative (N) and unstructured perceiver (P) to conjure up "one-upmanship" ideas that benefit them at the expense of customers and society. Beware when an ENTP is evading your normal business request; you may be the next victim of unethical behavior.

The second group is immature feelers. All thinkers feel and all feelers think. However, thinkers tend to make decisions based on what they think will achieve their goal. Feelers tend to make decisions based on their feelings about someone or something. The problem dealing with immature feelers happens when the item in question is unpleasant or threatening to them. They can be so uncomfortable with confrontation that they simply avoid you and the item. In these cases someone else has to do their job for them. This type can string you along, take no productive action and then finally have some "protector" tell you off.

Are all feelers this way? Fortunately, not. Many plunges ahead almost fearlessly. The key is to notice whether they are evading your request.

Ethics versus Competence

People sometimes confuse results and effort. Some blame a person's character for failure, when in fact the person is under resourced to do the job. By under resourced I mean lacking in guidance, understanding, time, funding, political support, etc.

When a professional baseball player strikes out, a pro golfer fails to break par, or a technical person fails to do something different that has never been done before, does it mean they are unethical? Of course not. Some challenges are too difficult to be successful every time. It took Thomas Edison over 10,000 tries before creating the first incandescent light bulb.

Even in the Wikipedia engineering ethics section some pre-1900 bridge builder is taken to task when failing to properly consider wind loading *before* there were design codes.

Some of our design codes are based on analysis of previous failures.

Some projects that met current design code during construction are still dangerous, as in the case of earthquakes causing upper level bridge decks to collapse and fall on traffic below. Our codes and engineering design ideas are based in part on the study of past failures as well as introductions of new construction materials and new design ideas.

Simply put, an engineer's job is to hit a moving target with an ever-changing gun, and then be shamed for missing.

This attitude was conveyed to me when I took a job with a state highway department. I had only been on the job for a week when my supervisor informed me, *"That if I designed a bridge that collapses, I'd better be underneath it when it went down."*

Knowing society's attitude about engineering structures that don't function in every imaginable condition is to blame all engineers still living (or even their descendants or their firm many generations later) should be enough to make every engineer error slightly on the side of caution.

Ethical concept: When faced with a design choice consider the more conservative option to protect you, society and our profession.

Ethical concept: Beware of any client who is dangerously underfunded. If a structure fails all blame will point at the engineer.

Stronger than Code:

My next career stop was as a civil engineer with the US Army Corps of Engineers where I would remain for the next 31 years until I retired.

I was placed in a two-year rotational training program. One of my earlier stops was the structures section. There I was placed under the tutelage of a very kindly gentleman who had designed the tallest tower and one of our longest bridges in our district. My job was to design a concrete gate-well structure over 20-feet deep. The function of the gate-well was to drain a large stilling basin. I went through the manuals and computations (mostly by hand back then) and when I finished I determined that the structure needed #4 bars placed every 10.75 inches. My tutor told me to just use 10 inches. Still believing in the infallibility of book learning I was a

little surprised, so I ask why the change. The answer was, **"to make it stronger and easier to construct"**.

This is an ethical judgment that engineers get to make. This change does add the cost of two additional reinforcing steel bars, but a 10-inch dimension is easier (simpler) to construct accurately and does make the structure a little stronger. Forty years later his tower and bridge are still standing, and my gate well is still functioning.

Ethical concept: Make it stronger than code and easier to construct. You will be protecting everyone.

Future Variations:

One of my other stops was in the flood plain section. There they did something they don't teach in textbooks. They analyzed flow that wasn't in a confined channel. One of my first assignments was to code a small backwater model. The reach contained a small bridge with two 4'x8' concrete box culverts. I input coded according to the manual and gave the coding sheet to my new mentor. He looked at it for a minute and then slowly said, "Where did you take your clean water hydraulics at?"

This hit me like a thunderbolt! All my academic training used clean water. But floods are anything, but clean water. There are full of sediment, debris, trash, logs, and even an occasion car, shopping cart or mattress. He said we needed to add a little something in for "trash allowance". In this case we could expand the middle pier by a foot in width. I asked how do we know how much to add and he replied, "Just look upstream and see what's headed at you."

Just because the software manual doesn't specify something that you see in reality (like dirty floodwater) doesn't mean you shouldn't alter input parameters to take observed reality into account. Making flow conveyances slightly larger to handle unknown factors is good design. Using trash reduced areas for bridge flows when doing flood insurance studies results an a very slightly higher 100-year flood plain. This is good analysis.

Ethical concept: Allow for future variations by designing for more than average conditions.

Fox Guarding the Hen House:

I rotated out to a extremely large earth embankment dam and reservoir project. I worked with the government inspectors taking soil samples. We were performing what was called "acceptance testing". I developed an eye for properly compacted soil. I also heard what the government field staff thought of a new construction management technique called

"contractor quality control". In previous projects the government did the testing and ordered the contractor to add water or remove bad fill. However, this made the government liable to many claims. Contractor quality control did eliminate the claims, but it also eliminated honest soil testing. The lab performing the tests was being paid by the contractor! Naturally they didn't want to bite the hand that was feeding them.

One morning the inspectors were all talking about the new guy on the night shift in the contractor quality control lab. He had performed a moisture test that failed slightly. It was only about one-percent below contract requirements. He had written the result on the lab report sheet that was posted in the contractor quality control lab. However, it didn't stay there long. I was shown the revised sheet that had a big erase mark on it. The test results were revised upward to just meet government specifications. I was then informed that the "independent" lab's tests had always past.

Out on the embankment one inspector explained how the contractor's lab got every test to past. They simply tested the harder spots on the embankment. Sometimes they would even take a sample in an equipment tract in order to ensure maximum compaction. As you look at an embankment under construction for test purposes, you are supposed to take a "typical sample" that represents an average condition.

Why was the contractor quality control lab unethical? The independent lab wasn't getting paid directly by the government. They were getting paid by the people they were supposed to be monitoring.

Ethical concept: Construction inspection firms must be paid directly by the customer and not by the contractor who is being monitored.

Being Ethical Empowers Your Subordinates:

My first job off the training program was as office engineer for the Corps on an extremely large earth fill dam. There were over 400-line items on the monthly bill. Additionally, we had contracts for utilities, operator's quarters, and a road. I stayed busy. I also learned a lot from the very experienced crew.

My position was ranked under the resident and project engineers. So, I didn't get to be the boss very often, but I knew what to expect from the contractor. My first counterpart with the embankment contractor was an ethical engineer. It was good dealing with him on the inevitable modifications that happen on large construction projects. Unfortunately, he transferred to another project and was replaced by a marginally ethical go-getter. One day both top men weren't there, and it was my turn to run the show. My experience with so many

residential subcontractors taught me how to play “stump the rookie”. I didn’t have to wait long. The call came just after 9 am.

The project radio had a call from one of the inspectors on the embankment. The contractor had put “fatty clay” on the embankment. The problem with fatty clay is that it swells when it gets wet and then shrinks when it dries leaving a hole in the embankment. This could contribute to a piping failure of the embankment followed by a dam break.

The inspector wanted it removed and the contractor didn’t want to. The contractor wanted my decision. When I arrived the embankment, contractor had a contingent of office and field personnel and even had high ranking corporate visitors dressed in suits to watch him “stump the rookie”.

I looked at the fatty clay. It was easy to spot because of its dark brown color as opposed to the pink clay and light brown random fill. Fatty clay is very greasy. It is slick to the touch. I observed the heavy equipment spinning wheels on the greasy surface. The inspector was right to have it removed.

I looked at the inspector. He was “sweating bullets”. Cautiously he explained that he thought that the biggest area of the clay

should be removed. I then turned to the go-getter. He had a sneer on his face and the many of the others had a smug smile. He said, “We don’t have to do that. Do we?”

I held my hands up to frame the reach that our inspector wanted removed and said to the go-getter: “I agree with you about not taking out this amount.” I paused. Everyone on the contractor’s side was smiling. Then I doubled the space between my hands to include every crumb of fatty clay on the embankment and said, “I want all of it out NOW!” The smiles vanished. No one said anything, but the inspector gave the contractor that “you heard the boss” look. I left. That was the first and last time any contractor on that project invited me to question an inspector’s call.

Ethical Concept: Being ethical empowers your subordinates.

Questions to Consider – First Hour

What are some error tolerances you have experienced in your field during your career that made you feel uncomfortable?

Have you ever experienced the gap between the black and white world of "by the book" and system reality?

Did you ever have to decide "What is the right thing to do"?

When looking for a good answer did you balance system sensitivity with error tolerance or code inadequacy?

Save Time and Money:

Ethics can be used to save time and money.

Have there been times when you used ethics to speed up planning by eliminating unethical alternatives?

Have you ever used ethics to cut short excessive design iterations or useless refinements?

Have you ever enabled builders to act ethically with proper inspection and work monitoring?

Over-optimization:

Over-optimization can be a problem.

Can you think of anytime in your career that you found a solution that was good enough for all, but not optimum for anyone?

Have you ever wished you had left something alone? Was it a case of "Better" is sometimes the enemy of "Good"?

Professional Reputation:

Our professional reputation is important when marketing our services.

In your work decisions which do you put first: you, client, society, or profession?

Have you ever been in the awkward position of having to go along with something you didn't believe was right?

Have you ever been thought unethical because you didn't produce the results someone wanted?

Have you ever been under-resourced to do a job?

Have you ever planned, designed or constructed anything better than Code?

Unethical:

Minimizing contact with marginally ethical people can help minimize trouble in our careers.

Can you name three marginally ethical people you have been forced to work with?

Have you experienced an evasive person at work? Did they turn out to be very ethical?

When you were first starting out did anyone try to take unethical advantage of your limited experience?

Have you experienced unethical treatment because someone had financial conflicts of interest?

Summation of 1st Hour

- Select solutions that are “good enough” for all parties, rather than optimal for any one party.
- “Better” is sometimes the enemy of “Good”.
- Unethical behavior eventually tarnishes the purveyor’s reputation.
- No craftsman likes to do substandard work. Deep inside of most of us is an ethical person.
- Almost all of us want to do right by society.
- When faced with normal work requests evasive people are generally less ethical – much less ethical.
- When faced with a design choice consider the more conservative option to protect you, society and our profession.
- Beware of any client who is dangerously underfunded. If a structure fails all blame will point at the engineer
- Make it stronger than code and easier to construct.
- Allow for future variations by designing for more than average conditions.
- Construction inspection firms must be paid directly by the customer and not by the contractor who is being monitored.
- Being ethical empowers your subordinates.

Ethics and Floodwater Engineering - 1

1-Hour

Quiz Problems

1. Engineering Ethics are useful to bridge the gap between:
    A. Money and power
    B. Reality and Code
    C. Right and wrong
    D. Law and Reason

2. Less precise forms of applied science can benefit from:
    A. Ethical perspectives on error tolerance
    B. Good Luck
    C. Both A and B
    D. None of the above.

3. "Error tolerance" refers
    A. Unexpected end-user behavior
    B. Unique site requirements
    C. Manufacturing errors
    D. All of the above.

4. The engineer's responsibility is to:
    A. Make the system work
    B. Make as much money as possible
    C. Have fun at work
    D. Be popular

5. The journey between the black and white world of "by the book" and system reality can be aided if the engineer asks what question
    A. What strategy will make my firm the most money?
    B. What is the right thing to do?
    C. Who can I dump this difficult job on?
    D. Will "Flood Plains for Dummies" help?

6. Ethics are:
    A. Bad for business
    B. OK taken in small doses
    C. Moral principles that govern the behavior of an individual or group.
    D. A conundrum

7. Engineering ethics sets the obligations by engineers to:
    A. Make a smaller profit than they had hoped on this job
    B. Themselves
    C. Minimizing client costs
    D. Themselves, their clients, society and to the engineering profession

8. "Situation ethics" is:
    A. A judgment based more on the context of a situation rather than absolute moral principles
    B. Whatever we want it to be
    C. A judgment consulting absolute moral principles
    D. Flexible judgments to maximize my income

9. Ethics is a battle of ideas about:
    A. Optimization
    B. Good
    C. Profit
    D. Effort

10. Who do ethical considerations involve?
    A. The engineer personally
    B. The engineer's client
    C. All of these
    D. Society