

PDH NOW

Ethics and Floodwater Engineering – 4

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Couse Description

This course is the 4th 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 PDHNow as follows:

By Email: info@pdhnow.com

By Phone: 1-833-PDHNOW9

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Ethics and Floodwater Engineering – 4th Hour

In the fourth hour we will look at ethical considerations for inspections of completed flood control works and emergency management.

Ethical concept: An ounce of prevention is worth a pound of cure.

I wish I'd said this first, but Ben Franklin beat me to it.

This saying applies to inspection of completed flood control works and to emergency management. Why build projects that have problems and why have damage from natural phenomena?

For a dozen years I headed our local Corps District's Inspection of Completed Civil Works Program and was Chief of their Emergency Management Branch. Pairing these two was a good marriage. If unusually high water occurred, we heard about it through our emergency channels and could then see if which of over 130 projects might be damaged. The Corps built projects under many authorities, but most had the same characteristics of the local sponsor (city, county, state, flood control district) providing lands, easements, and rights-of-way: holding the federal government harmless; and sharing the cost. If the locals maintained the project in good condition (as determined by our inspection group), then in the event of a large flood that damages the project, the Corps will repair the damage. Almost all locals keep the projects in good shape, but it does help to remind them every year or two of their responsibility and minor deficiency that needs to be fixed. Most local maintenance consists of minor erosion repair, channel clearing, and weed and trash removal at inlets.

I saw something that bothered me. We kept making the same mistakes on the same rivers.

The problem was a lack of feedback. The lifespan of these projects we were constructing was 100 years. Human life spans are not that long and engineering careers are much shorter. If a young engineer with only 5 years of experience was given a bank protection project, he or she would likely have only another 30 years or so for that project to be tested. So, there was only about 1 chance in 3 that the engineer would ever get feedback during a career.

We needed some way to provide feedback to the planning department. We tried taking a few along on inspections, but most only saw a few projects. Also, seeing a project didn't tell you its history, or its strengths and weaknesses.

In the early 1990's the Corps embraced Total Quality Management in the form Total Army Quality. TQM was based on three concepts: do an action, observe feedback, make an improvement and then do a revised action, etc. My problem was that planning wasn't seeing the feedback we were experiencing in our inspections.

I got permission under TAQ to do a Lessons Learned program. I contracted with a hydraulics professor and a respected consultant. During the next five years we did a Lessons Learned on each project. I knew where the skeletons were buried and pointed them out to our contractors. I started with some of the best projects so that people would like to read the reports and then slowly passed from the acceptable to the dubious. We also wrote a Best of Lessons Learned. Still I got the feeling that we hadn't communicated with new planners in a very efficient way.

I finally figured out a chart that might quickly "tell all". Listing the rivers in our district down the left of the page and types of bank protection across the top of two pages created a matrix. In each block was a circle that was clear for success, half black, or fully black for failure. Also, in each block was the page number from the report that gave the rating. For example, on one stream in our district every bank protection failed, except for extremely large rock. This told planners what they needed to do.

Ethical concept: Engineers who know history can plan better.

Sharing Information Helps Public Image:

As I was distributing the last report, I talked to one of the engineers. He hadn't seen any of the reports! I needed a better way to reach all the people and this new invention called the Internet might just be the way. With help from our computer folks, I got a computer firm to create a 7,000-page website. The data was scrubbed to eliminate any sensitive information. A giant map had hot links to navigate to individual projects. The website went public in 1999. It was popular in-house. I put a tracer on the email and found that all but 3 employees kept the email transmitting the website link. One key use was for identification of projects that the Corps had constructed many years ago, but that most employees did not know about.

The website was popular outside the Corps. Over the years I had talked to many environmentally interested people who didn't like our jetty jacks in our local river. They thought it spoiled the trees and sand beach areas. I then pointed out that the levees were there to prevent valley flooding and that the river threatened to erode the levees. So, we put jetty jacks to slow the water and allow it to dump some of its sediment load. This sand that was dumped formed the sand bars and sand beaches. Lastly, the cottonwoods started growing in the sandy areas. So, the jacks helped create the pleasant environment.

After the site went up, university students would call and ask informed questions. Their favorite publication was the "Best of Lessons Learned". No longer were we regarded with suspicion. It was a real pleasure to talk to an informed public.

Ethical concept: Sharing valid engineering application with the public enhanced our public image.

One thing I noticed during the first year was the absence of bad reaction to some of our unsuccessful bank protection projects. Owning up to past failures to improve future designs struck a positive note with the public.

On September 11, 2001 the government ordered all engineering data removed from the web. By the time I retired in 2003 I was starting to have the same old disappointing conversations caused by dealing with an uninformed public. The website continued to be used in-house.

Ethical concept: While education entails risk, there is a bigger risk in not educating.

Angry Victims

Next, we will deal with flood emergencies. I worked in the Emergency Management Branch during the last 14 years of my career and dealt with many flood victims before that.

Many times, we would get calls from angry citizens about their property being flooded and how they were going to march on the Senator's office if we didn't help them. Frequently, they had called three to five other people before reaching our area. They were angry. "Why did God do this to me? We go to church. We're good people."

Many times, flood victims are so angry they can't think straight. I've seen this irrational anger in the field when dealing with flood victims. I remember one house that was trapped between a levee and a road embankment when the flood wave rolled in. The water floated a partially full fuel oil tank causing the connecting pipe to break and stain the perimeter of the home. That was followed by cut hay floating in the water and sticking to the house. The house had been "tarred and feathered" and it still had a pond in the front yard. The lady inside saw me. Went to her porch and got into a row boat and paddled across her yard over to the road embankment where I had been standing. She calmly got out of boat and walked over to me and said, "I think I hate you." I found out that they got the animals to safety but weren't quick enough about moving all the automobiles to high ground.

Most of the time you can let them blow off steam and then start talking objectively. Fortunately, the Corps didn't have anything to do with that flood and ultimately we put in a large flood control channel that would protect against just such a flood as they had recently experienced.

Is there any other way to help a flood victim restore his or her objectivity?

Yes. One old timer taught me restore objectivity by asking, “Where are your children?” Invariably the person answers, “They are playing in the floodwater.” At this point we would explain “that floodwater is Mother Nature’s sewer system. It’s full of pesticide, fungicide, mine tailings, cow dung, and tetanus.” Immediately, the person forgets all the unimportant anger and starts thinking about what really counts.

Ethical concept: Our children come first. Everything else is a distant second.

The second emotional concept I would like to share with you is about emotional states of flood victims. There are dozens of emotions, but flood victims aren’t experiencing many of them. When flood victims are active enough to contact you, they are in three primary states: heroic, angry, or depressed. Note that some who are not contacting you may be in shock, injured, or paralyzed with fear.

Most rescues are by neighbors or family. Many of these are done by people in the heroic state. After the rescues, the heroic state usually subsides.

Flood victim emotional states are: heroic, anger, depression

I have only seen one case where the heroic state lasted for days. I received a call from a lady with a lilt in her voice while she explained that her land had been flooded and her house was in danger. I realized that she wasn’t angry or depressed. My first question to her was, “Has anything else happened in your life recently?” She responded with, “Oh, we buried my husband last Tuesday.” She was still in shock. I found out that she and her late husband had two children and had just purchased a small farm.

It was their dream place. I asked her where her two children were. Of course, they were playing in the floodwater. When she found out what was likely in that water, she snapped out of the heroic mode and became a practical parent. We talked for a while and I informed her that changes in regulation of a lake upstream would cause her land to flood more than in the past. We also talked about the difficulty of her working the land by herself. She realized she would have to sell. After the call, I called a local agency and talked to a person familiar with the situation and he said he would stop in the next day and check on her.

In this example, I moved the victim from the heroic state to the start of anger. I could sense the tears welling-up toward the end of our conversation. Unmet expectations cause anger. She and her late husband had planned an idyllic life together. She now had to confront the fact that their dream was dead and that for the sake of her children she needed to act quickly.

The best psychological article about flood victims I ever read was stated that the emotional objective when dealing with flood victims was to move them from heroic, to anger, to mild depression. I have never seen this model fail.

While our culture praises heroism, being in the heroic mode isn't very practical for day-to-day living because it is too risky. In the heroic mode people take extreme risks that are justified in extreme circumstances but are counter-productive in normal decision making.

Being angry can help us take action, but it's difficult to think clearly when extremely angry.

The best we can hope for is a mild depression. Note I am not talking about some paralyzing clinical depression. I am talking about disappointment that is so great you are forced to change your plans for the next year.

I know that our society holds depression in low esteem, but flood victims just aren't going to be happy. They may be relieved to have not lost friends, family members, or pets, but they are definitely not happy about being flooded.

I remember when I first heard the advice about moving the high esteemed hero state to the lowly depressed state, I didn't want to believe it. However, my experience with flood victims supports the notion of moving from hero, through anger to mild depression.

When flood victims are in a state of mild depression, they "own responsibility for cleaning-up their property". I remember one lady sighing and saying that "they had been planning to go to Hawaii, but that would just have to wait another year."

Once the flood victim is in the objective mild depressed state it is time to talk about removing all sheetrock up to (and a little above) the high-water mark in the house. The insulation behind the removed sheetrock also needs to be removed. The bed mattresses need to be discarded because they are full of contaminated water. Turn the power off and have an electrician check out your circuitry after it dries. Some things can be washed, but many should be discarded.

Ethical concept: During emergency situations the floodwater engineer needs to consider the emotional state of flood victims.

It is OK to ask for help:

It's ok to ask for help.

The generation of engineers before me built many projects. Most of those projects protected an ever-growing population. Growing populations mean more property is being protected and that increases benefits in the benefit/cost ratio. However, not every protected property grew in size or value.

We had several flood fights (one using prison labor) to save a levee protecting an old town. This levee had one extremely weak spot subject to bank erosion at moderate flows. I talked to one of the old timers and found out that they knew about that weak spot but couldn't afford to armor the bank with large angular rock because the additional cost would make the benefit/cost ratio less than one and that would kill the whole project. They knew that there would have to be a flood fight at that spot, but at least the locals would have a chance to avoid flooding.

The last flood did considerable damage to the levee and we needed a project to properly repair the damaged section and also armor it. The problem the Corp faced was that any repairs had to be added to the total cost of the levee and benefits would be based on the town's old depreciated buildings. Clearly the benefit/cost ratio for a Corps project wasn't going to happen.

What we needed was more money. I had met an individual who had some access to private grant funds. I called him and he said, "I'm on my way." The Corps was then able to repair the damaged levee and armor the vulnerable section as well.

Ethical concept: Don't be afraid to ask for help when it is for a good cause.

Acting Ethically

I have made the decision twice in my career to take action based on the possibility that slightly above normal rainfall could cause severe consequences.

As Chief of Emergency Management one of my duties was to do a quick hazard analysis every spring before the snowmelt runoff season began. I would ask myself "What's different?" I looked at our new construction projects. Most involved little or no increase in threat level. However, one year I noticed something very different. We were rehabilitating a levee directly across from very large drainage outlet that drained about twenty square miles of urban area. This is about the size of our larger thunderstorms. I started making inquiries. I found out that our specifications allowed the contractor to take down a mile of levee at a time! The contractor was also given two years to complete the job. This put an entire community at risk. I informed our District Engineer (a colonel) who did not like this vulnerability in his area. Ultimately this matter went to headquarters in Washington. This is always a little risk when raking down a poor levee to remake it with better materials and a better design. However, this was no small risk. I looked intently throughout our district streams and determined this was the only such situation we had. The reason this escaped the engineers doing a field review was that vegetation obscured a view of the outlet on the other side of the river. The reason I knew about it was that I had actually done some modification work on both projects in prior decades.

The contractor was informed of the danger, increased his effort, and completed the project in one year rather than the two years allowed by the contract.

Two things happened. First, I lost some long-term friendships by people involved in the project who felt that I had made them look bad. Secondly, it didn't rain enough that summer or the next to have made a difference.

Ethical concept: Doing the right thing isn't always popular or needed. But not doing the right thing could be a lot worse.

However, the second time I took action was different.

I participated in one very large emergency response in which a well-traveled road to a critical facility was in danger from ponded water piping through its embankment. A recent forest fire had increase runoff far above typical flows. It was thunderstorm season. The opening to the tiny drainage pipe through the road embankment had been buried in the mud. Our district with the aid of contractors responded by jacking a pipe through the embankment. At one point in the decision making the question was raised about which type of pipe. Concrete pipe would be more economical. I felt that time might be in short supply. I said "steel". We stayed with steel. I also went to every group and every person on the critical path of this project and ask for priority. They responded and several days were saved up front in the contracting and financial process. The construction began. The pipe was finally jacked through the embankment. That night we got a huge thunderstorm over the watershed in question. Estimates were that had we not had jacked the pipe through that day we would have had a record high pool against the embankment that would likely have failed the random fill structure.

Ethical concept: You don't always have "hard" data to base taking action on.

Final Ethical concept: "It might not rain" is a poor protective strategy.

My favorite quote about ethical solutions is, "One life that soon is past, only that made with love will last."

Summation of 4th Hour

Here is a summary of the ethical concepts covered in this hour.

From the inspection examples we saw that:

- **An ounce of prevention is worth a pound of cure.**
- **Engineers who know history can plan better.**
- **Sharing valid engineering application with the public enhanced our public image.**
- **While education entails risk, there is a bigger risk in not educating.**

From the emergency examples we noted:

- **Our children come first. Everything else is a distant second.**
- **During emergency situations the floodwater engineer needs to consider the emotional state of flood victims.**
- **Don't be afraid to ask for help when it is for a good cause.**
- **Doing the right thing isn't always popular or needed. But not doing the right thing could be a lot worse.**
- **You don't always have "hard" data to base taking action on.**
- **"It might not rain" is a poor protective strategy.**

Ethics and Floodwater Engineering - 4

1-Hour

Quiz Problems

1. You are assigned a conceptual planning study. Time is in short supply. You should
 - A. Use the same techniques that you use for final design even though they are much slower and more expensive.
 - B. If the situation is urgent and your idea is in the “good enough” category, then go with your idea and move the next step.
 - C. Avoiding useless refinements will save time and money. The job requirements should determine the level of detailed analysis used in a floodwater engineering study. Planning requires a less detailed effort than final design.
 - D. B and C

2. With the advent of Global Positioning Coordinates (GPS) river bank erosion projects can now be designed to the nearest foot and then be appropriately constructed as the plans show.
 - A. Not true because bank erosion will continue during the design process and the construction staff will have to use some judgment about the final placement.
 - B. True because constructors should always follow the designer’s lead.
 - C. Of course, we will build it exactly like the plans show. Why wouldn’t we.
 - D. Good idea so we can save money on field staff positions by hiring the youngest cheapest inspectors possible.

3. Widespread studies of levee bank erosion are important because
 - A. While education entails risk, there is a bigger risk in not educating.
 - B. A, C, and D.
 - C. Sharing valid engineering application with the public enhanced our public image.
 - D. Engineers who know history can plan better.

4. Which of the following is true about natural emergencies?
 - A. During emergency situations the floodwater engineer needs to focus on technical details with little concern for the emotional state of flood victims.
 - B. Most children are good swimmers, so we don’t have to worry much about them.
 - C. An ounce of prevention is worth a pound of cure.
 - D. It’s too big for any one person to make a significant difference.

5. When you have a chance to prevent a possible disaster you should:
 - A. Lie down quietly until the urge to do anything passes.
 - B. Depend on a Higher Power to keep it from raining.
 - C. Avoid upsetting other people by asking them for help.
 - D. Recognize that doing the right thing isn’t always popular or needed. But not doing the right thing could be a lot worse.

6. Being an ethical engineer means
 - A. You won’t always have “hard” data to base taking action on.
 - B. You will always do the optimal thing.
 - C. You will be popular and respected.
 - D. A and C

7. 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