

**2006-538: ENGINEERING ETHICS AND CONTEMPORARY ISSUES: KATRINA
IN THE CLASSROOM AND BEYOND**

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Getting an Ethics Charge out of Current Events: Some Doubts about Katrina¹

On August 29, 2005, “Katrina” was still only the name of an unusually large cyclonic storm (a “category-4 hurricane”). A few days later, it had become shorthand for a complex economic, political, and social disaster. A long stretch of the Gulf coast had become more or less uninhabitable. The convenient measure of time necessary to undo the damage would, it seemed, be years rather than weeks or months. New Orleans, one of the oldest cities in North America, a major port, had all but ceased to exist, many of its million residents seeking refuge far from home. State governors and federal administrators were blaming each other both for the slow response to the disaster—and for the severity of the disaster itself. The head of the Federal Emergency Management Agency was soon to resign in disgrace.

There is no doubt that Americans in general, and our students in particular, did find—and continue to find—Katrina “interesting”, even “relevant”. And, unlike much that they find interesting or relevant, Katrina clearly has connections with engineering. As one professor of civil engineering said: "Nothing this big has ever happened before in civil engineering."² At perhaps \$300 billion in destruction, Katrina is certainly the biggest engineering disaster in the history of the United States.

Yet, I doubt that Katrina is a good case for teaching engineering ethics—for now at least. There are at least three distinct reasons for doubt. First, there is the question of what happened. For a number of crucial decisions, we still do not know what their consequences were or what was thought to justify them. Second, there is the question of what part engineers had in what happened, which decisions were theirs and which belonged to elected or appointed officials who were not engineers. Third, there is the question of what part engineering ethics had, or should have had, in the decisions engineers did make (whatever those were). So far we lack any dramatic moment such as

the Challenger disaster provided, a moment when ethics mattered in a way both precise and interesting.

Though I have mentioned three reasons for my doubt's about Katrina's use in the classroom, this talk will focus almost entirely on the first—or, rather, on an important part of the first, our uncertainty about what caused the flood-control system of New Orleans to fail so disastrously.

Background

Even on an ordinary day New Orleans is a city that must work to prevent flooding. One of the world's largest rivers, the Mississippi, flows through it. From Jackson Park, the heart of the French Quarter, one of the highest points in the city, one can see the muddy river rushing by six feet or so *above* the street. The Mississippi would flood the city were it not for the levees that hold it back. Nor is the Mississippi the only watery threat. Though older parts of the city are as much as thirty feet above sea level, much of the city is below, and the sea, the Gulf of Mexico, reaches New Orleans at its back, through Lake Pontchartrain. Mostly developed since 1900, the newer parts of the city are, like much of the Netherlands, dry only because water is constantly pumped out of them. But for the huge screw pumps designed a century ago by a local engineer, Albert Baldwin Wood, New Orleans would be exactly what it was when Europeans first settled there in 1718, a small crescent-shaped island in a huge swamp.

While engineers did not found New Orleans, it has long survived only because of engineering—and it suffered disaster in part because the engineering was not better. While the levees along the Mississippi held, other parts of the flood-control system failed. The most important failures seem to have occurred along the 17th Street, London Avenue, and Industrial canals. (One breach in the 17th Street floodwall alone was 465 ft. long.) These canals are basically channels made by the floodwalls, a pair of “I” or inverse “T”-shaped slabs of poured concrete set on sheet pilings. The canals carry water pumped from low areas of the city to Lake Pontchartrain. Even on a dry day, the surface of the water in these canals may be ten or more feet above the neighboring street (and even higher relative to the lowest parts of the city). It is no surprise, then, that not long after

parts of the floodwalls gave way, three fourths of the city was under water; some parts under as much as twenty feet of water.³ Indeed, such an event had long been predicted.⁴ That much is undisputed.

Cause: “take 1”

For almost a month after Katrina smashed through New Orleans, the predominant view seems to have been that the cause of the disaster was water flowing *over* the floodwalls; the walls had failed because the cascading water had undermined them from the street side. There was good reason for this view. At many places, especially along Lake Pontchartrain, observers had actually seen water coming over the levees; and there was, in any case, plenty of evidence of just the sort of erosion “overtopping” would produce.

On this view, Katrina had only the simplest of lessons to teach. The flood-control system had been built to withstand a category-3 storm; a category-4 storm had overwhelmed it.⁵ Engineering is about trade-offs. Had those responsible for the floodwalls, the Army Corps of Engineers or the New Orleans Levee Board, spent more, New Orleans could have had floodwalls and levees high enough to hold back a category-4 storm. New Orleans would then have survived Katrina more or less as it had many category-3 storms. Some government agency had made a bet and lost. Whether the agency was right to bet that way is a political question, not a question of engineering. The engineers had informed both the decision-makers and the public. The only interesting question for engineering ethics is whether engineers should have done more to inform decision-makers or the public, how much would have been “enough”, and how they were to tell when they had done it.

Cause: “take 2”

Not long after the flood waters began to recede, two dozen or so engineers from the American Society of Civil Engineers, UC-Berkeley, and Louisiana State University began cooperating on a study of the disaster. They entered the city as soon as they could,

hoping to complete the onsite part of their work before repair destroyed much of the evidence. On November 2, they issued a preliminary report, 129 pages long, full of useful detail and revealing photographs.⁶ A fine piece of forensic engineering, it doubtless conceals many ethical issues resolved during drafting. I wish someone would tell us about the drafting process. But I digress.

Among the report's findings are several that do raise quite interesting questions of engineering ethics. There was, it turned out, no evidence that water in the three canals ever reached the fourteen-foot level necessary for water to cascade over the floodwalls. Both onsite evidence and computer modeling seemed to show that the water in the canals never rose above twelve feet. In some places where a floodwall had failed, big chunks had simply moved back as much as thirty-five feet, a effect inconsistent with overtopping being the cause of failure. The best explanation of such catastrophic failure seemed to be that the subsoil had become too wet to hold the pilings in place. The piles gave way, freeing the floodwalls to slide back under the pressure of the rising water. This explanation suggests either a design flaw (a failure of engineers) or a contractor who did not build to specifications (and engineers who did not check work carefully enough).⁷ There was, in fact, evidence of both.

The evidence for the design failure was a set of calculations showing that even if the pilings had been as designed, they would have failed when the water in the canal reached eleven or twelve feet. The Army Corps of Engineers had, it seemed, used the wrong rule to design the pilings. According to Billy Prochaska, a consulting engineer who participated in the preliminary report, the rule the Corps used applies "if you have uniform soils, and we certainly don't have that in the New Orleans area."⁸ The Corps should have adjusted its standard design for the special conditions of New Orleans. Everyone knows its soil is both unusually porous and unusually variable. The pilings should have gone much deeper. What was the Corps thinking?

The evidence that the floodwalls did not meet even the inadequate standard the Corps had set consisted of "sophisticated ground sonar that showed that sheet pilings that should have been sunk seventeen feet only went down ten".⁹ These soundings had been taken along parts of the floodwall that were intact but close to breaches. *The Times-Picayune*, New Orleans' daily newspaper, even obtained the "final review set of design

drawings for the project”. These showed “the pilings on the New Orleans side of the canal were to be driven 10 feet”.¹⁰

That seemed to be the last word. Even on December 22, 2005, the date I stopped my research, the entry for Katrina in *Wikipedia* (the online encyclopedia) still asserted: “The flood was caused by several levee breaches due to misdesign by the United States Army Corps of Engineers, improper construction, and lack of supervision by the Orleans Levee Board.”¹¹

Cause: “take 3”

As of that date (December 22), the Corps of Engineers still seemed to accept the finding that the design was, if not a mistake, at least a decision that experience had shown should not be repeated. The Corps was proposing to replace the 17 foot pilings with pilings that would go down 51 feet (three times as deep).¹² But the Corps continued to insist that the present pilings were 17 feet, not 10. And, by December 13, 2005, it had good reason so to insist. The Corps had hired a contractor to use sonar to identify eight “10-foot pilings”. The contractor then pulled the pilings and measured them. All turned out to be 17 feet pilings, not 10. Whatever the merits of its design, Corps supervision of construction seems to have been adequate. Or, rather it would so seem did not some of the engineers who issued the preliminary report (“Team Louisiana”) dispute the reliability of the sonar the Corps contractor used to pick pilings (while not disputing the length of the pilings actually measured or claiming to have pulled and measured any 10-foot pilings). When, and how, this dispute will end is anyone’s guess.¹³ The December 22 *Wikipedia* entry on Katrina may yet turn out to be right.

Conclusion

One of the advantages of “hypothetical cases” often has over “current events” is that that a hypothetical does not change while one is discussing it (or, at least, does not change in ways the instructor cannot control). Another advantage is that an instructor is

much less likely to get bogged down over *disputed* details (such as the cause of the disaster).

Of course, I agree that, all else equal, the richer the case the better (though I must add that, if time is short, a thin case may be better than a rich one). I also agree that a case is rich (in part at least) if it is “multidimensional”, that is, a coming together of technical design, management, and ethical issues. While I think that a hypothetical can, in principle, be as rich as a real case, I admit that reality tends to have a complexity that is hard to invent. And I would add that cases known to be real tend register in the “moral imagination” of students in a way similar but invented cases do not. Fact can teach lessons the merely hypothetical cannot. I even agree that the facts surrounding Katrina may some day have all those virtues. What I deny is that they have them now. What I have tried to show here is that we do not yet know enough about what actually happened to know who made the decisions, why, or when. We do not know what issues of engineering collided with what management issues. We do know what the ethical issues were—and when, if ever, engineers had a part in resolving them. We do not know what information decision-makers had at the time they decided what they did. What we have now is not a multidimensional case but a confused one; the difficulties we face in understanding the past are not the difficulties the decision-makers faced. All anyone teaching engineering ethics can do with Katrina now is resolve the confusion I have described here by stipulating (more or less plausible) possibilities. What we get that way may (or may not) be a rich, multidimensional case. What it will not be a real case; it will be an ordinary hypothetical, as cut and dried as we choose to make. It will be no more likely to seize the imagination of our students than any other hypothetical case—unless we present as what it is not, what actually happened, a way of teaching engineering ethics that strikes me as, well, unethical. So, for now at least, I recommend putting off the use of Katrina in class.

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NOTES

¹ This presentation is part of a panel, “Engineering Ethics and Contemporary Issues: Katrina in the Classroom and Beyond.” The other three panelists discuss their use of Hurricane Katrina as a case study in engineering ethics and contemporary issues in engineering; this paper presents an alternative viewpoint on the drawbacks of using recent cases such as Katrina in engineering ethics.

² Bob Marshall, “17th Street Canal Levee Was Doomed”, *Times-Picayune*, November 30, 2005. <http://www.nola.com/news/t-p/frontpage/index.ssf?/base/news-4/1133336859287360.xml> (December 22, 2005).

³ R.B. Seed et al. *Preliminary Report on Performance of the New Orleans Levee Systems in Hurricane Katrina on August 29, 2005* (Report UCB/CITRIS-05/01), November 2, 2005 (NSF Grant No. CMS-0413327).

⁴ See, for example, Mark Fischetti, “Drowning New Orleans”, *Scientific American.Com*, October 2001, <http://www.sciam.com/article.cfm?chanID=sa006&articleID=00060286-CB58-1315-8B5883414B7F0000> (December 22, 2005).

⁵ As in much else about this case, much has changed since discussion began. The category of the storm when it hit New Orleans may now be “3” rather than “4”. See, for example, Mark Schleifstein, “Katrina weaker than thought”, *Times-Picayune*, December 21, 2005. <http://www.nola.com/news/t-p/frontpage/index.ssf?/base/news-4/1135149118129420.xml> (December 22, 2005).

⁶ Seed et al., *Preliminary Report*.

⁷ Peter Whoriskey and Joby Warrick, “Shifting ground led to floodwall failure, investigators say”, *Houston Chronicle*, October 8, 2005. <http://www.chron.com/cs/CDA/assistory.mp1/nation/3387278> (December 22, 2005). See also Seed, “Preliminary Report”.

⁸ Marshall, “Doomed”. This information seems to have first become public several weeks earlier. See, for example, Bob Marshall, “Short Sheeted”, *Times-Picayune*, November 10, 2005 <http://www.nola.com/news/t-p/frontpage/index.ssf?/base/news-4/1131604614166260.xml>

⁹ Marshall, “Doomed”.

¹⁰ Marshall, “Short Sheeted”.

¹¹ http://en.wikipedia.org/wiki/Effect_of_Hurricane_Katrina_on_New_Orleans (December 22, 2005).

¹² Marshall, “Short Sheeted”.

¹³ Mark Schleifstein, “LSU expert defends pilings test”, *Times-Picayune*, December 15, 2005. www.nola.com/news/t-p/frontpage/index.ssf?/base/news-4/1134634183141790.xml (December 22, 2005).