Engineering Ethics: Crash Course Engineering #27

Crash Course: Engineering
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We all make mistakes.

In life and engineering, you're not always going to succeed. What's important is that you learn from your screw-ups and incorporate those lessons into what you do next.

Because when you don't, the consequences can be bad. Even deadly. To help keep us on track, we need something that will provide a sense of morality and a set of best practices for doing good in the world.

We need ethics. Specifically, we need engineering ethics. [Theme Music] Engineering is a broad, ever-changing field. With so many different branches, it's good to have some common ground – a general set of guidelines or ideas for how the engineers of the world should go about solving problems.

One of these is safety, which we'll talk about more next time. The other is ethics. In general, ethics is a moral philosophy that tries to deal with what's right, what's wrong, and what your duty is to do good – and not do bad.

Engineering ethics is essentially this same mindset, just applied to the field of engineering. It's the study of values, issues, and decisions that are involved with the work of engineers. Ethics has a particular importance for engineers because people's lives are so often going to be in your hands.

It's not just about remembering your manners or being nice to your neighbor. What you create as an engineer could save a person's life or take it away. When you swallow a pill at the hospital, you need to be able to trust that the people that came up with it had your best interests in mind.

When you drive over a bridge, you need to know that the civil engineers who designed it took the time to make it as sturdy as possible. The foods you eat – the cars you drive – the wires in your home they all need to be designed with ethics in mind. If you want to see how bad an engineering failure can be, look no further than the Kansas City Hyatt-Regency Collapse.

In July of 1980, the Hyatt Regency Hotel in Kansas City, Missouri was showing off its new multi-story atrium, decked out with two levels of suspended walkways. These walkways were supported by beams, which were supposed to be held up by long rods hanging from the ceiling. To even the load and reduce the stress on each beam, the walkways were supposed to have a single rod extending all the way through them.

But something happened between the initial design stage and the actual building of the atrium. When the builders had some difficulty putting it together, the system was modified to have 2 separate, shorter rods instead of a single longer one. This design change meant that the upper rod had to not only support the weight of the walkway that it held up, but also the one below it – essentially doubling the load.

During a party about a year after the atrium opened, these beams failed and the two walkways collapsed, killing 114 people and injuring 216 others. In terms of lost lives, it was one of the most devastating structural failures in U. S. history.

A lot went wrong, much of it caused by poor oversight and bad communication. A formal review of the changed design never happened, strength calculations were never performed, work was subcontracted out, and the engineer on record put their seal on the design without personally checking everything. It all could've been prevented, if only they'd followed the engineer's Code of Ethics.

There are a couple of different ones out there, but today we'll use the Code of Ethics from the American Society of Civil Engineers, or ASCE. Their Code of Ethics has eight distinct principles, the first being: "Hold Safety Paramount". This means that your chief concern as an engineer needs to be the health and welfare of the public.

The rule goes on to say that you should only approve designs that are determined to be safe and that conform with accepted engineering standards. The fact that there weren't any calculations done on the design changes to the walkway, and that the engineer on duty approved the designs without properly checking them clearly goes against this principle. That's why the Committee of Professional Conduct that reviewed the case ruled that the engineer had violated their code and suspended them from the Society for three years.

If you take a look at the rest of the Code, you can see some other useful rules about how engineers should approach a problem. The second rule is to "Service With Competence", which means that you should only work in areas that you're skilled in. If you're not an electrical engineer, you shouldn't be messing with the wires in a building.

The third states that you should always "Issue True Statements". Basically, don't lie. Then comes the need to "Act As A Faithful Agent" for each of your employers or clients and avoid conflicts of interest.

One of your jobs shouldn't cause you to sabotage another. There's also the rule of "Reputation By Merit", which means your reputation is built up by the work that you do and not by unfair means. That goes hand-in-hand with the requirement to "Uphold Professional Honor", where you act with integrity and have a zero tolerance policy for bribery, fraud, or any sort of corruption.

The 7th rule is to "Continue Professional Development," and it's one of the most important for the long-term growth of society and the engineering field. You need to not only foster your own development as an engineer, but that of other engineers as well. You always need to report what happens, no matter the consequences.

And finally, the eighth rule is to "Treat All Persons Fairly", which is really just a good mantra for life. Now, codes are great, but they're not perfect. People can, and do, break the rules.

And codes can't always address every situation. They may need to be updated as society and technology advance. So it all comes down to this: what are the highest priorities?

If engineers are trying to create good for the public, you need to ask "what is good" and "how can we prioritize good'? It can't just be consequentialism – having the end justify the means – or you leave the door open for some pretty big ethical gray areas.

No, we need better ethics than that. One of the most influential ethical theories to engineering has been utilitarianism. This is the belief that actions are right if they are useful or beneficial to the majority of people.

You should try and maximize the overall good that you can do, taking into account all of those that will be affected by your actions. Rights ethics is also very important. Simply put, you should do your best to respect the rights of others.

Acts of respect aren't just ideal, but necessary, regardless of whether or not they always maximize the overall good. In that way, you can see how ethical theories can stack on each other. There's

also duty ethics, which is all about respecting another person's autonomy.

This builds on rights ethics, but puts the spotlight on your duties, rather than another person's rights. If you have a right to live, then I have a duty to not market a misleading product that could kill you. Or sign off on a new walkway design that I haven't checked.

Applying engineering ethics is all about trying to balance these ethical theories with whatever situation you're put in. It's not always easy – or simple – but as an engineer, you have a duty to try your best. We improve, individually and as a community, with practice and learning from the past.

Remember that Citicorp building we talked about last episode? The one whose pillars were in the middle of its sides rather than at the corners? Wind from the wrong angle could cause the entire structure to fall, and no one realized until a student pointed out the problem after it was already built.

After those discoveries were made and they started immediate repairs, did they have an obligation to inform everyone in the building? How about the church that was underneath it? What about the people in the surrounding area?

Or the media? Or the local government? What was the proper protocol that they should have followed?

If you pick apart this incident, you can zero in on the ethics surrounding several of these points. To start, you need to analyze those wind loads. You need to check all of your calculations and not simply rely on building codes, which only set minimum requirements and aren't always what a specific project needs.

Then you should address the design changes, which in this case was a switch from welded connections to bolted ones. Those changes need to be considered in the overall design and checked by everyone involved. It can't just be a hasty decision.

You also have your professional responsibility to follow the codes of conduct for every chartered institution that applies to what you're doing. Public statements are absolutely necessary in a situation like this. The public has a right to know what's going on so they can plan accordingly.

If you don't release a public statement or, like Citicorp, put out one that's misleading, you're denying people their right to ensure their own safety and make their own educated decisions. Finally, no matter what happens, you need to share and contribute to the advancement of professional knowledge. Concealing the Citicorp problem for over 20 years robbed everyone of decades of ethical and engineering learning.

That's why even when tragedies happen, it's important to treat them as case-studies on what you might learn to do differently in the future when approaching other problems. Like if you're going to try and go into space, you need to know about the Space Shuttle Challenger disaster. In 1986, a leak in one of its solid rocket boosters ignited the main liquid fuel tank, resulting in the loss of the vehicle and the death of the crew.

NASA found the cause of the disaster to be the failure of an "O-ring" seal in the solid-fuel rocket, and while there were many factors that contributed to this disaster, it was fundamentally an ethics problem. Sufficient testing hadn't been done on the O-rings and NASA management didn't listen to the concerns of some engineers, all so they could stay on their launch schedule. Who knows what would've happened if a better ethical code was followed?

It could've still gone wrong, but maybe it wouldn't have. All we can do is try. And with a strong code of ethics at our side, and the knowledge of the past at our backs, we can make the best, most informed decisions to ensure our designs have the best possible impact.

There's no better way to do it. Today we talked about ethics and how it can be applied to engineering. We learned what a Code of Ethics is and how it can apply to a situation like the Kansas City Hyatt-Regency collapse.

Then we learned about engineering ethics and the ethical theories of utilitarianism, rights ethics, and duty ethics. Finally, we brought it all together by going back to the situation with Citicorp and analyzing it from an ethical perspective. I'll see you next time, when we'll talk all about safety.

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