

The Road Not Built



It is **disconcerting to new graduates** that much of what they design in the engineering office will never be used. In school, students work on neatly defined problem sets and projects. Their resulting work is the answer, what is expected. The students submit their work, the job is considered complete, and then the next assignment is tackled.

Unfortunately, outside of the neatly defined environment of school is the mess of the real world. Many projects are designed to varying degrees of completion but never built. File cabinets may be stuffed with calculations, but the physical landscape is not cluttered by these imaginary structures. These projects become virtual bridges, buildings, and tunnels, supported by painstaking calculations and details, described by volumes of documents. But they exist only in the imagination of the engineers. Robert Frost's poem claims that the road less traveled made all of the difference. I've often wondered about the road not built.

The Internet age has brought an explosion of communication and a corresponding increase in the documentation of everything. Now we can surf Web sites describing projects that were never built. The University of California at Berkeley set up a library project describing the bridges around San Francisco Bay (http://www.lib.berkeley.edu/news_events/exhibits/bridge/intro.html). One section, "Unbuilt Projects," includes documents showing bay crossings that never came into being, as well as discarded project designs of bridges that eventually were built. We think of the Golden Gate Bridge with reverence and awe. It is certainly one of the most beautiful bridges ever built, at one of the most spectacular locations. But early schemes for the crossing, as documented by the Web site, depict much different structures. One early scheme

was for a hulking, monstrous combination cantilever truss–suspension bridge, which surely would have been one of humankind’s ugliest structures had it made it off the paper. Frank Lloyd Wright had a vision for a second Bay Bridge crossing. His sketches show a low-slung, utilitarian concrete bridge, unlike the iconic, grand double-suspension crossing that had already been constructed. Other schemes for crossing the Bay had artificial islands and villages, all very Californian.

On the other coast, the New York metropolitan area has seen many schemes for projects that never made it to construction. Some of these projects are included on a Web site dedicated to New York crossings (<http://www.nycroads.com/crossings/unbuilt/>). Where there is a body of water without a crossing, someone thought about bridging it. For example, the eastern end of Long Island was to have a 30-mile-long series of causeways and suspended spans connecting Orient Point to New London, Connecticut. Real construction had proceeded to the point that part of a highway was built, connecting the end of the Long Island Expressway at Riverhead to the new bridge, but there’s no new bridge at the end, only a ferry. The highway dead ends on the north fork peninsula of the island.

Several bridges were planned to cross Long Island Sound. Probably the most notable, and the one that came closest to construction, was a bridge to be built from Rye to Oyster Bay on Long Island. This bridge was planned as an extension of the Cross Westchester Expressway, part of I-287, the New York metropolitan area’s beltway. Another freeway, the Seaford–Oyster Bay Expressway, was built on the Long Island side to receive the traffic. The bridge plan had I-287, which currently terminates at I-95 in Rye, continuing south up and over the Sound to Long Island. The proposed bridge required approaches through somewhat wealthier and more influential neighborhoods in Long Island and Westchester County. The project engendered fierce opposition from residents along both shores who didn’t want their backyards and pristine frontage on Long Island Sound spoiled by highways. The result was one of the earlier successful highway project rebellions in the late 1960s, and as a result, the bridge was never built. Now the engineering plans grow moldy in storage.

But politics is not only to blame. The engineering process itself results in a lot of design effort with nothing constructed to show for it.

For U.S. highway projects, the Federal Highway Administration requires two options, one in steel and one in concrete. Both are designed to 100% completion, but there is at least a 50% chance that one design will never turn into a real bridge (or more than 50% if the project is cancelled and nothing is built). Even without the choice between steel and concrete, engineering by its nature is iterative, so for every beam hanging in the air, there are hundreds of imaginary beams from the earlier design schemes.

We engineers take this process for granted. We all know that every time we put pencil to paper, the results will need a lot of fine-tuning and redesign. This is natural for us and expected. But, by accepting this iterative process, maybe we unwittingly buy into attitudes that devalue engineering work itself. For example, if a bridge design requires two options, there is at least a 50% chance that one of the designs will never be built. It is then easy to consider the work behind the unbuilt bridge option as not real design work. From there, it's a short step to viewing the work required to prepare the unbuilt option as so unimportant and trivial that it can just be thrown away. Nontechnical parts of the process—the politics, the publicity—don't feature the same degree of iteration. The public relations people don't work on the “steel and concrete” political alternatives and completely throw one away. If some of the technical engineering work is of such a value that it can just be shelved, then maybe it's not so important. Or at least that's the way it can seem working on the job.

We engineers probably won't have much success in building the roads not built. The nature of our work mandates iteration, change, and designs that never leave the CAD screen. But one thing we can do is celebrate the good work that is done, regardless of what is built. If the steel option is selected, then we can still be proud of the concrete option and document it. The conceptual design process offers a treasure trove of engineering thinking and development, no matter which scheme was chosen. In the dust bin of unbuilt bridge designs lies amazing engineering work, and also, perhaps, some opportunity for lessons to be learned from the less amazing work. Web sites such as the ones at Berkeley and New York show how we can celebrate and increase the value of what we do. It would be good to feature more of this as part of the process—to not just do the work, but to appreciate it, learn from it, and celebrate it. To do so would be good for education and good for engineering. It

would also help for teaching nonengineers about what we do, how we do it, how hard it is to do well, and how important it is to understand and support the process to get the best results.