I am pleased to join Chancellor Ryan in welcoming you to this special forum on rebuilding the infrastructure systems of the New Orleans region. I want to recognize and thank the University of New Orleans, Tulane University, Louisiana State University, and the American Society of Civil Engineers for joining with Georgia Tech in developing this forum, and also the Engineering Foundation for providing the funding for it.

When Katrina hit the New Orleans area, it was immediately clear to me and my colleagues at Georgia Tech that this disaster spoke very directly to engineering in general and to civil engineering in particular. Not only did the world see the extensive failure of levees and floodwalls that had been designed by engineers, but also other critical elements of infrastructure did not survive, causing a multiplicity of problems that worsened the situation. It struck me that nothing more than the credibility of engineering was at stake and that the only way we could restore it was for the engineering profession to step forward to understand where things had gone wrong, admit that mistakes had been made, and offer our services and expertise in the massive task of recovery and rebuilding. It also seemed that there was a distinct role for universities and the professional societies here, since we could help create a strategic view of how to go forward, given that the operational mission would be left to others.

However, Katrina had given the universities of this region immediately pressing issues to deal with – flooded campuses for example, roofs that had been blown away, and students whose lives were disrupted. While Georgia Tech welcomed about a thousand evacuees and 250 Tulane students and worked with them to find a safe landing, we knew we were the fortunate ones. We kept in close contact with our partners and were humbled to hear of each of their stories as they sought to deal with enormous odds and situations that never have been faced before in higher education. However in each case, they said regardless of the issues they were ready and enthusiastic about joining a collaborative effort that would focus on long range planning. Upon contacting our good friends at the American Society of Civil Engineers, we found a ready partner who would join with us and create a team that could tackle the large scale issues facing the New Orleans region. In fact, ASCE was already hard at work, reviewing the work of the Corps of Engineers as they sought to restore the hurricane protection system.

Our original idea was to hold this forum much sooner, in the months immediately following the disaster. However, the stars did not come into alignment that quickly, and
in retrospect that was probably a good thing. Because the rebuilding of the New Orleans Region will be one of the most massive and comprehensive infrastructure projects ever undertaken in United States history. It took a while for the extent of the undertaking to come into focus and to understand the many sectors that need to collaborate and coordinate their efforts.

Think with me for a minute about the Big Dig in Boston, which has been widely billed as the largest highway construction project in U.S. history. It was conceived in the 1970s. Planning for it began in the early 1980s. Ground was broken to begin construction in 1991. And it’s not done yet. The original price-tag was estimated at $2.5 billion in 1985. In July, the *Boston Globe* reported that the cost to date had ballooned to almost $15 billion. About the same time that article appeared, a concrete slab fell from the ceiling of a Big Dig tunnel, killing a woman in a car. We are now reading about an ongoing federal investigation centered around inferior materials, leaks, collapses, and criminal misconduct. A few months ago, *Design News* carried an article entitled, “Boston’s Big Dig – One of Engineering’s Biggest Mistakes.”

But, the Big Dig is pretty one-dimensional and straight forward compared to the rebuilding endeavor that the New Orleans Region faces. This region must solve transportation issues that are more comprehensive and complex than the Big Dig, and transportation is just one of the infrastructure pieces that must be addressed. The entire system of flood control and protection must be overhauled, and both the transportation and flood control systems must be interfaced with a number of other sectors that range from power supply to human factors.

The challenges engineers face here are not only much bigger than the Big Dig, but we also need to be much smarter and more effective and efficient in addressing them. While rebuilding the New Orleans region will clearly eclipse the Big Dig in scope, we certainly do not want to eclipse the Big Dig in being labeled “one of engineering’s biggest mistakes.” The reconstruction of this region will take place under the microscope of public scrutiny that is only now, after more than a decade of construction, coming to focus on the Big Dig. So, this conference offers an important opportunity is to take a step back and look across the breadth of the infrastructure challenges facing the New Orleans Region, and then place those challenges in a broader context.

My own experience with issues of flood control in this part of the country goes back more than 40 years to my very first job after I graduated from Georgia Tech. I worked for the Mississippi River Commission, which had oversight of flood control projects from St. Louis south through New Orleans to the Gulf of Mexico. So in a sense, my
career came full-circle back in December of last year when I was asked to chair the National Academies’ Committee on New Orleans Regional Hurricane Protection Projects to independently review the work of the Corps and ASCE and to report our recommendations to the Defense Department and the Office of the Secretary. Serving on the committee not only fit my background, but my wife, Anne, also has relatives here in the New Orleans area, and some of them lost their homes to Katrina. So this disaster has had a very personal impact on my family.

The Committee on New Orleans Regional Hurricane Protection Projects has sixteen members, a number of whom are highly qualified geotechnical experts, including Tom O’Rourke, John Christian, Andrew Whittle, and Delon Hampton. But it also includes representatives of the many other sectors and issues that come into play here, even including social service workers who add that important human dimension to the mix.

The work of the NRC oversight committee relates only to hurricane protection. Through the very considerable and impressive efforts of a large interagency team, the Corps recently issued a draft 6,000 page report examining why the hurricane flood protection system failed under the onslaught of Katrina. Between the Corps and ASCE and the NRC committee review, it is anticipated the report will be finalized in the spring of next year. As it pertains to this conference, it is important to note that most of the Corps report, as large as it is, focused on looking backwards, to understand why failures occurred. Our job in this meeting is to understand what happened, and then to use this information to look forward, as work proceeds to rebuild the New Orleans area.

One element of the Corps work that is forward looking is the risk and probability study of the flood control infrastructure. The study is now underway with the help of university experts, but it is complex and has never been applied to a flood-control system like that in New Orleans. For example, fragility curves, a key part of such an analysis that defines the vulnerability of a system, have never really been developed for a system of levees, floodwalls, and surge protection gates. In addition, we have only about 100 years of reliable records on hurricanes, and the pattern of hurricanes is changing while we are attempting to characterize it for purposes of analysis. What if global warming is indeed changing the paradigm for these massive storms? If that is so, planning based on the past 100 years might miss the critical points that will be in play for the next 100 years. This is not a simple effort.

Yet the risk and probability study should provide important planning information, in particular in helping establish the 100-year flood levels, which are needed to decide how high the levees and floodwalls have to be. This information is wanted as soon as possible, since thousands of homeowners and businesses of the region are still waiting
and waiting for a signal of what the future will bring for them. Insurance companies are waiting to make decisions on claims; banks and mortgage companies continue in limbo.

One of the advantages of the probability and risk study is that it helps us appreciate how the hurricane protection system performs as a system. And perhaps the most important thing we can take away from this forum is an understanding of the importance of taking a systems approach to the infrastructure challenges facing the New Orleans Region.

If you look at a land-sat photograph of the New Orleans region, it is easy to see that the landscape of this area is a complex of lakes, rivers, swamps, and land. The low-lying developed land is nominally protected from the effects of hurricanes by 284 miles of levees and floodwalls nominally built over a period of 40 years, but with elements dating back several hundred years. Yet, as acknowledged in the Corps report, these protection structures were not designed as a system, but as a series of independent pieces with different design philosophies. Now, add to that a system of ports and harbors, highways, water supply, waste handling, telecommunications, and evacuation networks, and you can see the need for a systems approach if the people living here are to have confidence in what we engineers have to provide them.

At the first meeting of the Committee on Regional New Orleans Hurricane Protection Projects, those who were assessing the wave and water action presented a comprehensive computer model that simulated what had happened to this entire ecosystem during Hurricane Katrina. They could effectively demonstrate how the storm surge had moved through the network of waterways during different times, and where the water went when levels were breached or overflowed. It was all there before us. This was a case where new advances in technology were important in helping engineers understand system performance from the standpoint of storm surges.

Yet it was also clear that we needed to find ways to communicate this kind of useful, but complex information, to the general public. Perhaps more than even before, the public in this case has a deep and pressing need and desire to understand what is happening and what the outcomes will be even in the interim stages of the work. As a result, in our first report the Committee recommended that the Corps look to newer means to explain their efforts, such as GIS technology, which could help organize the massive data base that is developing for this very challenging project. Progress has been made, but I would suggest this issue alone deserves a special study unto itself.

Webster defines a system as “a regularly interacting or interdependent group of items forming a unified whole.” I would suggest that we as engineers need to be in a position
to understand how systems work together as a whole in order to appreciate how to make judgments about design for individual pieces of it.

This includes the societal, historical, legal, and policy framework within which our infrastructure systems operate. We need to plan for systematic communication among the various entities and components involved in these systems. One of the challenges we face is the multiplicity of agencies involved. Levees and floodwalls fall under one jurisdiction, roads and bridges under another, and water and sewer under yet another. Since no one entity is in charge, who will insure coordination of the various efforts? Will all infrastructure be built to resist the same level of hurricane loading? I would suggest this conference should consider these questions.

And while we are thinking big, we should also not forget to think small and out of the box. Let me cite one example of “thinking small.” In one of my earliest trips to New Orleans after Katrina, I caught a ride in a cab and started a conversation with the cab driver. He told me his house was in the Ninth Ward, but it survived the flooding of Katrina. I asked him why this was the case, and he said the house was old. I asked him what he meant, and he said when it was built 100 years ago, builders had the common sense to understand that even a good levee system would be overtopped, so the house was built five feet above the ground. How did our present day codes, builders and engineers forget this lesson? How can we in the future re-learn it?

We can also look to others for wisdom about speeding recovery efforts. As civil engineers, we tend to think in terms of government systems and functioning within the context of those systems. But the magnitude of this challenge behooves us to step outside that box and to take a careful look at other paradigms. For example, how did private industry deal with the difficulties that Katrina laid on their doorsteps? In the immediate aftermath of the hurricane, we read reports of Home Depot and WalMart rapidly reopening their stores with dispatch and helping restore hope to their communities.

In some instances, Home Depot essentially took on the role of a first responder. For example, within days of Katrina’s landfall, Home Depot had met with the community leaders of Pass Christian, Mississippi, to identify local needs and opportunities. In partnership with those leaders, the company invested in a variety of recovery and rebuilding programs ranging from cash and supplies for the Salvation Army’s local relief operation, to construction and financing for new affordable housing units, to building the town’s first permanent public structure since Katrina – a playground surrounded by dozens of newly planted trees and shrubs as well as picnic tables and benches. The company’s engagement with local communities and investment in local
programs offers a model for businesses and non-profit organizations to make a
difference in their communities.

Last May the Business Roundtable asked the Home Depot CEO to chair its new Disaster
Response Task Force, which is composed of CEOs of member companies. The goal of
the task force is to improve the coordination of corporate America with the public and
nonprofit sectors to both prepare for and respond to natural disasters. This is an
example of the kind of disaster system that we as civil engineers need to be more aware
of, learn from, and take advantage of when the next occasion arises.

This conference is important because it calls upon us think beyond a narrow set of
disciplinary limits. It gives us the opportunity to see how the pieces fit together to
create a resilient system that will serve this area well in the future… a system that will
allow it to return to prosperity, survive future hurricanes, and give government officials
the means to manage the risks faced in this region.

- If we do this well, we can go a long way to restore the credibility of engineering
  and government.
- If we do this well, we can take the lessons learned and change the way we
  educate engineers for the future.
- If we do this well, we will be able to take pride as this important city, this iconic
  cultural asset, comes to life again.

I congratulate all of you for your willingness to join in this effort and look forward to
joining forces to see your findings put to work.