Civil Engineering in the Next Millennium

G. Wayne Clough
President, Georgia Institute of Technology

MIT Colloquium on the Future of Civil and Environmental Engineering
March 19-21, 2000
“We may need six computers worldwide, for government, etc.”

T.J. Watson, IBM, late 1940s

“There is no reason for any individual to have a computer in their home.”

Ken Olsen, Digital Equipment Corp., 1977

“640K ought to be enough for anybody.”

Bill Gates, Microsoft, 1981
In the Batter’s Box
Today’s challenges require civil engineering talent
• Genetically engineered micro-organisms will be used in the manufacture of high-strength building materials.

• Biotechnology disposal will eliminate plumbing pipes for waste.

• Photonics, lasers and fiber optics will replace metallic wiring, and computers will be pervasive in the building environment.

• Wall membranes of new materials will store and transmit light and heat.

Randall Vosbeck
Architectural Record, December 1999
Finding the Brightest and the Best
The Gathering Storm
Can We Absorb 4 Billion More?

World Population
The Rivers Are Running Dry
“The world has to significantly increase water production while at the same time restoring the world’s rivers if we are to have any hope of meeting the water needs of 8 billion people while protecting the environment.”

Ismail Serageldin

World Commission on Water for the 21st Century
Infrastructure Fails to Keep Up
One million Americans become sick every year from tainted drinking water, attributed in part to the role of decaying infrastructure in encouraging the growth of bacteria.

Centers for Disease Control
Waste Just Keeps Piling Up

Solid Waste Generated in the United States

In millions of tons

Transportation Demands Speed Up
Metro Atlanta was in violation of federal ozone standards 23 days last summer, second only to Houston which had 50 violations.
“By 2015 we can expect to see at least one major airliner crash per week... even if the current statistically safe level of air travel is maintained.”

Walter J. Boyne
Retired Airforce Colonel
Nature’s Revenge: Growing Hazard Exposure and Global Warming
There are 40% more intense Atlantic hurricanes now than there were 30 years ago.

Bill McGuire
University College, London

Global warming could increase the destructive power of hurricanes by 40 to 50% by the middle of the 21st century.

Kerry Emanuel
MIT
“More than any other time in history, mankind faces a crossroads: One path leads to despair and utter hopelessness. The other to total extinction. Let us pray we have the wisdom to choose correctly.”

Woody Allen

Side Effects
Armed with the right talent and technology, civil engineers can build the safe harbor humankind needs in the face of the gathering storm.
Technological Answers
Looking For
Civil Engineering
Solutions
Biotechnology

- Mapping the genome
- Implanting silicon chips
- Engineering living tissues
- Stretching cell longevity
American Centenarians*

*Persons who are at least 100 years old.
Microbes now clean up 80% of the world’s oil spills.
Advanced Communications: Do We Get IT?
Drafting Goes 3-D
Today’s structures:
Intelligent as well as good-looking
Digital cameras survey highways, sending a constant flow of images to a computer that manages an intelligent transportation system.
Today: Virtual reality with headgear and tactile gloves
Tomorrow: Virtual reality with neural implants
Nanotechnology and New Materials
Lighter, stronger bridge decking
Lacing Materials with Optical Sensors
New Management Strategies
Taking Business Online
The Boeing 777 has “132,500 uniquely engineered parts with a total of 3 million items. More than half of the airplane was manufactured by 487 U.S. suppliers and 58 suppliers in 12 nations… Powerful digital computer-aided design technology enabled designers to create the 777’s parts and systems as three-dimensional images… eliminating the need for a costly full-scale mockup of the plane.”

Philip H. Abelson
Science Magazine
Streamlining the Construction Process
Design-build brings all parties together around a consensus vision for the project.
Sustainability
“The environment is not a competing interest; it is the playing field on which all other interests intersect.”

Peter Dunne

*The New York Times*
“It’s not easy being green.”

Kermit the Frog
Educating a New Civil Engineer for a New Millennium
Conducting Hands-on Laboratory Work
The Classroom of the 21st Century
“The next big killer application for the Internet is going to be education. Education over the Internet is going to be so big it is going to make e-mail look like rounding error.”

John Chambers
CEO, Cisco Systems
Updating the Formal University Curriculum
The Changing Face of Civil Engineers
Drawing Minorities into our Profession
“The world is very different now, for man holds within his two hands the power to destroy all forms of human poverty and the power to destroy all forms of human life.”

John F. Kennedy
The first step toward achievement is to acknowledge the challenge.