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ENGINEERING A PLACE IN CYBERSPACE

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Unless you've been in hiding this past year, you must have heard about the Internet, that great global computer network that connects an estimated 30 million users daily in more than 80 countries. What role will this communications behemoth play in the future of the engineering profession? Will it be merely a giant marketing tool or something more?

The engineering profession is only now entering the Internet—e-mail addresses are appearing on some engineers' business cards, but very few engineering or construction firms are appearing on Internet's World Wide Web. In a cyberworld where seven-year-olds display their artwork and funeral homes present photographs of mahogany caskets on "home pages," or Web sites, it's hard to know where the engineering profession might fit, but fit it must. At press time, apparently only two construction firms—Winter Park Construction, Winter Park, Fla.; and Fletcher Pacific Construction, Honolulu—and two engineering firms—CH2M Hill and Anderson & Associates, Blacksburg, Va.—have Web sites.

"As our clients come to rely more on the Internet, we will count on their interactive input to identify exactly what information they value most," says Andre Armstrong, head of communications for Denver-based CH2M Hill. The firm's Web site is currently under construction. The Web, a system that provides hypertext and hypermedia links to other information sources throughout the Internet, is but one facet of this network that includes such things as e-mail, file transfer protocol and Usenet groups (see glossary).

"We're looking at making the published papers and presentations of our professionals available, as well as posting career

opportunities," says Armstrong. "We also plan to explore ways of linking our Web site with other Internet resources that may hold interest for our clients.

"We're not sure what's next, but we do know that the Internet's important. The last time our president and CEO [Ralph Peterson] had new business cards printed, he made sure his e-mail address was on them."

In fact, most people's introduction to the Internet is through their company's electronic mail. Don Phillips of Don Phillips Construction & Engineering, Columbus, Ohio, believes e-mail can go a long way toward solving communication problems that arise between various parties on-site. "I am based in Ohio. We recently modeled and added to a facility in Portland, Ore. Our Portland-based architect was on Prodigy [a commercial service provider], so establishing an e-mail relationship was easy."

The general contractor did not use e-mail, says Phillips. "On one trip to Portland, I took the project manager to a computer store. I bought him an external modem and CompuServe software. I chose CompuServe [a commercial service provider] because I use it at home, was familiar with it and could give him a 5 min class on e-mail.

"Within two weeks he was up and communicating. After a

month, he wondered how he had ever lived without it. Now the project architect, contractor and owner can send messages to one another, regardless of time differences," says Phillips.

Ken Anderson of Anderson & Associates believes e-mail narrows the mental distance between branch offices. He's pushing his more than 100 employees, located in four offices in three states, to use it daily. "We just opened our third branch office and we're trying to discipline ourselves to rely on e-mail. My staff told me that we needed a new fax machine, but I've been dragging my feet; there are better ways to communicate. We're trying to train ourselves to think in terms that will allow us to reduce the location limitation," says Anderson. "E-mail is absolutely critical to our operations."

Early this spring Anderson and his group created a home page for the Web. Their first attempt was rough. They included their logo, a description of their firm and a copy of the monthly company newsletter *Ampersand*.

"The Web has capabilities that most people don't know about. And in placing information on it, you need to think about it in nonlinear terms," says Karin Clark, Anderson marketing manager. "But we thought we'd first get something up and begin building on that." With the help of one of Anderson's friends who understands hypertext markup language (HTML), the company recently upgraded its home page, adding button graphics that a visitor may "push" to recover Anderson & Associate facts, examples of technology and projects, or the monthly newsletter.

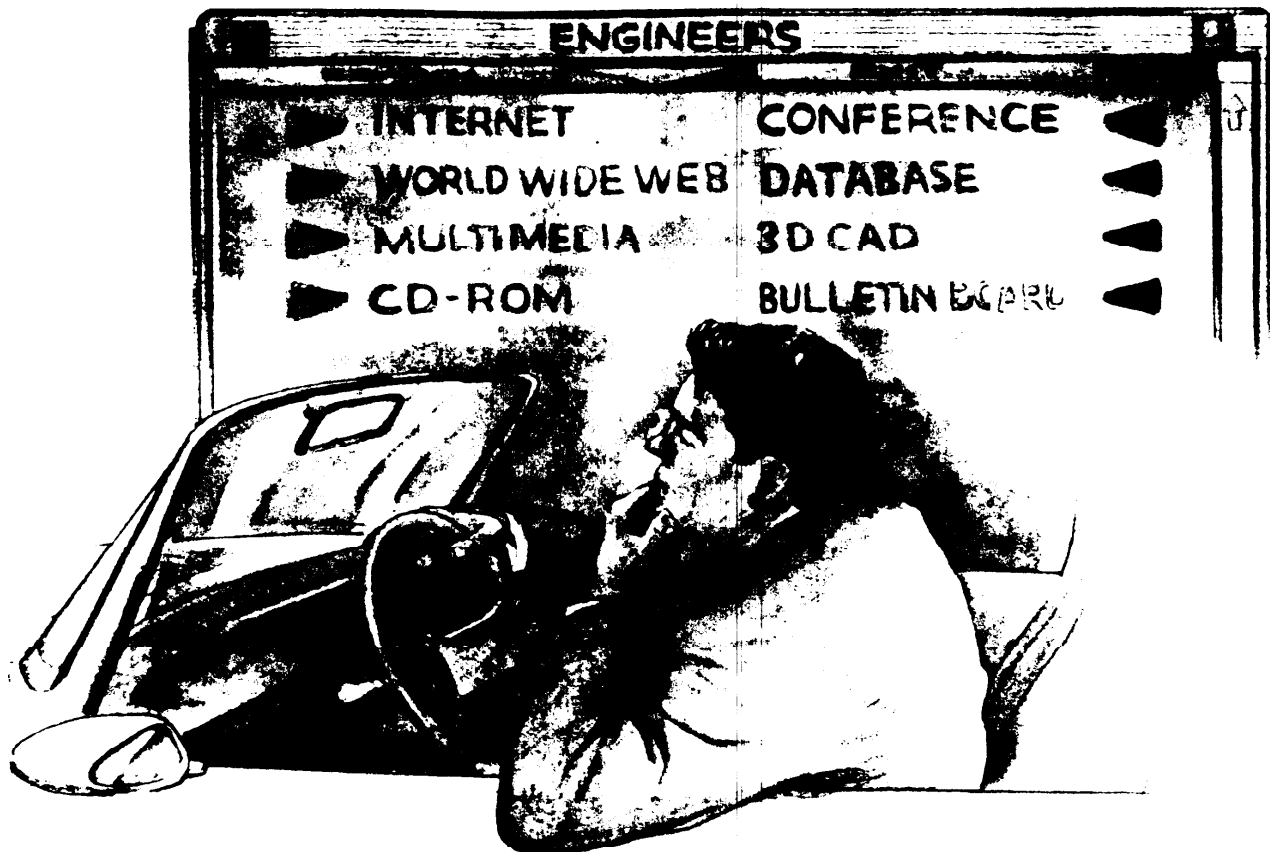
"Most of the response to our home page so far has been from students inquiring about jobs," says Anderson. "A future

update will provide some of our company philosophy, which will warn that we generally have a low initial pay scale to start and that we don't pay relocation costs. On the positive side, we will emphasize our employee ownership and our commitment to using state-of-the-art technology.

"We will use the Web for marketing, but I don't see that as such a big deal. We might, however, use it to increase the scope of our business," says Anderson. "We're a regional firm. We don't have the deep pockets necessary to compete directly for international work. But we might be able to team up with other companies to do nationally and internationally what we do best, and do it remotely through the Internet.

"We're also hoping to develop home pages for local economic development organizations," he says. "We can take our knowledge of GIS [geographic information systems] and add multimedia to create home pages that showcase an area to prospective industries around the world."

Anderson and his firm are also working with a graduate student to manage, probably for the first time, a construction project on the Web. Kaltajit De, a graduate student in construction management at Virginia Polytechnic Institute and State University, is designing a home page for the project team constructing an elementary school in North Carolina. He is currently translating into HTML construction designs; specifications; and correspondence among engineers, owners, suppliers and so on. He also hopes to place the project's AutoCAD files at the Web site. Licensed users of AutoCAD (from Autodesk, Inc., Sausalito, Calif.) who are involved with the project can then download the designs and run them on their machines.



ELECTRIFYING PUBLICATIONS

Via CD-ROM, multimedia, the Internet, on-line databases and expert software systems, ASCE is positioning itself for the 21st century. The following items, if not already a reality, are far along on the electronic drawing board. Check future issues of CIVIL ENGINEERING and ASCE NEWS for updates.

- An Internet World Wide Web site. An ASCE home page will appear on the Internet in the near future with information on society publications, upcoming conferences and future ASCE projects. Eventually, the Web site will be updated to let members order publications from an on-line ASCE publications catalog.

- A multimedia civil engineering textbook. Plans are under way to "publish" an interactive multimedia electronic textbook that will be the first of its kind for the engineering profession. The multimedia book—aimed at civil, mechanical and chemical engineering undergraduates who are studying fluid mechanics, and designed as a reference for practicing engineers—will offer pure electronic delivery and feature animation, video, audio and problem sets.

- Journals on CD-ROM. You can now subscribe to ASCE journals on CD-ROM and save both bookshelf space and research time. Using state-of-the-art Standard Generalized Markup Language, all ASCE journals on these compact discs are coded for digital electronic applications, and contain full text and content. Hypertext

applications allow rapid access to charts, graphs, and illustrations. They are compatible with Microsoft's Windows operating system.

A sophisticated search engine, OPTIWARE, developed by Reed Technology and Information Systems, Germantown, Md., executes precise or truncated word searches and Boolean logic operations. You can search using any word, author, title or subject, and can tailor the search to any combination of journals, issues or papers. A bookmark feature tags important papers. Type size and illustrations can be enlarged for easier viewing and copies of the full paper can be printed for private use.

Every journal published by ASCE appears on the disc. A customer code number allows a subscriber to access only those journals ordered. Each quarterly disc is a year-to-date accumulation of issues, ending with a final disc of the entire subscription year. Whenever you subscribe, you never miss an issue.

- CivilDisc. ASCE has produced this bibliographic and abstract database, in conjunction with the Knight-Ridder Information Services, Mountain View, Calif. (formerly Dialog Information Services), and Engineering Information, Hoboken, N.J. The special ASCE members' edition of CivilDisc provides a listing of civil engineering publications—more than 500,000 records of papers from almost 400 journals and periodicals—for the

past 20 years. With standard searching capabilities, you can pinpoint source documents by title, author, subject or time span.

- Civil Engineering Database. This on-line database provides easy bibliographic access to all Society publications published since 1975. It is available through STN International, Columbus, Ohio. More than 58,000 searchable records contain citation information, abstracts and indexing terms. It is updated bimonthly with about 5,000 records added each year.

- Wind-load expert-systems software. By the end of the year, the Society will offer interactive program software that features wind-load provisions of ASCE's *Minimum Design Loads for Buildings and Other Structures*. Forty engineers are currently beta-testing the program—its first test outside the laboratory—to verify designs against the wind-load standard. For more information contact Ashvin Shah, ASCE manager for codes and standards, tel. 202/789-2200.

These projects are only the beginning. Now that the journals are coded for electronic delivery, they eventually could be accessed over the Internet, as could other ASCE publications. Meanwhile, look for ASCE conference proceedings to show up on CD-ROM and the release of U.S. Army Corps of Engineers symbols for use with computer-aided design programs. For more information on available products, call 800/548-2723.

"Incompatibility of hardware is a problem in managing most construction projects," says De. "It's difficult to create a network among all parties because everyone uses different systems, different platforms. Some use Unix, some use PCs. The Internet offers the chance to provide uniform information and data and hypertext provide an interesting way to navigate the documents."

Hypertext allows a user to "click" on highlighted text and connect to another document or Web site that is linked to the highlighted text. For example, the owner might set up a home page showing project renderings, costs and completion dates. If the word "costs" were highlighted, then a user could click on the word to find contract documents provided by the designer, run from the design firm's server. "It doesn't matter where the information is stored. Hypertext can send the user to wherever the information is located," says De.

Information can be restricted by granting password access to approved users. But lack of true security on the Internet, thanks to much-publicized hackers, makes many company offi-

cials squeamish. "I attended a recent [Center for Integrated Facilities Engineering] conference at Stanford University," says De. "There was much discussion about security issues, but no one was really clear about what kind of information they wanted to protect. A company can spend a great deal of time and money building a 'firewall,' but it may not always be necessary." (A firewall is a series of computers set up to prevent intruders from stealing or destroying information.)

"A lot of people think things need to be secured that don't," says Anderson. "What happens if a competitor accesses information from a home page—what difference will it make?"

In addition to e-mail and the World Wide Web, there are other Internet tools that the profession may come to rely on. At Indiana DOT, contractors now must transfer designs using the Internet's file transfer protocol (FTP), a standardized method of transferring files from one computer to another. Some DOTs have Web sites (see sidebar, "Engineers' Hot List"), but Indiana DOT is apparently the first to use other Internet tools.

"Unlike other state DOTs, we've never required contractors

GLOSSARY OF ELECTRONIC TERMS

Term	Definition
World Wide Web	A networkwide software program that provides hypertext and hypermedia links to other Internet sources.
E-mail	Electronic mail sent via the Internet or another computer network.
File transfer protocol	A standardized text-based method of transferring electronic files from one computer to another.
Usenet groups	A "store and forward procedure" where a message is sent to a given host, who feeds it to other subscribers on that Usenet network. They are geared to specific topics and seldom moderated. To access a civil engineering Usenet group, specify sci.engr.civil.
Hypertext	Highlighted text that, when chosen by a user, allows the user to browse through related topics or Web sites.
Firewalls	Computers set up on a network to prevent unauthorized access.
Listserve	Similar to Usenet groups, but administered through e-mail and usually moderated.
Home page	Provides a starting point for accessing other sites (also referred to as a Web site).
Telnet	A method of logging onto another computer remotely.
Gopher	A menu-based retrieval tool that helps a user access databases, text files and other Internet resources.

to use a particular computer-aided design-compatible technology," says Bill Holloway, head of Indiana DOT's graphic engineering division (see "Connecting with DOTs," CE June 1991). "We needed standardized line styles, character fonts and naming conventions, but we didn't want to favor one brand of software over another. Not doing so made it more difficult to transfer information electronically. Now this wonderful thing called the Internet file transfer protocol has come along that allows us to have this information. It's easier and cheaper to use than translation software," says Holloway. "A typical Indiana DOT project uses 20-100 floppies to store drawings. And we do about \$400 million of projects. Instead of using floppies, we can transfer those designs through FTP. And an engineering firm doesn't need a computer staff to help them do it. They just need to access the Internet."

Holloway says Indiana DOT also will save money on the sending and printing of contracts. "Until recently we put plan drawings on Mylar and printed vast quantities of the contract to ensure that contractors would have fair access to bid information. We would run a huge printing using tons of paper, most of it eventually thrown away. With electronic transfer via FTP we can print on demand, giving contractors a first-generation copy, for a cost saving to Indiana DOT of about \$100,000 per project," he says. "And we're working with researchers at Purdue University to find even more ways to improve management and service efficiency using telecommunications advances."

Engineers in the private sector and government are not the only segment of the profession taking advantage of the Internet. Academia has been on-line from the beginning.

Nelson Baker, associate professor of civil and environmental engineering at the Georgia Institute of Technology, is overseeing the creation of a site called the Intelligent Learning Environment, which provides multimedia tutorials for engineering students. "When it is running, we can track individual performance and tailor a particular subject to the individual," says Baker. "It has an intelligent tutoring shell that incorporates multimedia to allow a student to learn in a variety of ways."

Over the past year, Baker also has been creating the Virtual Civil Engineering Library, a listing of civil engineering resources throughout the world. "A high school student from Australia recently contacted the Virtual Library for information about cable-stayed bridges for a school report," says Baker. Each hypertexted resource has a one- or two-sentence entry that describes what a particular library or facility has available. Clicking on one site in the list can transport you to that site's server, where you may find dozens of other sites to access.

Baker says the department is also considering placing student's resumes for potential employers to peruse. He recently added, with permission, an ASCE conference schedule and call for papers plus listings of several ASCE committees that are posting home pages.

Another virtual library, the Internet Connection for Engineering (ICE), has all the network resources to offer standards, bibliographic databases, patents, software, animations, statistical compilations, FTP sites and journals. You can even read or add to the latest engineering jokes.

The home page for ASCE's new *Journal of Infrastructure Systems* can be accessed from either the ICE or Virtual Library site. Journal editor Jeff Wright, also professor and director of Purdue University's Water Resources Research Center, has created a Web site that provides an introduction to the journal, its mission statement, a list of the editorial board and staff, abstracts of papers published, guidelines for authors, a call for reviewers and a password-protected status file of manuscripts under review. "We've had 42 potential reviewers sign up through the home page," says Wright, "and many more people have accessed the abstracts."

Wright chairs the ASCE Task Committee on Electronic Communications, recently established by the ASCE Technical Council on Computer Practices (TCCP). This committee has designed and presented workshops at the last two TCCP specialty conferences, and will do so again at this year's conference in Atlanta. Wright has presented the same half-day workshop at the past two ASCE Water Resources Planning and Management Division meetings. This fall he will teach a semester-long graduate course, "Internet Resources Design and Development," that will be carried regionally through Purdue's Network for Continuing Engineering Education, which is available—of course—on the World Wide Web. (For more information about the course, contact Wright at e-mail wrightje@ecn.purdue.edu.)

"The Internet has been an essential tool for many civil engineering researchers for more than a decade," says Wright. "And this is only the beginning. The Internet is almost 30 years old; the idea of an Information Superhighway is relatively new. We have a long way to go before this infrastructure is as reliable and robust as television, radio or the telephone. I hope the civil engineering profession is serious about helping to shape this future."