

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING  
UNIVERSITY OF MARYLAND, COLLEGE PARK

## Chairman's Message

The Department continues to move ever more toward new information technology in both its teaching and research. Perhaps the move is an inevitable result of the same forces in the economy as a whole. Increasingly our students are going toward careers that incorporate information technology in traditional areas of civil and environmental engineering, or they are making a transition away from traditional areas. It is not unusual today for our top students to be recruited by management consulting and systems integration companies, and at salaries substantially above what CEE firms are offering.

As with most engineering schools—indeed, university programs generally—an increasing number of our courses have become web-supported. Syllabi, reading materials, announcements, and even assignments are delivered and responded to over the web. The new Consortium for ITS Training and Education (CITE), hosted at the Department, is now delivering more than a dozen distance learning courses over the web to universities and transportation organizations worldwide.

The Department opened a new design studio this year, harking back to earlier times when all civil engineering departments hosted large drafting and design rooms. In the 60's and 70's, most of these graphics studios disappeared from the university landscape, along with the requirement of graphical problem solving courses and field surveying. But, with the advent of CAD, GIS, and 3D data

visualization, the design studio has reappeared at Maryland in the guise of computer graphics, modeling and analysis. The department is grateful to a generous gift from Greenhorne and O'Mara Incorporated and from an anonymous alumnus for making this new studio possible.

Professor David Schelling is among the faculty taking advantage of the design studio's new capabilities to change the way we deliver courses. In the past two years, Dave has fundamentally changed the way we teach steel design, along with the tool set available for structural analysis. Building on the integrative capabilities of modern office automation applications—spreadsheets, relational databases, word processors, and presentation graphics—ENCE 455 has moved away from blackboard lectures to interactive problem solving and design built around interactive computing.

Another area where information technology is having a major impact on the Department and the profession is hydrology. Through the pioneering work of Professor Emeritus Robert Ragan, the Department has long been a leader in the development of GIS technology for watershed analysis. This effort continues in the form of the Maryland GIS-Hydro program, under the able leadership of Professor Glenn Moglen, and with strong support from the Maryland State Highway Administration. The new design studio can often be found occupied by graduates and undergraduates pouring over digital maps of the mid-Atlantic

Spring and Summer 2000

## Inside

Proposed Study of Hydrologic Consequences of Land Development on Stream Environments	2
Fiber Reinforced Plastics in Highway Bridges	4
Prof. Ayyub Named SNAME Society Fellow	5
CTSM Project Update	6
New Superpave Software	8
Prof. Aggour Named Outstanding Educator	9

The **Technology Transfer Center (T<sup>2</sup>)** and the **Center for Advanced Transportation Technology (CATT)** are now located at the following address:

5000 College Ave. Ste. 3103  
College Park, MD 20742-6602  
FAX: (301) 403-4591

Dept. of Civil and Environmental Engineering  
1173 Glenn L. Martin Hall  
University of Maryland  
College Park, MD 20742  
Phone: (301) 405-7768  
FAX: (301) 405-2585  
<http://www.cee.umd.edu>

region, performing hydrologic analysis.

The advent of IT in civil and environmental engineering is causing a profound change, not only to the field, but also to the Department.

**Dr. Gregory Baecher**  
Department Chair

# Study to Examine “Smart Growth” and the Hydrologic Consequences of Land Development on Maryland Stream Environments

By Glenn Moglen

I grew up in Kensington, Maryland, about a 20 minute drive from the University. Some of my earliest memories are of playing in and around the creek that ran through a park about two blocks from my house. I'd pile up rocks in the flow, trying to dam the creek. Clearly I was an engineer and hydrologist in the bud! This, despite the fact that my mother forbade my playing there. (She later relented and just insisted that I “be careful”.) About 150 feet from that creek were a small woods that I'd also play in. If you try to find those woods now, you'll discover a small cul-de-sac street with about 5-7 houses off of it. All that is left of those woods is a small fringe of trees between the sub-division and the park.

Over the years I have met a number of lifetime Kensington natives, one in particular who remembered when Connecticut Avenue was simply “a wide dirt road”. As a kid, I used to shrug off such stories simply as boring “adult talk”. These tales were placed in the same category as the stories of hardships my parents faced walking to school in blizzard conditions and the like. Now I've observed firsthand these same types of changes. I would return to Maryland for the holidays and vacations over the course of my graduate studies and I'd always marvel at the new houses, wider roads, and greater traffic. Truth be told, that 20 minute drive from the University only applies now if the traffic is light.

So when I arrived here at the University, I remember pondering where I could find research funding. I brainstormed the pressing problems within Maryland as I saw them. Urbanization, sprawl, and concern for the Chesapeake Bay quickly came to

mind. I reasoned that funding for research that considered these issues from a hydrologic viewpoint would be plentiful and easily tapped. It has taken a while, and my initially naïve views have become refined a bit along the way, but I have recently won a significant grant from the EPA/NSF “Water and Watersheds” program. The study will examine linkages between the hydrologic consequences of land development on the stream environment from both a hydraulic and ecological perspective. The grant is multidisciplinary, involving two other Maryland professors in the Agricultural Economics and Biology departments and professors in Geology and Biology at other schools. Collectively we are studying several watersheds in Maryland from our various perspectives, drawing linkages between our disciplines to consider questions of growth impacts that could not be adequately addressed

by any one discipline alone.

As best I understand Governor Glendening's “Smart Growth” initiative, it seeks to avoid “sprawl-type” development and promote growth and urban renewal where existing infrastructure capacity (e.g. roads and utilities) can support such new growth. Maryland is perhaps the national leader in this type of effort. There's no disputing that the spirit of Smart Growth is to be commended and encouraged. However, there is a scientific void as to whether Smart Growth is truly beneficial from an environmental perspective. One question that my Water and Watersheds grant hopes to address is painfully simple: “Is Smart Growth, in fact, smart?”

Take, for example, the Northwest Branch of the Anacostia river shown in Figure 1. This figure shows the stream network and existing developed parcels of land as small black circles. Using GIS to apply a standard rainfall-runoff model, Figure 2a shows the current modeled 2-year peak discharge along the highlighted stream trace indicated in Figure 1. As would be expected, Figure 2a illustrates how the 2-year peak discharge increases in the downstream direction. The large discrete vertical “jumps” are indicative of confluences between the selected stream trace and other tributaries within the overall watershed.

To examine some very simplistic, hypothetical realizations of Smart Growth policies, we employ projections from my colleague, Nancy Bockstael, from our Agricultural Economics department. She has developed a novel economic “hazard” model that projects the likelihood and location of land development as a function of zoning

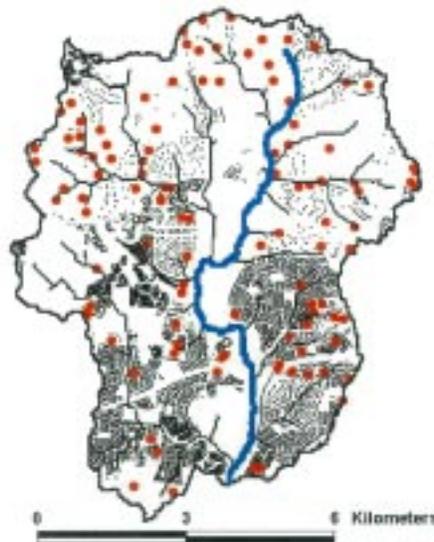


Figure 1: Existing (black circles) and projected future (red circles) development in the Northwest Branch of the Anacostia river. Blue stream indicates flowpath traced in Figure 2.

laws, population projections, and comparative values of individual land parcels in a variety of potential future land uses. Her projected development over a 20-year time horizon is depicted in Figure 1 as the large red circles. Given this projection, we will consider the following two scenarios:

**Scenario 1: Smart Growth policy dictates no new development within a given watershed.** The illustrated Northwest Branch watershed lies just west of the Paint Branch watershed in Montgomery County, Maryland. Considerable attention has been given to the Paint Branch in the debate over the construction of the Inter-County Connector (ICC). The Paint Branch is home to one of the few naturally reproducing trout populations in the area. Civic opposition to the construction of the ICC has contended that building this road would endanger the ecological health of this watershed.

In scenario 1a, all development slated for the region represented by the Paint and Northwest Branch watersheds is diverted to just the Northwest Branch watershed. In scenario 1b, the opposite is true. All development is diverted to the Paint Branch watershed. Traces labeled “Scenario 1a” and “Scenario 1b” illustrate the ratio of modeled future 2-year peak discharges to the current peak discharges given these diversions and the projected development from the economic model. Ratios greater than one in Scenario 1a indicate increases in 2-year peak discharge which can be as great as 60% more than current discharges along the stream reach between 9 and 10 kilometers from the watershed outlet. This is the price of diverting development from the Paint Branch watershed. Conversely, diverting all development from the Northwest Branch watershed leads to no change in the 2-year peak discharge as indicated by the Scenario 1b curve.

**Scenario 2: Smart Growth policy dictates all new development is to be uniformly distributed across the region.** In the spirit of spreading the impacts of development evenly, this scenario shares equally the burden of new development between the two watersheds and is shown crudely here as resulting in half the discharge increases of those modeled in Scenario 1a.

These scenarios illustrate how different policies, which seek to optimize different objectives, result in very different changes on discharge behavior within the Northwest Branch watershed. This little example provides a sense of the data, tools, and issues my grant will attempt to work with and address. I am very excited to be embarking upon this study, and my colleagues and I are hoping that our work will be valuable in helping to scientifically inform the “Smart Growth” efforts within the state and region.

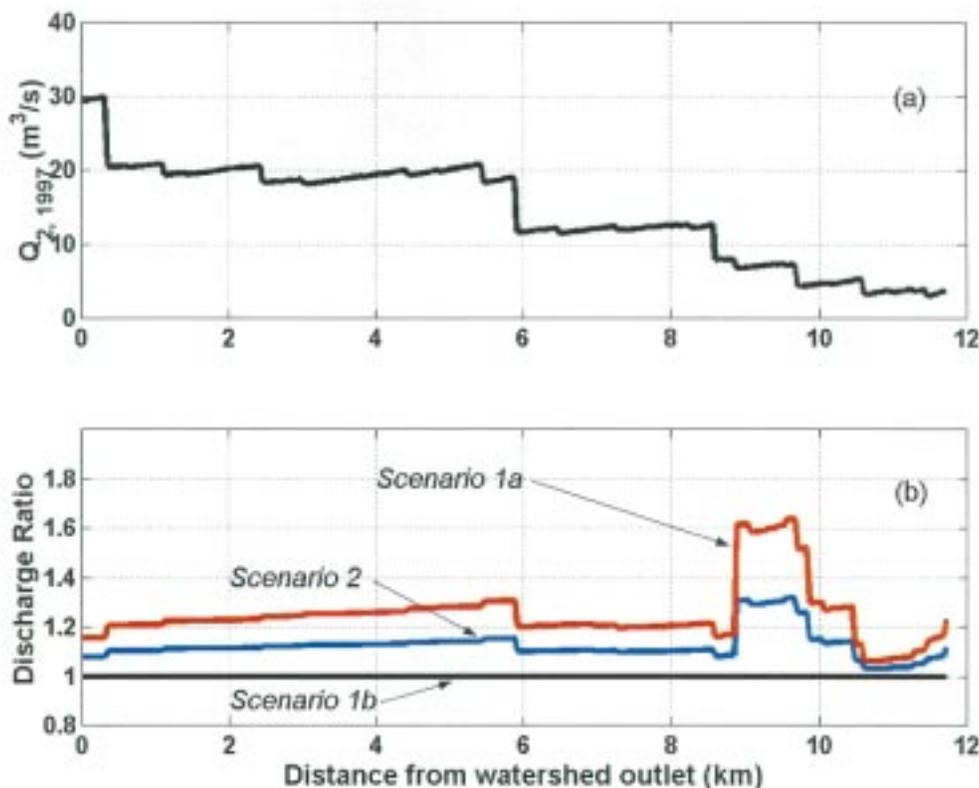


Figure 2: (a) 2-year peak discharge and (b) ratio of future to present 2-year discharge under various Smart Growth alternatives.

## Fiber Reinforced Plastics (FRP) Used in Highway Bridges

By Chung C. Fu, Ph.D., P.E.  
The Bridge Engineering Software and  
Technology (BEST) Center  
University of Maryland

The Transportation Equity Act for the 21<sup>st</sup> Century (TEA-21) was enacted on June 9, 1998 as Public Law 105-178. The Federal Highway Administration's Innovative Bridge Research & Construction (FHWA-IBRC) Program was established under TEA-21 to incorporate high-performance materials in bridge construction, renovation, and maintenance projects. There are seven goals for this program:

- (A) Development of new, cost-effective material for highway bridge applications;
- (B) Reduction of maintenance costs and life-cycle costs of bridges, including the costs of new construction, replacement, or rehabilitation of deficient bridges;
- (C) Development of construction techniques to increase safety and reduce construction time and traffic congestion;
- (D) Development of engineering design criteria for innovative products and materials for use in highway bridges and structures;
- (E) Development of cost-effective and innovative techniques to separate vehicle and pedestrian traffic from railroad traffic;
- (F) Development of highway bridges and structures that will withstand natural disasters, including alternative processes for the seismic retrofit of bridges; and
- (G) Development of new nondestructive bridge evaluation technologies and techniques.

Dr. Fu and the Bridge Engineering Software and Technology (BEST) Center, assisted by Dr. Amde, were successful in obtaining an award of \$362,500 assigned to the Maryland State Highway Administration from the FHWA-IBRC program for the first application in Maryland of a fiber reinforced polymer (FRP) bridge deck. The MD 24 bridge over Deer Creek in Harford County has been chosen for the project. Jeff Robert of the Maryland State Highway Administration is designated as the project engineer. Most of the funding will be used to acquire the

FRP deck and the rest will be used by the BEST Center for the evaluation and monitoring of the bridge.

Fiber-reinforced polymer (FRP) composites (see Figure 1) offer several cost-performance benefits for infrastructure applications. The material offers unique combinations of high strength-to-weight ratio, faster installation time, and reduced maintenance costs. With these benefits and years of proven performance of several pilot programs, FRP is considered as a replacement for steel, concrete, and wood used to build bridges.

The existing steel truss bridge (see Figure 2), built in 1934, carries two lanes

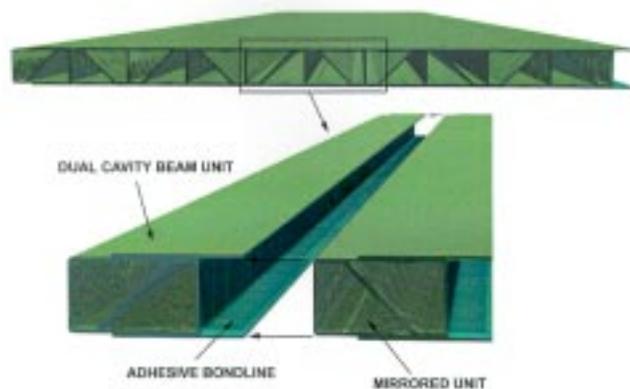


Figure 1. Schematic of Deck Panel

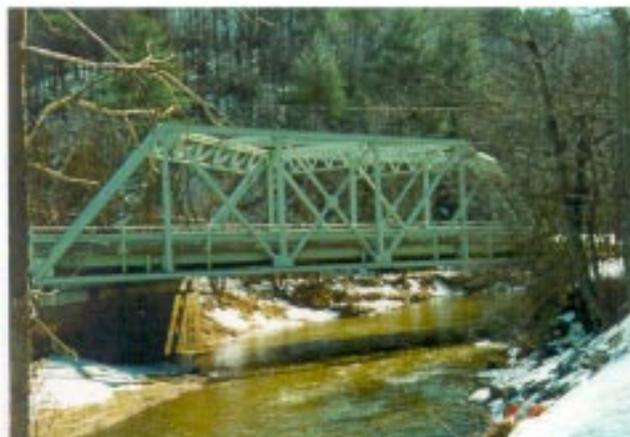


Figure 2. Truss bridge side view of MD24 over Deer Creek

of traffic, provides 30' of clear roadway, and is 123' long. The concrete deck on this bridge is in poor condition and needs to be replaced. The federal funding will be used to replace the existing concrete deck with a fiber reinforced polymer deck and to evaluate its design, constructability, and durability. The BEST Center, under the supervision of Dr. Fu, will work with manufacturers to develop plans for the replacement of the existing concrete deck with an FRP deck. When the project moves into the construction phase, the BEST Center team will check the construction plan and analyze the truss structure for the effect of dead load reduction caused by the lighter deck system.

The BEST Center team also will install a monitoring system to record the short- and long-term effects of the FRP system, including thermal effects, stress-strain relationships, bonding, deflection, and ultimate strength of the bridge.

This challenging project is now in the stage of selecting the manufacturer of the deck. During the summer 2000, the BEST Center will coordinate with the manufacturer to create contract details and submit the plan for type, size, and location (TS&L). The Plan, Specifications and Estimate (PS&E) will be submitted by the end of

September and it will be advertised for bids in October. It is estimated that the construction will be completed by September 2001 and then the BEST Center will begin monitoring the bridge's behavior for a period of one year. With this project, we will obtain a better understanding and application of the FRP deck on highway bridges.



Figure 3. Deck panel installation

## Ayyub Named Society Fellow by the Society of Naval Architects and Marine Engineers

Bilal M. Ayyub has made outstanding research contributions to reliability analysis and risk-based design, utilizing probability theory, fuzzy sets, and uncertainty modeling to produce realistic, practical solutions to design and analysis problems for marine systems. Currently, he is helping to develop reliability-based rules for ship structural design and risk-informed guidelines for assessing marine systems, dams, and personal flotation devices. He has written more than 250 articles that have been published in journals, conference proceedings, reports, and edited books. Dr. Ayyub chairs SNAME Panel HS-4 (Design Procedure and Philosophy) of the Hull Structure Committee, and is a member of the *Journal of Ship Research* Committee. He has received several

ASCE, ASNE, and NAFIPS awards, and chaired several committees.

## New Staff Maggi Gray

The Department of Civil and Environmental Engineering is pleased to welcome Magna "Maggi" Gray, our new Accounting Associate. Maggi earned her degree abroad prior to coming to the United States. Having worked for both the Department of Special Education and the College of Education here at the University of Maryland, she comes to us with a great deal of valuable experience.

Maggi has been associated with our department since November 1999. During this short period of time she has shown her great enthusiasm and willingness to do whatever it takes to make work flow efficiently. Her quiet demeanor and her attention to detail is in part responsible for her high level of

efficiency. Because of these qualities, she has been nominated for a Non-Exempt staff award.

Maggi is married and has two daughters, Mellissa and Michelle.

## Composting in the Community



Dr. Seagren's ENCE 489T, "Solid and Hazardous Waste Engineering," class on a field trip to the leaf composting facility in College Park, MD.

## Center for Technology and Systems Management

By Bilal M. Ayyub

On 17 April 2000, the Undersecretary of Defense for Acquisition and Technology officially sent a report on "An Independent Review of the Office of Naval Research Mobile Offshore Base Science and Technology Program" to the Chairmen and the Ranking Minority Leaders of both the Armed Services Committee and the Defense Subcommittee of the Committee on Appropriations in both the House and the Senate. This report has drawn extensively from and cited results produced by the CTSM on the construction feasibility of the Mobile Offshore Base (MOB). A MOB is a large platform up to 1500m (1 mile) in length by 120m (400 feet) in width that would be moved for long-term deployments in support of national defense priorities. The platform would be unprecedented in size and operations compared to any floating structure built to date. Operational requirements for the MOB include the ability to support Air Force cargo aircraft, support container ships, provide massive storage of bulk and liquid stores, house 10,000 or more troops, and discharge various amphibious craft. Additional information on the MOB is available at <http://mob.nfesc.navy.mil/>. Five concepts were provided to the Office of Naval Research (ONR), and investigated by the CTSM for their construction feasibility. The McDermott Technology Inc. concept, its components, and an

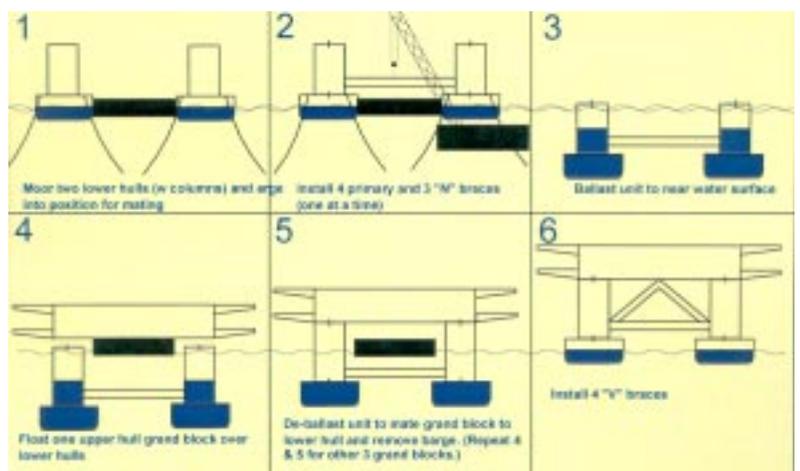
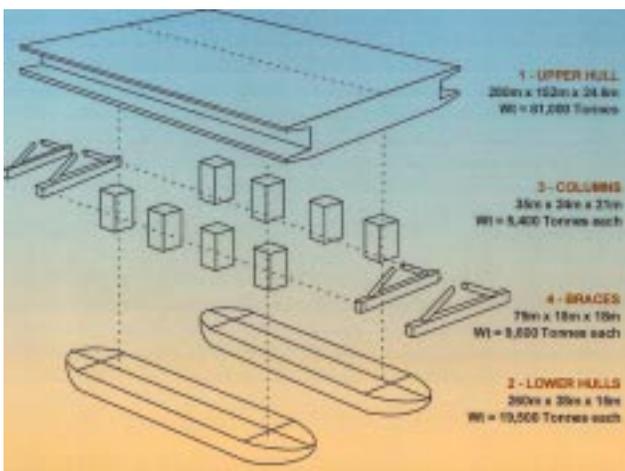


example assembly process are shown in the figures above and below. Two doctorate students have worked on the MOB project with the advisement of Professor Bilal M. Ayyub: Mr. William Bender and Mr. Andrew Blair. Mr. Blair completed his PhD degree in the Fall of 1999, and Mr. Bender was recently appointed as an assistant professor at Central Washington University.

The CTSM has recently developed general purpose, web-based reliability assessment programs for the U. S. Army Corps of Engineers. These programs are hosted on its web page for the Corps at <http://ctsm.umd.edu/> under the software tab. Corps engineers can access these programs using links from various Corps servers. The CTSM also developed programs to monitor, track and report on the use of these programs for the purpose of assisting the Corps in enhancing its

services and the support of its engineers. This project is part of a multi-year effort by CTSM personnel to build a library of reliability programs for the Corps on stability of gravity structures, piles and pile groups, and fatigue of miter gates at navigation locks. Some of the resulting reports can be downloaded from the publications tab at <http://ctsm.umd.edu/>. Dr. Bilal M. Ayyub, Dr. Khaled Elouseily and Ms. Clara Popescu were instrumental in developing these programs.

CTSM personnel have been working for the U. S. Navy to develop reliability-based design rules that are in a Load and Resistance Factor Design (LRFD) format since 1993. The rules are for surface naval ships subjected to environmental loads. The first draft of these rules was recently published by the Naval Surface Warfare Center, and is currently being



considered for use in guiding designers of several ship classes that include future land attack destroyers (DD21) and aircraft carriers (CVNX). Also, the American Bureau of Shipping has extensively drawn upon these rules in developing its classification guide of the mobile offshore base for the Office of Naval Research. Currently, the CTSM is developing similar rules for commercial ships in collaboration with the University of New Orleans. Future designs based on these rules are expected to have more consistent reliability levels than their predecessors. Ship structural integrity is key for survivability as was recently experienced with the USS Stark in the Arabian Gulf when it was accidentally struck by two missiles fired by Iraqi aircraft in 1987 as provided in the figures below. Dr. Bilal M. Ayyub, Dr. Ibrahim Assakkaf, Dr. Khaled Atua, and most recently Dr. Norma Jean Mattei were key researchers on these projects.

The research activities of the CTSM personnel also include the development of guidance on the safety of dams for the U. S. Army Corps of Engineers; the development of guidance on expert opinion elicitation for the Institute for Water Resources, hazard analysis of cargo hold spaces in auxiliary ships for the U. S. Navy, risk-based compliance approval of personal flotation devices for the U. S. Coast Guard, and risk-based lifecycle management of ships for the Ship Structure Committee; life expectancy assessment of marine structures for the Ship Structure Committee; development of reliability-based load and resistance factor design specifications for use in the AASHTO Code for the NCHRP; and development of visualization methods to aid engineers in decision making for the State Highway Administration. Currently, the CTSM is collaborating with the American Society of

Mechanical Engineers to develop risk-based standards and guidance for the design of piping in nuclear power plants, the qualification of mechanical equipment with a particular emphasis on motor-operated valves used in nuclear power plants, monitoring bio-hazardous traces in incinerators, skate parks and active recreational parks, and maintenance of port cranes. Several directors and associates of the CTSM were key in the success of these projects, including Dr. Bilal M. Ayyub, Dr. Gregory Baecher, Mr. Zbigniew Karaszewski, Dr. Joy Sircar, and Dr. Gilberto de Souza who has completed his sabbatical leave at the CTSM from the University of São Paulo, Brazil.

For additional information on any of these projects, please contact Bilal M. Ayyub at [ayyub@umail.umd.edu](mailto:ayyub@umail.umd.edu).



## New Superpave Software Hits the Street

The University of Maryland-developed Superpave software for the design and construction of asphalt concrete highway pavements made its public debut at the Transportation Research Board annual meeting in Washington, DC, last January. The software consists of modules for: volumetric design of asphalt concrete mixes; field quality control (QC); field quality assurance (QA); asphalt binder classification; and test data entry. The software is intended for use by pavement materials engineers and technicians, mix designers, asphalt paving contractors, and other asphalt paving professionals. It runs under the Windows 95/98/2000/NT operating systems.

The new software incorporates all of the latest changes to the Superpave mix design standards as approved last year by the American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Materials. It also incorporates the comprehensive temperature database developed for the Federal Highway Administration's (FHWA) LTPPBind software, making it easier for users to select the right grade of asphalt cement binder for the environmental conditions at a specific project location. Other key features include the modules for QC/QA, which allow contractors and agencies to control and verify asphalt pavement construction

quality, and the simplified compaction levels recommended by the FHWA Asphalt Mix Expert Task Group and the Superpave Lead States team and adopted by the AASHTO Subcommittee on Materials.

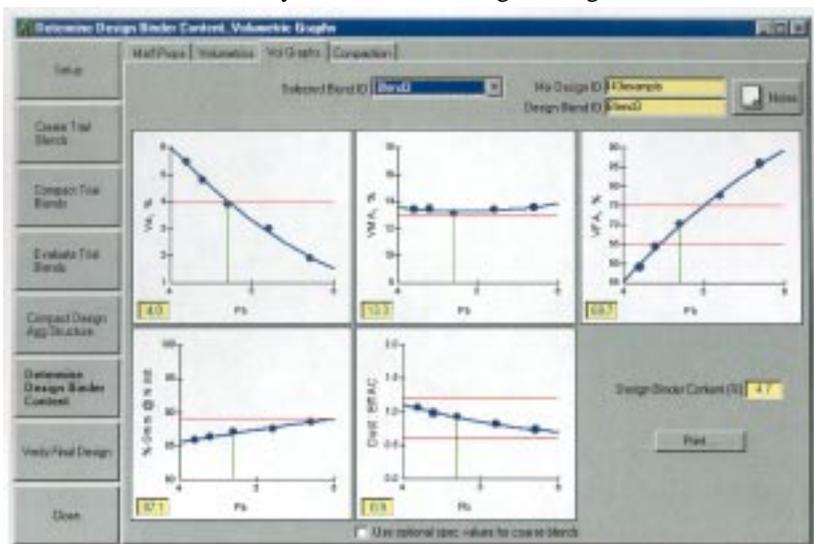
Dr. Charles Schwartz, Associate Professor of Civil and Environmental Engineering and leader of the University of Maryland team that developed the software, notes that the software not only simplifies and speeds the mix design calculations, but it also enables contractors and agencies to store, organize, and manage materials inventory and construction information with the software's database. The software also "ensures that mix designs conform to all of the latest Superpave standards," says Schwartz. "Another big advantage from a highway agency standpoint is standardized reporting of mixes and construction done by different contractors. For example, the Maryland State Highway Administration is planning to have all contractors on state road projects collect and submit all data electronically using the Superpave software."

Earlier versions of the software have already been successfully used on a pilot basis by the Maryland State Highway Administration (MSHA). A select group of Maryland contractors began using the

software for mix designs and field QC on real projects over the 1999 construction season after completing a one day training workshop. The reaction from these contractors has been "universally favorable," according to Larry Michael of MSHA.

The Superpave software was developed under FHWA sponsorship by the Superpave research team based at the University of Maryland. Final changes were made in late 1999 with support from the National Cooperative Highway Research Program. Dr. Matthew Witzak (now Professor Emeritus) is the Principal Investigator for this work, and Dr. Schwartz is a Co-Principal Investigator.

AASHTO has adopted the completed software, now named *AASHTO Superpave*, as part of its AASHTOWare catalog of products. Detailed information on the software features and support, as well as trial version downloads and online purchasing, are available at [www.aashtoware.org/superpave/spsite.nsf](http://www.aashtoware.org/superpave/spsite.nsf). AASHTO has also formed a task force, chaired by Sam Miller of the Maryland State Highway Administration, to oversee software licensing policies and support, maintenance, and enhancement services.



*Determination of Design Binder Content Using the AASHTO Superpave Software.  
(Please print to view in detail)*

## Professor Aggour Named Outstanding Educator of the Year 1999-2000 by the American Society of Civil Engineers



Dr. Aggour, an ASCE Fellow, obtained his B.S. in Civil Engineering at Cairo University in 1964 and M.S. in Structural Engineering, 1966;

and his Ph.D. in geotechnical engineering in 1972 from the University of Washington, Seattle, WA.

Before joining the University of Maryland, he worked in consulting firms. From 1972-1976 Dr. Aggour was an engineer for the geotechnical firm of Shannon and Wilson, Inc. in Seattle, WA, then from 1975-1976 was project engineer at the geotechnical firm of ATEC Associates, Inc., in Indianapolis, IN.

He joined the Civil Engineering Department at the University of Maryland at College Park in 1977 and is presently a Professor and Associate Chair of the Civil and Environmental Engineering Department. Primary teaching emphasis is in both undergraduate and graduate courses in Soil Mechanics, Foundation Engineering, Soil Dynamics, and Earthquake Engineering. He has received several teaching awards for his efforts both on campus and off. His research has included many Maryland Department of Transportation, Federal Highway, etc. investigations and research projects in geotechnical engineering, soil dynamics, and nondestructive testing of timber piles and concrete bridges. He has been the advisor of 10 Ph.D. and 44 M.S.

students. He has published more than 80 articles and 70 professional engineering technical reports in the areas of geotechnical engineering, nondestructive testing, earthquake engineering, materials, and waste disposal.

He is a registered Professional Engineer in the states of Washington, Indiana, and Maryland, a Fellow of the American Society of Civil Engineers, and a member of the National Society of Professional Engineers, American Society for Testing and Materials, Earthquake Engineering Research Institute, American Society of Nondestructive Testing, American Society of Engineering Education, and Transportation Research Board, Sigma Xi, Tau Beta Pi and Phi Kappa Phi.

### Write to Us!

We want to know what you have been doing and where life has taken you since you left UMCP. Return this form and please attach additional comments to another sheet of paper. Space permitting, we will use photos of you, your family, or your latest project. Thank you!

Send To: Gregory Baecher, Chair  
Department of Civil and Environmental Engineering  
Room 1173, Bldg. 088  
University of Maryland  
College Park, Maryland 20742

Name \_\_\_\_\_ Degree \_\_\_\_\_ Year \_\_\_\_\_

Street Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Home Phone \_\_\_\_\_ Business Phone \_\_\_\_\_

### Contributors to this issue:

Dr. Bilal Ayyub  
Dr. Gregory Baecher  
Dr. Chung C. Fu  
Dr. Glenn Moglen  
Dr. Charles Schwartz  
Dr. Eric Seagren

### Special Thanks:

Mr. Jason North  
Mr. Kevin Oberlin  
Mr. Jason Reed  
Mr. Alan Santos  
CEE Dept. Staff