

**Seattle University
School of Science and Engineering
Engineering Design Center**

**PROJECTS DAY
JUNE 3, 1994**



Welcome

Today is *Projects Day for the Engineering Design Center* a time for presenting the projects sponsored by industry and developed by seniors in the engineering design program at Seattle University. This is a wonderful opportunity for our students to share with you the results of their hours of toil.

We are most grateful to our industrial sponsors: those who are old hands at sponsoring our projects and also our new sponsors. With the recession in the Pacific Northwest, it is a tribute to your faith in our students and in the quality of their work that you choose to invest your time, people, and resources in these projects.

The senior design experience is perhaps the most important learning experience of our students' career at Seattle University. Working in small groups, solving problems that don't have answers in the back of textbooks, and being responsible to strict timelines, strict budgets, and outside agencies are surely good preparations for the engineering positions our seniors will soon fill.

We acknowledge today our student projects and our sponsors' assistance, but also we pay tribute to Dr. Rolf Skrinde for his seven years of leadership in the Engineering Design Center. Rolf, with the help of our engineering faculty, students, staff, and industrial colleagues, has brought the center from an idea to the successful educational enterprise it is today. Rolf will be leaving the directorship of the center to take a well-deserved sabbatical. We wish him well and thank him heartily for his important efforts in developing the Engineering Design Center at Seattle University. We dedicate this *Projects Day* to Rolf!

Kathleen Mailer, Dean
School of Science and Engineering

On behalf of our faculty and students, may I welcome you to *Projects Day 1994*, our seventh annual reporting of design team results to sponsoring organizations, visitors, and friends.

I would like to take this opportunity to acknowledge the encouragement and assistance provided by our Science and Engineering Advisory Board, who over the past seven years has been so helpful in achieving our goals of industrial sponsorship of design projects. I would also like to acknowledge the design coordination efforts of Professors Alvin Moser of Electrical Engineering and Ray Murphy of Mechanical Engineering. Special thanks go to the students in our engineering organizations who are your hosts today and who volunteer to carry out many of the tasks associated with our *Projects Day* event. These organizations include ASCE, ASME, IEEE, SEES, SWE, and Tau Beta Pi.

Having served as the first director of the Engineering Design Center for the past seven years, it is with pleasure that I welcome Dr. Patricia Daniels as the new incoming director, and wish her the best of success in her continuation of the design program.

Rolf T. Skrinde, Director
Engineering Design Center

Projects Day

9:00 a.m. Projects Day Registration and Tours—Lemieux Library Foyer

9:30 a.m. Project Presentations

Schafer Auditorium

- Design of a Closure Cover for Mixed Wastes
- High Speed, High Density Multiplier
- Hybrid Electric Vehicle Controls
- Verification of Bridge Design and Rating System (BDRS)
- Measurement Specifications of High-Bit-Rate Digital Subscriber Line (HDSL) System
- Cutter Design
- Assessment of Solid Waste Characterization Data
- DevDac: EMG Data Acquisition System
- Truck Mirror

Noon Lunch in the Lemieux Library Foyer

1:15 p.m. Project Presentations

Schafer Auditorium

- Chip/Substrate Model Validation
- Development of an FPGA-Based Advanced Video Frame Grabber Using Synario Design Tools
- Education Accelerometer
- Modeling and Verification of Three Phase Multi-Legged Transformers
- Computerization of the Bimanual Coordination Task
- SPICE Modeling of a Linear Variable Differential Transformer Transducer (LVDT)

Wyckoff Auditorium

- Improvement of 140th Way SE
- Design of a Discharge Flume Structure at Wolslegal Basin Puget Power White River Hydro Project
- Verification of Bridge Design and Rating System (BDRS) Computer Program for Stage-Constructed Bridges
- Weisner Drainage Study
- Cab/Sleeper Mounting Fixture
- Multiplane Motion Transfer Device

Schafer Auditorium

9:30 a.m.

Project Title: Design of a Closure Cover for Mixed Wastes
Sponsor: Westinghouse Hanford Company
Liaison Engineers: Dallas Hoover
Faculty Adviser: Professor Rolf Skrinde
Students: Jeff Dye, Steven Nicholas, Mark Stockton

Description:

The team designed a permanent cover for a mixed-waste disposal facility at the Hanford site north of Richland, Washington. The cover was designed to meet all state and federal regulations to prohibit infiltration of moisture into the storage facility. The cover consisted of a layered system of bentonite impregnated soil, geosynthetic materials, riprap, and topsoil, resulting in a permeability of less than one by 109 centimeters.

Project Title: High Speed, High Density Multiplier
Sponsor: Cascade Design Automation
Liaison Engineers: Tim Conners, Ray Farbarik
Faculty Adviser: Professor Paul Neudorfer
Students: Minh Hahh, Vadim Long, Donald Onorati, Amy Elizabeth Sutton

Description:

In the application specific integrated circuit (ASIC) design field, vendors of design systems need to provide libraries of layouts that are competitive in terms of speed and chip area. Hardware multiplication circuits in particular can originate from widely varying algorithms with resultant variance in performance and size. The team has designed a 32-bit hardware multiplier as an integrated circuit. The multiplier features reduced size and improved execution speed over previous implementations.

Project Title: Hybrid Electric Vehicle Controls
Sponsor: Seattle University
Faculty Adviser: Professor Jack Mattingly
Students: Michael Jackola, Shane Jackola, Gary McMann, Xang Moua, Lachlan Pope, Panaipon Uawithya

Description:

The purpose of this project is to improve Seattle University's hybrid electric vehicle. A hybrid electric vehicle, as its name implies, uses two power units to propel the vehicle, an electric motor and an alternative power unit (in our case, a conventional internal combustion engine). With the increased environmental sensitivity in the modern world, there is increasing concern over air pollution. Due to the heavy air pollution in the urban environment, efforts are underway to reduce automobile emissions. A vehicle with two power sources, an electric motor to produce zero emissions in an urban environment and an alternative power unit to extend the range of the vehicle, could seriously reduce the air pollution problem. The hybrid electric vehicle supplies this answer to the problem. Last year, Seattle University participated in the 1993 Hybrid Electric Vehicle Challenge sponsored by Ford Motor Company, the United States Department of Energy, and the Society of Automotive Engineers. We were one of 18 schools selected to participate in the conversion class of the challenge. The project went well, and the result was a fourth place finish overall. There were many problems with the vehicle and most of them were control oriented. It is the intent of this design project to design, build, and test modifications to the HEV that include an integrated control system and resolution of the numerous mechanical and electrical problems encountered at the 1993 competition. At the end of this process, Seattle University will again compete in the 1994 Hybrid Electric Vehicle Challenge sponsored by Saturn, the United States Department of Energy, the Society of Automotive Engineers, and Natural Resources Canada.

Project Title: Verification of Bridge Design and Rating System (BDRS) Computer Program for Stage-Constructed Bridges
Sponsor: Skilling Ward Magnusson Barkshire, Inc.
Liaison Engineer: Paul Brien
Faculty Adviser: Professor Richard Schwaegler
Students: Hans Grande, Manuelito Golez, Cedric Wong

Description:

Skilling Ward Magnusson Barkshire Inc. (SWMB) has developed a marketable computer program to design and load rate highway bridges. This bridge design rating system (BDRS) program was recently upgraded to handle more complex stage-constructed concrete drop-in-spans and post-tensioned segmental construction. The team undertook the task of verifying that the BDRS program yields consistent results for a specific type of bridge structure and construction. Their objective was to complete a detailed load rating analysis using independent hand and computer calculations for a combined cast-in-place structure plus pretensioned drop-in-span spread box girders, all made continuous with the addition of a compositely designed top slab. They compared their rating analysis to the output of the BDRS program and reported their findings to the sponsoring firm, SWMB. The actual bridge used in this analysis was the Evergreen Boulevard Under-Crossing, a part of the I-5 Interstate corridor just south of Olympia, Washington.

Project Title: Measurement Specifications of High-Bit-Rate Digital Subscriber Line (HDSL) System
Sponsor: US WEST Communications, Inc.
Liaison Engineer: Bill Liston
Faculty Adviser: Professor Patricia Daniels
Students: Mervin Casem , Ariel Jajalla, Gregory Olson, Loan Quach, David Remmerden

Description:

The team has produced data to typify the performance of the HDSL system under various conditions of signal interference. This data can be used by US West engineers to predict the success of proposed routings for new HDSL lines. HDSL is a combination of hardware and data communications protocol that provides an enhancement to the class T1 communications system. However, HDSL performance is not fully specified under conditions of signal interference such as cross talk and impulse noise. Therefore, engineers find it difficult to predict performance of an HDSL installation.

Project Title: Cutter Design
Sponsor: The Robbins Company
Liaison Engineer: Carl Lenaburg
Faculty Adviser: Professor Ananda Cousins
Students: Emily Hatt, Allan Lane, Chul Woo Lee, Derek Pagenkopf

Description:

The Robbins Company is working to increase the life of the center cutters on their Tunnel Boring Machines (TBM). The TBM functions by rotating a large drum on which free rolling discs cut rock in a manner similar to a glass cutter. The center cutter discs are in the center of the large rotating drum, and the face cutters are on the periphery. Presently, the center cutter discs wear at a rate six times faster than the face cutters. The frequency of changes currently required during tunnel boring jobs is inconvenient and expensive to the customer. Robbins asked the design team ME 94.2 to review and research the problem, and offer ideas for extending center cutter life. Thus, the primary goal of the design team was to extend wear life via center cutter redesign which entailed: 1) hardening the cutting edge material, and 2) changing the geometric design to reduce skidding.

Project Title: Assessment of Solid Waste Characterization Data
Sponsor: Weyerhaeuser Company
Liaison Engineers: Mick McCourt, Garrett Kang
Faculty Adviser: Professor Arthur Benedict
Students: Bret Beaupain, Long Bui, John Salas

Description:

The Weyerhaeuser project was a characterization study of solid waste and ash from Weyerhaeuser operations. The purpose of the study was to evaluate whether there are hazardous waste concerns with either waste. Data was placed into a uniform electronic format using GIS/Keys chemical database format. In addition, the data was summarized in tabular form for comparison with RCRA characteristic hazardous waste criteria, Washington State standards, Best Demonstrated Available Technology Standards, ECHO, CBEC and U/P list concentration standards.

Project Title: DevDac: EMG Data Acquisition System
Sponsor: DevDac
Liaison Engineers: Bruce Baker, David Hampton
Faculty Adviser: Professor Gary Erickson
Students: Lorraine Hoff, Briggs Lewis, Gregory O'Sullivan, Christopher Peterson, Ken Rulloda

Description:

Electromyographic (EMG) analyzers are typically high cost, stationary instruments. Occasionally a patient will carry about a tape recorder to record EMG over long periods, usually at a loss of resolution. The tape is later interfaced to the analyzer. The sponsor DevDac wishes to develop an EMG acquisition unit that is portable, provides diagnostic quality data, and is considerably less expensive than other such devices. The team has designed and built an EMG preamplifier and written software for capture and display of this data with a laptop computer with PCMCIA interface for a data acquisition card.

Project Title: Truck Mirror
Sponsor: PACCAR, Inc.
Liaison Engineer: Larry Orr
Faculty Adviser: Professor Gregory Mason
Students: Daniel Heiss, Travis Jacobson, David Lowe, Michael Wirawan

Description:

Cabs of heavy duty highway trucks have limited rearward visibility due to the vehicle configuration. An inside rear view mirror similar to one in an automobile is not possible because the rearward view is blocked by the truck sleeper or the truck trailer. Instead of a rear view mirror, mirrors are hung on the outside of the truck to get the best possible view on the right and left hand side. While the view from the left hand mirror is adequate, placement of the right hand mirror results in a limited field of view and long driver response time. To alleviate this problem the team designed a replacement mirror system for the existing right hand mirror. This system consists of two mirrors and a lens arranged in a periscope configuration. The first mirror is located directly in front of the driver on the truck's hood. A second mirror and lens is mounted on the right hand side of the truck. The new mirror system provides an improved right side/rearward view conveniently located directly in front of the driver.

Schafer Auditorium

1:15 p.m.

Project Title: Chip/Substrate Model Validation
Sponsor: Boeing Defense and Space Group
Liaison Engineer: Mostafa Rassaian
Faculty Adviser: Professor Dennis Wiedemeier
Students: Hans Manansang, David Quick, Scott Van Leuven, Tuan Vu

Description:

During airplane operation, electronic circuit boards located in various parts of the airplane can experience significant changes in temperatures. This causes the solder joints on the boards to expand and contract, causing cyclic stresses in the solder joints. The solder joints can fail in fatigue after a number of cycles. Design objectives for this project were to perform thermal cyclic testing on solder joints obtained from Boeing, use experimental data to verify theoretical results obtained from last year's design project, and determine the effects of ramp and dwell time on solder joints.

Project Title: Development of an FPGA-Based Advanced Video Frame Grabber Using Synario Design Tools
Sponsor: Data I/O
Liaison Engineers: Michael Holley, Steve Kaufer
Faculty Adviser: Professor Robert Heeren
Students: Brian Baggett, Ronnie Dhaliwal, Kellen Eiler, Mark Sasten, Pilar Soria

Description:

In the electronic design automation (EDA) industry, a significant problem is that of synthesizing complex digital designs across multiple field programmable gate array (FPGA) architecture. Data I/O has produced synario as a tool to solve this problem. They wish to demonstrate its case of use by showcasing a complex design produced by relatively unsophisticated users. The team has designed a full-color video frame grabber using a variety of commercially available FPGAs. All design has been done on Data I/O's synario development system.

Project Title: Educational Accelerometer
Sponsor: Allied Signal
Liaison Engineers: Tom Campbell, Mark Helsel, David Wine
Faculty Adviser: Professor Alvin Moser
Students: Christopher Akey, Burrelle Alamillo, Mercedes Bermudez, Vicki Meldrum, Aaron Wozniak

Description:

The concept of acceleration is sometimes difficult to transmit to high school, and even college students without an effective demonstration. Similarly, the principles of designing a transducer (i.e., an accelerometer) to convert acceleration to an electrical signal are not obvious even to engineers. A straightforward accelerometer for demonstrating these concepts would be valuable. The team has produced a prototype accelerometer that is of a size and durability to allow it to be used in demonstrations of the principles of acceleration and accelerometers in seminar and lecture formats.

Project Title: Modeling and Verification of Three Phase Multi-Legged Transformers
Sponsor: Seattle University
Liaison Engineer: Professor Xusheng Chen
Faculty Adviser: Professor Xusheng Chen
Students: John Gumataotao, Peter Konohia, Robert Mejdrich, Christina Ngo

Description:

The team has taken experimental data to verify a model that predicts the transient behavior of complex power transformers. The model has been developed in theory for the case of three phase multi-legged ferroresonant transformers by Professor Chen. This model can be of value to the power industry when the mathematical model is validated. Key parameters of the transformers in use are determined and Professor Chen's mathematical model is validated. The work of the team is a step toward acceptance of the model in power system analysis and design.

Project Title: Computerization of the Bimanual Coordination Task
Sponsor: Management Assistance and Concepts Corporation (MACC)
Liaison Engineer: Warren Brown
Faculty Adviser: Father Lammert Otten
Students: Joseph Deegan, Kevin Gilles, Greg Griffiths, Sophie Lim, Sonia Stout

Description:

There is much potential for applications for a device that could non-invasively test for neural impairment in the human subject. Application areas include early detection of AIDS-onset, and security clearance for access to sensitive areas. Such a device would ideally be easy to train for and use. The team has significantly extended the work of a previous team in reducing a previously manual (and tedious) test of neural impairment to a semi-automated, computer controlled task. Additionally, result data is now saved in formats compatible with standard databases for further evaluation and archiving.

Project Title: SPICE Modeling Of a Linear Variable Differential Transformer Transducer (LVDT)
Sponsor: Boeing Defense and Space Group
Liaison Engineer: Bryan Buchanan
Faculty Adviser: Professor Margarita Takach
Students: Alex Cheng, Tony Schulte, Samir Tozin

Description:

In modern design paradigms, simulation at all levels, including full systems before construction is becoming increasingly important. A design validated during simulation will typically have fewer bugs apparent when realized in hardware. Two difficulties in simulation are the simulation of inherent non-linear devices and the simulation of devices that cross the mechanical/electrical barrier, such as transducers. But models for simulating such devices are necessary in the validation of large electro-mechanical systems. The team has produced a non-linear SPICE model of an LVDT based on experimental measurements and curve fitting. The model will be used in system-level simulations of aircraft.

Wyckoff Auditorium

1:15 p.m.

Project Title: Improvement of 140th Way SE
Sponsor: Parsons Brinckerhoff Quade & Douglas
Liaison Engineers: Amarjit Marwaha, Kareem Greiss
Faculty Adviser: Professor Rolf Skrinde
Students: Heike Johnson, Kathryn Ladines, Madeline Toft

Description:

The team prepared the design of 140th Way SE near Renton, Washington, to upgrade it from a two-lane highway to four lanes plus center turning lanes at major intersections. Included also were bicycle lanes, sidewalks, and a slow-vehicle climbing lane at steep grades. The design took into account wetlands, an 80-foot drop on the east side of the road in some areas, and grades up to 10 percent. The design included horizontal and vertical alignment, super elevation, and safe sight distances.

Project Title: Design of a Discharge Flume Structure at Wolslegal Basin-Puget Power White River Hydro Project
Sponsor: Puget Sound Power and Light Company
Liaison Engineers: Fred Lunki, Pat Leach
Faculty Adviser: Professor Nirmala Gnanapragasam
Students: Chin Wei Huang, Phoebe Johannessen, Michael Magee, Thuan Nguyen

Description:

The flume at Wolslagel basin needs to be reconstructed because of erosion and deterioration of the structure and foundation. The goal of this project has been to research and identify the best material for rebuilding the flume and to provide studies, engineering, construction drawings, specifications, quantity take-offs, cost estimates and reports to support permitting and reconstruction of the flume. Tasks have included researching and reviewing existing facilities, drawing and requirements; making site visits and identifying surveying and geotechnical requirements; coordinating with hydro plant personnel; identifying scope of work, preparing recommendations and reports; and providing engineering and drafting to support the project as needed.

Project Title: Verification of Bridge Design and Rating System (BDRS) Computer Program for Stage-Constructed Bridges
Sponsor: Skilling Ward Magnusson Barkshire, Inc.
Liaison Engineer: Paul Brien
Faculty Adviser: Professor Richard Schwaegler
Students: Shayne Agawa, Erik Nakagawa, Dustin Ong

Description:

Skilling Ward Magnusson Barkshire, Inc. (SWMB) has developed a marketable computer program to design and load rate highway bridges. This bridge design rating system (BDRS) program was recently upgraded to handle more complex stage-constructed concrete drop-in-spans and post-tensioned segmental construction. The design team undertook the task of verifying that the BDRS program yields consistent results for a specific type of bridge structure and construction. Their objective was to complete a detailed load rating analysis using independent hand and computer calculations for a precast, prestressed, segmentally constructed and post-tensioned composite bridge. They compared their rating analysis to the output of the BDRS program and reported their findings to the sponsoring firm, SWMB. The bridge used in this analysis is named the Israel Road Under-Crossing and is part of the I-5 Interstate corridor just north of Vancouver, Washington.

Project Title: Weisner Drainage Study
Sponsor: King County Surface Water Management Division
Liaison Engineer: Steven Foley
Faculty Adviser: Professor Nirmala Gnanapragasam
Students: Nancy Chin, Tifo Hoang, Thomas Keown, Dale Nelson

Description:

This design project deals with a storm-water overflow problem. The site is located at the intersection of 133rd Avenue SE and SE 246th Street in the Kent-Renton area. Storm-water flows exceeding the capacity of the system between 132nd and 133rd avenues results in damage to yards, threatens homes, and flows into travelled roadways. The design effort included field surveys to determine the area contributing the storm-water and the topography of the site. Hydrologic and hydraulic modeling were then used to determine the amount and flow of floodwaters, and critical areas in the conveyance system. The design alternatives currently being evaluated are construction of detention ponds, upgrading of existing storm-water pipes and diversion of excess water through surface drains. The design standards followed are in accordance with the King County Surface Water Design Manual.

Project Title: Cab/Sleeper Mounting Fixture
Sponsor: Kenworth Truck Company
Liaison Engineer: Ken Lambie
Faculty Adviser: Professor Ray Murphy
Students: Thomas Anderson, Rikhard Bjorgum, Steven Blackburn,
Klaus Herrmann

Description:

Kenworth Truck Company has a combined production of more than 45 trucks a day at its Seattle and Renton truck manufacturing plants. Almost every truck on the assembly line has a different cab and/or sleeper configuration. To mount the cab on the chassis during truck assembly, the cab is lifted by a crane using a fixture to hold the cab. A different fixture is used for sleepers which are mounted behind the cab. Kenworth has also been developing a new product which is a cab-sleeper unibody structure called the Aero-Cab. The new product (Aero-Cab) cannot be accommodated by the current lifting fixtures. Kenworth would like to have a new lifting fixture that can accommodate all its existing cabs and sleepers, as well as the new Aero-Cab design. The task of the design team was to design, build and test a lifting fixture that can be used to lift the assembled cab from the finishing stand to the truck frame.

Project Title: Multiplane Motion Transfer Device
Sponsor: Boeing Commercial Airplane Group
Liaison Engineer: John Jewell
Faculty Adviser: Professor Ray Murphy
Students: Eric Essman, John McNaughton, James Murosako, Gilbert Tanudirdja

Description:

Motion transfer devices are mechanisms which take an input motion and transmit an output motion. The type of motion is dependent on the devices, such as gear boxes, motion amplifiers, linear actuators, and torque converters. Boeing is considering a new concept to replace these traditional motion transfer devices. This new device would use force transfer units travelling through sinusoidal races and machined in two concentric shafts to modify and transmit motion. The resultant output of the device is dependent on the sinusoidal pattern of each of the shafts. The sinusoidal paths on each shaft must have the same amplitude, but to create the desired speed reduction or amplification, their frequencies must be different. This concept claims several advantages over traditional devices, such as high speed, load sharing, low vibration, low hysteresis, less weight, and reduced space constraints. The design team designed and constructed a prototype of the motion transfer device that uses and demonstrates this concept in order to validate its cited advantages over traditional devices.

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Software Engineering

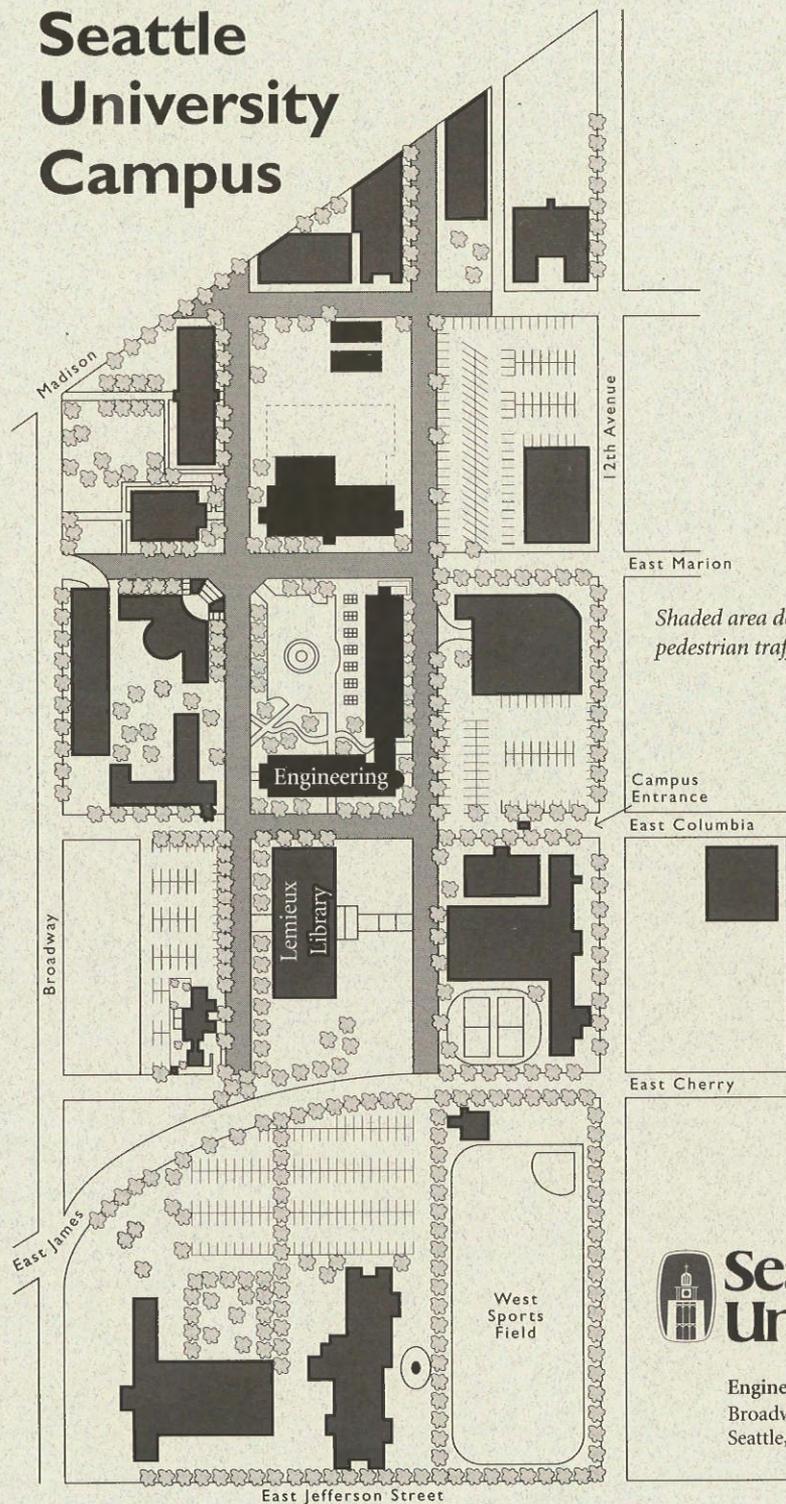
- Mr. Gene Haugen, US WEST Communications, Inc.
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Sponsoring Organizations and Liaisons

We want to acknowledge with special thanks the organizations who sponsored engineering design projects in 1993-94, and especially the liaison engineers representing the sponsors, who worked with the students throughout the year. The time these liaison representatives spent in consultation with our design teams is much appreciated by the students and their faculty advisers. It is the liaisons who provide the history and background of each project, its relationship to other work in the sponsoring organization, and much of the technical direction that makes a project successful.

Allied Signal	Tom Campbell, Mark Helsel, David Wine
Boeing Defense and Space Group	Bryan Buchanan, John Jewell, Mostafa Rassaian
Cascade Design Automation	Tim Conners, Ray Farbarik
Data I/O	Michael Holley, Steve Kaufer
DevDac	Bruce Baker, David Hampton
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Skilling Ward Magnusson Barkshire Inc.	Paul Brienien
US WEST Communications, Inc.	Bill Liston
Westinghouse Hanford Company	Dallas Hoover
Weyerhaeuser Company	Mick McCourt, Garrett Kang

Seattle University Campus



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Campus Entrance
East Columbia

East Cherry



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