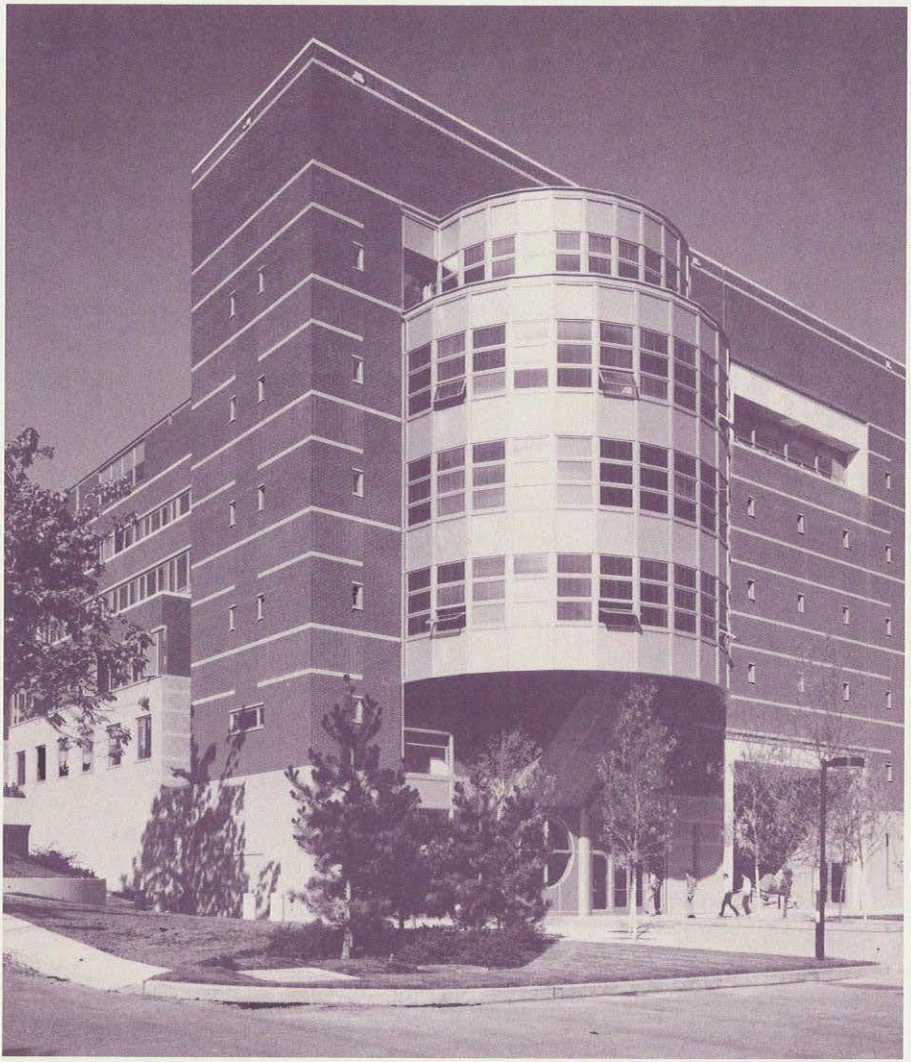
# Seattle University
# School of Science and Engineering
# Engineering Design Center

# PROJECTS DAY
# JUNE 4, 1993



# 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 programs 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. As the recession hits 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 whose "answer" is not in the back of the textbook, and being held responsible to strict timelines, a strict budget, and an outside agency is surely good preparation for the engineering positions our seniors will soon fill.*

*This is the sixth year of the Engineering Design Center's existence. As the new dean of Science and Engineering, I congratulate all those within the school and outside, and particularly director, Dr. Skrinde, for making this Center the success it is today. Welcome all of you—and thank you for joining us today.*

Kathleen Mailer, Dean
School of Science and Engineering

*May I add my words of welcome to Projects Day, 1993. I would like to acknowledge the support and assistance provided by our Science and Engineering Advisory Board, as well as each Engineering Department Advisory Board, in promoting the sponsorship of our design projects. Within our Seattle University team I would also like to acknowledge the design coordination efforts of Professors Alvin Moser in the Electrical Engineering Department and Ray Murphy in the Mechanical Engineering Department.*

*We appreciate you enjoying the day with us, participating in the paper presentations, reviewing the design projects that are exhibited, visiting our laboratories and classrooms, and sharing refreshments and lunch hosted by the Engineering Design Center.*

*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 events. These organizations include ASCE, ASME, IEEE, SEES, SWE, and Tau Beta Pi.*

Rolf T. Skrinde, Director
Engineering Design Center

# Projects Day

**10 a.m. ..... Projects Day Registration and Tours**

**11 a.m. ..... Project Presentations**

**Bannan Auditorium**

- Design of Finite Difference Analysis Program for Predicting the Thermally Induced Stresses in the Solder Bonding a Chip to a Substrate
- Improved Application Equipment for Cobactin Microbial Feed Additives
- Design of a Kenworth Truck Brake Adjustment Gauge
- Design of a SONET OC-3 Overhead Byte

**Noon ..... Lunch in the Engineering Building Gallery**

**1:15 p.m. ..... Project Presentations**

**Bannan Auditorium**

- CMOS Delta Sigma VDT Demodulator
- Medical Instrumentation to Database Interface
- Solid State Exciter Modifications
- Bi-Manual Coordination Evaluator
- Design and Test of 8 Bit CPU Core
- Stormwater Pollution Prevention Plans
- Stormwater Management at a Log Sort Yard
- Run-Off Control from Low Level Waste Trenches

**Wyckoff Auditorium**

- Compact Processing Unit Enclosure
- Stormwater Treatment System
- Airport Road HOV Study

*Hybrid Electric Vehicle Program*

- Electric Motor and Drive
- Battery System
- Auxiliary Power Unit and Drive
- Suspension and Vehicle Modification
- Driver/Vehicle Interface and System Controls

# Bannan Auditorium

## 11 a.m.

**PROJECT TITLE:** Design of Finite Difference Analysis Program for Predicting the Thermally Induced Stresses in Solder Bonding a Chip to a Substrate
**SPONSOR:** **The Boeing Company**
**LIAISON ENGINEER:** **Mostafa Rassaian**
**FACULTY ADVISER:** Professor Pierre Gehlen
**STUDENTS:** John Allen, Peter Leikvoll, David Marley, Karl Mowat

**DESCRIPTION:**
A finite difference method for predicting the thermal stresses in the solder bonding a chip to a substrate was developed. Linear elastic theory provided the differential equations linking temperature and stresses. The resulting equations were solved using finite difference techniques and a computer program. The team also used a finite element analysis program and experimentally determined results to verify the results of the program.

**PROJECT TITLE:** Improved Application Equipment for Cobactin Microbial Feed Additive
**SPONSOR:** **Bio Techniques, Inc.**
**LIAISON ENGINEER:** **Les Walters**
**FACULTY ADVISERS:** Professor Gregg Ayakawa, Professor Tom Griffith
**STUDENTS:** Fahad Al Rashid, Jason Griffith, Scott Smith, Nima Sthienchoak

**DESCRIPTION:**
Bio Techniques' product must be delivered to cattle along with other feed supplements and feed ingredients. The team designed a system to deliver the appropriate dosage of bacteria to the feed truck according to the weight of the feed ingredients input by the truck driver. The system is applicable to various feedlots, and is easily managed, recyclable and inexpensive.

**PROJECT TITLE:** Design of a Kenworth Truck Brake Adjustment Gauge
**SPONSOR:** **Kenworth Truck Company**
**LIAISON ENGINEER:** **Reid Nabarrete**
**FACULTY ADVISER:** Professor Lewis Filler
**STUDENTS:** Lloyd Esteban, Lee Perkins, Jim Stoner

**DESCRIPTION:**
All heavy-duty Kenworth trucks are equipped with air brakes. Prior to leaving the factory the truck brakes must be adjusted to meet design and Department of Transportation requirements. Brake adjustment is determined by the distance of travel of the brake chamber pushrod. The team designed and developed a tool that allows one person to measure the distance of travel of the pushrod and to determine if the brakes need to be adjusted.

**PROJECT TITLE:** Design of a SONET OC-3 Overhead Byte
**SPONSOR:** **US WEST Communications, Inc.**
**LIAISON ENGINEER:** **Paul Beckett**
**FACULTY ADVISER:** Professor Margarita Takach
**STUDENTS:** Lourdes Blanco, Eric Hartmann, Jeff Holmes, Paul Troyan

**DESCRIPTION:**
The team designed and built a working prototype of a reasonably priced test set for the fiberoptic based telecommunications system SONET (Synchronous Optical Network) at the OC3 level. This test set will allow US West technicians to conduct a quick check of functionality in an efficient manner.

# Bannan Auditorium

## 1:15 p.m.

**PROJECT TITLE:** CMOS Delta-Sigma VDT Demodulator
**SPONSOR:** **The Boeing Company**
**LIAISON ENGINEER:** **Bryan Buchanan**
**FACULTY ADVISER:** Professor Gary Erickson
**STUDENTS:** Bruce Baker, Richard Barrett, Felicia Khauv, Menaca Rangappa

**DESCRIPTION:**
The team designed and prototyped a deltasigma Analog/Digital converter configured specifically for use in conjunction with Boeing's Variable Differential Transformer transducer technology. This technology is in use in Boeing planes and presently utilizes analog output. The new device will introduce some of the benefits of digital signal transmission.

**PROJECT TITLE:** Medical Instrumentation to Database Interface
**SPONSOR:** **U.S. Public Health Service**
**LIAISON ENGINEER:** **Dave Snyder**
**FACULTY ADVISER:** Professor Al Moser
**STUDENTS:** Dino Cole, Glenn DeWysockie, Tom Gorton

**DESCRIPTION:**
The team has written and installed software in the MUMPS language to facilitate automated transmission of medical and environmental data to the POIS (Program Operation Information System) medical database being developed by the Public Health Service. The specific capabilities added are: receiving data from an ECG analysis device; use of a handheld data logger to relay data from remote environmental monitoring devices to an office POIS system; a utility routine to convert alphanumeric strings to printed bar codes which can be scanned rather than typed in; and maintenance of data transmission software previously written as the POIS system evolves and changes.

**PROJECT TITLE:** Solid State Exciter Modifications
**SPONSOR:** **Puget Sound Power and Light Company**
**LIAISON ENGINEER:** **Leroy Mock**
**FACULTY ADVISER:** Professor Xusheng Chen
**STUDENTS:** Eric Endres, Arlene Mariano, Jeff Maurer, Dave Nguyen

**DESCRIPTION:**
A microprocessor-controlled reference adjuster for solid state voltage regulators in generator plants has been implemented by the team. Performance has been analyzed, and appropriate installation documentation has been prepared. Other solutions to the problem situation have been analyzed.

**PROJECT TITLE:** Bi-Manual Coordination Evaluator
**SPONSOR:** **Management Assistance and Concepts Corporation**
**LIAISON ENGINEER:** **Warren S. Brown**
**FACULTY ADVISER:** Fr. Bert Otten
**STUDENTS:** Charry Hon San Chan, Mike Maruyama, Sami Millet, Quang Le

**DESCRIPTION:**
The Bimanual Coordination Task is a test that presently requires significant effort on the part of the administrator and produces results on paper only. The team has developed a PC-based equivalent test that is administered and scored automatically and produces results that can be saved and transferred electronically.

**PROJECT TITLE:** Design and Test of 8 Bit CPU Core
**SPONSOR:** **Cascade Design Automation**
**LIAISON ENGINEER:** **Ray Farbarik**
**FACULTY ADVISER:** Professor Paul Neudorfer
**STUDENTS:** Ron Calkins, Ardeshir Hashemi, Kevin Regimbal, Nick Tavernarakis

**DESCRIPTION:**
A micro-controller has been designed and tested by the team that has incorporated Design for Testability (DFT) principles throughout, while retaining an industry-standard operability. The design is implemented as a VLSI circuit, using the Chipcrafter silicon compiler.

**PROJECT TITLE:** Stormwater Pollution Prevention Plans
**SPONSOR:** **Port of Seattle**
**LIAISON ENGINEERS:** **David A. Aggerholm, Gary Minton, William Raymond**
**FACULTY ADVISER:** Professor Arthur Benedict
**STUDENTS:** Kelly Christy, Jon Ford, William Garrott, Abelardo Santos

**DESCRIPTION:**
The project team carried out studies and design to develop Stormwater Pollution Prevention Plans (SWPPP) for four sites used at Port of Seattle marine maintenance facilities. The SWPPPs are required by the Washington State Department of Ecology to prevent stormwater pollution, which could result from maintenance operations and storage of materials in areas that are exposed to rainwater and stormwater flows. The final report included studies leading to recommendations for Best Management Practices (BMPs), which would prevent stormwater pollution, and the effect of these BMPs on operations of the maintenance facility, staff time involved and costs.

**PROJECT TITLE:** Stormwater Management at a Log Sort Yard
**SPONSOR:** **Weyerhaeuser Company**
**LIAISON ENGINEERS:** **Philip S. Pagoria, Mari A. Chesser, Darla D. Wise**
**FACULTY ADVISER:** Professor Rolf Skrinde
**STUDENTS:** Stephen Hitch, Paul Lammer, Frederick Strick

**DESCRIPTION:**
The team developed a stormwater pollution prevention plan for a Weyerhaeuser log sort yard located at Vail, Washington. The work included the development of a site plan showing activities relating to the log sort process and the maintenance of vehicles and equipment involved in its operation. Following guidelines provided by Weyerhaeuser and the Washington State Department of Ecology, the team worked closely with site personnel to develop Best Management Practices (BMP) that would reduce or eliminate stormwater pollution. The BMPs were applied to assist in the planning and development of a new log sort yard at the site. Stormwater samples were analyzed to determine their chemical characteristics.

**PROJECT TITLE:** Run-Off Control from Low Level Waste Trenches
**SPONSOR:** **Westinghouse Hanford Company**
**LIAISON ENGINEER:** **Dallas A. Hoover**
**FACULTY ADVISER:** Professor Rolf Skrinde
**STUDENTS:** Patricia Carter, Joseph Mathieu, Carlos Rivera, Kyle Wong

**DESCRIPTION:**
The design team carried out evaluations and recommended methods for the control and disposal of runoff from capped Low Level Waste Burial Grounds (LLBG). The caps are required by the Washington State Department of Ecology during an interim 50-year period prior to removal and final disposal of the trench contents. The design team evaluated technical adequacy of alternative plans, life cycle costs, maintainability, and regulatory and Department of Ecology compliance relating to the alternatives. They selected and recommended a preferred alternative based on these evaluations.

# Wyckoff Auditorium

## 1:15 p.m.

**PROJECT TITLE:** Compact Processing Unit Enclosure
**SPONSOR:** **Battelle, Pacific Northwest Laboratories**
**LIAISON ENGINEER:** **William G. Richmond**
**FACULTY ADVISER:** Professor Rolf Skrinde
**STUDENTS:** Imelda Adhisaputra, Jeffrey Hamlin, Maciej Harezlak, Scott Tkach

**DESCRIPTION:**
One of the remediation processes being developed by Battelle for high-level wastes stored in tanks is the use of portable Compact Processing Units (CPU) that may be set up at each storage tank site. The waste will be drawn from storage and treated by processes located within the CPU. The CPUs must be heavily shielded to withstand the intense radiation. The design team evaluated several conceptual geometric designs of a CPU unit. For the preferred concept they designed the structures to include the shielding required as per regulatory standards, the structural foundation support and portable transport requirements.

**PROJECT TITLE:** Stormwater Treatment System
**SPONSOR:** **The Boeing Company**
**LIAISON ENGINEERS:** **Hal F. Alsid, Michael J. Reeve, Jeffrey L. Kellett**
**FACULTY ADVISER:** Professor Jean Jacoby
**STUDENTS:** Joe Dibee, Chris Kirkendall, Kris Stout

**DESCRIPTION:**
The Boeing Company treats stormwater from roads and parking lots at its Frederickson site (Puyallup, Washington) using detention ponds, oil/water separation, and biofiltration. Biofiltration, or grassy swales, are typically shallow, broad-bottom ditches with a dense growth of grasses, which physically remove pollutants from the water. The design team evaluated the pollutant removal effectiveness of two of the biofiltration swales, which follow stormwater detention and oil/water separation facilities at Frederickson. Using automated water samplers, the team collected stormwater samples from the biofilter influent and effluent during three-hour periods of multiple storm events in winter-spring 1993. These samples were analyzed for various metals and total petroleum hydrocarbons to assess pollutant removal efficiencies of the two biofilters. The team evaluated design criteria for the swales and recommended improvements to enhance swale performance.

**PROJECT TITLE:** Airport Road HOV Study
**SPONSOR:** **Parsons Brinckerhoff Quade & Douglas, Inc.**
**LIAISON ENGINEER:** **Susan Heutmaker**
**FACULTY ADVISER:** Professor Rolf Skrinde
**STUDENTS:** Richard Long, Trung Dinh Pham, Scott Soiseth, Jeannette Taylor

**DESCRIPTION:**
The design team determined the best use of High Occupancy Vehicle (HOV) lanes on 10 miles of the Airport Road Corridor, from SR 526 to Seattle Hill Road in Snohomish County. Measure of Effectiveness (MOE) studies included travel time savings, impact on overall traffic operations, safety impacts, travel time reliability and effectiveness in enhancing the regional HOV system. The final report included results of the study and recommendations of the best HOV method and design to apply to this arterial.

## Hybrid Electric Vehicle Project

*(see page 15)*

**PROJECT TITLE:** Electric Motor and Drive
**SPONSORS:** **Ford Motor Company, United States Department of Energy, Society of Automotive Engineers, Seattle University**
**FACULTY ADVISER:** Professor Stephen Robel
**STUDENTS:** Osama Alhouri, Peter Cao, Mark Ishida, Doug Morrison, Robert Vawter

**DESCRIPTION:**
The Electric Motor and Drive System team was responsible for determining the power requirements for the electric motor and drive, the type and size of the electric motor and controller. The team designed and effected modifications to the vehicle structure needed for installation of the motor and controller. The team installed the system in the vehicle, and tested the system to ensure it is safe, operational and compatible with the other vehicle systems.

**PROJECT TITLE:** Battery System
**SPONSORS:** **Ford Motor Company, United States Department of Energy, Society of Automotive Engineers, Seattle University**
**LIAISON ENGINEERS:** **Ted Sherzinger, Lew Plummer, PACCAR Technical Center**
**FACULTY ADVISER:** Professor Robert Heeren
**STUDENTS:** Brian Berryessa, Mark Henry, Paul Roos, Peter Trinidad

**DESCRIPTION:**
The work accomplished by the Battery System group includes four tasks: 1) Battery selection in conjunction with the overall vehicle contest strategy and battery-charging strategy, which included selecting a battery charger. 2) Design, construction and installation of a battery containment structure (sealed and vented) which secures the

batteries to the frame of the vehicle and contain the batteries in the event of impact or roll over. 3) Interconnection of batteries and any other necessary wiring related to the electric drive system. 4) Testing of the entire system in the vehicle prior to the contest.

| | |
|---|---|
| **PROJECT TITLE:** | Auxiliary Power Unit and Drive |
| **SPONSORS:** | **Ford Motor Company, United States Department of Energy, Society of Automotive Engineers, Seattle University** |
| **LIAISON ENGINEER:** | **Mike Haynes, Puget Sound Power and Light Company** |
| **FACULTY ADVISER:** | Professor Jack Mattingly |
| **STUDENTS:** | Marvin Baresh, Richard Batuna, Philip Kartes, Rhonda Knutson |

**DESCRIPTION:**
The design team provided the auxiliary power unit (APU) for this vehicle. This entailed determining the power requirements for the APU, the type and size of the internal combustion engine and transmission, the type of fuel to be used, the configuration and placement of the fuel tank, the design of the mounting system, and the installation of a halon fire protection system. The team installed the system into the vehicle and tested the system to ensure that it is safe, operational and compatible with other vehicle systems.

| | |
|---|---|
| **PROJECT TITLE:** | Suspension and Vehicle Modification |
| **SPONSORS:** | **Ford Motor Company, United States Department of Energy, Society of Automotive Engineers, Seattle University** |
| **LIAISON ENGINEER:** | **Roger Sackett, Machine Design Engineers, Inc.** |
| **FACULTY ADVISER:** | Professor Dennis Wiedemeier |
| **STUDENTS:** | Marzouq Al Ghanim, Jonas Hinton, John Kladouris, Anthony Teo |

**DESCRIPTION:**
The Suspension and Structural Modification group was responsible for making all required modifications to the suspension system of the HEV. Other responsibilities include design, fabrication and installation of the roll bar, replacing seats, tires wheels, modifying the braking system as required and ensuring overall vehicle structural integrity.

The suspension system modifications consisted of installing an alternate rear axle assembly and upgrading other suspension components, such as springs, sway bars and shocks. Testing of designs, modifications and structural integrity were conducted to ensure a safe and operational vehicle.

| | |
|---|---|
| **PROJECT TITLE:** | Driver/Vehicle Interface and System Controls |
| **SPONSORS:** | **Ford Motor Company, United States Department of Energy, Society of Automotive Engineers, Seattle University** |
| **LIAISON ENGINEERS:** | **Ken Brown, Anderson Controls** |
| **FACULTY ADVISER:** | Professor Ray Murphy |
| **STUDENTS:** | Roger Baldevia, John Luoma, Jim Swanson, Steve Thompson |

**DESCRIPTION:**

This team was responsible for designing the driver/vehicle interface and necessary controls for the vehicle. This includes equipment for monitoring and collecting data from all active control systems on the vehicle, for developing appropriate strategies for efficient response to immediate conditions, while complying with all regulations, legal requirements and contest rules. The primary concern was in the operation and control of the vehicle when the hybrid mode of operation is active.

# Departmental Advisory Boards

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*Also, the chair and vice chair of each departmental advisory board are SEAB members.*

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Mr. Joel Frenk, Boeing Computer Services

# Sponsoring Organizations and Liaisons

*We want to acknowledge with special thanks the organizations who sponsored engineering design projects in 1992-93, 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.*

Battelle, Pacific Northwest Labs ..... William G. Richmond

Bio Techniques, Inc. ..... Les Walters

The Boeing Company ..... Hal F. Alsid
Michael J. Reeve
Jeffrey L. Kellett

The Boeing Company ..... Mostafa Rassaian

The Boeing Company ..... Bryan Buchanan

Cascade Design Automation ..... Ray Farbarik

Kenworth Truck Company ..... Reid Nabarrete

Management Assistance and Concepts Corporation ..... Warren S. Brown

Parsons Brinckerhoff Quade & Douglas, Inc. ..... Susan Heutmaker

Port of Seattle ..... David A. Aggerholm
Gary Minton
William Raymond

Puget Sound Power and Light Company ..... Leroy Mock

Seattle University—HEV ..... Ted Sherzinger, PACCAR Techincal Center
Lew Plummer, PACCAR Technical Center

Seattle University—HEV ..... Mike Haynes, Puget Sound Power and Light Company

Seattle University—HEV ..... Roger Sackett, Machine Design Engineers, Inc.

Seattle University—HEV ..... Ken Brown, Anderson Controls

US Public Health Service ..... Dave Snyder

US WEST Communications, Inc. ..... Paul Beckett

Westinghouse Hanford Company ..... Dallas A. Hoover

Weyerhaeuser Company ..... Philip S. Pagoria
Mari A. Chesser
Darla D. Wise

# Hybrid Electric Vehicle Projects

*Seattle University is one of 30 schools nationwide selected by the Ford Motor Company, The Society of Automotive Engineers, and the U.S. Department of Energy to design and build a hybrid electric vehicle. A hybrid electric vehicle is a car designed to have two sources of power. The primary source of power is an electric motor, which receives power from a battery pack located in the vehicle. The secondary source of power is an internal combustion engine. Ford Motor Company donated a 1992 Ford Escort station wagon to the university. The design and modification of the Ford Escort, to convert it into a hybrid electric vehicle, was accomplished by five teams. The vehicle is entered into a national competition taking place in Dearborn, Michigan, in June 1993.*

# Sponsors for, and Major Contibutors to, the HEV Project

## Material, Equipment, and Services:

Ford Motor Company, Dearborn, MI
Dyno Battery, Ballard, WA
ICI Fiberite, Charlotte, NC
Northwest Composites, Marysville, WA
Kilsby-Roberts, Kent, WA
Oregon Metal Slitters, Portland, OR
BP Oil Company, Cleveland, OH
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PACCAR Technical Center, Mt. Vernon, WA
Seattle Boiler Works, Seattle, WA
Anderson Controls, Kent, WA
Goodyear Tire and Rubber Co., Akron, OH

## Financial Contributions:

Golder Associates, Redmond, WA
Johnson Controls, Milwaukee, WI
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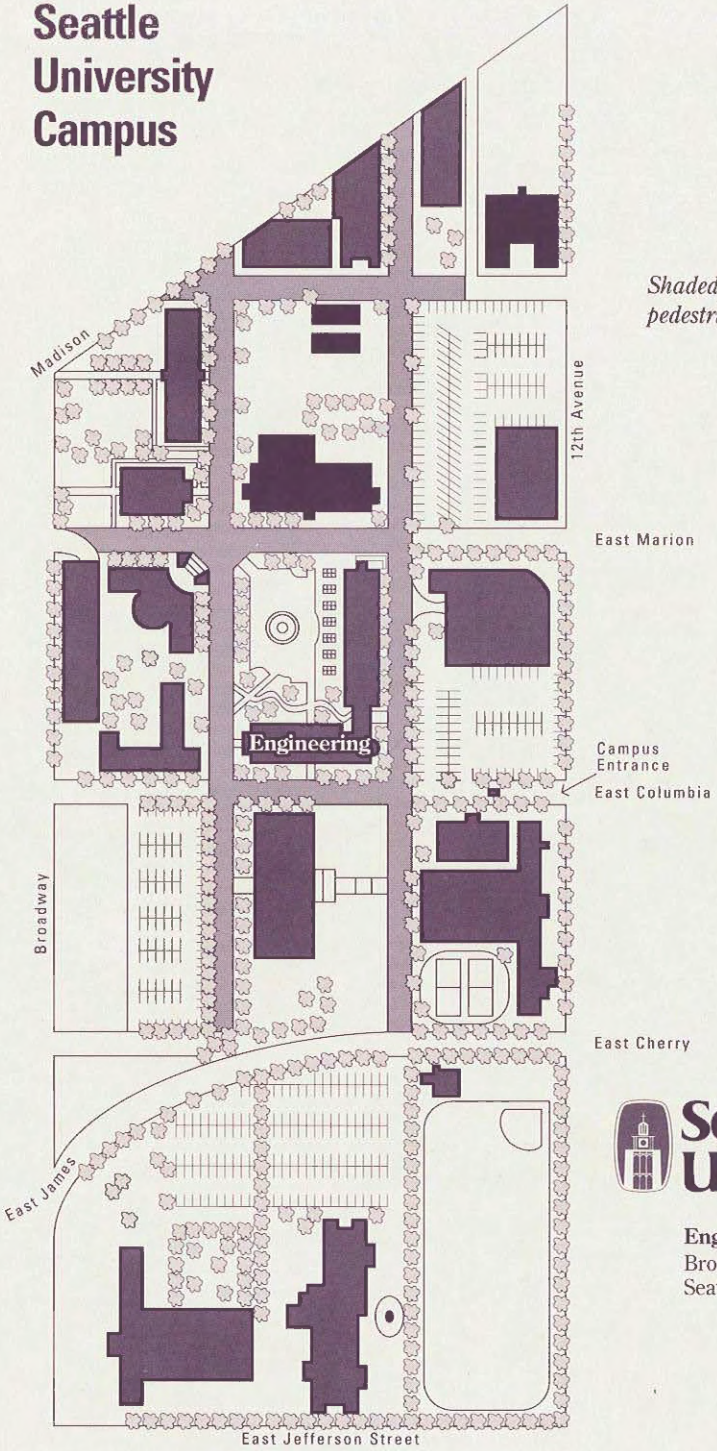
# Seattle University Campus

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