

SEATTLE UNIVERSITY

School of Science and Engineering
Science and Engineering Project Center

PROJECTS DAY

June 2, 1995

Senior Design Projects 1994-95



W E L C O M E

On this, Projects Day 1995, we present the results of student work sponsored by industry and government and developed by senior students 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 and government sponsors: those who are old hands at sponsoring our projects and also those who are our new sponsors. 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 this student work and the Science and Engineering Projects Center.

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 timeliness, strict budgets, and outside agencies are surely good preparations for the engineering positions our senior will soon fill.

Today we acknowledge our student projects and our sponsors' assistance. We also welcome Dr. Patricia Daniels, who has just completed her first year as director of the Projects Center. We welcome Ms. Sheridan Botts, from the Contract Office, another new hand in the Projects Center. With the help of Dr. Daniels, Ms. Botts, and our sponsors, the Science and Engineering Projects Center provides students with the bridge between the classroom and laboratory work of university and the "real world" of engineering. On a final note, let us acknowledge our soon-to-be new engineers as they tell us today how their projects helped them cross that bridge.

*Kathleen Mailer, Dean
School of Science and Engineering*

On behalf of our faculty and students, I also welcome you to Projects Day 1995, our eighth annual presentation of design team results to sponsoring organizations, visitors and friends. I would like to thank Dr. Rolf Skrinde, the founding director of the Seattle University Engineering Design Center, for his outstanding leadership in building our design program. This year we have changed our name to the Science and Engineering Project Center to reflect our interest and that of our industrial and government partners in developing more interdisciplinary research and design projects.

I am grateful for the encouragement and assistance provided by our Science and Engineering Advisory Board, and especially its Project Center Committee, in promoting the external sponsorship of our design projects. We also have had the benefit of the expertise and advice of Mr. Bill Finnegan, former chair of our Science and Engineering Advisory Board, who worked closely with us this year in the continuing development of the Project Center. I would also like to acknowledge the design coordination efforts of professors Arthur Benedict in civil and environmental engineering, Alvin Moser in electrical engineering, and Ray Murphy in mechanical and manufacturing 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 celebration. These student societies are the American Society of Civil Engineers; the American Society of Mechanical Engineers, the Institute of Electrical and Electronics Engineers, the National Society of Black Engineers, the Society of Environmental Engineers and Scientists, the Society of Women Engineers and Tau Beta Pi.

*Patricia D. Daniels, Director
Science and Engineering Project Center*

PROJECTS DAY

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

9:30 a.m. Project Presentations

Schafer Auditorium

Design of a Stormwater Treatment System

Mixed Signal Integrated Circuit Design

Thermal Analysis of a Multi-Chip Module

Assessment of Forest Product Industry Sludges for
Hazardous Waste Characteristics

Viewer-Editor for True-Type® Font Files

Design and Testing of a Hydraulic Bearing for
a Tunnel Boring Machine

Chemical Product Substitution Research

Mark-7 Motor Controller

Design of a Two-Speed Manual Drive for Wheelchairs

12:30 p.m. Lunch in the Lemieux Library Foyer

1:30 p.m. Project Presentations

Schafer Auditorium

Des Moines Creek Basin Detention Facility Study

Stream 1 Crossing Design

Twin Tunnels Foot Bridge Design

Courtad Drainage Study

SR-520/I-5 Express Lane Ramp Connection:
Structural Design

Stimson Room

Development of a Quick Access Recorder

Torsion Bar Suspension Improvements

Optimal Two's Complement Adders

Fatigue Evaluation of Chip Bonded to Substrate

Design and Validation of a SPICE Model

Project Title: Design of a Stormwater Treatment System
Sponsor: Weyerhaeuser Company
Liaison: Darla Wise
Faculty Advisor: Prof. Nirmala Gnanapragasam
Students: Yonia Akini, Colin R. Elliott, Katie Gazarek, Tri Ong

Description:

The team designed a stormwater treatment system to treat stormwater runoff from the Everett pulp mill waste site on Smith Island, prior to its discharge into the Snohomish River. In order to develop an efficient design, the team defined the drainage area, determined the quantity and quality of runoff, and decided on a suitable location for the treatment system. The team also performed a feasibility study to evaluate cost, maintenance and constructability issues.

Project Title: Mixed Signal Integrated Circuit Design
Sponsor: Boeing Defense and Space Group
Liaison: Bryan Buchanan
Faculty Advisor: Prof. Gary Erickson
Students: Princet Gill, Joseph Hale, Michael Hoornstra, Kristin Meijer

Description:

This group carried out the design and construction of a digital frequency synthesizer with analog output. The synthesizer produces a sine wave output with low distortion. The frequency is digitally selectable from 50, 60, and 400 Hz. The phase is also digitally selectable as 0, 120, or 240 degrees. The design can also be implemented as a single chip.

Project Title: Thermal Analysis of a Multi-Chip Module
Sponsor: Boeing Defense and Space Group
Liaison: Devin Hersey
Faculty Advisor: Prof. Ray Murphy
Students: Ahmad Al-Qattan, William Anderson,
Martin Woodard, Eric Zumdieck

Description:

The project consists of validating the assumptions and evaluating the performance of existing Multi-Chip Module (MCM) thermal models. Currently the Boeing Defense and Space Group uses highly simplified computer thermal models with non-validated assumptions to predict how the heat will flow throughout the MCM. The design team has built thermal models for a thick-film MCM, using finite element analysis and employing computer spread sheets. The team obtained test data by instrumenting the MCM with microthermocouples and has taken thermal images of the component during operation. The finite element model and the test data were compared in order to determine which assumptions produce the best correlation.

Project Title: Assessment of Forest Product Industry Sludges for Hazardous Waste Characteristics
Sponsor: Weyerhaeuser Company
Liaison: Mick McCourt
Faculty Advisor: Prof. Arthur Benedict
Students: Raymond Chu, John Gemin, Kevin J. Stoll,
Michelle Whisman

Description:

This project involves evaluating analytical data on sludges from over 40 Weyerhaeuser operations to determine if any exceed state and federal criteria for designation as hazardous waste. Existing and expected state and federal hazardous waste regulations were reviewed to identify appropriate criteria. Potential beneficial reuse of forest product solid wastes was also analyzed and compared to existing methods of disposal.

Project Title: Viewer-Editor for TrueType® Font Files
Sponsor: ElseWare Corporation
Liaison: Bill Kuhn
Faculty Advisor: Prof. Alvin Moser
Students: Anna Chang, Bridget Dwyer, Matthew Harkins,
Leanne Cheung, Loren Eubank

Description:

The team designed a Windows™ application that is able to open a TrueType® font file and display the various tables defining the font. The tables may also be edited and the new font file saved. The development was done with Microsoft's Visual C++™ and is based on Microsoft Foundation Classes. It conforms with Microsoft Windows design standards and ElseWare's coding standards. The design is modularized such that viewing and editing of other font formats can be incorporated.

Project Title: Design and Testing of a Hydraulic Bearing for a
Tunnel Boring Machine
Sponsor: Robbins Company
Liaison: John Gibson
Faculty Advisor: Prof. Gregory Mason
Students: Scott Crawford, Susan La Point, Mark Williamson

Description:

The design team has evaluated the feasibility of two separate bearing designs for use in small tunnel boring machines. Evaluation was accomplished through the design, construction, and testing of a bearing model. Design parameters and specifications for this model met those provided by the Robbins Company. The model was tested and evaluated under a variety of conditions.

Project Title: Chemical Product Substitution Research
Sponsor: Weyerhaeuser
Liaison: Chuck Bradley
Faculty Advisor: Prof. Amani N. Abdelmessih
Students: Michael J. Harrington, Heather M. Harris,
Andrew J. Hendrickson, Heidi M. Reynolds

Description:

The objective of this project is to develop a systematic approach for selecting products to be used for industrial applications. The design team conducted an in-depth review of existing literature and corresponded with both product vendors and industry representatives. The team has developed a unique approach for evaluating products. The selection process consists of two phases: a preliminary evaluation, and, if needed, an in-depth analysis including process modification or alternative technologies. The major criteria are: regulations, effectiveness, worker and environmental safety, characterization of wastes generated, and cost. The selection process is further fine tuned via the evaluation and subsequent recommendation of specific products.

Project Title: Mark-7 Motor Controller
Sponsor: Waterfront Construction
Liaison: Rod Wilcox
Faculty Advisor: Prof. Xusheng Chen
Students: Sandon Broek, Gia Le, Debra Lowe, Steve Tang,
Ann Vanlandingham

Description:

The team carried out a complete redesign of the controller for a commercial boat lift. The controller can be constructed with various options specified by the customer. Primary goals in this project have been reduction in material cost and reduction in assembly labor. Attention has also been paid to maintaining those features needed for U.L. certification.

Project Title: Design of a Two-Speed Manual for Wheelchairs
Sponsor: University of Washington/Harborview
Rehabilitation Medicine Center
Liaison: Anthony J. Margherita, MD.
Faculty Advisor: Prof. Ananda Cousins
Students: Khaled A. Al-Awadhi, Rebecca Aleshire,
Jean M Livesay, Myke J. Woodwell

Description:

The team has designed, constructed, and tested a prototype two-speed manual drive that can be retro-fitted on existing manual wheelchairs. The two-speed capability increases the mobility of persons using wheelchairs by allowing them to progress up inclined surfaces with less effort than previously possible in manual wheelchairs. The design is especially targeted toward paraplegic and quadriplegic users. The final design was based on the following constraints: the user must be able to move easily through a standard doorway; the existing mobility of the user must be maintained (backward, forward, and turning motion); the existing center of gravity and stability should not change; and the system must be fail-safe and user-friendly.

Project Title: Des Moines Creek Basin Detention Facility Study
Sponsor: City of Des Moines, Washington
Liaison: Loren Reinhold
Faculty Advisor: Prof. Gary Minton
Students: Chris Eggers, Court Harris, Ravi Singh,
Curtis F. Steinke

Description:

The basin study focuses on the mitigation of stormwater-related effects in the Des Moines Creek watershed. These effects, which include flooding, erosion, sedimentation, and the destruction of fish habitat, have adversely affected Des Moines Creek. The team performed a hydraulic and hydrologic analysis of the watershed followed by a detention facility site assessment based on current wetlands and FAA regulations, and current and future land use plans. Preliminary designs for detention, including costing, have been submitted by the team as a finished product.

Project Title: Stream 1 Crossing Design
Sponsor: USDA Forest Service
Liaison: Janel Winborne
Faculty Advisor: Prof. Nirmala Gnanapragasam
Students: Glen Anderson, Jim L. Gessford, Ingrid Haynes,
Craig Moore

Description:

Phase II of the Iron Goat Trail construction includes the construction of a stream crossing and a ravine crossing of two locations on the trail. The team carried out surveying, geotechnical and hydraulic analyses for both sites. The team also proposed four conceptual designs for the stream crossing for which complete design analyses were performed.

Project Title: Twin Tunnels Foot Bridge Design
Sponsor: USDA Forest Service
Liaison: Janel Winborne
Faculty Advisor: Prof. Richard Schwaegler
Students: Loren Gehring, Steven Marshall, Bradley Swanson,
Kylie Yamatsuka

Description:

The USDA Forest Service, Skykomish Ranger District, has requested the design of a 100 ft. long timber foot-bridge. The construction of this bridge allows for the extension of the lower segment of the historic Iron Goat Trail in the Stevens Pass area. The project entails submitting three schematic proposals to the Forest Service for the foot-bridge at the Twin Tunnels stream crossing site. After a brief review of these three schemes, the Forest Service selected one for final design. The design team then proceeded with the final design calculations and generation of construction documents, including design drawings and specifications.

Project Title: Courtad Drainage Study
Sponsor: King County Surface Water Management
Liaison: Steve Foley, Bruce Johnson
Faculty Advisor: Prof. Robert Cornwell
Students: Steve R. Chapman, Pauline G. Irawan,
Vivianne W. Louie

Description:

The design team developed a solution to a flooding complaint filed by a county resident near the city of Bothell, Washington. A drainage channel on the complainant's property is filling up with gravel and other sediments as a result of storm water flows. During heavy rainstorm events, this channel overflows its banks threatening the complainant's house and that of a neighbor. The team's task was to evaluate several alternatives and recommend a solution to the county.

Project Title: SR-520/I-5 Express Lane Ramp Connection:
Structural Design
Sponsor: Parsons Brinckerhoff
Liaison: Susan Heutmaker, Kareem Greiss
Faculty Advisor: Prof. Robert Cornwell
Students: Jesse Binford, Chris Cole, Barbara Hyde

Description:

Parsons Brinckerhoff has proposed to undertake a vast reconstruction project to mitigate the SR-520 congestion problem by implementing an SR-520 Corridor Improvement Program. Since its opening in 1963, SR-520 has seen a traffic volume increase of approximately 400 percent. It is now one of the most heavily traveled four-lane limited-access highways in the country. The team assisted Parsons Brinckerhoff in meeting their long-range goal by providing a design for the ramp connecting the HOV lanes on SR-520 to the I-5 express lanes. Specifically, the project provides two parallel retaining walls and a south bridge abutment for the connector ramp. The project also includes a construction/cost analysis of the structural systems available and the delineation of feasible design alternatives. The project concludes with the overall analysis and design of the ramp.

STIMSON ROOM

1:30 p.m.

Project Title: Development of a Quick Access Recorder
Sponsor: AlliedSignal Avionics Inc.
Liaison: C. Mark Wilson
Faculty Advisor: Prof. Robert Heeren
Students: Mark Loarie, Darcy Smith, Lowell Tamayo,
Andrew Tea, Joan Vaughn

Description:

The team built a multi-character alphanumeric LED display/controller board. The board operates under temperature extremes. It is implemented with programmable devices and contains an interface to the parallel port of a PC. The team also wrote software for the PC to mimic the behavior of a flight data recorder receiving real time data and displaying it on the LEDs using a real time operating system.

Project Title: Torsion Bar Suspension Improvements
Sponsor: Kenworth Truck Company
Liaison: Shane Jackola
Faculty Advisor: Prof. Dennis Wiedemeier
Students: Arnold Joyce, Nathaniel Lee, Daya Mungra, Tina Ross

Description:

The goal of the project is to resolve the high maintenance requirements associated with the spherical bearings located on the Kenworth torsion bar suspension system. This problem has been approached by research, analysis, and development of a spherical bearing that eliminates the need for lubrication. The ultimate goal of the Kenworth Truck Company is to reinstate this discontinued design into active production.

Project Title: Optimal Two's Complement Adders
Sponsor: Cascade Design Automation
Liaison: Hossein Ahmadnia
Faculty Advisor: Prof. Paul Neudorfer
Students: Chris Bradbury, Dale Fox, Craig Hurst,
Peter Lekhakul

Description:

The design group evaluated the performance of several addition hardware algorithms with respect to the criteria of speed, density, and low power. As a result of that evaluation they were able to design an algorithm for use by a typical user of Cascade Design Automation's Epoch software for designing VLSI chips. The algorithm allows the user to specify the bit width of the adder and which criterion to optimize for. It then produces the input for Epoch for the best adder design.

Project Title: Fatigue Evaluation of Chip Bonded to Substrate
Sponsor: Boeing Defense and Space Group
Liaison: Mostafa Rassaian
Faculty Advisor: Prof. Pierre Gehlen
Students: Van Duong, David Lawicki, Shawn Schuler,
Anne Walkky

Description:

The design team has modified a previously developed computer model, using SIMULINK, to determine the fatigue life of a solder bond between a microchip and a circuit board due to cyclic thermal loading. The model was validated using data gathered from thermal cyclic testing of sample specimens. Additionally, the SIMULINK model was validated by finite element computations.

Project Title: Design and Validation of a SPICE Model
Sponsor: Physio-Control
Liaison: Steve Firman
Faculty Advisor: Prof. Margarita Takach
Students: Mat Bielstein, Bobby Dhaliwal, Andy Djermani,
Robert Johnson, Brian Rafferty

Description:

A mixed-mode SPICE model for a hybrid preamp circuit was designed. Then, a process to verify and validate the electrical model of the hybrid was defined and carried out, which can be used to validate changes in the design without further testing. The overall goal has been to create and test the model of the preamp hybrid to demonstrate that the SPICE model accurately represents the hybrid as built. A statistical study was performed on several hybrids to estimate the tolerance that must be applied to the model to validate the design.

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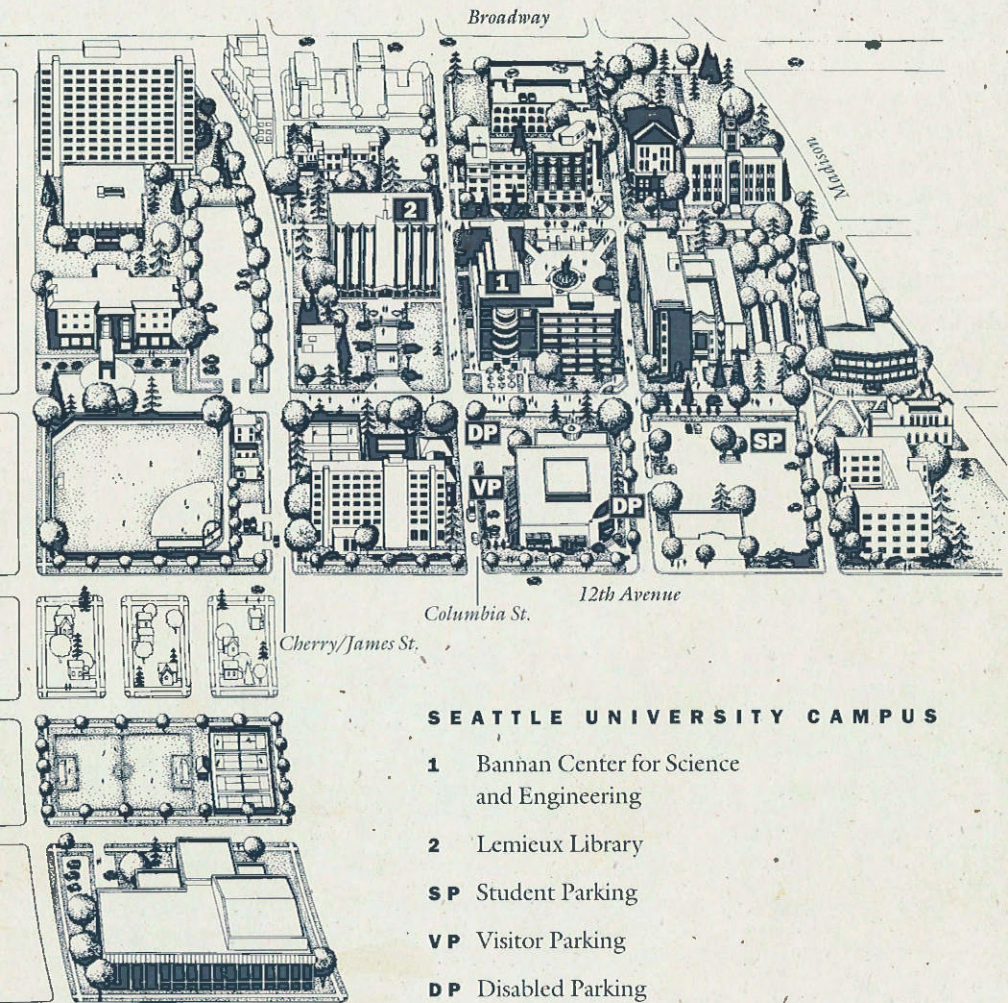
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SPONSORING ORGANIZATIONS AND LIAISONS

We want to acknowledge with special thanks the organizations who sponsored engineering design projects in 1994-95, and especially the liaisons 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.

AlliedSignal Avionics, Inc.	C. Mark Wilson
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Cascade Design Automation	Hossein Ahmadian
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ElseWare Corporation	Bill Kuhn
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King County Surface Water Management	Steve Foley, Bruce Johnson
Physio-Control	Steve Firman
Parsons Brinckerhoff	Kareem Greiss, Susan Heutmaker
Robbins Company	John Gibson
University of Washington/	
Harborview Rehabilitation Medicine Center	Anthony J. Margherita, MD
USDA Forest Service	Janel Winborne
Waterfront Construction	Rod Wilcox
Weyerhaeuser Company	Chuck Bradley, Mick McCourt, Darla Wise



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