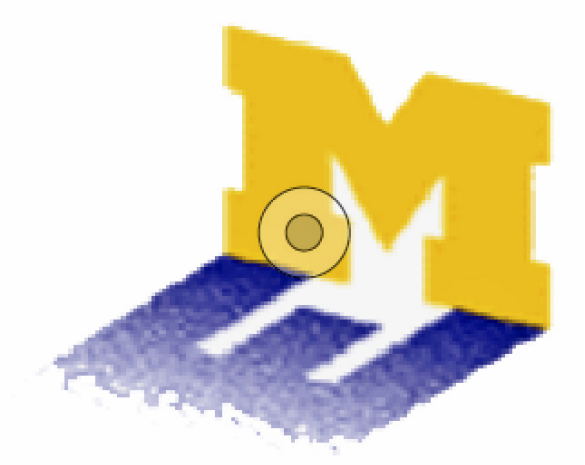
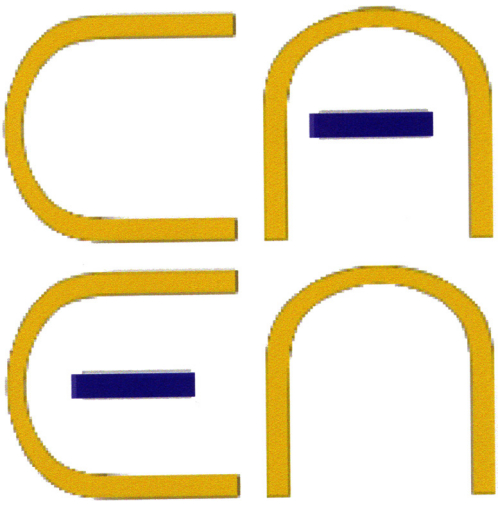
THE UNIVERSITY OF MICHIGAN
COLLEGE OF ENGINEERING



COMPUTER AIDED ENGINEERING NETWORK



The Millennium Project
2001 Duderstadt Center
The University of Michigan
Ann Arbor, Michigan 48109

Preface

The University of Michigan has long been a leader in computing technology. Because of the early importance of this technology in engineering practice, the University created some of the earliest academic programs in this area, first expanding Electrical Engineering into Electrical Engineering and Computer Science (1957) and later creating a Division of Computer Science and Engineering (1965). For most of these early years, the computing technology on campus consisted of a large central computer coupled to digital terminals through a University-wide computer network, the Michigan Terminal System or MTS.

However by the 1980s, as smaller powerful computers began to appear (e.g, DEC VAX computers, Apple and IBM personal computers), the UM College of Engineering, led by faculty and staff members such as Richard Phillips, Dan Atkins, Paul Killey, Randy Frank, and Lynn Conway created a powerful alternative to the MTS computer network: the Computer Aided Engineering Network or CAEN, consisting of hundreds of mini and micro computers connected in a robust network that students and faculty could use in a far more flexible fashion adaptable to the changing nature of college learning and professional practice. Indeed the CAEN technology provided a mechanism to bring together the schools and colleges of the University's North Campus into a "Media Union", a large facility relying upon the CAEN network to support the creative activities of the students and faculty of the North Campus schools (Engineering, Music, Art, Architecture, and later the School of Information).

The initial mission of CAEN (and the Media Union (aka later as the James and Anne Duderstadt Center) was to provide students and faculty with access to advanced tools and the experience of collaboration using the "real stuff" of the digital technologies required for their future professions guided by real-life practitioners. But today it has become clear that the importance of CAEN has become far greater. Today's students are citizens of the digital age. They have spent their early lives surrounded by robust, visual, interactive media—not the passive broadcast media, radio and television, but rather wiki's, iPhones, Facebook, Google, virtual reality, and artificial intelligence.

Today's students are no longer the people our current educational system was designed to teach. Instead they learn by experimentation and participation, not by listening or reading passively. They embrace interactivity and demand the right to shape and participate in their learning. These students will increasingly demand new learning paradigms more suited to their learning styles and more appropriate to prepare them for a lifetime of learning and change. The challenge of today's faculty is to adapt to these new requirements, to help them form learning communities that enable them to create and learn new knowledge and to learn "how to be".

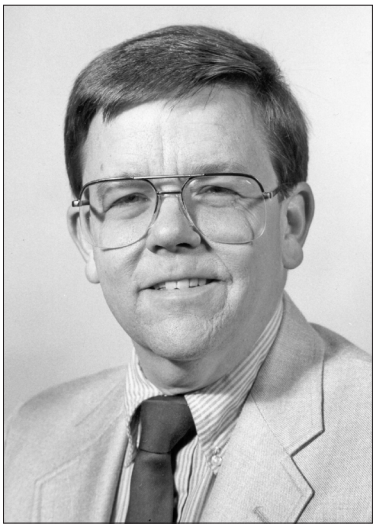
These goals have become the primary mission of the Computer Aided Engineering Network and the learning experiences it enables for the students, faculty, and staff of the creative schools and colleges of the North Campus, the University's "Renaissance Campus"!

In the early 1980s a new vision for computing in the University of Michigan College of Engineering was introduced when dean, James J. Duderstadt, brought together a group of faculty to plan the "complete integration" of computing into the life of the college. This faculty group concluded that:

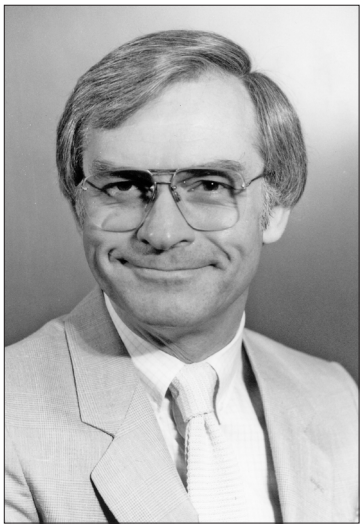
"The personal computer/workstation, connected to the rest of the world via a hierarchical, heterogeneous, multi-vendor network, will be central to the engineering computing paradigm well before the turn of the century."

Jim Duderstadt - Dean of Engineering 1981-1986

In 1983, the College of Engineering establishes the Computer Aided Engineering Network (CAEN) as part of a plan to expand and intensify the research activities of the College in technology, management, computer-aided engineering, and communication. The effort was led by Daniel Atkins and Richard L. Phillip. Phillips was named Director.



Daniel Atkins
Co-Founder of CAEN



Richard Philips
Co-Founder and First Director of CAEN

A BRIEF HISTORY OF COMPUTING AT THE UNIVERSITY OF MICHIGAN

1946

The use of computers at the University of Michigan began following World War II. Technology developed for the war efforts opened doors for further inquiry. Arthur W. Burks had participated in the design of the Electronic Numerical Integrator and Computer (ENIAC).

Arthur Burks

Arthur Burks joined the Department of Philosophy in 1946 and founded the Logic of Computers Group in 1949, the first research organization dedicated to computing at the University.

Professor Burks co-authored several books and articles (1981-2003) with his wife, Alice R. Burks that documented in great detail the workings of the ENIAC, the details of the Atanasoff and Berry computer of 1938, and the legal battles that ensued over the patent rights of those who participated in these early computers.

Alice Burks

Arthur Burks working on the original ENIAC (left)
A portion of ENIAC on display in the EECS Building (right)

1953

The first digital computer developed at the University of Michigan was the Michigan Digital Automatic Computer (MIDAC), at the Willow Run Research Center. The computer came on line in 1953 and shut down in 1958. It was used primarily for defense work.

MIDAC - Willow Run

A BRIEF HISTORY OF COMPUTING AT THE UNIVERSITY OF MICHIGAN

1956

In 1956 computing facilities for the Univerity of Michigan academic programs became available to students. An introductory computing course in mathematics was taught by Bernard A. Galler.

Bernard Galler

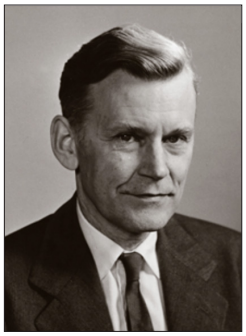
As a pioneer in the field of computer science, Professor Galler helped shape this discipline at the University. In the early 1960s, he was active in the development of the new Communication Sciences Program, and in 1966, he became associate director of the Computing Center. His association with the Computing Center continued through 1991, during a period of tremendous growth and change in the areas of computer science and computing services. He became a charter member of the new Department of Computer and Communication Sciences (CCS) in 1966 and served as chair of the department from 1973-75. In 1984, Professor Galler was instrumental in negotiating the merger of the CCS Department and the Department of Electrical Engineering and Computer Science. The Department of Computer and Communication Sciences was one of the first of its kind in the country, so it is not surprising that Professor Galler was influential in the development of the software and mathematics curriculum for computer science. (Regents' Proceedings, May 1, 1994, page 288)

1957

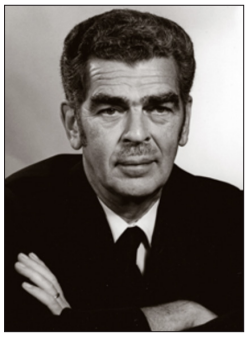
In 1957 the Graduate School began to offer Ph.D and M.A degrees in a program "Language Models and Logical Design" later changed to Communication Sciences. A number of faculty from LS&A were interested in the program and formed a committee for the graduate program.

Arthur Burks - Mathematics, (see proceeding page)

Gordon Peterson
Speech



Gunnar Hok
Electrical Engineering



Edward Walker
Psychology

Robert Thrall
Mathematics

Anatol Rapoport
Mental Health Research Institute

Herbert Paper
Linguistics

A BRIEF HISTORY OF COMPUTING AT THE UNIVERSITY OF MICHIGAN

1959

In 1959, the University of Michigan Computing Center was established as a "research and service activity of the Graduate School." The center installed a sequence of increasingly capable computers from its inception in 1959 through 1991 that were used for research and education. Robert Bartels served as the first director.

Robert Bartels
Director 1959-1978

In late 1958, when the University of Michigan planned to move its small computer operation off campus and discontinue general computer access to students and faculty, Professor Bartels embarked on a successful campaign to reverse this decision and to establish a viable central computing facility to support teaching, research, and administration. He became the Computing Center's first director in 1959 and remained at its helm until his retirement in 1978. During that time, he actively promoted the University's development of Computer Science education and research. Important advances in programming languages and operating systems were nurtured in the computing environment he established. He was also responsible for organizing an important series of short courses and lectures during a 15-year period with the UM Engineering Summer Conferences in the late 1950's and early 1960's that encouraged some important early developments in the theory and software for computer mathematics. (LSA Minutes)

1960

In 1960, the Communication Sciences Laboratory was established as a separate budgetary unit. The Communications Sciences Program was a graduate program until 1963 when a 300-level course for undergraduates was taught by Bernard Galler.

1964

In 1964 a new Department of Communication Sciences was established. Bernie Galler noted that it was not called Computer Science because it was not a standard computer science department as it had a great deal of interdisciplinary activity.

1965

In 1965, Communication Sciences was introduced as an undergraduate concentration program when CCS 200, "Introduction to Communication Sciences" was offered.

A BRIEF HISTORY OF COMPUTING AT THE UNIVERSITY OF MICHIGAN

1967

As the number of computer users increased, the limitations of batch mode processing became evident. MTS, the Michigan Terminal System replaced the use of batch mode, punch card driven computing with a multi-programing multi-processing, terminal-based system that gave each user the impression that there were no other users.

1968

In 1968 the name of the "Communication Sciences Department" was changed to "Computer and Communication Sciences" (CCS).

Even as the CCS Department grew and matured as it reached the mid 1980s, the study of and research into various aspects of computing at the University of Michigan had become increasingly distributed as faculty across campus saw the need and potential for computing. Engineering departments and Business Administration had acquired computing resources and developed courses in computation tailored to their curricular needs.

In 1968 an interdepartmental graduate program in the College of Engineering was established, known as Computer, Information and Control Engineering (CICE). The CICE program was open to engineering students as well as mathematics and physics students with an interest in computation.

By the early 1980s CICE had grown to over 100 students with 43 faculty from five engineering departments teaching seventy courses.

1984

With large enrollments, wait lists, excessive teaching loads and lack of resources, computing at Michigan had reached a crisis.

A Memorandum of Understanding between the Dean of Engineering and LSA was issued recommending that the CCS Department and the CICE program be incorporated in a Computer Science and Engineering (CSE) Division of a newly named Electrical Engineering and Computer Science Department (EECS).

A BRIEF HISTORY OF COMPUTING AT THE UNIVERSITY OF MICHIGAN

The Computing Center's first machine was in the basement of the Rackham Graduate School Building. Students signed up to reserve time on the machine, and then they operated it themselves, but only between 8 and 5 o'clock and "never" during lunch hours or on weekends. But, however much computing may have changed, student ingenuity seems to have remained much the same. Those who used the IBM 650 quickly discovered the window (at the rear), and began letting one another in to use the machine after hours. Professor Bernard A. Galler, who started a long and distinguished career in computer science at the U-M in 1955, is operating the punch–card input/output machine at the right of lower photo.

Horace Rackham Graduate School

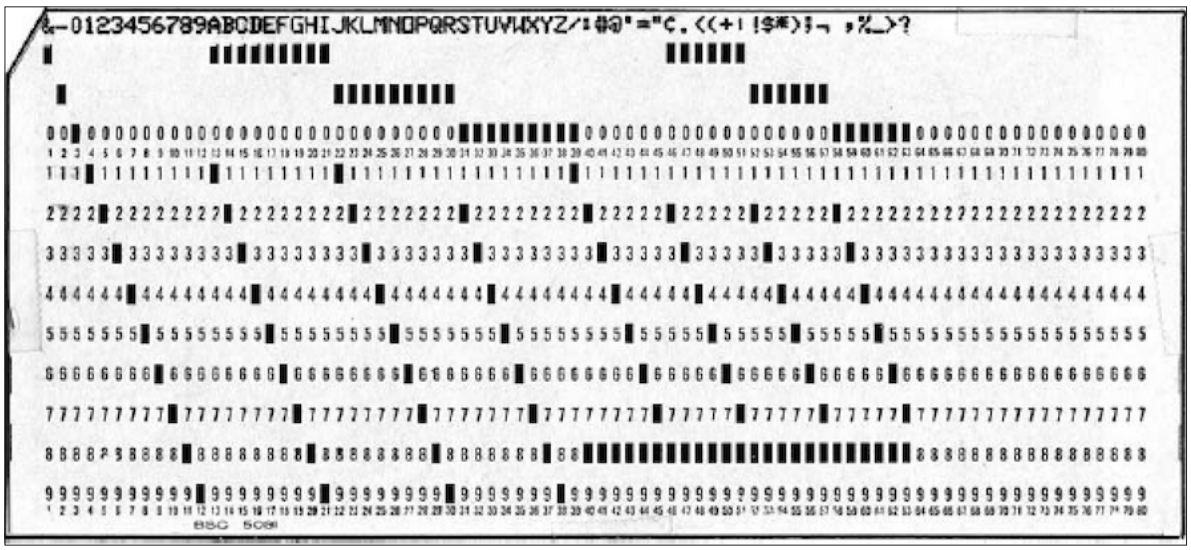
IBM 650 Computer, Bruce Arden (left) Bernard Galler (right)

A BRIEF HISTORY OF COMPUTING AT THE UNIVERSITY OF MICHIGAN

The IBM 704 computer at the Computing Center in the North University Building Station (NUB). Bruce W. Arden is with the printer (left) and Bernard A. Galler sits at the console (right), with tape drives in the background. NUBS was demolished in 2002 to make way for a new Life Sciences Building.

Bernard Galler - IBM 704 Computer

A punched card, with the holes shown in black. A total of 63 characters (printed at the top) could be represented, each needing either a single, double, or triple punch in its column. The punched card was the main source of significant program input at the University of Michigan until 1982.



Punch-Card

THE FORD FOUNDATION PROJECT

In 1959 the Ford Foundation provided funds to the College of Engineering that gave faculty release-time to learn about digital computing, Computer-solvable problems could be assigned in regular engineering courses, and specific course curricula could be developed that exploited problem-solving capabilities of such a system. This three-year project provided a solid base of computing experience and expertise in the College of Engineering and gave the University of Michigan a significant head start in the instructional use of computers.

The early 1960s were to become a crucial period for introducing students and faculty to new computational methods and the blessings and curse of the digital computer. In 1959, Donald Katz (chair of Department of Chemical & Metallurgical Engineering) foresaw the tremendous impact that computing would have on engineering practice. He convinced the Ford Foundation to support a $900,000 feasibility study of broad-scale integration of computer use in undergraduate engineering curricula.

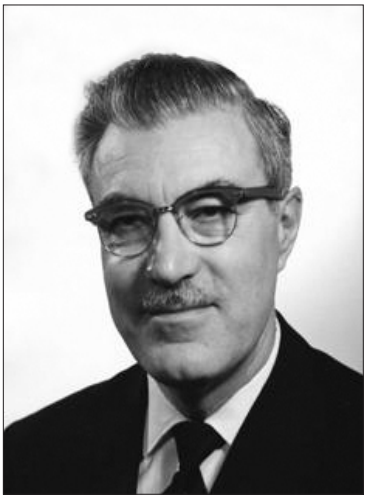
Grants were made available for people both at Michigan and other universities, who came to Ann Arbor to participate in the Ford Foundation project.

In four years, over 200 faculty from nine engineering disciplines and 65 engineering schools participated in the various activities of the Michigan project.

Goals of The Ford Foundation Project:

1. Train faculty to use computers;
2, Provide "free" time-shared computing services to all students;
3, Require a computer-programming course;
4 Teach numerical and optimization methods;
5 Integrate computing assignments into all engineering, science, and design courses;
6 Stress design-like (now called "open-ended") problems through the curriculum.

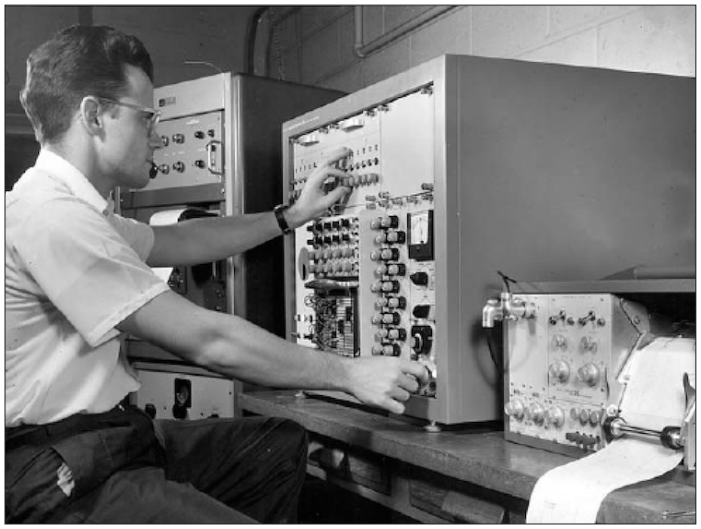
James Wilkes, *"A Century of Chemical Engineering at the University of Michigan",* page 273



Donald Laverne Katz

Donald Leverne Katz prodigious research and professional activities centered on gas and petroleum reservoir engineering, and on the phase behavior of hydrocarbon systems. He collaborated with 45 doctoral students, and has hosts of co-authors for his 260 publications. His magnum opus is the classical Handbook of Natural Gas Engineering (McGraw-Hill, 1959), in which much of his previous work is summarized.

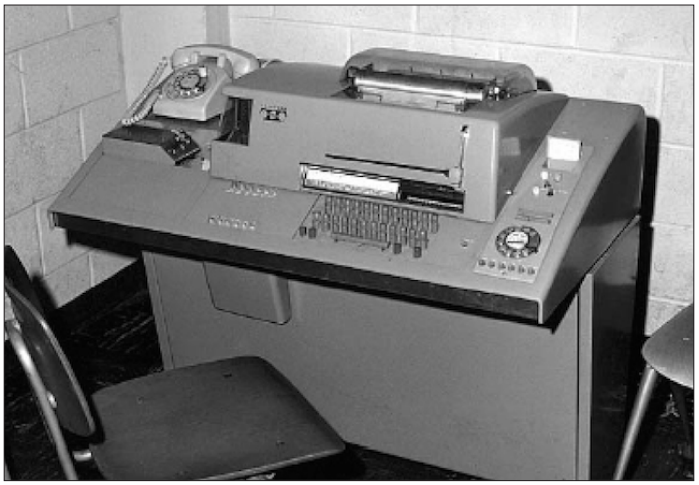
Always deeply interested in teaching, his research work has led to stimulating classroom presentations. He was a pioneer in the applications of digital computing in engineering education, and from 1959 to 1963 had spearheaded a large project that drew world-wide attention to this area.
(Regents' Proceedings, April 1, 1977, page 758)



D. Grant Fisher (Ph.D. 1965) using the Applied Dynamics analog computer, which was one of the key additions to the 1963 expansion and upgrade of the Chemical Engineering Department's Process Dynamics and Control Laboratory in the East Engineering Building.

Graduate student Stanley C. Jones using the Ford Foundation Project Bendix G-15 computer to solve reservoir engineering problems involving unsteady-state flow of water in porous beds.

East Engineering 1955 (photo by Jim Wilkes)

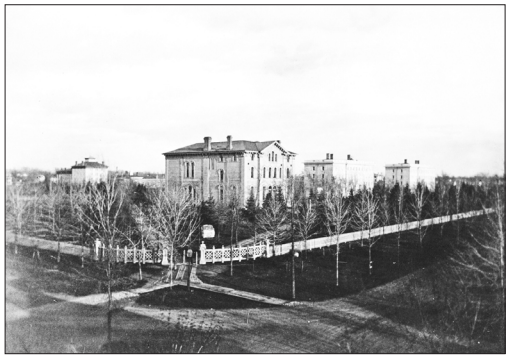


Model 35KSR teletypewriter, third floor, East Engineering

LGP-30 computer, used by the Ford Foundation Project

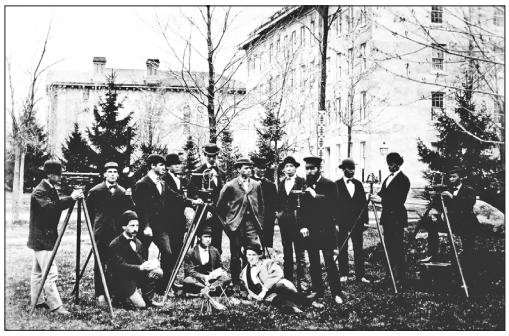
A BRIEF HISTORY OF ENGINEERING BUILDINGS AT THE UNIVERSITY OF MICHIGAN

In 1854 the first "engineering course" taught at Michigan was an introduction to English composition for engineering students Early engineering courses were laid on a foundation of instruction in science and humanities in the Literary College. Instruction in surveying began in the sophomore year. The University's scientific curriculum was subdivided into specific four-year majors in general science, chemistry and biology. Since the first two years of the engineering curriculum was essentially identical to that of the other science majors, the engineering majors also were regarded as subdivisions of the scientific course in the Literary Department.



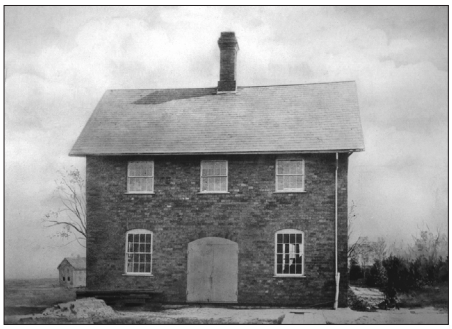
1860s University of Michigan Campus
South College (right)

1854 South College
First Engineering Classes held in South College

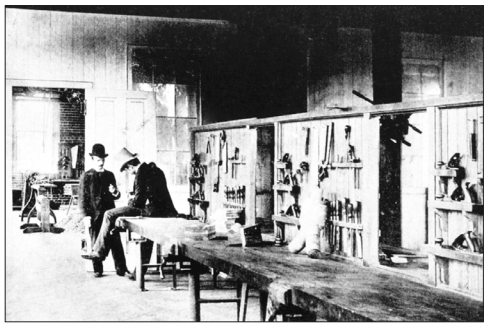


Survey Class 1860s

Survey Class 1895



1882 Scientific Blacksmith Shop



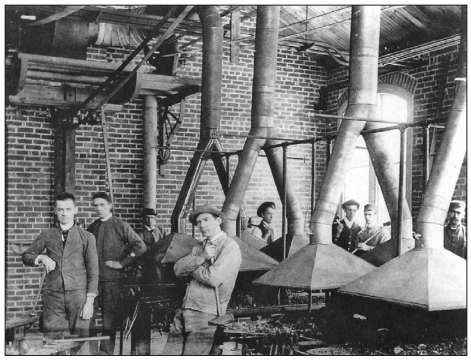
Scientific Blacksmith Workshop

1883 Scientific Blacksmith Shop (left)
Workshop (right)

A BRIEF HISTORY OF ENGINEERING BUILDINGS AT THE UNIVERSITY OF MICHIGAN

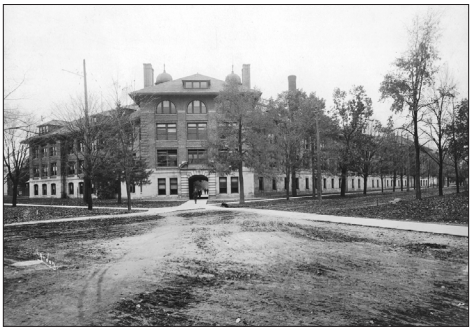
In 1895 Engineering was separated from the Department of Literature, Science and the Arts when the Regents resolved that "A School of Technology be organized, comprising the Departments of Civil, Mechanical and Electrical Engineering. In 1915 the University adopted the nomenclature based on standards approved by the Association of American Universities and the National Association of the Carnegie Foundation for the Advancement of Teaching. Those units of the University, which admitted students directly from high school and preparatory schools were designated as "Colleges", while the units which required some collegiate work before admission were labeled "Schools". Consistent with this practice, the department of Engineering was renamed the College of Engineering in 1915.

1885 Engineering Shops



1887 Engineering Forge

1887 Engineering Shops



1904 West Engineering
Corner of South & East University

West Engineering (left)
Engineerig Shops (right

1904 West Engineering
Viewed from the "Diag"

1891 The Engineering Building

1923 East Engineering

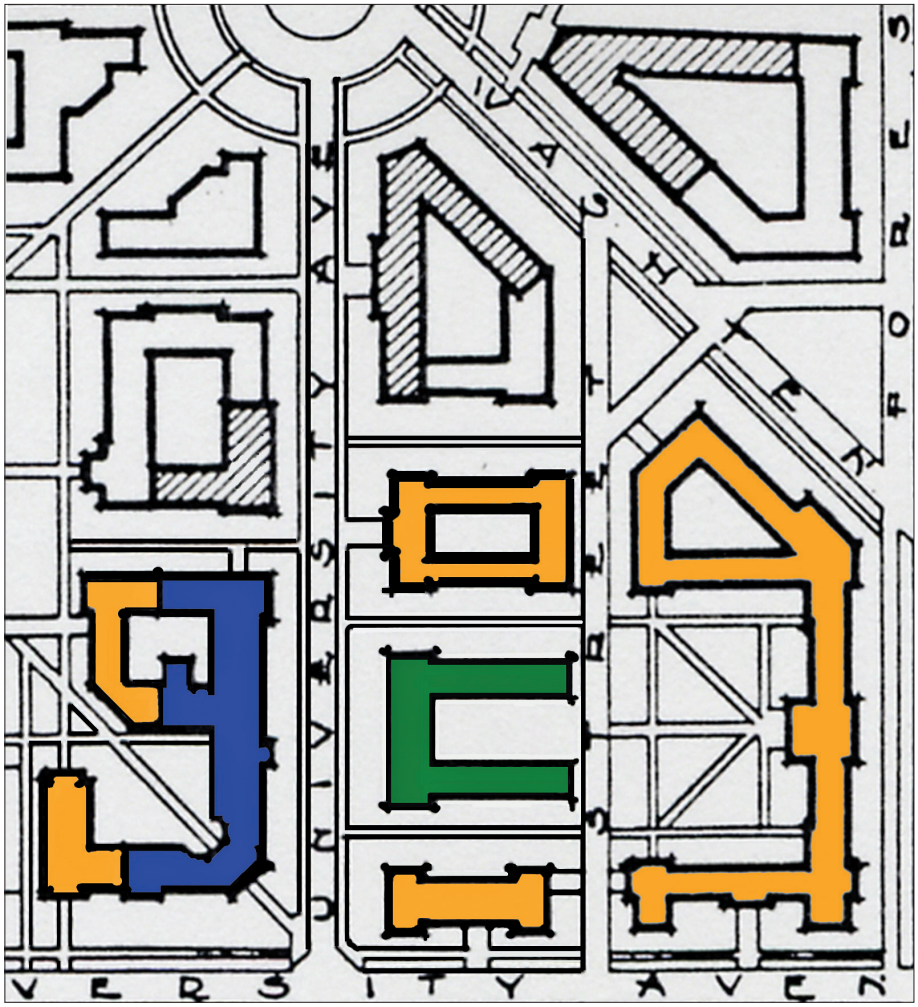
1947 East Engineering Addition
(right)

A BRIEF HISTORY OF ENGINEERING BUILDINGS AT THE UNIVERSITY OF MICHIGAN

In the fall of 1941, just prior to World War II, the College was thought to have reached its enrollment capacity at 2,070. Yet as the war ended and veteran students returned, enrollment had grown to over 4,500 by 1947, including 2,967 veterans. The dilemma facing the College was familiar: Either reduce enrollments or build new facilities. In 1944 the University conducted an exhaustive study on how to meet the needs of the veterans returning to college from wartime service. The report stated that "The University of Michigan commits itself to the proposition that the educational needs of war-service veterans and, hence, of the community must be met to the fullest extent its facilities will allow."

A plan was developed for a major expansion of the Engineering campus to meet the anticipated enrollment growth. This plan, shown below, envisioned the development of an "Engineering Quadrangle" to the east of the campus, along with a major expansion of West Engineering (Michigan Alumnus, December 18, 1943, p. 183).

Although the University did not have the capacity to launch the massive plan developed in 1944, it did commit the funds to expand East Engineering.



The "Engineering Quadrangle" West Engineering (blue) East Engineering (green)
The orange buildings are the additions and new proposed buildings.

Space was still inadequate to accommodate the post-war growth of Engineering and even more so for the University. In anticipation of this growing need, the Regents had begun to acquire farmland property on the sloping hills lying just to the northeast of the Huron River.

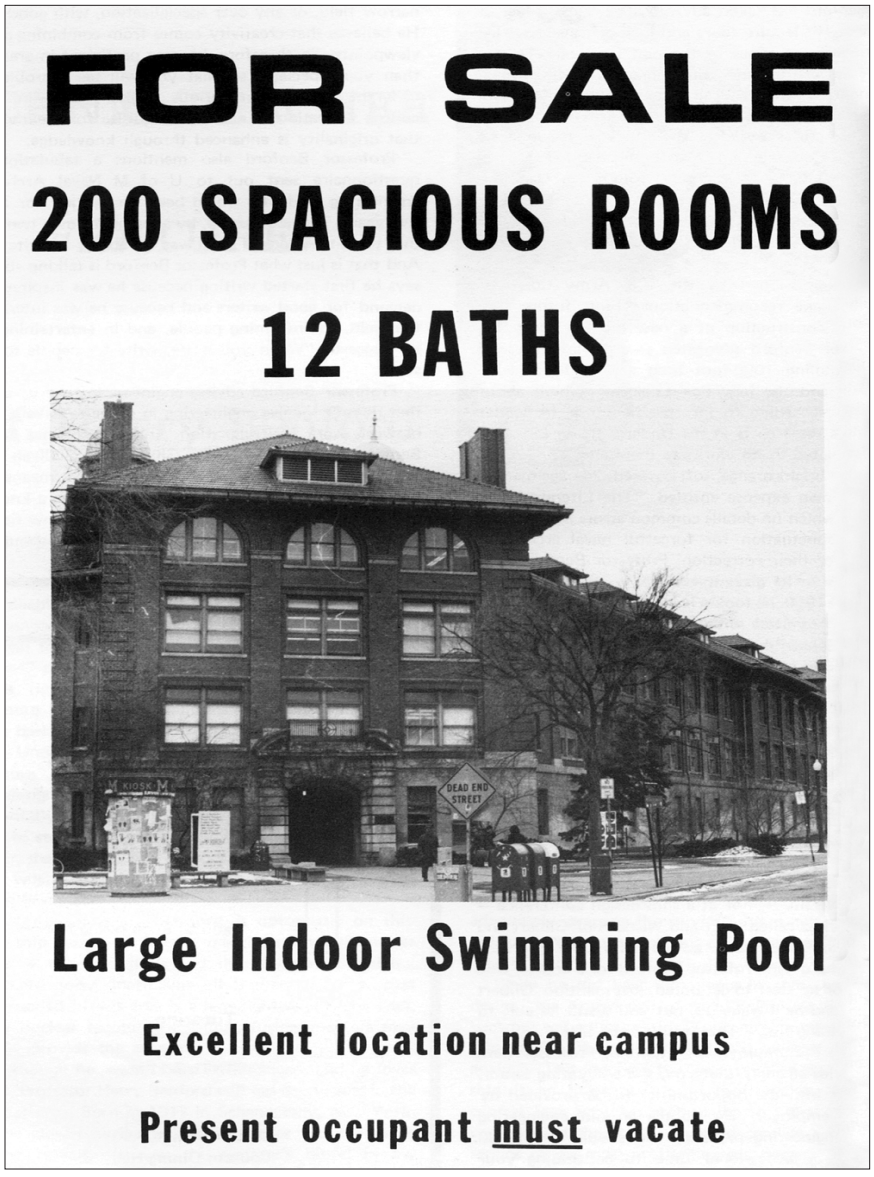
Although there were some early thoughts given to relocating the School of Education, Natural Resources, Music, and Fine Arts to the North Campus, the construction of the Phoenix Memorial Project soon repurposed the site for engineering research. The Cooley Memorial Laboratory housed the electronics research associated with the Willow Run Laboratories. The Phoenix Memorial Laboratory (A WWII Memorial) was built next to the Cooley Laboratory. The automotive laboratory and a storage library were also located on North Campus.

"The increasing responsibilities and demands upon the University and the projection of necessary growth in the future have made it imperative that plans for expansion be formulated now. Of course, there must be some further construction on the present campus, but we know now that there is not adequate space for an enrollment of 25,000 students or more, which it is reasonable to anticipate in the 1960's." (Michigan Alumnus, 1951-52, p. 257)

A view of the farmland across the Huron River from the University Hospital
The early 1950s

THE UNIVERSITY OF MICHIGAN COLLEGE OF ENGINEERING
THE MOVE TO THE NORTH CAMPUS

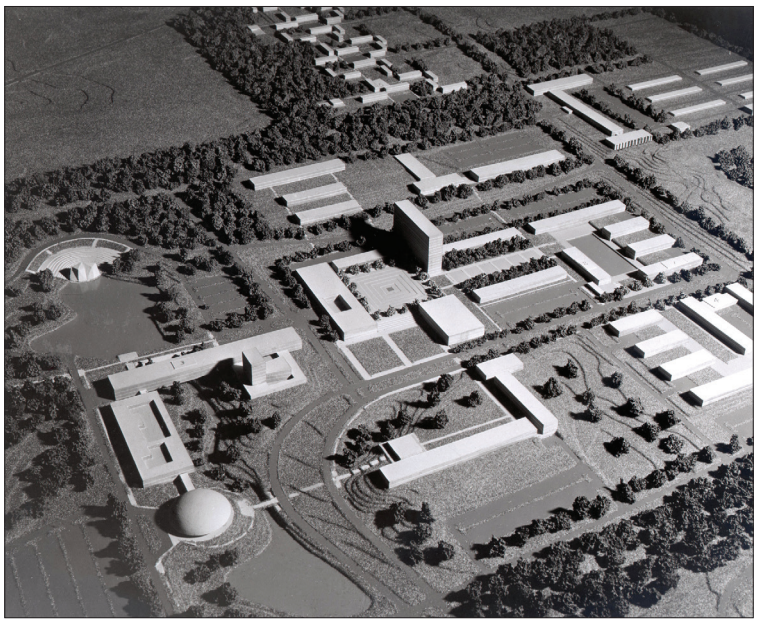
In the 1970s the College launched a major fund-raising campaign. The intention was to combine the proceeds with a match from state funding to complete Engineering's move to a new four-building complex on the North Campus. In this four-building plan, the largest building, Engineering Building I would house Mechanical Engineering and Applied Mechanics, Civil Engineering, Industrial and Operations Engineering, Humanities, and the College administration. Engineering Building II would contain Chemical and Metallurgical Engineering. Engineering Building III would be for Electrical and Computer Engineering and Nuclear Engineering, and Engineering Building IV would be for Naval Architecture (with a possible new towing tank on the North Campus).



In great anticipation for the move to North Campus, this add was placed in the Michigan Technic.

THE UNIVERSITY OF MICHIGAN COLLEGE OF ENGINEERING
THE MOVE TO THE NORTH CAMPUS

The fund-raising campaign was only a modest success because of the weak American economy during the 1970s. It raised only $8 million for facilities, an amount inadequate to trigger the North Campus move. With inflation rapidly eroding the funds raised during the campaign, the College decided to direct the entire amount (and then some) to the construction of the Herbert H. Dow Building (Building II) and defer indefinitely any further effort to continue with the rest of the four-building project. The College approached the 1980s with only a very modest presence on the North Campus: several research buildings, a modest concrete block building for Aerospace Engineering, another small building for the water resources program, and the construction site for the Dow Building.



Original Plan for the Engineering North Campus

After a thorough review of the existing plan to move the College into four new buildings, funded from state and private sources, Jim Duderstadt, then dean of Engineering, concluded that in the current climate this plan was clearly both impractical and unworkable. A far more modest plan was proposed to the University administration, based upon the reassignment and renovation of several existing North Campus structures and a single new, state-funded building for Electrical Engineering. This pragmatic yet workable plan was to result in the move of the entire College of Engineering to the North Campus by 1986 and laid the foundation of what would eventually become one of the finest campuses for engineering education in the nation.

For more information on the history of the University of Michigan College of Engineering go to:
Milproj.dc.umich.edu
All Publications & Videos

2003 The University of Michigan College of Engineering:
A Photographic History Celebrating 150 Years
2003 UM Engineering On the Move

THE COMPUTING CENTER 1959

The Computing Center in the North University Building (NUB)

The Computing Center of the University of Michigan was established in July 1959. Located in part of the ground floor of the North University building, formerly a plant maintenance and storage facility.

About 6,400 gross square feet housed the IBM 704 computer, the type 650 computer, a public workspace and staff offices.

The College of Engineering Ford Foundation project, with the establishment of the Computing Center almost at once led to a demand for more public space. Two additional rooms were renovated in 1959 and added to the Center's space,

In June 1962, additional space, including part of an inside loading area was enclosed, when the model 709 was replaced by the 7090 computer.

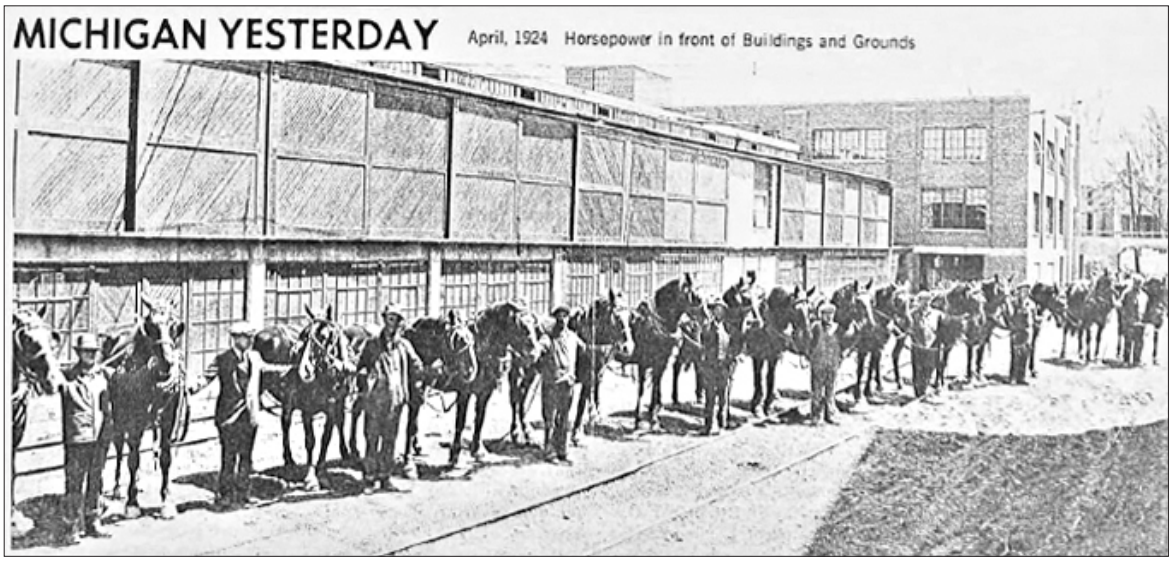
The advent of the model 67 computer forced an expansion. The computer area was enlarged in November 1966 by removing a central hall and incorporating a counseling room, a keypunch room, and public work space. The new space accommodated the installed duplex model 67 and its associated communications equipment.

To compensate for the lost office and public workspace, an attached garage was renovated at the same time and some offices and a basement in an adjacent wing were made available. The basement area, previously used for the storage of geological core samples, was converted to faculty and programmer offices even though it was far from ideal.

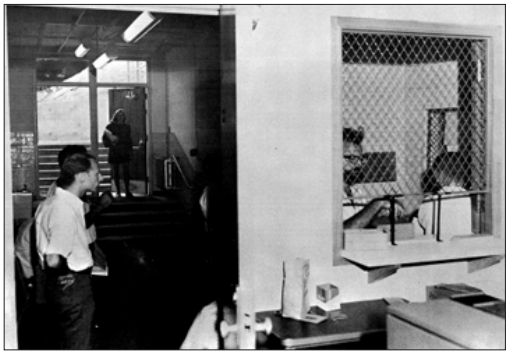
The center employed 19 when it was first opened. By the late 1960s there was a staff of 76. The computer users went from 400 to 4000 during that time.

The makeshift building was never designed as a facility for a computing center, never well suited to accommodate the power, air-conditioning, communications, and security requirements of a computer installation. The building had been successively modified on an ad hoc basis until further expansion was impossible. (A Computing Center Building Proposal, Page 20)

THE COMPUTING CENTER 1959



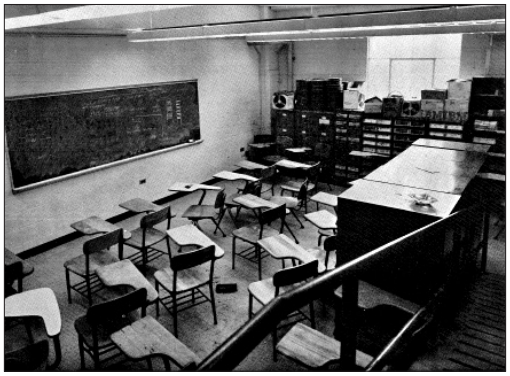
The Computing Center - Housed in the Original Buildings & Grounds Department Building



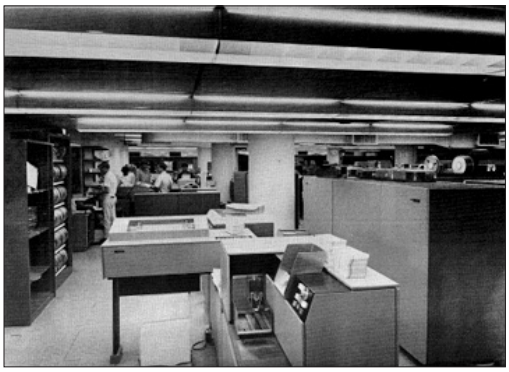
Main entrance as seen through machine room door with dispatch window at right.

Completed in 1914 with an addition in 1922, the Buildings and Grounds Department Building housed the office of the superintendent and divisions of the Department. A portion of the building was used to store supplies.

Public work space with partitioned counseling area at right.



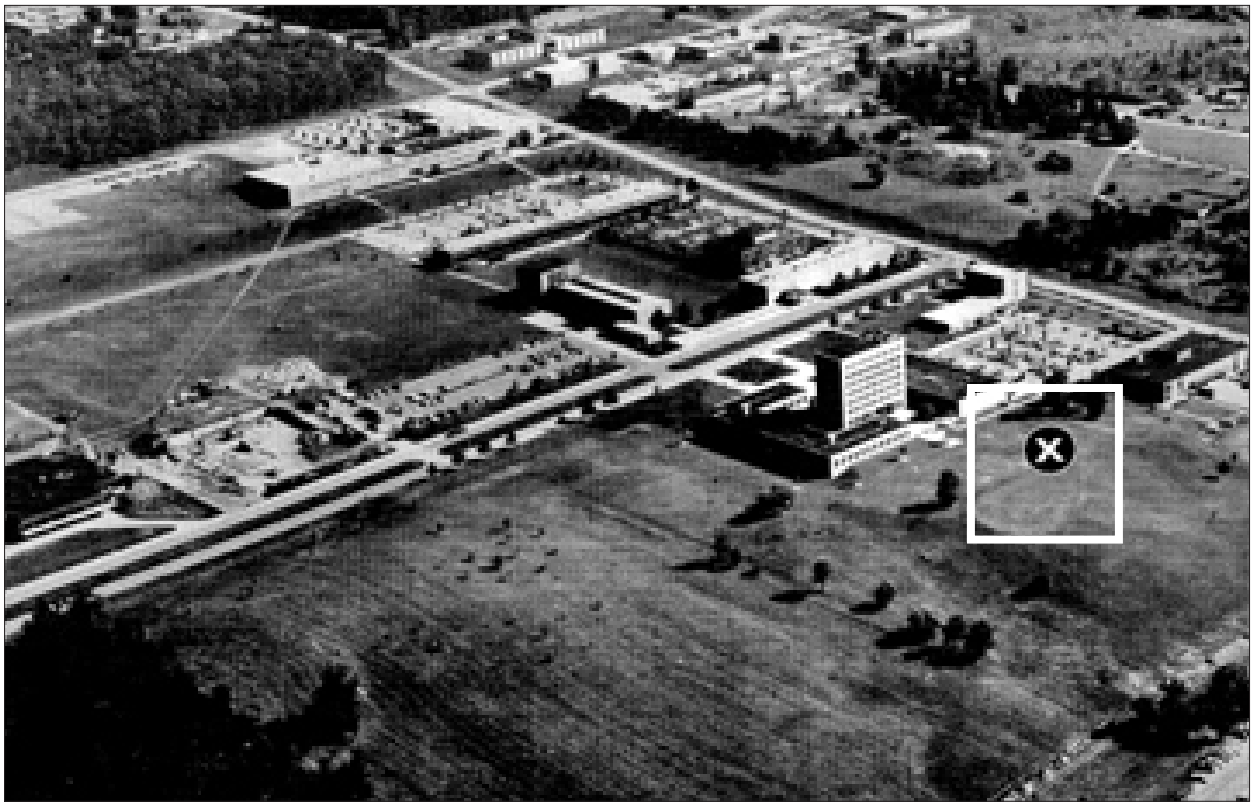
Seminar room and storage.



Machine room on dispatch window side.

The keypunch room.

THE COMPUTING CENTER ON NORTH CAMPUS

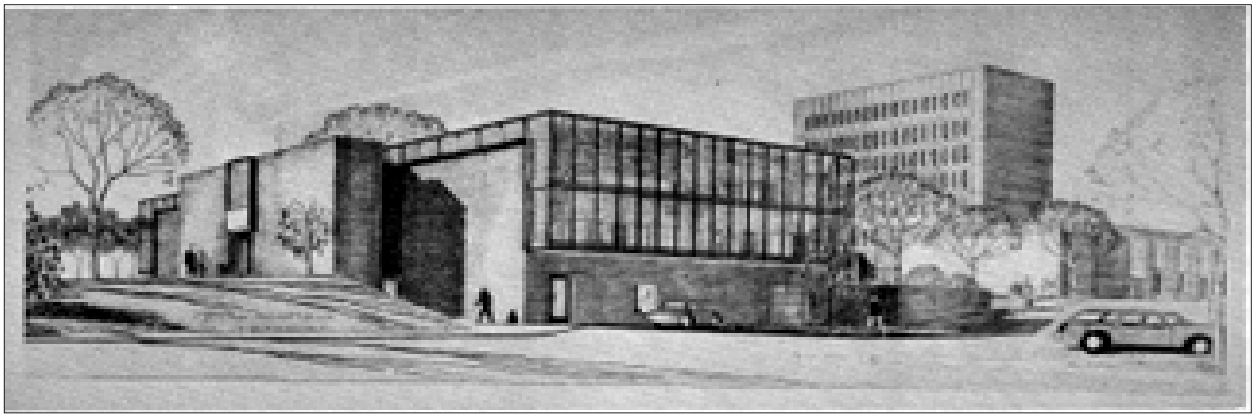


Location of the New Computing Center on North Campus

By the late 1960s the original Computing Center had more than 5,000 user with this number growing 300-500 per month. The education of these users became critical.

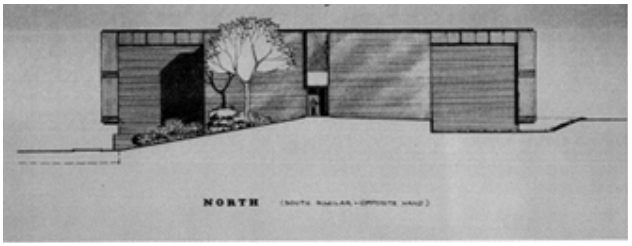
The new Computing Center Building was proposed, to be located on North Campus just south of the Institute of Science and Technology on North Campus Boulevard just west of the University Printing Building on Beal Avenue. The site was within easy walking distance of the proposed College of Engineering complex, the Chrysler Center for Continuing Engineering Education, and the North Campus Commons (Pierpont Commons).

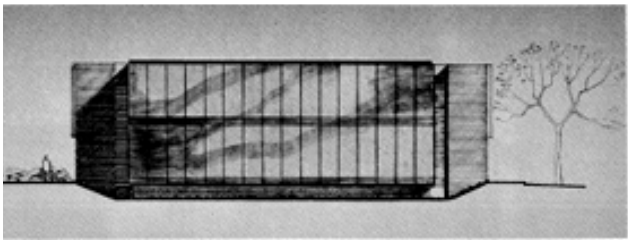
The three-story masonry building was the first phase of a planned expansion of the I.S.T. complex.



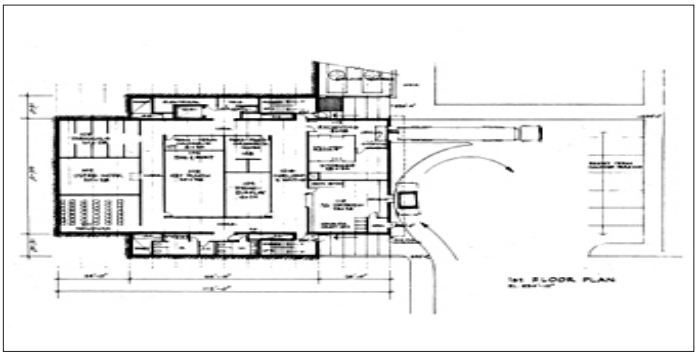
Architectural Drawing of the New Computing Center (I.S.T. right)

THE COMPUTING CENTER ON NORTH CAMPUS

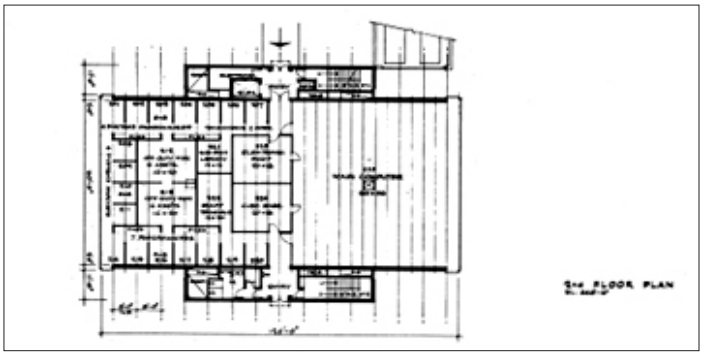




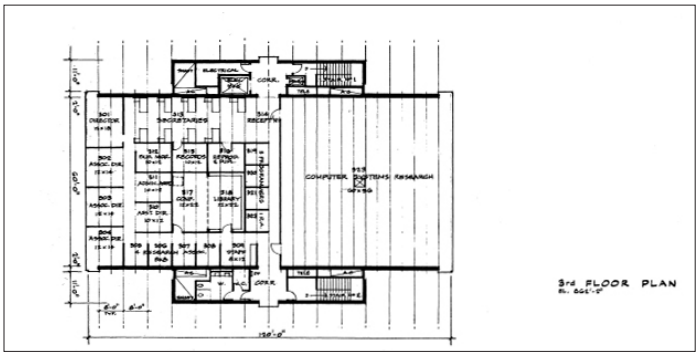
The building was a simple rectangle in plan with a small service-core appendage on the north and on the south. Elevator, stairs, restrooms, janitor's closets, duct shafts and pipe chases were housed in these external cores, which allowed for future expansion to the north and/or the south. The structural system was clear-span, precast-concrete double tees carried by load bearing masonry exterior walls.



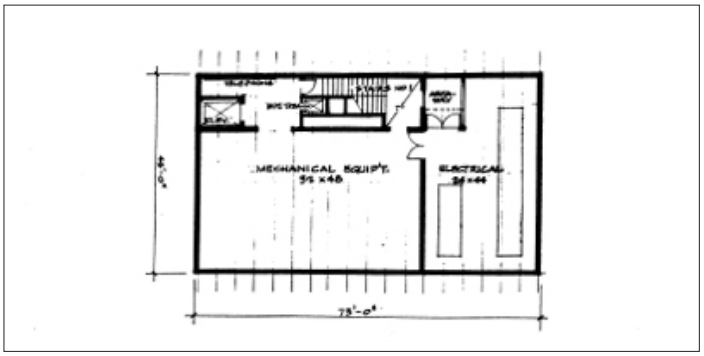
The First Floor contained all public functions, including Reception and Control, I/O Dispatch, Users Terminals and Workroom, Seminar, Keypunch Room, Counseling, and Demonstration and Display. General Receiving and Paper Storage opened directly off a truck dock. A particular feature of the I/O Dispatch function permiting direct contact between vehicular traffic and dispatch via a drive-in window arrangement.



The Second Floor provided at-grade entrance from the north and included the Computer Room, and an adjacent open office landscape area housing Programmers, Systems Analysts, Staff Terminals and Electronics and Customer Engineer Shops. Future expansion of the Computer Room could encompass the entire floor and could be easily accomplished by removing the low-height partitions.



The Third Floor was similar to the Second Floor, except for office use. These spaces were administrational and included Director, Associate Directors, Assistant Director, Administrative Assistant, Business Manager, Research Associates, Programmers and related conference Secretarial Records, and Library facilities.



The Basement Floor was entirely assigned to mechanical and electrical equipment, including service entries for all underground utilities and for steam from new and existing boilers in the I.S.T. building.

UNIVERSITY OF MICHIGAN COLLEGE OF ENGINEERING
COMPUTER AIDED ENGINEERING NETWORK (CAEN)

The College of Engineering faced a very major challenge in building a modern computing environment for its students, faculty, and programs. Part of the problem was developing an appropriate vision for a state-of-the-art system and then financing it. But another challenge for the College was the success of the University-wide Michigan Terminal System (MTS). Developed with IBM in the 1960s, this had long been one of the nation's leading time-sharing systems. Yet it was an inhouse system, adopted by few other universities, and during the 1970s it rapidly lost ground to the new generation of minicomputers such as DEC's VAX systems for science and engineering applications. By the end of the 1970s, most engineering and science departments at top research universities had acquired their own VAX systems. Yet, Michigan remained not only moored to the increasingly aging mainframe-based MTS system, but also to centrally administrated computer policies that prevented academic programs from breaking away and acquiring more advanced computing environments. In fact, every purchase of a computer had to be approved by a central committee at the University.

Hence, to build a leading engineering college, we would have to become a leader in information technology. This view was shared by many members of the College. Dan Atkins assumed the leadership for this effort, assisted by Dick Phillips, Lynn Conway and other members of the faculty. A rather ambitious goal was set: To build the most sophisticated information technology environment of any engineering college in the nation, an environment that would continually push the limits of what could be delivered in terms of power, ease of use, and reliability to our students, faculty, and staff. The system was called CAEN, the Computer Aided Engineering Network, a name that reflected its functional architecture as a sophisticated information technology network integrating the Colleges' instruction, research, and administrative activities together with both on-campus users (students, faculty, staff) and off-campus participants (industry, government, alumni). CAEN was envisioned as a distributed intelligence, hierarchical computing system linking personal computer workstations, superminicomputers, mainframe computers, function-specific machines (CAD/CAM, simulation) and gateway machines to national networks and facilities such as supercomputer centers. The network was designed to support not only general scientific computing, but computer aided instruction, administrative services, and access to technical and bibliographic databases.

We first had to fight a battle on State Street to allow us to break away from the University MTS system. Not surprisingly, this involved many of our old foes in the kingdom of the vice president for research, since they ran campus computing at that time. Fortunately it was easy to convince President Harold Shapiro and Vice-President Bill Frye that they needed to encourage more diversity in computing, and in particular, allow some units to move far out on the curve of advanced computing as pathfinders for the rest of the University. Engineering and Business Administration were given the go-ahead to build their own environments (which would eventually lead to the disappearance of MTS, although it would take almost a decade).

We first provided every member of the faculty with a personal computer (a choice of either an IBM PC or an Apple II computer). We next began to acquire several networked clusters of state-of-the-art computer workstations for research (Apollo, Sun, HP, Apple Lisas, Silicon Graphics). We faced a very major challenge in providing adequate computing resources for our students, since our large enrollments (6,000) would require a massive investment. To address this, we took two very important steps: First, we persuaded the University to allow us to charge students a special $100 per term computer user fee to help support their computing environment. This generated $1.5 million each year that we then could use to buy (or even debt-finance) computer equipment. We made absolutely certain that every penny of these fees (along with significant contributions from the College) went entirely to equip numerous student computing clusters around the College that would be restricted solely for the use of engineering students.

To provide a vivid demonstration of just what the students were getting for their fees, two large lecture rooms on the first floor of the Chrysler Center were converted into a gigantic computer cluster, equipped with over 100 of the new Apple Lisa workstations. This was quite a sight—probably the largest collection of Apple Lisas that ever existed—and it really impressed the students. We adopted the philosophy that these were the students' computers, without any constraints on how they could use them. Similar computer clusters were built around the College.

The second element of our plan for students involved developing a mechanism to help them purchase their own personal computers, since we realized that the College would never have sufficient assets to equip all 6,000 students. We explored the possibility of negotiating very deep discounts (60% or more off list price) with key vendors such as Apple and IBM. They were quite willing to do this, but the principal hangup was with the University, nervous that the local computer stores might complain to the state legislature that we were undercutting their business. After considerable effort, we finally managed to convince President Shapiro and Vice-President (CFO)Jim Brinkerhoff that the leading universities would be achieving massive deployment of personal computers to students through such bulk discounts, and that Michigan would rapidly fall behind if we did not do the same. However, the impact, on local retailers was very positive because of the secondary hardware and software sales stimulated by the student.

The final step in bringing CAEN to the level of sophistication we had envisioned was made possible by a $2 million gift from General Motors that allowed us to acquire over 350 highend computer workstations, connected with high speed networks, to serve the advanced needs of students and faculty. Our philosophy was simple: We were determined to stay always at the cutting edge, but with a very strong service focus. We sought to remove all constraints on computing, with no limit whatsoever on student and faculty use. We went with a multivendor environment, moving with whatever technology was most powerful. Needless to say, these were highly controversial issues in the early 1980s, particularly at the University of Michigan. But as a result, by the mid-1980s the College could boast one of the most sophisticated computing environments of any University in the world, a fact of major importance to recruiting outstanding students and faculty.

The Apple Lisa Lab in the Chrysler Center

1987 Fall Computer Kickoff Sale

1987 Fall Computer Kickoff Sale

UNIVERSITY OF MICHIGAN COLLEGE OF ENGINEERING
TEACHING STUDENTS AND FACULTY TO USE THE COMPUTER NETWORKS
James Wilkes, A Century of Chemical Engineering at the University of Michigan, Chapter 12

In 1983 a group of faculty came together to plan the "complete integration" of computing into the life of the college. The group concluded that:

"The personal computer/workstation, connected to the rest of the world via a hierarchical, heterogeneous, multi-vendor network, will be central to the engineering computing paradigm well before the turn of the century."

The group decided that a networked personal-computer/workstation infrastructure was the first prerequisite for effective implementation of the broad goal of "computing in the curriculum." In 1984, the college began to implement the plan by:

- Starting to build a college network connected to, but otherwise independent of the university's central mainframe computing facilities.
- Creating a college network management structure that would foster personal, academic, and research use of the new facilities, including a full-time network staff and an executive committee representing the faculty. An "applications sector" concept for supporting general-purpose commercial productivity and discipline-oriented professional software (e.g., CAD, design, control) was also initiated.
- Putting a networked personal computer on the desk of every faculty member in the college. The dean sent out the word that electronic mail should be the principal means of communication for the faculty and staff (although— surreptitiously—some of us did still talk to one another!)
- Establishing a long-range financial plan. The college made a firm commitment to maintain state-of-the-art facilities, replacing outdated equipment and software with the current "best" affordable. The plan did call for a surcharge on student tuition, but we believe that it was a better option than the strategy at many other universities—that of requiring each student to purchase a computer at the beginning of his/her college education and hoping somehow that it would suffice for the next four years.

The irector of the Computing Center was invited to join the project, but still clung to the concept of one central facility; thus, the College of Engineering spearheaded the networked concept and for several years enjoyed high-quality distributed facilities unavailable to the rest of the U–M. Since its inception in 1984, the college network grew substantially, and by 1990 it included the following:

1. A 100 mbps FDDI (fiber distributed-data interface) optical-fiber token-ring backbone.
2. Two IBM token-ring LANs (local-area networks) interfaced to the backbone.
3. Over 30 Ethernets (at least one in each engineering building) interfaced to the backbone.
4. Three bridged Apollo workstation 15 mbps optical-fiber token rings, gatewayed through Ethernets to the FDDI backbone.
5. Subsidiary LANs (e.g., office Apple Talk networks gatewayed to building Ethernets).
6. About 2,000 attached machines distributed as follows: 650 in 18 open (24 hours/day) computing clusters, principally for undergraduates. 700 in departmental teaching and research laboratories, principally for graduate student and faculty research. 650 on faculty and professional staff desks, and for college and departmental administrative and clerical staffs.

The public workstations in 1990 included a mix of IBM PS/2 (386DX and 386SX), Macintosh II computers, and workstations by Apollo, DEC, Sun, Hewlett Packard, and IBM (RS6000).

UNIVERSITY OF MICHIGAN COLLEGE OF ENGINEERING
TEACHING STUDENTS AND FACULTY TO USE THE COMPUTER NETWORKS
James Wilkes, A Century of Chemical Engineering at the University of Michigan, Chapter 12

Freshman Computing Instruction

For various extended periods since 1967—and continuously over the 15-year period 1981–1996—Brice Carnahan and Jim Wilkes were responsible for organizing and supervising all freshman engineering digital-computing courses at the U-M and maintaining the freshman engineering computing (FEC) laboratories. The main-frame computer at the Computing Center was used exclusively in these courses until 1982 (the year in which punched cards were abandoned!), when two IBM PC laboratories were installed in East Engineering.

As of mid-1984, there were 50 IBM/PC computers in the FEC laboratories, configured in a local-area network manufactured by the 3com Corporation using the Ethernet communication protocols. Four PC/XT computers, each with a 10-megabyte hard disk, functioned as network servers. Each of the IBM/PCs could also communicate via secondary communications processors (modified DEC LSI–11 microcomputers) and the state-funded MERIT packet-switching network to the U–M's large Amdahl 5860 mainframe computer at the Computing Center. Each of the IBM/PC computers was equipped with:

- An Intel 8088 microprocessor and 256K bytes of main memory.
- A keyboard, and an Epson dot-matrix printer with Graftrax, enabling the printer to generate graphical images.
- A Zenith green-screen monitor with a color graphics board, thus allowing graphical images to be displayed on the monitor screen.
- Two single-sided floppy disk drives with 180K bytes per diskette.
- An RS–232 port to the MERIT network.
- A 3com Ethernet connection board.
- A battery-powered time-of-day clock.
- A game board that allowed future use of a mouse or other pointing device.

When the basement of the Herbert H. Dow building was finished in 1985, these computers were moved at that time to North Campus, occupying two classroom/laboratories (1210 and 1214 Dow) and one open-computing laboratory (1218 Dow). New IBM PS/2 computers were acquired in 1989. A further move occurred in 1992 to the basement of the North Campus Commons (later renamed the Pierpont Commons), where the facilities that we designed included two 38-station classroom/laboratories (B505 and B507 NCC), an open-computing laboratory (B521 NCC), an office for the student instructors, an office for the laboratory assistants, and a storage room.

By 1992, there were 70 IBM PS/2 computers in the FEC laboratories. Each PS/2 was attached to a 16–Mbps IBM token ring local-area network (LAN) through a token-ring adapter. Two IBM PS/2 Model 80 computers with hard-disk storage capacities of 314 Mbytes each were also attached to the token ring and functioned as network servers. Additional connectors also allowed access to computing resources outside the FEC laboratories.

The enterprise had constantly grown in magnitude and complexity, to the point where it occupied about half of Brice and Jim's professional time for the decade 1986–1996. During this period these courses were taught, very successfully, by an all-student cadre of instructors, many of whom were either U–M undergraduates or had moved on to graduate work at the U–M. Thus, most of the instructors were very sympathetic to the problems and concerns of our college freshmen, and often acted as mentors to them.

The general excellence of these student instructors showed in their teaching evaluations, which were significantly higher on average than those for the engineering faculty. At any time during this period, Brice and Jim typically worked with approximately 15 student instructors and 30 laboratory assistants; management of the computers was very ably supervised by Jim Rennell, who had graduated with his B.S.E. from the EECS department at the U–M, and eventually worked at CAEN.

UNIVERSITY OF MICHIGAN COLLEGE OF ENGINEERING
TEACHING STUDENTS AND FACULTY TO USE THE COMPUTER NETWORKS
James Wilkes, A Century of Chemical Engineering at the University of Michigan, Chapter 12

Typically, about 1,100 students enrolled each year (including the spring half term in May/June) in about 30 sections of four different courses, with a maximum enrollment of 38 students per section. The courses were chosen to respond to the needs of the various departments. Three of them were four-credit hour courses: Engr. 103 (FORTRAN based), Engr. 104 (C based), and Engineering 106 (including Matlab and C); the fourth course was Engineering 105, which offered a one-credit introduction to the Michigan computing scene for transfer students.

After substantial and continuing consultation with college faculty, the following topics were included in Engr. 103, 104, and 106: • General computer "literacy." • Hardware and network facilities to be used throughout the students' academic careers.

Jim Wilkes and Brice Carnahan

Over the years, Brice and Jim have directly impacted perhaps 30,000 U–M freshmen through these courses. Very frequently—sometimes annually—they updated their two books for use in these freshman courses, the last titles being FORTRAN for the Macintosh and IBM PS/2 (1994) and The Macintosh, the PC, and UNIX Workstations: Operating Systems and Applications (1996). In all, there have been 27 different editions of these two texts or their predecessors, some of which are shown in an accompanying photo.

UNIVERSITY OF MICHIGAN COLLEGE OF ENGINEERING
TEACHING STUDENTS AND FACULTY TO USE THE COMPUTER NETWORKS
James Wilkes, A Century of Chemical Engineering at the University of Michigan, Chapter 12

Freshman Computing Instruction 297

- Basic productivity software to be used later in the students' academic careers, regardless of their discipline: word processing, drawing, drafting, plotting, spreadsheeting, symbolic mathematics, and data-base manipulation.
- Programming in a procedure-oriented language.
- Solution of problems designed to expose students to topics from different engineering disciplines.
- Participation in a group activity, typically cooperative design and implementation of a problem solution on the computer.

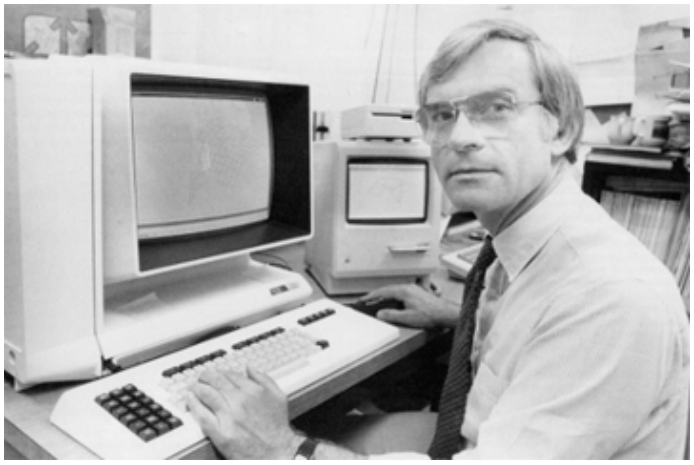
The Student Freshman Engineering Computing Instructors

Group of freshman engineering computing instructors at the home of Jim and Mary Ann Wilkes, April 12, 1993. Back row (left to right): Nobil Abdel-Jabbar, Matt Houser, Jim Wilkes, Brian Kirby, Melissa Babcock, Jim Rennell. Front row: Bill Cosnowski, "Fuss," Scott Arens, Debby Lenz, Scott Carr, Scot Osburn, Neil Chintamanent, Glen Forbis, Rob Lepler.

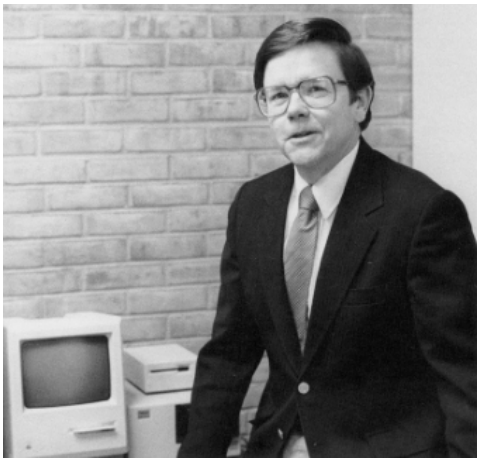
COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

1983

The University of Michigan College of Engineering established the Computer Aided Engineering Network (CAEN) as part of a plan to expand and intensify the research activities of the College in technology, management, computer-aided engineering, and communication. Richard L. Phillips and Daniel Atkins were the co-founders and Dick Phillips served as the first director.



Richard L. Phillip



Daniel Atkins

The College of Engineering negotiated a very deep discount (60 % or more off list price) with key vendors such and Appe and IBM to help students purchase their own personal computer.

(l to r) Dick Phillips, Dan Atkins, William Podeska (Apollo), Jim Duderstadt, Steve Jobs (Apple)

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

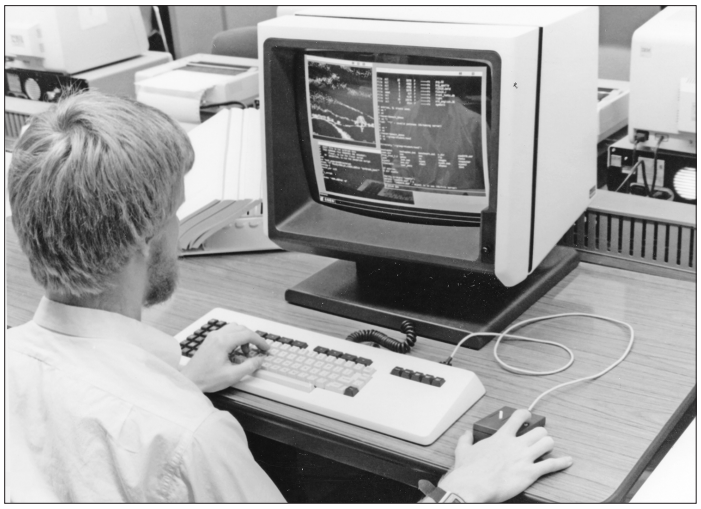
September 1983

First group of 100 Apple Lisa computers were available for open computing use by all Engineering students in three labs (145 Chrysler Center, 2070 Dow, and the Engineering Library. The Lisas featured all four characteristics for a modern workstation -- a full 16 bit CPU, a minimum of ½ megabyte of memory, a window management style of output display, and a mouse-controlled, menu selection style of input!

Apple Lisa Computer Lab - Chrysler Center

September 1984

CAEN staff set up Apollo lab in East Engineering; Apple Lisa and 128K Macintosh and IBM XT labs emerge in UGLi (Shapiro Library) and Chrysler Center with Apple ImageWriter dot matrix printers.



Early Apollo

CAEN Workstations

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

April 1984

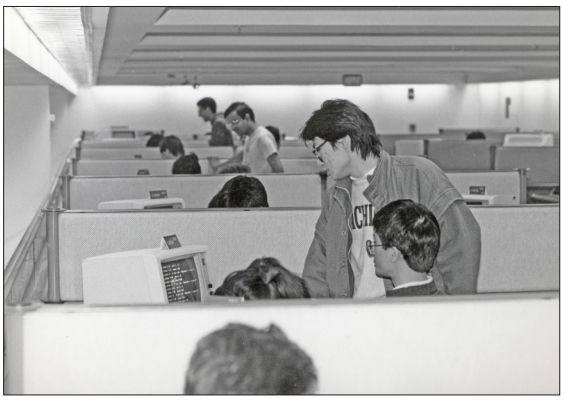
John Van Roekel named Director of CAEN, 1984-1986. John received a B.A. in aerospace engineering and an M.A. in computer engineering. He is the author of three historical novels: Lorenzo's Assisin, Prisoner Moor and Braver Deeds. He is also a Screen Writer.

John Van Roekel

January 1985

CAEN installs 16 UMnet/MTS lines in 2074 Dow lab – students can connect to MTS from Apple Lisa and IBM XT computers.

MTS Computer Display



1985 Dow Mezzanine Lab

1985 Mac Lab

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

February 1985

CAEN goes "green" and begins recycling discarded computer paper.

July 1985

Macintoshes feature internal hard disk "HyperDrives" arrive.

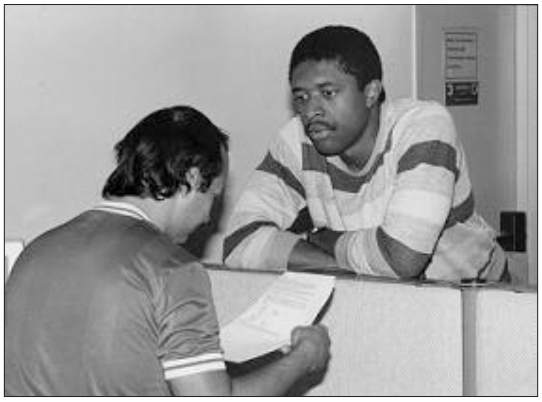
Cindy Bond with Macintosh HyperDrive

August 1985

Dow Mezzanine Lab, CAEN's 7th lab, opens as a premier public computer facility.

September1985

First ten CAEN student counselors join over 100 student monitors employed by CAEN, starting pay is $4.25 per hour.



Amadi Nwankpa, CAEN's first student couselor.

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

October 1985

New Macintosh bundles for students featuring 512K Macintosh, External Disk Drive, Imagewriter I, Carrying Case, and package of 10 diskettes sell for $2090.00

512K Macintosh - Carrying Case

August 1986

Randy Frank becomes Director of Information Technology and CAEN, 1986-2001.

Randy Frank

August 1986

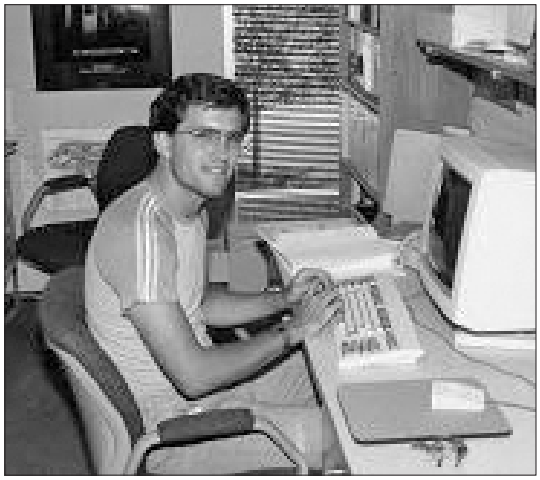
CAEN Hotline opens to support Apollo network of 120 nodes.

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

September 1986

CAEN staff develops MacMonitor "lab check-in" program to check students into the eight existing CAEN labs (111 Autolab, 151 Chrysler Center, Dow Mezzanine, 2340 EECS, 4440 EECS, 2271 G.G. Brown, and 3rd and 4th Floor Shapiro Library).

CAEN Student Checkin



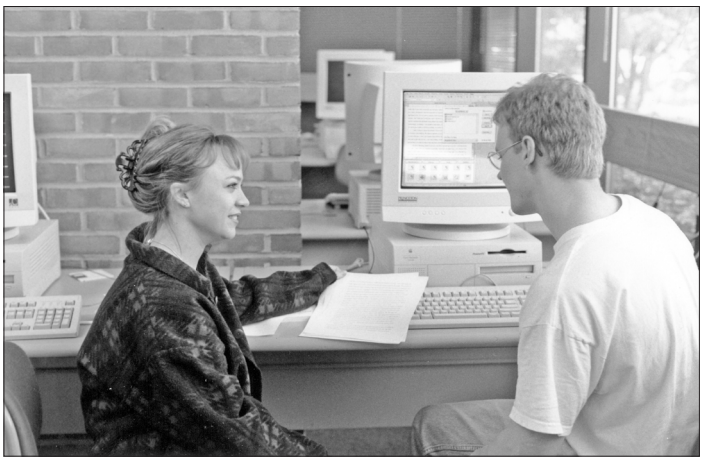
CAEN Hotline - Chrysler Center

July 1987

North Campus Proteon Ring now moves data at 80 megabits per second and connects CAEN's two Apollo rings (290 nodes) with departmental Ethernets.

September 1987

30 Macintosh SE computers arrive along with 20 Macintosh II computers (15.67 MHz, 1MB RAM, 1 800K disk drive, 40 MB hard disk).



COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

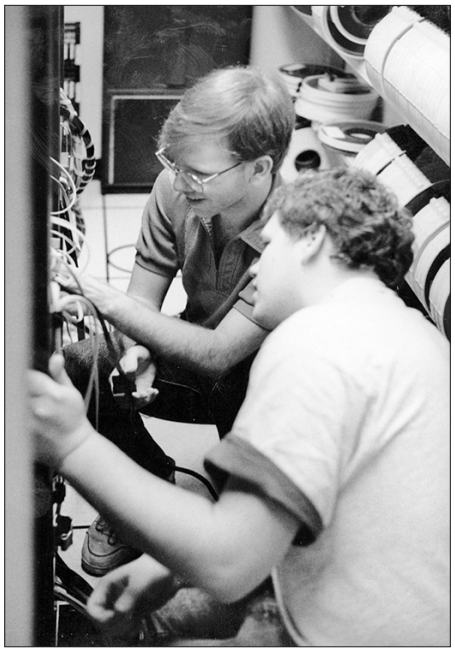
January 1988

CAEN completes new machine room in Chrysler Center to hold storage exceeding 30 GB.

Machine Room
Chryser Center

Machine Room
Chryser Center

Machine Room
Chryser Center



Andy Hoover and Steve Bollinger
"Figure Out the Fiber"

February 1988

Telnet becomes available on Macintosh computers.

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

April 1988

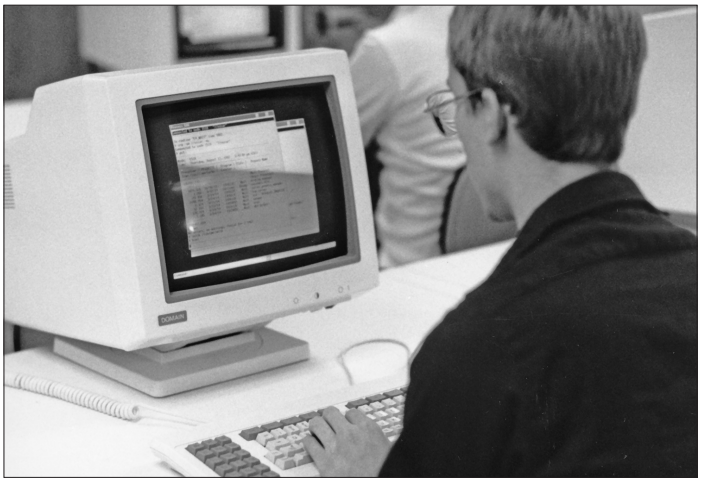
CAEN staff develop 4-CAEN automated voice response system (a.k.a. DecTalk) (CAEN FIRST!).

CAEN Student Macintosh Programmers

August 1988

Apple Lisa support ends; Apollo DN 330 computers in Dow Mezzanine lab upgraded to 3 MB of RAM and Apollo 3000 & 4000 workstations upgraded to 8 MB of RAM and 170 MB Hard Disks.

Early Apollo Lab



Early Apollo Lab

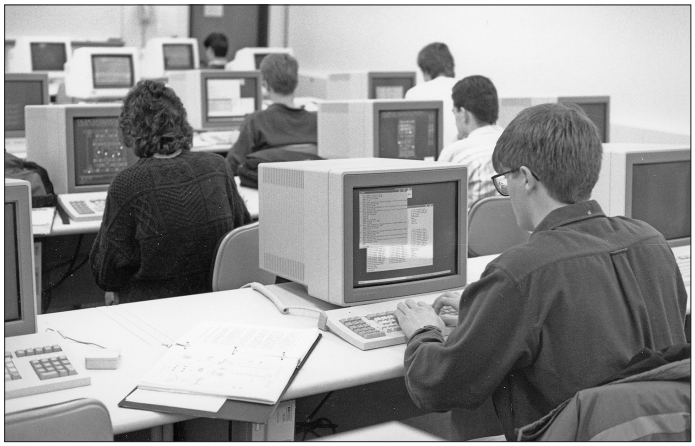
COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

September 1988

Viruses attack CAEN Macintosh labs and CAEN programmers develop Dr. Mac to come to the rescue. (CAEN FIRST!)

January 1989

IBM PS/2 model 70s arrive in the CAEN labs.



IBM Lab

IBM Lab

February 1989

Advanced Visualization Facility opens up in 145 Chrysler.

Vizlab

Vislab

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

April 1989

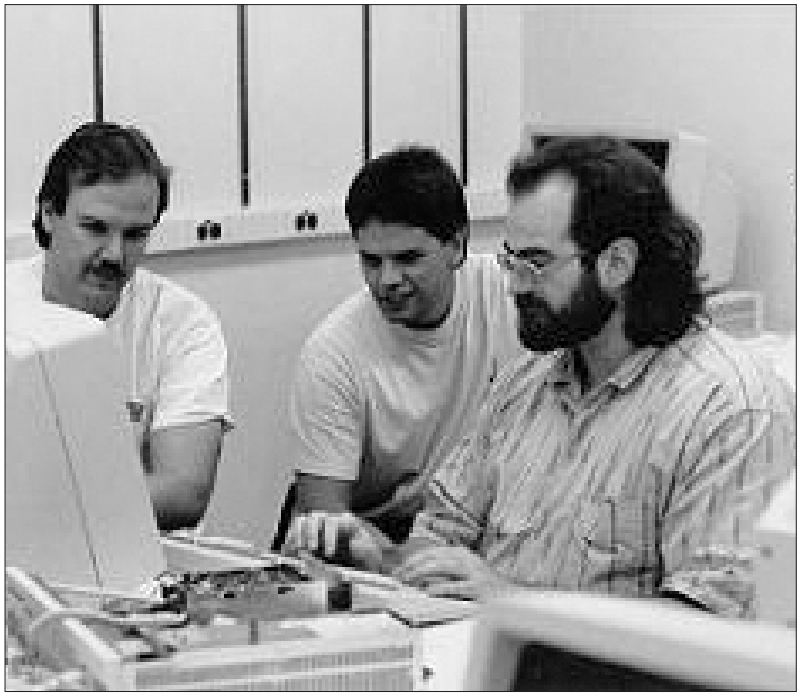
4327 EECS becomes first CAEN Lab to implement 24 hour card key access.

September1989

Launchbreak (predecessor of KeyServer) for Macintoshes is developed at CAEN to check out software licenses on the network. (CAEN FIRST!)

November 1989

First CAEN UNIX lab featuring DEC 3100 workstations opens at 2341 EECS.



John Muckler (left), Paul Killey (right) set up first CAEN UNIX lab

August 1990

Online CAEN Request information system (caenhelp) becomes available at CAEN. (CAEN FIRST!)

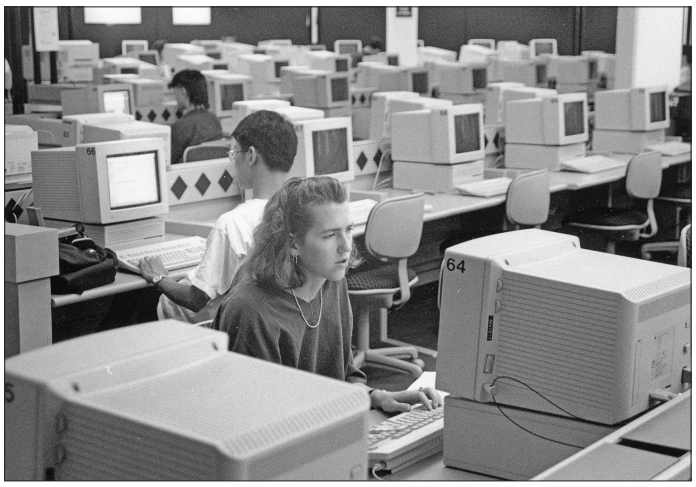
September1990

24 hour access expands to all 18 CAEN labs. (CAEN FIRST!)

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

September 1990

First joint CAEN-ITD lab opens up in North Campus Commons (Wilbur and Maxine Pierpont Commons) with 90 Macintosh IIci computers and 10 IBM RS/6000 workstations.



Pierpont Commons Lab

November 1990

AFS (Andrew File System) becomes available on CAEN UNIX workstations.

November 1990

CAEN installs Sun SPARCstation 1+ computers in labs.

Engineering Students using Sun SPARCstation in 4440 EECS Lab

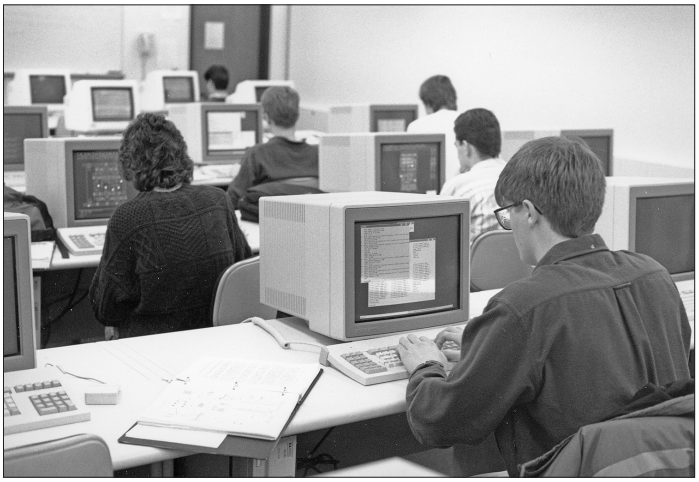
June 1991

CAEN upgrades the "backbone" network from Proteon Pronet-80 to FDDI (Fiber Distributed Data Interface) to transfer data at 100 MBits per second.

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

August 1991

IBM PS/2 model 35 computers operate with Windows 3.1.1.



PS/2 Lab

August 1991

Macintosh System 7 OS arrives.

September 1991

CAEN deploys new X Window System “look and feel” for all CAEN UNIX workstations.

January 1992

IBM PS/2 Model 70 token ring switches over to Novell NetWare.

March 1993

TULIP project provides online access to 37 materials science journals.

April 1993

Newly established Center for Parallel Computing announces account availability on KSR1.

November 1993

Last Apollos exit labs.

January 1994

The text-based Pine mail program on UNIX workstations becomes the most widely used email program.

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

April 8, 1994

Faculty, staff and students join President James J. Duderstadt and six deans on North Campus to celebrate groundbreaking for the new Integrated Technology Instruction Center (ITIC) - a core facility planned to link the disciplines of architecture and urban planning, art, engineering and music, and information resources.

Jim Duderstadt, Allen Samuels, Daniel Atkins, Robert Beckley, Paul Boylan, Richard Dougherty, Peter Banks

May 1994

CAEN and the College make their appearance on the WWW.

June 1994

Camp CAEN offers its first summer computer classes for high-school students, and later elementary school students. (CAEN FIRST!)

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

June 1995

Paul Killey becomes Director of CAEN, 1995-2001.

Paul Killey

January 2, 1996

ITIC is renamed the Media Union and CAEN moves in as its first residents.

November 1996

The Media Conversion Facility (predecessor to Groundworks) opens next to the Hotline and offers new technology such as slidemakers, scanners, jazz and zip drives, and CD writers. Machines include: Dell GX Pro personal computers with 64 MB RAM, 200 MHz processor, 2 GB hard disk, running Windows NT 4.0, and Power Macintosh 8500/150 personal computer with 48 MB RAM, and a 1 GB hard drive.

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

March 1997

Mobile computing arrives – a DHCP server provides IP connectivity to the public jacks in the Media Union. Students and staff members flood the CAEN Hotline to register their Ethernet cards in order to utilize this service.

September 1997

AFS quotas increase to 75 MB.

August 1998

ATM (Asynchronous Transfer Mode) replaces FDDI network technology at CAEN.

October 1998

Adaptive technology workstations become available to make computers more accessible to students with disabilities.

September 2000

All PCs in Media Union upgraded to 128 MB RAM and converted to dual-boot Rehat 6.1 Linux and Windows NT 4.0.

September 2000

New CAEN Sun Ultra 10/4440 workstations run Solaris 2.6 and feature 256 MB of DRAM, 2-MB L2 Cache, CD-ROM, 1.44 M-byte floppy, and a 9.1 GB 7200 RPM internal disk drive.

September 2000

The CPC (Center for Parallel Computing) announces the addition of 64 nodes to its existing production environment of 48-node IBM SP scalable parallel system.

2001

CAEN completes installation of Ethernet cabling in all CoE Buildings.

January 2001

Five CAEN labs equipped with overhead projectors to display computer output (4327 EECS, B505 Pierpont, B507 Pierpont, 2230 SPRL, B610 IOE).

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

September 2001

Mark Giuffrida becomes Director of CAEN, 2001-present.

Mark Giuffrida

September 2001

The CAEN main server and network equipment "data center" in Chrysler Center is rebuilt.

January 2002

Center for Parallel Computing and Lab for Scientific Computation merge to become the Center for Advanced Computing with Bill Martin as director.

William Martin

January 2003

The Media Union goes wireless for all U-M students, faculty, and staff with a valid uniqname and password.

Students Using Wireless in the Media Union Atrium

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

March 19, 2004

The Board of Regents renames the Media Union in honor of James Duderstadt, the 11th president of U-M, and his wife Anne.

Anne & Jim Duderstadt

January 2004

CAEN glows green again -- CAEN News goes to digital-only format!

June 2004

CAEN labs in 2230 SRB and 4440 EECS remodeled to transform CAEN labs into up-to-date learning and collaboration environments that support instructional technology applications in addition to traditional drop-in computer use.

4404 EECS Lab

COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

September 2005

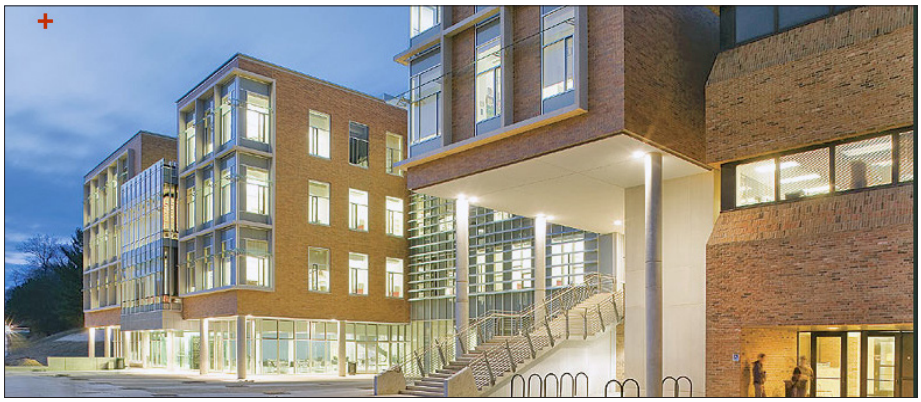
CAEN Hotline and Groundworks move to the 1st floor of the Duderstadt Center.

Hotline Express

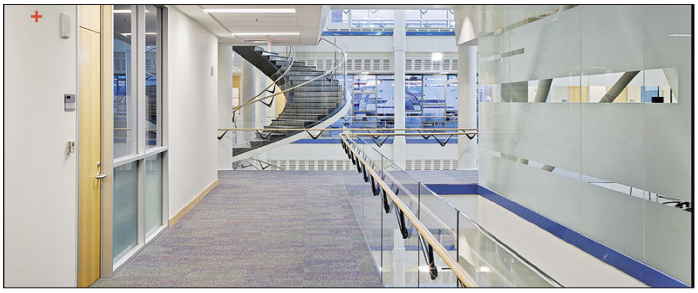
Hotline Express

January 2006

New Computer Science and Engineering Building (CSE) opens with two new CAEN labs featuring 55 new Intel-based PCs with 19" LCD monitors.



Computer Science & Engineering Building



COMPUTER AIDED ENGINEERING NETWORK (CAEN) TIMELINE

September 2007

The Freshmen Engineering labs receive new PC computers (Dell OptiPlex 745 (2 x 2.13 GHz) 20" LCD 250 GB 2 GB) running Windows XP.

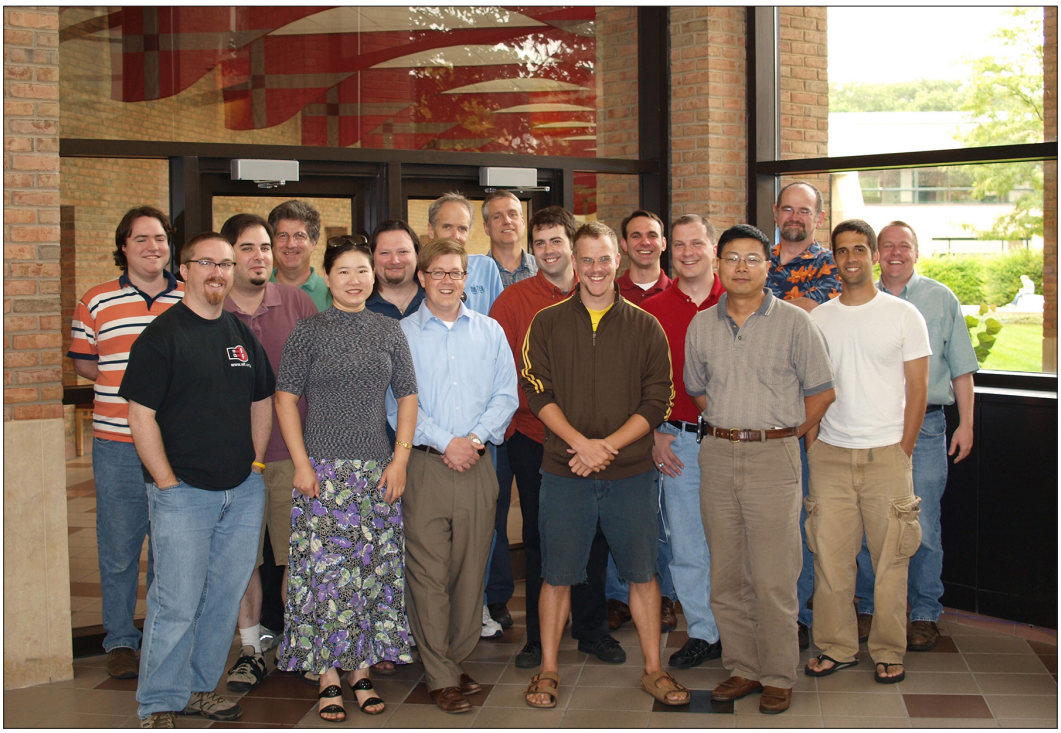
Freshman Engineering Lab in B505 Pierpont Commons

January 2008

Student Apple Laptop bundle sells for $1199.00 featuring 2.4 GHz Intel Core 2 Duo, 2 GB memory, 160 GM hard drive, SuperDrive, and an accompanying iPod.

September 2008

CAEN celebrates twenty-five years at the College of Engineering.



CAEN Staff celebrate 25 Years

CAEN 25th ANNIVERSARY EXHIBIT

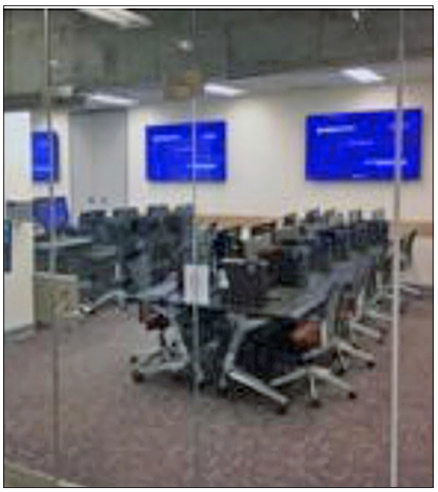
CAEN 25th ANNIVERSARY EXHIBIT

CAEN 25th ANNIVERSARY EXHIBIT

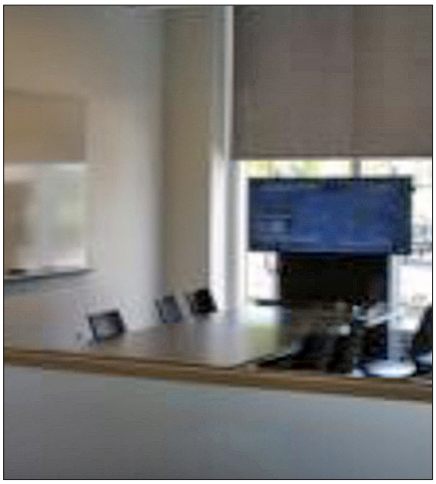
CAEN 25th ANNIVERSARY EXHIBIT

CAEN COMPUTER LABS - 2020

Bob & Betty Beyster Computer Engineering Building



Beyster 1620 (54)



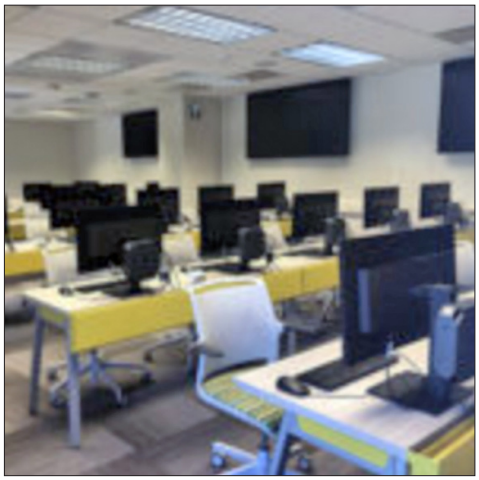
Beyster 1637 (2)

Beyster 1637 Collaboration Station (2)

Beyster 1695 Collaboration Station (4)

CAEN COMPUTER LABS - 2020

Climate & Space Research Building



Climate & Space Research 2230 (26)

Chrysler Center for Continuing Engineering Education

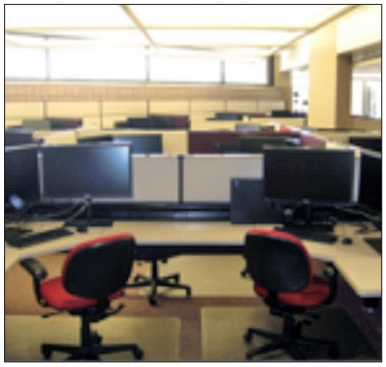
Chrysler Center 273 (13)

Mortimer E. Cooley Laboratory

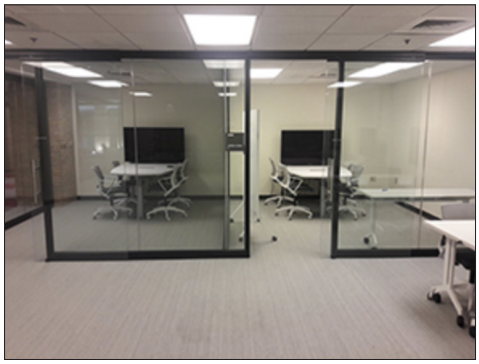
Cooley 1934 (12)

CAEN COMPUTER LABS - 2020

James & Anne Duderstadt Center



Duderstadt Center
3rd Floor East (24)



Duderstadt Center
3rd Floor Collaboration Stations (2)

Duderstadt Center
Lower Level (11)

Duderstadt Center
3rd Floor Easst Alcove (22)

Duderstadt Center 2nd Floor Southwest
Collaboration Stations (11)

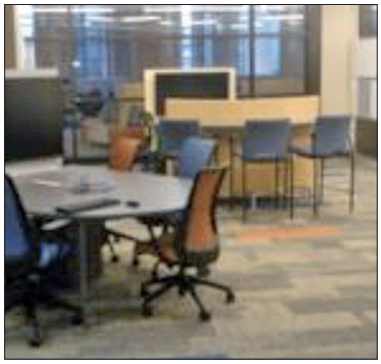
Duderstadt Center
3rd Floor Northeast (71)

CAEN COMPUTER LABS - 2020

James & Anne Duderstadt Center

Duderstadt Center
3rd Floor South (20)

Duderstadt Center
2nd Floor South (20)



Duderstadt Center
2nd Floor Southwest (15)

Duderstadt Center
3rd Floor Southwest (45)

Duderstadt Center 3rd Floor Southwest
Collaboration Stations (3)

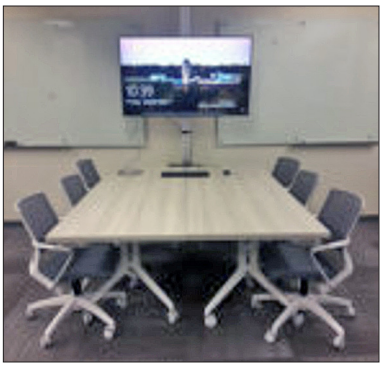
Duderstadt Center
3rd Floor West Alcove (5)

CAEN COMPUTER LABS - 2020

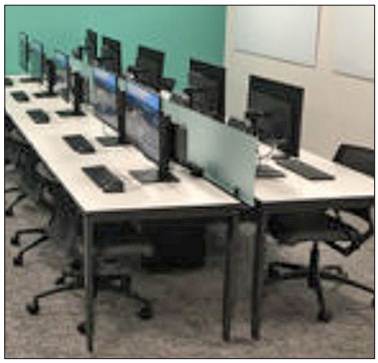
Electrical Engineering Computer Science Building EECS

EECS 4440 (5) Collaboration Stations

EECS 2331 (21)



EECS 4440 (6)
Collaboration Stations



EECS 2420 (22)

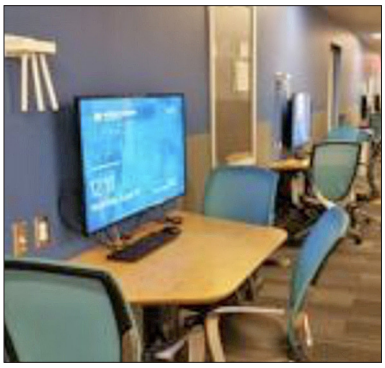
EECS 2420 (2)
Collaboration Stations

CAEN COMPUTER LABS - 2020

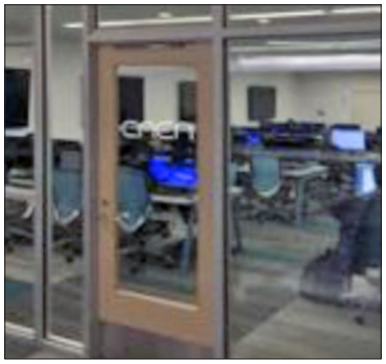
Electrical Engineering Computer Science Building EECS

G. G. Brown 2570 (4)
Collaboration Stations

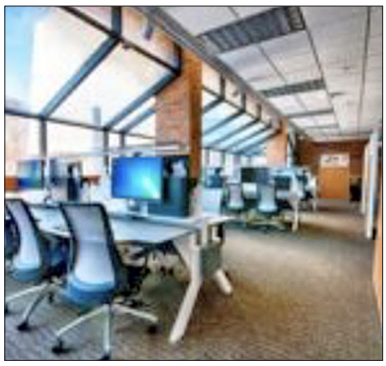
G. G. Brown 2502 (4)
Collaboration Stations



G. G. Brown 2502 (4)



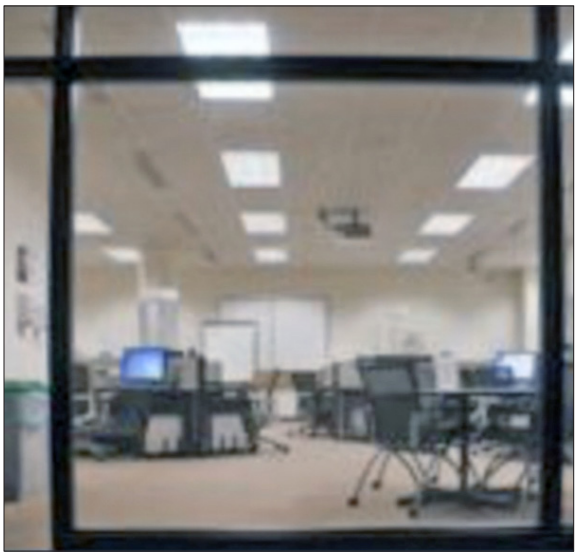
G. G. Brown 2517 (47)



G. G. Brown 2570)16)

CAEN COMPUTER LABS - 2020

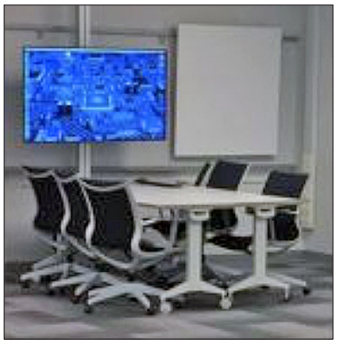
Francois-Xavier Bagnoud Aerospace Building



FXB B085 (24)

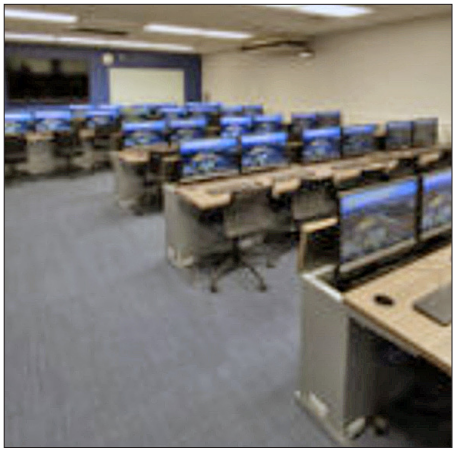
Francois-Xavier Bagnoud Aerospace Building
Mia Lin's Wave Field

GFL 224 (13)



GFL 224 (12)
Collabortion Stations

Naval Architectur & Marine Engineering Building



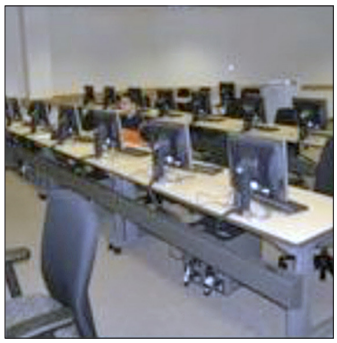
NAME 134 (32)

CAEN COMPUTER LABS - 2020

Industrial & Operations Engineering Building

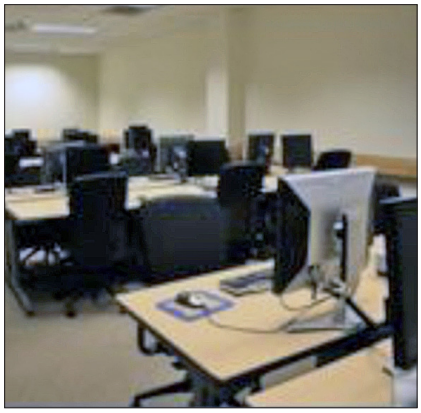
IOE G610 (25)

Wilbur K. & Maxine Pierpont Commons



Pierpont Commons
B507 (29)

Pierpont Commons
B505 (29)



Pierpont Commons
B521 (12)

Harold & Vivian Shapiro Library

Shapiro Library B000 (51)

CAEN COMPUTER LABS - 2020

Ford Motor Company Robotics Building (17)