CIVIL & ENVIRONMENTAL ENGINEERING
UNIVERSITY OF MICHIGAN

NEWSLETTER FOR ALUMNI AND FRIENDS

WINTER 2004

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This newsletter is dedicated to the 150-year history of Civil and Environmental Engineering at the University of Michigan. Professor Eugene Glysson searched through old documents, contacted former faculty and staff, and compiled some previously unknown data that we hope you will find interesting. The key article in the newsletter is an illustrated history of our department from 1854 to 2004. Our Department was actually founded in January 1837, but the first class was taught on January 20, 1854 by Alexander Winchell, the first Civil Engineering professor. The first Engineering degree was awarded in 1857 to William V. Snyder. This made the University of Michigan the sixth university and the first public university in the country to award a degree in Engineering. The first African American graduate in Civil Engineering was Fred B. Pelham who completed his degree in 1887. The first female graduate in Civil Engineering was Marion Sarah Parker, who is shown along with the CEE class of 1895 on the cover. As you read Prof. Glysson’s article, you will recognize many names of those who devoted the better part of their lives to the creation of what is today a premier institution of teaching and research. Space restrictions have limited the article to a simple enumeration of facts. We hope that by documenting these facts we will establish a baseline to which further details can be incorporated. If you have a story about the department that you wish to share with us, we will make sure that it is included in the Michigan CEE history, which we hope to publish separately.

The celebration of 150 years of excellence may be historically important, but it unavoidably raises the question: what does this rich heritage mean today and for the future of the CEE family at Michigan? Instead of enumerating our accomplishments once again and elaborating on the future opportunities, I have decided to share with you three stories related to our department that I have been fortunate to experience over the last couple of months. I will let you decide if the spirit of excellence is alive within Civil and Environmental Engineering at Michigan.

I was recently discussing the department’s needs with a devoted alumnus of the department, when he indicated his desire to sponsor an endowed chair that among other things could enhance the undergraduate design experience. I was commenting that we would be honored to name the chair after the donor, so our students would learn of his contribution, when he responded: “I am an old Dutch boy that does not wish any publicity. All I care is to give back to the department, so the coming generations of students will benefit from their education as much as I did. As a student of Civil Engineering at Michigan I learned that my imagination is the only limit to what I can achieve. I believe that my teachers showed me the way and I want the next generation to see it too.” I looked into his eyes and I knew that the CEE department had done well in the years that passed.

Just after the winter semester ended, we were all worried about the health of one of our top graduating seniors, who had to undergo heart surgery just after classes ended. I was delighted to see him walk into my office a couple of weeks later, a little pale but smiling. I asked what his plans were for the summer. “First,” he said, “I am going to Colorado this weekend for the steel bridge national competition. I wouldn’t miss that for anything in the world. My department, my classmates and my team need me and I will be there for them.” I looked into his eyes and I knew that the CEE department has done well in the present year.

At the end of each year, I have the privilege of conducting the exit interviews of the graduating seniors. They are asked to fill out a questionnaire and then we have a talk about their experiences at Michigan. Some graduates write a few extra lines summarizing their thoughts and they hand me their paper during the interview. The following is a quote from one of this year’s graduates: “Teaching Engineering is very similar to teaching painting. Many other engineering schools teach engineering methods like one teaches how to paint by numbers. At Michigan, we are given a blank canvas and a brush and paint. We are allowed to engineer with a clean slate but with some restrictions (i.e., size of canvas, colors, brush) but can create anything we like within those restrictions.” I looked into his eyes and I knew that the CEE department will do well in the years to come.

Let's all work together, so Civil and Environmental Engineering will be the place to be for the next 150 years!
The spring technical meeting was a rousing success and the discussion of the Science/Practice curriculum balance and ASCE’s Policy 465 was lively. Thanks again to Tom Newhof and Rich Anderson for their educational presentations and sharing of their perspectives on the issues. If you haven’t taken the time yet to review ASCE’s Policy 465, I encourage you to do so.

One of the duties of the CEEFA President is to issue the annual appeal letter requesting donations to the CEEFA Endowment Fund. A number of you responded generously and I want to send a special thanks to all of you who directed a gift to the fund. The solicitation letter also elicited a response from an alumni (Class of ’43) who indicated the solicitation letter was the first contact he’d had from his Alma Mater in 60 years. His letter summarized his successful private practice as a Professional Engineer, Land Surveyor, and Registered Architect. He also relayed that he had “no special affection for the College of Engineering” because he worked three jobs to put himself through school, was offered no support, and “paid very dearly for every credit hour”. His primary message was that some students, due to heavy outside work requirements, don’t achieve the grades necessary to qualify for most scholarships. With his permission, I hope to share his letter at an ASCE Student Chapter meeting during the fall launch of the mentoring program. My purpose in paraphrasing his letter here is to acknowledge that all alumni and friends of the department have a different perspective and all input is welcome.

The ’03 - ’04 mentoring program was a success for those students that made the effort to contact their designated alumni. Next year’s ASCE student chapter president has indicated that several seniors are very interested in the program. Our process is to have students sign up, indicate their area of career interest, match them with alumni who have expressed similar interest, and have the student make the initial contact. We encourage at least an initial face-to-face meeting with follow-up discussions by phone, Internet, or in person as decided by the student and the mentor.

In closing, thanks to all who have supported the efforts of CEEFA and the department over the years. If you have any ideas you wish to share or want to add your name to the potential mentor list, please contact me at croarty@nthconsultants.com. I look forward to hearing from you.

Charles J. Roarty, Jr., P.E.
CEEFA President

History of Civil Engineering Department
University of Michigan

By Eugene A. Glysson, Ph.D., P.E., D.E.E.,
Professor Emeritus, Department of Civil and Environmental Engineering

1837-1903

The history of the Civil Engineering Department at the University of Michigan begins when the superintendent of public institutions for the State of Michigan in January 1837 presented to the Michigan legislature a comprehensive plan for public education in the state. In this plan he proposed the establishment of three new professorships at the University of Michigan, one in Rhetoric and Oration, one in Fine Arts, and one in Civil Engineering and Architecture. The Civil Engineering professorship was not filled until November 1853, when Alexander Winchell became the first Engineering faculty member at the University of Michigan, accepting an appointment as professor of Physics and Civil Engineering, arriving in Ann Arbor in January 1854.

The first engineering class was taught by Professor Winchell on January 20, 1854 and was entitled “Parker Aids”, which was a sort of an engineering grammar course (named after the text he used). This marks the real beginning of engineering at the University of Michigan. The first Civil Engineering lecture was given on February 10, 1854. Professor Winchell continued to develop the engineering courses until he was transferred to the chair of Natural History in September 1855. He worked as a surveyor, became a geologist for the State of Michigan and was away from the University for four years to be president of Syracuse University and professor at Vanderbilt University. He taught at the University of Michigan for 33 years.

The first Engineering degree was awarded in 1857 to William Vanderan Snyder. This made the University of Michigan the sixth university in the country and the first public university to award a degree in Engineering.


A statement in the announcement read, “The entire course can be accomplished by the industrious student in four years, but a longer time may be occupied upon it with advantage and profit.”

The first engineering class to complete the new four year Civil Engineering curriculum graduated in 1860 and was made...
Most of the teaching during the 1860’s was done by Wood alone, although he had assistants and instructors to lessen the burden at times. Cleveland Abbe was Instructor in Physics and Civil Engineering in 1859-60; Elmore Horton Wells was Instructor in Engineering in 1864; and William Butler Morgan was Instructor in Mathematics and Civil Engineering in 1865-66. G.Y. Wisner was Assistant in 1865 and J. Burkitt Webb in 1871.

In his 1871 report Wood first raised the question concerning the Engineering Department as a unit separate from the Department of LS & A. President James B. Angell in his 1872 report asked for an endowment for the purpose of establishing a scientific school at Michigan. Unfortunately no one stepped forward to meet this request. The separation did not take place until 1895 and then only the engineering courses were included in the new college.

Wood resigned in 1872 to teach at Stevens Institute of Technology. Engineering instruction at Michigan was then placed in the hands of a triumvirate which guided it for 30 years. This group consisted of C.E. Greene, J.B. Davis and C.S. Denison.

Charles Ezra Greene, first Dean of the College of Engineering (1895-1903), obtained his Bachelor of Science in Civil Engineering from MIT in 1868 after service in the Union Army. He worked as a professional engineer in several capacities until 1872 when he was appointed Professor of Civil Engineering at Michigan. Greene surveyed the Ann Arbor Railroad and designed and was superintendent of the construction of the Ann Arbor water works [1885] and sewerage system [1890].

Charles Ezra Greene

Joseph Baker Davis (68e [CE] A.M. hon ’12) was appointed Assistant Professor of Civil Engineering in 1872 and was the only teacher of engineering familiar with the work at Michigan at that time. He had spent the second semester of 1869-70 as Instructor under De Volson Wood after having worked four years as an engineer after finishing college. Davis was responsible for the work in surveying. In 1874 he organized the University camp for field work in surveying. This was the pioneer surveying camp for field work in this country (later to be known as Camp Davis). Davis, like Greene, was a successful consulting engineer as well as teacher, serving as a city engineer for Ann Arbor for 16 years. In 1891 he was appointed to the chair of Geodesy and Surveying which he held until his retirement in 1910. He served as Associate Dean from 1904-1908.
Charles Simeon Denison (Vermont ’70 CE ibid ’71, ScD ibid ’07) was appointed Instructor in Engineering and Drawing in 1872. He also served as head of the Department of Drawing and worked as an Ann Arbor City Engineer for seven years.

By Fall 1872, the teaching staff of the Department of Engineering consisted of three appropriately trained and experienced graduate engineers, Greene, Davis and Denison. For 30 years, these three had a most friendly and productive association.

Greene’s leadership in the department coincided with the beginning of President Angell’s long administration. The presence of Davis and Denison allowed Greene to be relieved of the burden of teaching surveying, drawing, descriptive geometry, stereotomy, and mechanism, so that he could devote his time to structural mechanics and the theory of structures. Greene had the reputation among his students of being severe but many spoke of him in later years in praise of his excellent teaching, his perfect logic and clear exposition. He ranks as one of the greatest engineering teachers of his time. He was made the first Dean of the Engineering Department in 1895. He died suddenly in 1903.

Mortimer E. Cooley who had arrived on the campus in 1881 and was serving as Professor of Mechanical Engineering was made the second Dean of Engineering in 1904.

Based on limited information, the first African-American engineering alumnus was a Civil Engineer. Fred B. Pelham graduated in 1887. The first female to receive a B.S.E. degree in Engineering (Civil) was Marion Sarah Parker in 1895.

1904-1946

Gardner Stewart Williams (’89e [CE], CE ’99) came from Cornell University to succeed Greene as Chair. He was appointed in June 1904 and began his duties the following semester as Professor of Civil, Hydraulic and Sanitary Engineering.

Albert Emerson Greene (’95, 96e [C.E]) was made Assistant Professor of Civil Engineering. He had been working for the Canadian Bridge Co. and returned to the University to teach in structural engineering.

Also at this time (1904-05), several other changes to the faculty were made. Clarence George Wrentmore (’93e [CE], MS ’98, CE ’02) was made Assistant Professor of Civil Engineering, Charles Joseph Tilden (Harvard ’96e [CE] A.M. hon Yale ’19) came as Instructor in Civil Engineering. George Gottlieb Stroebe (Chicago ’01, Mich ’07e [CE]) became Instructor in Civil Engineering in 1906.

In 1904 the West Engineering Building was opened with the Department of Civil Engineering a major occupant.

In 1907, John Howell Griffith (Wisconsin ’93, M.S. ibid ’98) was appointed Assistant Professor of Civil Engineering and in 1908, Charles Alton Ellis (Wesleyan ’00, CE. Illinois ’22) and Edward Dunbar Rich (C.E. Rensselaer Polytechnic Institute ’95) were appointed Assistant Professors in Civil Engineering. Archie Burton Pierce (California ’90e [CE], PhD Zurich ’03) transferred to the department from Mathematics without change of rank as Assistant Professor.

Wrentmore and Stroebe left the department to accept appointments in outside practice (1909-11). Arthur James Decker (’05e [CE]) joined the staff as Instructor in 1909 and became Professor in 1918.
In July 1911, Dean Cooley presented a plan to reorganize the department to the Regents. The plan included the creation of a separate department of engineering mechanics. The Regents approved the creation of the new department and appointed Professor Tilden an additional title of Professor of Engineering Mechanics.

Professor Gardner Williams resigned as a consequence of this reorganization. Albert E. Greene was promoted to professor and made acting head of the Civil Engineering Department. At this time also Assistant Professor Griffith resigned.

Dean Cooley recruited Henry Earl Riggs (Kansas '86, C.E. Michigan '10, D. Eng. ibib '37) to become Professor of Civil Engineering and to have general charge of all branches of the subject. He began his appointment in May 1912. Professor Riggs had been in engineering practice for 26 years and had very critical concerns about the Civil Engineering curriculum, contending that the courses were awfully short of what should be expected. He proposed more courses in structural engineering and hydraulic engineering and new courses in railroad engineering. He also proposed courses in water supply, sewerage, sanitary engineering and power.

The reorganization resulted in five professorships: civil, structural, hydraulic, municipal and sanitary, and geodetic engineering. At the time that Professor Riggs became Professor of Civil Engineering, Professor Greene’s title was changed from Professor of Civil Engineering to Professor of Structural Engineering, and Horace William King (’95e [CE]) was appointed Professor of Hydraulic Engineering.

Greene resigned in July 1912 in protest of the reorganization. Greene’s departure meant that two of the five programs needed help. Geodetic engineering was taught by Clarence Thomas Johnston (’95e [CE], CE ’99).

The two positions were filled by William Christian Hoad (Kansas ’98e [CE]) Professor of Sanitary Engineering, and Lewis Merritt Gram (’01e [CE]) Professor of Structural Engineering.

William Christian Hoad

Courses in highway engineering and highway laboratory work were first given in 1912-13 under Assistant Professor Rich. In one-half of the Physical Testing Laboratory sufficient equipment was installed to permit standard tests of paving brick and cement, but space was limited and the interest in the subject small. To stimulate students’ interest to make the laboratory available to smaller cities and villages in the State, the Regents authorized testing work for Michigan municipalities in January 1913.

Assistant Professor Rich resigned in 1913 and John Joseph Cox (Hiram ’09e [CE]) was appointed Instructor in Civil Engineering.

Provision was made in 1914 for a summer assistant in the Highway Laboratory to perform city tests. In 1915, Dean Cooley sent a communication to the Regents urging certain co-operation with the work of the State Highway Department. The Regents agreed on condition that the co-operation of the University could be had without displacing or otherwise interfering with the regular work of the University. This was the first step in the establishment of the State Highway Laboratory, which would become an important contact between the University and the State.

In July 1919 Associate Professor Cox resigned and Arthur Horace Blanchard (Brown’99e [CE] A.M. Columbia ’02) Professor of Highway Engineering at Columbia University was appointed Professor of Highway Engineering. Professor Blanchard resigned in 1927. From 1921 until 1923 Herschel C. Smith (’13e [CE] MSE ’21) served as Assistant Professor of Highway Engineering.

In 1919 John Henry Bateman (’15e [CE] CE ’22) was put in charge of the Highway Laboratory. Bateman had been chief engineer of the State Highway Department before he was appointed Assistant Professor of Highway Engineering in the Civil Engineering Department. Before he resigned in 1924, he developed one of the finest highway laboratories in the country.

Professor Bateman was succeeded by Roger Leroy Morrison (Illinois ’11 AM Columbia ’14 CE Illinois ’17) who was appointed Associate Professor of Highway Engineering in 1924 and became Professor of Highway Engineering and Transport in 1928. He also served as Director of the Michigan State Highway Laboratory from 1924 to 1927, and was curator of the Transportation Library after 1946.

Walter Johnson Emmons (Brown ’12e [CE], A.M. Columbia ’14) was appointed Associate Professor of Civil Engineering in 1927 and also was Director of the State Highway Lab until 1933. In 1944 he was appointed Secretary and Assistant Dean of the College; he became a full Professor in 1951.

James Harlan Cissel (Purdue ’10e [C.E.]) was appointed Instructor in 1915. When Professor Gram became head of the department in 1928, Cissel was made Professor of Structural Engineering and head of the Structural Engineering Division within the department and served until his death in 1949. Associate Professor Glenn Leslie Alt (Kansas ’16e [C.E.] C.E. ibib ’51) came as Instructor in 1918 with a background in professional practice. Edward Leerdrup Eriksen (Polytechnic School, Copenhagen ’10e [C.E.]) transferred from the Department of Engineering Mechanics and was made Associate Professor of Civil Engineering in 1920. He left the University in 1923 and returned in 1930 to the Engineering Mechanics Department. William Stuart Housel (’23e [C.E.], MSE ’32) was appointed...
Instructor in 1924 and rapidly established himself as an authority in soils and foundations. He was promoted to Professor in 1950.

Robert Henry Sherlock (Purdue ‘10e [C.E.]) joined the staff as Instructor in 1923 and was appointed to a professorship in Civil Engineering in 1933. He served as head of the Structural Division while Professor Cissel was on leave of absence from 1933 – 1936.

In 1922 the Regents created the chair of Transportation Engineering to bring together in one division all phases of instruction in transportation in the Department of Civil Engineering not covered by the Division of Highway Engineering. John Stephen Worley (Kansas ’04, M.S. ibid ’04 CE ibid ’22) was appointed Professor of Transportation Engineering in 1922. Walter Clifford Sadler (Illinois ’13e [C.E.], C.E. ibid ’27, L.L.B. Michigan ’30), appointed Assistant Professor of Civil Engineering in 1925, was assigned the work on railroad engineering. He became professor in 1941.

The organization of the Division of Sanitary Engineering in 1912, the establishment of a special sanitary engineering curriculum and the appointment of Professor Hoad, marked the beginning of the long period of very effective work in this field. By an arrangement with the City of Ann Arbor, the sewage treatment plant completed in 1936 was made available to the University as a laboratory for graduate student research in sewage treatment. Co-operation between the Department of Civil Engineering and the Medical School resulted in the development of courses in Public Health Engineering. The United States Public Health Service gave sufficient funds to the University to make possible an expansion in public health education. As a result, in 1936 Harry Edgar Miller (‘16e [C.E.], MS Harvard ’32), of the University of Kansas, who was appointed Professor of Municipal and Sanitary Engineering in the College of Engineering and Professor of Public Health in the School of Public Health in 1944. This dual appointment helped to increase the interaction between the two programs.

In 1946, Professor Decker retired after 36 years of teaching and service in the field of Sanitary Engineering. Professor Gram also retired that year. He had not only been serving as chairman of the Department but also as Director of Plant Extension for the University. Professor Worley also retired in 1946 with the title of Professor Emeritus of Transportation Engineering and Curator Emeritus of the Transportation Library.

Due to demands from his private practice, in 1928 Professor Riggs presented his resignation. The Regents gave him a leave of absence until 1930. Then, instead of the usual retiring title of Professor Emeritus, the title of Honorary Professor of Civil Engineering was conferred on him. It was hoped that he might continue to serve in a semi-official capacity in the interest of the University.

During World War II the program of the Department was continually modified and graduate study largely replaced by special courses offered under the auspices of the Army and Navy programs. All of the faculty members contributed significantly in the various areas of their expertise. Professors Sherlock, Morrison, Emmons, Carey, Wisler, Brater, Housel, Alt, Hoad, Decker, and Maugh, were the faculty at that time.

In addition to his other duties, from 1945 – 1947, Dean Ivan Charles Crawford (Colorado ‘12e [C.E.], C.E. ibid ’15, D. Sc. hon. Ibd ’44) carried the responsibilities of the chairman of the Civil Engineering Department.

In 1941 Geodesy and Surveying was discontinued as a separate department and the staff and activities were reunited with the Department of Civil Engineering. They had been closely related throughout the period of years since 1921 when the Department of Geodesy and Surveying was established. There were numerous required surveying courses in the Civil Engineering curriculum as well as the surveying camp activities.

Professor Johnston retired in 1941 and Harry Bouchard (’11e [C.E.]), who was appointed Instructor in 1918 and had been promoted to Professor in 1941, assumed the direction of work in Geodesy and Surveying. In 1941 he also became Director of Camp Davis, the summer surveying and geology camp in Jackson, Wyoming. Associate Professor Clifton O’Neal Carey (’06e [C.E.], C.E. ’14) retired in 1945. He had been appointed Instructor in Civil Engineering in 1908 and was transferred to work in Geodesy and Surveying in 1910. He continued to serve in that department until it was reunited with the Department of Civil Engineering.

There were three other teachers in Geodesy and Surveying that should be recognized for their long years of service to the department and University. Edward Young (’21e [C.E.]) became Instructor of surveying in 1920 and Associate Professor in 1947. His special interest being in the field of photogrammetry. George Moyer Bleekman (’16e [C.E.], M.S.E. ’23) was appointed Instructor of Geodesy and Surveying in 1923 and Assistant Professor in 1930. He specialized in the field of municipal surveying and land subdivision. Harold James McFarlan (’17 C.E.) became Instructor in Geodesy in 1920 and was promoted to Assistant Professor in 1926. In addition to teaching surveying courses he assisted with instruction in drawing and mathematics during World War II.
**1947-1959**

Professor Earnest Boyce was appointed Chairman of the Department in 1947. With the movement of the Department of Electrical Engineering to the new addition to East Engineering Building, space in the West Engineering Building was released for use by the Civil Engineering Department. Laboratory facilities for hydraulics, structures (including structural models), and sanitary engineering, were provided. This greatly increased departmental resources for teaching and research in both undergraduate and graduate work.

Structural engineering was under the direction of Professor Cissel until his sudden death in January 1949 when Professor Sherlock was given that responsibility. Also in the structural area was Lawrence Carnahan Maugh ('31e [C.E.], Ph.D. '34) who was appointed Instructor in 1925 and promoted to Professor in 1948. Leo Max Legatski ('31e [C.E.], Sc.D. '37) who was made Assistant Professor in 1947 and promoted to Associate Professor in 1951 was in the structural area along with Robert Blynn Harris (Colorado '40e [Arch.E.], M.S.E. California Institute of Technology '47) who was appointed Instructor in Structural Engineering in 1947 and promoted to Assistant Professor in 1949. Bruce Gilbert Johnston (Illinois '30e [C.E.], Ph.D. Columbia '38) came to the University as Professor of Structural Engineering in 1950 from Lehigh University where he had been Professor of Civil Engineering and director of the Fritz Laboratory (Structural Research).

In the field of hydraulics, Professor King retired in 1939 followed by Professor Wisler in 1951. Ernest Frederick Brater ('34e [C.E.], Ph.D. '30) who was first appointed Instructor in 1937, thus became Senior Professor in Hydraulic Engineering. Vladas Merkys (Ecole Nationale Des Ponts et Chaussées '28, D. Eng., Technische Hochschule [Karlsruhe] '46) was appointed Resident Lecturer in Hydraulics in 1950. The development of a Lakes Laboratory at Willow Run and the construction of the hydraulics laboratory in the West Engineering Building by Professor Brater greatly improved the teaching and research capability in this field.

The areas of transportation and highway engineering were carried forward by Professors Worley and W.C. Sadler who became Professor in 1941. With his training in law and his background of engineering experience, Professor Sadler developed special courses in specifications, contracts and engineering law.

The post war programs in highway construction and traffic engineering were under the supervision of Professor Morrison until his death in 1952. John Clayton Kohl ('29e [C.E.]) who was appointed Assistant Professor in 1946 to teach in both highway and railroad engineering, was made Associate Professor in 1949. In 1952 his active interest culminated in the establishment of the Transportation Institute within the College and he became its first director.

All during this period the State Highway Laboratory had been very active. In 1949 Edwin Boyd terminated a period of 35 years of service as Instructor in Highway Laboratory Practice (one-half time shared with the State Laboratory). The vacancy was filled by the part-time appointment of Frank Evariste Legg ('33 M.S. '34) as Assistant Professor of Engineering Materials. From 1946 to 1951 Gerald Oscar Kerkhoff (Michigan College of Mining and Technology '31, E.M. ibid '31) held a one-half time appointment as Assistant Professor in Soil Mechanics.

In September 1951, Robert Oscar Goetz ('49e [C.E.], M.S.E. '50) was appointed Instructor in Soil Mechanics. Following the death of Professor Morrison, Donald Nathan Cortright (Illinois '39e [C.E.], M.S.E. Michigan '51) was appointed Assistant Professor of Highway Engineering.

The Michigan Highway Conferences, founded in the 1920's, continued annually with the transportation and highway faculty of the department serving on the executive committee. To save energy following the oil crisis in the fall of 1972, it was determined that the meeting would be cancelled for the next spring. No additional conferences were held with University of Michigan participation.

The post war program in Sanitary Engineering was stimulated by the world-wide need for engineers qualified in this field and by co-ordination with the School of Public Health. With his dual appointment, in 1944 Professor Boyce introduced several changes based on co-ordination of instruction with the School of Public Health. This led to the establishment of the degree of Master of Science in Engineering (Sanitary Engineering) in 1945.

Upon the retirement of Professor Decker in 1946, Richard King (Texas A. and M. '38e [C.E.], M.S.E. Illinois Institute of Technology '40) was appointed Assistant Professor of Sanitary Engineering.

With the development of the sanitary engineering laboratory and increased interest in the field, additional staff members were needed. Assistant Professor Jack Adolph Borchardt (Illinois '40e [C.E.], M.S.E. Carnegie Institute of Technology '41, Ph.D. Wisconsin '48) was added to the faculty in 1948. Professor King resigned in the summer of 1950 to accept an appointment as Associate professor of Sanitary Engineering at Georgia Institute of Technology and Eugene Andrus Glysson (Vermont '49e [C.E.], M.S.E. Michigan '51) was appointed Instructor in Sanitary Engineering in 1951.

The State Highway Testing Laboratory continued to play an important role in the Civil Engineering program providing the means for testing materials for highways and bridges. The Soil Mechanics Laboratory had a very important part as well in the testing of soils and various treatment methods. All of the facilities were located in the East Engineering Building.

In 1948 the Hydraulics Laboratory, located in the West Engineering Building, had pumps, sumps, pipes, channels, flumes, and weighing and measuring devices necessary for undergraduate teaching and general research activities.

In 1948 the Lakes Hydraulics Laboratory at Willow Run was equipped with a large wave tank, wave making machines, and instruments needed for study of problems arising along shorelines of large bodies of water. This laboratory was used for sponsored and basic research.

In 1948 Sanitary Engineering facilities were also available in the West Engineering Building for the analysis of water and sewage and industrial wastes. There was special equipment available for laboratory studies including a complete water filtration plant which enabled research on industrial and domestic waste. Portable equipment was available for studies under field conditions. As a result of Professor Borchardt's interest in the trans-
fer of new technology to the active water and waste water professionals in the mid-west area, he established a conference centered on the newest innovations in the field. This conference was first offered in 1950 and has been co-sponsored by the Civil and Environmental Engineering Department and the Michigan Department of Public Health ever since. It is conducted every two or three years. It is now named the Borchardt Conference and is held on the University of Michigan Campus. The 20th conference will be held in 2005.

The undergraduate option in Construction Engineering was adopted in 1948.

In 1949 the Structural Engineering Laboratory had a 400,000 pound capacity universal testing machine, a loading frame for testing large assemblies, deformeter gages loading frames for testing models, electric strain gage equipment, and a well equipped shop for making models and test assemblies. These facilities allowed the testing of full-scale structural members and small scale models. The laboratory provided for class demonstrations, graduate study and research.

In 1949 the Michigan Chapter of Chi Epsilon was established with Professor Jack A. Borchardt as advisor.

In 1952 the Transportation Institute was established with Professor John C. Kohl as Director. The college announcement in 1953-54 lists the faculty and staff as of 1952 as follows: Earnest Boyce, Professor of Municipal and Sanitary Engineering, Chairman of Civil Engineering Department and Professor of Public Health Engineering in the School of Public Health; Robert H. Sherlock, Professor of Civil Engineering (Structures); Harry Bouchard, Professor of Geodesy and Surveying and Director of Camp Davis; Walter C. Sadler, Professor of Civil Engineering; Lawrence C. Maugh, Professor of Civil Engineering (Structures); William S. Housel, Professor of Civil Engineering (Soil Mechanics); Bruce G. Johnston, Professor of Structural Engineering; Ernest F. Brater, Professor of Hydraulic Engineering; Walter J. Emmons, Professor of Highway Engineering and Assistant Dean and Secretary of the College of Engineering; Glenn L. Alt, Associate Professor of Civil Engineering (Construction); Edward Young, Associate Professor of Geodesy and Surveying; John C. Kohl, Associate Professor of Civil Engineering (Transportation) and Director of the Transportation Institute; Leo M. Legatski, Associate Professor of Civil Engineering (Structures); Arnold J. McFarlan, Assistant Professor of Geodesy and Surveying; George M. Bleekman, Assistant Professor of Geodesy and Surveying; Jack A. Borchardt, Assistant Professor of Civil Engineering (Sanitary Engineering); Robert B. Harris, Assistant Professor of Civil Engineering (Construction); Frank E. Legg, Assistant Professor of Engineering Materials; Donald N. Cortright, Assistant Professor of Civil Engineering (Highway Engineering); Robert O. Goetz, Instructor in Civil Engineering (Soil Mechanics); Eugene A. Glysson, Instructor in Civil Engineering (Sanitary Engineering); Vladas D. Merlys, Resident Lecturer in Civil Engineering (Hydraulics); Wadi S. Rumman, Instructor in Civil Engineering (Structures).

In addition to the above were technicians George Geisendorfer in charge of the structures, hydraulics and sanitary laboratories, and Lorenzo Plumpton who was responsible for the geodetic and surveying equipment.

An indication of the number of Civil Engineering degrees granted over the years up to 1952 follows:

**Bachelors Degrees in Civil Engineering**

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<th>1920-39</th>
<th>1940-52</th>
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**Graduate Degrees in Civil Engineering**

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<th>1900-19</th>
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<td>49</td>
<td>330</td>
<td>354</td>
<td>756</td>
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In 1951-52 the College Announcement indicated there were 238 undergraduates in Civil Engineering.

In 1953 Professor Harry Bouchard died and Professor Bleekman assumed the Directorship of Camp Davis. Mr. Glenn O. Lease was appointed Instructor of Civil Engineering (Structures) and Professor E. Wendell Hanson was appointed Professor of Meteorology.

The program in Meteorology had been assigned to the Department of Civil Engineering to provide a location to present its course work and conduct its research until it could become established. Several other faculty members would be added in the next few years, namely, A. Nelson Dingle, Lecturer in Meteorology in 1954 and Gerald C. Gill, Lecturer in Civil Engineering (Meteorology) in 1956.

In 1958 the Meteorology area included Frank R. Bellaire, George W. Reynolds, Donald J. Portman, David L. Jones, and Floyd C. Elder. All were Lecturers in Meteorology at that time. The Meteorology group was transferred to the Engineering Mechanics Department in February 1961.

In 1953 Clinton L. Heimbach was appointed Assistant Professor of Railroad Engineering. In 1954 Ward K. Parr was made Associate Professor of Highway Engineering, and Ralph M. Berry, Professor of Geodesy and Surveying. The graduate program in Construction Engineering was established in 1954 by Professor Robert Harris.

In 1955 Victor L. Streeter was appointed Professor of Hydraulics, and in 1956 Glen V. Berg was appointed Lecturer in Civil Engineering (Structures). Berg would become Chairman of the Department in 1969.

The development on North Campus to eventually allow the movement of the College of Engineering to this location had proceeded in 1957 to the completion of the Automotive Laboratory which was to provide space for the Civil Engineering surveying classes and instrument room. The Mortimer Cooley Laboratory had been completed in 1955 along with the Phoenix Memorial Laboratory. This construction was followed by the completion of the Fluids Engineering Building in 1958 which provided laboratory facilities and space for all engineering departments with fluid dynamics interests. This provided the hydraulics laboratory for the Civil Engineering Department. The Fluids Laboratory would be later renamed the G. G. Brown Building.
In 1958 Harold J. Welch joined the faculty as Instructor of Geodesy and Surveying, and Bruce D. Greenshields as Lecturer in Transportation Engineering and Engineering Mechanics and Assistant Director of the Transportation Institute.

In 1959 Ulrich W. Stoll was made Instructor in Civil Engineering (Soil Mechanics) and Clinton L. Heimbach was appointed Lecturer in Civil Engineering. Professor Walter Sadler died in October of that year.

1960-1979

In 1960 Lloyd L. Kempe was appointed Professor of Sanitary Engineering and Chemical Engineering to teach classes and conduct research in both departments. He was also to become associated with the Medical School. He provided courses in Microbiology for the Sanitary Engineering students for several years. Joe E. O’Neal was named Lecturer in Civil Engineering to teach surveying and legal aspects of engineering.

In 1961 Chairman Earnest Boyce retired and Professor Lawrence C. Maugh served as interim chairman of the department for 1961-62. During this interval the department established its own curriculum committee to revise and update the curriculum and to evaluate any new courses proposed. This provided for complete investigation of course proposals before being acted upon by the departmental faculty.

Professor Frank E. Richart, Jr. (Geotechnical Engineering) of the University of Florida was appointed Chairman of the Civil Engineering Department in 1962. New emphasis was placed on the quality of teaching and research. The soil mechanics laboratories were relocated to the new addition to the G. G. Brown Laboratory and expanded in 1963, with new emphasis on research in soil dynamics. The addition to the G. G. Brown Laboratory also provided space for increased research in structural dynamics and for the relocation of the Lakes Hydraulics Laboratory from Willow Run. This resulted in greatly increased activity and has brought world-wide recognition to the Department.

In 1962 the College of Engineering dropped its mentor system for undergraduate student counseling and established a system of program advising in each department. Professor Robert B. Harris was appointed the first program advisor for the Civil Engineering Department.

New faculty in 1962 were Clifford McKechnie, Lecturer in Surveying; Joseph Price and Alfred M. Beeton, Lecturers in Sanitary Engineering; and John Lysmer, Lecturer in Soil Mechanics.

In 1963 there were two new faculty members, John R. Hall (Geotechnical) and Walter J. Weber, Jr. (Environmental) appointed as Assistant Professors of Civil Engineering.

In 1964 the new faculty members were Wayne F. Echelberger, Instructor in Civil Engineering (Environmental); E. Benjamin Wylie, Instructor in Civil Engineering (Hydraulics) who later would become Professor of Civil Engineering and then Chairman of the Department in 1984; Robert V. Galbreath, Assistant Professor of Civil Engineering (Construction); and Larry L. Kole, Lecturer in Civil Engineering (Transportation). In that year also, the requirement to attend Camp Davis was dropped from the Civil Engineering curriculum and after the summer session that year the camp was turned over to the Geology Department for use by that department for the continued teaching of geology. The Transportation Library was moved from the East Engineering Building to the third floor of the new Undergraduate Library.

In 1965, Donald E. Cleveland was made Professor of Civil Engineering (Transportation) and Joe O’Neal was made Adjunct Professor of Contracts and Specifications. The Sanitary Engineering Laboratory was remodeled to add a Solid Wastes Laboratory to accompany the new scholarship program funded by the U.S. Public Health Service in Solid Waste Engineering and Management. This program would continue until 1973. Professor Jack Borchardt stepped down from being faculty advisor for the Chi Epsilon Chapter and Professor Eugene Glysson took his place.

In 1966 the new faculty members consisted of Donald H. Gray, Assistant Professor of Civil Engineering (Geotechnical); Robert D. Hanson, Assistant Professor of Civil Engineering (Structures); and Gilbert T. Satterly, Jr., Associate Professor of Civil Engineering (Transportation).

It was in 1966 that the County Road Association of Michigan with the cooperation of Professor Donald Cortright began a series of annual meetings under the name of County Road Workshop. These meetings continued for many years under the guidance of Professor Egon Tons.

In 1967, Charles P. Powers, Assistant Professor of Sanitary Engineering; Richard D. Woods, Assistant Professor of Civil Engineering (Geotechnical); and John M. Armstrong, Instructor in Civil Engineering (Environmental) joined the department. Professor Robert Harris was appointed the first Associate Chairman of the Department.

Historically the undergraduate semester hour requirement for graduation at the Bachelors level had been set at 120 hours until 1897 when it was raised to 130 hours. In 1904 this requirement was raised from 130 to 140 semester hours. With the institution of the requirement that trigonometry be required as an entrance requirement this was reduced to 138 hours for graduation. This requirement was in effect until 1967 when the undergraduate degree requirement was reduced to 128 hours and the Department underwent complete curriculum review with respect to content and currentness.

In 1968 the engineering Graphics Department was added to the Civil Engineering Department which meant that Professor Herbert T. Jenkins, Professor of Engineering Graphics, and Professor Alfred W. Lipphart, Professor of Engineering Graphics and Assistant Dean of the College of Engineering, were added to the faculty of the Department. Jonathan W. Bulkley, Assistant Professor of Civil and Water Resources Engineering, joined the Department along with Raymond P. Canale, Assistant Professor of Civil Engineering (Environmental); Subhash C. Goel, Assistant Professor of Civil Engineering (Structural); Allen R. Cook, Instructor of Civil Engineering (Transportation); and John E. Schenk, Instructor of Civil Engineering (Environmental).

In 1969 Professor Glen V. Berg became Chairman of the Civil Engineering Department following the completion of the term of Professor Frank E. Richart who remained on the faculty of the Department. New faculty consisted of Egon Tons, Associate Professor of Civil Engineering (Highway Materials); Robert L. Pretty, Lecturer in Civil Engineering (Transportation); and Edwin L. Bidwell, Associate Professor of Civil Engineering (Construction). Government funding greatly aided the Department's
efforts in research in the areas of earthquake engineering, hydraulics, soil dynamics, and sanitary and water resources engineering. This increased activity demanded additional space and plans were set in motion to construct new laboratories for sanitary and water resources, replacing the overtaxed facilities in the West Engineering Building. Building I-A on the North Campus was started in 1973 and occupied by this division in 1975. This building was to become known as the Environmental and Water Resources Engineering (EWRE) Building.

In 1970, Movses J. Kaldjian was appointed Assistant Professor of Civil Engineering (Structures), and Sidney E. Shorter was made Adjunct Associate Professor of Civil Engineering (Structures).

In 1972 it is interesting to note that the question was raised by the students at that time concerning the use of small electronic calculators during examinations instead of slide rules. (Initially they were banned, but after a couple years it was determined that they could be used if they were not programmable.)

In 1973 the faculty was joined by Guillermo Ponce-Campos, Adjunct Assistant Professor of Civil Engineering (Construction) and James K. Wight, Assistant Professor of Civil Engineering (Structures). A rule was established by the University that there should be no smoking in classrooms by either students or faculty.

In 1974, the new faculty were: Robert J. Jagow, Adjunct Professor of Civil Engineering (Surveying); Charles J. Hurbis, Adjunct Professor of Civil Engineering (Legal Aspects); John E. Robbins, Adjunct Lecturer in Civil Engineering (Transportation); and Robert L. Henry, Adjunct Professor of Civil Engineering (Legal Aspects). Professor Eugene Glysson became the second Program Advisor, replacing Professor Robert Harris who had become Associate Chairman of the Department. There were 263 undergraduate students and 109 graduate students in attendance.

In 1975, Professor Robert B. Harris served as Acting Chairman while Professor Glen V. Berg was on sabbatical leave. New faculty were Richard H. Shackson, Adjunct Professor of Civil Engineering (Transportation) and Gary R. Elling, Lecturer in Civil Engineering (Construction). As was mentioned earlier all the laboratories, classrooms and offices in Building I-A were occupied for the first time. There were 262 undergraduates (14 women). A 3 year – 2 year program with Hope College was adopted leading to a Bachelor of Science degree from Hope College and an M.S.E. degree from Michigan. This program joined one already in place of the same sort with Calvin College. There were 315 undergraduates enrolled in the Department that year which made the Civil Engineering Department the third largest in the College of Engineering.

In 1978 Mohamed Elgaaly was appointed Adjunct Assistant Professor of Civil Engineering (Structures); Constantine N. Papadakis, Adjunct Assistant Professor of Civil Engineering (Hydraulics) (he would later become President of Drexel University); and Charles H. Gould, Lecturer in Civil Engineering (Construction).

In May 1976, the Department hosted the first U.S. National Conference on Earthquake Engineering in the Rackham Auditorium. Professor Robert Hanson was Chairman of the organizing committee and served as the host for the conference. Professors Berg, Goel and Wight were all members of the organizing committee and served critical roles in planning and hosting the conference.

In 1977 Amin M. Almuti was appointed Adjunct Assistant Professor of Civil Engineering (Structures); Thomas M. Heidtke, Adjunct Assistant Professor of Civil Engineering (Environmental); Lidia P. Kostyniuk, Assistant Professor of Civil Engineering (Transportation); and Steven J. Wright, Assistant Professor of Civil Engineering (Hydraulics). The State Highway Testing Laboratory, which had for many years been located in the East Engineering Building, was moved into a new building in Lansing, terminating a long relationship of over sixty-two years with the Civil Engineering Department. The Department maintained a materials testing laboratory in that space until the laboratory was moved to the G. G. Brown Building on North Campus in 1980 where it was named the William S. Housel Laboratory. In the early 1970’s, Professor Harris was heavily involved with the design and arrangement of the buildings on North Campus to be utilized by the Civil Engineering Department (Building I-A and G. G. Brown). He also was involved with the relocation of space in the East Engineering Building due to its reorganization. A committee of alumni and friends had been organized to assist in raising funds for the required equipment to be utilized in this laboratory. In April 1983 the Civil Engineering Alumni and Friends Association was formed. There were 315 undergraduates enrolled in the Department that year which made the Civil Engineering Department the third largest in the College of Engineering.

William S. Housel Concrete Pavement Laboratory

In 1978 Mohamed Elgaaly was appointed Adjunct Associate Professor of Civil Engineering (Structures); Garrett H. Evans, Adjunct Assistant Professor (Geotechnical); and Robert K. St. Claire, Adjunct Assistant Professor (Structures). Robert Carr was appointed Professor of Civil Engineering (Construc-
The Transportation Institute was discontinued that year and the University of Michigan Transportation Research Institute was formed. This was to become a very important research facility for highway and transportation issues. Geodesy and Surveying were discontinued as an area of concentration within the Civil Engineering Department. The basic surveying course was retained as a required course and one other as a technical elective.

In 1979 Andrzej S. Nowak joined the faculty as Assistant Professor of Civil Engineering (Structural) and John E. Schenk as Adjunct Associate Professor of Civil Engineering (Environmental).

Mr. George Geisendorfer retired at the end of the academic year in June of 1979. He had been the principle laboratory technician for 35 years. Mention was made earlier of him and Mr. Lorenzo Plumpton. It is appropriate to mention several other technicians who have made really significant contributions to the success of the various laboratory and academic activities of the Department over the years. These men are: Mr. Waldemar B. Buss (1962-77), Mr. Harold (Bud) Chalmers (20 years), Mr. Rick Burch (20 years), Mr. Kevin Schmidt (24 years), and Mr. Tom Yavaraski (15 years). Recognition should also be given to the contributions made by the secretarial staff who have served the Department over the years. A few who gave a great many years are: Miss Pauline Bentley (25 years); Miss Reta Teachout (50 years); and Mrs. Genny Singleton (26 years).

In 1979, the US National Science Foundation initiated a long-term cooperative agreement with its Japanese equivalent for research on earthquake engineering. Professor Robert Hanson was the initial US Chairman of the technical organization committee. The first major tests were conducted during 1980-81 on a full-scale seven story reinforced concrete building. The structure was tested at the Building Research Institute in Japan and Professor James Wight was selected to be the US representative for the construction, instrumentation and pseudo-dynamic testing of the structure. The second major structure in this research program was a five story steel structure. The testing of that structure also took place in Japan and Professor Subhash Goel served as the US representative for those tests.

1980-2004

In 1980 the William S. Housel Materials Laboratory was opened in the G. G. Brown Building as was referred to earlier.

In 1981 Nikolaos D. Katopodes joined the faculty as Assistant Professor of Civil Engineering (Hydrology); he would eventually become Chairman of the Department. Also joining the faculty were, William F. Maloney as Assistant Professor of Civil Engineering (Construction) and Rajendra K. Aggarwala, Lecturer in Civil Engineering (Surveying) to teach the surveying courses. The Hydraulics and Hydrology group was relocated to Building I-A in the summer of 1983.

In 1982 the new faculty members were Richard B. Kapuscinski, Assistant Professor of Civil Engineering (Environmental) and Will Hansen, Lecturer in Civil Engineering (Materials). Professor Jack Borchardt became Professor Emeritus upon his retirement that year. The Civil Engineering Department Alumni Friends Association was formed to encourage interaction between the Department and its graduates. The Master of Science degrees in Sanitary and Water Resources Engineering were integrated into the Master of Science degree in Environmental Engineering from that time on.

In 1983 Antoine E. Naaman was appointed Professor of Civil Engineering (Materials). In July 1984 Professor E. Benjamin Wylie was made Chairman of the Civil Engineering Department, Linda M. Abriola was appointed Assistant Professor of Civil Engineering (Hydrology) as was Photos G. Ioannou (Construction), and Will Hansen was promoted to Assistant Professor of Civil Engineering. The Victor L. Streeter Computational Laboratory was dedicated that year.

In 1985 Roman D. Hryciw was made Assistant Professor of Civil Engineering (Geotechnical). In the fall of that year the entire Civil Engineering Department (that portion that had not already moved) was relocated in the G. G. Brown Building on North Campus and the faculty utilized the remodeled offices and classrooms for the first time. During this time period, the structural engineering laboratory was designed and constructed within the G. G. Brown Building. Professor James Wight was the structural designer for the strong floor and strong walls that composed the laboratory, and the overhead crane system. At the time of construction this was a unique laboratory for simulated earthquake testing in the US, and was a smaller version of the large reaction wall testing facilities in Japan. After its construction, Professors Wight, Goel, and Hanson were able to obtain a grant from the National Science Foundation for equipping the laboratory with hydraulic actuators and data acquisition systems. The Frank E. Richart, Jr. Soils Dynamics Laboratory was dedicated in the G. G. Brown Building.

In 1984 the William S. Housel Materials Laboratory then housed within the G. G. Brown Building as was referred to earlier.

In 1985 Roman D. Hryciw was made Assistant Professor of Civil Engineering (Environmental) along with Ralf Peek as Assistant Professor of Civil Engineering (Structures). All the materials laboratories in the Department were remodeled and modernized in the years 1987-88 with a National Science Foundation grant. In 1987 Professor Robert Harris stepped down as Associate Chairman and was replaced by Professor Richard Woods. When Professor Harris retired he had been on the faculty for 40 years. The surveying laboratory was moved from the Automobile Laboratory to the G. G. Brown Building in 1987.
In 1988 Professor Timothy Vogel, Assistant Professor of Civil Engineering (Environmental); Avery H. Demond, Assistant Professor of Civil Engineering (Environmental); Iris D. Tommelein, Assistant Professor of Civil Engineering (Construction) were added to the faculty; and Professor Donald Cleveland retired. This was the year that the Transportation Program offered by the Department was discontinued as well.

During the late 1980’s much more developmental work was done in the G.G. Brown Building Materials Laboratory. Several new laboratories were constructed to allow for use of new construction materials and technology.

In 1989 Victor C. Li joined the Department as Associate Professor of Civil Engineering (Materials) and in 1990 the name of the Department was changed to the Department of Civil and Environmental Engineering. In 1990 John G. Everett joined the faculty as Assistant Professor of Civil Engineering (Construction) and in 1991 Peter Adriaens was appointed Assistant Professor of Civil Engineering (Environmental).

In 1989 Professor Timothy Vogel, Assistant Professor of Civil Engineering (Environmental); Avery H. Demond, Assistant Professor of Civil Engineering (Environmental); Iris D. Tommelein, Assistant Professor of Civil Engineering (Construction) were added to the faculty; and Professor Donald Cleveland retired. This was the year that the Transportation Program offered by the Department was discontinued as well.

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In 1991, Professor James Wight was selected to serve a six-year term as the Chairman of the American Concrete Institute Building Code Committee. This committee writes the code that is used for concrete buildings throughout the US and in several other countries around the world.

In 1992 one of the topics of conversation was ethics and where it was being included in the curriculum. ABET accreditation was in the horizon and there was concern as to how that would proceed. In 1993 to address the ethics/professionalism content of the Civil and Environmental Engineering curriculum a new course CEE 401(1) Professional Issues in Civil and Environmental Engineering was introduced in the fall semester.

In 1994 Professor Richard Woods was appointed Interim Chairman of the Department; he was to become Chairman in January 1996. Professor Nikolaos Katopodes was Associate Chairman from 1996-2001. Professor Donald Gray was made Program Advisor, replacing Professor Eugene Glysson who was on retirement furlough. ABET approved the curriculum for the BSE (CEE) for six more years. On September 23, 1994, the first Camp Davis Reunion was held to bring together students who had attended the Camp in Jackson, Wyoming.

In 1995 the new faculty members were Jeremy D. Semrau, Assistant Professor of Civil Engineering (Environmental); Michael J. Barcelona as Professor of Civil Engineering (Environmental), he had been on the staff as a Research Associate; Kevin R. Collins, Assistant Professor of Civil Engineering (Structures); and Bozidar Stojadinovic, Assistant Professor of Civil Engineering (Structures). Professor E. Benjamin Wylie was named Program Advisor.

In 1997 Pierre Goovaerts was made Assistant Professor of Civil Engineering (Environmental).

In 1998 the new faculty consisted of Garrett H. Evans, Adjunct Professor of Civil Engineering and Program Advisor; Richard C. Nolen-Hoeksema, Associate Research Scientist and

Environmental and Water Resources Analytical Laboratory

During the period of 1989 to 2002 the Great Lakes and Mid-Atlantic Center for Hazardous Substances Research was formed with the cooperation between the University of Michigan, Michigan State University, Howard University and Georgia Tech to conduct research. Also during this time, 1994-2000, the Wurtsmith National Center for Integrated Bioremedial Research and Development was established at the closed Wurtsmith Air Force Base near Oscoda, Michigan. Active research on remediation of contaminated soils was conducted at this site.

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Lecturer (Geotechnical); and Gerald J. Keeler, Associate Director, Institute for Environmental Science, Engineering and Technology (IESET) now held positions in the Department. That year a 1,000,000 pound testing machine for strong concrete was installed in the Materials Laboratory. This was to replace the old 400,000 pound machine in West Engineering. There was also a major remodeling of the Hydraulics Laboratory to relocate the tilting flume and other equipment in that laboratory. Also in 1998-99 there was space made available in the Institute for Sciences and Technology Building for Environmental Engineering research laboratories and some offices.

**Fluid Mechanics Laboratory**

In 1999 Aline J. Cotel joined the faculty as Assistant Professor of Civil Engineering (Hydraulics) along with Radoslaw L. Michalowski as Professor of Civil Engineering (Geotechnical).

In February 1999 the Michigan Chapter of Chi Epsilon hosted a Great Lakes District Conclave in celebration of its 50th Year Anniversary as a Chapter. There were representatives from seven universities in attendance. As of 1999 there were four student organizations in the Civil and Environmental Engineering Department: American Society of Civil Engineers (ASCE); Chi Epsilon; Earthquake Engineering Research Institute (EERI) established at UofM in 1995; and the newest put in place in 1999, the Graduate Environmental Engineering Network of Professionals, Educators and Students (GrEENPEAS).

In 2000 Gustavo Parra-Montesinos joined the faculty as an Assistant Professor of Civil Engineering (Structural) and Terese M. Olson as Associate Professor of Civil Engineering (Environmental). Plans were being made for the ABET accreditation to be made in 2000. The ABET accreditation visit raised the question of the lack of comprehensive engineering design.

In 2001 Professor Nikolaos Katopodes was made Chairman of the Department, Russell A. Green was made Assistant Professor of Civil Engineering (Geotechnical) and Christian M. Lastoskie was made Associate Professor of Civil Engineering (Environmental). That year saw the discontinuation of all the surveying classes offered by the Department as well as the program itself. A major initiative in 2001 for the Civil and Environmental Engineering Department was the Sustainability Infrastructure Systems (SIS) program adopted by the Department in May of that year.

In 2002 James R. Barber who was a Professor of Mechanical Engineering was also appointed Professor of Civil Engineering. Professor John P. Boyd also held a joint appointment with Atmospheric and Oceanic and Space Sciences and Civil Engineering. Associate Professor Marc Perlin of the Department of Naval Architecture and Marine Engineering was given a joint appointment as Associate Professor of Civil and Environmental Engineering. Vineet R. Kamat was appointed Assistant Professor of Civil Engineering (Construction).

In 2003 both Professor Robert Harris and Professor Ernest Brater passed away. They had been lifetime members of the Department and will be sorely missed.

The U of M student chapter of the American Society of Civil Engineers (ASCE) has been active in the Department for many years. Over the years, starting at about 1968-71 with Professor Richard Woods as Faculty Advisor, the first of many concrete canoes were made. In 1975 or there about, with Professor James Wight as ASCE Faculty Advisor, another generation of canoes was constructed. These canoes were entered into competition with other universities to see who could build the lightest, fastest and most attractive model. The first one in the late 60’s was a joint effort of the Civil Engineering Department and the Department of Naval Architecture. Later models were designed and built by the Civil Engineering students alone. These competitions still continue with schools competing in districts and then the district winner going to National finals.

**Fiber Reinforced Concrete Laboratory**

The competition was expanded to include a steel bridge which is judged by its load carrying capacity, lightest weight and speed of assembly. The bridge has to meet certain rules concerning the span, etc., and is designed and fabricated by the students themselves. With Professor Kevin Collins serving as Faculty Advisor between 1995 and 2002, the bridge team achieved its best performance and placed fourth in the National Competition in 2002. They were the National Champions in 2003 with Professor Gustavo Parra-Montesinos as Faculty Advisor. They won the National Competition against 44 schools out of about 180 teams that participated in regional competitions including teams from the US, Canada, Mexico and Japan.
The Civil and Environmental Engineering Department would like to congratulate Professor Antoine E. Naaman on his award from the Japan Concrete Institute. This award was presented to Professor Naaman for his paper entitled, “Engineered Steel Fibers with Optimal Properties for Reinforcement of Cement Composites.” In addition, The American University of Beirut Faculty of Engineering and Architecture awarded Professor Naaman the Distinguished Scholar Award for his excellence in research in the fields of prestressed concrete, fiber reinforced concrete and ferrocement, and his outstanding contributions to education.

Acknowledgements: Data and information were gathered from a great many sources for this work: “A Century of Engineering Education” published in 1954 by the University of Michigan Press; the Annual Announcements by the College of Engineering for the University of Michigan from 1940 to 2004; the minutes of Civil Engineering Department faculty meetings; various Departmental reports and files; individual interviews and comments; numerous issues of the “Benchmark”, the Civil Engineering student newsletter; the Civil and Environmental Engineering News Letter; and The Bentley Historical Library. Notes written by Professor Robert Harris were invaluable, as well as a brief Civil Engineering History presented by Dean Stephen W. Director at a Chi Epsilon banquet in 2003. My own memory and the memories of my colleagues were also accessed. The contributions of Professors Wight, Wright, Woods, Hanson, Cleveland, Katopodes, and Wylie, are most appreciated. They have added much to this account.

Appreciation for the numerous typing editions and revisions, and photos, goes to Jill Miller.

Faculty News and Honors

Promotion

The Civil and Environmental Engineering Department would like to congratulate Will Hansen on his promotion to Professor of Civil Engineering. Professor Hansen’s research areas include civil engineering materials, pavement design, durability, and non-destructive testing. Congratulations Professor Hansen!

Faculty Awards

The Civil and Environmental Engineering Department would like to congratulate Professor Antoine E. Naaman on his award from the Japan Concrete Institute. This award was presented to Professor Naaman for his paper entitled, “Engineered Steel Fibers with Optimal Properties for Reinforcement of Cement Composites.” In addition, The American University of Beirut Faculty of Engineering and Architecture awarded Professor Naaman the Distinguished Scholar Award for his excellence in research in the fields of prestressed concrete, fiber reinforced concrete and ferrocement, and his outstanding contributions to education.

Concrete Mixing Laboratory

Several other types of ASCE competitions have been carried out by the chapter over the years. One is the toothpick bridge contests which were conducted with the high schools in the area to see which one could build the strongest model from a standard kit of toothpicks supplied by the ASCE Student Chapter. These were judged and tested by the ASCE students here at the University on Tech Day each year.

Over the years several of the faculty received the honor of being elected to the National Academy of Engineers. They were Frank Richart, Jr., Robert Hanson, Walter Weber, Jr., Richard Woods and Linda Abriola.

The Civil and Environmental Engineering Department has been recognized as being one of the most outstanding departments in the country for many years. It has received national recognition in many ways, with the Environmental Engineering Program being ranked number one a number of times. There have been many text books written by the faculty and graduates. There have been many innovative new technologies developed including new ways to reinforce concrete, new construction methods, new ways to treat water and waste water, and better ways to build buildings and bridges. Graduates from the program have gone on to become very successful in academia and in engineering practice.

Source: CRAS and CEE Department Database
Professor Andrzej Nowak has been named a Fellow of the International Association for Bridge and Structural Engineering (IABSE), a major international organization for structural engineers, based in Zurich, Switzerland. Professor Nowak said that he is “very happy about the IABSE fellowship as it means joining an elite group of top international experts.”

Professor Victor Li, Rector (equivalent to our President) of the Technical University of Denmark

Professor Victor Li was conferred an honorary doctorate degree by the Technical University of Denmark (DTU) during their Graduate Ceremony on April 30, 2004. The ceremony was conducted in the presence of Her Majesty the Queen of Denmark. The diploma read “... in recognition of outstanding, innovative contributions to materials, research and engineering and providing our society and the construction industry with new, safe and sustainable building materials.”
Staff Anniversaries 2004

50 Year Anniversary

Reta Teachout
Administrative Associate

On June 18, 2004, an anniversary celebration was held to honor Reta Teachout for her 50 years of service in the Department of Civil and Environmental at the University of Michigan.

New Staff Members

In June Kimberly Bonner joined the CEE department as the new Administrative Assistant I. Kimberly will lead our outreach efforts, coordinate the department’s calendar, and provide support for the chair and faculty.

Kimberly holds an Associates degree in Humanities/Social Sciences from Washtenaw Community College. Kimberly has been with the University of Michigan since 1989, with her most recent appointment in the Lurie Engineering Center.

In April Jan Pantolin joined the CEE department as the new Technical Services Supervisor. Jan holds a BSE degree in Electrical Engineering from the Oakland University.

Jan has worked in industry for over fifteen years as program manager, design engineering and technical supervisor. Jan supervises the teaching and research laboratories in Geotechnical, Hydraulic, Materials and Structural Engineering.

In May Betty Sweet joined the CEE department as an Administrative Assistant II. Betty will provide research and general financial support and will help coordinate personnel needs for the EWRE program.

Betty holds a General Studies Associate Degree in Business from Washtenaw Community College and has been with the University of Michigan since 1995, with her most recent appointment in Mechanical Engineering.

Staff Anniversaries 2004

20 Year Anniversaries

Left to Right: Merrick Burch and Robert Spence
Engineering Technicians

On Friday, April 23, 2004, a retirement celebration was held in the Lurie Engineering Center to honor Genevieve Singleton for her 26 years of service in the Department of Civil and Environmental Engineering at the University of Michigan.
Beam-to-column moment connections in steel frames have been traditionally designed by using classical Euler-Bernoulli beam theory, which leads to the assumption that the flanges are primarily responsible for transferring moment while the web connection resists the shear force. The results of the finite element analysis showed that stress distribution in the vicinity of moment connections fundamentally differs from the pattern assumed in the classical beam theory. This is in agreement with the boundary effect postulated in the famous Saint Venant's Principle in 1855. More basic principles of mechanics, such as Poisson effect, restraint to shear deformation, etc., were found to be working here. The finite element study showed that the magnitude and direction of the principal stresses in the connection region are better approximated by using truss analogy rather than the classical beam theory (Figure 2). Thus, both the bending moment and the shear force are transferred across the connection near the beam flanges through diagonal strut action. As a result, the beam flange regions of a traditionally designed moment connection are over stressed. This conclusion corroborates with the moment connection failures near the beam flanges during the 1994 Northridge and 1995 Kobe earthquakes.

Based on realistic stress distributions in the connection region, two types of beam-to-column connections were developed at The University of Michigan. The first connection type, called the Michigan connection, utilizes the truss analogy in order to resist beam flange overload and stress concentration by using reinforced connection elements to the beam flanges (Figure 3). The second connection type, called the Free Flange connection, is designed to create constraint-free region in the beam flange of sufficient length from the column face, thereby reducing its stiffness and diverting the shear force back into the web (Figure 4) [Choi et al., 2000]. The design concepts of these two connections were successfully validated by tests of full size connection specimens in the laboratory (Figure 5). Later, the Truss Analogy Theory was also extended to column base-to-footing connection (Figure 6), and has the potential of being applied to a number of other connection types subjected to moment and shear [Lee et al., 2001].

**Truss Analogy Theory for Beam-to-Column Moment Connections in Steel Structures**

Following the unprecedented and wide-spread failures of welded beam-to-column moment connections in steel buildings during the 1994 Northridge and the 1995 Kobe (Japan) earthquakes extensive research was carried out in both countries to find the reasons of those unexpected failures and to improve their behavior. Since most fractures occurred in or near the beam and column welding region, poor welding practice and use of low toughness weld metals were initially considered as the main reasons (Figure 1). The analytical and experimental study at Michigan showed that consideration of realistic stress distributions and force transfer mechanisms within the connections are much more important [Goel et al., 1996; Lee et al., 1997].

**Figure 1: Common Zone of Fracture Initiation in Conventional Beam-to-Column Connection**

**Figure 2: Principal Stress Vectors and Force Transmission in the Truss Model**

Earthquake ground motions can cause severe damage to civil infrastructure leading to huge economic and life losses to the society. The goal of earthquake engineering is to minimize those losses through proper design, detailing and construction. During the past fifty years major advances have been made through research in this field. However, much remains yet to be learned regarding the true behavior and response of civil structural systems as has been evidenced by the experiences from recent major urban earthquakes, such as 1994 Northridge, California, and 1995 Kobe earthquake in Japan. Development of new methodologies for design and analysis of structural systems and their components continues, as the existing theories and practices are challenged and improved upon with the help of new knowledge.

The author has been involved in research in this field for over forty years, most of which at The University of Michigan. Two of his recent research topics are briefly presented in this article.

**Earthquake-Resistant Design of Structures: Old Methodologies Challenged, New Proposed**

**By Subhash C. Goel, Ph.D.**

**Professor of Civil Engineering**

**Department of Civil and Environmental Engineering**

**Faculty Research**
Performance-Based Seismic Design of Structures

It is well recognized that building structures designed by past and current code procedures are expected to undergo large cyclic deformations in the inelastic range when subjected to design level severe ground motions. Nevertheless, most seismic design work around the world is carried out by elastic methods using equivalent static design lateral forces. The design lateral forces are obtained from expected forces assuming the structures to behave elastically, and reducing them by certain force reduction factors. Appropriate detailing provisions are followed in order to meet the expected ductility demands. However, no explicit checks through inelastic analysis are required to be made. Therefore, when struck by severe ground motions, the structures undergo large inelastic deformations in a rather uncontrolled manner. The inelastic activity can be unevenly and widely distributed in the structure, resulting in undesirable response, such as for-
mation of a story mechanism (Figure 7). This may lead to total collapse of the structure or make the repair work after the earthquake a more difficult and costly effort. This has been evidenced by extensive damage to building structures during the past earthquakes including the more recent ones, such as the 1994 Northridge, the 1995 Kobe and the 1999 Taiwan events.

New seismic design codes are moving towards adopting performance-based design framework. The goal of performance-based design is to produce structures that have predictable performance under multiple levels of earthquake hazard. In order to do so it is essential that the behavior of structures be targeted in advance, both in the elastic as well as inelastic ranges of deformation. Consequently, design factors such as, determination of member strength hierarchy, selection of desirable yield mechanism, and structure strength and drift, etc., become the primary elements of a performance-based design procedure.

The research focused on developing a new approach based on energy and plastic design methods. The design concept uses pre-selected target drifts and yield mechanisms as performance limit states (Figure 8). The expression for design base shear is derived by using the energy balance equation where the energy needed to push the structure up to the target drift is calculated as a fraction of elastic input energy which is obtained from the selected elastic design velocity spectra. Also, a new distribution of lateral design forces has been developed, which is based on relative distribution of maximum story shears obtained from inelastic dynamic analyses. Plastic design is then performed to select frame member sizes in order to achieve the intended yield mechanism and behavior. Results of inelastic static and dynamic analyses prove the validity of the proposed methodology as applied to steel moment resisting frames [Leelataviwat et al., 1998; Lee et al., 2001]. The frames developed strong column-weak beam yield mechanism as intended, and the story drifts were well within the selected target drift, thus meeting the selected performance objectives.

It should be noted that in the proposed design methodology the designer selects the target structural drifts (thereby, damage level), and yield mechanism (providing ease of post-earthquake damage inspection and reparation), and determines the design forces and frame member sizes for a given earthquake hazard (spectrum). There is no need for “artificial” factors, such as $R$, $C_a$, etc., as required in the current design codes.

Figure 7: Story Collapse of the Kobe City Hall Building Caused by 1995 Earthquake

The methodology was initially developed for steel moment frames and the results have been excellent. Work is currently in progress to extend the approach to other framing types, such as concentric and eccentric braced frames, truss moment frames, composite and hybrid frames.

References


Figure 8: Idealized Moment Frame in the Target Drift Response with the Pre-Selected Strong Column Yield Mechanism

Professor Subhash C. Goel
Reduced Iron Sulfide Systems for Removal of Heavy Metal Ions from Groundwater

By Dr. Kim E. Hayes
Professor and Program Director
Environmental and Water Resources Engineering
Department of Civil and Environmental Engineering

A research team from the Environmental and Water Resources Engineering (EWRE) program will begin a 3-year project in September 2004 to develop new iron sulfide materials for the cleanup of groundwater contaminated by toxic metals. Lead by Project Director, Professor Kim Hayes, the team, which includes Professors Peter Adriaens, Avery Demond and Terese Olson of the EWRE program and Professor Linda Abriola formerly of the EWRE program but now at Tufts University, as well as four Ph.D. students, and one postdoctoral fellow, will perform laboratory scale experiments to demonstrate the effectiveness of these new reduced iron materials for removing arsenic (As) and cadmium (Cd) from groundwater in permeable reactive barrier applications.

Background
Permeable barrier systems (PRBs) offer great potential and cost savings advantages for removing heavy metal ions from contaminated groundwater supplies. In these systems, reactive material is introduced into a “permeable wall” placed in the groundwater flow path to remove targeted contaminants. Of particular interest is the use of particulate FeS in PRB applications. FeS has a high capacity for non-redox active metals such as Pb(II) and Cd(II) in which highly insoluble Cd or Pb sulfides form by favorably exchanging for Fe in FeS. For redox-active metals such as As or Cr, FeS serves as an effective reductant, converting oxidized forms (As(V) and Cr(VI)) to more reduced forms (As(III) and Cr(III)) and subsequently removing the metals by adsorption or formation of mixed-metal sulfide phases. A natural consequence of redox and exchange reactions and introduction of oxygenated water is the formation of more oxygenated forms of FeS. In situ microbiological processes could provide a potentially attractive and cost effective way to rejuvenate FeS for long term use and re-use and to maintain reducing conditions. Also, since FeS can be generated as a coating on other commonly prepared materials for PRB applications (such as iron-coated sands or zero valent iron), it may be feasible to produce reactive FeS economically in a whole range of particle sizes. This may facilitate the use of FeS in a variety of applications, ranging from constructed near-surface PRB walls to colloidal injection of FeS into difficult to treat locations such as under buildings or into deep aquifers. The successful design and performance evaluation of FeS PRBs will require the application of reactive transport models, based upon a clear understanding of the metal ion sequestration mechanisms and their impact on porosity and permeability under realistic geochemical conditions.

Objective
The objective of this research is to evaluate the effectiveness of FeS for simultaneous sequestration of As and Cd in PRB applications. This research will lead to (1) a detailed understanding of the mechanisms of the reaction of As and Cd under changing geochemical conditions; (2) an assessment of the potential to rejuvenate FeS by biological means; (3) a determination of the feasibility of using various forms of FeS; (4) an understanding of the impact of metal removal mechanisms on transport properties in porous media; and (5) the development of a reactive transport model for design of PRB-FeS systems.

Summary of Process/Technology
FeS will be evaluated for treating heavy metal contaminated groundwater plumes in PRB systems. Cd and As are the targeted “heavy metals.” FeS performance under various geochemical conditions will be investigated in bench-scale batch reactor and column reactor systems. Metal ion removal mechanisms will be verified by molecular-scale surface techniques. Various forms of FeS and emplacement methods will be tested. Rejuvenation of FeS using sulfate reducing micro-organisms will be examined. A reactive transport model will be developed using batch uptake and column breakthrough data.

Benefit
Removal of heavy metal ions in metal mixtures from anoxic contaminated groundwaters is particularly challenging. Reduced iron sulfide in PRB systems show promise for such applications. This project will develop FeS materials, emplacement methods, and reactive transport simulators that can be used to design PRB systems for field-scale remediation applications.

Permeable reactive barrier concept for heavy metal ion removal using FeS as the reactive material and microbial rejuvenation

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Defining Exposure from Industrial Legacies in the Tittabawassee River Floodplain: The University of Michigan Dioxin Exposure Study (UMDES)

By Peter Adriaens, Ph.D., P.E.
Professor, Environmental and Water Resources Engineering, Department of Civil and Environmental Engineering, and School for Natural Resources and the Environment

and

Avery H. Demond, Ph.D., P.E.
Associate Professor, Environmental and Water Resources Engineering, Department of Civil and Environmental Engineering

Few chemicals conjure up as emotional a public reaction as the group of compounds known as ‘dioxins’. Dioxins are associated with some of the most infamous industrial accidents and spills, such as Love Canal (NY), Seveso (Italy), and Times Beach (MO). Further infamy was gained from the use of Agent Orange (a blend of two herbicides, contaminated with low levels of dioxins) as a defoliant in Vietnam, which recently has resulted in a lawsuit from the Vietnam government against ten U.S. manufacturers of the product.

Dioxins in the Environment

To put the issue in proper context, dioxins are never intentionally manufactured (except as analytical standards), but are formed as trace-level contaminants in organochlorine synthesis (e.g., phenols, paints, etc…), and from natural (e.g., forest fires) and anthropogenic (e.g., incinerators, barbecues, automobile exhaust, etc…) combustion processes. Hence, dioxins have been around for millennia and are present in the entire foodchain (including humans) at trace levels. Ambient concentrations (even in otherwise pristine areas) resulting from atmospheric deposition are on the order of parts-per-trillion (ppt) to parts-per-quadrillion (ppq) (yes, this is 10-12 to 10-15 g/g!) in air, soil, water, sediment at the bottom of rivers, streams, and lakes, and in foods like meats, dairy, fish, and shellfish. The Michigan average background concentration in soils is 6-8 ppt, even in the Upper Peninsula. Dioxins are actually a mixture of 75 compounds, of which 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) (Figure 1) is perhaps the most hazardous. Typically, dioxins co-occur with a structurally similar group of chemicals, called dibenzo-para-furans, of which 135 different forms exist, depending on the position and number of chlorines.

![Figure 1. Dibenzo-p-dioxin (left) and dibenzo-p-furan (right)](image)

The latest version of the Dioxin Draft Reassessment Report (EPA, 2000) states that “…dioxin should be regulated as a probable carcinogen…at any level in the environment…” In practice, EPA has promulgated a federal action limit of 1000 parts-per-trillion. But responsibility has been delegated to a number of states, including Michigan, which then allows the State to set its own action level. In Michigan, this is currently 90 parts-per-trillion. The dioxin levels which trigger health effects are not known, even though correlations have been shown with certain cancers, diabetes, and chloracne.

Dioxins in the Tittabawassee River Floodplain

When the enterprising Herbert Dow was rummaging in his Midland shed in the 1890s, few locals knew what the man was up to. Dow was in fact digging a deep water well to mine the salty brine – from an ancient underwater sea beneath the city – to extract bromine. He was applying the knowledge mastered at Ohio’s Case School of Applied Science to make potassium bromide that he would market to pharmaceutical companies for use as a sedative and stomach soother.

Unfortunately, this process produced trace quantities of dioxins and furans, and it is currently assumed that the bulk of dioxins in the Tittabawassee River and its floodplain (Figure 2) was generated between 1890 and 1915. A second pulse of dioxins may have been generated with the manufacturing of Agent Orange in the 1960s. In addition, incinerators operated since the 1950s may have resulted in atmospheric deposition. Smaller discharges of dioxins may be associated with the effluent of the wastewater treatment plant. During the last century, flooding and sediment transport has exacerbated a local issue to become a regional problem, involving 22 miles of river and the Tittabawassee floodplain between Midland and Saginaw.

Over the last two decades, the dioxin issue has become a controversial priority for Michigan, managed by the Michigan Departments of Community Health (MDCH) and Environmental Quality (MDEQ), with a huge participation by community stakeholders. On June 12, 2003, the DEQ issued a hazardous waste management facility renewal operating license to Dow’s Michigan Operations for its treatment, storage, and disposal facility in Midland, Michigan, and related corrective action activities. In addition to on-site corrective action activities, the operating license also addresses major off-site corrective action activities for Midland area soils, the Tittabawassee and Saginaw Rivers and their flood plains, and the Saginaw Bay.

The University of Michigan Dioxin Exposure Study

A unique consortium of researchers from the School for Public Health’s Department of Environmental Health Sciences (Drs. David Garabrant and Alfred Franzblau) and the Department of Biostatistics (Dr. Brenda Gillespie), the Institute for Social Research (Dr. James Lepkowski and collaborators), the CoE Department of Civil and Environmental Engineering (Drs. Adriaens and Demond) has been awarded a contract to conduct one of the largest environmental epidemiology studies (700 residents) of dioxin exposure among the population of Michigan to describe the pattern of serum dioxin levels among adults and to understand the factors that explain variation in serum
Figure 2. Topographical map of Michigan, indicating the Tittabawassee River floodplain and surrounding counties. Top pictures show the recent flooding in March 2004.

Figure 3. Conceptual environmental contaminant exposure model
dioxin levels. There is concern that body burdens of dioxins may be elevated because of environmental contamination. The appropriate way to respond to these concerns is to measure the serum dioxin levels in a random sample of the population in the region and to estimate each individual’s past exposure to various factors that are believed to contribute to the body burden of dioxins (Figure 3). By measuring factors that reflect potential exposure to dioxins through air, water, soil, food intake, occupations, and various recreational activities, we can identify the factors that correlate with (and explain variation in) serum dioxin levels.

The central goal of the study is to evaluate correlations between dioxin levels in soil, house dust and blood levels, to determine which factors explain variation in blood serum dioxin levels, and to quantify how much variation each factor explains.

For the CEE Department’s Environmental and Water Resources Engineering (EWRE) group, the characterization of exposure pathways to environmental contamination represents a new direction with strategic alliances with entities across campus. By capitalizing on the expertise in site characterization and remediation, the EWRE group will develop the expertise to characterize exposure to environmental contaminants. The CEE project component will involve two professors, a data manager, ten graduate students, and two postdoctoral researchers, in addition to collaborators from MSU, the University of Saskatchewan (Canada), and ENVIRON International Corporation.

The scope of work for CEE involves the following components:

- A short course (15 participants) for training in soil/sediment sampling methods;
- Field sampling of 700 residences involving well over 10,000 soil cores;
- Sample processing (depth strata) and preliminary screening for dioxin-like toxicity using a novel bioassay; and
- Chemical analysis of a subset of soil samples for 29 dioxin/furan/PCB compounds.

The management of the tasks at hand and the schedule are daunting, and are unlike any other project in the CEE Department, due to the QA/QC and chain-of-custody issues related to the handling of the multitude of soil cores. Following training in field sampling techniques and HAZWOPER certification (Figure 4), the soil sampling teams will be deployed in the field to collect soil samples. Back in EWRE, a sample staging area will be set up to process the cores by stratifying and compositing the vegetation, a top and a deeper soil layer. These samples, in turn will be subjected to a rigorous screening process for dioxin-like toxicity. A composite sample from each residence will be sent out for analysis. In addition, a novel rapid screening technique which allows for quantification of dioxin-like toxicity (in toxic equivalents, TEQ) will be employed (Figure 5).

The principle of the technique is fairly simple, and is based on the presence of what is called an Aryl Hydrocarbon (Ah) receptor in mammalian cells. This receptor recognizes and binds...
compounds such as dioxins and PCBs (AhR ligands), and then transports the chemicals inside the cell nucleus with the help of a transporter protein. There, the compound-Ah receptor complex binds to the cell DNA, where it interferes with gene expression. Molecular biologists have constructed genetically-modified mammalian cell lines, whereby the genes responsible for light production in the firefly have been inserted in the DNA. These genes will be turned on by the Ah receptor complex binding to the DNA. In other words, if any dioxin-like molecules are present in the soil extract, the cells will emit light, proportionate to the concentration of the compounds. Then the samples exhibiting the highest levels will be analyzed for the entire suite of compounds.

This sample screening technique has been widely applied within the realm of ecotoxicology, and has resulted in a draft EPA Method. The UMDES and EWRE team hope that the application of the assay in soils, and as a potential indicator for dioxin levels in blood, will serve to promulgate new EPA methods to measure human exposure to environmental dioxin-like toxicity.

**Exposure Mitigation Strategies for Dioxin-Contaminated Sediments and Floodplains**

Only once the exposure is quantified can effective remedial or mitigation strategies be proposed and negotiated. To facilitate the discussion in this area, Dow presented the CoE Environmental Technology Council (ETC) (Dr. Adriaens, Director) with a gift of $65,000 which was used to help sponsor a national workshop on this topic. Organized by the ETC and LimnoTech, Inc. (Dr. John Wolfe, Project Manager), the workshop was co-hosted by the South & South-West Hazardous Substance Research Center (Dr. Danny Reible, Director), and was held in the Michigan League on the Ann Arbor campus. Aside from invited speakers from around the nation and the U.K., the workshop drew 130 participants from academia, industry and state and federal program offices.

**Integrating Uncertainty Analysis in the Risk Characterization of InPlace Remedial Strategies for Contaminated Sediments**

By Noémi Barabás, Ph.D. and John R. Wolfe, Ph.D. Limno-Tech, Inc.

Contaminated sediments are one of the most difficult environmental contamination legacies to manage due to special circumstances that distinguish sediments from other media. The bottoms of rivers, lakes and seas are the ultimate sinks of material that is conveyed by moving water and wind. As such, sediments world-wide have accumulated contamination released over the entire industrial history of large watersheds and regions. Sediments are difficult to clean up because the contamination is diluted in a very large amount of solid matter and water. Access to these sediments is not only difficult due to the overlying body of water, but their removal is fraught with challenges of containment during removal or capping (e.g. covering with a layer of clean sand) of material in an environment in constant motion, i.e. water. If removed, disposal is problematic due to the limited availability of specially designed landfills and confined disposal facilities. Further, the effectiveness of capping and monitored natural attenuation (closely monitoring the progress of natural processes that lead to a slow decrease of contamination over time) is often challenged, and is, in fact, inadequately understood, especially in high energy marine and estuarine areas. En-
environmental regulators and potentially responsible parties alike have become aware that more research is necessary to understand the fundamental interactions that determine how contaminants behave in capped and uncapped sediment over time, as well as the critical uncertainties, so that better management decisions can be made and more effective solutions implemented for the protection of human and ecological health.

In 2003 UM received an award over 4 years for research integrating the study of fundamental processes determining contaminant mobility, on the small scale, with mathematical modeling and uncertainty propagation to site-wide scale. Funding was provided by the Strategic Environmental Research and Development Program (SERDP) of the Department of Defense and the Department of Energy. The study is a close collaboration between UM (Drs. P. Adriaens and S. Wright and students), Limno-Tech, Inc. (Drs. N. Barabás, J.R. Wolfe, and J.V. DePinto) and the University of Toledo (Dr. C. Gruden). The project will involve two prominent pilot study sites of contaminated sediments: the Anacostia River, D.C. (Figure 1.) (Demonstration of Innovative Capping being conducted by the South and Southwest Hazardous Substance Research Center, current Principal Investigator: Dr. D. Reible) and tentatively, also Hunter’s Point in San Francisco, CA (Figures 2 and 3.) (studies being conducted by the U.S. Navy). Battelle (Dr. Victor Magar) will assist the UM team by providing data from ongoing studies at both sites. The project team will address two of the least well understood phenomena in sediments and caps: the production of gases (Figure 4.) and other biogeochemical changes due to microbial activity, and the movement of water through the sediment/cap either from surface water into groundwater (e.g. induced by wave action) or from groundwater into surface water (e.g. induced by regional gradients). The team will measure the impact of these processes on the stability of the sediment and the associated chemicals alike. These impacts are rarely acknowledged quantitatively, simply because models that inform the decision making process do not have the necessary fundamental scientific information to adequately incorporate these processes into their framework. The overall goal of the project is to use a rigorous science-based, scaled laboratory approach to formulate pertinent relationships and decision criteria with reduced and quantified uncertainty in space and time, to allow better prediction of decision variables, system integrity and performance of in-place remedial strategies.

In this collaborative effort, Limno-Tech, Inc. will apply its extensive experience with modeling of fate and transport processes at contaminated sediment sites and identify uncertainties in process representation in models; the types of data needed; those that are typically available; and the scale at which they are obtained to support scientifically sound decisions. The results of this work will be employed to help guide and interpret laboratory experiments performed at UM. UM will perform a complex set of experiments exploring mechanisms of interaction between sediment biogeochemistry, groundwater advection and sediment stability under flowing water and wave action. These experiments include bench top models, sediments in columns and large flumes (Figure 5.). Sediments for these experiments have been and will continue to be provided by the Anacostia
River Capping Project and the Hunter’s Point Pilot Study with field assistance from Limno-Tech. Specially adapted, reactive capping material and related expertise will be provided in part by Aquablok (Dr. Joe Jersak). The University of Toledo will assist with analyses of microbial community and activity. As data become available from laboratory, field and modeling efforts, the results will be integrated within a probabilistic framework in jointly by UM and Limno-Tech. This step will involve stochastic simulation in which spatial and measurement uncertainties are integrated and propagated across scales to determine the relative impact of parameter uncertainties on critical parameters of technology performance (i.e. caps and monitored natural attenuation).

Communication of insights gained through the project is a high priority, and will be accomplished through several forums. As an example, in August of this year, a SERDP/ESTCP workshop on contaminated sediments will take place, at which several team members have been invited to draft, present, and discuss background papers to help strategically guide future investments in support of the Department of Defense’s management of contaminated aquatic sediments in marine and estuarine environments.

Figure 5. Photograph of a flume in which water flowing over a bed of capping material is used to induce erosion.

**STUDENT NEWS**

**Students Make a Case for Waste Elimination and Energy Recovery**

By Laura Bailey

While sharing a plate of French fries this past winter, CEE graduate students had an idea about how to make the University’s transportation system more sustainable: use the waste grease produced at the University dining halls to make biodiesel fuel for U-M buses.

During a term project for a course in environmental sustainability, a four-student team led by Lisa Colosi and Andres Clarens concluded and demonstrated that it is economically and technically feasible to harvest the 10,700 gallons of waste grease produced in the 10 campus dining halls to make an effective biodiesel fuel, which they produced in the lab and tested out on a small U-M tractor.

The students’ vision, “from the fryer to the fuel tank” could save an institution that produces significant amounts of waste grease thousands of dollars in transportation and disposal costs by adopting even a portion of their proposal, said the course instructor, CEE professor Walter Weber Jr.

As part of its commitment to being a green university, U-M recently began purchasing 60,000 gallons of biodiesel fuel from a commercial vendor to blend with regular diesel fuel to make up the 300,000 gallons of combined fuel it uses annually. The principal raw material for regular diesel fuel is petroleum. The principal raw material for the biodiesel fuel purchased by U-M is oil extracted from soy beans.

“The challenge the students had in this project was to produce a satisfactory or better substitute biodiesel fuel from waste cooking oils,” Weber said. “And they did it.”

The students collected waste grease from deep fryers in the West Quad cafeteria and mixed it in a tank with potassium hydroxide and methanol to create a reaction that produced a glycerine and fatty acid methyl ester solution. They then separated the glycerine and heated the residual solution to evaporate excess alcohol and water to produce their more than satisfactory biodiesel fuel. The report the students submitted further suggested that the glycerin by-product of the process could be cured and used to make a biodegradable alternative to commercial soaps for use on campus.

By replacing 10,700 gallons of the 60,000 gallons of commercial soy bean oil biodiesel with the students’ product, the report projected that U-M could achieve an estimated $28,000 annual cost savings. Weber said this annual savings could be increased to more than $150,000 by incorporating waste greases from the University Health System cafeterias and area restaurants. The report recommends that the University construct a pilot processing facility on campus to further demonstrate the efficacy of the process.

“The project provides an intriguing idea and presents possible options for increasing our waste recycling while yielding a usable product,” said Dave Miller, director of U-M’s Parking and Transportation Services. “We are exploring the research results and analyzing the potential impact on our existing operations.”

Among the things U-M would need to confirm are the quantity and quality of the grease and the costs involved to create a stable supply, he said.

The potential economic and environmental benefit is huge, Weber said, to any institution that produces large quantities of waste. For instance, the University produces nearly 11,000 gallons of waste fat annually that is removed at a cost of 95 cents a gallon. Even if an institution determined it didn’t want to produce the biodiesel fuel itself, it could still realize significant savings in disposal costs and perform an environmentally friendly deed by harvesting the waste grease and contracting a vendor to convert it to biodiesel fuel.

Laura Bailey is a science writer at U-M News Service and College of Engineering. This article appeared previously in the May 24, 2004, issue of The University Record.
Student Awards

Yanfei Peng, a doctoral student in Materials Engineering, was awarded a Barbour Scholarship for the 2004-05 academic year. Yanfei Peng is a student of Professor Will Hansen. The Barbour Scholarship program was established in 1914 at the University of Michigan to train young women in modern science, medicine, mathematics and other specialties critical to the development of their native lands. These scholarships were established for women of the highest academic and professional caliber who are citizens of countries in the area once called the “Orient.”

Wanda Cameron, a doctoral student in Geotechnical Engineering, received the Rackham Predoctoral Fellowship for the year 2004-05. Wanda Cameron is a student of Assistant Professor Russell Green. Rackham Predoctoral Fellowships are awarded by the Rackham Graduate school to a diverse group of outstanding students who will complete the dissertation in the year in which they hold the fellowship and who will complete the doctorate within six years of beginning their programs.

Environmental and Water Resources Engineering (EWRE) Ph.D. graduate Julie Beth Zimmerman was a recipient of a 2003 Rackham Distinguished Dissertation Award. Distinguished Dissertation Awards recognize authors whose doctoral dissertations are exceptional, both for high quality of the scholarship and for the significance and interest of their findings. Her award winning dissertation, “Formulation and Evaluation of Emulsifier Systems for Petroleum- and Bio-Based Semi-Synthetic Metalworking Fluids,” was completed in August 2003. Her dissertation committee was co-chaired by Professor Kim Hayes of the EWRE program, Professor Steve Skerlos of Mechanical Engineering, and Professor Jonathan Bulkley of the School of Natural Resources and the Environment. Dr. Zimmerman is currently Program Coordinator, at the National Center for Environmental Research, Office of Research and Development, United States Environmental Protection Agency in Washington D.C.

Each year the MLK Spirit Awards celebration honors North Campus students whose leadership and service have exemplified the spirit of Dr. Martin Luther King, Jr. This year the MLK Spirit Awards celebration honored the Engineering for the Community (ENG 490) team. Andres Clarens and Hans Triticco, Environmental Engineering graduate students, were members of the team.

During the spring of 2004 three graduate students in Environmental Engineering received national fellowship awards. Lisa Colosi, a first year student working with Dr. Walter Weber, Jr. received the highly competitive National Science Foundation Fellowship. The fellowship provides Lisa with full funding for the next three years. Andres Clarens and Nicole Dolney, second year students of Dr. Kim Hayes and Dr. Peter Adriaens respectively, each received a Science to Achieve Results (STAR) Fellowship from the Environmental Protection Agency (EPA). These fellowships provide them with tuition and stipend for three years. The fact that two Michigan CEE students received STAR fellowships this year is particularly impressive given the recent budget cuts at the EPA and the reduced number of fellowships given nationally. Congratulations to Lisa, Andres, and Nicole!
EWRE Ph.D. graduate Denis O’Carroll was the recipient of the 2004 Walter J. Weber, Jr. Student Award for Excellence in Environmental Engineering and Science. This award is given annually to a senior EWRE Ph.D. student who most embodies excellence in research, outstanding academic achievement, and exceptional service in the field of environmental sciences and engineering.

**Denis O’Carroll**

EWRE Ph.D. graduate Michael McCormick was the recipient of the 2003 Association of Environmental and Engineering Science Professor’s (AEESP) CH2M-Hill Dissertation Award for his dissertation entitled, “Biotic and Abiotic Transformations of Alkyl Halides in Iron-Reducing Environments.” This dissertation award is given for the most outstanding dissertation in environmental engineering and science. His dissertation adviser was Professor Peter Adriaens. Dr. McCormick is currently an Assistant Professor of Biology at Hamilton College in New York.

EWRE Ph.D. graduate student Hoon Y. Jeong won a 2004 American Chemical Society (ACS) Environmental Chemistry Division Paper Award for a paper entitled, “Sorption of Mercuric Ion on Iron Sulfide,” co-authors B. Klaue, J. D. Blum, and K. F. Hayes. The ACS Graduate Student Paper Award is the highest honor given by the Environmental Chemistry Division to graduate students (limited to five annually).

ODEI andros Samothrakis, Ph.D. Candidate in EWRE, has received the award for the Best Student Paper/Presentation at the 2004 Engineering Mechanics Conference of ASCE. The selection was based on the technical content of the paper, the presentation quality and style. The paper was co-authored with Prof. Aline Cotel.

**College of Engineering Awards**

A College of Engineering Distinguished Achievement Award is presented to the outstanding undergraduate and graduate student in each degree program. Criteria used in selecting award recipients are academic achievement, exemplary character, leadership in class and activities, and potential for success in future endeavors.

**Graduate Distinguished Achievement Awards**

**Burcu Burak, Structures**

**John Christ, Environmental**

**Chongba Sherpa, Construction**

**Undergraduate Distinguished Achievement Award**

**Justin Voss, Civil and Environmental Engineering**
ALUMNI UPDATES

Katherine Banicki
Katherine Banicki, President of Testing Engineers & Consultants, has been elected to the Associated General Contractors of Michigan Board of Directors. She is the first woman to serve on the AGC Board. Her company specializes in environmental and geotechnical services, air quality, construction materials testing, property condition assessments and automotive component testing.

Brian M. Boals
Orchard Hiltz & McCliment, Inc. (OHM), announced that Brian M. Boals, P.E., has recently joined OHM in its Municipal Engineering group. Boals, a licensed engineer, has eleven years of experience in the areas of water distribution, wastewater collection, grading, pavement, drainage, and storm water management. In his position as a Client Representative for OHM, he will serve several municipalities.

Boals holds a Bachelor’s Degree in Civil Engineering from Michigan Technological University and a Master’s Degree in Civil Engineering with a concentration in Hydraulics from the University of Michigan. He is a member of the American Society of Civil Engineers.

“We are excited to add Brian’s talents to our Municipal Engineering group. His depth of experience and water management expertise will be a significant value in meeting the goals of our client communities,” said Russ Gronevelt, President of OHM.

Raymond Chyla
Testing Engineers and Consultants proudly announces the 35th anniversary of Raymond Chyla at the firm. Chyla began his career as a laboratory technician while attending college and moved into full time employment as field technician and driller for the geotechnical department. After valuable experience he returned to the office and was promoted to laboratory and field supervisor. Later he served as manager of the Construction Services Department, Director of Operations and Regional Manager. He now holds the position of Corporate Radiation Safety Coordinator and Manager of the Construction Services Department.

Romola Almajose Corcuera-Mercado
I am a golden jubilarian this year [Degree: Master in Engineering (Civil) Major in Structural Design, Class Year 1954 (Summer)]. I received the Outstanding National University Alumni in the field of Structural Engineering award from National University.

Editor’s Note: Excerpts from the NUALFI 2000 Souvenir Book & Directory, P. 27, follow.

In 1953, she left for the University of Michigan in Ann Arbor, Michigan. Romola was the youngest and first Barbour Scholar in Engineering. She was again the only female in the class of international scholars.

After a year, Romola went back to the Bureau of Public Highways as a Bridge Designer. After one-and-a-half years, she went back to the United States for her practical training in Bridge Design as a paid trainee of the International Road Federation. They waived two (2) requirements to accept her: age and sex. Trainees must be 28 years old and male. Romola was only 23 years old and a female at that.

In January 1957, Romola represented the Philippines as a delegate to the International Road Federation Convention and the American Road Builders Association in Chicago, Illinois. This is held every ten years. Romola was the only woman out of the 67,000 delegates from 80 countries and territories around the world. After two years, she came home and worked with the Bureau of Public Highways and then got married. She resigned in 1965 and went to real estate and private practice. At present, Romola still practices as a Structural Consultant of her Interior Design daughter and as a Real Estate Dealer. 2002 was her Golden Jubilee in Civil Engineering.

Jimmie Lee Horton, III
Jimmie Lee Horton, III, is currently a structural design engineer for Tennessee’s Department of Transportation (TDOT) developing new structure for the new built U.S. 64 in southern TN in Lawrence County. Jimmie Lee Horton says, “I plan on working for my home state until I get my PE license before moving on to bigger and things where I can do like Prof. Katopodes told me in ‘building and blessing buildings’ since I’m a licensed minister.”

Harold (Hal) M. Hultquist
Harold (Hal) M. Hultquist, P.E., was awarded the esteemed Harry S. Swearingen Award by the American Public Works Association (APWA) in 2003. Since 1953 Hultquist has been steadfastly devoted to building and nurturing the Michigan Chapter of APWA. With Orchard, Hiltz & McCliment’s (OHM) Construction Services Group since 1988, Mr. Hultquist serves as one of the firm’s construction engineers. He graduated from the University of Michigan’s Engineering School in 1949.

OBITUARY

John M. Armstrong
John M. Armstrong, Ph.D., age 67, passed away Tuesday, June 22, 2004, in Ann Arbor, MI. He was born in New Britain, CT, on November 11, 1936, the son of Howard W. and Ruth (Kiltz) Armstrong. Dr. Armstrong married Patricia Ribecky on September 13, 1958, and she survives. He graduated from the University of Michigan with a degree in Aeronautical Engineering in 1959, then received his master’s degree in Aeronautical Engineering and Fluid Mechanics in 1960, and received his doctorate in civil engineering in 1969. Dr. Armstrong taught at the University of Michigan from 1969 to 1986 as a Professor of Civil and Environmental Engineering. He served as the director of the Sea Grant Program at the University of Michigan. He started his own environmental engineering company, The Traverse Group, Inc. in 1975, which he successfully ran until his retirement in 2001. After retirement, Dr. Armstrong remained a private consultant and continued to inspire those in his field with his innovative ideas.
CIVIL & ENVIRONMENTAL ENGINEERING FRIENDS ASSOCIATION

21ST ANNUAL TAILGATE BRUNCH & FOOTBALL GAME

Saturday, September 25, 2004

Brunch: 2 ½ hours before kickoff
Kickoff: TBD
Place: O’Neal Construction, Argus Building
525 W. William Street

MICHIGAN VS. IOWA
GO BLUE!

Brunch attendees will receive first priority for football tickets. Any remaining tickets will be issued on a first-come, first-serve basis. If you have additional questions, contact Janet Lineer at (734)764-8405 or Karen O’Neal at (734)665-2242.

If you buy tickets but do not attend the Brunch, you can pick up your tickets at the Chrysler Center WILL CALL window. You must have picture identification.

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MICHIGAN vs. Iowa

Return this section by September 10, 2004, with your check payable to “CEEFA.”

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Send to:  CEEFA
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Department of Civil & Environmental Engineering
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