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Matching NSF Grant Supports New Lab

A matching grant of $49,800 from the University of Missouri and the National Science Foundation, Washington, D.C., provided the initial impetus for establishing the department's fluid dynamics and heat transfer laboratory in May 1969. It is under the direction of Dr. Miles and Dr. David Wollersheim.

However, much of this laboratory's expensive equipment and instrumentation was obtained at little or no cost to the University by engineering faculty members who searched through government surplus property warehouses and solicited help from friends of the College in industry.

Civil Engineering Has Weather Study

Many construction operations are extremely sensitive to changes in weather. As a result, thousands of construction managers throughout the United States are faced every working day with the responsibility of predicting what the weather's going to be.

If they guess wrong, it could cost their companies heavily in wasted labor and materials.

The department of civil engineering is pursuing two lines of investigation involving this sensitivity of the construction industry to weather.

First objective will be to determine the economic impact on the industry of the effective use of weather information. Although studies have been made of the effects of weather on construction, few of them measured the degree of weather sensitivity or expressed it in quantified terms. The department proposes to develop decision models for specific operations . . . concrete pouring, for example. The models will then be evaluated on the basis of analyses of actual economic data obtained from the construction industry.

In the second phase of this investigation, civil engineers will measure the impact of weather changes on the construction industry in a large urban area. Because such operations as steel erection, concrete pouring, masonry, and painting are sensitive to minor changes in temperatures near the freezing point, even small variations will markedly influence the number of days suitable for working. They also significantly affect construction costs, labor contracts, construction completion times, and speed of completion.

This second phase of the study will determine the yearly amount of construction in a large urban area, identify the portion that is weather-sensitive, and then develop quantified measures of the potential effect of weather changes on that area's construction industry.

Offer Free Exhibits

There are various tourists attractions offered by some University departments. They differ from the commercial variety of sightseeing, however, because on the Columbia campus such attractions are offered free of charge.

The University department of geology's collection of fossils, rocks and minerals, renovated this summer by a graduate student in geology, is open to the public in the Geology Building. Some 30 display cases may be viewed from 8 a.m. to 5 p.m. daily and from 8 a.m. to noon on Saturdays.

In the fourth floor of the new Physics Building the astronomy department offers a free look at the universe through its $12,000 telescope from 8 to 10:30 p.m. every Friday. A graduate assistant is present at all sessions to operate the telescope and answer questions. The telescope magnifies the images of planets and stars so the observer sees them as he would be looking out the porthole of a space ship millions of miles from earth.

Endorsement For Pre-Fab Construction

Congress estimates that the U.S. will need 26 million new dwellings over the next ten years to keep up with the demand for new housing. In the face of today's construction costs, however, this would be a staggering building program to undertake.

Many construction engineers now see instant housing, or factory-built homes, as the logical answer to the great housing needs of this decade.

"Our stubborn commitment to conventional building practices," points out Dr. Kenneth Buchert, professor of civil engineering at the University of Missouri-Columbia, "is preventing us from getting on with the housing programs this country so desperately needs.

"Right now, the Soviet Union is outproducing the United States two to one in new housing units. In fact, nearly every country in Western Europe is building new housing at a faster pace than we are."

How do we catch up, then?

"By using the technology we already have," said Buchert. "With present instant housing techniques, new and less expensive housing can be complete from foundation to roof in two weeks or less."

Buchert is part of a research team of civil engineers at Columbia who have drafted a set of standard specifications for instant housing . . . specifications designed to replace various city building codes and allow quality housing to be built efficiently and economically.

"As we look at this concept of instant housing," said Buchert, "this is what we think it can do: A family moves out of its present house into a motel or hotel for, say, two weeks; then they return to the same neighborhood location and their new house is completed and ready for them to move into.

"We think this is important, because it now takes anywhere from one to three years to build housing. Besides, some urban renewal projects often result in some bad things as well as good things, and certainly one of the bad things is moving a ghetto from one area of the city to another.

"You see, it sometimes takes a year to tear down existing buildings, another year or two to find the finances for the new buildings, and another year or so to build them. This destroys the existing school area, church area, shopping centers, etc. But with instant housing the basic neighborhood environment doesn't change. We feel that instant housing has a social aspect to it that is most important."

Pre-fab has been sort of a dirty word. People used to think of pre-fab housing as shoddily built boxes designed only for low-income families.

"But certainly this is no longer true," said Buchert. "I can show you $30,000 factory-built homes that look as nice and are as solidly built as any comparably priced conventional housing. And you won't be able to tell that it's a pre-fab house."

Civil engineers here are looking at a number of problems associated with factory-built housing, including the unrealistically restrictive building codes still used by many cities.

"In some places," said Buchert, "the code simply says that 'In the opinion of the building official, the structure should be sound.' "

"Well, what is *sound?* Everyone has a different idea. So what we're doing is actually writing technical performance specifications — for example, a house should be able to withstand a 75 mph wind. And we don't care whether it's built of wood, aluminum, steel, concrete, magnesium, plastic, or what have you. As long as that house will withstand a specified force, then we'll accept it."

What about building costs?

"According to some estimates, the cost of instant housing will be about the same as conventional housing. Other estimates suggest a saving of 10 per cent; the most optimistic, 25 per cent.

"However, when you look at costs remember that Congress wants to build 26 million new housing units in ten years. We estimate that this will cost $500 billion . . . and that's 20 times the cost of the entire U. S. space program. Besides, present construction methods we can't even begin to build the number of houses required by this program. It's just not possible.

"What we'd like to see," said Buchert, "is the widespread adoption of instant housing. We've already done a great deal of work in this area and we think we have a solution. Whether it's the right solution, of course, will depend on its acceptance both by construction people and prospective home and apartment owners.

"Ideally, we'd like to move into a city, work with the city government, and use our specifications as an alternative to their present building codes.

"In other words, we can sit here in the laboratories of the College of Engineering, sure of our concept of instant housing and the technology that will make it work. But the final proof of our theories must be established out in the field, right there on the building site.

"We look forward to some progressive city's inviting us to do just that."

New Faculty Learn Teaching Methods

New freshmen are not the only ones who face unexpected problems in college classrooms every fall. Many new young teachers also find themselves in uncomfortable situations because they simply have little or no experience with college teaching techniques.

A summer program at the Columbia campus was designed to forestall some of the problems for young faculty and graduate student instructors.

This Symposia on Undergraduate Learning and Teaching was the initial step in a campus-wide effort to prepare new instructors for teaching responsibilities.

The program consisted of three different sessions for three groups. The first deals with the natural and physical sciences and mathematics; the second with social science; and the third with humanities.

The groups (limited to 50 persons) met on Thursday and Friday afternoons with panels of experienced faculty in the specific group area.

Sessions usually had four panels covering the following questions: elements of effective college teaching, the psychology of learning, the professional role and responsibilities of the college teacher and professional preparation for college teaching.

The aim of the program was to create an on-going series of seminars devoted to preparing teaching assistants and young faculty members for future teaching, to encourage professional responsibility, to show campus-wide concern about the quality of undergraduate teaching and to consider ways to evaluate and reward outstanding teachers.

The program also attempted to introduce the new teachers to technological resources on the campus. They visited the Office of Instructional Television and Educational Research and Development Laboratory in the School of Medicine.

"Universities tend to demand excellence in scholarship and research but frequently tolerate less than mediocrity in teaching," says Dr. Edgar R. Thomas, who headed the program. "One of our greatest problems is to change this concept and reward great teachers as well as great researchers."

If the desire is expressed, the provost's office hopes to provide opportunities for a series of conferences, seminars or informal sessions with experienced, distinguished colleagues and others to help provide the needed professional experience.

The outcome may be the development of outstanding, sensitive teachers much earlier in their careers than is usually the case.

Old Theories Of Teaching Questioned

by Truman S. Storvick

I don't think the classical-lecture approach to teaching engineering ever has been effective. If a student is to learn, he must perform. He learns best by performing, by doing something, by becoming actively involved. Learning is an active rather than a passive process.

When you lecture to a student, he's essentially cast in the passive role. He's therefore not learning in the sense that I'm interested in; that is, he's not learning how to perform.

I see the lecture as a poor way to teach, if what you are trying to teach is performance.

In the lecture hall, ideas come at the student too fast and over too long a period of time each day. His interest lapses and he loses contact with the information that's being fired at him. Fifty minutes several times a day is too much lecture. A student can't concentrate that long and the result is an inefficient transfer of information.

The classical role of the lecturer (or reader, when there used to be only one handwritten copy of the text and it was read to the class) has been reduced by modern printing methods and the other ways we have of presenting information . . . programmed instructions, films, and do-it-yourself study kits, for example.

Programmed instructions can be printed sheets containing both problems and solutions, arranged so that the student can learn at his own pace, check his answers, and identify the areas in which he's weak as he goes along. The sheets are often supplemented by specially prepared tapes and slides that the student can study as often as he wishes.

This programmed text material has the advantage of being immediately available to the student whenever he's inspired to work on it. This is important in engineering, because engineering is the kind of discipline that requires lots of practice. You learn a certain fact, you learn a certain principle or law of physics. Then you practice using this technique, this tool, this law of science or this information.

You can't teach this in a lecture. You just can't teach people, by lecturing, to perform the acts required to get from the statement of a problem to its solution.

As a lecturer, you can put a solution on the board. The student reads it, even writes it down and takes it home, but the fact is that he didn't **do** it. And solving problems in engineering isn't something you learn to do by rote memory. Solving one exercise in class doesn't mean that you'll ever be able to solve it again when it's disguised as part of another problem.

An introductory course is much easier to outline carefully, to specify what you're going to cover and how much time you expect to spend on each topic. This careful outlining and scheduling, however, is the thing that makes the whole program stultifying. This procedure also inhibits the teaching-learning process. You lose the dynamics of being able to move quickly when the class moves quickly, of moving slowly when the class is having difficulty. You have this time schedule you want to stay on, and you force the material presentation into a mold that was prescribed before you had any experience with the students currently taking the course.

Professors who want to teach effectively are going to have to write more of their own material, maybe in the form of programmed instructions. One or more professors could work together to prepare the material, editing it frequently to keep it up-to-date. This will probably work best for introductory or intermediate-level courses, because the basic principles of engineering really don't change very much. But to help motivate the students to learn we must bring this basic information to bear on problems that they see as real problems today. This requires a constant updating of the material.

You essentially write a current textbook, and you write it so that the student can understand it. You don't write it for your fellow professional teachers; you make no attempt to impress them at all. Your only objective is to convey as much information as you can to the student as quickly as possible, presenting it in such a way that he can use it to solve the new problems he recognizes as important.

We now have more alternatives to the lecture than we've ever had before, alternatives made possible by methods of preparing written material quickly and inexpensively. Even 25 or 30 years ago, the effort required to prepare mimeographed mats, proof them, and get them ready for reproduction was a real chore. It was a messy job and fairly expensive, so it was rarely done.

Today, if you can write and proofread rather quickly, and have someone to do the typing, the reproduction is simple. You make a black-on-white original, and all the copies you want can then be run off quickly and inexpensively.

When the professor writes his own material, a course textbook becomes much less important. Students have trouble with these textbooks anyway because they are often written at a level that is too advanced for them (the book was probably written to impress the author's peers) and they are often irrelevant to problems the students consider important. This causes a real drop in student motivation.

As the level of the work increases from introductory to intermediate to advanced, the textbook becomes less and less important. For example, it is almost impossible to find a textbook that can be used for graduate-level courses on any subject in the rapidly changing fields of engineering. One reason is the time it takes to write the book.

It would probably take me at least six months to write the first draft of a textbook. That's if I could spend almost full-time on it. Then I submit the manuscript to a publisher and it is reviewed, and another six months go by. So now a year has passed, plus the three or more months it will take me to write the changes recommended by the reviewer. The publisher will probably require six more months to get the page proofs out of the way and then the book is ready to print.

This whole process involves a time lag that's going to run from eighteen months to two years, even under the best of circumstances.

So the book I write in 1970 won't appear until 1972, and the information I have in the book is based on the literature of 1970. Those of us who report our work in research papers know that today's literature is two years behind the current work of people in the field. Students who read this "new" textbook in 1972 will be somewhere between four to five years behind current work in that field. This is an intolerable time lag, particularly for students in advanced courses.

In the case of a textbook for beginning engineering students, this isn't too serious. We all know that the conservation of energy, the conservation of mass, Newton's laws of motions, etc., won't change between 1970 and 1972. One can only present them to the student in a form that is both palatable and interesting. It must be written so that he stays with the subject.

As courses become more advanced, it is increasingly important that the material I present be up-to-date. My senior students should be learning to formulate their own questions about the open-ended problems they are trying to solve; they should be refining their techniques of problem solving. Any new material presented in these courses should be right on top of the current technology, and this means that I should revise my course materials every time I teach the course.

At the advanced graduate level, the courses are directed readings in the current literature, and the direction becomes less and less until the student can do it all by himself. This takes a level of intellectual maturity that may develop slowly in some students and rather quickly in others. It is obvious that textbooks are too inflexible to supplement teaching at this level. Books are used, but only for assigned readings in specific areas that the student must understand before he can explore a subject in the current literature as part of his self-study, programmed learning experience.

The whole relationship between the professor as a lecturer-teacher and the engineering student as a listener-learner has changed significantly in the past ten years. If, as professional educators, we are to provide the kinds of engineers society needs, then it is time we modified the rigid lecture-and-textbook tradition of teaching engineering.

Doctoral Candidate Develops Technique For Speech Study

Jing-shihong Shih, a doctoral candidate in the department of mechanical and aerospace engineering, has adapted an engineering technique to the rapid screening of large numbers of cleft-palate people, primarily children.

With simple and relatively inexpensive equipment, he can identify and assign numerical values to the degree of their speech impairment.

"We're actually measuring the volume flow rate of air, orally and nasally, during the production of specific sounds," said Shih. "If the required sound must come largely through the mouth, as it does in most English words, then the speaker with a cleft palate has difficulty producing it properly. This is because the cleft palate allows air to leak between the mouth and nasal passages. And when this happens, the production of sound is greatly changed."

Shih first established in his research the most desirable ratio of nasal to oral air emission by testing the speech production of 60 children with normal palates and 44 with cleft palates. He took the average of 10 attempts by each child to produce a specific sound. Their ages ranged from five to 16 years.

Jin-shihong Shih demonstrates technique used in assessing clef-palate children's speech.

Using a specially modified mask to isolate air emitted from the speaker's nose and mouth, he found that undesirable air leakage between the mouth and nasal passages was about five per cent for children with normal palates. In sharp contrast, this leakage was as high as 30 per cent in some of the children with cleft palates.

Shih established his criteria by measuring the velocities of air conducted from the separate nose and mouth chambers of the mask to hot-wire anemometer probes.

In these sensing devices, air flowing around an electrically heated wire 0.0005 inches in diameter changes the temperature, and hence the resistance, of the wire. The resulting change in voltage produces a direct meter reading of velocity.

Air velocities produced in the formation of speech sounds ranged from 0 to 60 feet per second.

By identifying differences in speech production through various statistical analyses, Shih's equipment enables medical people to:

* Determine how well a cleft-palate patient has responded to corrective surgery.
* Detect the degree of speech improvement brought about by the fitting of a prosthetic device. It also helps a physician decide at what point a child should be fitted with a prosthetic device of different design to accommodate his changes in growth.
* Rapidly screen large numbers of cleft-palate people and establish comparative numerical values that will identify the degree of their speech impairment.

X-ray equipment, along with devices that record pressure measurements and muscle movements, are also used in the evaluation and treatment of cleft-palate patients. Shih's equipment, however, requires no inserting of uncomfortable probes in the patient's nose or throat. This is an important advantage, particularly when working with young children. And besides being relatively inexpensive, the equipment is easily portable and simple to operate.

Shih, who completes his Ph. D. work in mechanical and aeroengineering this fall, undertook this research under the supervision of Dr. John B. Miles, professor in MAE, and in cooperation with Dr. Samuel D. Richards, chief of speech and hearing, Missouri Crippled Children's Services.

A native of Tainan, Taiwan, Shih did his undergraduate engineering work there and in Japan before enrolling in the College of Engineering. The title of his Ph.D. dissertation, not surprisingly, is: "Measurements and Analyses of Nasal and Oral Air Flow in Isolated Sound Production by Normal and Cleft-Palate Speakers."

Wind Tunnel To Benefit Research

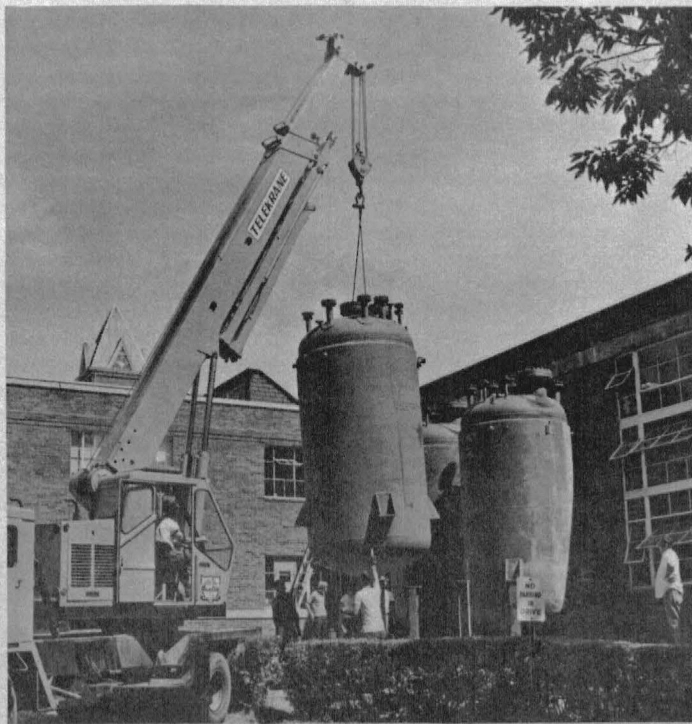
Scheduled for completion by late 1970, the department of mechanical and aerospace engineering's new supersonic wind tunnel is an unusually large facility of this type for a college of engineering. Sophisticated enough for faculty research, it will also supplement instructional and research programs for undergraduate and graduate students majoring in mechanical and aerospace engineering on the Columbia campus. It will be an integral part of MAE 331, experimental methods in fluid flow and heat transfer, a course added to the curriculum last semester.

"We'll be looking at aerodynamic shapes," said Dr. John Miles, professor and director of graduate studies for the department "including missile, aircraft, and jet engine components. We're interested in almost any situation in which a supersonic airstream encounters a solid surface."

Air for the operation of the supersonic wind tunnel is first routed through a two-stage compressor system and two separate and completely automatic drying systems before being stored at 300 psi in the three new interconnected tanks outside the Engineering Building.

There are two branches in this facility's air distribution system. One is for blowdown operation where the full vdlume of air in all three storage tanks is admitted to a test section through a quick-opening pressure regulating valve. Because of the relatively large area of the wind tunnel test section used with this branch, there's only enough air for about one minute of operation. However, the steady-flow branch leads to a smaller test section that can be kept continuously supplied with air by the compressors.

The flow of air around a model or component suspended in the wind tunnel is made visible by a Schlieren system. By directing a beam of light through plate glass observation ports, changes in air density around the model cause the light rays to bend selectively. This effect is picked up by an optical system and photographed. By interpreting the shades of black and white in the photographic print, it is possible to calculate the velocities and pressures at various locations of interest.



Two 14-ton air storage tanks, free from the General Services Administration, were installed as part of the supersonic wind tunnel of the fluid dynamics and heat transfer lab. Controlled air flows in the tunnel test section will reach speeds up to Mach 3.

Advisory Council Meets On Campus November 13, 14

First meeting of the newly-established Advisory Council for the College of Engineering is scheduled for November 13 and 14 on the Columbia campus. The sessions will primarily be devoted to briefing the 22 members on the current status of the College in order that the council can begin its functions. These include the following:

* Discuss and evaluate the present programs of the College of Engineering.
* Explore all available resources for providing the best possible and most complete opportunities in engineering education on the Columbia campus.
* Advise the dean of Engineering on the operations of the College of Engineering.
* Make industry and government more aware of the services provided by the College.
* Provide liaison between the College and both industry and government.

Basically, the council will serve in an advisory and consulting capacity, reporting the results of its studies and efforts to the dean of Engineering. Members will serve three-year terms initially and are eligible for reappointment.

Council members, many of them alumni of the College, are as follows:

Charles Miller, chairman, retired vice president, General Electric Co. Columbia; Lewis S. Armstrong, vice president and general manager, A. B. Chance Co. Centralia; John S. Ayres, president, Cook Paint and Varnish Co. Kansas City; Robert Baeker, plant manager, 3M Co., Columbia, Theodore B. Bloom, general director of personnel, GM Assembly Division, General Motors Corp., Detroit, Michigan; J. H. Brown, vice president, St. Louis-San Francisco Railway Co., Springfield, Missouri; B. M. Carothers, executive vice president, Union Electric Co., St. Louis.

Paul N. Doll, executive director, Missouri Society of Professional Engineers, Jefferson City; Thomas A. Hermann, Zurheide-Hermann, Inc., St. Louis; Robert A. Kraay, general manager, Western Electric, Lee's Summit, Mo.; J. E. Kunkler, vice president and general manager, Armco Steel Corp., Middletown, Ohio; F. C. Lindvall, vice president, Deere and Co., Moline, Illinois; John W. Logan, Weston, Massachusetts; J. R. McCray, vice president and general production manager, Armstrong Cork Co., Lancaster, Pennsylvania; P. L. Metzger, vice president, Kansas City Power and Light Co., Kansas City.

Robert Naka, deputy under secretary, Department of the Air Force, Washington, D.C.; T. B. Robinson, assistant managing partner, Black and Veatch, Kansas City; Ernest S. Robson, Jr., director of purchasing, Monsanto Co., St. Louis; T. Spencer Shore, chairman of the executive committee, Eagle-Picher Industries, Inc., Cincinnati, Ohio; B. D. Simon, Jr., president, B. D. Simon Construction Co., Columbia; Harold E. Thayer, chairman of the board and president, Mallinckrodt Chemical Works, St. Louis; and R. A. Young, executive vice president, Missouri Farmers Association, Columbia.