

HIGHWAY RESEARCH INFORMATION SERVICE EVALUATED BY WESTERN STATES

How can the Transportation Research Board improve the nature and use of the Highway Research Information Service? This question was the theme of a workshop held at the University of California, Berkeley, May 19 and 20, 1977. Representatives from 14 state highway and transportation departments and other users from the western United States attended the workshop, which was chaired by Adolf D. May, Jr., University of California, Berkeley.

Task group chairpersons were Lorna Flesher, California Department of Transportation; Carl Crumpton, Kansas Department of Transportation; and Barbara Russo, Washington State Department of Highways. Beverly Hickok, librarian for the Institute of Transportation Studies of the University of California, Berkeley, was host coordinator for the workshop. Participants included representatives from the state highway and transportation departments in Arizona, California, Colorado, Idaho, Kansas, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming; the Transportation Center at Northwestern University; the Metropolitan Transportation Commission of Berkeley, California; the Department of Civil Engineering and the Institute of Transportation Studies of the University of California, Berkeley; the Federal Highway Administration and the Office of the Secretary of the U.S. Department of Transportation; and the Transportation Research Board. In preparation for the workshop, all states were invited to suggest agenda items for the discussion groups.

In the initial plenary session, the HRIS operations, services, and products were reviewed. It was noted that the HRIS data base now contains about 11 000 research in progress summaries and nearly 62 500 abstracts of research reports, journal articles, technical papers of con-

ference proceedings, and other documents. Approximately 40 percent of the stored records represent non-U.S. projects and documents. A significant input trend is to acquire machine-readable records on computer magnetic tape from other information centers. Approximately 40 percent of the 1977 input has been acquired in machine-readable form.

HRIS now offers four major services: batch mode file searches on a weekly basis, monthly distribution of TRB-selected HRIS responses to search requests, monthly current awareness service, and quarterly publication of *HRIS Abstracts*. In addition, HRIS is a supplier to the TRIS-on-line data base at Battelle Columbus Laboratories. Users of TRIS-on-line can thus search HRIS records and those of other information services. The TRIS-on-line data base now contains 32 700 HRIS records; 25 000 abstracts that correspond to issues of *HRIS Abstracts* published from June 1971 through December 1976 and 3800 summaries of research in progress in the United States are available for searching in the TRIS-on-line data base. In cooperation with the International Road Federation, HRIS has also contributed 3900 summaries of non-U.S. ongoing research projects to the on-line file. About 15 HRIS sponsors are now using the TRIS-on-line service.

All 50 state highway and transportation departments, Puerto Rico, the District of Columbia, and the Federal Highway Administration have obtained products and services from HRIS during 1977. Forty-seven of these TRB sponsors requested 620 file searches on specific subjects during 1976.

The typical response to a sponsor's file search contained 85 selections. User feedback from HRIS file

searches showed that 95 percent of respondents judged the retrieval results to be either valuable or extremely valuable.

Each month a selected list of file search subjects is circulated to sponsors, who may then request copies of the file search responses. In a typical month 47 sponsors each requested 7 of the 9 responses that were offered. The HRIS current awareness service provides computer printouts of records stored by HRIS during the previous month, packaged by sets of HRIS subject areas. During 1976 each of 37 sponsors requested 5 of the 8 packages available each month. The typical current awareness package contained 120 information items. Twenty-three sponsors received a special transportation energy current awareness package. During 1977 each quarterly issue of *HRIS Abstracts* contained about 1000 abstracts of documents from U.S. and non-U.S. sources. Sponsors received 1300 copies of the 2500 copies distributed each quarter. Feedback on *HRIS Abstracts* and other HRIS services was obtained through a questionnaire survey in April 1976.

Major findings from the survey were published in the Information Services Section of *Transportation Research News*, No. 67, November-December 1976, and in the final report of the Central Region HRIS Users Workshop, October 1976, held at Northwestern University. Further analysis of the survey responses disclosed the following:

1. Publications received by librarians are used by many people and much more frequently than those received by TRB representatives;
2. TRB representatives in state highway and transportation departments prefer *HRIS Abstracts* to be published semiannually instead of quarterly, and other groups of users prefer a quarterly publication;
3. Publications received by TRB representatives are used by more people than those sent to any other group except librarians;
4. State and federal government respondents have generally learned about HRIS within their own organizations, but respondents from other organizations (particularly academic institutions) more frequently learned about HRIS from TRB publicity;
5. Government organizations use HRIS publications primarily for browsing and current awareness, but individuals from universities and industry use them for searching specific questions;
6. State transportation department respondents are very much aware of the selected responses and find them very useful (more popular than file searches), but federal respondents appear to be largely unaware of this product;
7. Governmental agencies find foreign information of little value, but academic organizations and industry find the non-U.S. information of substantial value; and
8. TRB representatives and librarians request more full-text documents per month than the average respondent does, and librarians report a significantly higher

level of satisfaction in obtaining these documents than do TRB representatives.

Changes in HRIS operations and services that were implemented as a result of the recommendations of the Central Region Users Workshop at Northwestern University were reviewed and are summarized below.

1. The input processing rate was increased from 155 items per week to 190 items per week.
2. A microfiche title listing is used to check new selections for redundancy with earlier entries.
3. Only document records stored by HRIS since January 1, 1971, are searched to develop a response to a batch mode file search request unless the requester specifically requests that the older material be searched in place of or in addition to the newer material. HRIS has processed 364 batch mode file searches from January 1 to May 1, 1977. Nearly all (336 or 92 percent) of the searches were of the newer material in the file (document records stored since January 1, 1971). Of the 28 searches in the total HRIS file, 7 were made at the user's request and 21 were made by decision of the TRB staff because the subject content of the request was addressed in depth by literature published before 1971.
4. Internal routing of acquired items has been modified to reduce the amount of nonrelevant material sent to each information service for selection.
5. A pilot program has been initiated with the transportation department libraries in California, Illinois, and New York (three large research states) to acquire state-funded research reports and additional state material for HRIS entry.
6. Research in progress summaries are grouped together in the front of each monthly current awareness subject area group package.
7. The TRISNET secretariat has been advised that HRIS users need more information about TRISNET concepts, services, access mechanisms, and guides to search strategies for on-line retrieval of highway information.
8. Abstracts of HRIS selections are sent to Battelle Columbus Laboratory to be added to the TRIS-on-line data base quarterly instead of semiannually.
9. The International Road Research Documentation (IRRD) and HRIS are pursuing the development of an IRRD-HRIS thesaurus concordance.
10. The number of TRB-selected HRIS responses offered to the state highway and transportation departments each month has increased by about 25 percent.
11. An HRIS user guide has been drafted and includes a list of HRIS information sources, journal titles and conferences proceedings that are systematically screened for HRIS selections, and contributing organizations. The draft guide also includes chapters on selection criteria and file search strategies and techniques for both batch mode and on-line retrieval.

Using the HRIS status report, the survey observations, suggestions from HRIS users, and the recommendations from the Central Region Workshop as background material, the participants from the western states were divided into three discussion groups. One group considered input improvements, one considered output improvements, and one considered improvements in intermodal information transfer. Some of the major conclusions and recommendations of the groups are listed below.

1. The notion of restricting selection of acquisitions from non-U.S. sources, recommended by the central region HRIS workshop, should be discussed again at the eastern region workshop. The western group did not concur in the central region recommendation. Foreign language publications may be the only source of information on a new technology. There is a reluctance to use non-U.S. information because of acquisition and translation problems.
2. The HRIS subject area list should be revised to include new subject areas such as "energy" and "environment," scope notes should be added to some existing areas, and the names of some areas should be changed to more accurately reflect the information content of the subject area. For example, the name of subject area 27 should be changed from bridge design to structural design to more accurately identify the content and to provide a place to file information on tunnel design. Scope notes could identify areas in which users could expect to find information on topics such as vehicle noise (52), traffic exhaust gas measurements (55), and effects of exhaust gases on vegetation (24).
3. HRIS should publish a pilot *TRIS Abstracts* and survey user reaction to the publication. The abstracts now published in *Transportation Research News* could be dropped. The *TRIS Abstracts* could also contain information on topics of current interest to all modes.
4. HRIS should continue its present selection policy. More information on few projects is preferred to receiving little information on many projects. HRIS should continue to store journal articles, conference proceedings, and final reports about a given research project, but should omit interim reports. Information about a project in different forms may present views different from those of the author and improve availability of the information.
5. The Special Technical Activities Division of TRB should study the feasibility of adopting a uniform subject area scheme for the information services of all transportation modes. Problems may arise when the TRIS service is developed, for the subject areas of the modes are not compatible.
6. If the current awareness is discontinued, all abstracts stored by HRIS should be published in *HRIS Abstracts*, research-in-progress summaries should be published biannually with indexes, and cumulative indexes to *HRIS Abstracts* should be published annually.
7. A cost awareness of HRIS operations should be maintained. Cost effectiveness cannot be easily or accurately measured.
8. The present scope of HRIS should be continued. Non-research information should be left out of HRIS. Standards, specifications, and the like can become outdated and thus be misleading in a computer data base.
9. The part of the user guide for experienced users should be further condensed.
10. A one-page document-availability sheet should be provided with each selected response. The document-availability sheet should be similar to information provided in the front of *HRIS Abstracts*.
11. The report number should be cited on the document records of research reports in place of, or in addition to, contract numbers. Contract numbers are of no help to most users.
12. The viewpoint of the states and other interested sponsors toward the establishment of an overall transportation research information service should be investigated. More than 30 states now have transportation departments. The modal information services operated by TRB should be merged into one overall transportation research information service.
13. The feasibility of placing a transportation research information service on-line with a commercial data base vendor should be investigated. Potential vendors should indicate their expected level of effectiveness.
14. The modal identification of the transportation research information services should be maintained until a unified transportation research information service is established. An editor should be employed to identify gaps in the total collection of information maintained by the modal information services.
15. An organized approach to identify sources of transportation statistics should be continued by the U.S. Department of Transportation and expanded. No comprehensive directory of statistical data on transportation information has been identified.
16. The possibility should be investigated of acquiring for HRIS the transportation regulations published in the *Federal Register* if the *Federal Register* is available on computer tape. There is a widespread difficulty in identifying regulations within the *Federal Register*.
17. HRIS should pursue a broad marketing program. More exposure of HRIS is needed in the professional transportation media.
18. An HRIS representative should be appointed in each major user organization. The representative should either be the librarian or work closely with the librarian.
19. HRIS should provide a better method of distinguishing between research-in-progress summaries and abstracts of published works.



TRB Executive W. N. Carey, Jr., Honored by Alma Mater

W. N. Carey, Jr., Executive Director of the Transportation Research Board, was the recipient May 4 of the Outstanding Achievement Award of the University of Minnesota, its highest alumni award. Carey, who graduated from the university in 1937 with a BCE degree, was one of three recipients. The others were John H. Gerstenmaier, president of the Goodyear Tire and Rubber Company, and Donald K. Slayton, astronaut and executive in the Space Shuttle Program. The awards were made by C. Peter Magrath, president of the University of Minnesota.

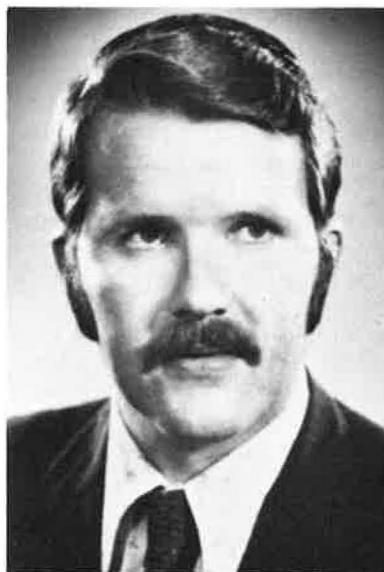
TRB Committeeman D. W. Gwynn in Ten Public Works Men of Year

David W. Gwynn, chief engineer, Transportation Operations and Local Aid, New Jersey Department of Transportation, has been named one of the Top Ten Public Works Men of the Year by the American Public Works Association. Selection of these top engineers and administrators is part of the nationwide observance of National Public Works Week, designed to increase citizen understanding of public works, encourage and assist young people in career planning in public works, and recognize outstanding contributions of outstanding public works officials.

Gwynn is an active TRB committee member, serving on the Group 3 Council and several NCHRP advisory panels. He was cochairman of the Conference on Transportation System Management held by TRB for the U.S. Department of Transportation. He has traveled extensively as president of the Institute of Transportation En-

gineers and is active in numerous ITE programs. In his position with the New Jersey transportation department he is responsible for traffic engineering, traffic operations, local aid and safety programs, and electrical operations; these duties are performed by a staff of 700. He also administers \$66 million worth of street and highway programs.

He formerly headed research and development activities for the department and before that conducted research for West Virginia University and held several traffic engineering positions with the West Virginia Department of Highways.



NCHRP Panel Member Honored for Solving Bridge Problem

Harry Czyzewski, president of MEI-Charlton, Inc., and a member of the NCHRP Advisory Panel on Acceptance Criteria for Electroslag Weldments in Bridges, was the recent recipient of the American Consulting Engineers Council Award for Engineering Excellence for high professional execution of engineering design. The award was made for Czyzewski's work on the Fremont Bridge in Oregon, and the award also went to his clients, the Oregon Department of Transportation and the Federal Highway Administration.

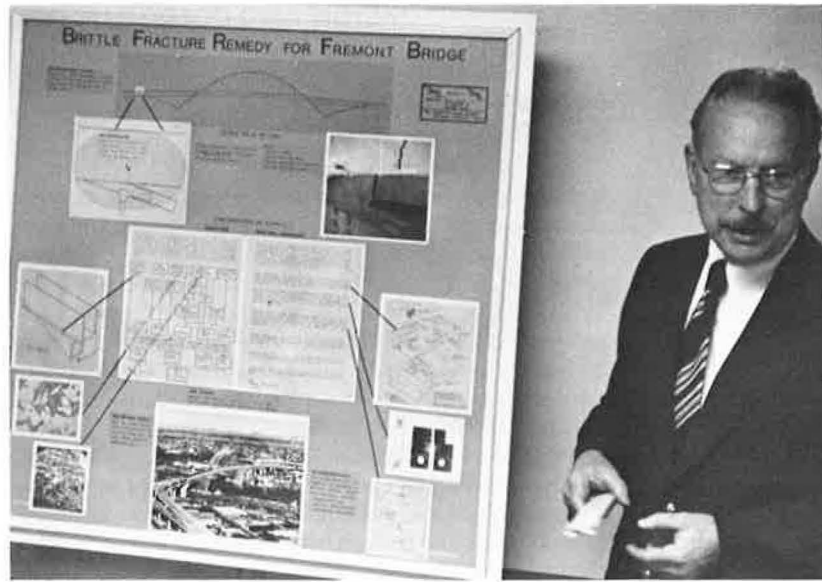
Czyzewski was consulted to determine the cause when the bridge under construction developed a brittle crack 4.5 m (15 ft) long. The factors leading to this crack were found to be a series of complex interactions. Czyzewski's assignment included recommendations for the repair and correction of any defects. The remedy prescribed replacement, after redesign, of the failed section and three other sections. The cost was \$5 million and the delay of the bridge schedule was more than 1 year.

The recommendations that the consultant made, as a consequence of this study, were adopted by the clients and resulted in revisions to the standard specifications for bridge design of the American Association of State Highway and Transportation Officials. They included revisions to design practices, material specifications, and fabrication procedures.

In bridge failure history, the investigation of the Fremont Bridge crack has a respected status. Fortunately, the failure occurred during construction and no persons were injured. The Oregon Department of Transportation and the Federal Highway Administration encouraged release and wide distribution of all technical information. The same corrective measures used at the Fremont Bridge were introduced in three other bridges that were under construction at that time and had been originally designed under similar considerations.

The study has been presented in programs at many structural and metallurgical societies. It has been recognized as a pattern for such failure investigations within the Federal Highway Administration. Several other important findings are also cited, for example, in studies of fracture control in large structures and of nondestructive evaluation criteria.

The analyses used advanced techniques of fracture study, including scanning electron microscopy in which false fatigue "striations" were correctly identified as representative of material defects under brittle fracture. Fracture-toughness test methods had to be adapted to materials that had a high level of flaws. A residual stress study was made of a 13.7-m (45-ft) long section of the girder in which thorough mapping was done of the complex pattern of residual stresses. These were "locked in," first in one direction and then in another, by welding of the many elements as the section was built up.



Paper Deadline Near

The deadline for submission of papers to be given at the 1978 Annual Meeting of the Transportation Research Board is August 10. TRB Committee on Track Structure System Design will consider papers on the subjects of track, track components, roadbed, and ballast. Information on submission may be obtained from J. H. Seamon, Rail Transport Specialist, Transportation Research Board, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

PLANNING AND ADMINISTRATION

Nation's First Free Bus Program Funded by UMTA

The nation's first free bus program funded by the Urban Mass Transportation Administration has been approved for Trenton, New Jersey, and is expected to begin operation in off-peak hours next January. The 1-year demonstration program on Mercer Metro lines is aimed at determining the various impacts that would result from eliminating the present 15-cent fare on weekdays from 10:00 a.m. to 2:00 p.m., after 6:00 p.m., and on Sundays and holidays. About 7200 persons ride Mercer Metro buses on an average weekday during off-peak hours.

Total cost of the demonstration program is \$625 000; UMTA's 80 percent contribution will be matched by 20 percent from Mercer County. The project will include telephone interviews, bus rider interviews, interviews at shopping centers, and interviews in homes.

DESIGN AND CONSTRUCTION

Increased Use of Concrete Ties for Railroads and Transit Systems

It may not be long before concrete ties become standard components in railroad track structures, according to experts who attended a 3-d workshop on the subject at Lincolnwood, Illinois. More than 150 engineers, manufacturers, and railroad officials from as far away as Japan and Poland attended the workshop, which was sponsored by the Portland Cement Association in cooperation with the Association of American Railroads and the Prestressed Concrete Institute.

The Canadian National Railway (CNR) test installation has shown that concrete ties are superior in eliminating the problems of extreme rail deterioration, inability to hold gauge and surface, the "signature effect," and corrugation experiences with the use of wooden ties under wheel loads and unit trains. CNR plans to use 1.5 million concrete ties for its 885-km (550-mile) section in the mountain region. About 320 km (200 miles) of the

Florida East Coast Railway Company track will have concrete ties by the end of this year.

Concrete-tie portions of transit systems such as BART (San Francisco), CTA (Chicago), and MBTA (Boston) show excellent results and require practically no maintenance. MARTA (Atlanta) plans installation of concrete ties in its system under construction. Transit use of concrete ties could be as high as 150 000 annually for the next 10 years. Although the present initial cost is higher than the cost for wood because of low production runs and non-standardization, the lower maintenance factors should encourage users to go ahead.

Participants in the workshop visited the Portland Cement Association laboratories to observe concrete ties being tested and later traveled to the Santa Fe test installation near Streator, Illinois, to observe concrete ties under actual operating conditions. The installation consists of different types of concrete ties and fasteners whose relative merits are being evaluated under actual traffic conditions.

Cement Industry Uses Less Energy

Energy consumption by the U.S. cement industry was 6.7 percent less for each megagram of cement produced in 1976 than in 1972, despite relatively weaker market conditions and lower capacity use. The improvement is largely attributable to stepped-up conservation programs, including plant retrofitting and changes in processing. The industry is moving toward increased use of coal. In 1976 cement producers used 24 percent more coal, 41 percent less natural gas, and 30 percent less oil than in 1972.

Pioneer Solar Energy Program to Heat Asphalt for Roads

Solar energy is being used to heat asphalt for road maintenance purposes in a project new to the Arizona Department of Transportation and possibly the nation. The energy crisis motivated the department to consider an alternative to fuel sources, and a study showed that the \$18 000 solar energy project will be cheaper than natural gas, electricity, and butane over a 25-year period.

Collectors 1.2 by 2.4 m (4 by 8 ft) heat oil as it passes through them en route to a series of coils in a 30.3-m³ (8000-gal) asphalt emulsion tank, heating asphalt up to



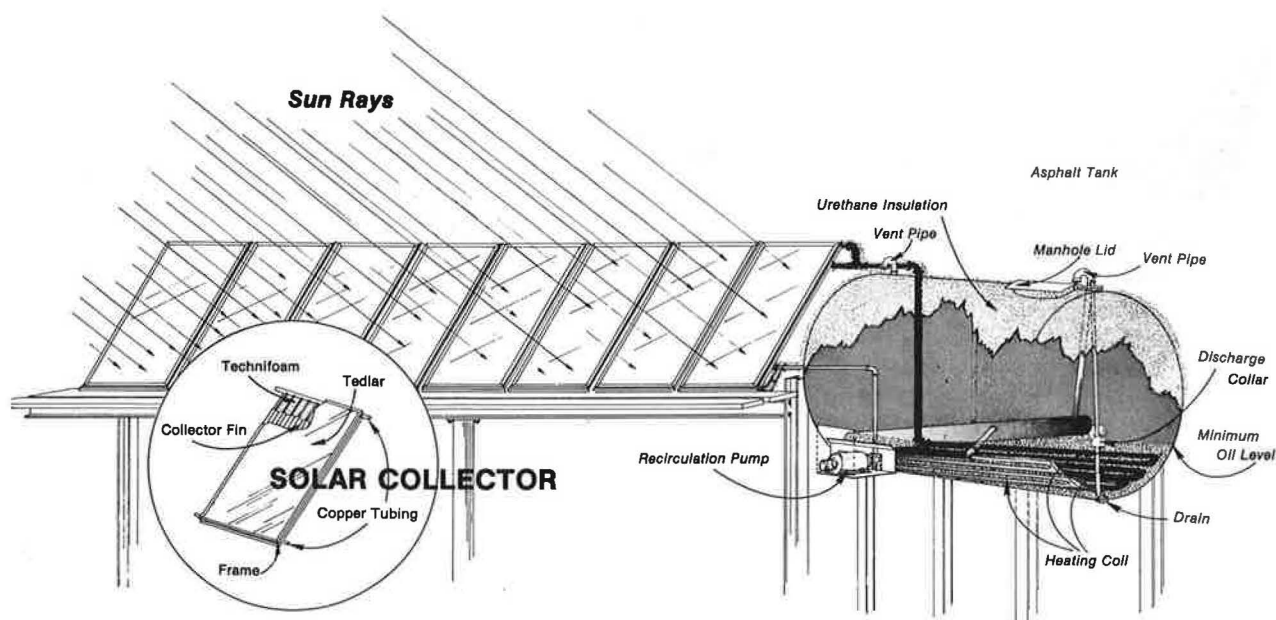
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1 Claire Ball (left), research engineer for the Portland Cement Association, discusses various types of concrete ties and fastenings with participants at the workshop on concrete ties.

2 Engineers inspect Santa Fe's concrete in test installation near Streator, Illinois, about 160 km (100 miles) from Chicago.



51.7°C (125°F). If the installation, which became operational June 1, proves to be successful, other solar-heated asphalt tanks will be installed in the state. Solar energy hardware will keep asphalt heated to 21°C (70°F) or more even if overcast weather persists for 14 consecutive days, an improbability in southern Arizona.

The department's decision to move ahead on the solar energy project followed an announcement from Southwest Gas Company denying a gas hookup to heat the asphalt tank. The company's decision was based on the supply of natural gas, according to Don Cornelison, maintenance engineer for the transportation department and the project designer.

Instruments measure the temperature of heating oil, asphalt emulsion, air, wind direction and velocity, and amount of sunshine.

Collectors mounted on the tank have a tedlar film 25.4 μm (4 mils) thick through which the sun shines onto a heat absorber made of extruded aluminum. The heat absorber transfers heat to a copper tube through which the heating oil flows. The heat reflects off an aluminum foil under the heat absorber and the copper tube, helping to heat the tube. A 12.7 mm ($\frac{1}{2}$ in) of insulation is placed under the aluminum foil. The heated oil flows from collectors into a heating coil in the bottom of the tank, continuing through 50.8-mm (2-in) steel pipes and a 304.8-mm (12-in) expansion tube, thereby heating the asphalt. The tank is covered by 76.2 mm (3 in) of polyurethane. A pump returns the heating oil from the tank to the collectors after the heat has dissipated.

OPERATION AND MAINTENANCE

SST Already Servicing New York!

The SST is landing in New York City six times a day, with little or no publicity or complaints from the resi-

dents. No, it is not the Concorde, but the Seaplane Shuttle Transport that flies from Philadelphia. The airplane is a float-equipped De Havilland Otter, which flies from its Delaware River base in Philadelphia to the East River just south of Wall Street in New York City. It carries 19 passengers.

Experimental Cars Will Demonstrate Safety, Fuel Efficiency, and Comfort

Experimental cars that are fuel efficient, clean, economical, and safe will be designed and constructed for the U.S. Department of Transportation by the Calspan Corporation of Buffalo, New York, and Minicars, Inc., of Goleta, California.

In January 1977, preliminary contracts were awarded to the two companies for initiation of phase 3 of the research safety vehicle (RSV) program, designed to build and test safety features that could be included in cars by the mid-1980s. The program is focusing on cars that weigh less than 1361 kg (3000 lb) and that will permit survival of occupants in 80-km/h (50-mph) head-on collisions.

Completion of this stage of the 5-year program will lead to phase 4 activity involving a complete evaluation of emissions, fuel economy, damageability, and safety, including crash testing of the vehicles by an independent contractor beginning in 1978.

Minicars provide the same degree of protection in a subcompact car that boasts a large interior volume for comfort. The company's mockup features 325° of visibility and gull-wing doors for easy access; it weighs less than 975 kg (2150 lb). The Minicars vehicle is designed to ultimately produce more than 14.5 km/L (34 miles/gal) with a stratified charge engine. Minicars also will explore the use of a variety of other engines and powertrains, including diesel engines.

Current work on this vehicle includes an air bag for crash protection, foam-filled body structure members for



1 Research safety vehicle developed by Calspan and Chrysler is loaded with many features including reinforced structure; soft front end, rear, and interior; run-flat tires; and Inflatabelt restraints. The car weighs 1361 kg (3000 lb).

2 Minicar's sporty approach to the RSV emphasizes maximum visibility, gull-wing doors, electronic instrument display, air bag protection, and radar-actuated braking.



added protection, a compartmentalized front end that can be easily and inexpensively replaced in the event of damage, and four-wheel independent suspension and anti-skid brakes that cut stopping distances 30 percent when compared to today's cars. It also includes a dashboard electronics display that enables the driver to monitor the running health of the car and that provides a radar system that will signal a warning if the vehicle is too close to the rear of another vehicle and automatically actuates the braking system if a high-speed crash is unavoidable.

The Minicar's innovative RSV design will produce a vehicle lighter than and not so conventional as that produced by the Calspan design. By integrating advanced technology engines and transmissions in this lightweight vehicle, fuel economy levels of 20 to 25 km/L (50 to 60 miles/gal) appear achievable.

NCHRP

NCHRP to Test Validity of Energy-Flow Concept

The energy-flow concept, which has been identified as having a high potential for identification of legitimate environmental concern in transportation planning, will be studied by the Cannon Group of Tallahassee, Florida, under a \$15 000 contract from NCHRP. The research project is designated NCHRP Project 20-11C and will be completed by the end of 1977.

The widespread environmental awareness that began in the late 1960s added significant new issues to those faced by transportation planners. Concern with the qual-

ity of the environment remains an important responsibility of transportation agencies, even as new issues emerge. The current issues associated with physical and monetary resource limitations have increased the need to identify legitimate environmental concerns so that the use of these limited resources will provide the maximum benefit. This type of analysis requires the application of a methodology that can consider economic, environmental, and energy factors in a common framework and indicate courses of action that optimize the interaction of these factors. The energy-flow concept, developed by Howard Odum, is claimed to meet these requirements.

The energy-flow concept is also known as energetics or general energy systems theory. It is a part of a broader body of theory, known as general systems theory, which has been under development to deal with complex interdisciplinary problems. In this context, system is defined as a combination of parts organized into a unified whole (e.g., a machine, an animal, or a country). Energy systems are those that process flows of energy; they include virtually every physical system.

There are various ways of isolating a system (that is to say, defining its boundary) to deal with individual transportation issues. An example would be an urban area surrounded by undisturbed natural area and farmland. The regional system would include both man-made and natural environmental concepts. An analysis of transportation and land use in that system would have to include both the work contributions of the natural environment and of human technology as a basis of the regional economy.

The theory of energy-flow analysis is outlined in detail in several sources, and there are numerous examples of its application to particular problems, including several transportation issues. Methodologies for applying the

theories have been developed as particular problems have been addressed. It is now developed to the point of being useful for addressing many significant transportation issues. An investigation of the needs of future research in the area is necessary to evaluate the benefits to transportation agencies, and the NCHRP project is designed to carry out this investigation.

The researchers will develop research study designs to verify and extend the energy-flow concept, including a reexamination of basic transportation and location theories; testing of the validity of the energy-flow concept when applied to transportation problems; and extension of the theoretical understanding of the application of energy flow to new aspects of transportation decision-making, such as social costs and benefits.

The study designs will call for research to examine the possibility of applying existing techniques to new issues and to test new tools and procedures for the application of energy-flow analysis.

Use of Freeways Studied to Carry Utility Lines

An increasing number of requests are being made to place utility lines, both overhead and underground, in the medians and on the shoulders of limited-access freeways and highways. The drawbacks and advantages of this practice are being examined by the research company of Byrd, Tallamy, MacDonald and Lewis of Falls Church, Virginia, under a \$50 000 contract from NCHRP.

The 66 000 km (41 000 miles) of Interstate highways connecting the nation's larger cities are characterized by the wide rights-of-way necessary for their construction and maintenance. Since land acquisition and construction of Interstate highways are 90 percent federally funded, the system truly belongs to the citizens of the United States. Major utility systems, like Interstate highways, link distant population centers and serve the same citizens, usually joining the same points served by the highway systems.

In terms of efficiency, economy, and preservation of an acceptable environment, it can be argued that public interest will benefit by locating publicly and privately owned underground and overhead utilities within Interstate highway rights-of-way. Where the right-of-way is wide enough to accommodate these utilities without danger or inconvenience and where there is a coincident demand for both the utility and the highway, this is a logical conclusion. However, the safety of those using the highway must be the first consideration; if the occupation of the right-of-way by utility lines constitutes a hazard, then access must be denied. The Federal Highway Administration charges each state to exercise care in allowing utilities to be installed in highway rights-of-way. Each state has its own policy, but all reflect a desire to locate utilities as far as possible from the traveled way and never under the actual pavement, except in urban

areas. Attachment of utility lines to highway structures is also discouraged as far as possible. The definitive publication on the subject is *A Guide for Accommodating Utilities on Highway Rights-of-Way*, which was published in 1969 by the American Association of State Highway and Transportation Officials (AASHTO).

In 1975, the American Telephone and Telegraph Company, with AASHTO's sanction, conducted a study and issued a report, *Feasibility Study of Joint Occupancy, Buried Waveguide, Interstate Right-of-Way*. The usefulness of this study was limited by its emphasis on steel-encased, copper-lined steel tubes alone, the unique signal-transmission medium of the Bell System. Although the report contained valuable information within defined limits, the AASHTO Standing Committee on Engineering and Operations, after reviewing the first-phase report, accepted the responsibility for studying the overall matter of joint use of freeway rights-of-way by utilities. It further recommended that the study should be undertaken under the NCHRP program.

As a result, the Byrd, Tallamy, MacDonald and Lewis team is conducting a study to determine the feasibility, need, and merit for permitting utilities to be installed longitudinally within the rights-of-way of Interstate highways and other freeways. Completion of the project, which is designated NCHRP Project 20-7, Task 11, is scheduled for March 1978.

Ramp-Control Systems Studied by Texas A&M Research Foundation

A \$250 000 contract to develop guidelines for design and operation of ramp-control systems on freeways has been awarded to the Texas A&M Research Foundation, College Station. The study, designated NCHRP Project 3-22A, is a continuation of previous NCHRP research on the subject. This project is scheduled for completion by April 30, 1979.

Urban freeways have experienced traffic congestion since their early stages of development in the 1950s. Urban motorists increased their expectations for mobility and changed their travel patterns to take advantage of newly opened freeways. The traffic demands that were generated by these new freeways often exceeded their capacity.

Early studies of freeway operations included experiments with ramp control, usually by closing entrance ramps during peak hours. The success of those studies prompted the development of more efficient forms of ramp control by traffic signals. The evolution of ramp-control systems closely resembles that of traffic control for at-grade intersections.

Since the early 1960s, several projects have been organized to develop, install, operate, and evaluate freeway surveillance and control systems. NCHRP, along with the Federal Highway Administration, the Urban Mass Transportation Administration, and state highway and trans-



portation departments, has continued to search for better ways to operate freeways. Despite 15 years of research and development of ramp-control systems, the level of implementation is below expectations. This problem may be attributable in part to research programs that attain increased efficiency but at the same time make the ramp-control systems so complicated and expensive that they are not acceptable to the agency responsible for freeway operations.

If ramp-control systems are to be successfully applied to urban transportation problems, a set of guidelines is needed that can be used by the operating agencies for defining the costs, operational and maintenance requirements, and expected benefits of ramp-control systems for a range of control methods, such as local fixed-time, local actuated, and system control.

This is the main object of the Texas A&M study. It will update and complement the findings of previous projects, notably NCHRP 3-22, but will include more concise and specific guidelines for selecting the appropriate control and associated hardware for implementation of ramp control.

According to a Texas A&M spokesman, "The problem of making optimal use of existing freeway facilities is no longer just desirable—it is mandatory. In past years highway engineers have applied cost-effectiveness analyses to determine whether a new construction project is justified and, if so, which design is most cost beneficial. It is now necessary to apply similar analyses to various control techniques to determine which may be most cost beneficial within the constraints of funding and objectives to be obtained."

Effectiveness of Noise Barriers Studied by Penn State University

Noise barriers to reduce the traffic sounds reaching residences and businesses along busy highways are becoming increasingly common. Although barrier designs have become more efficient in recent years, certain acoustical factors need to be examined further. As a result, NCHRP

has entered into a \$75 000 contract with Pennsylvania State University to investigate selected acoustical parameters of noise barriers. The project, designated NCHRP Project 3-26, will be completed by the end of February 1978.

Specifically, the study will concentrate on the potential acoustical effects of barrier cross-sectional shape, barrier surface characteristics, and influence of barriers on the noise-reducing value of various ground covers. These factors are not considered in currently used noise-prediction procedures. The researchers will use current analytical models to predict the sound pressure at points in a region adjacent to a highway, both with and without a noise barrier. They will then use mathematical models to predict the sound pressure in the same regions after different barrier shapes and surface impedances are introduced.

Various types of noise barriers will be considered in the Pennsylvania State University project. Several of these barriers are described in previous NCHRP project reports, notably reports 117 and 144. Among the designs are the thin-wall (knife-edge) barrier that has acoustically hard walls, the sharp-cornered wedge design, the flat-top barrier, the curved-top barrier, and various combinations of each of these types.



Penn State University to Study Upgrading of Marginal Aggregates

NCHRP has awarded a \$150 000 contract to Pennsylvania State University to investigate the possibility of upgrading poor or marginal mineral aggregates for use in building asphalt or concrete pavements. The project, designated NCHRP Project 4-12, is expected to be completed by the end of February 1979.

In common with many natural resources, the availability and reserves of proven high-quality mineral aggregates have become a matter of national concern. In recent years, the annual consumption of aggregates for highway use averaged about 453.5 Pg (0.5 billion tons) in the United States alone. Furthermore, the annual increase in demand results in a doubling of output about every 15

years. The situation is compounded by the loss of existing sources through economic considerations, zoning restrictions, pollution control, and appreciating land values.

In those areas of the nation where high-quality aggregates do not exist or have been depleted, there is nearly always a supply of marginal or poor-quality aggregates. If they can be processed economically or treated to improve their quality, this would help to relieve the shortage of good aggregates. Two potential approaches are available to improve the performance of poor or marginal aggregates. They may be processed to eliminate specific deficiencies, or admixtures may be developed to add to the mixture and counteract certain problems. This can be accomplished in several ways, including coating aggregate particles to render them harmless, treating them with chemicals, blending the marginal aggregates with high-quality aggregates, and removing harmful particles by mechanical means.

The overall objective of this project is to advance methods of upgrading poor-quality or marginal coarse aggregates to acceptable durability and structural levels for use in high-quality bituminous and portland cement concrete mixtures. Research is limited to the use of different types of coatings, chemical treatments, or impregnation. Only natural mineral coarse aggregates, such as gravels and crushed stone, will be considered in this study.

The Pennsylvania State University research team will identify problems associated with the use of natural coarse aggregates used in asphalt and concrete paving mixtures and then identify existing and potentially available practices and methods for upgrading aggregates. They will analyze these practices and methods and carry out a laboratory development and evaluation program on selected aggregates that have demonstrated deficiencies in the identified problem areas. A final report will detail the findings of the research and include recommendations for possible field evaluations of selected procedures.

FOREIGN

Subways, Expressways, Tunnels: Hong Kong's Transit Explosion

The tiny colony of Hong Kong, clinging to the vast bulk of mainland China, and surrounded on three sides by the China Sea, has nowhere to go but up. Multistory office buildings and hotels, apartment buildings, and government public housing blocks are climbing up the side of the mountains surrounding Victoria Harbor and forming new towns in the formerly pastoral lands of the New Territories, ranging back to the borders of the People's Republic. The population of the British colony, which was just over 3 million in 1961, is now more than 4.5 million, and is expected to reach almost 6 million in the next 15 years.

In the early 1960s Hong Kong had 805 km (500 miles) of roads to accommodate 40 000 vehicles. Today, the road system has increased to 1125 km (700 miles), but the vehicle count has soared to 190 000, largely because of the rapid economic growth of the colony.

Traffic congestion in the twin cities of Hong Kong and Kowloon has grown increasingly worse. Although the limited number of arterial streets and expressways within the city limits help to alleviate the situation, the roads leading to rural farming areas and fishing villages are mostly narrow, winding, and unsuited to carry the volume of traffic.

A new program of road building, tunnel and subway construction, and upgrading of public transit is now in full swing, largely as a result of a detailed \$1.7 million study by Wilbur Smith and Associates.

In reviewing the study for the Hong Kong Public Works Department, Bruce Maxwell analyzed the situation thus. "Transport modes are unbelievably varied for a modern city-state. From traditional Chinese rickshaws and junks, Hong Kong has sprouted forth sampans, wallah wallahs (motorized sampans), passenger and vehicular craft of

Multimodal transportation seen in one block of Hong Kong traffic includes streetcars, double-deck buses, single-deck buses, jitneys, taxis, private automobiles, and one motorcycle.





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1 Excavation for Hong Kong's subway system goes on under the towering hotels and office buildings along Connaught Road. The First World War memorial, an exact replica of the Cenotaph in Whitehall, London, is at center right.

2 An entire village had to be relocated to make way for the Sham Tseng Viaduct, part of the \$76 million Tuen Mun Road that will link the New Territories with downtown Kowloon.

3 Remote fishing villages on Hong Kong Island will be linked by modern highways to Hong Kong and Kowloon.





3

various denominations, hovercraft, and hydrofoils and jetfoils for the 64-km (40-mile) run to the neighboring Portuguese enclave of Macau. All of these crisscross the harbor among other marine craft and oceangoing ships.

"On land, besides the rickshaws that are now almost exclusively used by tourists, there are funicular or railway trams, buses, public light buses (14-seaters with no fixed stops), taxis, hire cars, pak paks (illegal taxis), and of course private cars. A railway line stretches 35 km (22 miles) from Kowloon to the Chinese border at Lo Wu where passengers change trains for Canton."

In 1973 when the Wilbur Smith study began, the 6000 buses, trams, and public light vehicles carried 3.2 million passengers daily; 133 000 private cars and taxis carried another 1.3 million, and in the harbor the famous Star Ferries accounted for 580 000 passengers a day despite the opening in 1972 of the four-lane Cross Harbour Tunnel.

New towns are being built in the rural New Territories to attract residents who would otherwise live in crowded Kowloon and Hong Kong. But the present roads are inadequate to provide proper communications between the new towns and the older cities. Two of the new towns, Tuen Mun and Tsuen Wan, will be linked with Kowloon by a \$76 million, six-lane highway now under

construction, the most expensive highway project ever undertaken by the Hong Kong Department of Public Works. The 15-km (9.5-mile) road cuts through solid and decomposed granite and volcanic rock, clings on pillars to the mountainside, crosses a bay on a causeway, and straddles a village on an elevated viaduct. The Tuen Mun Road will be a divided highway with three lanes in each direction and with interchanges at two intermediate points. The eastbound roadway is currently being constructed and will be opened to traffic while the west-bound lanes are built. This new high-capacity road is considered to be essential to the development of Tuen Mun, which is located about 32 km (20 miles) from downtown Kowloon. It will replace the old two-lane Castle Peak Road that winds through fishing villages along the coast and will cut travel time between Kowloon and Tuen Mun from 1 h to about 20 min.

Another large-scale project that is vital to Hong Kong's highway network got under way recently when construction began on the \$56 million twin-tube Aberdeen Tunnel. It will run 1.9 km (1.2 miles) under the 426-m (1000-ft) high range of hills that form the island's central spine. The project will provide a north-south express link through the island, a route that had been blocked in the past by the hills. When completed in late 1980, the tunnel will

form an integral part of a trunk route through Hong Kong Island, Kowloon, and the New Territories.

Instead of building one dual-lane tunnel and then expanding later to two tunnels, the Department of Public Works engineers decided to go ahead with simultaneous construction of both tunnels. Each tunnel is built to handle a traffic flow of some 2400 vehicles/h. In conjunction with the twin tunnels, an interchange is being built at Wong Chuk Hang, the tunnel's southern portal, along with a \$97 million extension of the elevated highway at the northern end.

The initial tunnel breakthrough has already been completed. For more than 2 years the contractors, in close association with the Department of Public Works, have been drilling and blasting an \$800 000 pilot tunnel through Mount Nicholson to determine whether soil and rock conditions deep within the mountain will support a tunnel highway. The only apparent problem is at the southern portal, where the soil is waterlogged and will have to be stabilized by chemical grouting. Apart from this section, the project will simply involve excavation and widening the pilot tunnel and simultaneously driving the twin tunnel alongside it.

Meanwhile, tunnels of a different nature are being built under the business district of Kowloon and Hong Kong as part of a \$1 billion, 15-km (9.7-mile) subway system. Completion of the line and its 15 stations is anticipated by March 1980. Twelve stations and 12.9 km (8 miles) of the system will be underground. The line ex-

tends from the industrial suburb of Kwun Tong down the Kowloon Peninsula and through a sunken-tube tunnel under Victoria Harbor to the financial heartland of Hong Kong Island. Only a small part of the subway is being built by cut and cover. Tunneling is used to prevent disruption of traffic and commercial activity. A major segment of the line was routed directly under the center of one of Kowloon's busiest streets to avoid demolishing commercial buildings and disturbing the piles on both sides of the streets that support the structures. In one area where the route narrows, the twin tubes are stacked on top of one another.

The Metro is concentrated within the heart of the central areas and is designed for heavy traffic flows. The peak-hour flow in a single direction will be 40 000 to 50 000 passengers/h on more than 60 percent of the system; the daily total will be 1 million passengers in the 1980s.

The stations will be closely spaced, at a relatively shallow depth, and will be equipped with escalators, public address, and closed-circuit TV systems.

A \$60 million contract has been awarded to Metro Cammell, Ltd., for the construction of 140 cars; there is an option for 70 more. Each car will seat 48 passengers and carry a crush load of 375 for each car and 3000 for an eight-car train. The cars will operate in pairs; only one car will have a driving cab. The trains will operate automatically on a maximum headway of 2 min and a maximum speed of 80 km/h (50 mph).

Artist's impression of the portals to the 1.9-km (1.2-mile) long Aberdeen Tunnel.

