Paving The Way

EDITOR'S NOTE: *For many years the United States has been among the leaders in most areas of research, development, and implementation of new technologies. Recently, however, a number of countries have forged ahead of the United States in the development and implementation of various innovative technologies. For this country to remain internationally competitive during the evolution of a global economy, global innovations must be transferred to U.S. practice. This can best be done by learning from and sharing with our global partners. The most effective means of fostering technology transfer is through direct contact and visits with the innovators.*

The following article is an account of a study tour sponsored by the Federal Highway Administration and the National Asphalt Pavement Association. More than 20 transportation leaders from state and federal transportation departments, industry, and scientific organizations participated in a 14-day tour of six European countries in an attempt to learn more about innovative and effective European asphalt pavement technology.

On U.S. asphalt study tour of Europe: *from left,* Wayne Muri; Raymond Sauterey, France's Technical Advisor to the Director of Roads on International Affairs; and Francis Francois, AASHTO Executive Director.

WAYNE MURI

I am a proud American and an avid competitor. You know the type: the fan the camera pans at football games signaling "We're No. 1!". I am also a proud Missourian, born and raised in the Show Me State.

Then one day last September I stepped off a plane in Sweden with about 20 other U.S. transportation officials for a 14-day tour of Europe to study the latest European asphalt pavement technology and see if it could be applied in the United States. With some skepticism, I waited to be convinced that we could learn from these countries. Show me, I thought, just show me.

Sponsored by the Federal Highway Administration and the National Asphalt Pavement Association, the tour was to take us to major highways and motorways throughout Sweden, Denmark, France, Germany, Italy, and the United Kingdom. We would inspect pavements, laboratories, asphalt plants, and other ongoing projects.

Fourteen days and six countries later, my eyes were opened wide. No longer so sure about my country's first place status in the field, I had developed a respect for the European competition.

I am going to step into some dangerous water now, in case others are as stubborn as I was, because I will generalize about

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countries with very different legal, economic, and cultural features.

I was "shown" as early as my first ride from the airport to our Swedish hotel. The ride was smooth and the road free of potholes. No fast-food containers and soda cans littered the roadway; no rundown homes or junked cars spoiled the countryside. My first sight of the people showed them to be fit and satisfied. I realized I was going to have to take another look at my view of the United States as No. 1. For a confirmed competitor, this was a bitter pill to swallow.

In hindsight, I realize I should not have been surprised. When I am not chief engineer of the Missouri Highway and Transportation Department, I am a Christmas tree farmer. To have pine trees grow to be Christmas trees, you have to trim them. After trying every American-made knife I could find, I gave up and bought a knife made in Germany, even though I am a stubborn "Buy America" shopper. My German knife cost twice as much, but it is a good knife, of a quality that would be hard to beat. So I should have realized that in some areas the United States is falling behind, and the gap is widening.

You could say that the United States has become like a boiled frog. If you drop a frog into a pot of boiling water, it will try to jump out of the heat. But if you put a frog in a pot of water and slowly turn up the flame, the frog will not realize what is happening and eventually will die. The rest of the world is turning up the heat; the United States has not yet noticed that the temperature has reached the lethal point.

I am not the only one who has realized that the United States is starting to "boil." In August I attended a meeting of the governing board of the National Research Council in which U.S. Department of Commerce Under Secretary for Technology Robert M. White delivered a strong message stating that the United States is failing to compete in the world market. Why? Because this country fails to implement technology quickly. This country still believes that what is all right today will be all right tomorrow. Our competitors do not think this way. Through research and technology, they are overcoming the disadvantages of fewer natural resources and smaller labor forces.

U.S. Group Tours Europe To Study Latest Asphalt Pavement Technology

Analyzing the Smooth Ride

Along with my prejudices, I took with me on the European tour more than 30 years of experience in highway construction and maintenance. After my first smooth ride from the airport in Sweden, my prejudices took over. I decided that although the pavements were smoother, it was probably because Europe does not have the truck traffic equal to that in the United States.

Again, my prejudices were wrong. Traffic volumes in Europe are actually higher than they are in the United States. To add to my disbelief, I found that European trucks are about 20 percent heavier than U.S. trucks, and many use single instead of dual tires. This bowled me over. Every highway engineer knows that pavements—especially asphalt pavements—cannot handle those heavy loads.

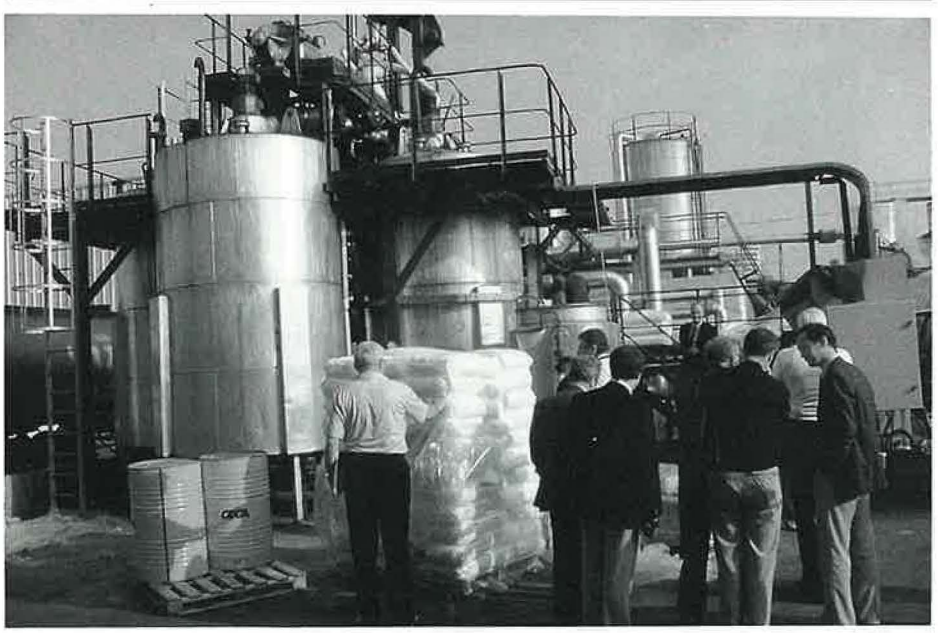
How could this be, I wondered. As we traveled from country to country, I realized that I could not single out one factor that made Europe's pavements superior to the ones I had built back in the United States. It was a combination of factors. First, Europeans are willing to invest in transportation. In fact, their investment is three times greater than that in the United States. Fuel costs about $3 to $5 per gallon; $2 to $4 of this cost is a tax, of which about 30 percent is for roads.

Second, Europeans implement technology rapidly. Because they are driven by whatever it takes to be competitive, they are continually searching. Europeans also emphasize quality and effectiveness. They strive to be customer-oriented, tailoring their transportation system to the users who pay the bills. They also support a strong team effort among public, private, and academic interests.

So what, one may wonder. It is certainly nice to have smooth pavements, but what's the big deal? The big deal is that in many parts of Europe the standard of living is better than ours. Europe's superior four-lane road system ensures its competitive edge by boosting productivity. The big deal is that European trucks can haul loads 20 percent heavier than those in the United States. Freight moves much less expensively than it does in this country because of these heavier loads and higher speeds. Faster speeds mean deadlines are met. Better roads mean less wear on vehicles. So not only do smooth pavements mean a better ride, they also represent profits and economic survival.

Savings in the Bank

European countries, with huge reserves in infrastructure, especially in transportation, have what I call "savings in the bank." Because Europeans paid for their system as they went along, they do not face huge deficits. Anyone who lives in the United States knows that this contradicts the U.S. situation, in which we have a huge infrastructure debt, especially in our transportation system, because we have not invested in our infrastructure. The debt becomes apparent when you see congestion, pavements failing, and bridges deteriorating. Our situation is not too different from a business that is failing. When a company's profits fall, the company stops investing in capital. This in turn puts the business on a collision course with bankruptcy.



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Liquid asphalt production facility in France: one stop on U.S. Asphalt Study Tour of Europe.

Reversing the Trend

It is not too late for the United States. The American competitive spirit can help turn things around. The United States has a great wealth of natural resources. It also has a more extensive highway system than does the European community, and one that is about four times safer. In addition, the United States can draw on a history of efficiency. For example, U.S. asphalt plants produce two to three times more than their European counterparts.

In my year as chairman of the Transportation Research Board I have seen the organization take a hard look at implementing foreign technology. TRB, with its aim to encourage the application of research, is an appropriate organization to be taking this action.

The United States, however, cannot just rapidly implement European techniques. As in running my tree farm, there are no shortcuts—much learning and preparation were necessary before my trees were ready for Christmas. The Europeans have spent many years perfecting their techniques. They have a society different from ours, a society that supports such notions as a higher transportation investment.

European Versus U.S. Transportation Systems

Once I had accepted the fact that pavements in the European community are better than their counterparts in this country, I tried to understand why. Although I realize that every country has its own methods, I make here some generalizations about techniques in the European community that I believe lead to superior pavements.

Remember, I am an engineer who is used to dealing with concrete and asphalt and girders and guardrail. While I am not a psychologist, I realize that there are some intangible traits that give Europe a leg up on the United States. For example, in Europe the government and the private sector have an effective relationship. Industry actively participates in research, testing, and new product development. And in Europe there is limited litigation.

Europeans are driven by quality and effectiveness, whereas Americans emphasize efficiency. Europeans focus on results, not on the process. For example, road contracts are for "what you want" not "how to do it." Instead of testing the materials that make up an asphalt mix design, Europeans test the pavement performance.

Because the European transportation system is customer oriented, it responds to the public in areas such as noise, environment, and congestion. In turn, taxpayers feel better about paying high gasoline prices. For example, Europeans try to reduce noise by designing noise-reducing pavements and tires, building sound barriers, and planting trees and shrubs. Porous asphalts are used in pavements to reduce noise, and in most of Europe truck exhaust is directed down under the truck to diminish the sound.

Europeans also appear to pay more attention to aesthetic details. They do little right-of-way mowing but use extensive landscaping. Ground not used for the roadway is planted with trees, bushes, or flowers. I even saw a butterfly sanctuary and a deer-crossing bridge on the tour.

With few exceptions, litter was not a problem in Europe; the surroundings were clean. I saw a woman in Germany, for example, vacuum cleaning her driveway. There are few billboards, and many bicycle paths run alongside the roads, even in rural areas.

Applying European Techniques

In the application of European methods to the engineering arena in this country, I believe that the United States would do well to pursue six technical areas through the FHWA, the states, the contractors, and the public:

- Heavy-duty pavements,
- Modified asphalts,
- Rut-testing devices,
- Porous asphalts,
- Contractors' guarantees, and
- Lane rental.

Heavy-Duty Pavements

Europeans build heavy-duty pavements that are made with a mix called stone mastic asphalt (SMA). SMA pavements were invented in Germany in the mid-1960s under the name of Splittmastix. Like pavements built by the Romans long ago, these pavements are built using a stone-on-stone concept. The aggregate does not swim around in asphalt and sand.

SMA contains discontinuous or gap-graded crushed stone aggregate with approximately 80 percent plus No. 10 material. SMA is not necessarily the large-stone mixture being investigated by many states. The maximum size aggregate used in SMA is about 5/8 inch; 1/2-inch aggregate is common. The mix has a relatively high binder content of 6.5 to 7.5 percent. To achieve stability of the binder and to prevent it from draining off the aggregate, the bitumen is modified with mineral or cellulose fibers or rubber powder.

Using SMA helps stop pavement rutting and increases pavement durability. Thus Europe's heavy-duty pavements are able to handle the high volume of truck traffic and heavier truck weights. Within the United States, the FHWA could promote SMA research by cooperating with the states for field trials. The National Center for Asphalt Technology is another organization that could undertake this research, analyzing the technical data and including European field information.

Modified Asphalts

Modified asphalts are used extensively throughout Europe. The asphalt cement is modified by adding ground rubber, latex, fiber, resins, and polymers, or the asphalt is chemically altered to improve some specific

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European milling and resurfacing project. Although most European and U.S. pavements are asphalt-surfaced, Europeans resurface what would be considered relatively good pavements in the United States.

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Trucks on European highways are about 20 percent heavier than their U.S. counterparts and often are equipped with single instead of dual wheels.

property. This makes asphalt cement perform better as a material.

In France, for example, we saw mixes containing polymers, resins, and a substance called "dope." When polymers are added to asphalt, the asphalt almost appears to take on the characteristics of a polymer, which is tougher. Resins are added to ensure that asphalt retains its stickiness. As for the dope, it appears to be a secret; we were not told what type of ingredient this is.

In the United States, the American Association of State Highway and Transportation Officials (AASHTO), the Associated General Contractors, and the American Road and Transportation Builders Association are drafting generic specifications for 1991 that include European information on polymer-modified asphalts. In addition, the Strategic Highway Research Program is researching modified asphalts; some states such as Missouri have test sections with modified asphalts. A paper published in TRB's *Transportation Research Record 1171* entitled "Field Trials of Plastic- and Latex- Modified Asphalt Concrete" (*1*) covers test strips of eight products in five states.

Rut-Testing Devices

When the Missouri Highway and Transportation Department handles an asphalt-mixture project, field inspectors and central laboratory personnel check the asphalt cement, the aggregate, and the mix itself before it is approved for the road. This practice is common in most states, but not in Europe, where performance is measured instead of materials. It does makes sense to test material by the desired performance, as well as for what it is.

To this end, Europeans perform extensive rut testing of asphalt pavements. For example, we visited the Laboratoire Central des Ponts et Chaussées in France where sophisticated wheel-tracking equipment is used to test for rutting and other pavement fatigue.

Some areas in the United States are moving in this direction. Georgia's Department of Transportation is currently evaluating rut-testing devices, and the FHWA has provided demonstration funds to four states with plans to provide funds to four more for this purpose. In its Indiana laboratory, Elf Asphalt has installed a rut-testing device that is similar to the one in France, but less expensive. SHRP, too, is evaluating performance-related asphalt test equipment. In the future, FHWA laboratories could be equipped with rut-testing equipment, and FHWA could encourage more state evaluations of rut testing.

Porous Asphalt

With the European community's sensitivity to the public's needs, it is not surprising to find many European pavements made with porous asphalts because this material contributes to noise reduction. However, porous asphalts also produce better friction and less hydroplaning, characteristics that would be appreciated by the U.S. traveling public.

The porous asphalt used in France and other European countries is similar to the open-graded friction course used in the United States. European porous asphalts are gap-graded mixes with 20 to 25 percent air voids and a maximum $^1/_2$-inch aggregate. Generally modified binders such as polymers, rubber, or fibers are used to increase durability.

I believe it could benefit the United States to consider using porous asphalts. To move in this direction, I recommend that a study be conducted to relate Europe's use of this material to our use of open-graded friction courses. The states could then undertake experimental porous asphalt pavement projects.

Contractors' Guarantees

Whether buying a car or a toaster, consumers want warranties. In turn, these warranties help boost consumer confidence in the quality of a product. Europeans benefit from the same approach in their transportation system. Contractors guarantee their work through full-replacement, three- to five-year warranties.

In a variation, the United Kingdom does not require warranties; instead, the contractor maintains the job for one year at which time it is reviewed before acceptance. During the maintenance period, 1.5 percent of the contract cost is retained. France also varies the use of guarantees. Other than for major highways, one-year guarantees are used.

European contractors often are allowed to use their own designs. Even though they are given greater freedom in selecting their own materials and designs than are U.S. contractors, they are also held accountable for these choices. Europe's extensive road pavement laboratories, which have no equal in the United States, are of great value to contractors who are required to guarantee their work. The laboratory work apparently gives contractors a level of comfort with their designs.

Requiring contractors to guarantee work encourages attention to quality and innovation, and creates good will with the public because the users receive and appreciate a guaranteed product.

Currently, the FHWA is recommending setting up federal-aid projects that require contractors to guarantee wearing surfaces for five years. The Transportation Research Board is also involved in this area: contractor guarantees are featured as a TRB research topic for 1992. In the future, AASHTO could possibly develop guarantee guidelines and procedures.

Lane Rental

Motorists stalled in a traffic backup caused by construction would agree that it is a good idea to make contractors who close lanes to motorists rent the lanes from the motorists.

In the United Kingdom, for example, three types of lane rental are used to determine the low bid. In the first two, the contractor pays a daily rate for the construction site or for the lanes closed. With the third type, the low bid is determined by adding the cost of performing the work to the total of the daily rate times the number of days it takes to complete the job.

Using lane rental gives contractors an incentive to complete jobs quickly; lane rental results in 30 to 50 percent less closure time with only a 10 percent cost increase. It reduces motorist inconvenience while including this factor as part of the construction contract.

The use of lane rental in Europe is similar to the use of incentive-disincentive clauses in contracts in some states. A TRB task force is looking at innovative contracting practices that could incorporate the concept of lane rental. The FHWA could pursue the implementation of lane rental through experimental projects.

Other Technical Points

Other technical advantages of Europe's transportation system should be noted. For example, most European countries build pavements to last 40 years, not 20 years as

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International Activities at TRB

The Transportation Research Board has been and is currently involved in various activities to increase its international outreach, thereby helping to disseminate new concepts and procedures in transportation research and technology development and to learn from others. Among the noteworthy efforts that have made their mark on the international community is *National Cooperative Highway Research Program Report 230: Recommended Procedures for the Safety Performance Evaluation of Highway Appurtenances*, published by TRB in 1981. This document, wholly or in part, has been adopted by countries throughout the world as a basis for the testing of highway safety features.

Currently, under NCHRP Project 22-7, procedures for crash testing are being updated through a contract with the Texas Transportation Institute. A distinguished international group of highway safety experts will review these procedures before the final report is released. It is expected that participation by the international community will lead to improved understanding of the effectiveness of roadside hardware, increase opportunities for technology transfer, and enhance the capability of public agencies to advance highway safety.

TRB has also provided a forum for fostering international cooperation. Noteworthy among these activities have been those held at the TRB Annual Meeting, which include the International Roundtable, sponsored by the Committee on International Activities, and the Workshop on International Harmonization of Testing and Evaluation Procedures for Roadside Safety Hardware. The proceedings of this workshop, sponsored by the Federal Highway Administration in conjunction with the TRB Committee on Roadside Safety Features, will be available this summer.

In addition, a joint TRB/PIARC (Permanent International Association of Road Congresses) Symposium on Urban Road Issues was held at TRB's 1991 Annual meeting. Cooperation between the two organizations is reflected in the appointment of TRB's Executive Director to serve on PIARC's Permanent International Commission, along with other committee appointments by both organizations.

Future planned TRB international efforts include an International Conference on Road Transport Informatics and Intelligent Vehicle-Highway Systems to take place in Italy; an International Symposium on Highway Capacity to be held in Germany; and conferences in France and England on the transportation needs of the elderly and disabled.