roads bridges transit
technology news
Local Transportation Information Center
Iowa State University Engineering Extension Service
Nebraska Edition
May 1984

The facts on highway safety improvement

More than 20,000 people are alive today and more than 175,000 others have been spared serious injury as the result of highway safety improvements. Although fewer people are being killed or injured on highways in the U.S. now than in previous years, the numbers are still intolerable. The technology to save lives and reduce injuries in the future is available now. Leadership in promoting, developing, and implementing this technology must be provided, however, at federal, state, and local levels of government.

The following data was provided to the FHWA for inclusion in the Office of Highway Safety's 1983 Annual Report on Highway Safety Improvement Programs.

Accident costs
According to the National Safety Council, accidents cost the U.S. more than $40.6 billion in 1981. This cost includes $12.5 billion for lost wages, $3.8 billion for medical expenses, $9.6 billion for insurance administration costs, and $14.7 billion for motor vehicle property damage. It does not include indirect costs such as courts, litigation, public agency expenses, or the value of cargo losses in commercial vehicles.

A significantly higher estimate of what traffic accidents cost our society is the $57.2 billion figure quoted in a recent NHTSA report. This amount probably incorporates some of the indirect costs listed above and so is considerably higher than the National Safety Council's estimate.

Even the conservative $40.6 billion exceeds the amount spent by all federal, state, and local agencies for construction, design, and maintenance of the entire U.S. roadway system.

Small vehicle accidents
Passenger cars and single-unit trucks represented most of the vehicles on the road in 1981 (75.1 and 20.2 percent of all registered vehicles); traveled the most miles (71.9 and 22.8 percent of the vehicle miles traveled); and were involved in the most fatal accidents (64.1 and 19.7 percent of the total fatal accidents).

Motorcycles comprised only 3.5 percent of the registered vehicles and traveled only 1.2 percent of the total vehicle miles, but were involved in a disproportionate 7.7 percent of the fatal accidents.

Small cars (small compact, subcompact, and compact) accounted for 54.5 percent of the passenger car fatalities in 1981 according to NHTSA's FARS data. This high percentage possibly may be due to an increasing number of small cars in the vehicle fleet, to noncompatible highway designs, or to other reasons. Whatever the reasons, it is

Distribution of fatalities by first harmful event or most harmful event for specific fixed objects—1981

Fixed object	Fatalities	Percent of total fatalities (49,268)
Tree or Shrubbery	4,000	8.1
Utility Pole	2,145	4.4
Guardrail	1,635	3.3
Culvert or Ditch	1,618	3.3
Embankment	1,525	3.1
Curb or Wall	1,192	2.4
Bridge or Overpass	1,106	2.2
Sign or Light Support	801	1.6
Fence	552	1.1
Misc. Pole or Support	374	0.8
Divider	251	0.5
Building	244	0.5
Impact Attenuator	19	0.0
Other Fixed Object	959	1.9

Source: Fatal Accident Reporting System (FARS), NHTSA, 1982.

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becoming clearer that the definitions of "typical passenger vehicles" presently being used for highway design should be carefully considered. This problem is presently being studied to determine its magnitude.

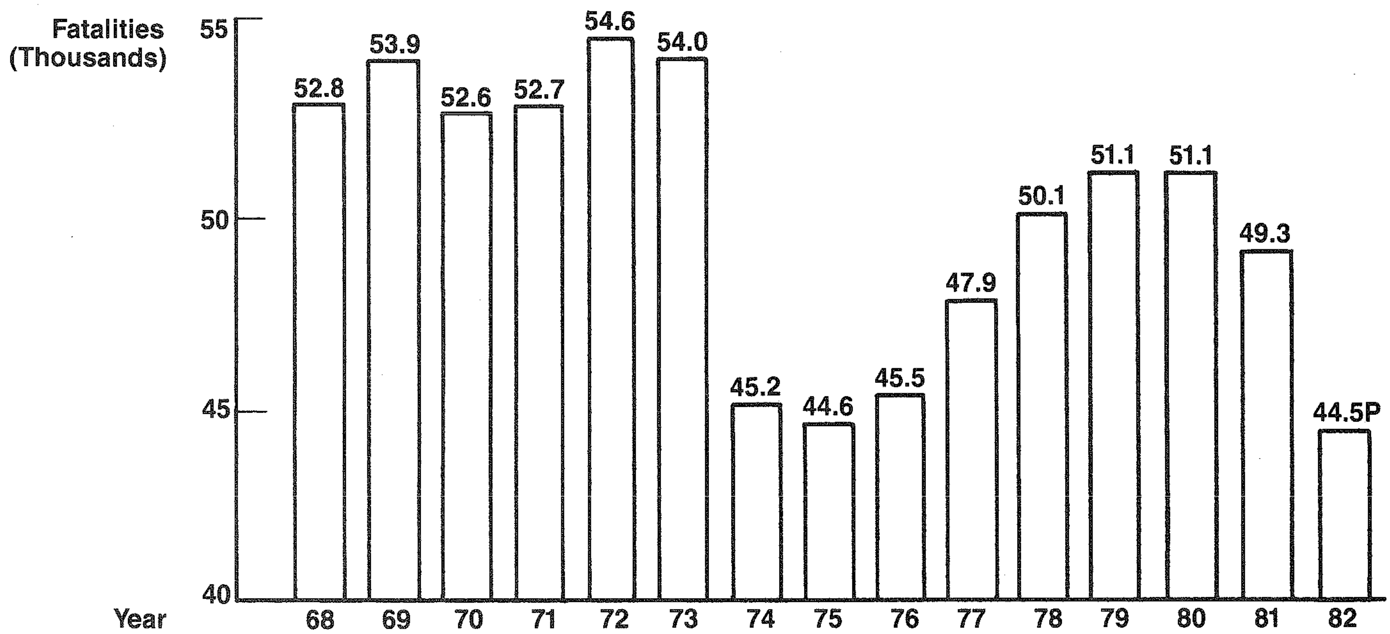
Work zone accidents

In 1981, there were 461 fatal accidents in construction and maintenance work zones. This represented about 1 percent of all fatal accidents in that year and was slightly less than in 1980.

A national effort was set forth to ensure that adequate consideration was given to motorists, pedestrians, and construction workers on all federal-aid construction projects. As a result of this effort, many states have made work zone safety a priority item. Procedures, including traffic control plans, are developed for controlling traffic in work zone areas, analyses are made of work zone accidents, and safety deficiencies are corrected.

A safer condition for the traveling public can be created during construction by the use of longitudinal sloped joints. Arizona has revised its specifications on asphaltic concrete longitudinal joints to permit joints formed by overlapping. This eliminates vertical drop-offs. It was concluded that the wedge joint, from a practical construction application, was superior to the vertical butt joint.

Fatalities 1968-1982



Highway safety improvements with benefit/cost ratios greater than 1.0

Rank	Improvement type	B/C ratio
1	Traffic signs	14.1
2	Upgraded bridge/guardrail transition	3.6
3	Upgraded guardrail	3.2
4	Breakaway sign supports	2.8
5	Roadway lighting	2.6
6	New median barrier	2.4
7	Impact attenuator	1.9
8	New traffic signals installed for safety purposes	1.8
9	Upgraded traffic signals	1.5
10	Sight distance improvements	1.5
11	Channelization and turning lanes	1.3
12	Pavement grooving	1.2
13	New median strip	1.0
14	Skid resistant overlay	1.0
15	Obstacle removal	1.0

Source: Highway Safety Evaluation System, FHWA, 1982.
American Transportation Builder, Summer 1983.

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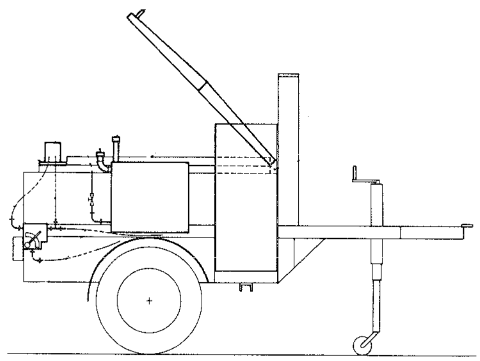
civil engineering extension

tips from the field

The Iowa Department of Transportation has developed a recirculating crack-filling wand that improves the efficiency of maintenance crews when sealing pavement cracks. The recirculating wand keeps a constant supply of heated sealing material at its tip. This prevents freezing-up caused by the material cooling and solidifying at the tip. For more information about the wand and names of possible manufacturers, contact Arlo Merritt at the Iowa DOT, 800 Lincoln Way, Ames, Iowa 50010; phone 515/239-1227.

If you have a piece of equipment, modification, or an innovative technique that would be beneficial to others involved with local transportation systems, please share it with us. Contact Walter E. Witt, special projects engineer, Nebraska Department of Roads, Box 94759, Lincoln, Neb. 68509-4759.



Tar kettle with hydraulic driven pump and recirculating wand.

Local transportation publications available from TRB

Although the Transportation Board (TRB) has products useful to county, town, and small-city transportation offices, it's often difficult to keep up with TRB publications activities.

A recent promotion of TRB publications and research reports considered to be of interest to local transportation officials elicited an excellent response. More than 506 publications were ordered by 112 county highway officials.

If you are interested in receiving a list of appropriate publications on bridges, recycling, design, and maintenance research, contact Edward J. Ward or Crawford F. Jencks, TRB, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

Buying a van? Figure life cycle cost

If your town is considering the purchase of a van, you will want to determine the vehicle's life cycle cost (LCC). Frank Sherkow of Iowa DOT's public transit division provided us with their LCC method, which satisfies UMTA's Section 16 (b) (2) program. This method has been used for several years to purchase vans for universities and for the DOT.

The method involves the following contract award formula:

CA = B + G − R

CA = Contract award
B = Bid price
G = Projected fuel expenditure $G = \frac{12{,}500}{\text{Combined EPA MPG estimate}} \times$ Projected fuel price/gallons for year

R = Resale value (where applicable) after 5 years/75,000 miles

Where the DOT currently requires use for submission of the following data in preparing bids:

Expected life: 75,000 miles = Projected annual fuel consumption (PAFC)

Annual fuel expenditure (AFE) = PAFC × projected fuel cost per gallon

G = AFE'83 + AFE'84 + AFE'85 + AFE'86 + AFE'87

Project gas diesel

Project	gas	diesel
1983:	1.29	1.35
1984:	1.39	1.49
1985:	1.48	1.57
1986:	1.56	1.65
1987:	1.63	1.73

Determination of MPG
EPA estimated miles per gallon will be used.

Resale value
Average trade-in value from NADA Used Car Guide. The value used will be of a comparable model from 2 to 5 years old based on model changes.

EPA rated fuel consumption
Each bidder must also submit two sets of annotated gas mileage guides or complete tests or EPA estimated miles per gallon showing each make/model, engine, transmission combination bid.

A chance to share and work together

Public works officials in cities large or small are under constant pressure to do more with less. Budgets are tight and will remain at restricted levels for years to come. The days of federal handouts are over. One method for coping with the situation is to work together to solve problems and to share ideas and information. Public works officials are innovators and can help each other through cooperation.

A public works official is often caught between the staff, the citizens, and the city council. Each group looks to the official to solve its problems. The position can be a lonely one. However, it's possible to turn to those in similar positions in neighboring cities or in locations across the state or even the nation. Public works officials are usually more than happy to assist with problems and to share ideas.

The Local Transportation Information Center administered by ISU is a program to promote idea sharing, with activities such as technical information dissemination and short courses. The program can be successful only if everyone becomes involved. How can you participate? Share an idea, volunteer to write a newsletter article, be an organizer for a regional conference, or just read the newsletters and apply the ideas to your own job.

Professional organizations such as the American Public Works Association (APWA) hope to participate in regional one-day short courses that cater to the small- and medium-sized cities. These regional conferences can be a great way to share ideas and information and to formulate joint problem-solving methods.

Working together can solve many problems, be rewarding, and take some of the pressure off those tight budgets. Let's become active today!

Lon Hawbaker, Department of Public Services, West Des Moines.

Roofing compound works as crack patch

When asphalt roofing shingles blew off a lumber truck, stuck to the pavement, and could not be pulled up, Texas road officials took notice.

In the summer of 1977, they began two years of crack maintenance tests using standard 90# asphalt roll roofing. Their findings—it works.

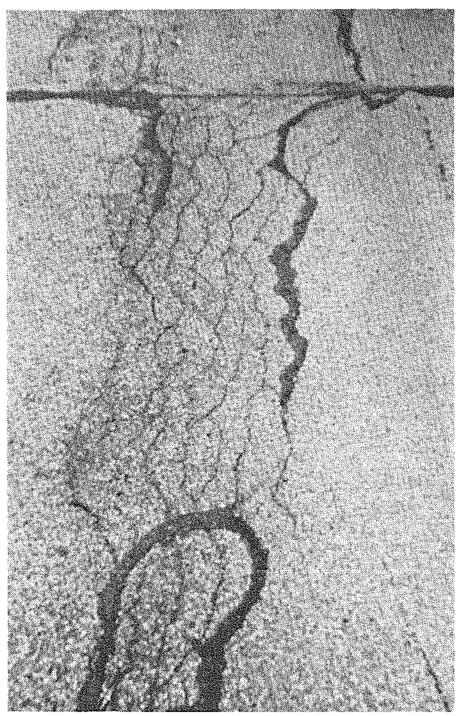
According to a 1979 FHWA report, asphalt roll roofing patches do not bleed through hot mix overlays and potholes do not develop as quickly as with other methods. No special skills are needed to place the patches, the report says, and, more cracks can be patched by this method than can be poured (1,050 yd^2/day versus 350 yd^2/day of premix patches). Furthermore, the material costs about 37¢ per square foot less than premix patches.

The primary use of the material has been for temporary maintenance on asphalt pavements where serious alligator cracking has occurred in the wheel paths. If not maintained, these cracks develop chuckholes and potholes. For these applications, Texas officials estimate the life of roll roofing patches to be one year, although some may serve two to three years when placed over small cracks.

The procedure found **most** effective in Texas should be done in the summer. The first step is tacking the area to be patched with emulsion (EA-11M) at the rate of one-tenth gallon per square yard. After the water is out, the material is rolled out by hand, then walked down. A truck is used to "bull-wheel" it in place. After the patches are placed, the material should "cure" for one to two hours before opening to traffic. Following a short period of use, the material cannot be pulled up.

With wide cracks, the roofing compound is spread in the crack before the roll roofing is applied, thus providing a seal. For patches wider than the roll width of 36 inches, only 2 inches of overlap are needed.

It appears that Texas has developed a temporary maintenance tool that has merit.



Asphalt roll roofing works well for temporary patches on alligator cracking.

Asphalt pavement failure can be avoided

Although our extensive system of streets and highways must be maintained to carry increasingly heavy loads, the user is becoming more concerned about the amount of taxes paid to fund the system. The answer is to upgrade maintenance programs and switch from stop gap measures to a long-term maintenance plan.

From crack to pothole

Most failures in asphalt surfaces begin with a minor crack or series of cracks. These cracks can progress to secondary cracking and depressions or bumps that increase impact loading; and then progress further to potholes and total failure. Proper crack maintenance can minimize or prevent many of these failures.

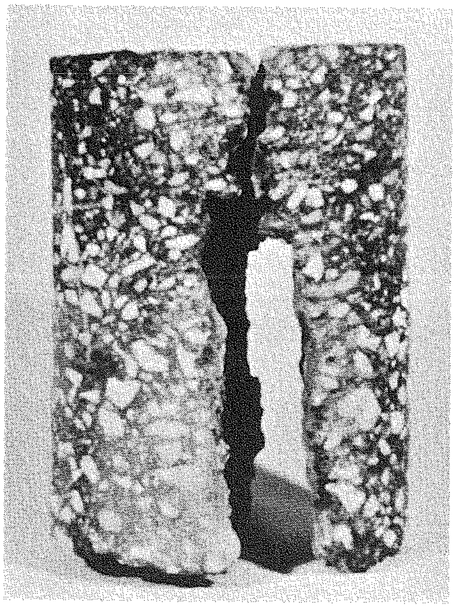
Cracks in asphalt surfaces are a result of fatigue, thermal expansion and contraction, and weathering.

Weathering, fatigue cracks

The first signs of weathering or fatigue cracks may be a mere shadow of moisture when the pavement surface dries following a rain. Unless these cracks are treated immediately, they will progress by raveling (due to frost and repeated wheel loads) until spalls develop. These will deepen and lead to the ponding of water that will penetrate the pavement, soak up the base, and eventually cause pavement failure.

Thermal cracks

Thermal cracks develop as temperatures cause expansion and contraction of the pavement. These cracks generally penetrate full thickness of the pavement. Thermal cracks less than one-quarter inch wide may not be visible at legal highway speeds but they will allow large quantities of moisture to enter the surface and penetrate the base. Moisture entering the small cracks will freeze and expand, fracturing the asphalt pavement structure. Repeated axle loads over this saturated and fractured area will cause the free moisture to flush the asphalt cement and fines from the mix and carry it away leaving voids. These voids will cause secondary cracking on the surface and dips over the cracks.



Core sample of an asphaltic joint. Although crack at surface appears small, flushing action has caused erosion of the asphaltic cement below the surface. Unless crack is properly sealed, the void will increase in size and eventually become a pothole.

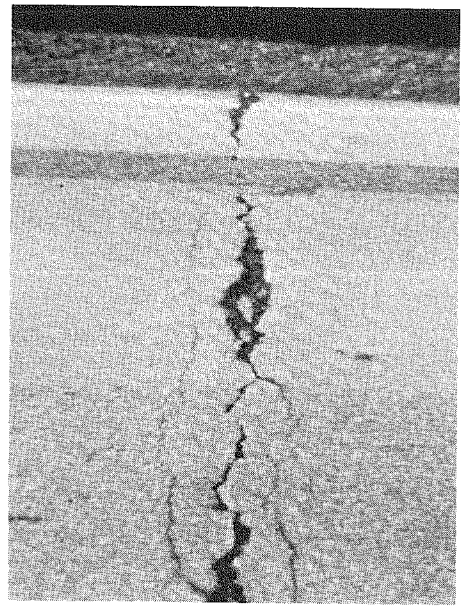
Stop moisture penetration

The excess moisture that flows through the pavement, saturating the base and subgrade causes frost heaves in the winter and instability following rains. The moisture works like a cancer, destroying the structure needed to support the loads. This moisture must be kept out of pavements.

Early signs of weathering or fatigue cracks are a sign that surface maintenance is needed. A minimum treatment would be skin patching the smaller areas or fog sealing the entire pavement surface. In some cases where this type of stress is progressing rapidly, a seal coat may be appropriate. The purpose is to fill these small shallow cracks and seal them off before moisture can penetrate the surface and cause further damage.

Clean, fill, and seal

Thermal cracking also must be sealed to prevent moisture from entering the crack. These cracks should be sealed when they first appear. Filling the crack with a liquid bituminous material such as an emulsion can be best accomplished after the crack has been thoroughly cleaned with high pressure water and/or high pressure air. This will allow the liquid material to flow deep into the crack if the crack is filled during cool temperatures. This type of crack sealing with liquid emulsion may need to be repeated two or three times on an annual basis to adequately seal the crack the full depth of the pavement. After the crack is well filled, the surface can then be more permanently treated with a high joint sealant with cold weather elasticity to stretch and compress as the pavement structure moves.



This unproperly sealed transverse joint has allowed moisture to penetrate. Deterioration of surrounding pavement is due to freeze-thaw cycles and the pumping action caused by wheel loadings. Note the well sealed longitudinal joint which does not show the same deterioration.

The longevity of asphalt pavements is directly related to the quality of construction and the quality of maintenance. Filling and sealing cracks of all sizes must be a regular part of a street and highway maintenance program if we are to expect maximum longevity. Repeated fog seals, seal coats, and crack cleaning are the important parts of this program.

Robert Samuelson, Iowa Department of Transportation

Successful street maintenance workshop to be repeated

In October, the Local Transportation Information Center sponsored two workshops on street maintenance for small communities. On October 12, 40 people attended the North Platte workshop and on October 14, 88 attended the workshop held in Lincoln.

Participants learned about techniques, specifications, and construction procedures involved in the maintenance of Portland cement concrete and asphaltic concrete pavements. They also received a detailed set of course notes on street maintenance practices.

The workshop, which was given high marks in participants' evaluations, will be repeated in Norfolk on May 16 and in Lincoln on May 17. For more information on the Street Maintenance for Local Agencies workshop contact Walter Witt at the Nebraska Department of Roads, 402/471-4567.

Increase equipment life with preventive maintenance

The Federal Highway Administration and the California Department of Transportation held an Equipment Management Symposium in Sacramento, Calif. in May 1983. The following observations were made by the State of Georgia's representative, Ed Hudgins, and are taken from the report, **Equipment Management Symposium Proceedings Synopsis—Final Report, September 1983.**

Georgia believes in good preventive maintenance; that is, minor repairs should be made before they become major repairs. Because of this, they have implemented a Preventive Maintenance Program that has increased their equipment serviceability rate by 80 percent. This program is aimed at training operators and user personnel. This training consists of:

1. A basic Preventive Maintenance Manual,
2. On-the-job training in a classroom environment,
3. Inspection at worksites, and
4. Inspection for safety hazards and to see that necessary tools are available to do the job.

They set up a good PM program consisting of daily inspections, driver care of vehicle, how to determine defects during operation, how to prevent equipment abuse, and insuring qualified drivers and operators.

This has accomplished: less downtime, lower operational costs, better performing vehicles, increased life of vehicle, and employee satisfaction of a job well done.

They have looked into other ways of saving money:

1. Do it right the first time—don't send it back;
2. Mechanic cost—time and money lost when he stands around waiting for parts or long coffee breaks, etc.;
3. Parts manager involved in making parts more available;
4. Training operators;
5. Taking advantage of manufacturer's warranty;
6. Rebuilding equipment;
7. Use of equipment management concepts; and
8. Cannibalization of parts—much more cost-effective than selling at surplus sales.

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