roads bridges transit
technology news
Local Transportation Information Center
Iowa State University Engineering Extension Service
March 1986

Guardrails for secondary roads

by Larry R. Jesse, P.E., Iowa DOT

Prior to the 1960s, the general concept was "those people who run off the roadway deserve what they get." Since then, the concept has gradually changed to, "many innocent people are killed by a hostile environment along side the highways." As a part of the increased awareness of roadside safety, traffic barrier systems have been developed and improved over the past 15 years to be used to redirect and reduce the impact to vehicles.

A guardrail is a longitudinal roadside barrier that shields a roadside obstacle located on the right of way within an established minimum width of 10 feet from the edge of the surfacing or pavement for all local roads and low-speed farm-to-market routes, to much greater widths on higher speed farm-to-market routes. These distances can be determined from the 1977 AASHTO publication, *Guide for Selecting, Locating, and Designing Traffic Barriers*. This publication, commonly called *The AASHTO Barrier Guide,* is now being rewritten with completion anticipated in 1987.

A guardrail itself is a potential hazard since it usually is a larger target than the object it is shielding and it is located close to traffic. It should be used to shield an object or condition that is more hazardous than the guardrail itself. The initial review of a possible hazard should consider whether it can be removed, relocated outside the clear zone, or reduced so it has less potential hazard than the guardrail. If these alternatives are not practical, a decision must be made whether to shield the possible hazard with a guardrail. Sometimes the cost of shielding a possible hazard outweighs the potential benefits.

Roadside barriers are generally classified according to their stiffness. Three categories are used: flexible barriers (cable rail), semirigid barriers (w-beam barrier), and rigid barriers (concrete barrier). The term "guardrail" usually implies the w-beam barrier but may refer to cable rail. The majority of guardrails used on county roads are to shield non-traversable hazards such as large culverts, and fixed objects, such as the concrete end posts on bridges.

In conjunction with the Federal Highway Administration (FHWA) it has been determined that on federal aid projects on secondary roads, guardrails should be installed at:

1. All four bridge ends on newly constructed bridges on the farm-to-market system unless the bridge is located in an established speed zone of 35 mph or less,

2. The approach ends (right side) on new bridges constructed on the local road system unless within a 35 mph or less speed zone,

3. All four bridge ends on existing bridges within a 3R (reconstruction, restoration, resurfacing) project on a FAS (federal aid secondary) route,

4. Culverts that are larger than 8' x 5' when the headwalls are within the clear zone.

Other obstructions located within the right of way and the clear zone should be reviewed for possible installation of a guardrail.

There are three major components (see figure) in a guardrail system to

The preparation of this newsletter was financed through the Technology Transfer (T2) Program. The T2 Program is a nationwide effort financed jointly by the Federal Highway Administration and individual state departments of transportation. Its purpose is to translate into understandable terms the latest state-of-the art technologies in the areas of roads, bridges, and public transportation, to local and county highway and transportation personnel.

The T2 Center at Iowa State University is sponsored by the Iowa Department of Transportation and provides information and counsel to the municipalities and counties in Iowa. This newsletter is designed to keep you informed about new publications, techniques, and training opportunities that may be helpful to you and your community. Individuals wishing to receive future copies of this newsletter at no cost may send their requests to: John Moody, Local Transportation Information Center, Engineering Extension, Iowa State University, Ames, Iowa 50011.

The opinions, findings, or recommendations expressed here are those of the Local Transportation Information Center and do not necessarily reflect the views of the Federal Highway Administration or the Iowa Department of Transportation.

protect a vehicle from a bridge end. They are:

1. End section—Usually a breakway cable terminal (BCT) which is intended to slow a vehicle down and not spear, vault, or roll the vehicle;

2. Standard section—This main section is designed to redirect and/or contain the vehicle;

3. Transition section—Is used to change the guardrail stiffness to provide continuity between different barriers such as a semi-rigid (w-beam guardrail) and a rigid barrier (concrete bridge rail).

These components are interrelated and dependent upon each other.

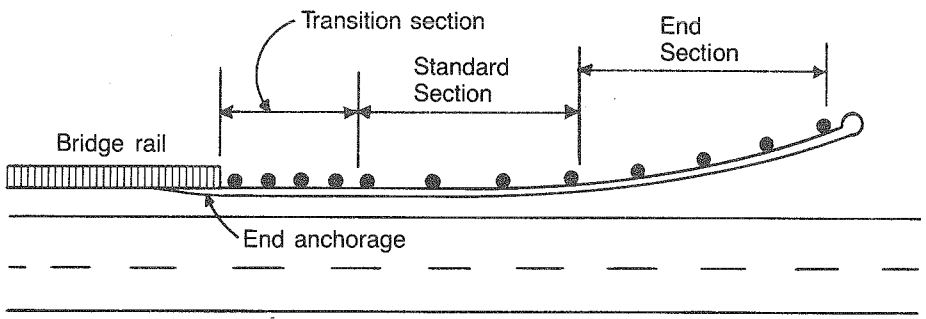
Proper design and installation of guardrails are the keys to their acceptable performance. Any substantial changes can have pronounced effects on impact behavior. The guardrail should be installed according to the appropriate standard road plans contained in section RE of the *Road Design Manual*. *The Construction Manual* within section 12.40 provides a checklist of the critical elements that should be inspected during the installation.

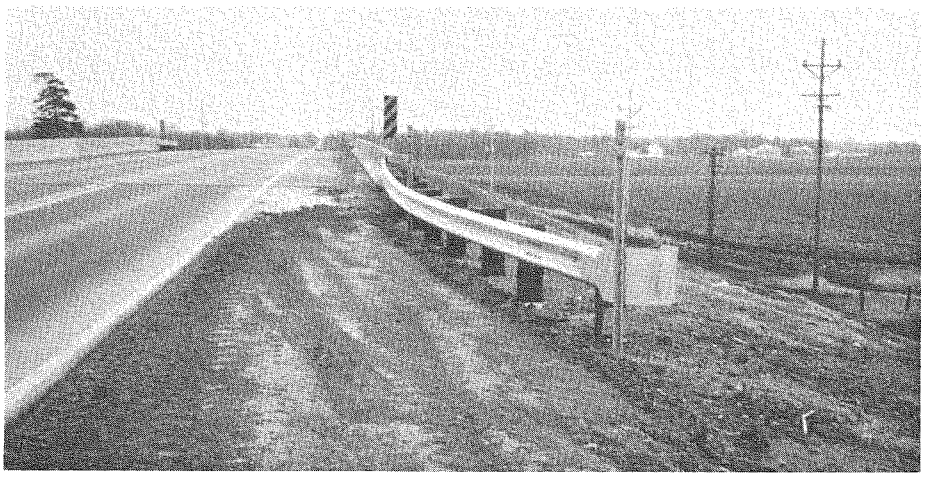
The placement of the guardrail at a bridge is according to the standards, but for fixed object hazards that are located beyond the shoulder's edge, the amount a guardrail will deflect upon impact is a critical factor in its placement. The w-beam guardrail normally used in Iowa has a deflection of 2.8 ft. with the posts spaced at 6 ft. 3 in, and the cable rail has a deflection of 11.0 ft. at 16 ft. post spacings. Therefore, the fixed object hazard should be located outside these distances. W-beam guardrail with a transition section can be attached to a rigid object, such as a bridge pier, if space is limited.

Counties may substitute crash cushions or impact attenuators for guardrails in certain situations.

Safety is one consideration to be taken into account in the design process of a highway or bridge improvement, and various traffic barrier systems are available to enhance roadside safety. These systems will probably continue to change rapidly as new designs are developed and crash tests are conducted. The revision to the 1977 *AASHTO Barrier Guide,* expected in 1987, may present additional improvements in the field of roadside safety.

Any questions concerning guardrails may be adressed to the Office of Local Systems or the District Offices of the Iowa DOT.





Guardrails should be used to shield an object or condition more hazardous than the guardrail.

Technology News is published by the Local Transportation Information Center
Engineering Extension Service
Haber Road
Iowa State University
Ames, Iowa 50011
1-800-262-8498 (in Iowa)
Program manager—Stan Ring
Coordinator—John Moody
Editor—Mary Holz Clause
Editorial assistant—Marlys Nieman

Transportation Info-Line
Call toll-free
1-800-262-8498
(in Iowa)
In Ames call
294-8815

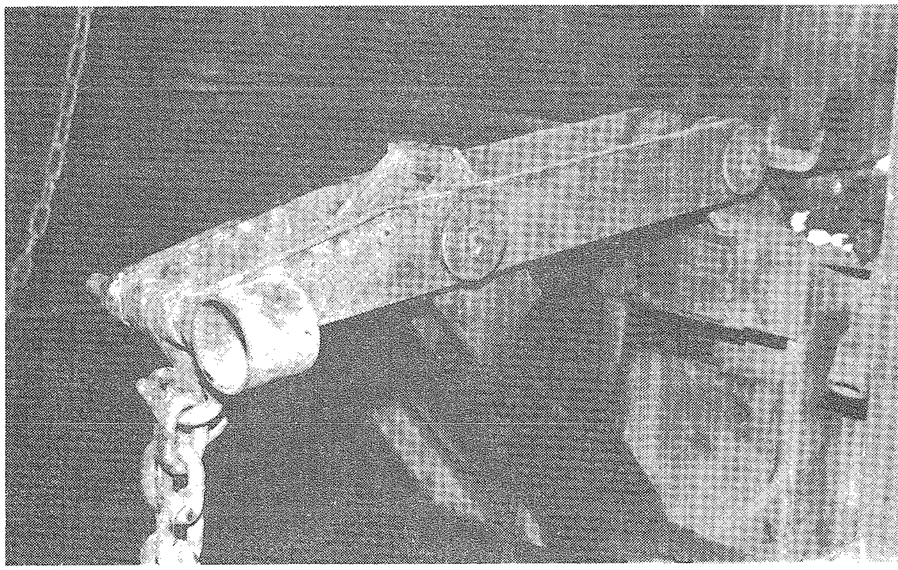
U.S. Department of Transportation
Federal Highway Administration

DEPARTMENT OF TRANSPORTATION
IOWA

Wing stop

The wing stop is a clevis-shaped device that straddles the hydraulic ram of a snow plow and acts as a wedge to prevent the wing blade from lowering completely to the ground. By keeping the shaft of the cylinder extended, the wing stop creates a 1 in. clearance between the blade and road surfaces, and helps alleviate the problem of rock being shoved from the road and shoulder during a plowing operation.

The wing stop is make of 3 in. by ¼ in. flat steel, built into a U-shaped square. It mounts on the ram of the hydraulic cylinder, and in the downward position (resting on the ram) acts as a spacer to hold the blade off the ground. By rotating the stop 180 degrees into an upward position (away from the ram), the blade will be dropped to ride flush with the road surface. A major benefit of the wing stop is that the blade may be positioned up or down, depending on the circumstances. It was developed by personnel of the Ames maintenance shop of the Iowa D.O.T.



The wing stop has been rotated clockwise 180 degrees to the downward position and will cause the blade to be lifted 1 in. off the road surface.

For more information contact John Moody, Local Transportation Information Center, Haber Road, Iowa State University, Ames, Iowa 50011, phone 1-800-262-8498.

"Expert" explanations from the past aren't concrete

In the early years of Portland cement concrete paving construction in Iowa, little was known about this new product. *The Road-Maker,* a Des Moines based magazine, had a regular feature, "The Highway Engineer's Problems." In the September 1916 issue, a reader posed the question, "What do you consider the main points to be given special attention in a concrete road inspection?" The expert answered, "By all means, the inspector should demand proper consistency in mixing. In the writer's opinion, this should be such that if a man walks in the concrete he must use an effort to pull his foot out, and when he pulls his foot out, the hole should not fill up with concrete." Simpler explanations like this one from the past are a far cry from the extensive detailed specifications of today.

The Highway Engineer's Problems

Every-Day Questions and Unusual Situations which are up to the Engineer for Decision

By H. J. Kuelling, C. E., Highway Superintendent of Milwaukee County

Showing Proper Consistency in Mixture of Concrete

The Road Maker, September 1916.

Videotapes available for free loan

The May 1985 and November 1985 issues of *Technology News* listed a total of 10 videotapes produced by the Portland Cement Association available for loan. The following additional tapes can now be obtained by calling or writing your Technology Transfer office:

1-800-262-8498 (in Iowa only)
Engineering Extension Service
Haber Road
Iowa State University
Ames, Iowa 50011

Please specify tape titles.

PCA 4R—Video Transfer #11 (15 min. 0 sec.)—*Whitetopping I-80* Washoe County, Nevada.

Construction of 8-in. minimum depth concrete overlay on existing asphalt roadway from west of McCarran Blvd. to Vista, Washoe County. Eight in. plain concrete pavement, slip-formed 38-ft. wide with 10 ft. shoulder on right and 4 ft. shoulder on the left. Traffic was maintained head to head on the eastbound lanes while westbound lanes were under construction. Sequences reversed during construction on eastbound lanes.

PCA 4R—Video Transfer #12 (17 min. 27 sec.)—*Reconstruction of New York State Thruway (I-95).*

Reconstruction of existing P.C.C. Pavement with recycling options for base only. Two projects involved; located in Bronx and Westchester Counties. Ten in. mesh dowel pavement formed one lane at a time in each new 36-ft. wide roadway. Texture by transverse tining. Traffic was maintained on two lanes in each direction on existing northbound roadway (including strengthened asphalt shoulders). Portable barrier was placed down the center. Sequence reversed when southbound roadway was constructed.

Warning signs should keep their distance

by R.L. Carstens, P.E., professor of civil engineering, ISU

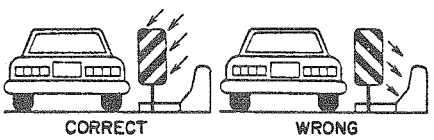
Each of the last three editions of the *Manual of Uniform Traffic Control Devices (MUTCD)* has included a statement to the effect that in rural areas, warning signs should normally be placed about 750 ft. in advance of hazardous conditions. On high-speed roads, particularly freeways, advance warning distances should be at least 1,500 ft., whereas on low-speed roads, as in urban areas, the advance warning distance need only be about 250 ft.

This has properly been interpreted to permit the placement of warning signs at varying distances in advance of potential hazards depending on the road profile and other factors affecting the sign's visibility. However, when accidents lead to lawsuits, plaintiff's lawyers and the "experts" have tended to suggest that the 750 ft. and 250 ft. distances are precise and inviolate.

Some examples of cases in which the placement of a warning sign became a matter at issue in a lawsuit are: a railroad advance warning sign at 511 ft. on a paved county road, a T-intersection sign at 605 ft. on a county gravel road, a reverse turn sign at 350 ft. on a paved county road in a suburban location, a curve sign at 233 ft. on an oiled county road, a stop-ahead sign at 1,302 ft. on a state primary highway, and a stop-ahead sign at 1,676 ft. from the intersection on a paved county road.

In the latter case, the location of the "stop ahead" sign probably was given considerable weight by a jury, so that it returned a very large judgment against the county for their negligence. The primary highway sign at 1,302 ft. led a plaintiff's "expert" to state, "If motorists are given advance warning too far ahead then it is difficult for them as motorists to retain that information and to relate it to the hazard that is being warned about."

However, in a recent change to the MUTCD, minimum warning sign placement distances are specified and vary with the posted or the 85th percentile speed. Although it is too early to judge the result of this change, it is certain that those responsible for the placement of warning signs must be more attentive to the minimum distances prescribed for the placement of warning signs and also to the maximum distance where the motorist will retain the sign's message.



When placing traffic barriers on site, think of the diagonals as "arrows" pointing down to the wheels of a vehicle to direct traffic away from the hazard.

conference 1 2 3 calendar

March 27-29—Land Surveyors Conference and Workshop, Scheman Building, ISU
April 1—Maintaining Granular Surfaced Roads, Mason City
April 3-4—Public Works Conference, Scheman Building, ISU
April 22—Airport Conference, Scheman Building, ISU
May 7—Safety Features for Local Streets and Roads Workshop, Scheman Building, ISU
May 8—Iowa Traffic Safety Control (ITSC) meeting, Scheman Building, ISU

Other important events

April 2-4—APWA Mid America Conference and Equipment Show, Kansas City
April 2-May 2—Rural/Specialized Transit Management Workshop, University of Wisconsin
April 16-18—Iowa Municipal Finance Officers Workshop, Des Moines
April 24-26—Iowa Engineering Society Annual Meeting, Waterloo
May 19-22—Community Transit Local Options Workshop, University of Wisconsin
June 9-11—APWA Tri-State Conference, Bloomington, Ill.
June 16-27—Transit Management Workshop, University of Wisconsin

---

Nebraska T2 Center

Bill Bowmaster has pioneered a technology transfer center at the University of Nebraska Lincoln that now offers its own individual services.

for more information

The Local Transportation Information Center has a limited supply of the following publications:

Compilation of State Laws and Regulations on Matters Affecting Rail-Highway Crossings, a Technical Share report that is a compilation of the many state statutes and regulations related to railroad-highway grade crossings. It is intended as a reference tool for those working in the rail-highway crossing safety field. This compilation should be useful in assessing differences among state laws and in making comparisons to the Uniform Vehicle Code (UVC). The laws and regulations are organized by state, keyword, and subject, and are rewritten in layman's language. Thus, this is not a legal document.

Public Roads, a journal of highway research and development. The September 1984 issue contains two articles of interest to *Technology News* readers: "Two-Lane Rural Highway Safety," a discussion of the Federal Highway Administration (FHWA) study identifying safety problems on two-lane rural highways and offering general guidance for investing funds; and "Railroad-Highway Crossings and Route Selection for Transporting Hazardous Materials," a report on the FHWA development of route selection criteria based on the probability of a hazardous materials accident that specifically addresses the omission of railroad-highway crossings from the study. Copies of these reports can be made available at no cost (as long as the supply lasts) to anyone wishing to have one by writing or calling the Technology Transfer on Haber Road—Telephone 1-800-262-8498 (in Iowa); in Ames call 515-294-8815.

Transportation Research Board, a publications catalog published by the National Research Council. TRB features various topical listings of pertinent publications and reports and also information on how to order. For more information, write Transportation Research Board, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418 or call 202-334-3218.

Publications for Professionals, a categorized listing of educational publications for those in the civil engineering field. For more information write American Public Works Association, 1313 East 60th Street, Chicago, Ill. 60637 or call 312-667-2200.

Publications Catalog, a catalog sponsored by the Institute of Transportation Engineers listing periodicals, library series, issue papers and more covering the latest topics and studies of civil engineering. For more information write Institute of Transportation Engineers, 525 School Street, S.W., Suite 410, Washington, D.C. 20024-2729 or call 202-554-8050.

Call for papers

The Transportation Research Board's Low Volume Road Committee is organizing a paper session for the 1987 Annual Meeting in January. The session theme is Microcomputer Applications to Low Volume Roads. Those who have used the microcomputer for an application to low volume roads are asked to write a paper for this session. The deadline for receipt of papers is August 10, 1986. For more information write Dr. Everett C. Carter, Technology Transfer Center, Department of Civil Engineering, University of Maryland, College Park, Md. 20742 or call 301-454-3103.

Know your D.O.T.

This is the first in a series of articles to better aquaint *Technology News* readers with field representatives from the Department of Transportation's Highway Division. This issue introduces field engineers from districts 1 and 2 and some highlights of their major projects.

District 1 projects

On I-235, in West Des Moines, an improvement will be under way this spring to widen three bridge structures: Rancho Grande Boulevard, Cummins Parkway, and Walnut Creek. Also one lane in each direction adjacent to the median will be added to provide a six lane facility. The project was let in December 1985 at a cost of $3.4 million.

District 2 projects

A by-pass on U. S. 20, extending from U.S. 63 west to the Grundy County line is being constructed in district 2. This project involves the completion of work that was let in spring, 1985, at a cost of $10 million.

Letting for a grading, and paving project on U.S. 63 from Donald Street in Waterloo to the Black Hawk County Road No. C-66 will be in April. This 3 mile long project will expand the road to include five lanes, with the center lane serving as a continuous left-turn lane.

The accompanying map illustrates the geographical areas and various offices of each district.

District 1 engineers

Ames, 515-239-1635
Bob Humphrey, P.E., district engineer
Rodolfo Laudencia, P.E., district maintenance engineer
Dick Mumm, P.E., district materials engineer
Ben Klaus, P.E., local systems engineer
Gene Mills, P.E., district transportation planner

Resident construction engineers

Ronald L. DeBok, P.E.
Jefferson, 515-386-8166

Thomas R. Jacobson, P.E
Ames, 515-233-1033

Paul J. McGuffin, P.E.
Des Moines, 515-262-5692

John E. Peters, Jr., P.E.
Marshalltown, 515-752-4657

Resident maintenance engineers

Robert E. Choate, P.E.
Grinnell, 515-236-6581

Paul J. McGuffin, P.E.
Des Moines, 515-262-5692

Don Schumann, P.E.
Ames, 515-233-3734

Bob Younie, P.E.
Fort Dodge, 515-955-3766

District two engineers

Mason City, 515-423-7584
Bob Bortle, P.E., district engineer
M. Dean Browning, P.E., district construction engineer
Philip M. Hassenstab, P.E., district materials engineer
William D. Kupka, P.E., local systems engineer
Odell C. Solem, P.E., district transportation planner

Resident construction engineers

Thomas A. Jenkins, P.E.
Decorah, 319-382-3632

Gerald L. Lund, P.E.
Waterloo, 319-235-9503

Brian McWaters, P.E.
New Hampton, 515-394-3161

David Roeber, P.E.
Britt, 515-843-3881

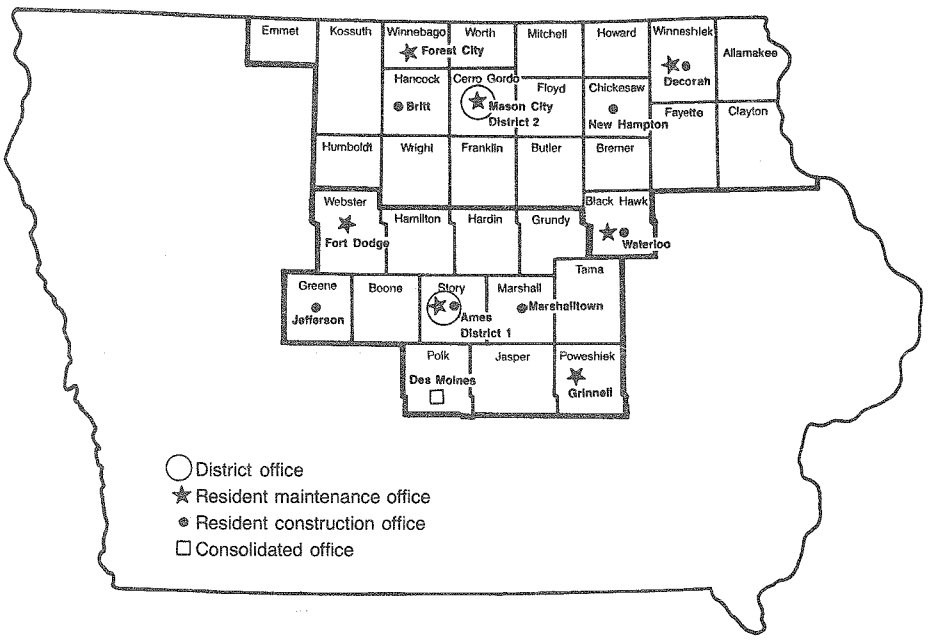
Resident maintenance engineers

Robert W. Davis, P.E.
Decorah, 319-382-3631

James A. Nelson, P.E.
Waterloo, 319-235-9503

Jim Sommer, P.E.
Mason City, 515-423-8516

Richard L. Wing, P.E.
Forest City, 515-582-4298



Iowa child restraint law now in its second year

Since January 1, 1985, Iowa law has required drivers to have their occupants under age three in an approved car seat, and those under age six, either in an improved child restraint or seat belt.

A survey conducted by the Iowa DOT in August 1985 indicated 43 percent of the children were buckled up. This compares to 34 percent that were in restraints in 1984, before the law was in effect. Says Gus Horn of the Iowa DOT, "We hope when the survey is conducted this August, compliance will be much higher. As with many safety programs, it takes time to change attitudes and behaviors."

Preliminary statistics for 1985 show more than 900 citations were issued for noncompliance. The penalty for violating the law is $10 per offense plus court charges.

According to Horn, three children under age six were killed last year on Iowa's highways. None of the children was using seat restraints. In 1984, six children under age six lost their lives on Iowa's highways.

The Iowa DOT estimates more than 300 hospitals, employers, and service organizations in the state have instituted car seat loan programs. "These public minded groups have recognized the importance of this law and are helping Iowans provide a safer journey for our little ones," says Horn.

Revisions of *MUTCD* incorporated in Iowa signing law

In recent administrative rule matters, the Iowa DOT adopted by reference the revisions in the 1978 *Manual on Uniform Traffic Control Devices for Streets and Highways*.

The rule revisions intended to implement *Iowa Code* section 321.252 are:
Revision No. 1 published December 1979,
Revision No. 2 published December 1983,
Revision No. 3 published September 1984.

Agencies that have the *MUTCD* on file should have received these revision updates. However, to be in compliance with Iowa law note these revisions and incorporate them into signing practices.

New training program available

A new training program is available for loan from the Local Transportation Information Center. The program consists of a series of videotapes and a manual explaining safe and correct procedures when working with motorgraders, front-end loaders, dump trucks, and industrial tractors with 15-foot rotary mowers. It is suggested this course be requested and administered by county engineers for their employees.

Developed by the Iowa DOT, the objectives of the course are to train employees using approved, standard, safe work methods, and to improve current work methods by correcting old habits, practices that are unsafe, and techniques that are inefficient.

Each course has five components. Included are a lesson plan that outlines the materials and equipment necessary to conduct training sessions; two or more videotapes designed to present the principles, procedures, and safety precautions; a check list for preventive maintenance; a short quiz; and an observation sheet that provides guidlines for assessing performance.

And justice for all
Appointment, promotion, admission, and programs of University Extension at Iowa State University are administered equally to all without regard to race, color, creed, sex, national origin, disability, or age. Call the Affirmative Action Office at 515/294-7612 to report discrimination.

engineering extension service
iowa state university, ames, iowa 50011

Forwarding and address correction requested.

Route to:

_____

_____

_____

_____