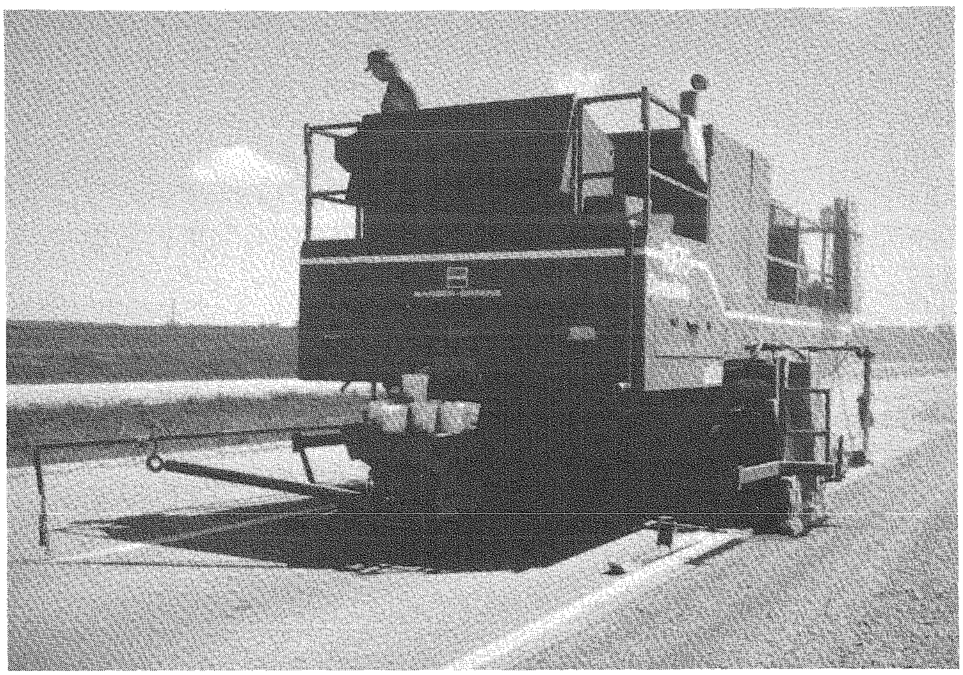
Technology News
Roads Bridges Transit
Iowa State University Engineering Extension Service
Local Transportation Information Center
February 1989

Carbide teeth cut milling expense

By Elena A. Aguilar
FHWA - Iowa Division

A 1987 Iowa Department of Transportation research project (HR-283) demonstrated that a carbide-tooth milling machine — modified with a greater number of teeth — can produce an acceptable surface texture faster and at less expense than diamond grinding.



Research shows acceptable results with carbide milling

A nine-mile section of badly faulted portland cement concrete (PCC) pavement on Route 163 east of Des Moines was milled in 1988. The bid price was 75 cents per square yard for PCC containing limestone coarse aggregate and $1.21 per square yard for PCC containing gravel coarse aggregate. This is currently accomplished by diamond grinding, which costs approximately $2.20 per square yard. The Profile Index measure with a 25-foot California Profilograph was improved from an average of 55.2 inches per mile prior to milling to 10.6 inches per mile after milling.

Past experience had shown that milling machines with carbide-tipped teeth have the capability of profiling most asphalt cement concrete (ACC) and PCC pavements, but leave a relatively coarse surface texture that is objectionable to most motorists. Milling with carbide tip has been used in Iowa to remove many miles of curb from PCC pavements.

The milling research project utilized a 12-foot wide Barber Greene equipped with a mandrel manufactured by Keystone Engineering and Manufacturing Corporation of Indianapolis, Indiana. The teeth were arranged in spiral wraps around the drum. Iowa DOT Supplemental Specification 1044 for Pavement Surface Repair (Milling) September, 1987, required 60 cutting teeth per foot at a transverse spacing of approximately five millimeters (standard spacing is 15 mm or

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Inside pages

Upgrading signal systems requires careful study

By Mary Rose Anderson

When upgrading traffic-signal systems, Iowa cities must carefully consider the pros and cons of several different types and levels of technology. Medium-sized communities which need to coordinate several intersections along a main arterial should closely examine three technologies: 1. Time-based coordination (TBC); 2. The interconnected, master-controlled system (synchronization pulse or sync pulse); and 3. A new atomic clock-based system.

TBC synchronizes traffic lights along an arterial by coordinating a time relationship between green signals with "super-accurate," solid-state, electronic clocks inside the controllers. The sync pulse connects each intersection with a hardwire. Both TBC and sync pulse create a progressive flow of traffic.

In a sync-pulse system, a master controller coordinates all other controllers along an arterial by providing a common time base. It generates a pulse that travels along the wire to all units. This pulse is provided once per series of green-yellow-red light indications, or cycle.

The synchronization pulse is received simultaneously by all controllers in the series. Depending on the distance between intersections, each controller waits an appropriate length of time before turning green. This coordination establishes traffic progression.

The sync-pulse technology has advantages over a TBC system. In TBC, a trained technician manually sets each controller's crystal clock. When the clocks' time relationships drift, they must be reset manually at each cabinet. The reliability of TBC often depends on the controllers used. Some are more accurate than others. Noise or interference, such as electrical power-line noise, can disrupt the accuracy of TBC clock crystals. Occasionally, the crystals fail.

Although the sync-pulse system can coordinate a whole thoroughfare with one controller, its hardwire connection has some disadvantages. Downed or malfunctioning lines can cause a dozen controllers to fail at once. Electro-mechanical controllers limit the sync-pulse technology to two or three different timing plans. Solid-state controllers allow for nine or more plans.

Neither sync pulse or TBC systems is easily made responsive to immediate traffic fluctuations. These systems are most effective in networks or arterials where traffic conditions change predictably.

The cost of installing sync-pulse systems varies with the length of hardwire needed to connect intersections and with the sophistication of the controllers used. Sync pulse can be particularly cost effective when coordinating a dense network of controllers. However, it may be expensive to lay hardwire for sync pulse where there are parking lots, buildings, driveways, and other structures in the hardwire's path.

To avoid the cost of laying hardwire and conduit, communities trying to save money in the short run may choose a TBC system. However, if long-range plans indicate the eventual need to upgrade with a closed-loop system, a sync-pulse system can

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Technology News is published by the Local Transportation Information Center, Iowa State University, ISU Extenson -- Business and Engineering, EES Building, Haber Road, Ames, Iowa 50011

Program manager--Tom Maze; Coordinator--John Moody; Editor--Larry Mendenhall

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 personnel.

Department of Transportation Iowa

U.S. Department of Transportation
Federal Highway Administration

IOWA STATE UNIVERSITY EXTENSION

Guidelines needed for road crowns

Tort Liability

By R. L. Carstens
Professor Emeritus of
Civil Engineering

How much crown should an aggregate-surface road have? Written sources vary in their recommendations but seem to have led to a conclusion that the maximum crown should not exceed 1/2 inch per foot of width. For example, the NACE booklet "Blading Aggregate Surfaces" (1986) on page 14 states "For good drainage, a road should have a crown of 1/3 to 1/2 inch for each foot of width measured from center of road to outside edges where road meets shoulder." The writer disagrees. For many such roads, a crown of 1/2 inch per foot is insufficient to carry water rapidly off the road. This is especially true if the road is on a grade or if the surface is of average or greater roughness. A more reasonable value is presented in the AASHTO Maintenance Manual (1976) that suggests crowns of 1/2 inch to one inch per foot for earth-aggregate surfaces (see Sections 2.300 and 2.560).

Like every aspect of design or maintenance, this issue has arisen in a number of tort liability cases. In several, a plaintiff has alleged that there was insufficient crown. Generally, the crown was about 1/4 inch per foot in these cases in the location affecting an accident. At least one case is being litigated based in part on a plaintiff's allegation that a crown of 3/4 inch per foot is excessive.

From reading a number of their depositions it is clear that most grader operators are aware of the need for an appropriate crown. However, few seem to have any specific value in mind. Although most roads seem to end up with enough crown, thanks to the skill, experience, and good judgment of the grader operators, a more definitive answer than "enough" would be better when a grader operator is asked how much crown a road should have. It is suggested that jurisdictions having responsibility for aggregate-surface roads establish guidelines for the amount of the crown.

Figure 1 - An aggregate road with a minimal crown. Photo taken in January.

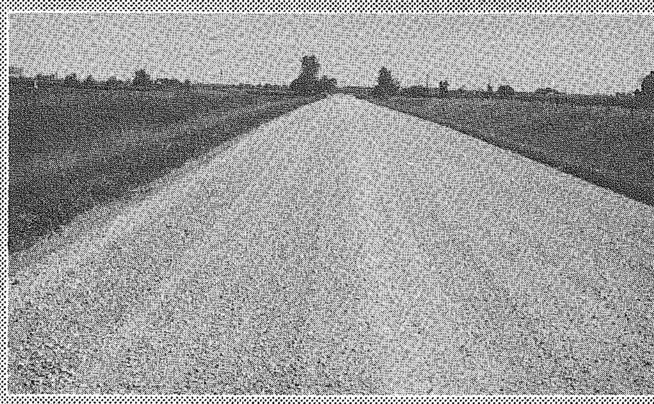


Figure 2 - A road with a high crown. Photo taken in June.

In northern climates, the most desirable crown might vary from season to season. The maximum crown might be used in the spring when runoff from snow melt and spring rains present the greatest problems of surface drainage. A lesser crown might be more appropriate in the winter when ice on the road is likely to be of more concern than running water.

It is difficult to judge the amount of crown from inspection. Although they may look the same, the accompanying photographs illlustrate differing views on the amount of crown. The road in Figure 1, taken in January, has a minimum crown. A much greater crown is on the road in Figure 2, taken in June. The two roads are in different states, both in the upper midwest.

In any case, some guidelines are better than none to help prevent the occurrence of the road without crown. A road with insufficient crown will be a liability problem when it is the location of an accident.

Surge suppressors may save data

Microtechnology

By Tom Maze
Program Manager

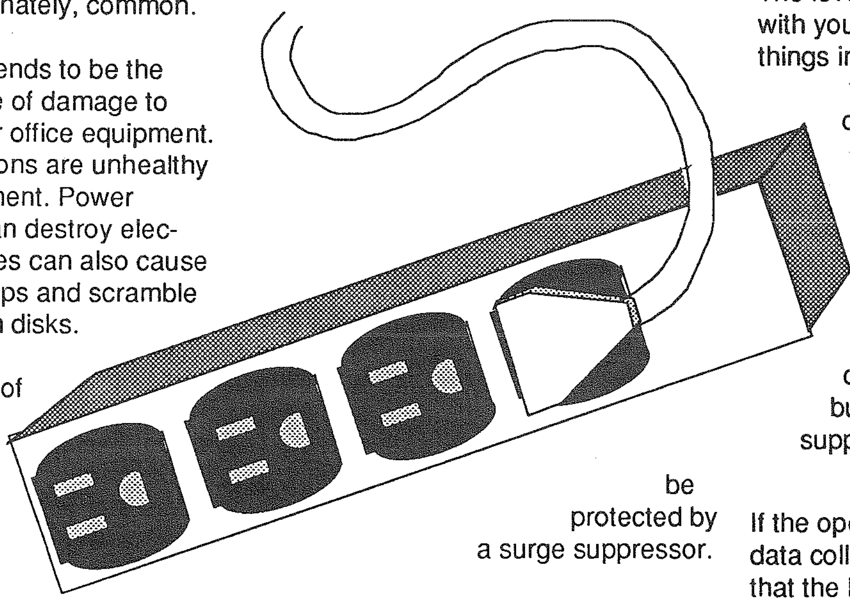
A few months ago, I was visiting with Charlie Trailer, assistant to the county engineer in Shelby County. Charlie related an experience he had with his CAD (computer aided design) system.

He had been working on a drawing for about 2 1/2 hours when someone decided to use the copy machine. Charlie's computer and the copier were on the same circuit. Given the age of the wiring of the Shelby County courthouse, the drain on the power supply of both the copier and the computer blew the circuit breaker and Charlie's work vanished. Similar stories about poor quality of power supplies are, unfortunately, common.

Poor power quality tends to be the most common cause of damage to computers and other office equipment. Power level fluctuations are unhealthy for electronic equipment. Power surges, or spikes, can destroy electronic circuitry. Surges can also cause errors in memory chips and scramble data being read from disks.

There are two types of power surges. One is a "normal or tranverse spike." Those occur when there is a fluctuation in voltage. For example, a normal spike occurs when a copier that uses the same circuit as a computer is turned on. The other type is a "common mode spike" where a voltage surge occurs between either or both of the electric supply lines and ground. The most common source of common spikes are lightning strikes.

Common spikes occur infrequently, but they can destroy equipment. Generally, common spikes can be controlled with the use of a surge suppressor. Surge suppressors are inexpensive (roughly $10 to $100) and they clamp the voltage when it reaches a predetermined level above the norm. The cost of a surge suppressor is dependent on the speed it performs clamping, the amount of energy it can dissipate, the number of outlets on a unit, and whether each outlet is separately filtered. Every computer, and other sensitive equipment, should be protected by a surge suppressor.



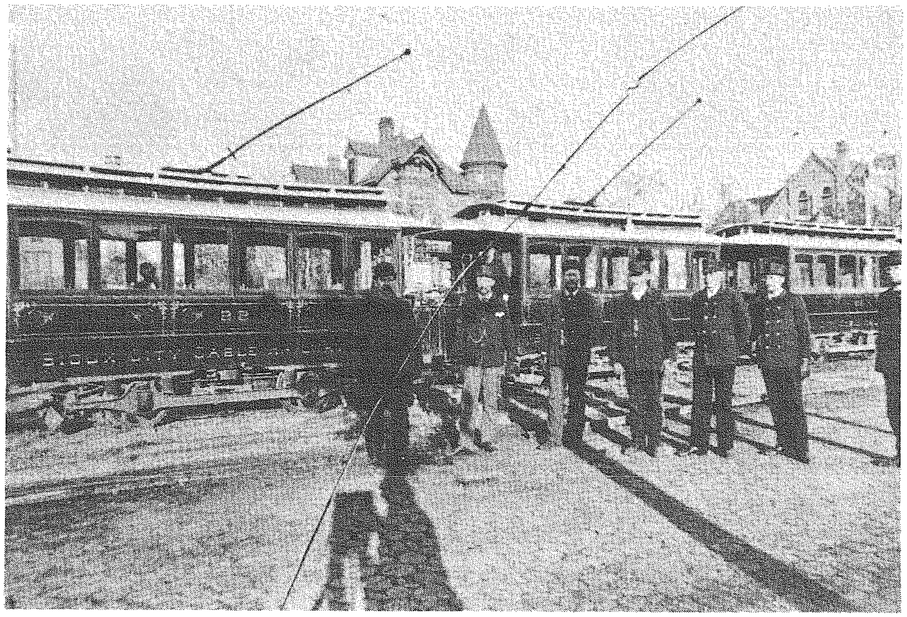
The next level of power supply protection is a power conditioner or power stabilizer. They protect against both normal spikes and common spikes. Power conditioners will range in price from $60 to $400. The variation in price generally depends on the watts of power drawn by the equipment protected, the number of outlets, and the performance (speed, power dissipation, low voltage protection limits, etc.) of the unit.

Although a power conditioner can provide clean power, it cannot provide constant power. Constant power is provided through an uninterruptable power supply (UPS) unit. A UPS unit automatically switches to a battery power supply when it senses a loss of power and warns the user. The UPS provides the user with a minimum of several minutes of power while the user backs up files and powers down the device. UPS units vary in price from $250 to several thousand dollars. The variation in price is dependent on the unit's performance and the duration and wattage of the backup power.

The level of power protection to use with your system depends on several things including:

1. The expense and sensitivity of the equipment protected.
2. The value of the work being produced on the computer and the loss that would be suffered if the work "disappeared."
3. The consistency of power levels within your community, within your own building, and within your power supply circuit.

If the operation of equipment and the data collected are vital, then it is clear that the highest level of protection should be provided. For example, computerized fueling systems must typically provide users with fuel whenever they need it. Any loss of automatic record keeping capabilities, by switching the equipment to manual when the computer has failed, causes a loss of data integrity. Therefore, computerized fueling systems are far too important not to protect with the highest level of power protection, a UPS. On the other hand, a common computer used in word processing may not warrant this level of protection.



This photo of Sioux City's cable car system shows the cars after they were modified to run electrically.

Cable railroad inventor ran Sioux City's system

Past Roads

By Dr. Stanley Ring

The Sioux City Cable Railroad was incorporated in that city in 1888. Included as a signer was William Phenix, who is noted as the inventor of the railroad system. He is reported as staying in Sioux City and operating the line during its first year.

A moving cable operated continously in a groove in the pavement. The operator placed a grip over the cable and squeezed it to start the car moving by gripping the cable. The San Francisco cable railway still operates in this manner.

The line extended from downtown Sioux City over some large hills to 40th Street and had a spur line. The entire route was about three miles.

The powerhouse to run this cable line also furnished power for the street lights on the Jackson Street cable line.

The only known remaining photo is from a glass plate in the Sioux City Library. It would appear that these cars have been electrified as that was the fate of the cable railroad.

Milling continued from page 1

approximately 5/8 inches). The contractor was able to mill approximately one mile per day. In contrast, grinding with diamond blades, traveling approximately at the same speed as the milling machine, is relatively slow because most diamond grinding equipment is less than three feet wide.

All milling proceeded against the normal traffic flow. The depth of cut was controlled by a sliding ski. A narrow gallion mill was used to blend significantly different levels between the driving and passing lanes. The conveyor for removing the material cut from the surface makes immediate inspection of ridges resulting from broken teeth possible. Broken teeth should be replaced immediately to prevent the forming of ridges or valleys. The contractor checked and replaced broken teeth hourly, and replaced all teeth daily. Milling with sharper teeth (a point not greater than 75 degrees is recommended) during warmer summer temperatures resulted in less damage to the transverse joints.

Carbide-tooth milling should be considered as an acceptable alternate method of reprofiling even though it results in some spalling of joints. Milling profiling is not recommended where the pavement joints are substantially open or deteriorated. Iowa Research Board reports, "Pavement Texturing by Milling," January 1987 and "Pavement Profiling By Milling," September 1988 by Iowa DOT research engineer Vern J. Marks, were used as reference.

New editor starts duties for *Technology News*

A former newspaper photographer and editor, Larry Mendenhall, is now the editor for Technology News.

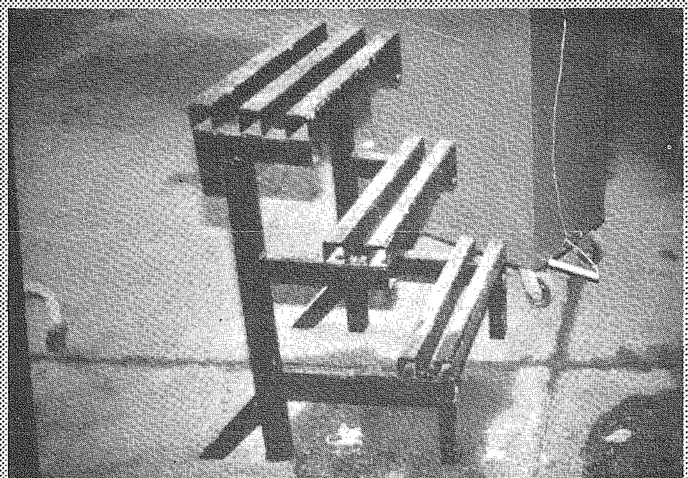
Mendenhall replaces Teddi Barron, who now works on the Traffic Signalization Program and the Iowa Radon Project.

Tips From The Field

Portable step

This handy step designed by Robert Flaws of the City of Johnston Public Works Department gives a boost to mechanics working under the hoods of tall vehicles.

This step is welded together from 2"-by-2" square tubing, with no-slip strips as recommended below. Stability is provided by two angled struts in front. The step is portable and moves easily around the shop.



This handy and portable step was designed by Johnston's Public Works Department.

To create non-slip surfaces for dangerous areas such as bumpers, steps, or ladders, City of Clive Public Works Department applies paint to a surface and dusts it with a layer of silica sand. The sand provides a gripping surface that can reduce work hazards and accidents.

For more information or specifications, contact John Moody, Local Transportation Information Center, Haber Road, Iowa State University, Ames, Iowa 50011.

Signal system choices continued from page 2

save money because the conduit is in place.

However, TBC also can be upgraded to a closed-loop system without laying hardwire. Radios at each TBC control box enable controllers to communicate vehicle counts, schedule changes, and other messages to each other.

A new, pulse-based signal technology coming to Iowa circumvents the need for hardwires. The atomic clock-based signal-system relies upon the pulse of the U.S. atomic clock in Boulder, Colorado.

The pulse is broadcast by WWV, the National Institute of Standards and Technology's radio station. Special AM radio receivers inside each controller are tuned into the beat of the famous atomic timepiece. While sync pulse timing is more accurate than TBC timing, it eventually gains or loses a few seconds. The atomic clock system improves wireless coordination because it will not lose a single second in 300,000 years.

City officials must carefully weigh technological alternatives, tailoring their traffic signal systems to meet their communities' unique traffic demands. Every community hoping to improve its traffic conditions should start by examining the various levels of technology available.

For more information, call Jan Graham at the Local Transportation Information Center, 515/294-8082.

Calendar

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edge of equipment management, preventive maintenance programming, and maintenance planning.
Contact Tom Maze (515) 294-6777

Portland Cement Concrete and Asphaltic Cement Pavement Maintenance Workshop
April 26, Scheman Building, ISU, Ames
April 27, Western Iowa Community College, Council Bluffs
This workshop covers a number of fundamental methods for the efficient maintenance of pavements. The course focuses on pavement maintenance at the most practical level. Contact Tom Maze (515) 294-6777

For More Information

The following video tapes are available on a "loan only" basis. Contact John Moody at the Local Transportation Information Center at (515)294-0787 to order or use the order form below.

"Concrete Pavement Rehabilitation for City Streets" (No. 24 - running time 22 minutes - produced by the Iowa Concrete Pavers Association) This tape takes a close look at improving concrete pavement service by rehabilitating the surface. It explains the importance of a proper inventory, techniques for rehabilitation, plan development, traffic control, and contracting. Detail explanations of various ways of patching, joint rehabilitation and other CPR techniques are included.

"First on the Scene" (No. 25 - running time 32 minutes - produced by Chemical Manufacturers Association) This tape is geared toward fire officers, fire fighters, police officers, emergency medical staff members as well as highway maintenance and traffic personnel. The tape covers topics such as: how to identify the material at a chemical spill, how to approach the scene, how to stabilize the accident scene, and where to obtain help with the problem. There are no restrictions on reproducing this program.

"Potholes - Causes, Cures and Prevention" (No. 30 - running time 12 minutes - produced by the U.S. Army Corps of Engineers - Cold Regions Research and Engineering Laboratory) This tape shows the various conditions such as weather and traffic patterns which combine to cause potholes. It shows proper repair procedures for potholes and makes recommendations for the development of repair and maintenance programs and a comprehensive inspection schedule. This tape can be used in conjunction with "Pothole Primer," No. 24, which was listed in the August 1988 issue of Technology News.

"Heavy Equipment Operations" (No. 32 - produced by the Iowa Department of Transportation) This is a 10-tape series dealing with heavy equipment operation. The following tapes are available.

No. 32A - Two tapes dealing with operating rotary mowers on heavy-duty tractors. Running time: 14:30.

No. 32B - Two tapes dealing with dump truck operation. Running time: 16 and 13 minutes.

No. 32C - Three tapes on loader operation. Running time: two at 11 minutes, one at 16.

No. 32D - Three tapes on motorgrader operation. Running time: two at 18 and one at 17 minutes.

"Highway Condition and Quality of Highway Construction Survey" (No. 98 - by Roger E. Smith, Michael I. Darter and Stanley M. Herrin, staff members at the University of Illinois' Civil Engineering Department, published 1979) This manual (198 pages) provides standardized identification of distress types associated with four types of conventional highway pavements. These include: jointed plain concrete, jointed reinforced concrete, continuously reinforced concrete, asphalt surfaced with granular or stabilized base, and asphalt overlays over portland cement concrete. Each distress type is described along with its primary mechanism, degrees of severity, measurement criteria, and photographs of each type. Limited Supply.

"Pothole Primer" (No. 24) Copies still available.

Publication order form

To obtain the materials listed as available from the Local Transportation Information Center, return this form to the Local Local Transportation Information Center, Iowa State Univ ersity Extension, EES Building Haber Road, Ames, IA 50011.

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Phone (__) ________			

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___**Please send a complete listing of all audio visual materials available**

Conference Calendar

Traffic Signal Maintenance and Maintenance Management Workshop
February 14, Iowa Lakes Community College, Spencer
February 27, Southeastern Community College, West Burlington
February 28, Hawkeye Technical Institute, Waterloo
March 3, Iowa Western Community College, Council Bluffs
March 9, Scheman Building ISU, Ames
This workshop is designed to give traffic signal technicians working knowledge of the importance and fundamental elements of a planned maintenance program for traffic signals. Course is a hands-on program taught by instructors experienced in traffic signal operation and maintenance.
Contact Jan Graham (515) 294-8082

Legal Liability and Traffic Signing
March 1, Mount Pleasant
March 2, Carroll
This course covers the MUTCD and signing and the legal liability implecation of proper signing. This is intended to be a practical course on maintenance crew members and supervisors, and local highway professionals.
Contact Tom Maze (515) 294-6777

Local Road Surface Management Workshop
March 7, Scheman Building, ISU, Ames
This workshop is intended to be an introduction to systematic methods for managing paved and unpaved road surfaces. The course will provide practical training on organizing information on the conditions, construction history, and physical features of road surfaces.
Contact Tom Maze (515) 294-6777

Rehabilitation of Beam Bridges
March 22 & 23, Starlite Village, Ames
This workshops covers low cost methods for and the feasibility of rehabilitating beam bridges. The course features Iowa examples of practical bridge rehabilitation techniques.
Contact Tom Maze (515) 294-6777

Missouri Valley Section of ITE Meeting
March 29, 30, & 31, Oklahoma City
Contact Jim Dickenson (515) 274-4731

Understanding Intersection Traffic Control:
A Workshop for Elected and Appointed Officials
April 12, Urbandale, Urbandale Library
May 1, Fairfield, City Hall
May 2, Ames, City Hall
May 3, Cedar Rapids, City Hall
May 8, Mason City, City Hall
May 9, Decorah, City Hall
May 30, Storm Lake, City Hall
May 31, Atlantic, City Hall
The purpose of this workshop is to provide elected and appointed officials with a fundamental understanding of the purpose for intersection control, warrants for intersection, and traffic engineering terminology and techniques.
Contact Jan Graham (515) 294-8082

APWA Mid-America Conference & Exibit Show
April 19, 20, & 21, Kansas City

Vehicle Fleet and Maintenance Management For Rural and Small Urban Transportation Service Providers
April 24 & 25, Dubuque, Midway Best Western
April 27 & 28, Council Bluffs, Western Iowa Community College
This workshop is intend for rural, specialized and small urban transit managers. It provides basic knowl-

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