



Intelligent Transportation

by Dr. Airton G. Kohls & Matt Cate

Coupling data and communication technologies with transportation systems to optimize safety, reduce vehicle wear, shorten travel times and cut fuel consumption are some of the objectives of ITS (Intelligent Transportation Systems). In 1991 the Intermodal Surface Transportation Efficiency Act (ISTEA) established a Federal program to research, develop and promote the implementation of ITS.

The city of Franklin, TN is one example of successful deployment of Intelligent Transportation Systems. In 1996, the Transportation Management Association initiated a study that identified a need for the City of Franklin's Traffic Operations Center and, on April 27th, 2002 it became reality. The TOC is capable of seamlessly optimizing traffic conditions helping citizens with their everyday transportation needs. ITS is an economically sound investment with benefits outweighing costs, providing a reduction in traffic congestion for Franklin motorists as well as environmental improvements with the reduction in vehicle emissions and fuel consumption.

The City Traffic and Transportation Engineer Mr. Carl Baughman and ITS Project Manager Mr. Kevin Comstock pointed out some details and advantages of the system. The City of Franklin, TN has a total of 95 signalized intersections, of which 60 are interconnected. The city operates 5 cameras, utilizing mostly a 12 count fiber and hardwire FSK communications network feeding back to the TOC.

Traffic data can be analyzed and traffic signal timings can be updated directly from the center, proactively managing adverse situations. More than that, the direct connection of the system to the police department facilitates incident management. A public access channel television broadcast during peak commute hours gives advance information on traffic conditions and is supplemented by a website (<http://www.franklin-gov.com/toc>). Citizens can also follow a Twitter account (<http://twitter.com/#!/FranklinTraffic>) where there will be frequent updates of lane closures, work zones, incidents and clear-by times. The Twitter service was shown to be especially useful during the floods of 2010. Finally, the school system, emergency services and transit are also constantly updated with pertinent traffic conditions.

Franklin's ITS infrastructure has been revised and upgraded throughout the years, with a target horizon of evaluating each system every 3 years. The next proposed step is to replace the current system software, update the fiber communication system adding Ethernet capability, adding 17 cameras and extending the system to the Cool Springs area. By including the ITS Master Plan as a part of an update to the Franklin Major Thoroughfare Plan, the city is able to assess a



Traffic/Transportation Engineer Carl Baughman (left) and ITS Project Manager Kevin Comstock show off the city's Traffic Operations Center in downtown Franklin.

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The views, opinions, and recommendations contained within this newsletter are those of the authors and do not necessarily reflect the views of FHWA and TDOT.

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From the Director

April showers bring May flowers. I've heard that all my life, as I'm sure most of you have. With these spring showers, you should consider checking drainage along your highway systems. Poor drainage is a major cause of damage to pavements and subgrades, and standing water also presents major safety problems for highway users. Drainage systems get that water off the road and to a location where it will do no harm, provided that ditches, culverts, and other drainage elements are well maintained. That's the rub, though. Water deteriorates or clogs the drainage system just like it does other highway components. Effective drainage requires that you regularly inspect and maintain the ditches, culverts, catch basins, storm drains, etc. The payoff for doing this is high, so it's worthwhile to make the effort. You can get a good idea how good drainage is by driving your roads during a heavy rain. If you want advice on how to deal with problems, TTAP has a regularly offered class on the subject.

Whenever you work on drainage issues, please make sure to take proper safety precautions. Traffic control is a must when work encroaches into a traffic lane or shoulder. Working in storm sewers or catch basins requires appropriate confined space precautions. Of course, water always presents a drowning hazard. Recently in our state, a public works employee attempting to unplug a culvert after a rainstorm was caught by the rushing water, swept into the pipe, and drowned. This tragic event hammers home the need to always be prepared with the proper procedures, equipment, and help to get the job done safely.

On another note, as I write our elected leadership in Washington still hasn't taken action to reauthorize our surface transportation programs. The continuing battle over budgets continues to overshadow everything else, politically. The conventional wisdom is that a bill needs to be put on the President's desk by late summer before the political season begins. If this doesn't happen, reauthorization may well be delayed until after the 2012 elections.

Adequate highway revenue is one of the pressing issues in reauthorization. At present levels, motor fuel taxes aren't generating sufficient funds to sustain our highway network. Efforts to reduce petroleum use by increasing fuel efficiency or promoting electric vehicles have negative impacts on tax revenue, as do reductions in travel due to high fuel prices. Efforts to increase the fuel tax or index it to price have little political support. Something needs to be done to address the revenue needs. While local roads get significant support from other revenue sources, fuel taxes are still a substantial percentage of the total. As I said last month—political theater. Maybe I'll have better news next issue.

The dogwoods are in full bloom in east Tennessee, and spring fever is raging here in the office. We're eager to get away from our desks and do some field work, so if any of you need some help, please call! TTAP looks forward to serving you.



portion of the costs for future ITS improvements as part of its impact fees for new developments. This allows the system to grow with the city rather than playing catch-up after traffic outgrows the current system.

We would like to thank Carl and Kevin for taking the time to share their ITS success story with us. We are looking forward to keeping up with the Franklin TOC and its future growth!

Among the several areas that TTAP (Tennessee Technical Assistance Program) provides education on, the Traffic Signal area is one that has received special attention lately. Several workshops are being offered in 2011 and many more are being developed for 2012 to help practitioners on their everyday duties. The main objective is to provide guidelines for effective signal timing, as well as updated information on standards and best practices, just like the example of the City of Franklin Traffic Operations Center.

Check our website: ctr.utk.ttap for latest workshop schedule.

Protecting Workers from Heat Stress

Heat Illness

Exposure to heat can cause illness and death. The most serious heat illness is heat stroke. Other heat illnesses, such as heat exhaustion, heat cramps and heat rash, should also be avoided.

There are precautions your employer should take any time temperatures are high and the job involves physical work.

Risk Factors for Heat Illness

- High temperature and humidity, direct sun exposure, no breeze or wind
- Low liquid intake; previous heat illnesses
- Heavy physical labor
- Waterproof clothing
- No recent exposure to hot workplaces

Symptoms of Heat Exhaustion

- Headache, dizziness, or fainting
- Weakness and wet skin
- Irritability or confusion
- Thirst, nausea, or vomiting

Symptoms of Heat Stroke

- May be confused, unable to think clearly, pass out, collapse, or have seizures (fits)
- May stop sweating

To Prevent Heat Illness, Your Employer Should

- Provide training about the hazards leading to heat stress and how to prevent them.
- Provide a lot of cool water to workers close to the work area. At least one pint of water per hour is needed.
- Schedule frequent rest periods with water breaks in shaded or airconditioned areas.
- Routinely check workers who are at risk of heat stress due to protective clothing and high temperature.
- Consider protective clothing that provides cooling.

How You Can Protect Yourself and Others

- Know signs/symptoms of heat illnesses; monitor yourself; use a buddy system.
- Block out direct sun and other heat sources.
- Drink plenty of fluids. Drink often and BEFORE you are thirsty.
- Avoid beverages containing alcohol or caffeine.
- Wear lightweight, light colored, loose fitting clothes.
- Be aware that poor physical condition, some health problems (such as high blood pressure or diabetes), pregnancy, colds and flu, and some medications can increase your personal risk. If you are under treatment, ask your healthcare provider.

What to Do When a Worker is Ill from the Heat

- Call a supervisor for help. If the supervisor is not available, call 911.
- Have someone stay with the worker until help arrives.
- Move the worker to a cooler/shaded area.
- Remove outer clothing.
- Fan and mist the worker with water; apply ice (ice bags or ice towels).
- Provide cool drinking water, if able to drink.

IF THE WORKER IS NOT ALERT or seems confused, this may be a heat stroke. CALL 911 IMMEDIATELY and apply ice as soon as possible. If you have any questions or concerns, call OSHA at 1-800-321-OSHA. <http://www.osha.gov/SLTC/heatstress>

A Closer Look at Street Name Signs

by Matt Cate, P.E.

Street name signs are found on most roadways. From local streets to arterial highways, in urban and rural areas, the purpose of these signs is to help drivers identify intersecting roadways. These signs are especially important for drivers that are not intimately familiar with the area. While these drivers might only be out for a Sunday drive or trying to find a shortcut to work, we might also encounter situations where law enforcement officers, firefighters, or EMTs are also relying on street name signs to navigate the road network. Missing or inadequate street name sign usually result in nothing worse than a driver missing a turn, but they could make all the difference in the world for an ambulance, fire truck, or police car responding to a call.

Past editions of the Manual on Uniform Traffic Control Devices (MUTCD) have addressed the design of street name signs, but many agencies have not interpreted this information correctly. The 2009 MUTCD does a much better job of assembling and presenting this information in a way that most agencies can apply to their sign operations. This article summarizes many of the recommendations and requirements for street name signs found in the current MUTCD. To see this information in its entirety, Chapter 2D (Guide Signs – Conventional Roads) and Section 2D.43 (Street Name Signs) may be found online at <http://mutcd.fhwa.dot.gov/htm/2009/part2/part2d.htm>.

Placement (Section 2D.43, paragraphs 01, 20-24)

Street name signs should be installed at all urban intersections and to identify rural roads that lack other identification (such as route markers). Signs should identify all streets at the intersection. If a road has different names on opposite sides of the intersection, both names may be shown on the street name sign along with directional arrows. Each sign should be mounted parallel to the street it names.

In residential areas, at least one set of street name signs should be installed at each intersection. In busier commercial areas and on principal arterial highways, at least two sets of street name signs should be placed on diagonally-opposite corners. Street name signs may be placed above Stop and Yield signs with no additional vertical separation. The use of overhead street name signs should be considered in urban and suburban areas, especially where advanced street name signs are not used at major intersections.

Lettering (Section 2D.42, paragraphs 03-09)

Roadway names must use a combination of lowercase letters with initial uppercase letters. This mixed case lettering is intended to increase the legibility of signs. This rule applies to the name of a place or roadway on any guide signs. The required, recommended, or optional size of letters is shown in the table below. Use of 6-inch uppercase and 4.5-inch lowercase letters is the only standard (mandatory) statement in the Chapter. Use of larger letters (high-speed multilane, overhead) is recommended, while use of smaller letters (low-speed, two-lane streets) is optional. The type of roadway (street, drive, avenue, etc.) may be indicated using 3-inch uppercase and 2.25-inch lowercase letters. Use only



Overhead signs place street name information in a prominent location, particularly at signalized intersections. Also note the size of the lettering (12") relative to the adjacent signal indications.

approved abbreviations as defined in Section 1A.15 of the MUTCD.

| Type of Mounting | Type of Street or Highway | Speed Limit | Recommended Minimum Letter Height | |
|------------------|---------------------------|------------------|-----------------------------------|-------------|
| | | | Initial Upper-Case | Lower-Case |
| Overhead | All types | All speed limits | 12 inches | 9 inches |
| Post-mounted | Multi-lane | More than 40 mph | 8 inches | 6 inches |
| Post-mounted | Multi-lane | 40 mph or less | 6 inches | 4.5 inches |
| Post-mounted | 2-lane | All speed limits | 6 inches* | 4.5 inches* |

* On local two-lane streets with speed limits of 25 mph or less, 4-inch initial uppercase letters with 3-inch lowercase letters may be used.

Color (Section 2D.43, paragraphs 17 and 18)

The standard colors for conventional guide signs, including street name signs, are a white legend (text and border) on a green background. For agencies that wish to use different colors to distinguish their roadways from those maintained by another agency, the Federal Highway Administration (FHWA) has identified three acceptable alternatives. The green background may be replaced with blue or brown (the legend is still white), or a black legend on a white background may be utilized. No other color combinations are permitted. Advanced street name signs must be white on green.

Retroreflectivity (Section 2A.08)

Street name signs must meet the minimum sign retroreflectivity standards introduced in Revision 2 to the 2003 MUTCD. The only color combination addressed in the retroreflectivity table is white on green. However, this does not



These signs show three of the four available color options for street name signs, including the standard white on green (top), white on brown (lower left), and white on blue (lower right).

Minimum Maintained Retroreflectivity Levels for Street Name Signs¹

| Sign Color | Sheeting Type (ASTM D4956-04) | | | | Additional Criteria |
|----------------|-------------------------------|-------------------------|-------------------------|-------------------------------|---------------------|
| | Beaded Sheeting | | | Prismatic Sheeting | |
| | I | II | III | III, IV, VI, VII, VIII, IX, X | |
| White on Green | W ² ; G ≥ 7 | W ² ; G ≥ 15 | W ² ; G ≥ 25 | W ≥ 250; G ≥ 25 | Overhead |
| | W ² ; G ≥ 7 | W ≥ 120; G ≥ 15 | | | Post-mounted |

¹ The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m² measured at an observation angle of 0.2° and an entrance angle of -4.0°.

² This sheeting type shall not be used for this color for this application.

mean the retroreflectivity of alternate color combinations can be ignored. Section 2D.43 explicitly states that “the street name sign shall be retroreflective or illuminated to show the same shape and similar color both day and night.” Additionally, it would be no stretch for a plaintiff’s attorney or expert witness to argue that the white legend of blue or brown street name signs should meet the minimum levels of retroreflectivity even if there is no direct equivalent for the background colors. Similarly, black on white street name signs could be held to the same standard as regulatory signs using the same color combination.

Retroreflectivity requirements will limit sign sheeting choices. In all cases, the white legend must use Type II (super engineer grade) or higher retroreflective sheeting. For overhead signs, the legend must utilize a Type III or higher prismatic sheeting. In all applications, the green background may use even Type I (engineer grade) sheeting provided that it meets or exceeds the minimum level of retroreflectivity shown in Table 2A-3. Many agencies are now using a transparent green film overlaid on white retroreflective sheeting to create street name signs. For these signs, the green retroreflectivity level must be compared to the minimum value corresponding to the underlying white sheeting.

Border (Section 2D.43, paragraph 15)

The standard street name sign includes a border, but agencies are given an option to omit this feature.

Pictographs (Section 2D.43, paragraphs 10-13)

In addition to alternate street name sign colors, agencies also have the option to use a pictograph. A pictograph can be used to identify governmental jurisdiction, an area of jurisdiction, a governmental agency, a military base or branch of service, a government-approved university or college, or a government-approved institution. If used, the height and width of the pictograph should not exceed the uppercase letter height of the street name. The pictograph should be positioned on the left side of the sign.



These street name signs provide examples of properly-sized and placed pictographs. The top picture shows street name signs maintained by Knox County. The bottom picture shows a pictograph used to indicate a privately-maintained roadway.

Ornamental Signs

Remember that the MUTCD is “the national standard for all traffic control devices installed on any street, highway, bikeway, or private road open to public travel.” Only roadways within private gated properties, parking areas, and driving aisles within parking areas are exempt from the standards within the MUTCD. These standards also apply to street name signs on privately-maintained roadways open to the public. The manual does not prohibit ornamental sign posts, provided that they meet the requirements for crashworthiness (yielding or breakaway) when placed inside the clear zone. Many ornamental signs fail to meet the standards described in the MUTCD for size, color, retroreflectivity, and/or shape. Signs may be mounted in an ornamental frame as long as the sign itself conforms to the Manual on Uniform Traffic Control Devices.



These ornamental street name signs fail to meet MUTCD requirements for color, legibility, letter height, and/or retroreflectivity. The top sign is almost illegible under perfect conditions and will provide little if any benefit during nighttime hours.

Sign Vandalism

(adapted from TCHOA News, Tennessee County Highway Officials Association, April 4, 2011)

Vandals in Cumberland County hit two subdivisions in March stealing approximately 20 road signs. At a Region II Highway Officials meeting Scott Blaylock, Cumberland County Highway Superintendent, advised those in attendance that he has contacted all the scrap material dealers in his area asking them to be on the lookout for individuals trying to sell road sign blanks and posts. He had also told the news media he would prosecute anyone caught stealing county property. Several other highway officials reported they were continuing to have the same problem. The consensus was this problem will only get worse due to the actual increase in the sign size and scrap value of the new sign materials.

In July 1998 the Tennessee General Assembly passed T.C.A. 54-10-112 which classified the possession of municipal or county traffic control signs to be a Class B misdemeanor punishable by a fine of not more than \$500 per sign. However, many general session judges and municipal court judges may not be aware of the updated laws dealing with the theft of road signs. UT County Technical Advisory Service (CTAS) legal staff has summarized the applicable laws governing sign vandalism and theft. You may want to share the following statutes and penalties with your local judges.

(1) Possession of municipal or county traffic control signs—

Unlawful possession of traffic control signs is a Class B misdemeanor punishable by a fine of up to \$500. Each illegally possessed sign constitutes a separate offense. Upon conviction, the person must also pay restitution to the highway department for the cost of replacing the sign. This only applies to signs that have markings or other identification indicating which agency installed the sign and the date the sign was acquired or erected by the agency. Additionally, only signs acquired or erected after July 1, 1998 are covered by the statute. T.C.A. § 54-10-112.

(2) Possession of municipal or county street, road or highway signs—

Unlawful possession of street, road or highway signs is a Class B misdemeanor punishable by a fine of up to \$500. Each illegally possessed sign constitutes a separate offense. Upon conviction, the person must also pay restitution to the highway department for the cost of replacing the sign. This only applies to signs that have markings or other identification indicating which agency installed the sign and the date the sign was acquired or erected by the agency. Additionally, only signs acquired or erected after July 1, 1998 are covered by the statute. T.C.A. § 54-10-113.

(3) Vandalism of highway structures—

Knowingly vandalizing highway bridges, overpasses, tunnels, fences, walls, traffic control devices, signs or other public highway structures or buildings is a Class A misdemeanor. The penalty for a Class A misdemeanor is up to 11 months and 29 days imprisonment or a fine not exceeding \$2,500, or both. Any person who reports such illegal activity that leads to a conviction shall receive a \$250 reward. The county where the conviction occurs is responsible for paying the reward money. The reward money comes from the proceeds of the fines collected under the highway vandalism statute. The fines collected under the statute are to be placed in a dedicated county fund by the court clerk and are to be primarily used to pay the vandalism enforcement rewards. Any excess funds may be used for litter control programs upon adoption of a resolution by the county legislative body. T.C.A. § 54-1-134.

(4) Damaging or removing signs or historical markers—

Willfully or maliciously damaging or removing signs or historical markers along the state highway system, or affixing outdoor advertising to such signs or markers, is a Class C misdemeanor. Each month during which the offense is committed or continues constitutes a separate offense. The penalty for a Class C misdemeanor is up to 30 days of imprisonment or a fine not to exceed \$50, or both. T.C.A. §§ 54-21-110 and 54-21-113.

(5) Tampering with road construction signs and barricades—

Intentionally tampering with or disregarding signs and barricades placed on highways or roads in this state is a Class A Misdemeanor. The penalty for a Class A misdemeanor is up to 11 months and 29 days imprisonment or a fine not exceeding \$2,500, or both. T.C.A. § 39-17-108.

(6) Placing signs on fences bordering interstate highways—

Placing signs, banners, advertisements, etc. on fences or barriers along interstate highways is a Class C misdemeanor. This only applies if the fences or barriers are constructed or owned by a governmental entity. The penalty for a Class C misdemeanor is up to 30 days of imprisonment or a fine not to exceed \$50, or both. T.C.A. § 39-17-110.

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