MATES

MICHIGAN DEPARTMENT OF TRANSPORTATION

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I WANTED A BUD LIGHT!

Imagine, for a moment, what driving would be like if there were no traffic signals, no directional signs, no STOP or YIELD signs, no streetlighting, no paint stripes and no edge-of-pavement reflectors. As a driver approaching an intersection, how would you know whether to stop or hurry through? At points where roadways merge or diverge, how would you know what direction to take without the help of readily visible signing? Think of all the indicators that we presently take for granted that line our urban and rural roadways. The key to the effectiveness of these important driving aids depends upon their being visible under all conditions.

For traffic control devices to be visible requires the appropriate use and control of light. Photometry—'photo' meaning light, plus 'metry,' signifying measurement—is a branch of science dealing with the measurement of light properties. In the field of transportation, photometry concentrates on visibility as it bears upon roadway, air, and rail travel. Visibility of traffic control and motorist information devices is a critical area of highway photometrics. Nighttime urban visibility becomes increasingly complex with additional background lights competing to attract the motorist's attention and detracting from traffic control and motorist information indicators. As traffic volume and transportation environment continue to change, the challenge to the Department is to improve roadway visibility, traffic control, information transmission, and accident prevention.

Visual contrast, color, and brightness are the major components of visibility. Visual contrast can be improved by better lighting or enhanced brightness. Effective use of contrast is essential for sign legibility, for example, as the lettering must be very bright in comparison with the background—and it must be equally effective under both day and night conditions. The sign background, in turn, must be bright in comparison to the roadway environment in which it stands. Color and shape are restricted to a greater degree by nationally adopted standards in order that confusion be avoided when traveling from state to state.

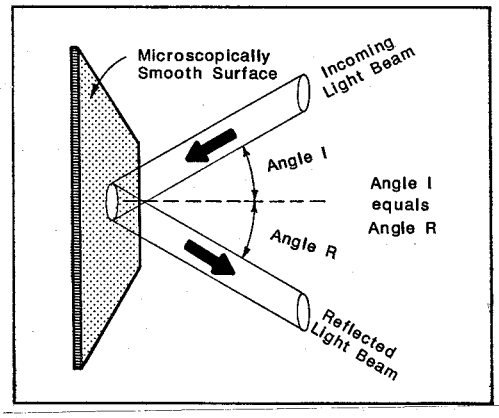


Figure 1.

Although we use many means for traffic control, such as signal lights, warning lights, lane striping, etc., the two most basic and familiar are signs and, in rural areas, the small post-mounted reflectorized discs or reflectorized sheets along the shoulders. In order for these items to be effective at night, light beams (from the motorists' headlamps) must be reflected directly back toward the eye of the driver. Smooth, glossy, mirror-like materials reflect the light beams away from the source (Fig. 1). The angle at which the beam leaves the surface is identical with the angle at which it strikes it. In order to redirect the light rays back to their source (the approaching car) our signs and reflectors employ various techniques.

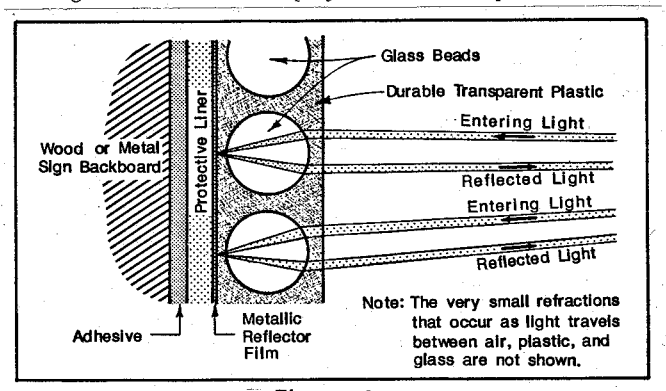


Figure 2.

The majority of traffic signs, from the familiar STOP sign to the large billboard-like freeway informational signs, are surfaced with reflectorized sheeting that is bonded to a metal or wood backing. The most common method used in reflectorized sign sheeting for reflecting light back to the driver is a layer of tiny spherical glass beads. These beads are cemented to a reflecting aluminum film and covered with a protective coating to prevent weather damage. Figure 2 shows how light rays are bent by the bead, reflected off the aluminized backing, bent again by the bead, and returned in the direction from which they came. You will note from the figure that it makes no difference at what angle the light enters; therefore, as the car approaches the sign (thus changing the angle between the headlights and the sign) the light is still reflected back toward the motorist.

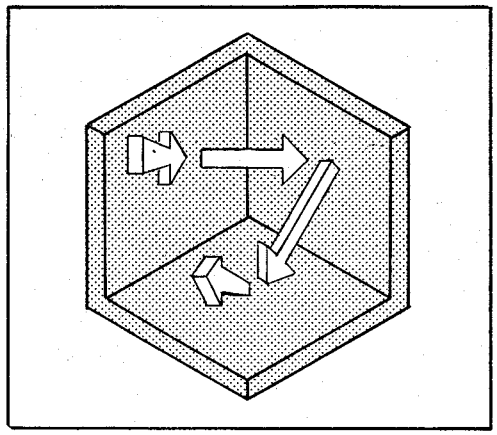


Figure 3.

There are times when a bright 'point of light' is required, as with our small reflecting discs and sheets that delineate the edge of the roadway. For these, we use another reflecting principle called 'cube corner' reflection. The cube corner is three adjoining, mutually perpendicular surfaces (Fig. 3) almost like the two walls and the floor in the corner of a room. Much larger than the beads, each

cube corner is adjacent to another and the material looks somewhat like a bee's honeycomb. As shown in Figure 3, the light beam reflects from each of the surfaces in succession and then returns in the originating direction. Unlike the glass beads, where we have seen that the angle of the entering light can be relatively large, the angles reflected from the cube corner reflectors are relatively small, but more concentrated. Thus, cube corner reflectors are used where they must be seen at a greater distance (such as pavement edge delineation) and beaded sheeting is used where light of lesser intensity must be returned at greater angles.

In order to ensure that the best, most economical sign material is being used on MDOT projects, the Department must choose amongst various grades or brightness of reflecting materials to select one that is adequate for a specific job. The Photometry Laboratory of M&T's Research Laboratory Section evaluates these materials through a testing program, to make sure that they meet MDOT specifications for reflectivity and color, and to ensure that we are getting the proper quality materials for our State system. A long (100 ft) indoor testing range is used to evaluate reflective materials (as well as signals and lighted signs). In a typical night driving situation, vehicle headlights are the predominant source of light, so a high-intensity 'reference lamp' is used to simulate headlights in the laboratory, and a light-detecting phototube is used to detect what a driver's eyes would see under actual conditions. The item or material to be tested is rotated horizontally and vertically so that the intensity of the reflected light (or emitted light in the case of signals or lighted signs) can be measured at various directions and angles. The data obtained are compared to the standard specifications for that particular material type, color, etc. Hundreds of samples are tested annually on this photometric range and, if specifications are not met, the material or item is rejected.

This, of course, is only a small part of the testing activities of the Photometry Laboratory; other areas not touched in this brief article include traffic signals and lamps, roadway and street overhead lighting, pavement marking paint and tape, warning flashers, and other light-generating or reflecting devices. Not only are such devices measured, but also 'light pollution,' or glare is determined. Glare is light that interferes with visibility, and is a problem particularly in our urban areas. Control of glare in signing and lighting situations is another area of concern of our staff.

Laboratory personnel also conduct field investigations to evaluate visibility of signs, lights, and other objects at accident sites, or at sites where excessive glare from signs, etc., has been reported. Field evaluations also play an important role in providing actual roadway situations and comparing their results with those obtained in the laboratory.

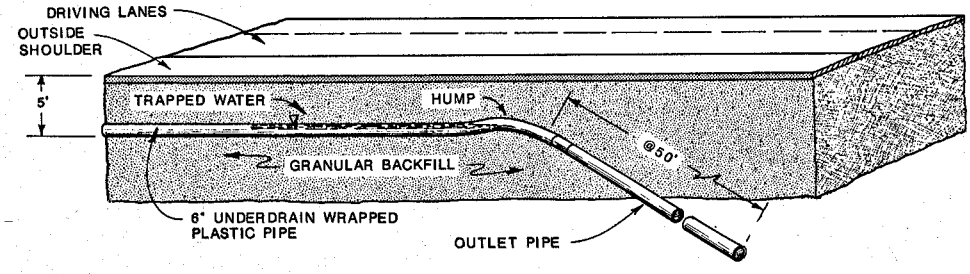
Our Photometry group represents another specialized, though very important, area of service provided to the Department in fulfilling long-range goals of safer, more pleasant travelling.

-George Smith

DRAINAGE OF SUBGRADE UNDERCUTS

Several subgrade undercut areas on I 96 in Ionia County were investigated by the Soils, Bituminous and Pavement Performance Unit. The undercuts were provided with 6-in. fabric-wrapped edge drains connected to outlets terminating near the ditch bottom. Borings in the undercut area revealed a saturated condition in the lower 1 ft of the granular backfill despite little or no flow of water coming from the pipe.

On further excavation, a hump was found in the pipe at the bend where it entered the side outlet trench as shown in the sketch. Even though the entire outlet pipe was excavated in only one undercut the other five undercuts on this project have saturated backfills (bottom 1 ft) with little or no flow coming from the outlets.



District Soils and Materials Engineers should check any similar undercut drains so the problem can be corrected. In the case cited, exposure of the outlet pipe with a backhoe (provided by Maintenance) plus a little hand shovel work permitted the hump to be pushed down into a proper grade for drainage.

-Jack DeFoe

TECHADVISORIES

The brief information items that follow here are intended to aid MDOT technologists by advising or clarifying, for them, current technical developments, changes or other activities that may affect their technical duties or responsibilities.

SPECIFICATION UPDATE

Mixers Used to Stabilize In-Place Bituminous Aggregate Base Course, 4.07(1), dated 01-12-89. A special provision calling for this equipment was used on selected projects in 1987 and 1988 to gain experience with the equipment. It presented no significant problems and is, therefore, being issued as a supplemental specification.

NEW MATERIALS ACTION

The New Materials Committee recently:

Approved

Monsanto Hydraway Drain Drop Tee Outlet
Armorflex Erosion Control System
Ero-Mat Erosion Control Blanket
Polyplate Engineered Composite Sign Panel

Approved for Trial Installation

Agro-Tack
Matrex Geogrid
Tackifier Fin A500 Hydro-Stik
Nu Wool Hydroseeding Mulch
TIC (Transverse Interflow Channel)

It should be noted that some products may have restrictions regarding use. For details please contact Don Malott at (517) 322-5687.

This document is disseminated as an element of MDOT's technical transfer program. It is intended primarily as a means for timely transfer of technical information to those MDOT technologists engaged in transportation design, construction, maintenance, operation, and program development. Suggestions or questions from district or central office technologists concerning MATES subjects are invited and should be directed to M&T's Technology Transfer Unit.

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