

AUTOFLAGGER Research Project

- Final Report -

Original Report Dated April, 2000 – Finalized February 2005

Background:

In June of 1996 the Minnesota Department of Transportation (Mn/DOT) requested permission from the Federal Highway Administration (FHWA) to experiment with a new traffic control device called the AUTOFLAGGER. This submittal was made under section 1A-6 “*Manual Changes, Interpretations and Authority to Experiment*” of the June 1, 1996 update to the 1991 Minnesota Manual on Uniform traffic Control Devices. Permission to experiment was officially granted on September 18, 1996. Continuation of the experimentation was granted January, 2003.

The AUTOFLAGGER is a device intended to act as an enhancement to the flagging operation on two lane roadways by lowering the overall exposure of the flaggers to injury or death. Removing the flaggers from the traffic lane and repositioning them in a location away from the flow of traffic accomplish this reduction in exposure.

When used as intended by the manufacturer a unit is placed at each end of the job-site and the single flagger takes a position within the work area, which provides an unobstructed view of both units. From this location the flagger can now control all traffic entering the project from either direction.



Original Testing Criteria:

The request to experiment contained guidelines to allow the testing of the device while at the same time providing a degree of protection for both the workers and the motorists. The testing was contingent upon the following:

- * The flagger should always remain in a close and safe proximity to the “AUTOFLAGGER” and remain visible to the driver. The flagger must provide all flagger hand signals. These actions indicate to approaching drivers that the “AUTOFLAGGER” is an active traffic control device used by the flagger rather than a temporary stop sign, which permits a driver to proceed after stopping. The use of the remote controlled stop sign should be to enhance the efficiency and safety of the flagger and the flagging operations but not a substitute for a flagger.
- * The device should not be located as to cause a hazard to highway users, flaggers or other workers. For example it should not be located in the travel lane.

Every effort was made to follow these guidelines in the selection of test sites and in the operation of the AUTOFLAGGER devices.

To document the response of both flaggers and motorists to the AUTOFLAGGER a number of documents were developed for use during the field testing. These documents consisted of the following:

- * *Motorist survey card.* This pre-addressed, postage paid card was handed out to the first vehicle stopped in each queue. It contained a number of questions intended to determine the motorists' opinion of the device being tested. The card was slightly modified in 1997 to clear up some confusion as to how the questions should be answered.
- * *Observation Report.* This document was filled out by an observer sent out from the Office of Traffic Engineering to observe the operation of the equipment, the actions of the flaggers and the reactions of the motorists.
- * *Vehicle Count Sheet.* This document was filled out by the crews working on the project. It includes questions about the operation of the equipment as well as a count of the vehicles passing through the project.

Field Tests:

As stated earlier, final permission to experiment was not received until September 18, 1996. Because permission was granted so late in the construction season only two projects were available that year. NOTE: All projects reviewed took place on two lane roadways.

1996 Testing Sites

- *Winona Bridge:* This project took place on the MNTH 43 bridge over the Mississippi River in Winona. It consisted of repairing a number of expansion joints and repairing some noisy expansion plates. The work started on September 16th and was completed in one day.
- *Wabasha Bridge:* This project took place on the MNTH 60 bridge over the Mississippi River in Wabasha. It consisted of repairing a number of structural members on the truss bridge. The work took place over an 11-day period during which the AUTOFLAGGER was used for three days. This extended period allowed time for a comparison between a standard flagging operation and the AUTOFLAGGER device.

1997 Testing Sites

- *MNTH96:* This project took place on MNTH 96 west of the city of Stillwater. It consisted of repairing a culvert by jacking a plastic sleeve inside the in-place structure. The work started on July 10th and took only one day to complete.
- *St. Louis River Bridge:* This project took place on the USTH 2 bridge over the St. Louis River west of the junction with MNTH 33. It consisted of inspecting the structural integrity

of the bridge by utilizing a “snooper” device. The work started on August 11th and took two days to complete.

- *Jackson Street Bridge:* This project took place on Jackson Street in the City of St. Paul. It consisted of concrete rehab work on the north approach panel to the bridge. The work started on October 28th and lasted only one day.

The response to survey cards for this project was small, but noticeably negative. This project was the only non-Mn/DOT job we looked at and we believe this poor response is directly attributable to the traffic control setup followed by the City of St. Paul employees. During our review of the setup we observed:

- Non-standard advance signing both in the number of signs, the messages displayed and their location prior to the work area. Advance signs did not warn of a flagging operation, they were placed in obstructed locations and because of the number used, were placed too close to the actual work to give the motorist time to respond.
- Improper placement of traffic control devices to clearly inform the approaching drivers that a lane of traffic was closed. Traffic cones were not placed correctly in the transition area or alongside the work in the extended lane closure.
- Poor control of traffic by the flaggers. The persons running the AUTOFLAGGER were not trained in proper flagging techniques. These individuals were bridge maintenance workers who are normally not responsible for any type of flagging. We attempted to correct as many of the deficiencies as possible (repositioning signs and cones, requesting additional signs be brought to the site etc.) but our requests were too late for this one day operation.

We have included a description of this city location in the report for two reasons. First, for completeness to demonstrate to the FHWA how few locations we were able to test. And secondly, as a comparison to show that when the devices are utilized correctly with the proper advance signing, traffic control devices and trained flaggers the AUTOFLAGGER functioned precisely as predicted. Drivers were not surprised by the presence of the device, they reacted appropriately and they endorsed the continued use of the device.

The five listed projects represent all locations where the AUTOFLAGGER was tested during the initial two years of testing where observation and motorist information was documented.

The following summary gives the number (and percentage) of responses for each question for all the survey cards returned during the testing. Because of some confusion on the part of the persons filling out the cards, the number of responses does not always match the number of cards returned.

Total Respondents: 275 survey cards received (from all 5 sites)

YES 230 (84%) NO 44 (16%) **Question 1.** As you approached the intersection, did you expect to see a flagger controlling traffic?

YES 41 (15%) NO 231 (85%) **Question 2.** Were you in any way confused when you saw a mechanical device rather than a person controlling traffic?

		Question 3. If the worker had not been near the equipment, would you have:
	68 (23%)	(a) stopped, then proceeded as if it were a standard stop sign, or
	222 (77%)	(b) stopped, then waited for a SLOW sign as if this were a standard flagging operation?
YES 251 (92%)	NO 21 (8%)	Question 4. Did you think the device clearly and effectively controlled the flow of traffic in this work zone?
		Question 5. Should Mn/DOT:
	218 (72%)	(a) continue using this device as it is,
	50 (16%)	(b) modify this device before further use, or
	36 (12%)	(c) use only people to control traffic?

Copies of the Observation Reports, comments from the some project superintendents or operators, a summary of the responses from the survey cards, a listing of the comments received on these cards can be made available upon request.

Mn/DOT made a concerted effort to locate a large number of test sites for the 1997 season. Initial response to the request for test sites was high but the actual number of sites quickly dropped to three. This small number of test sites is a direct result of the restrictions placed on the use of the equipment during testing.



Numerous inquiries were made to the Office of Traffic Engineering about the possibility of using this equipment on both construction and maintenance projects across the state. Requests for more information came from both Mn/DOT and local agencies. These agencies anticipated using this device as the manufacturer recommended such that only one flagger would be needed to control both directions of traffic. This would effectively free up one additional worker for the project. Interest quickly evaporated when the project personnel found out they would not “gain” a worker through the use of this device during this testing phase.

Modified Testing Criteria:

In 1999, Mn/DOT modified the original 1996 testing conditions, and found the compliance to the device, and worker safety were both greatly enhanced. The modifications included:

1. Originally the devices were to be placed on the roadway shoulder away from the traffic lane. In a number of our locations (specifically the bridge sites) the lack of shoulders prevented us from positioning the device on the shoulder as called for. We found that these sites worked better than the locations where the devices were placed on the shoulder. When the device slightly encroaches into the lane it provides a clear message that this lane is closed to traffic and the motorist must share the other traffic lane. For this reason, Mn/DOT recommends that future

usage allow for the positioning of the device partially encroaching the traffic lane.

2. The original test criteria also stated that “a flagger must be positioned near each device”.

Mn/DOT feels that the device is performing as intended by the manufacturer and that it may be safely operated with a single flagger located away from the devices within visual limitations of the site. In general, the single operator works safely when the distance between AUTOFLAGGER devices is less than 1000 feet. This distance is highly dependent on the operators ability to clearly see the devices and approaching traffic from both directions. This operator’s position, located within the work zone area, provides a hazard free location for the operator to work. Using the equipment in this manner for several years with no incidents of property damage or injuries, has successfully demonstrated that the AUTOFLAGGER does lower the flagger’s exposure to hazards while still providing the necessary messages to motorists.

These changes have been the key to our determination that the device can ever be used as an effective traffic control device and not simply “a mechanical flagging paddle”.

Driver Behavior:

In 1999, to validate the compliance to the AUTOFLAGGER device, four locations were videotaped while traffic was being controlled by the AUTOFLAGGER device. The test locations were in rural Minnesota near Sleepy Eye, Windom, Northfield and Zumbrota. During this time, we recorded driver behavior on video for 15 hours. Analysis of this video revealed that during the 15 hours we stopped 313 queues of traffic and observed 5 violations of the AUTOFLAGGER. None of these violations resulted in a crash or endangered workers or other motorists. Workers have stated that this is not out of the ordinary for any flagging operations. However, we do not have data on the number of violations occurring during normal flagging on these types of projects.

Conclusions:

After reviewing the responses received on the motorist cards, the comments obtained from the various flaggers who used the device, from field review observations made by Traffic Engineering staff and review of the driver behavior videos, Mn/DOT believes this device has demonstrated it fills the need originally set forth. The AUTOFLAGGER device provides a useful tool which when used correctly and can enhance the safety of flaggers in work zones on two lane roadways.



The positive responses from the motorists were much higher than we would have expected for a uniquely different type of traffic control device. With increased exposure and some sort of public awareness campaign we believe the acceptance of this device will only increase.

The response from the workers has been undeniably positive. The flaggers see this device as a way of removing themselves from the dangerous activity of flagging. Some of the comments they made regarding the equipment were “it is easy to set up and use”, “clearly understandable” and “safe”. As we all know, if the worker does not like or trust a device it will either not be used or used incorrectly. The fact that the flaggers who tried this device were so overwhelmingly positive says something about the future acceptance by other workers.

From the observations and videos of driver’s behavior made of the equipment while it was functioning it is clear that the AUTOFLAGGER does not present an “additional element of confusion” in a work zone. An extremely small number of people failed to immediately understand what the device represented and how to correctly respond to it. As mentioned earlier, this level of comfort will only increase as the device becomes more readily used.

Since 1999, we have continued to use the AUTOFLAGGER device on many maintenance projects statewide. Thousands of hours of flagging have been logged with this device. Every Mn/DOT District has tried the device and the weather conditions have varied from sunny and hot to cold and dark. During the extended time this device has been used, NO crashes have occurred, driver compliance has been at least as good as with human flaggers, and most importantly, NO flaggers were placed in dangerous traffic conditions.

In the future, the State of Minnesota intends to utilize the AUTOFLAGGER device as a replacement for flaggers on projects where the conditions fall within the specified restrictions of the device. We will therefore consider usage of the AUTOFLAGGER device whenever project conditions fall within these limits as listed:

- 2-Lane 2-Way roadways closed to one lane of traffic.
- ADT less than 1500 vehicles per day.
- Lane closures distances of 800 feet or less for single operator and engineering judgment for greater distances and multiple operators.
- The operator(s) shall have unobstructed view of the device(s) and the approaching traffic in both directions.

Because of the device’s acceptance and compliance by drivers, the proven field operation reliability, worker acceptance, and inherent safety benefits to the flagger(s), the State of Minnesota intends to fully adopt the AUTOFLAGGER device into the MN MUTCD. The device is now designated by the FHWA as an Automated Flagging Assistance Device (AFAD) which includes 2 varieties of devices which ultimately perform the same function, and Minnesota has requested Interim Approval of continued use of the AFADs until the Interim Rule IA-4R is fully adopted.