EVALUATION OF EXPERIMENTAL RUMBLE STRIP AREAS IN LOUISIANA

Interim Report No. 1

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ABSTRACT

This interim report was prepared to provide a review of nineteen rumble strip areas installed experimentally in Louisiana between August 1982 and September 1983. Situated randomly throughout central and southern Louisiana, construction of these coarse-textured, exposed aggregate rumble strip areas was accomplished by district maintenance forces using conventional asphalt spraying equipment.

The purpose of this study is to develop an economical supplement to typical traffic control devices, such as signs or signalization, where a substantial reduction in speed is required to divert driver attention to a potentially hazardous intersection or situation. It is hoped that the intermittent pattern of coarse-textured, exposed aggregate rumble strip areas will increase driver reaction time by providing audible and tactile stimuli to augment or reinforce standard visual traffic control devices. The measure of effectiveness of this procedure would be a reduction in the type and/or severity of accidents before and after installation.

As of this writing, there are nineteen rumble strip areas ranging from one to two years old installed for evaluation. More installations are projected for the near future and will be cited in the final report. This report addresses major areas of concern which focus on installation problems/techniques, durability, maintenance effectiveness, aggregate loss determinations, accident reduction and development of rejuvenation procedures.

METRIC CONVERSION CHART

To convert U.S. Units to Metric Units (S.I.), the following conversion factors should be noted:

Multiply U.S. Units	By	To Obtain Metric Units
	LENGTH	
inches (in.)	2.5400	centimeters (cm.)
feet (ft.)	0.3048	meters (m.)
yards (yd.)	0.9144	meters (m.)
miles (mi.)	1.6090	kilometers (km.)
	AREA	
square inches (in^2)	6.4516	square centimeters (cm^2)
square feet (ft^2)	0.0929	square meters (m^2)
square yards (yd^2)	0.8361	square meters (m^2)
	VOLUME	
cubic inches (in^3)	16.3872	cubic centimeters (cm^3)
cubic feet (ft^3)	0.0283	cubic meters (m^3)
cubic feet (ft^3)	28.3162	liters (l.)
cubic yards (yd^3)	0.7646	cubic meters (m^3)
fluid ounces (fl. oz.)	29.57	milliliters (ml.)
gallons (gal.)	3.7853	liters (l.)
	MASS (WEIGHT)	
pounds (lb.)	0.4536	kilograms (kg.)
ounces (oz.)	28.3500	grams (g.)
	PRESSURE	
pounds per square inch (p.s.i.)	0.07030	kilograms per square centimeters (kg/cm^2)
pounds per square inch (p.s.i.)	0.006894	mega pascal (MPa)
	DENSITY	
pounds per cubic yard (lb/yd^3)	0.5933	kilograms per cubic meter (kg/m^3)
bags of cement per cubic yard (cement bags/yd^3)	55.7600	kilograms per cubic meter (kg/m^3)
	TEMPERATURE	
degrees fahrenheit (°F.)	5/9 (°F.-32)	degrees celsius (°C.) or centigrade

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IMPLEMENTATION

The Department is considering forming a policy for the use of rumble strip areas on state highways. Four trial installations, constructed by district maintenance crews in 1979, received favorable response. Nineteen additional rumble strip areas have been installed and are undergoing evaluation by the Research and Development Section. This interim report provides the current status of these installations, defines the methods of evaluation and establishes procedures for future performance appraisals.

INTRODUCTION

During the late 1970s, the Department recognized that many intersections with low traffic volume, many of which had good alignment and visibility, also had unexpectedly high accident rates. These conditions did not warrant costly corrective measures, such as signals, to augment existing traffic control devices. Frequent lack of driver response to these devices, however, dictated that an alternative be developed.

In a poll of other states the Department acquired several promising methods utilizing delineators or coarse-textured aggregate placed in a series of intermittent intervals, i.e., "rumble strip areas." One report (1)* stated that rumble strip areas provided audible and tactile stimuli to alert drivers to potentially hazardous intersections or situations and tended to increase driver reaction time, whereas existing visual stimuli were otherwise largely ineffective.

Based upon the findings and recommendations of others (2), the Department's Research and Development Section developed an experimental rumble strip area configuration (Figure 1). In October 1979, with the assistance of district maintenance forces, four experimental coarse-textured, exposed aggregate rumble strip areas were installed on low volume rural roads for interim evaluation. After one year of satisfactory performance, rumble strip areas were approved for experimental installation on a statewide basis. Subsequently, nineteen rumble strip areas have been installed throughout central and southern Louisiana for evaluation purposes. This interim report presents the performance results of those installations.

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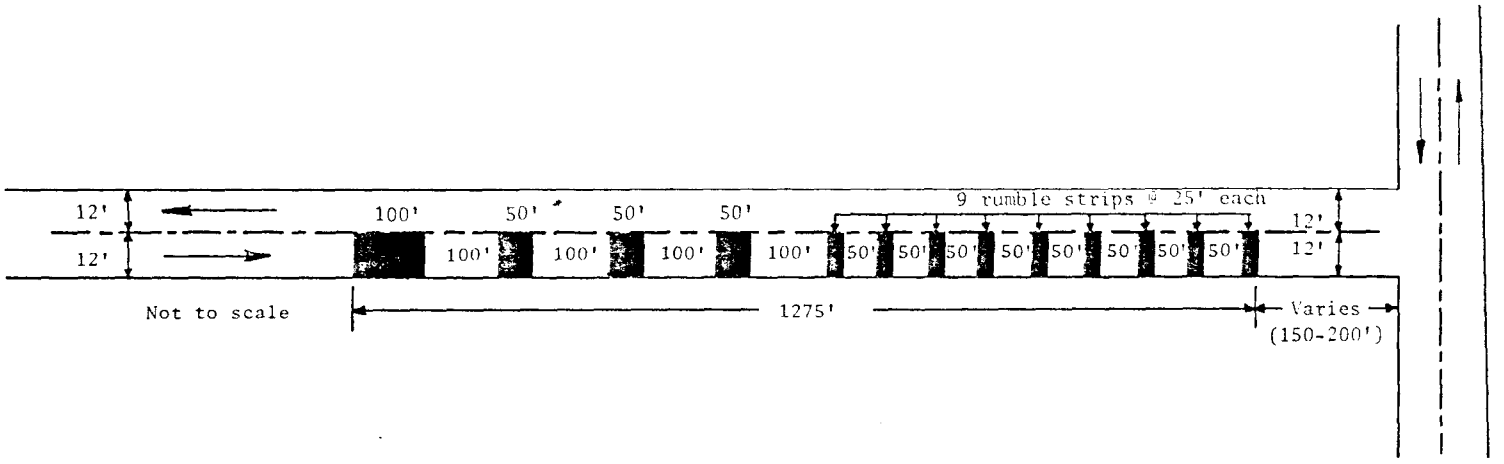
*Underlined numbers in parentheses refer to list of references.



Note: 1) Shaded areas denote exposed aggregate surfacing (rumble strips).

2) Rumble strips should be sealed with a fog-seal coat after compaction.

3) "Experimental Surface Area Ahead" signs should be erected in advance of the experimental section.

Exposed aggregate (sandstone preferred) surfacing approximate gradation:

1" - 100% passing

3/4" - 20 to 60% passing

5/8" - 0 to 10% passing

(1 x 100') + (3 x 50') + (9 x 25') = 475' Total length of rumble areas

(475' x 12') ÷ 9 = 633 sq. yd. Total area of rumble areas

633 x 45 lbs. aggregate/sq. yd. = 28,485 lbs. or approximately 15 tons stone

633 x 0.45 gals. asphalt/sq. yd. = 285 gallons or approximately 300 gals. of asphalt

Revised 1/9/84
SGB:AIM

Figure 1

Experimental Rumble Strip Area Configuration

METHODOLOGY

SITE SELECTION

In December 1980, the Department sent a memorandum to each of its nine District Traffic Operations Engineers requesting that they designate five potential intersections for installation of rumble strip areas on an experimental basis. These locations were to be restricted to rural two-lane asphaltic concrete or bituminous surface treatment roadways. Selections were to be based upon previous traffic studies, accident occurrences or other conditions that indicated a need to warn motorists of an approaching stop condition.

MATERIALS EVALUATED

During the site selection process, information was obtained concerning various rumble strip area configurations constructed by other states (1) (2). From these findings, an experimental rumble strip area was developed (Figure 1). A source of aggregate supply and aggregate gradation specifications were developed and installation techniques and procedures were established (Appendix). These guidelines were preceded by installation of four experimental rumble strip areas in the Chase District in 1979. The intermittent pattern rumble strip areas were found to be effective in producing a series of changes in sensation, unlike a single stimuli as would a long, continuous rumble area. Based upon these installations, the best aggregate appeared to be 3/4" (nominal size) washed sandstone. Each District was then instructed to order 120 tons of aggregate, enough to complete five installations using the proposed configuration, and to plan for installation on an experimental basis at the earliest convenience by their respective maintenance forces. As of this writing, nineteen installations have been completed and are undergoing evaluation by the Research and Development Section. More installations are anticipated in the near future.

FIELD INSTALLATION

The coarse, exposed aggregate rumble strip areas were installed by district maintenance forces utilizing conventional asphalt distributing equipment. The intermittent pattern was measured and masked off using conventional brown wrapping paper (Figure 2) to protect the centerline markings and to provide a square leading edge.

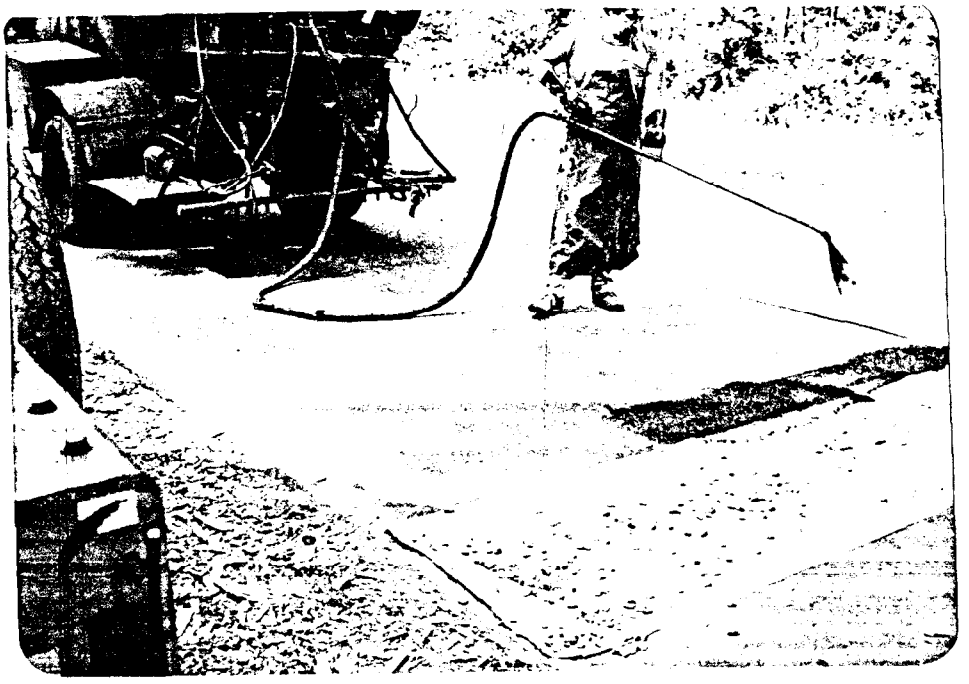


Figure 2

Cationic Asphalt Slurry Application

Cationic asphalt was then applied at a rate of approximately 0.45 gal./sq. yd. to provide a slurry slightly thicker than that used for typical surface treatment applications (Figure 3).

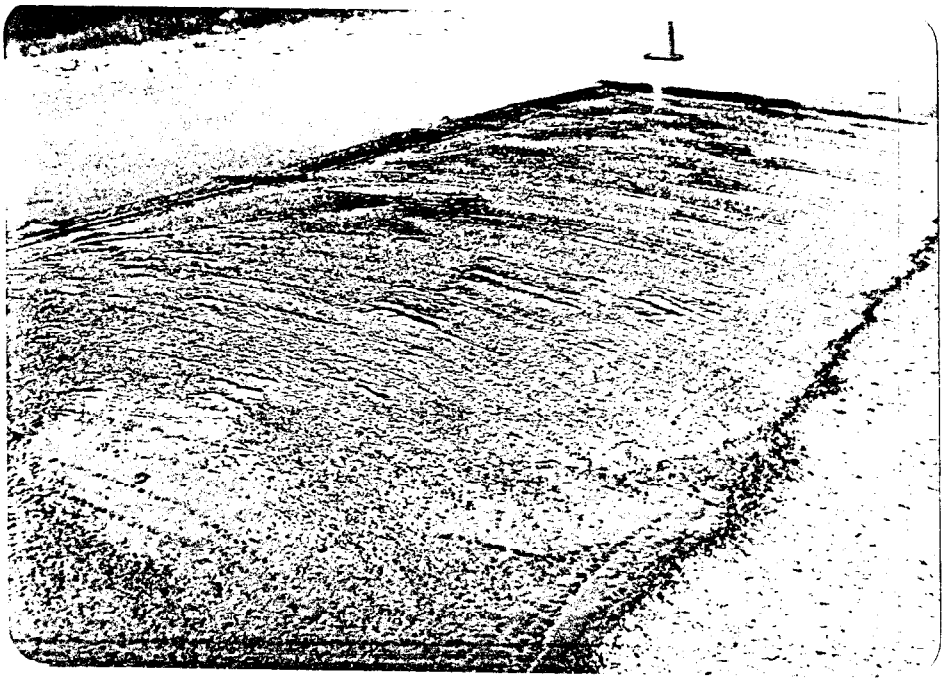


Figure 3

Application Rate of 0.45 Gal./Sq. Yd.

This thicker slurry was used in an effort to enhance adhesion to 3/4" (nominal size) aggregate being used. It was applied with either hand-wand distributors (Figure 2) or with conventional asphalt spray bar distributing equipment (Figure 4). There has been no discernable difference noted in aggregate retention relative to the method of application.

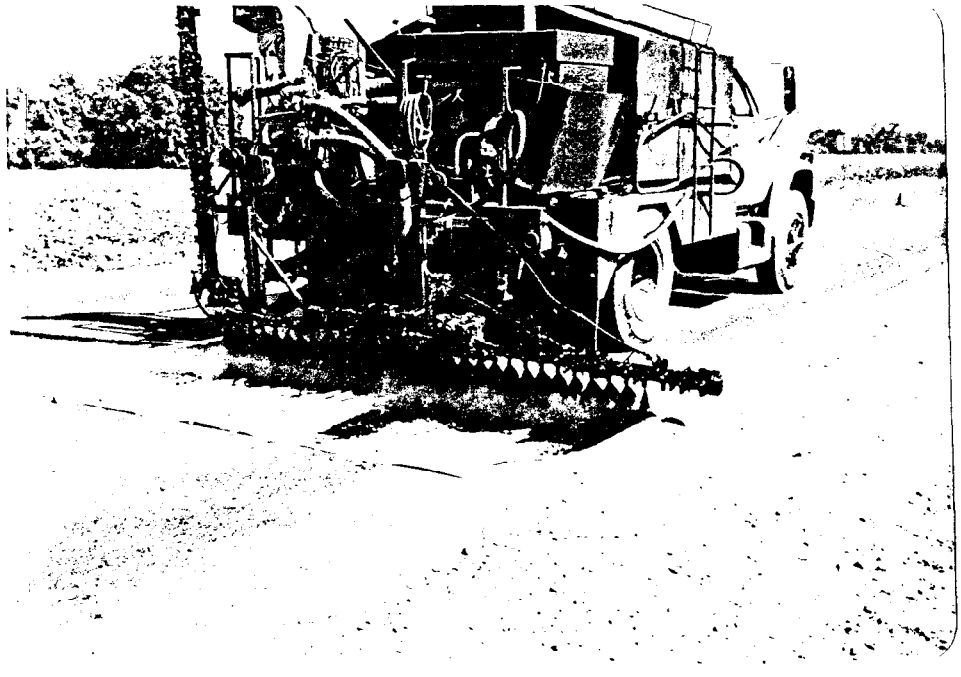


Figure 4

Asphalt Distributor Application

On four of the rumble strip areas, an experimental polymerized asphalt was used in lieu of conventional cationic emulsion. The addition of polymers to the asphalt creates a chemical reaction that is intended to strengthen the cohesion of the binder and impart an elastomeric characteristic that enhances the binder's adhesion. A more rapid, pliable "set" was achieved that permitted opening the rumble strip areas to traffic in almost half the time required by the conventional methods. Comparative evaluations are being conducted to determine the effectiveness of this material for future applications on HMAC as well as plant mix seal coats.

Coarse, washed sandstone of the following approximate gradations were distributed:

1"	-	100% passing
3/4"	-	20% to 60% passing
5/8"	-	0% to 10% passing

This washed 3/4" (nominal size) exposed aggregate was chosen based upon the favorable results from the four experimental rumble strip areas installed in the Chase District during 1979. Although most of the aggregate was applied using spreader boxes, at least one district was successful in spreading and distributing it manually (Figure 5).

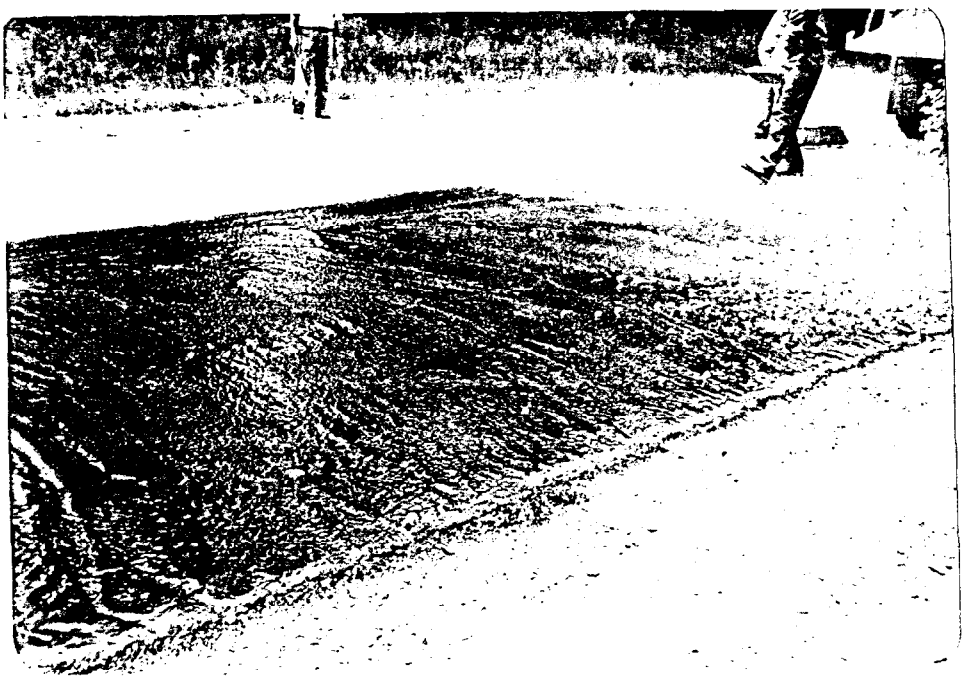


Figure 5

Manual Application of Coarse Aggregate

After application by either method, stiff push brooms were used to spread the aggregate uniformly to eliminate "bald spots" (Figure 6).

Figure 6

Distribution of Aggregate Prior to Rolling

Application of excessive aggregate always contributed to rapid loss once opened to traffic, with approximately 5 - 10% being strewn onto the shoulder or into the opposite lane overnight (Figure 7). Experience gained to date can be utilized in the application of future installations to maximize coverage and minimize waste. Distribution of aggregate with excessive fines or deleterious material should be avoided. Stockpiles of materials should be maintained on paved areas wherever possible and used as soon after receipt from the quarry as is practical.

Figure 7

Initial Overnight Loss of Loose Aggregate

The rumble strip area was rolled using either steel wheel or pneumatic rollers (Figure 8). While both have been successful, the pneumatic roller is preferred. Large steel wheel rollers should be emptied of ballast. Even using light steel rollers, fracturing of the aggregate, which may reduce the effectiveness of the rumble strips, has been noted. Generally, six to eight overlapping passes appear to give adequate penetration into the emulsion. Rolling should be reduced significantly when using polymerized cationic as its more rapid "set" and tackiness tends to retain the aggregate more readily.

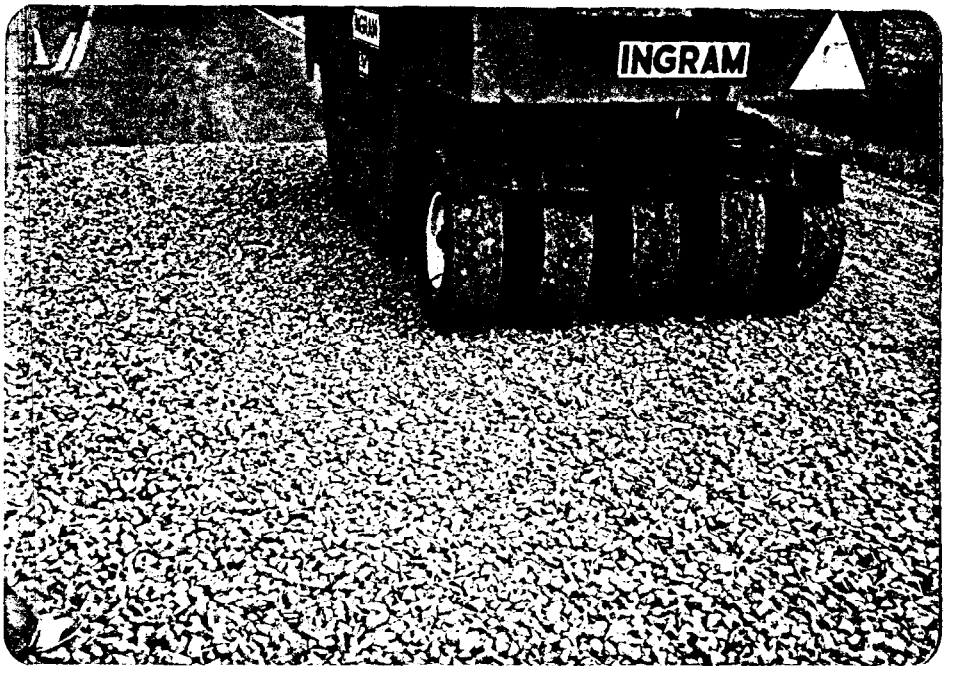


Figure 8

Pneumatic Roller Embedding Coarse Aggregate

Traffic should be kept off the freshly compacted rumble strip areas as long as practical. Due to the close proximity of busy intersections, it has been necessary to open several "bands" of strips to traffic almost immediately because of the excessive length of the construction train. This process is used for the polymerized asphalt, as it gets tacky and resilient within 10 to 20 minutes, depending upon temperature and humidity, and has more elasticity to insure maximum aggregate retention. The use of a flagman is recommended to keep speeds down and to give the emulsion time to set-up.

FIELD EVALUATION

Evaluation of completed rumble strip area installations consisted of visual inspection of the overall condition and effectiveness of the exposed aggregate surfacing. Of primary consideration was the retention of aggregate, especially in proximity of the wheelpaths. Other areas of concern were the cause of excessive "bald spots" and "bleeding" of the cationic emulsion that literally engulfed the aggregate, greatly reducing their effectiveness. In general, periodic overall visual inspection was conducted to determine the cause of any condition that might create a loss of the audible or tactile stimuli thereby reducing the effectiveness of the rumble strip areas as a supplemental traffic control technique.

Secondly, in order to make a more definitive aggregate loss determination, a photo-box utilizing a 35 mm camera with a remote flash unit was employed. At each site, five locations were selected at random in alternating wheelpaths throughout the section. Using a template oversprayed with paint to identify and locate each selected test spot, the photo-box was used to photo-document the exposed aggregate with a superimposed grid pattern. These slides were taken initially after a two-week "wearing-in" period following installation and then annually during the anniversary month. These were then compared to determine the loss rate of nominal large size aggregate and establish the rate and percent of loss per annum.

Other factors to be evaluated are traffic volume, alignment, sight obstructions, the type, severity and frequency of accidents (before and after installation) and public reaction to the improvements. Sufficient time has not lapsed as of this writing to provide an in-depth account of the effects of these variables. A more concise determination will be presented in the final report.

PERFORMANCE EVALUATIONS

This interim report provides individual site location descriptions, the number, type and severity of accidents for a period of two years prior to installation and any significant features or deviations from the typical recommended installation layout (Figure 1). As most of these rumble strip areas are less than two years old, observations relative to durability and effectiveness will be kept general in nature. A comprehensive final report will address these topics in depth after sufficient time has lapsed to provide a more objective determination.

Site No. 1 and 2

The first installation of rumble strip areas was on La. 3225 where it intersects with U.S. 167 in Alexandria, Louisiana (Figure 9).

Figure 9

Site No. 1 and 2 on La. 3225 at Alexandria

At this location, U.S. 167 is a four-lane, divided major north-south arterial highway with raised medians and turn lanes.

La. 3225 is a two-lane undivided city street (Figure 9) and is controlled with stop signs and an overhead flashing red light in the center of the intersection.

Although this same light has flashing amber for U.S. 167 through traffic, the intersection is situated on an elevated curve (Figure 10) and is partially obscured from view. The majority of accidents occur when the high speed through traffic disregards the amber caution light and collides with traffic ignoring the stop signs and flashing red light.

Figure 10

Elevated Curve of Eastbound Approach of La. 3225

Although there were no fatality accidents, seventeen injury accidents with property damage prompted selection of this location for installation of rumble strip areas on La. 3225 on both approaches to U.S. 167. It was hoped that if drivers were more attentive to the stop situation, the high incidence of right-angle and sideswipe accidents might be averted. Accidents subsequent to installation, however, will not be available from the master computer files until the latter part of this year.

Initial driver reactions prompted driving on the improved HMAC shoulders (Figure 11) or swerving (intentionally) into the opposite lane facing oncoming traffic rather than traverse the rumble strip areas. This is an indication that drivers were alerted to an impending situation. It is too early to tell if this increased the frequency of complete stops at this heavily traveled intersection.

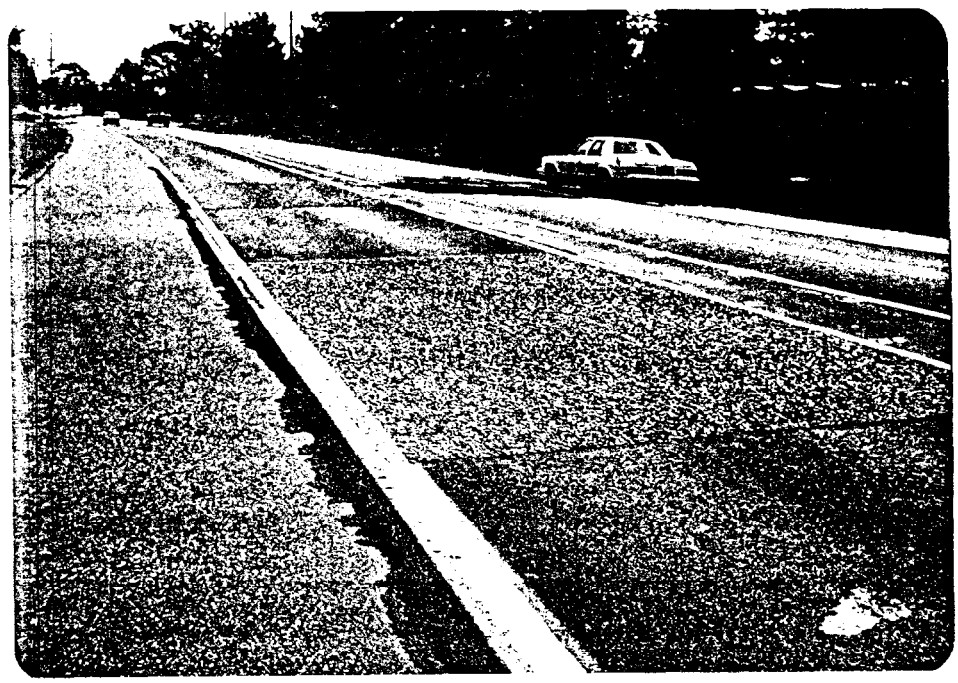


Figure 11

Improved shoulders drivers utilize to avoid the rumble strip areas on La. 3225

Although the posted speed limit is 35 mph, repeated passes were made at 50 mph in a short-wheelbase, four-wheel-drive truck and a full-size departmental auto without noticing any tendency of loss of control or undue driver discomfort. Within either vehicle, only a 7 - 9 decibel increase in noise level was noted on a meter situated at driver's ear level. Following installation, there were no reports of vehicle damage or windshield breakage that might have been attributed to loose aggregate.

After two years, only negligible aggregate loss is noted. Local inquiries indicate that overall response is generally favorable to this installation as a safety feature.

Site No. 3

At this intersection with U.S. 190, La. 3158 is a two-lane country road bordered with dense trees and heavy underbrush (Figure 12). Opposite the stop sign of this "T" intersection is a deep ditch with a large concrete culvert. Three years prior to installation of the rumble strip areas, there were seventeen instances of cars running through the intersection into the ditch, most of them striking the culvert as well. While only two accident reports indicated severe injuries, all cited extensive damage to the undercarriage of the vehicle. Additionally, there were five sideswipe or right-angle collisions recorded attributed to failure to stop at the intersection.

Figure 12

Site No. 3 Intersection of La. 3158 at Hammond

Virtually all of these accidents occurred on Saturday or Sunday night between midnight and 5:00 a.m. Most operators had been drinking and fog or rain were the typical weather conditions. There are no traffic control devices other than the stop sign. There is only negligible aggregate loss since installation in September 1982 on this lightly traveled country road.

Site No. 4

At this location (Figure 13), La. 28 is a moderately heavily traveled country road that terminates at its intersection with La. 84 adjacent to a levee. Although there are no sight obstructions, vehicles have a tendency to approach the intersection too fast and overshoot La. 48, coming to rest on the levee or overturning in the painted turn lanes.

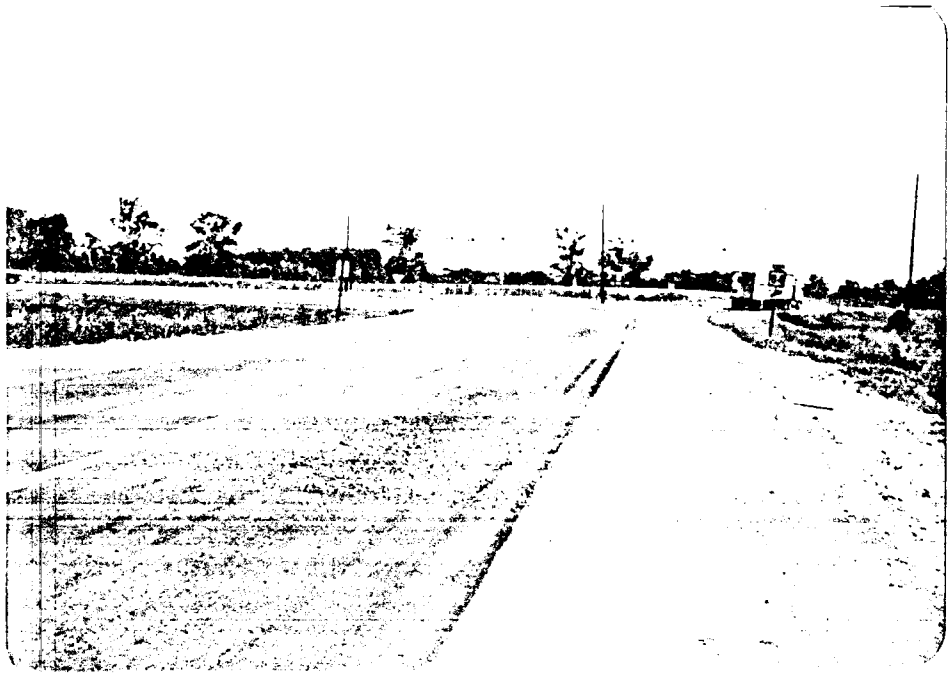


Figure 13

Site No. 4 Intersection of La. 28 at Archie

Prior to installation, there were only three accident reports on file. The first two were right-angle collisions with other automobiles and the third was a tractor-trailer that overturned while trying to negotiate a right-hand turn. Two reports indicated that

the drivers were apparently asleep at the wheel. The third involved an intoxicated driver whose car ran over the stop sign and hit a utility pole. Prior to installation of this rumble strip area, the only traffic control devices were a stop sign and a flashing amber caution light.

Site No. 5

At the subject location (Figure 14), La. 126 is a country road that intersects La. 124 in a curve. At night this curve presents a sight obstruction for drivers on La. 124. The absence of advance warning lights to warn drivers of the impending stop situation on La. 124 was responsible for three right-angle collisions. A fourth accident at 2:00 a.m., involved a pick-up that overshot the intersection, was airborne for 60 feet and landed upside down in a ditch, killing the driver. There were no skid marks or other indication that the driver was aware of the intersection. This lightly traveled rural location is typical of the many intersections that do not warrant

Figure 14

Site No. 5 Intersection of La. 126 at Jonesville

costly traffic control devices, but need timely advance warning of an impending stop or hazardous approach situation with low lying fog and poor visibility at night.

Site No. 6

This site is on La. 4 at its intersection with U.S. 65 at Newellton (Figure 15). This busy intersection, with flashing amber warning lights, striping and turn lanes, has a history of many turning/ collision accidents attributed to driver inattentiveness.

Figure 15

Site No. 6 Eastbound Approach of La. 4 at Newellton

Even though there are no vision obstructions, most accidents occurred during daylight hours on dry pavement. While glare may have been a contributory factor, all accidents were attributed to driver neglect or violation. Driver intoxication was not in evidence. It is hoped that the rumble strip areas will increase driver awareness of the approach to U.S. 65 with high volume through traffic. Prior to installation, there were six accidents involving

property damage only and two that caused injury to four people and resulted in one fatality. The westbound approach of this cross-intersection is bordered by mixed residential and business establishments and has no history of accidents. Therefore, it was not considered a hazardous intersection.

Site No. 7 and 8

Cross-intersection of La. 26 with U.S. 190 at Elton, Louisiana.

At this rural location, both La. 26 and U.S. 190 are two-lane undivided asphalt highways with low traffic volume. However, since 1979 it has been the scene of thirteen turning accidents attributed to driver neglect and violations. There were no sight obstructions and weather conditions were good at the time of the accidents. Insufficient advance warning for the high-speed through traffic on U.S. 190 did not allow inattentive drivers enough reaction time to slow down properly for turning movements. Rumble strip areas on both approaches of La. 26 are intended to alert drivers to this hazardous situation. The decision to use this intersection in the rumble strip area experiment was further warranted when an automobile driver, in broad daylight and on dry pavement, disregarded the stop sign and flashing red light and was struck broadside by a tractor-trailer, resulting in one severe injury and three fatalities.

Site No. 9

"Y" intersection of La. 3034 (Wax Road) with the junction of La. 3035 (Sullivan Road) near Central Louisiana.

At this location, triangular, raised medians separate the junction to provide turn-lanes onto and off of Sullivan Road. Since 1979 there have been forty rear-end, side-swipe and turning accidents. Although there were two noticeable injuries and several instances where complaints of injury were noted, most were minor property

damage only (PDO) accidents. Although most of these were during dry, clear weather, fifteen occurred during inclement weather when the roadway was wet. Skid tests confirm that these particular asphalt roads are very slick and dangerous when wet. Another contributory factor is the high traffic volume of these minor urban arterial access roads. The Sullivan Road approaches are also elevated curves with trees and mixed residential structures providing distractions and sight obstructions.

Site No. 10

At this heavily wooded rural location, La. 662 is a narrow, winding and old asphalt road that intersects La. 398 with a sharp right-hand curve (Figure 16) with only a stop sign for traffic control. La. 398 is a long curve, and the dense swamp to the left provides a sight obstruction to the intersection of La. 662. Installation of rumble strip areas at this location were preceded by eighteen accidents in which there were eight instances of injuries reported.

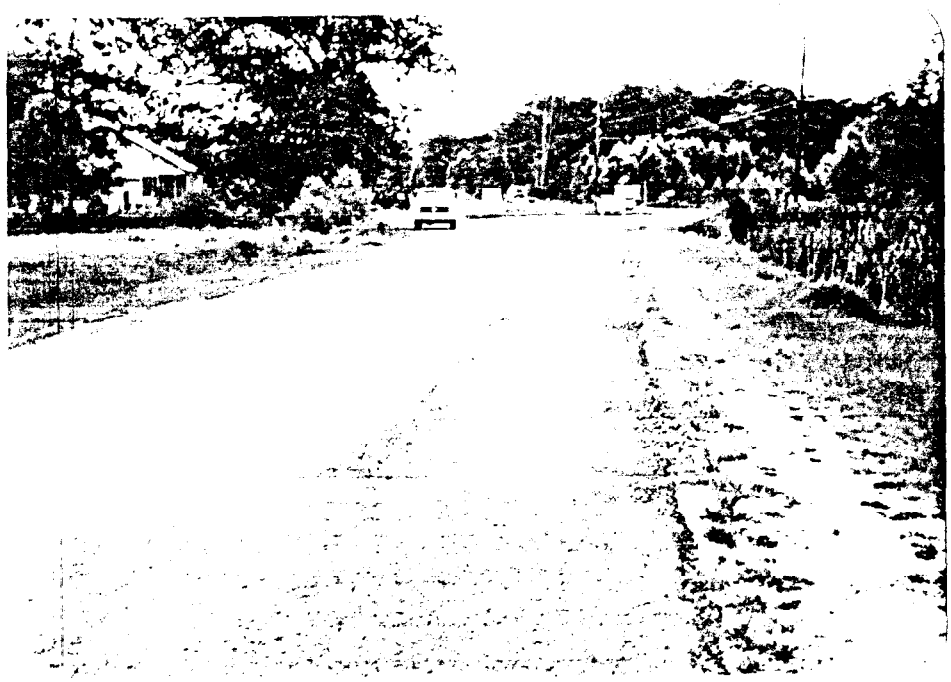


Figure 16

Site No. 10 Route La. 662 South of Labadieville

While one of these involved a motorcycle rider who sustained severe injuries, there were no fatalities. Because the dense, swampy area provides heavy fog in the early morning, most accidents occurred during daylight hours. (Almost all of the accidents happened when the drivers lost control of their vehicles in the curves, and the sight obstructions prevented avoidance.) The rumble strip areas are intended to increase the driver's awareness to the potential danger at the intersection of these curves. Although accident information following installation is not yet available, it should be interesting to analyze because of the rapid deterioration of the strips closest to the intersection. Aggregate loss has been rapid due to the curvature of the road and the harsh braking to the right. This location also has excessive "bleeding" of the cationic emulsion. This results in the asphalt softening and rising to engulf the aggregate, thereby cushioning and reducing the audible and tactile stimuli. This symptom has been noted mainly where the emulsion has been applied too heavily on older asphalt roadways. Efforts will be made to devise methods of rejuvenating these strips in order to maintain their effectiveness as a traffic control supplement.

Site No. 11

Junction of Spur La. 70 where it crosses La. 308 in Plattenville, Louisiana.

At this location, both roadways are two-lane blacktop pavement with improved shoulders. There are no vision obstructions at the intersection of this busy rural crossroad with only striping and stop signs for traffic control.

At this location, La. 308 is a through highway with no signing or traffic control devices. Since 1979 there have been twenty-one accidents in which there were two fatalities, four severe and twenty-six minor injuries reported. The majority of accidents were

right-angle collisions due to driver violations, neglect or inattentiveness and failure to yield after stopping. Rumble strip areas were installed on the curved approach of Spur La. 70 (Figure 17) in an effort to reduce speeds and increase driver awareness.

Figure 17

Site No. 11 Spur La. 70 at Plattenville

After two years, there is evidence of excessive bleeding of the cationic asphalt (Figure 18) in the wheelpaths that lower the audible response and soften the tactile effect. Efforts will be made to rejuvenate these strips during 1985.

Figure 18

Excessive Bleeding of Cationic Emulsion

Site No. 12 and 13

Both east and westbound approaches of La. 3059 are tee-intersections with La. 383, staggered by approximately one-quarter mile. Three years prior to installation, there were only three minor property damage only accidents reported. These consisted of one failure to yield, causing the vehicle to overshoot the intersection and strike a fence, while the other two were collisions that occurred after stopping at the stop sign. All were daylight accidents in which weather, sight obstructions and pavement conditions were not contributory factors. Local inquiries did not reveal any significant features that would warrant installation of rumble strip areas or other traffic control devices at either of these intersections.

Site No. 14

Curved approach of La. 109 with the tee-intersection of La. 389 near Fields, Louisiana.

This location has a 25-mph curve-regulatory sign posted just before the stop sign on La. 389. In 1980, two tractor-trailers exceeded this recommended speed only to skid, turn over on their side and slide into the fields opposite the intersection. A possible contributory factor may have been unfamiliarity with the area as the drivers were both from out of state. The primary factors, as is the case in most accident reports reviewed, are driver inattentiveness and/or violations. There are no records of any other accidents at this lightly traveled rural intersection.

Site No. 15 and 16

Both approaches of La. 1126 at the intersection with La. 382 at Roanoke, Louisiana.

A thorough search of the master computer files revealed that there have been no reported accidents at this low volume rural location during the last three years. Only the presence of fog in this low-lying, marshy rural area can provide justification for installation of supplemental traffic control devices.

Site No. 18 and 19

Intersection of U.S. 167 at the junction of La. 10 in Nuba, Louisiana.

At this busy intersection, U.S. 167 is a newly reconstructed highway with improved asphalt shoulders. The high volume traffic stems from the fact that this is technically a north-south detour pending completion of Interstate I-49. U.S. 167 continues west while La. 10 continues north to more direct routes.

Traffic volume should drop drastically when I-49 is completed or the next segment is opened to traffic in the near future. Meanwhile, there have been twenty accidents with ten injuries prior to installation. Most accidents occurred during the reconstruction of U.S. 167. Heavy underbrush created sight obstructions for the through traffic on La. 10 and was generally cited as the most prominent contributory factor. This has recently been corrected by the construction of turn lanes and placement of traffic signals instead of flashing caution and stop lights. This should drastically decrease the frequency of rear-end collisions created by drivers creeping forward to get a better view of oncoming traffic. This area is also frequented by dense fog that further reduces visibility. The rumble strip area should provide timely advance warning of this once poorly lit, obscure intersection and will hopefully reduce the frequency of accidents.

AGGREGATE LOSS DETERMINATIONS

In order to ascertain the relative durability or wearability of rumble strip areas installed under various traffic, alignment and surface type conditions, photographic means previously cited were employed to make aggregate loss determinations. Utilizing slides with a superimposed grid pattern, comparisons were made with original aggregates at one- and two-year intervals after installation. Interestingly enough, of the nineteen sites under evaluation, all the aggregate depicted in the original slides remains in place. Although, as cited in the individual performance evaluations, where the overall condition may reflect balding or bleeding in evidence, aggregate at the test locations remained in place. In summation, after two years, aggregate loss is negligible within each rumble strip area at five randomly selected sites situated in alternating wheelpaths. Bleeding and balding in some areas tend to soften the audible and tactile effect somewhat, but this cannot be attributed to aggregate loss.

SUMMARY

There needs to be an economical alternative to conventional traffic control devices where they are proven ineffective by high accident frequency, and yet do not provide justification for costly corrective measures.

Many states have reported varying degrees of success using coarse, exposed aggregate in a series of continuous or intermittent patterns to alert drivers to potentially hazardous intersections or situations. These have resulted in a reduction in the type and/or severity of accidents reported prior to installation.

Between August 1982 and September 1983, Louisiana's District Maintenance Crews installed nineteen rumble strip areas throughout south central Louisiana for evaluation purposes. This interim report provides performance evaluations of those installations. While post-installation accident statistics are unavailable as of this writing, early indications are that these rumble strip areas have met with favorable responses from the motoring public.

Installation of the coarse, exposed aggregate rumble strip areas was accomplished readily by District Maintenance forces utilizing conventional asphalt distributing equipment. While both EA-4 and polymerized cationic were used, the resiliency, tackiness and rapid set indicate that polymerized cationic is preferable. In addition to better aggregate retention, its rapid set provides a minimum disruption to traffic because it can be opened to traffic sooner than conventional EA-4 allows.

During 1984, seven additional rumble strip areas were installed in northeast Louisiana. These will be evaluated with the original nineteen cited in this interim report and reported in the final report. Accident statistics subsequent to installation will be available and will provide for a more definite effectiveness analysis at that time.

CONCLUSIONS

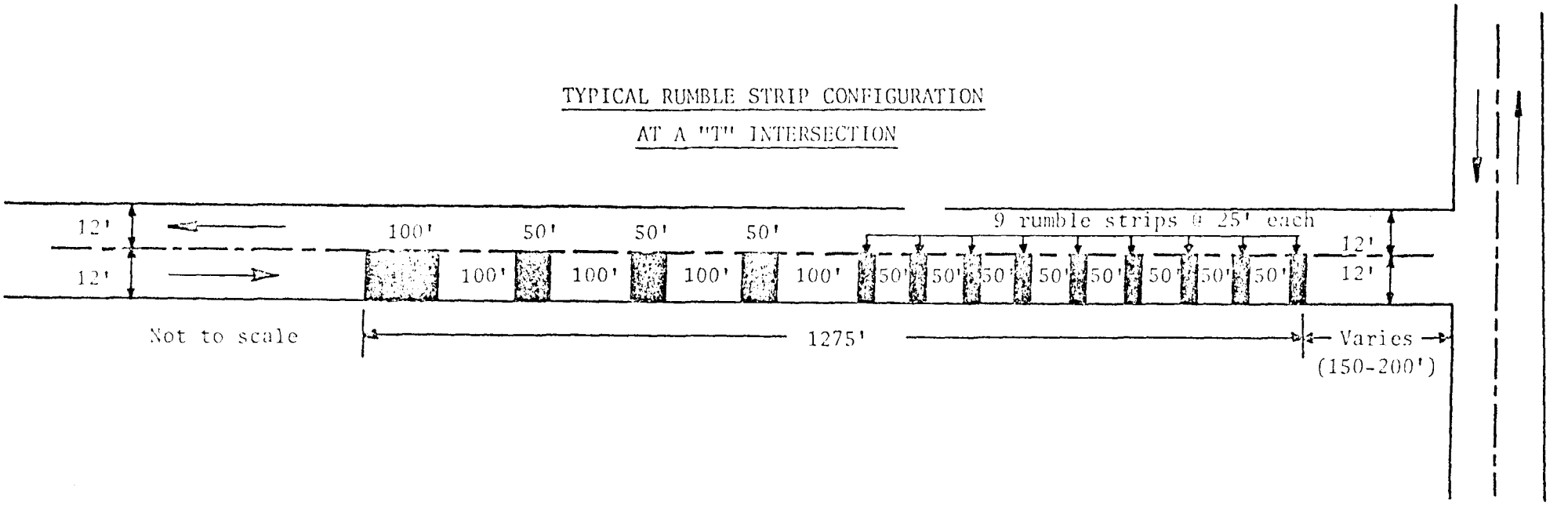
In conclusion, early indications are that coarse, exposed aggregate rumble strip areas provide an economical, supplemental traffic control deterrent at potentially hazardous intersections. They provide a strong, nondestructive, audible and tactile stimulus to alert drivers where conventional traffic control devices have proven largely ineffective as evidenced by the high incidence of accidents at certain intersections.

LIST OF REFERENCES

1. Mark L. Kermit and T. C. Hein, "Effects of Rumble Strips on Traffic Control and Driver Behavior," Proceedings, Highway Research Board, Vol. 41 (1962), pp. 469-482.

2. John T. Capelli, Audible Roadway Delineators, New York; Report NYSDOT-ERD-73-SR 14, May 1973.

TYPICAL RUMBLE STRIP CONFIGURATION
AT A "T" INTERSECTION



Note: 1) Shaded areas denote exposed aggregate surfacing (rumble strips).

2) Rumble strips should be sealed with a fog-seal coat after compaction.

3) "Experimental Surface Area Ahead" signs should be erected in advance of the experimental section.

Exposed aggregate (sandstone preferred) surfacing approximate gradation:

1" - 100% passing

3/4" - 20 to 60% passing

5/8" - 0 to 10% passing

(1 x 100') + (3 x 50') + (9 x 25') = 475' Total length of rumble areas

(475' x 12') ÷ 9 = 633 sq. yd. Total area of rumble areas

633 x 45 lbs. aggregate/sq. yd. = 28,485 lbs. or approximately 15 tons stone

633 x 0.45 gals. asphalt/sq. yd. = 285 gallons or approximately 300 gals. of asphalt

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SGB:AEM