HOUSTON ACRES

TRAFFIC CALMING/SPEED HUMP & SPEED BUMP (TRANSVERSE RUMBLE STRIP) EVALUATION

Houston Boulevard

Houston Acres, Kentucky

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Table of Contents

I. Introduction & Background

II. Existing Conditions

III. Data & Analysis

IV. Conclusion & Recommendation

Appendices:

1. ***FHWA-Speed Management Countermeasures***
2. ***FHWA-Fact Sheet: Rumble Strips and Noise***
3. ***FHWA-Traffic Calming Case Studies***

TRAFFIC CALMING/SPEED HUMP & SPEED BUMP (TRANSVERSE RUMBLE STRIP) EVALUATION

I. Introduction & Background

This study/analysis is provided for the City of Houston Acres (Exhibit 1), to discuss Traffic Calming options for the main entrance located at Houston Boulevard off Taylorsville Road in order to recommend if the existing Transverse Rumble Strips located between Taylorsville Road and Martha Avenue are the best option for traffic calming along this stretch of road (the main entrance to the City). Residents have complained that the series of transverse rumble strips that have been installed create too much noise from traffic rolling over them.

The transverse rumble strips were installed to slow traffic (and to reduce traffic volumes) along this stretch of Houston Boulevard. Houston Boulevard has historically

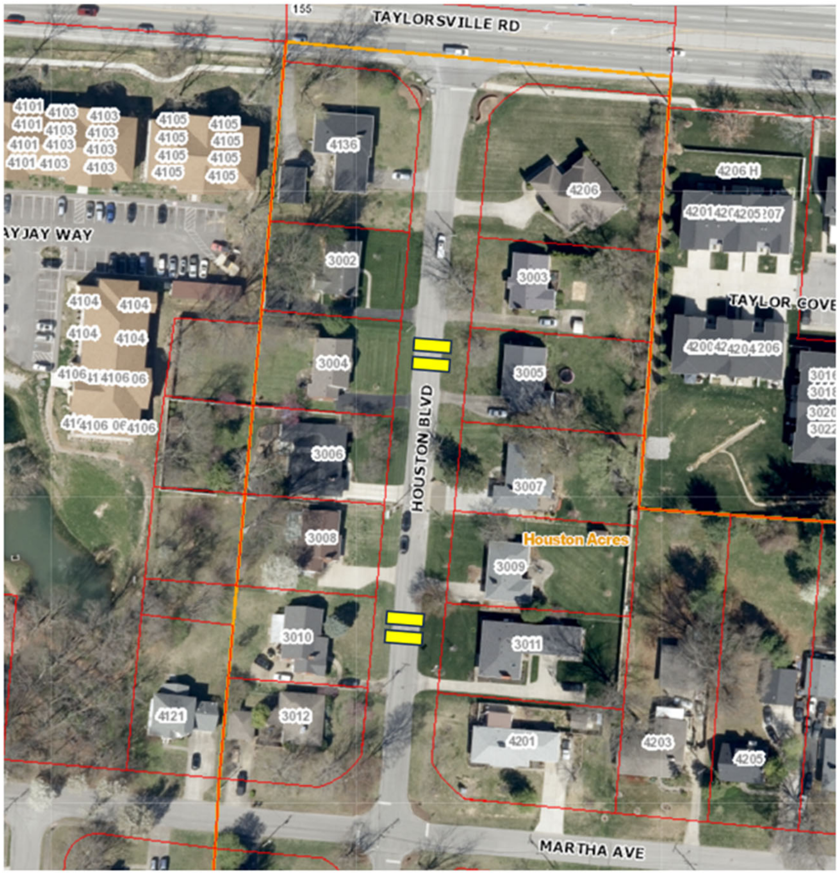
Ex. 1 - Location Map

been a cut-through street for vehicular traffic (residents) going to the adjacent Hunsinger Acres Subdivision located to the west of Houston Acres (Exhibit 2). In addition to the (2) sets of transverse rumble strips, speed radar signs are located on this stretch of Houston Boulevard, and have provided speed data and volumes for the City to utilize.

Ex. 2 – Traffic Cut-through Houston Blvd

II. Existing Conditions

Houston Boulevard is approximately 24 to 25 feet wide, and is a “local” roadway by street classification and thus considered a residential subdivision street. As such, the posted speed limit is 25 miles per hour. Currently, transverse rumble strips (the speed bump type) have been installed at (2) locations along Houston Boulevard (approximately 240 feet apart), between Taylorsville Road and Martha Avenue, in front of 3004/3005 and 3008/3009 (Exhibit 3). Each location includes a set of (5) raised white strips (Exhibit 4).



Ex. 3 – Existing Rumble Strip locations

Ex. 4 – Rumble Strips & Speed Sign

While the installation of the transverse rumble strips has likely reduced the volume of traffic cutting through the City, the strips have created additional noise to the nearby residents when vehicular traffic traverses the rumble strips. The nearest houses at 3004/3005 and 3008/3009 are located approximately 55 feet away from the rumble strips.

III. Data & Analysis

Speed Data:

While the “Speed data” (Exhibit 5) provided by the City does not warrant rumble strips based on the 85th percentile of speeders, the data does show a reduction of speeds from the installation of the rumble strips. In addition, comparing total vehicles from before and after the rumble strips were installed indicates a reduction of trips (and that adjacent residents in Hunsinger Acres may be avoiding using Houston Boulevard and are likely continuing down to McMahan Blvd).

Drivers Traveling at or Above 35 MPH

- **Before Installation (Mar 1 – Apr 14)**: **0.34%** of drivers (73 out of 21,276 total vehicles) traveled at or above 35 MPH.
- **After Installation (Apr 15 – Aug 12)**: **0.09%** of drivers (51 out of 56,400 total vehicles) traveled at or above 35 MPH.

Ex. 5 – Speed Data on Houston Blvd

Traffic Calming Options:

For purposes of this study a good reference for Traffic Calming (or rather Speed Management Countermeasures) is from the Federal Highway Administration (FHWA) provided in Appendix 1. The “Speed Management Countermeasures” handout provides a good summary of options many cities refer to when determining the best option for reducing speeds on their roadways, and changing motorists behavior. Options include:

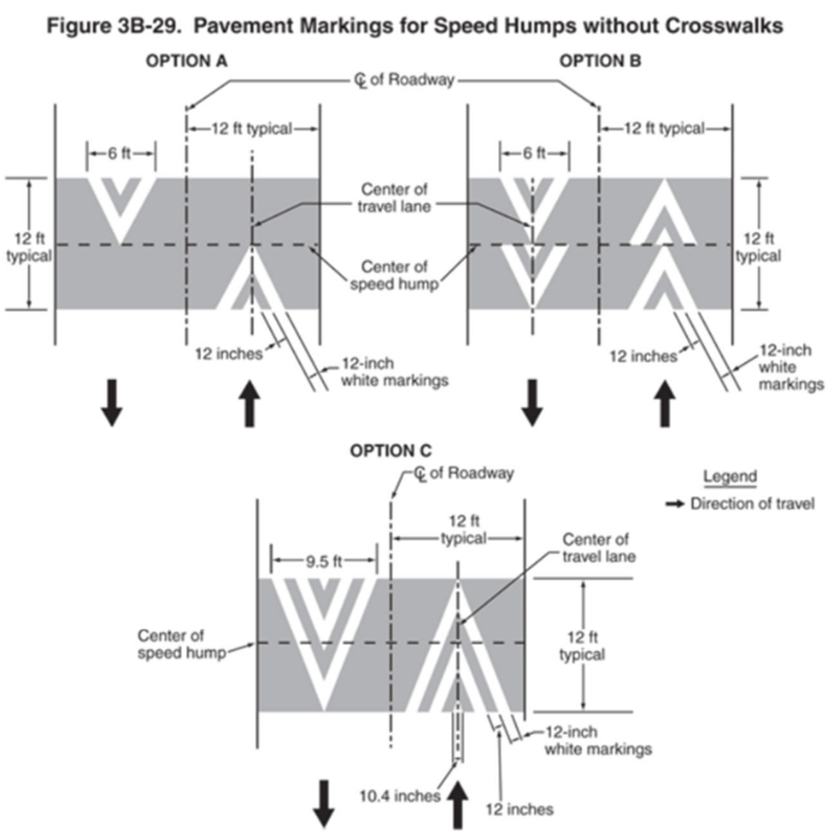
- Speed Humps
- Speed Feedback Signs
- Enhanced Curve Delineations
- Roundabouts
- Road Diets

Factors that help decide which option(s) to utilize include:

- Roadway Setting (Urban vs. Rural) – note that “an Urban Neighborhood may not welcome the idea of rumble strips due to the additional noise, but rumble strips are appropriate and effective on a rural highway” and typically provide advance warning of a stop or other change in traffic conditions

- Roadway Type – note that "Speed Humps are well suited for streets with speed limits below 35 mph"
- Speeding related Crash History – there doesn't seem to be any crash related history for Houston Blvd and since we are not concerned about the intersection, roundabouts or curve delineators would not apply
- Road Users – considering other road users for Houston Blvd include bicycles and pedestrians and could consider if a bike and ped lane could be added
- Cost – budget limitations can sometimes affect which countermeasures can be adopted
- Effectiveness – FHWA's Proven Safety Countermeasures website provides more information (http://highways.dot.gov/safety/proven-safety-countermeasures) note that "Road Diet" doesn't typically apply to a rural subdivision roadway and is more applicable to Urban areas

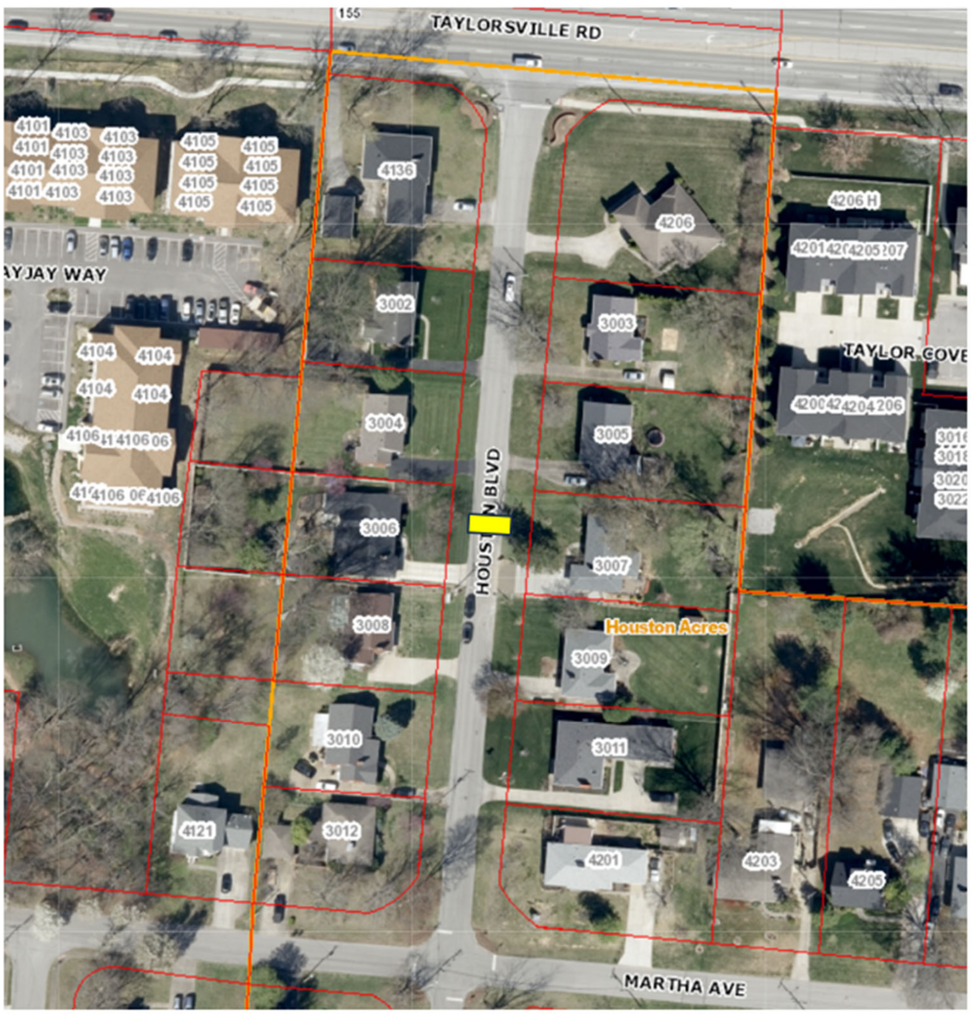
Other options including road narrowing, or construction of a chicane at midblock, however in residential neighborhoods changing the road alignment can include requiring more right-of-way, impacts to residents yards and driveways, and much more expensive cost scenarios.



Ex. 6 – Speed Hump & Markings

For purposes of traffic calming along Houston Boulevard, and for typical rural subdivision streets, speed humps are the recommended countermeasure that may be utilized (Exhibit 6 shows the standard Speed Hump & Markings from Figure 3B-29 in the Manual on Uniform Traffic Control Devices).

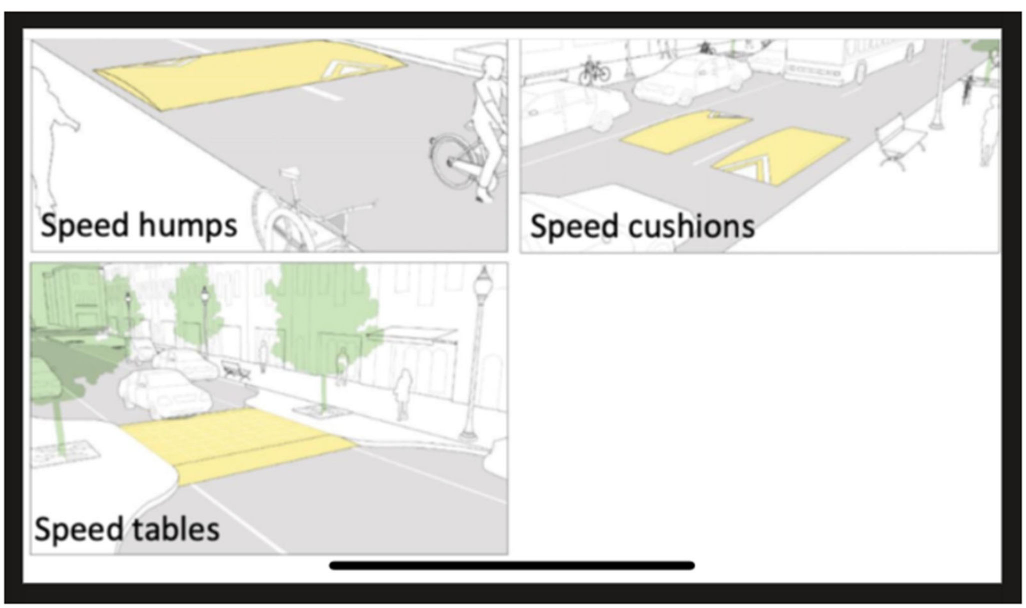
Per the Institute of Transportation Engineers (ITE) “Guidelines for the Design and Application of Speed humps”, and additionally referencing the “Louisville Metro Public Works – Speed Hump Guidelines”, typical spacing for speed humps is between 260 feet and 500 feet. Since the block distance for Houston Blvd is approx. 640 feet, one speed hump could be located midblock between Taylorsville Road and Martha Avenue, in front of 3006/3007 as shown in Exhibit 7. Optionally, speed humps could be installed in similar locations to the current rumble strip locations, however that would not be required.



Ex. 7 – Proposed Speed Hump Location

Noise Concerns:
Numerous agencies have conducted noise impact studies for both rumble strips and speed humps, however neither ITE nor FHWA have published any stand alone, dedicated acoustic noise studies exclusively evaluating speed humps. Rumble strips in the normal sense (typically used on higher speed roadways) tend to produce a higher pitched sound, whereas speed humps produce a lower frequency thud. Rumble Strips on roadways installed as “Speed Bumps” as in this situation tend to provide more vibrations to vehicles thus causing higher and louder sounds to nearby residents (see Appendix 2-FHWA Fact Sheet: Rumble Strips and Noise). There have been documented concerns from residents over both types of traffic calming devices because of the rattling of vehicles and especially trailers. Smoother parabolic installation of speed humps typically helps soften the impact of the vehicle traversing the speed hump, as opposed to the multiple speed bumps in the noted rumble strip configuration. Recent use by State DOT’s of “Sinusoidal Rumble Strips” reduce the external noise by 6 to 12 decibels, and are more gentle, rolling waves or ripples in the pavement, however they are not recommended for slower speed roadways like residential subdivisions because they do not provide the full affect required from use on higher speed roadways.

If noise is the major concern, speed tables or cushions can be considered. Speed tables are longer, more than 20’ with a flat top, and accommodate longer wheel bases (like fire trucks and buses) to minimize severe impact noise. Speed cushions similarly, accommodate larger emergency vehicles with wider wheel bases that “straddle” the raised cushion in the middle of each lane. However, speed tables and speed cushions do not slow down motorists like speed humps, and typically promote vehicles to traverse them at higher speeds, finding drivers sometimes swerving to avoid a speed cushion. Exhibit 9 shows a comparison of a Speed Table, Speed Cushion, and Speed Hump.



Ex. 8 – Speed Table, Speed Cushion vs. Speed Hump

A good comparison of Traffic Calming Case Studies is provided by FHWA in Appendix 3, that references cities across the United States with similar traffic calming needs, and how they selected their final countermeasures, with most all selecting speed humps in their final selections for roadways with speed limits under 35 mph.

IV. Conclusion & Recommendation

From analyzing speed data on Houston Blvd to comparing various "Speed Management Countermeasures", it's clear that the utilization of Rumble Strips (multiple Speed Bumps in series) is not the preferred traffic calming device for a local residential neighborhood street, especially where noise is a concern. Houses sit just 55 feet off the roadway, and general transportation guidelines from FHWA and transit research bodies like the Transportation Research Board (TRB) indicate that a safe setback threshold would need to be up to 300 feet to allow for noise to dissipate over that distance.

While Speed Humps do provide some level of noise intrusion it's much less considering the proper design and installation of a parabolic speed hump. In addition, over time with drivers and residents becoming more aware of the location of speed humps, the reduction in overall speeds leads to smoother driving over the speed humps with less noise.

Therefore, we are recommending that the Rumble Strip/Speed Bumps be removed and either one of two options be implemented and installed on Houston Blvd:

1. Construction of (1) new Speed Hump located at the midpoint of Houston Blvd between Taylorsvile Road and Martha Avenue, or
2. Construction of (2) new Speed Humps located where the current Rumble Strips exist

Standards for Speed Hump size/dimensions, pavement markings, and signage shall be based on the MUTCD and other Louisville Metro Public Works adopted standards.

--- END---

Appendix 1: FHWA-Speed Management Countermeasures

SPEED MANAGEMENT COUNTERMEASURES

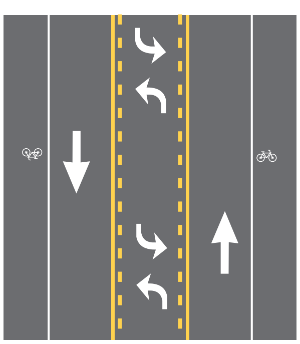
More than Just Speed Humps

U.S. Department of Transportation
Federal Highway Administration

SPEED FEEDBACK SIGN


CURVE DELINEATION


ROUNDABOUT


ROAD DIET

Setting speed limits that are safe, consistent, and reasonable is the first step in speed management and is important in order to protect all roadway users. Transportation practitioners employ a variety of strategies to manage speeds on roadways, and speed limits are an integral part of this. However, simply lowering the speed limit on a particular stretch of roadway does not always lower the actual speed at which most people drive on that roadway. Therefore, transportation agencies often install speed management countermeasures in order to get drivers to slow down.

WHAT DO SPEED MANAGEMENT COUNTERMEASURES LOOK LIKE?

COUNTERMEASURE:
Any intentional, long-term alteration to the roadway or its environment that causes changes in motorists' driving behavior.

Some speed management countermeasures are familiar to drivers and have been used for many years. Others are relatively new. All provide great safety and speed management benefits, and may offer operations and cost-savings benefits as well.

Some examples include:

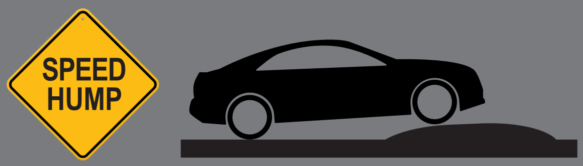
- **Speed Humps.** Generally located on residential streets or other low-speed roads, these raised pavement structures force motorists to slow down to a safe speed. Studies show speed humps can be effective at reducing speeds by nearly 10 mph.[1] (See page 2 to learn the difference between speed humps and speed bumps.)
- **Speed Feedback Signs.** These portable, interactive signs display a vehicle's current speed to remind the driver to slow down and obey the posted speed limit. Research shows these types of signs have been effective at reducing speeds by 5 mph.[2]
- **Enhanced Curve Delineation**. By improving striping or signing along horizontal curves, motorists are more aware of the road's curvature and are more likely to slow down to a speed that matches the curve's perceived severity. Depending on the type and combination of delineation countermeasures chosen, studies show speeds can be reduced by nearly 10 mph.[3]
- **Roundabouts.** This type of circular intersection is very effective at safely moving traffic through an intersection and can have significant traffic calming effects. Features such as channelized approaches, a center island, and circular design encourage lower speeds. Studies have shown roundabouts can lower speeds by as much as 15 to 20 mph[4] and reduce severe crashes by nearly 80 percent.[5]
- **Road Diets.** The most common Road Diet converts a four-lane undivided roadway to a three-lane roadway consisting of two through lanes and a center two-way left-turn lane. Studies show that Road Diets, when implemented in appropriate contexts, can lower the 85th percentile speeds and greatly reduce the number of motorists speeding excessively.[6]

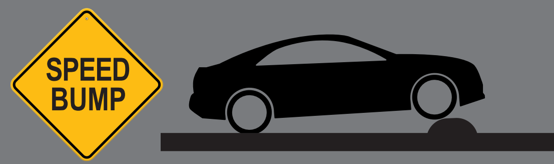
[1, 2, 3, 4] FHWA, "A Desktop Reference of Potential Effectiveness in Reducing Speed," July 2014. Available at: http://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/reducing_speed.cfm.

[5] FHWA, "Proven Safety Countermeasures - Roundabouts," FHWA-SA-12-005 (Washington, DC: 2012). Available at: http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_005.cfm.

[6] FHWA, *Road Diet Informational Guide*, FHWA-SA-14-028. Available at: http://safety.fhwa.dot.gov/road_diets/info_guide/.

Speed Hump vs. Speed Bump - both are used to control traffic speeds





- A speed hump is a gradual raised area on low-speed roadways, typically found on residential or local streets.
- A speed bump is an abrupt raised area generally located in private driveways or parking lots.

CHOOSING A SPEED MANAGEMENT COUNTERMEASURE

Many agencies have traffic calming manuals or speed management policies that outline and guide their decisions on choosing speed management countermeasures. Transportation practitioners consider a variety of factors when selecting these countermeasures, which can be loosely grouped into the following categories.

Roadway Setting (i.e., Urban vs. Rural)

Most countermeasures are versatile and can be applied in a variety of locations, but some countermeasures may be more appropriate in either a rural or urban setting. For example, an urban neighborhood may not welcome the idea of rumble strips due to the additional noise, but rumble strips are appropriate and effective on a rural highway.

Roadway Type

Whether a roadway is an interstate, a freeway, or a city street influences the type of countermeasures that practitioners select. For instance, speed humps are not appropriate for a higher-speed roadway, but are well suited for streets with speed limits below 35 mph.

Speeding-related Crash History

Transportation agencies often choose speed management countermeasures based on where, when, and what type of crashes are occurring. For example, curve delineation and rumble strips are effective countermeasures when a roadway is experiencing many speeding-related run-off-the-road crashes, and improving the visibility of intersections or installing roundabouts may reduce speeding-related intersection crashes.

Road Users

Practitioners also consider the users of the roadway and its surrounding area. For example, Road Diets are very effective at reducing speeds and allow designers to incorporate features such as bicycle lanes, pedestrian refuge islands, parking spaces, and wider sidewalks to accommodate the needs of all road users.

Cost

Budget limitations can affect countermeasure selection. Agencies allocate their resources to achieve the best safety benefits with their available funding. Practitioners evaluate multiple alternatives to determine the solution that provides the best result for a specific location or for the system as a whole.

Effectiveness

Agencies carefully monitor studies that examine the effectiveness of speed management countermeasures in order to select the best solutions. The CMF Clearinghouse is an online resource practitioners can use to gather information on these studies and countermeasure effectiveness. FHWA's Proven Safety Countermeasures website provides information on safety countermeasures that can be used for speed management such as Road Diets, medians, rumble strips, and roundabouts.

FOR MORE INFORMATION

To learn more about speed management, visit FHWA's Speed Management Safety web page.

For more information on speed limits, check out FHWA's *Speed Limit Basics* fact sheet.

Appendix 2: FHWA-Fact Sheet: Rumble Strips and Noise

NOISE

RUMBLE STRIPS AND NOISE

Center and edge line or shoulder rumble strips are extremely effective in reducing severe roadway departure crashes at a low cost. Rumble strips use both noise and vibration to alert a driver that he or she is leaving the travel path. To be effective, the noise generated inside the vehicle must rouse a drowsy driver or grab the attention of a distracted driver. Since there is a wide range of "drowsiness" and "distraction" inside the vehicle compartment, more noise is typically better. On the other hand, the noise generated outside the vehicle can be disruptive to residents or businesses in the area, and the goal is to produce as little sound as possible outside the vehicle. The focus of this fact sheet is to address ways to mitigate those exterior noise concerns while maintaining the effectiveness of rumble strips as a safety countermeasure.

Noise Facts

- The sound of rumble strips has a different character than highway traffic, which may heighten annoyance.
- Rumble strip noise is measured using a sound-level meter similar to that shown in Figure 1. There is no method that adequately measures the different character of the noise of rumble strips, so the methods developed for measuring highway traffic noise are used, but with a focus on the maximum noise level rather than averages over a period of time.
- Increased alerting noise in the vehicle is found with higher speeds, shallower departure angles, decreased rumble strip spacing, and increased rumble strip depth, width, and length.

Photo: Spectrum International

Figure 1. Sound Level Meter

Placement Issues And Solutions

Standard agency practices will typically take into account noise and other concerns, but there may be unique locations, situations, or conditions that need to be assessed, and flexibility in design and application may need to be considered. Any mitigation effort will potentially result in reducing the safety effect.

Horizontal curvature can cause additional incidental contact (and associated noise) with:

- Center line rumble strips due to vehicles intentionally cutting the curve short, or
- Edge line or shoulder rumble strips due to inadvertent off-tracking. This is especially true where the operating speeds do not correlate with the superelevation or where the percentage of large vehicles is high.

To address this potential source of unnecessary road noise, agencies may consider widening the pavement through the curve or using a "spiral transition" to reduce the likelihood of vehicles crossing the rumble strips. Where pavement width cannot be adjusted prior to installing rumble strips, here are some options to consider:

- For center line rumble strips, consider restriping the pavement to increase the travel lane width while reducing the shoulder width.
- For edge or shoulder rumble strips, consider placing the strips at a greater offset from the edge line in the specific locations where noise might be problematic.

Intersections and major driveways are locations where rumble strips are typically discontinued because:

- Center line rumble strips within the intersection would be crossed by left-turning traffic or entering vehicles, and
- Edge line or shoulder rumbles on the approach may cause noise concerns due to drivers pulling to the right in advance of a right turn.

Passing zones with center line rumble strips will result in occasional noise from passing maneuvers. In sections where significant passing is expected, such as steep slopes without climbing lanes or tangents following a long curvilinear alignment, consider a break in the rumble strips within the passing zone if there are residences nearby.

Design and Flexibility for Reduced Noise

Agencies balance rumble strip safety effectiveness and quality of life for those who live along the roadway when developing rumble strip policies and design standards. Some DOTs vary rumble strip dimensions in order to allow use of rumbles along more corridors while reducing noise on sections of roadway where it might otherwise be unacceptable to install rumble strips.

Offsetting shoulder rumble strips from the edge line is the primary method currently used by agencies to reduce nuisance noise from shoulder rumble strips. While vehicle tires tend to touch edge line rumble strips more frequently than shoulder rumble strips due to their placement closer to the traveled way, edge line rumble strips provide better wet nighttime visibility and pavement marking durability. Increasing the offset of shoulder rumble strips from the standard practice is an option in sections where noise is a concern.

Depth is also a dimension that has been adjusted and is known to offer a significant reduction to the loudness inside the vehicle, which likely translates to some reduction externally.

Spacing of the rumble strips may also be adjusted to reduce external noise, although this adjustment is currently experimental.

Sinusoidal-shaped rumble strips are a new design concept that is also being studied to determine whether it minimizes external noise while maximizing the alerting noise inside the vehicle. Research currently indicates that, as with other shapes, this depends greatly on the specific dimensions installed.

Outreach

Garnering public support prior to installation of rumble strips on a statewide or regional basis may be critical to the success of this low-cost countermeasure. Agencies have garnered public acceptance by:

- Inviting the public to comment and address their questions and concerns directly,
- Emphasizing road user safety first and foremost,
- Seeking to understand the specific concerns of each community member and being willing to modify the design and placement of rumble strips on an as-needed basis, and
- Educating the public on options.

FOR MORE INFORMATION

The following resources provide more details related to rumble strip noise, use, and design:

- ✓ **FHWA-SA-033: Rumble Strip Implementation Guide: Addressing Noise Issues on Two-Lane Roads**
- ✓ **NCHRP 641: Guidance for the Design and Application of Shoulder and Centerline Rumble Strips**
- ✓ **FHWA's Rumble Strip Website:** http://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/

FHWA-SA-15-029

Appendix 3: FHWA-Traffic Calming Case Studies

Module 8: Traffic Calming Case Studies

The following five case studies cover both (1) effective processes used to plan and define a local traffic calming program or project and (2) assessments of the effects of individual and series of traffic calming measures. A brief summary is provided for each case study, followed by a hyperlink to a report or other document that provides additional detail.

City of Wauwatosa (Wisconsin) Traffic Calming Case Study

The City of Wauwatosa, Wisconsin is located immediately west of Milwaukee and has a population of nearly 50,000. The traffic calming study area is a residential neighborhood through which vehicular traffic was thought to be cutting through in order to avoid traffic congestion on nearby streets. The neighborhood is served by three streets, each with a posted speed limit of 25 mph and a width of 30 feet with on-street parking.

Four measures were used to assess the degree of a traffic cut-through or speed problem on the study area neighborhood streets:

- A comparison of traffic volumes between parallel neighborhood streets (including an estimate of excess traffic not generated by the neighborhood dwelling units along with hypotheses for why volumes on one street differed from another)
- Identification of a peak hour percentage of daily traffic volume that was atypically high (i.e., as a likely result of diversion of traffic from congested nearby major streets)
- Measurement of 85th percentile and maximum vehicle speeds by direction (maximum speeds of 60 mph were measured on two of the streets)
- Field observations of (1) queuing on nearby major streets and (2) apparent cut-through turns at neighborhood street intersections with major streets at the neighborhood boundary

Four types of traffic calming measures were considered: speed hump, speed table, median island, and choker. The recommended action was to install speed tables on all three neighborhood streets – a pair of speed tables on two of the streets and a midblock speed table on the third street.

The full report can be accessed at the following hyperlink:

https://www.ayresassociates.com/project/traffic-calming-case-study/

City of Sunnyvale (California) Canary Drive Traffic Calming Case Study

The City of Sunnyvale, California is located in Santa Clara County near San Jose and has a population of approximately 140,000. The city has an established traffic calming policy. The following case study describes an application of the process for a specific neighborhood residential street. The case study covers the analysis of the problem, selection of an appropriate traffic calming action, implementation of the action, and evaluation of its effectiveness in resolving the observed problem.

The policy defines initial criteria that must be satisfied for any traffic calming measures to be considered.

- The road must be classified as a neighborhood residential street
- The ADT must be greater than 1,000 vehicles
- The 85th percentile speed must be greater than 32 miles per hour

Canary Drive is a neighborhood residential street with single-family homes. Its length is 1,200 feet and has a posted speed limit of 25 mph. Neighborhood residents reported concerns over high-speed traffic and unsafe driving on the street. The daily volume of 1,200 vehicles and 85th percentile speed of 35 mph met the threshold for consideration.

The policy defines a range of measures that can be considered once initial data collection is complete. The Stage I measures include education/neighborhood outreach, police enforcement, increased signing and striping, deployment of radar speed trailers, and warranted traffic control measures (Stop/Yield signs). With the support of the neighborhood, a subset of the Stage I measures were selected for implementation:

additional speed limit signs, increased enforcement of the speed limit, deployment of a radar speed trailer, and installation of a double yellow centerline.

Four months after Stage I implementation, traffic volumes and speeds were reevaluated. Daily traffic volume had decreased from 1,200 to 1,100 and 85th percentile speed had decreased from 35 mph to 34 mph. The post-implementation volume and speed values still exceeded the initial threshold criteria.

Potential Stage II traffic calming measures were then evaluated. The measures include speed humps and tables, traffic circles and roundabouts, median islands, corner extensions and chokers, median barriers and median barriers, turn prohibition signs, and street closures. Technical analysis and neighborhood support settled on three measures: a median island, speed hump, and traffic circle.

A temporary rubber speed hump was initially installed as a one-month demonstration, after which the neighborhood supported a permanent installation. One month after implementation of the three recommended measures, the 85th percentile speed had decreased to 26.5 mph (a significant reduction from the pre-implementation speed of 35 mph).

New York City Neighborhood Slow Zone Program

New York City has embraced the Vision Zero concept that aims to eliminate all deaths from traffic crashes. The City made a commitment to improve street safety in every neighborhood and in every borough with expanded enforcement against dangerous moving violations like speeding and failing to yield to pedestrians, new street designs and configurations to improve safety, broad public outreach and communications, and a sweeping legislative agenda to increase penalties for dangerous drivers.

One element of the Vision Zero initiative is the Neighborhood Slow Zone Program. The program uses three primary tools to reduce motor vehicle speeds: gateway signage, 20 mph pavement markings, and speed humps.

Positive criteria used in the selection of candidate sites include crashes (crash injuries per mile and total injuries in the proposed zone), vulnerable populations (schools, daycares, senior centers), community support, subway stations, and a strong boundary with bus and truck routes. Negative criteria include fire stations, hospitals, and bus routes and truck routes internal to the zone.

With installation of 26 Neighborhood Slow Zones, the effects have included 10-25 percent reductions in vehicle speeds, a 10 percent overall reduction in crashes with injuries, and a 27 percent reduction in vehicle crash injuries.

A summary of the overall program and detailed individual project results can be accessed at the following hyperlink:

http://www.nyc.gov/html/dot/html/motorist/slowzones.shtml

Seattle Safe Routes to School Program

The overall objective of the Seattle Safe Routes to School program is to make it easier and safer for students to walk and bike. The program has five essential components:

- Engineering: To build new sidewalks and curb ramps, improve crosswalks, coordinate with neighborhood greenways, and promote safe driving;
- Education: To give pedestrian and bicycle safety skills and knowledge to kids and families
- Encouragement: To get more parents involved in their kids' schools and get kids more familiar with their neighbors and community
- Enforcement: To make sure everyone obeys the rules of the road and traffic circulation plans adopted by school communities
- Evaluation: To make sure the programs are achieving their goals

The Seattle Department of Transportation developed an Engineering Toolkit that presents 16 strategies that are used in Seattle. Five of the listed strategies are covered in depth in this ePrimer:

- Crossing Treatments
  - Crossing islands (considered a median island in ePrimer)
  - Curb bulbs (considered a corner extension or choker in ePrimer)
  - Curb ramps
  - Marked crosswalks
  - Crossing beacons
  - 20 mph zones
  - Traffic signals
  - Stop signs
- Along the Street Treatments
  - Sidewalks
  - Bikeways
  - Radar speed signs
  - Lane reduction (considered a road diet in ePrimer)
- Traffic Calming
  - Speed humps and cushions (considered speed humps, speed cushions,
  - and speed tables in ePrimer)
  - Traffic circles (covered in ePrimer)
  - Neighborhood greenways

- Other
  - Bicycle parking

The Engineering Toolkit provides references, resources, and examples in Seattle for each strategy. The Toolkit also answers four questions:

- What is the purpose of [strategy]?
- How does Seattle DOT decide where to install [strategy]?
- How much does [strategy] cost?
- How long does it take to install [strategy]?

The complete toolkit can be accessed at the following hyperlink:

https://www.seattle.gov/documents/Departments/SDOT/NTO/seattlesaferoutestoschoolengineeringtoolkit.pdf

Portland (Maine) Traffic Calming Study – Massachusetts Avenue Neighborhood

The traffic calming study area is a residential neighborhood through which vehicular traffic was determined to be cutting through in order to avoid traffic congestion on nearby streets. The neighborhood is served by nine neighborhood streets, each about one-half mile in length. Current AADT on the nine streets ranged between 285 and 1,140.

A series of speed humps, traffic circles, and all-way Stops were installed throughout the neighborhood. The purpose of the case study was to assess the effectiveness of the traffic calming measures to reduce cut-through traffic volumes and vehicle speeds. The post-implementation evaluation was determined to be too soon to enable an accurate assessment of overall and site-specific crash rate changes.

Speed and vehicle count data were collected at nine locations along the neighborhood streets.

- 85^{th} percentile vehicle speeds were found to decrease at all nine locations.
- Mean vehicle speeds were found to decrease at seven locations and to remain the same at one location. For the one location with an increase in mean speed, the hypothesis is that a change in counting equipment affected the results. The pre-implementation data at this site only were collected with tube counters that were visible to the motorist (and may have resulted in more caution and slower speed). The post-implementation data were collected with a radar recorder.
- Estimated AADT was found to decrease at six of the nine locations. The pre- and post-implementation data were collected during the months of April 2013 and June 2015, respectively. The count data were factored to represent AADT with the use of seasonal factors that reflect areawide facility type seasonal variations. The hypothesis for the inconsistent changes in neighborhood street traffic volumes is the use of seasonal factors that may not accurately reflect variations in this particular neighborhood. In addition, the proximity to athletic fields for several of the streets is likely to have skewed the seasonal variation factoring.

A summary report can be accessed at the following hyperlink: http://gorrillpalmer.com/services/transportation/

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‹ **Module 7: Traffic Calming Programs and Planning Processes**

Traffic Calming ePrimer

Module 1: Purpose and Organization of ePrimer

Module 2: Traffic Calming Basics

Module 3: Toolbox of Individual Traffic Calming Measures Part 1

Module 3: Toolbox of Individual Traffic Calming Measures Part 2

Module 3: Toolbox of Individual Traffic Calming Measures Part 3

Module 4: Effects of Traffic Calming Measures on Motor Vehicle Speed and Volume

Module 5: Effects of Traffic Calming Measures on Non-Personal Passenger Vehicles

Module 6: Effects of Traffic Calming Measures on Non-Motorized Users

Module 7: Traffic Calming Programs and Planning Processes

Module 8: Traffic Calming Case Studies

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