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Maryland Transportation
Technology Center -
Local Technical Assistance
Program (LTAP)
University of Maryland at
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INSIDE

Cover Story Sign Management and Maintenance

Page 2 Stopping Sight Distance

Page 4 The Great Escape: How Retirement, Recruitment, And Retention Are Impacting The Field Of Public Works

Page 7 DOT Announces Record Low Highway Fatality Rate in 2004

Page 8 Chip Seals

Page 11 Typical Problems in Highway Work Zones and Their Solutions

Sign Management and Maintenance



Traffic signs promote highway safety and provide for the orderly movement of all road users. They notify road users of regulations and provide warning and guidance needed for safe, uniform, and efficient travel.

The Manual of Uniform Traffic Control Devices (MUTCD) governs traffic signs in all states. It states that signs must:

- Fulfill a need,
- Command attention and respect,
- Convey a clear, readable message, and
- Allow the driver time to respond correctly.

To meet these purposes, agencies should keep signs properly positioned, clean, and legible. They must repair or replace damaged or deteriorated

signs. To ensure proper signage, they should have a maintenance system.

Maintenance Systems

Maintenance systems enable managers to prepare repair work plans. Some prepare budgets to accomplish the plans. Managers should give priority to critically located signs, such as at intersections and around schools.

Agencies must regularly inspect all its signs for repair or replacement. The MUTCD recommends day and night inspection. Managers must thoroughly train field inspectors. In addition, they should train employees who travel on roadways to report unsafe signs. Inspectors should look for obstructions that obscure sign visibility. Glare, shadows, and orientation are also visibility issues. Inspectors should also identify where new signs are needed. They should also ensure proper sign height and offset.

Mounting Height. The MUTCD requires signs on rural roads to be at least 5 feet from the bottom of

continued on p3



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Janette Gets Promotion

My faithful Scottish assistant, **Janette Prince**, has recently been promoted to Assistant Program Manager. This was appropriate since she does all the work around here, I'm just a pretty face. (Boy, are we in a lot of trouble!!!)

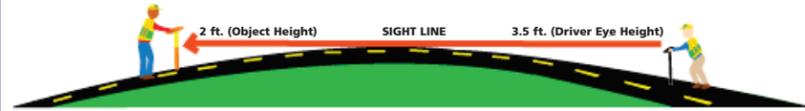
Janette came over to this country in 1999 from her home in Balloch, Scotland, a little village near on as she says "the bonnie, bonnie banks of Loch Lomond" and took a job with the Center in 2000. If any of you have called the Maryland Center you'll remember the lady with the thick Scottish Brogue.

Janette books all the workshop venues, takes registration, runs registrations at the sites, makes travel arrangements for the instructors, arranges for breaks and lunches, works on the website and does many other tasks as well. Over the past two years I've actually learned to understand what she's saying. Janette is my good right arm and I'd actually be lost without her. If you were around our office you'd know that by the way she always tells me where to go. Her previous experience in the whisky industry gives her a leg up in working here at the Center without losing her mind.

I seriously would like to congratulate her and thank her for all her good work.

Ed Stellfox
Program Manager

Stopping Sight Distance



"Sight Distance" is the length of roadway that a driver can see ahead. "Stopping sight distance" (SSD) is the minimum sight distance required for a driver to stop a vehicle on wet pavement after seeing an object without hitting the object. SSD determines minimum lengths of vertical curves and minimum radii of horizontal curves.

the sighting rod. They compare this distance with the minimum required stopping sight distance in Table 1.

The easiest way to prevent sight distance problems is to avoid them by ensuring new roads adhere to the minimum standards for stopping sight distance. Sight distance improvements may be costly but necessary in places where inadequate sight distance

Table 1. Minimum Required Stopping Sight Distances 2004 AASHTO Green Book

Vehicle Speed (mph)	Reaction Distance (feet)	Braking Distance (feet)	Summed Distance (feet)	Stopping Sight Distance (feet)
15	55.1	21.6	76.7	80
20	73.5	38.4	111.9	115
25	91.9	60.0	151.9	155
30	110.3	86.4	196.7	200
35	128.6	117.6	246.2	230
40	147.0	153.6	300.6	305
45	165.4	194.4	359.8	360
50	183.8	240.0	423.8	425
55	202.1	290.3	492.4	495
60	220.5	345.5	566.0	570
65	238.9	405.5	644.4	645

Note: Brake reaction distance predicated on a time of 2.5s; deceleration rate of 11.2 ft/s² used to determine calculated sight distance.

The American Association of State Highway and Transportation Officials (AASHTO) establish the minimum SSD. The SSD in Table 1 are for passenger cars and do not consider the distance necessary for trucks to safely stop. Generally, separate stopping sight distances for passenger cars and trucks are not considered. The extra sight distance provided by the higher seat position of a truck driver compensates for the extra distance needed to safely stop.

To measure sight distance on an existing road, one person stands in the center of the travel lane sighting from the top of a sighting rod, while another holds a target rod at a length away in the direction of travel and records the distance at the point in which the bottom two feet of the target rod moves out of view of the person with

has resulted in crashes. Agencies should consider improvements when the recorded distance is less than the minimum requirement. It is most cost effective to combine sight distance improvements with other road improvements to make more cost effective. Traffic control devices, creating no passing zones, and establishing public awareness campaigns are techniques to improve the safety at locations where there is poor stopping sight distance.

References:

- Mearkle, Jim, Nuggets & Nibbles, *Cornell Local Roads Program*, Vol. XXII, No. 4.
- *Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials, Washington, DC 2004.
- "Stopping Sight Distance," Bay State Roads Program, Tech Note #25, 2004.

continued from p1

the sign to the near edge of the pavement. The MUTCD requires that where parking or pedestrian movements occur, the clearance to the bottom of the signs shall be at least 7 feet.

Lateral Offset. The minimum distance from the shoulder edge to the near edge of a sign must be 6 feet. If no shoulder exists, the distance is from the pavement edge.

Causes of Damage

Retroreflectivity makes signs visible at night by bouncing light back to its source. Age, sunlight, and air pollution reduce it.



Sign damage often hinders the message. Support damage can cause it to fail. Weather, accidents, and vandalism cause sign and support damage. Weather deteriorates sign faces and metal backing. It causes support to rust. Vehicle accidents bend and scrape them. Vandalism also causes missing and paint-sprayed signs. Bullet holes and dings can erase at least parts of a sign message. Many bullet holes reduce retroreflectivity. Crews should replace these signs.

Shop and Field Repair

Crews can sometimes repair minor sign damage in the field. They should repair major damage in the shop. If they remove a sign to repair it, they should install a temporary sign.

Whatever the cause of reduced reflectivity, crews should replace such signs. They should also replace signs if a repair will reduce reflectivity. They should replace any damaged signs when motorist cannot easily read the message.

Crews can repair bent signs if they can straighten it on the post by hand pressure. If it is necessary to

remove the sign and pound it flat, they will probably damage the background or legend. They should replace it, which is usually less expensive.

Many agencies find that replacing supports with breakaway posts is less expensive over time. They also cause less damage and injury when struck. State law requires calling One-Call before digging. Crews cannot remove paint from this school sign without damaging the retroreflectivity. They should replace it.



Furthermore, the new sign should be a MUTCD designated S1-1. (See Part 7 of the MUTCD.)

Sometimes crews can remove paint without reducing the sign's reflective properties. To remove paint:

1. Wipe the sprayed area lightly with a soft cloth moistened with mineral spirits. If ineffective, go to step 2.
2. Wipe the sprayed area with a soft cloth moistened with lacquer thinner.

Abrasive materials and compounds usually scratch the sign face. Retroreflective sheeting damage depends on paint type, paint exposure length, and the cleaning chemical. After cleaning, night inspection is best. Repaired signs that look good in daylight can be ineffective, and unsafe, at night.

SIMS (Sign Inventory Management System), a software-based system, will assist road managers with inspection and reviews. Its purpose is repair plan development. Contact the Maryland Technology Transfer Center for more information. The MD T² Center also has information on the MUTCD and sign placement.

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The Great Escape: How Retirement, Recruitment, And Retention Are Impacting The Field Of Public Works

By Dr John F Luthy

While recently attending a retirement party for a 38-year career public works employee, I was shocked by the number of his fellow employees who were planning for retirement within five years. In that particular division, over 40 percent of the employees (25 out of 60) were eligible for full retirement by 2009-virtually all of them serving in key technical, planning, or administrative positions. Our surveys indicate that many public works organizations will face similar retirement numbers beginning in 2005 and escalating rapidly for the next twenty years. In one department I recently visited, fully 80 percent of an entire division will be eligible for retirement before 2010!

This phenomenon is certainly not new. According to the Bureau of Labor Statistics, between 2002 and 2012 the number of people in the labor force ages 55 and older will increase by 51 percent and those ages 65 and older by 43 percent. Obviously, this means that large numbers of older employees will reach retirement age at approximately the same time. For those working in "Rule of 85" or "Rule of 90" programs, many are eligible for retirement beginning at age 55 or even younger. No matter how the numbers are calculated, the message is irrefutable-large numbers of public works employees, many with great technical expertise, will begin retiring within five years. The challenge of replacing talented employees has become a major national crisis that must be addressed by not only the public works profession but also by elected officials and public managers in every state, city and county in America.

The Growing Dilemma

There is an element of "predictable surprise" in this dilemma. A simple review of age and tenure can help predict potential retirement schedules and estimated numbers. More departments are becoming aware of the situation and are able to predict the talent loss. But awareness often compounds the true challenge-replacing seasoned professionals who have gained the bulk of their institutional memory through many years on the job with continuous training during years of extraordinary technical innovation. Simply placing ads to replace retiring talent does not address issues of lost institutional knowledge, acquired skills, and community-wide collaborative relationships.

It is clear that the number of seasoned, talented public works professionals approaching retirement far outpaces the number of young or mid-career employees entering the profession. Yet, recruitment is becoming more difficult, turnover is higher than ever, and options for training and career development are being hampered by misguided budgetary decisions. At a time when the public works profession is being decimated with retirements there are converging variables that portend a grim future. How public works, transportation, and utility organizations deal with this growing dilemma will have a huge impact on every community's ability to sustain basic infrastructure that supports a level of comprehensive community development that is essential for economic vitality.

A Tough Sell

Conversations with senior managers across the US have underscored the difficulty with recruitment. With some positions open for six to eighteen months, many departments still cannot attract the expertise required to replace seasoned veterans. Surveys conducted during broad-based strategic planning reveal that the current public environment has created a negative atmosphere in which to recruit and that retention is growing increasingly difficult.

Clearly, many public works organizations have not gained a significant level of respect, stature and support in their communities. In many ways, they continue to remain transparent to the general public. This is partially due to the tendency of technical professionals to focus on critical projects while spending little time on public relations or political coalition building. There is little time for image building when waste treatment, road resurfacing, water system capacity, stormwater planning, and reducing traffic congestion remain vital to community development. Unfortunately, the result is that our public works departments are rarely seen as magnets for young career-minded professionals.

The number and complexity of technical projects have also escalated over the past twenty years while public scrutiny and political demand have become almost overwhelming. In our studies, we consistently find that very few public works departments have staffing levels adequate for the growing workload, yet financial support has declined as budgets are stretched by slow economies, conflicting priorities, and continuing security concerns. And, with so many conflicting projects, it has become increasingly difficult to sustain long-term project plans without constant amendment.

Similar to the aging public infrastructure, the facilities and capital equipment of many departments have become outdated and insufficient to meet evolving program needs. Luring new talent to a department through the promise of great facilities, the latest technology, and modern equipment is not an option for many managers. Yet, among high school and college graduates, these ingredients are among those most often noted when describing an ideal work environment.

Perhaps the two most significant issues for potential recruits are salary and career opportunities. Frankly, salaries have not kept pace with private industry and are in many places 25% to 40% below similar positions in industry. To exacerbate this, many recruits seem interested if there is a clear career path and the promise of job growth, but decline when learning that training and professional development budgets have been all but eliminated. A pretty bleak picture for mid-career recruits or bright young people who are seeking a promising career!

In this environment, why would anyone want to join or remain with a public works organization? What might motivate talented people to join the public works team, build a career, and do great work?

The "Catch-22"

Taken alone, the growing number of retirements would seem to be a straightforward problem. But when combined with the increasing number of employees leaving public works after staying from three to ten years and the lack of recruitment success, the challenges stated here have no simple remedy. While business journals such as Forbes, Fortune, and INC. magazine also address the pending number of Baby Boomer retirements, various authors suggest sensible remedies related

to salary adjustments, accelerated career paths, more elaborate professional development options, and ingenious recruiting strategies. This might work fine for private industry, but are those same options available to government? Essentially, the answer is "No."

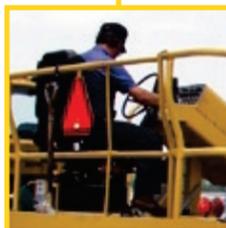
Cumbersome personnel and human resource policies hamper recruitment at a time when process innovation and evolution have become vital. When compared to private business, public agencies are far too constricted and confined when competing for talent, especially in highly technical fields. Similarly, salary surveys consistently indicate that private industry is far ahead of government when establishing equitable salary structures, something sorely needed for almost every professional or technical position in public works. When adjustments are required to attract talent, business can make them virtually overnight-something that is generally impossible in overly bureaucratic and ponderous public personnel systems. (This is often not due to lack of expertise among HR and personnel staff, but to archaic public policy and/or lack of awareness and support among elected officials.)

As noted earlier, when promising applicants are inclined to accept a position for less money, they often lose interest due to poorly defined career paths and the absence of formal professional development programs. Even the prospect of working on challenging public projects cannot overcome a marginal salary, long hours, constant public/political scrutiny, unclear career opportunities, and lack of continuing professional training. So, at a time when we are losing many of our most respected senior employees, technical complexity and project workload are increasing, and retention is becoming more difficult, public works leaders are finding even fewer options for sustaining or building a workforce to meet predicted demand.

Five Recommendations

There are five critical areas where progress is needed. Each requires collaboration with and support from elected officials, personnel managers, and human resource departments, but all offer the means to break the cycle that will otherwise continue to plague the public works profession.

- 1. Provide a "clinical" assessment of employee retirement, turnover, and retention issues.** Prepare a very clear, concise and "clinical" assessment of employee retirement with schedules showing loss of institutional memory as well as essential technical knowledge and skills. Consider this a discussion paper that outlines the situation pertaining to talent loss, rate of turnover, declining tenure, and recruitment difficulties. Review the status of professional development and training programs, indicating their value and your department's current level of formal employee development. Discuss salary surveys, with supportable data related to comparable salaries in similar industries and government agencies. Inform decision makers of the issues with documented impact on program and project delivery, service quality, and cost to the community.



2. Focus on employee training and development. For many technical disciplines, half of what is learned in college or in specialized training is obsolete within five to eight years. State and local government has been extraordinarily myopic about continuing professional development, often cutting the very training and development programs that would otherwise help sustain desired quality and service levels. Public works leaders must address this through honest discussions with elected leaders and policy makers. Establish mentoring programs, develop internal orientation and training programs for core competencies and specialized skills, and create your own development systems. The International City/County Management Association (ICMA) has published and currently distributes this author's guide detailing how to evolve from performance review systems to employee development systems that promote performance while creating clear career paths for all employees. Research tells us that new recruits and established employees will increasingly demand career and professional development. To successfully retain employees and recruit new talent, it is essential. Remember, the only thing worse than training people and having them leave is not training them and having them stay.



3. Use retired technical talent. Recent AARP surveys report that fully 80% of retiring Baby Boomers plan to work in retirement. This will provide and is already providing a huge talent repository replete with every technical specialty and type of experience needed in most departments. The only barriers involve existing policies that might not accommodate individuals who want to work part time or have very flexible hours. Forward-thinking leaders will recognize this cadre of talented professionals and immediately begin to develop personnel policies that allow flexible contracts. Based on survey information, retirees in this growing talent pool are already well trained, are inured to difficult project demands, like to work, and are very experienced. Combined with sensible recruitment and succession planning, using capable retirees will ensure adequate staffing for scheduled projects, provide more senior talent to use as mentors, and will moderate staff costs.

4. Conduct succession planning. Similar to private industry, it is essential that every public works department have a clear management development and succession plan. Take time to analyze the management structure and determine how retirement or resignations might impact service delivery, institutional memory, and operating effectiveness. Develop If-Then scenarios for several potential situations involving loss of personnel and pose remedies designed to maintain the highest quality work output and project delivery. For those considered top leadership candidates, provide a formal development program that will allow them to grow professionally while preparing for potential management openings. Invite broad participation—every learning opportunity pays dividends for both the community and your department.

5. Accelerate recruiting. Public works must establish itself as a wise professional career choice. This cannot be done without a totally revamped recruiting system that actively seeks new talent, both early and mid-career. Learn to showcase your department and what it means to the community. Establish a team of employees that visit local high schools, junior colleges, and universities during career fairs, explaining to prospective candidates the exciting challenges associated with public works. Talk about your history, contributions, projects, career opportunities, job variety, and other aspects of public service. This must be done as a formal, planned and continuous process that may require support from elected officials. They must understand that it takes time and resources but will pay dividends to the community while ultimately saving money.

Meeting The Challenge

For leaders of technical organizations, sustaining a strong employee base is similar to football coaches who have to constantly recruit new talent to take the place of graduating or lost players. It takes a concentrated effort and often requires new processes, structures, and support systems. For public works, this major leadership challenge must be shared with elected policy makers as well as public

managers at all levels. The changes needed to address growing problems are not small, but not meeting challenges associated with retirements, recruitment and retention will have potentially disastrous long-term consequences.

Of all the work required of public works leaders, developing and sustaining a competent, vibrant, and renewable workforce is the most essential. Don't ever forget that employees are your greatest single asset, with the power to energize or debilitate, create or destroy, innovate or stagnate, motivate or contaminate a section, bureau, division, or entire department. The challenge is defined...the choices are clear.

*Reprinted with permission from *APWA Reporter*, December 2004. This document is found at www.techtransfer.berkeley.edu/

DOT Announces Record Low Highway Fatality Rate in 2004



The fatality rate on the nation's highways in 2004 was the lowest since record-keeping began 30 years ago, the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA) announced today. The number of alcohol-related fatalities also dropped for the second straight year.

All told, 42,636 people died on the nation's highways in 2004, down from 42,884 in 2003. The fatality rate per 100 million vehicle miles traveled (VMT) was 1.46 in 2004, down from 1.48 in 2003. The fatality rate has been steadily improving since 1966 when 50,894 people died and the rate was 5.5.

Since 2001, the number of states with primary safety belt laws has increased to 22, along with the District of Columbia and Puerto Rico, leading to an 80 percent safety belt use level, the highest ever. In addition, all states, plus the District of Columbia and Puerto Rico, now have 0.08 blood alcohol laws for drivers. Minnesota's 0.08 law took effect today, August 1.

In 2004, VMT increased to 2.92 trillion, up from 2.89 trillion in 2003, according to the DOT's Federal Highway Administration.

"The progress we've made reflects the Bush Administration's strong commitment to improved safety. And credit must also go to those states where safety also is a high priority," said NHTSA Administrator Jeffrey Runge, MD. He announced the new fatality numbers in Buffalo, where he's a keynote speaker at the 2005 Traffic Records Forum.

NHTSA's Fatality Analysis Reporting System (FARS) also shows that, between 2003 and 2004:

- Motorcycle fatalities increased from 3,714 to 4,008, an 8 percent rise.
- Alcohol-related fatalities dropped from 17,105 to 16,694, a 2.4 percent decline.

"Drivers are safer today on our nation's highways than they have ever been, in part because of the safer cars, higher safety belt use, and stronger safety laws that this Department has helped champion...But as long as the number of highway deaths remains as high as it is, we will keep advocating for the kind of vehicles, roads and driving habits that make people safer in their cars and trucks."

—Secretary of Transportation Norman Y. Mineta.

- Rollover deaths among passenger vehicle occupants increased 1.1 percent from 10,442 to 10,553.

- Total fatalities in sport utility vehicles (SUVs) increased 5.6 percent, from 4,483 to 4735, while fatalities in passenger cars, pickup trucks and vans decreased a total of 834.

- Twenty-seven states, the District of Columbia, and Puerto Rico had decreases in the total number of fatalities. The highest percentage decreases were in the District of Columbia (-36 percent), Rhode Island (-20 percent) and Minnesota, Montana, and Nebraska (-13 percent). The highest percentage increases were in Vermont (+42 percent), New

Hampshire (+35 percent), New Mexico (+19 percent), and Alabama and Oklahoma (+15 percent).

- Passenger vehicle occupant fatalities dropped to 31,693 – the lowest since 1992. Declining fatalities in passenger cars are consistent with more crashworthy vehicles in the fleet and increases in safety belt use.

- Pedestrian deaths declined 2.8 percent from 4,774 in 2003 to 4,641.

- Fatalities from large truck crashes increased slightly from 5,036 to 5,190.

- In 2004, 55 percent (down from 56 percent in 2003) of those killed in passenger vehicles were not wearing safety belts. This underscores the value of the need for states to adopt primary safety belt laws.

NHTSA earlier estimated that highway crashes cost society \$230.6 billion a year, about \$820 per person.

NHTSA annually collects crash statistics from the 50 states, the District of Columbia, and Puerto Rico to produce annual reports on traffic fatality trends. This early report on results from the 2004 Annual Assessment is available on the NHTSA web site at: <http://www-nrd.nhtsa.dot.gov/pdf/nrd-30/NCSA/RNotes/2005/809897.pdf>

Chip Seals

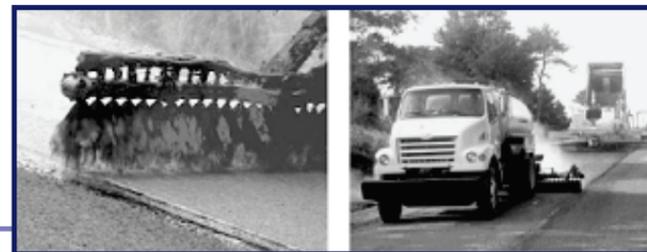


Elements Of A Successful Chip Seal

Poor weather may cause newly constructed chip seals to fail. Ideally, weather will have low humidity, no wind, and sustained high temperatures. High humidity results in poor adhesion between the binder and the aggregate.

Warmer air temperatures create a better bond between the binder and aggregate, and the pavement surface. Pavement temperature affects the viscosity of the binder and the speed at which it will set. It should be more than 70°F and less than 130°F.

Rain will cause chip seal failure. If unexpected rain occurs crews must immediately spread sufficient aggregate to cover the binder. If possible, they should close the road to traffic, or keep traffic speed low because adhesion between the binder and aggregate is at risk. They should reduce or stop the rolling while the aggregate is wet as the binder may be picked up on the wheels of the roller.



Pavement preparation is crucial for a good chip seal. A well-prepared pavement is uniformly textured and smooth, with only minor defects. To prepare the pavement surface for a chip seal:

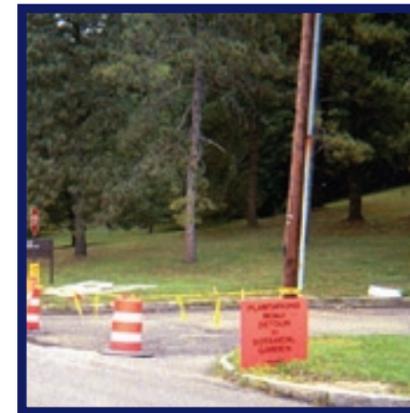
- Patch all holes and depressions,
- Fill and seal all cracks 6 to 12 months before the chip seal to allow sealant curing,
- Level all bumps, waves, and corrugations,

A chip seal or seal coat is a single layer of asphalt binder covered by embedded aggregate (one-stone thick). Chip seals are the most often used preventative maintenance (PM) treatment. Effective on structurally sound pavements, they are popular because of low initial cost compared to thin asphalt overlays. Chip seals seal the fine cracks in the pavement's surface and prevent water from getting into the subgrade and base. They prevent distresses resulting from oxidation as well as enhance skid resistance for vehicles. Chip seals do not provide structural capacity to pavement. For badly cracked or weathered pavement surfaces, road managers should reconstruct, rehabilitate, or apply a conventional overlay.

PM is a proactive approach to preserve and extend a pavement's life. Its purpose is to maintain pavement before it develops major distresses. Therefore, to achieve the most benefit, cities and towns should apply a chip seal early in the pavement's life. It can be beneficial to apply three or four chip seals to a pavement before it reaches the end of its design life. This article will discuss the elements of a successful chip seal: weather, pavement preparation, application, rolling, and sweeping.

- Remove excess asphalt on patches and joints, and
- Broom the full surface width to be treated.

The distributor is an asphalt tank equipped with spraying equipment mounted on a truck chassis. Crews must calibrate the distributor for the specified transverse application rate. Many distributors have parallel spray bars (also called wheel-path bars) that enable variable spray rates across the lane. When temperature and humidity are ideal, the time between binder and aggregate applications



should not exceed 3 minutes or 300 feet. The aggregate spreader applies an even layer of aggregate across the full width of the binder. Self-propelled chip spreaders are necessary for larger-scale projects. Tailgate box spreaders are usually sufficient for spot (strip) sealing. Self-propelled spreaders give the operator more control to create a uniform spread of aggregate. The Tailgate box spreaders do not lay aggregate as smoothly and continuously.

Many spreaders are equipped with computerized controls that allow the gates to open and close hydraulically, which will compensate for varying spreader speeds. Some models have a vibratory hopper that further improves the uniformity of the discharge.

Dump trucks hitches must match the spreader so the dump truck bed will not damage the spreader's receiving hopper. This will also reduce spillage on the roadway. Sometimes, dump trucks or spreaders have aprons to control the dumping of aggregate into the spreader hopper.

In areas where extensive stopping and turning of traffic occurs, crews should apply some excess aggregate to reduce scuffing and rolling.

Rollers embed the aggregate into the binder and orient the chips so that maximum bonding occurs. Pneumatic (rubber-tired) roller weight provides the force needed to embed the aggregate firmly in the binder. To ensure good embedment and orientation, rolling should occur right after aggregate application.

Operators should roll at a speed that will not displace stone. They should make at least three passes to embed the aggregate into the binder.

Static steel-wheeled rollers have a smooth surface steel drum. Agencies should use with caution because they can crush the aggregate. If used when the underlying pavement has ruts, the roller bridges over ruts

and will not properly seat the aggregate in the wheel path.

Sweeping cleans the existing road surface and removes excess aggregate from constructed chip seals. Two types of sweepers are used in chip seal construction: rotary brooms and pickup or vacuum sweepers. Rotary brooms remove excess aggregate from the chip seal surface without dislodging the embedded particles. Too much downward pressure will cause the broom's bristles to remove the aggregate with a flicking action. Crews should use steel bristles prior to chip seal construction. After, plastic bristles are less likely to damage the new chip seal.

Rotary brooms move the excess aggregate to the roadside. They generate dust and may affect visibility for traffic. Usually the aggregate ends up back in the traveled way by either rain or vehicles using the shoulder for parking.

Pickup sweepers minimize dust and remove all excess aggregate from the project. A pickup sweeper features a broom that sweeps the aggregate to a suction head into a storage tank. Pickup sweepers are useful in urban areas to remove aggregate accumulating in gutters or along the roadway edge.

The recommendations in this article will provide a long lasting chip seal. Chip seals typically provide good performance on roads for 4 to 7 years. Chip seals done correctly reduce wind shield damage from kicked up stones, tire noise, prolonged traffic during construction, flushing, streaking due to non-uniform binder application, and premature failure.

Reproduced from UNH Newsletter Summer 2005.

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- http://trb.org/publications/nchrp/nchrp_syn_342.pdf, May 6, 2005.
- *Participants Manual for Preventive Maintenance Treatments Workshop*, UNH T2 Center, November 1996.

Typical Problems in Highway Work Zones and Their Solutions



The following common problems in work zones can increase the danger to motorists and workers.

- **Signs left up when no work is going on.** When drivers see work zone signs but no work activity, they lose respect for such signs. Before leaving the work zone, crews should keep up only those signs necessary to warn motorists of the road conditions. Especially important is the removal of the "Flagger Ahead" sign.
- **Improper signs and sign stands.** Wooden and heavy metal signs and sign supports can cause considerable harm in minor accidents. They should be "crashworthy," which means that they conform to NCHRP Report 350. Suppliers can provide certification that signs and supports meet "350" requirements.
- **Too few cones and barrels.** There must be enough cones or barrels to define the transition area tapers clearly. The minimum number depends on taper length and traffic speed. They should be evenly spaced along the taper length.
- **Devices too small.** In greater than 35 mph work zones, and in all work zones at night, cones must be 28 inches high. They must have two retroreflective stripes or lights. In 35 mph and less work zones, cones can be 18 inches high with one retroreflective stripe. Barrels must be at least 36 inches high and 18 inches wide. They must be orange with at least two white, 4 to 6 inch wide, retroreflective stripes. Barrels can have weight in the bottom, but not be filled.

- **Non-reflective devices.** All signs and other devices must be retroreflective and visible at night.
- **Flaggers using flags.** Flags should be used for emergency use only. Flaggers should use STOP/SLOW paddles, and hand signals when necessary. Paddles must be 8-sided (not round), retroreflective, at least 18 high and wide, and on a rigid handle.
- **Complacent flaggers.** Flagging can be boring and tiring, but flaggers must stay alert and pay attention at all times. One moment of complacency can result in injury to motorists, passengers, workers, and/or the flagger.
- **Poor flagger location.** Flaggers should be on the outer edge of the travel lane they are directing. They should stand alone, away from equipment and other workers. They should stay out of shadows and be visible to drivers well in advance of their location.
- **Lack of termination signs.** As a courtesy to drivers, all lane closures should end with an "End Road Work" sign.

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References:

- MUTCD, <http://mutcd.fhwa.dot.gov>
- "Ten problems in highway work zones", *Oklahoma LTAP News*, October 2004, p. 8.
- Slides from Workzone Traffic Control, UNH T2 Workshop.



Slick Idea for Stopping Sign Thieves

"We had one street that was being vandalized regularly. It happened four times in one year, and it was costing us \$200 or more to replace the signs each time. The last time it happened, we decided to weld an extra section on the sign post to make it taller, and then we greased it. We used the messiest, dirtiest black axle grease we could find. We figured if they did it again, all we would have to do is look for someone with a black streak down the front of their jacket. Six months later we haven't lost a single sign on that road."

— Don Schumacher, Town Chairman, Rush River, Wisconsin

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