STANDARD PRACTICE FOR TREATMENT OF HIGH STRESS PAVEMENT LOCATIONS USING HOT MIX ASPHALT

November 26, 1997

The Standard has been developed by Flexible Pavements, Inc., an Association for the development, improvement and advancement of quality asphalt pavement construction in Ohio. The most current update of this document can be obtained by contacting Flexible Pavements, Inc. at 1-888-4 HOT MIX.

1. Scope

1.1 This standard covers methods for treating pavement areas exposed to high stresses induced by heavy vehicular traffic. Pavement areas such as intersections, bus lanes, delivery docks, climbing lanes, and ramp termini are typical of such areas.

1.2 Methods purported by this standard are a compilation of industry's best practices for eliminating rutting, shoving, corrugations and slippage cracking in asphalt pavement. The standard does not purport to remedy pavement areas exhibiting distress resulting from a lack of pavement structure. Necessity for a designer to follow an accepted methodology for pavement thickness design still exists. Accepted design methods include: Asphalt Pavement Design & Construction Guide, by Flexible Pavements, Inc.; The Asphalt Institute, Manual Series No. 1; Ohio Department of Transportation, Location and Design Manual; AASHTO Guide for Design of Pavement Structures.

1.3 The designer should, after performing the necessary evaluations, select the appropriate rehabilitation strategy and asphalt mixture. In cases where the area being treated has exhibited distress, the use of a forensic analysis prior to selecting the method of remediation is strongly encouraged.

2. Referenced Documents

2.1 Asphalt Institute, Manual Series No. 17 - Asphalt Overlays for Highways and Street Rehabilitation

2.2 Asphalt Institute Superpave Series No. 2 (SP-2)

2.3 Ohio Department of Transportation (ODOT) Construction and Materials Specifications

2.4 Ohio Department of Transportation (ODOT) Draft Guidelines for Treatment of High Stress Pavement Locations

3. Terminology

3.1 Definitions

3.1.1 asphalt binder – an asphalt cement or a modified asphalt cement which acts as a binding agent to glue aggregate particles into a dense mass and to waterproof the mixture.

3.1.2 composite pavement structure -- a pavement structure, placed above a granular base material and comprised of portland cement concrete covered by a hot mix asphalt layer(s).

3.1.3 corrugations – a form of plastic movement typified by ripples across the pavement surface.

3.1.4 flexible pavement structure – a pavement structure, placed above the subgrade or improved subgrade, with all the courses consisting of asphalt-aggregate mixtures, or a combination of asphalt and untreated aggregate courses.

3.1.5 heavy traffic -- number of trucks (ADTxT24) in the current traffic is 1500 or more. If a project is in a mining or manufacturing area where there will be loaded trucks carrying coal, gravel, stone, steel, etc. making starting, stopping, or turning movements creating higher stresses in the pavement, 750 trucks is used for the threshold of heavy.

3.1.6 high stress location -- pavement areas such as intersections, climbing lanes, docking areas, sharp curves, etc. where multiple heavily loaded vehicles firmly brake, travel at slow speeds or remain standing for periods of time.

3.1.7 hot mix asphalt (HMA) – high quality, thoroughly controlled hot mixture of asphalt binder and well-graded, high quality aggregate, thoroughly compacted into a uniform dense mass. 3.1.8 medium traffic -- number of trucks (ADTxT24) in the current traffic is 50 to 1499. If a project is in a mining or manufacturing area where there will be loaded trucks carrying coal, gravel, stone, steel, etc. making starting, stopping, or turning movements creating higher stresses in the pavement, 50 to 749 trucks is used as the criteria for medium.

3.1.9 rutting – is visually identified as vertical depressions in the pavement surface along the wheel tracks. Rutting is measured transversely across the depression using a string line or other appropriate straight edge. Rutting is generally considered significant when it approaches 3/8 inch in depth.

3.1.10 shoving -- a form of plastic movement resulting in localized bulging of the pavement.

3.1.11 slippage cracking -- cracks, sometimes crescent-shaped, that point in the direction of the thrust of wheels on the pavement surface.

4. Parameters for Identifying High Stress Pavement Locations

4.1 High stress locations are found at areas of high acceleration and braking, at intersections, sharp curves, ramps, docking areas and where heavy vehicles frequent at slow speeds.

4.2 High stress locations occur at intersections with forced stop control typically having the following criteria:

- i. The approach grade to stop control is greater than or equal to 3.5 percent.
- ii. Current average daily truck traffic (ADTT) in the design lane exceeds 500 trucks per day.
- iii. Current ADTT in the turning lane exceeds 250 trucks.

4.3 High stress locations occur on ramps or sharp curves with or without forced stop control having greater than 250 trucks per day. As truck counts on ramps are often unknown, and the term sharp curve is subjective, exercising engineering judgment will be necessary when designing new facilities.

4.4 High stress locations may occur on stretches of roadway as exhibited by past failures of standard HMA mixes. These stretches of roadway generally exhibit rutting due to combination of trucking/traffic patterns, counts and weights. Additionally, high stress locations may occur on stretches of roadway where long and/or steep grades exist.

4.5 Loading and unloading facilities where cartage is transferred are areas of high stress due to loads being sustained for long periods of time.

4.6 Bus lanes and areas where buses stop to board and deboard passengers.

5. Treatment of High Stress Locations

5.1 There are several options available for the use of flexible pavement in high stress locations. For cost consideration, the ‘Next Step’ approach should be used. Next Step approaches are as follows:

> 5.1a. In a high stress area which would otherwise require a medium traffic pavement mix design, specify a heavy traffic pavement mix design.
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> 5.1b. In a high stress area which would otherwise require a heavy traffic pavement mix design, specify an Asphalt Concrete Mixture for High Stress Applications

5.2 For all high stress locations where pavement deformation is evident, a forensic analysis should be performed. The purpose of the forensic analysis is to identify the depth of the deformation and ensure all possible causes for the failure have been considered.

5.3 Where deformation has occurred, pavement planing should be specified to remove all deformed material. The depth to which planing is to occur should be determined only after a forensic analysis has been performed. When forensic analysis is not possible or practical, removal of the asphalt concrete should be as herein directed.

5.3a. For flexible pavement, planing should be specified at least 75 mm (~3 inches) below the deepest portion of the rut.

5.3b. For composite pavement, planing should be specified at least 125 mm (~5 inches) below the deepest portion of the rut or to the surface of the rigid base pavement. (Note: A minimum cover of 50 mm (~2 inches) should be left in place. If milling is required to remove asphalt concrete within the 50 mm (~2 inches) cover then all the asphalt concrete should be removed so as not to allow the occurrence of delamination.)

5.3c. For composite pavement with a brick base, planing should be specified at least 75 mm (~3 inches) below the deepest portion of the rut. (Note: A minimum cover of 50 mm (~2 inches) should be left in place. If milling is required to remove asphalt concrete within the 50 mm (~2 inches) cover then all the asphalt concrete should be removed so as not to allow the occurrence of delamination.)

5.4 Surface preparation prior to HMA overlay shall be as directed herein.

5.4a. Tack coat

i. Where the existing or milled surface is an asphalt pavement and a standard heavy traffic ODOT mixture is being employed, tacking materials shall meet the requirements of ODOT item 407.

ii. Where the existing or milled surface is an asphalt pavement and an asphalt concrete mixture for high stress applications is being used, tacking materials shall meet the requirements of ODOT Supplemental Specification 924 except the content of rubber solids shall be 3%.

iii. Where the existing or milled surface is brick or portland cement concrete, tacking materials shall meet the requirements of ODOT Supplemental Specification 924.

5.4b. Scarification of the surface shall be required whenever an HMA overlay is to be placed on a portland cement concrete (PCC) surface. Scarification shall be to a depth of 10 mm (~3/8 inches) to provide mechanical interlock between the asphalt overlay and PCC surface. Scarification shall be set up as a separate pay item in square meters (yards) to ensure complete coverage when the work is performed.

5.5 Lift combinations and thickness requirements will generally be the same as would be required for a standard flexible pavement or overlay. Where surface courses using no. 7 size aggregate or larger is specified the minimum compacted lift thickness shall be 38 mm (~1_ inches).

6. Limits of High Stress Locations

6.1 The limits of the high stress treatment should be determined as follows:

i. A minimum of 60 m (~200 ft.) back from the location of stop termini.

ii. The length of the turn lane.

iii. The entire roadway bounded by stop control intersections which have less than approximately 150 m (~500 ft.) spacing and a speed of less than 72 km/hr (~45 mph).

HOT MIX ASPHALT (HMA) MIXTURES FOR HIGH STRESS APPLICATIONS

Provided as an attachment are specifications for HMA mixtures which have been used successfully in high stress applications in Ohio. The mixtures incorporate a variety of additives and modifiers, all having unique methods for addressing the various pavement performance criteria. The designer should be aware that this variety manifests itself in varying mix performance. For example, where mix “A” may exhibit superior performance to mix “B”, for a given parameter, mix “B” may prove superior for a different parameter. Additionally, the variety of additives and modifiers will result in varying mixture costs.

The designer should be aware that successful performance of high stress asphalt mixtures is reliant, in large part, upon the mixture gradation and aggregate composition. The use of modifiers and additives cannot correct a poor aggregate structure or compensate for low quality aggregate. However, given a proper high quality aggregate skeleton, modified HMA mixes have given exceptional performance under the most adverse traffic and loading conditions. As such, the attached specifications, except where noted, utilize the gradation and aggregate quality requirements of the Ohio Department of Transportation’s heavy traffix mixes.

Prior to specifying the HMA mixture, the designer should evaluate the severity of the pavement loading, identifying the quantity of traffic, pavement geometrics, and nature of the loads (consult *Standard Practice for Treatment of High Stress Pavement Locations*). Additionally, the designer should familiarize himself or herself with the performance characteristics of the various mix types provided, and select the HMA mixture which most closely addresses the conditions for which the pavement has been designed. For example, where only a slight improvement over conventional HMA is desired, select the high stress mix type which provides that amount of improvement to the performance parameter in question. Following this methodology should optimize the Benefit to Cost ratio. The specifier should recognize however, that material costs will vary depending upon availability, the contractor’s familiarity with the product, and market demands.

In selecting a specification using modifiers, the specifier should rely on his own experience. In the absence of such, reference should be made to the attached table. The table provides a relative indication of the impact of each high stress mixture, over that of conventional HMA, in improving the various performance criteria. The table is based upon the general performance of pavements as subjectively observed by the Ohio Department of Transportation for projects on their system. No comparative testing of these products was done by the ODOT and as such, the table is not to be construed as their endorsement of any products listed. The table is provided to help guide the specifier to a modified HMA mixture that will provide the performance desired at the least cost. The specifier should take note that instances have occurred where actual field performance has been superior to that indicated by the table.

PERFORMANCE PARAMETER

Specification 400HS: Improvement to:	Rutting Resistance	Stiffness	Fatigue Resistance	Low Temperature Cracking Resistance	Reflective Cracking Resistance	Moisture Damage Resistance	Durability Toughness
Asphalt Concrete - High Stress using SBR Latex	[2] H	H	H	H	M	H	H
Asphalt Concrete - High Stress using SBS Polymer	H	H	H	H	M	M	H
Asphat Concrete - High Stress using Polypropylene Fibers	H	M	M	M	M	H	M
Asphat Concrete - High Stress using Polyester Fibers	H	M	M	M	M	H	M
Asphalt Concrete - High Stress using Gilsonite	H	H	H	H	H	H	H
Asphalt Concrete - High Stress using SMA with Cellulose	M	H	H	H	H	H	M
Asphalt Concrete - High Stress using SMA with SBS Polymer	H	H	H	H	H	H	H

Note 1: The icon provides a relative indication of the mixture's impact on the performance parameter. The maximum impact is seen as a completely filled area.
Note 2: Indicates the confidence level in the rating used to establish the icon for the particular performance parameter.

Low (L) - this indicates a low confidence level in the rating used to establish the icon. The low confidence level may be as a result of unfamiliarity with the product, or variability in the performance of the product.

Medium (M) - indicates a moderate confidence level in the rating used to establish the icon. The moderate confidence level may be as a result of some unfamiliarity with the product, or moderate variability in the performance of the product.

High (H) - indicates a high confidence level in the rating used to establish the icon.