Austin District Pavement Design Standard Operating Procedures

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Table of Contents

Attachments

List of Table & Figures

Austin District Pavement Design Process

Pavement Design Reports

A pavement design concept conference and a pavement design report are required for all the following projects over 500 ft. long, as stated in the Department's Pavement Manual, Chapter 2, Section 9:

- new location projects (flexible and rigid);
- reconstruction projects (flexible and rigid);
- rehabilitation (3R) projects (flexible and rigid);
- hydraulic cement concrete (rigid) overlays of existing pavements; and
- hot mix asphalt (HMA) overlays greater than 2" thick.

Exceptions to this guideline or special cases will be considered by the District Pavement Engineer (DPE) during the Pavement Design Concept Conference. The pavement design for special cases will typically be based on engineering judgment, historical performance, district policy, and other Department guidelines. A design report may be required for documentation purposes or sufficient documentation of the rationale used may be required for the project records.
The following list provides examples of special cases that require documentation of the criteria and rationale for the strategy selected for projects greater than 500 ft. long:

- approaches on a bridge replacement
- detours
- pavement widening including shoulders and turn lanes
- HMA overlays of rigid pavements
- bonded rigid overlays on rigid pavements
- thin whitetopping of flexible pavements.

For design categories not covered above, contact the DPE for guidance about recommended design procedures and documentation requirements.

Pavement Design Process

At the early phase of the project development, the designer should coordinate with the Area Office (AO) and District Maintenance, when applicable, to receive concurrence with the pavement concept. Upon AO concurrence, the designer will send a pavement concept to the DPE via email. <u>All pavement designs will be prepared by the DPE, unless the DPE assigns it to the District's pavement design contract project manager</u>. The designer will include the description of the project and all available preliminary data in the request (refer to Attachment 3). The DPE will provide a preliminary pavement design to ensure adequate funding is selected for the project.

Preliminary pavement sections will be provided by the DPE at the 30% PS&E review, unless essential information for design is pending. The pavement report will include the proposed typical sections, materials, and structural analysis, when applicable. If all design information is available, DPE will provide a pavement design report at the 60% PS&E review.

Traffic Analysis (Flexible or Rigid Pavement)

Submit TxDOT Form 2124, "Request for Traffic Data" from Transportation Planning and Programming Division (TPP) through the designated contact in the District Advance Planning Office. When developing the traffic data request, in all cases request the information be developed using the following information:

- Flexible Pavement
  - SN = 3
  - 20-year projections
- Rigid Pavement
  - 8" slab thickness
  - 30-year projections

Request that all traffic be developed for the frontage roads and main lanes separately, otherwise TPP will combine these traffic totals. Provide as much information to TPP concerning the potential truck traffic generators in the project and any future development that would impact the growth of ADT and percent trucks. Additional 24-hour classification counts may be needed to support the estimated traffic and can be used as a basis for estimating ESALs. If the available TPP traffic report is older than 5 years or it is known that traffic trends have changed in the project, request an updated report or use spreadsheet TRAFFIC6 to update the traffic information supplied by TPP.

Pavement Design Procedures for New Construction or Reconstruction

Foundational Design (Flexible or Rigid Pavement)

A pavement evaluation of the existing pavement and subgrade soil conditions is required to characterize and design subbase or foundational layers of the new pavement structure as a part of the pavement design process.

Soil Exploration & Testing

The DPE will develop the scope of testing and the evaluation for analysing the subgrade and existing pavement structure to supplement the pavement design report. The geotechnical investigation should identify the existing pavement structure and at least 7 ft. of the proposed subgrade. For pavement design purposes, it is recommended to take at least one bore for each soil type based on the United State Department of Agriculture (USDA) website. Use the testing protocol in Table 1 to characterize the subgrade soils for foundational pavement designs.

Table 1: Soil Exploration & Testing Protocols

Testing	Properties	Purpose
Dynamic Cone Penetration (DCP)	Subgrade Soil Shear Strength	To determine the moduli and shear strength of the supporting subgrade soil.
Soil Classification (Tex-104-106-E, Tex-110-E, Tex-142-E)	Plasticity, Particle Distribution, Percent Binder, and Soil Classification	To classify and determine type of subgrade soil treatment and use for Modified Triaxial Design Check.
Potential Vertical Rise (Tex-124-E or Centrifuge method)	Potential Vertical Rise (PVR)	To determine the depth of treatment needed to meet the maximum allowable PVR.

Soil Movement Mitigation

Potential Vertical Rise (PVR): Mitigation strategies for soil movement or PVR will only be considered when risk concerns and ride are of the highest importance and the traffic volumes and pavement thickness requirements warrant a substantial capital investment.

Based on the Department's guidance for design (Memorandum from John A. Barton, P.E. (PVR), July 6, 2009), the District will evaluate PVR for new construction projects meeting at least one of the three following criteria:

- High speed and traffic facilities with highly expansive soils
  - Design Speed > 45 mph;
  - ADT ≥ 40,000 vpd; and
  - Subsurface soils with plasticity index (PI) ≥ 30 (sections mainly located East of the Balcones Fault Zone).
- CRCP designs, Perpetual Pavements, or Pavement with HMA thicknesses >12"
- Design-Build (DB) or CDA projects (general purpose and main lanes)

All projects meeting these criteria will be evaluated on a case-by-case and location-by-location basis, as the presence of expansive soils does not necessarily require mitigation of soil movement. PVR requirement will not apply to widening projects when matching the existing pavement sections. PVR must be determined from a soil column 15-feet deep as measured from the top of the proposed finished pavement grade. PVR can be determined using a 10-foot soil column from the top of the proposed finished pavement grade if the subsurface soils consist primarily of impermeable, high plasticity clays (CH) within the top 5 feet of the soil column.

The maximum allowable PVR values for design are 1.5" for main lanes and 2.0" for frontage roads, in accordance with the Pavement Manual.

Subgrade Soil Treatment or Stabilization Design: Use Table 2 to choose the appropriate treatment or stabilization. Select the type of treatment or stabilization in accordance with Guidelines for Modification and Stabilization of Soils and Base for Use in Pavement Structures (2005). If sulfate-rich soils are encountered, select the type of treatment or stabilization in accordance to the Department Guidelines for Treatment of Sulfate-Rich Soils and Bases in Pavement Structures (2005).

Table 2: District Subgrade Soil Treatment & Stabilization Guidelines

Purpose	Description	Guidelines
Construction Platform	To provide a stable platform for construction and compaction of overlying pavement layers.	○ For soil with PI<25, a construction platform is not required. ○ For Clays and Silts (CH, MH, CL, ML), for construction purposes, a range of 8" of lime treated subgrade would be prescribed. The target lime content can be determined by Tex-121, Pt III. ○ For Gravels and Sands (GW, GP, GM, GC, SW, SP, SM, SC), a range of 6" cement treatment may be used. The target cement content will be the minimum cement content to obtain a UCS of 50 psi determined in accordance with Tex-120, Pt I. ○ This treatment is considered temporary, and no structural credit is assigned to this type of treatment. ○ If subgrade stabilization is not doable due to construction constrains, require additional 4" of flexible base. Treat the additional base as treatment subgrade in the design.
Modified Triaxial Design	To provide a structural layer to be included in overall Modified Triaxial Design requirements to prevent a single load subgrade shear failure.	○ For Clays and Silts (CH, MH, CL, ML), a range of 8" to 12" of lime stabilized subgrade would be prescribed depending on the required Modified Texas Triaxial Check (MTTC) thickness requirement. Determine the target lime content using Tex-121, Pt III. The target lime content determined by Tex-121 Pt. III should produce a minimum UCS of 50 psi., in accordance with Tex-121 Pt. I. ○ For Gravels and Sands (GW, GP, GM, GC, SW, SP, SM, SC), a range of 8" to 12" of cement treatment or lime-cement stabilization may be used. The target cement content will be the minimum cement content to obtain a UCS of 50 psi determined in accordance with Tex-120, Pt I. ○ When more than 12" of lime or cement treatment is required, increase the base course layer thicknesses.
Mitigate Soil Movement	To significantly reduce volumetric swelling and shrinkage of soil underlying the pavement structure, to reduce distress and maintain high levels of serviceability. Applies only for roadways meeting the minimum requirements for PVR evaluation.	○ The depth of treatment must be determined using Tex-124-E to meet the maximum allowable PVR. ○ For expansive soil with a PI ≥ 25 (CH, MH, CL, ML), determine the target lime content to achieve volumetric swell to less than 7% by utilizing the volumetric swell test in TxDOT Project 5-4240. ○ For depths of treatment greater than 12", undercut the natural subgrade to the determine depth of treatment and replace with select fill. Reference "Material Selection" guidelines for material properties for select fill. ○ When the PVR exceeds the maximum allowable levels and the top soil strata (1 to 3 feet) is non-expansive and is underlined by expansive soils, do not undercut or chemically treat this layer, as it will be economically and practically prohibitive to treat these depths. Instead, use geogrid reinforcement in the base course layers and/or use a thicker base course to compensate for any

		minor movement. Typically, when this occurs, the PVR only exceeds the maximum allowable by a small amount.

Soil Stabilization in High Sulfate and Organic Soils: When significant concentrations of sulfate are present in natural subgrade soils, substantial volumetric expansion or sulfate heave can occur and cause detrimental damage to the pavement structure.

When soil treatment is required in sulfate-bearing subgrade soils, the protocols in Table 3 will apply. The protocols stated in Table 3 supplement the guidelines stated in the Department's Guidelines for Treatment of Sulfate-Rich Soils and Bases in Pavement Structures (2005).

Table 3: District Protocols for Treating Sulfate-Bearing Soils

Sulfate Concentration (ppm)	Protocol
$SC \leq 3000$	Conventional lime treatment can be utilized.
$3000 < SC \leq 7000$	There is a significant risk using conventional lime treatment practices. The mellowing time and the amount of moisture must be increased relative to conventional practices. The minimum mellowing time and amount of moisture can be determined by Tex-146-E. Determine the target lime content as prescribed in Table 2.
$SC > 7000$	Calcium-based stabilizers (lime and cement) are prohibited. The DPE will determine alternatives methods to reinforce or stabilize expansive subgrade soils, such as geosynthetics, lime-fly ash treatment or remove/replace with select fills.

Significant amounts of organics can react and consume calcium-based stabilizers and prevent or significantly limit the amount of soil stabilization. Determine the organic content in accordance with Tex-148-E and adhere to the protocols in Table 4 when organics are encountered in soils schedules for calcium-based stabilizers.

Table 4: District Protocols for Treating Organic-Rich Soils

Organic Content (%)	Protocol
< 1%	○ Determine the organic content in accordance with Tex-148-E. ○ No action is required. ○ Additional 0.5% lime can be added to the target lime content for assurance of effectiveness.
≥ 1%	○ Determine the organic content in accordance with Tex-148-E. ○ Additional lime will be required to compensate for the additional reaction. ○ The target lime content must be verified with Tex-121-E, Pt. III for soil modification. ○ If permanent stabilization is required, verify the target lime content with volumetric swell testing.

Select Fill Undercut: When soil movement mitigation is required, but chemical stabilization is not feasible due to high concentrations of sulfate or organic or other factors, undercut to the depth required and backfill with select fill.

Table 5 provides the material requirements for the select fill for the undercut areas. Perform ordinary compaction for both embankment items with proof rolling for each lift as acceptance. Proof rolling should be subsidiary to the embankment item.

- TY C1 is a select fill from a borrow source or within the ROW used for mitigating soil movement (PVR) and offers uniform pavement support. TY C1 should be used within 24" of the bottom of base course. Construct in lifts no greater than 6" compacted.
- TY C2 is low to non-plastic soil with PI control to meet PVR requirements and for sources from outside or within the ROW. TY C2 gradation requirements are meant to prevent the use of quarry screenings or friable, silty loams. Construct in lifts no greater than 6" compacted. If a depth greater than 24" is required, TY C2 should be used within 24" of the bottom of TY C1.

Table 5: Select Fill Requirements

Item	Description	Percent Retained-Sieve					LL Max	PI Max	PI Min
		3"	1 ¾"	3/8"	#4	#40			
132	Embankment (Ordinary)(TY C1)	0	0-10	-	45-75	60-85	45	20	6
132	Embankment (Ordinary)(TY C2)	-	-	0	30-75	50-85	55	25	8

Subgrade Support: Determine the level of support the natural subgrade could provide the new pavement structure. Perform non-destructive testing described in the Pavement Manual in Chapter 4, Section 4, Non-Destructive Evaluation of Pavement Structural Properties. Use these structural properties to determine the level of natural subgrade support in the structural design analysis.

Pavement Type Selection Guidelines

Perform both flexible and rigid pavement designs for all full construction roadways with more than 14 MESALs for a 30-year design life . If MESAL do not exceed these minimum ESAL levels, only a flexible pavement design is required. Otherwise, perform both types of pavement designs within the design parameters and material requirements of this SOP.

Once a flexible and rigid pavement section is determined, perform a life cycle cost analysis (LCCA) over the design life for both design sections using the District LCCA application. LCCA provides a means to select the most economical and effective pavement type for the design life of the pavement. The LCCA should only include capital costs to the District, such as initial construction and future maintenance costs. Do not consider unrealized user costs in the LCCA. Perform the analysis in accordance with the Department's Pavement Manual, Chapter 2, Section 5, and the Maintenance Division's LCCA guide.

Performing both rigid and flexible pavement designs is not required for the following circumstances:

- Projects where it is necessary to match adjacent pavement types (i.e. intersections or projects of minimal length)
- Projects where constructability constraints such as limitations in width, traffic control, drainage, construction sequencing, etc., dictate a specific pavement type.

Flexible Pavement Structural Design

Perform all flexible pavement designs in accordance with the latest version of the Department's Pavement Manual. If the traffic and soil conditions vary, this will require segmenting the roadway and performing multiple designs. All designs must be developed in the most cost-effective method while meeting all design requirements. All phases of work will be taken into consideration in developing the most effective design. The latest applications, materials and methods will used to improve the design and construction process.
The following details the design process for analysing and developing the structural design of the pavement design process.

FPS 21 Design Parameters: Use all default design input values and general inputs stated in Table 5-1 and Chapter 5, Section 3 of the Department's Pavement Manual. Use 10 years as the default value for the Minimum Time Between Overlays parameter.

The following are the District guidelines for the Minimum Time to First Overlay parameter:

- For low volume roadways (≤ 1 million ESAL), use 10 years for the Minimum Time to First Overlay.
- For moderate volume roadways (1 million < ESALs ≤ 10 million), use 12 years for the Minimum Time to First Overlay.
- For high volume roadways (ESALs > 10 million), use 15 years for the Minimum Time to First Overlay.

Design Type: Select the appropriate design type as prescribed in the Department's Pavement Manual. When using a gap-graded or open graded surface mixture (SMA, TOM, or PFC), an impermeable dense graded Type D intermediate layer must be used directly beneath these types of surface mixtures with a minimum layer thickness of 1.5".

Material Parameters: Table 6 provides the material parameters which apply to locally available materials to the Austin District. Many of these parameters are based on historical field and laboratory testing.

Table 6: District Material Parameters for New Flexible Pavement Design

Material Property	Design Modulus	Poison's Ratio	Other Considerations
Natural Subgrade	Back-calculated moduli from FWD or DCP	0.40	○ Historical FWD data in the area can be used, if the new construction is near and the same soil formation/classification. ○ Typical range is 8 to 20 ksi. ○ DCP or FWD data must be obtained to apply a modulus outside this range. However, the subgrade's back-calculated modulus must be reduced by 50% as a safety factor.

Lime Treated Subgrade (Item 260)	3 times the modulus of the natural subgrade	0.30	o Must have a UCS ≥ 100 psi. for structural credit. Otherwise, all lime treated layers are not given structural credit. o Minimum of 8" for construction purposes, Triaxial check (MTTC), or soil movement mitigation (PVR). o Maximum thickness of 12"
Cement Treated Subgrade (Item 275)	40 ksi.	0.30	o Must have a UCS ≥ 100 psi. for structural credit. Otherwise, all cement treated layers are not given structural credit. o Minimum thickness of 8" o Maximum thickness of 12"
Cement Treated Road-Mix (Item 275)	100 ksi.	0.30	o Minimum thickness of 6" o Maximum thickness of 12"
Cement Stabilized Base (Item 276)	150 ksi.	0.25	o Minimum thickness of 8" o Maximum thickness of 12"
Flexible Base (Item 247)	40 ksi.	0.35	o Maximum thickness of 13" for weak natural subgrades (≤ 12 ksi)
Seal Coat (Item 316)	200 ksi.	0.35	o Do not assign structural credit to seal coats if used as underseal.
Dense Graded HMA (Item 341/3076)	500 ksi. (≤ 4" Total HMA) 650 ksi. (> 4" Total HMA)	0.35	o Minimum total dense graded HMA thickness of 4.5" when placed on flexible base. o Use for Intermediate, Level-up or Base HMA courses. Do not specify as riding surface, unless the DPE approves it. o Allowable Layer Thickness: o TY B – 3" or greater o TY C – 2" to 4" o TY D – 1.5" to 2"
Permeable Friction Course (Item 342/3079)	500 ksi. (1.5" PFC-C) 300 ksi. (1" PFC-F)	0.35	o Must override default modulus in FPS 21 for PFC-C. o Use PFC-C at 1.5" o Use PFC-F at 1" (needs DPE approval)
Thin Overlay Mixtures (TOM) (Item 347/3081)	650 ksi. (TOM-C) 500 ksi. (TOM-F)	0.35	o Must override default modulus in FPS 21 for TOM-F o Use TOM-C at 1" and TOM-F at ¾"

Stone Matrix Asphalt (Item 346/3080)	650 ksi. (≤ 6" Total HMA)	0.35	○ Allowed when the 20-year ESALs are over 25 million. ○ Use SMA-D from 1.5” to 2.0” ○ Use SMA-F at 1.25” ○ Do not specify SMA-C, as it tends to have construction issues.
	750 ksi. (> 6" Total HMA)		

<u>Modified Triaxial Design Check</u>: The Modified Texas Triaxial Design Check (MTTC) must be performed for all new construction projects. Perform this procedure as specified in the Pavement Manual in Chapter 5, Section 3.

The following are some District guidelines when performing MTTC:

- Use a percent tandem axles ≥ 50% when the 20 year ESALs are greater than 10 million. Otherwise, enter a percentage less than 50%.
  - Consider using a portable WIM station to verify the truck loads or/and verify information with Area Office,
- Use Option 2 to determine the Texas Triaxial Classification (TTC), which requires a plasticity index (PI) representative for the pavement location.

<u>Mechanistic Design Check</u>: The Mechanistic Check must be performed for all new construction projects to ensure the new pavement structure will resist long-term rutting and fatigue cracking for the design life of the pavement.

The following are some District guidelines when performing this analysis:

- For turnkey construction, select a FPS pavement section producing a 20-year design life.
- For phased construction, select a FPS pavement section with a design life in terms of rutting and cracking roughly equivalent to the traffic projected at the end of the 1st performance period.
- If multiple layers of HMA are incorporated, place the tensile arrow directly beneath the lowest HMA layer. Tensile strain should be evaluated at this location.

<u>TxME Check</u>: The TxME check can be used for a detailed Mechanistical-Empirical analysis of the pavement. This check should only be used as a tool when changes are needed to the design to meet the Mechanistic Design Check. This check is not required.

<u>Stress Analysis Check</u>: The analysis estimates pavement stresses at each layer based on FWD loading response. This check can be used to locate layers with high concentrations of stress and strain levels.

<u>Material Selection</u>: Refer to Attachment 1, “District Surface Selection Guide” and Attachment 2 “District Material Selection Summary” for selecting materials for the initial 30% plans pavement section. Final material selection will be provided by the DPE at 60% PS&E review.

Flexible Pavement Design for Other Types of New Pavement Structures

<u>Detours/Temporary Pavement</u>: When the temporary pavement will be in service for less than 2 years, the general typical sections shown in Table 7 may be used.

If the detour or temporary pavement will be in service more than 2 years or there is a need to reduce the general typical sections in Table 7, then refer to Chapter 5, Section 5 of the Pavement Manual for the pavement design requirements for detours. This process will require 20-year ESAL traffic. If the detour is complex, a special request to TPP for project specific traffic may needed. Network level FWD data in proximity to the proposed project may be used for this purpose to design the structural capacity.

*Table 7: General Minimum Typical Temporary Pavement Sections**

	Material	Poor Subgrade Support (Clays and Silts; PI ≥ 25)	Good Subgrade Support (Gravels and Sands; PI < 25)
HMA Surface Course	D-GR HMA TY D PG 76-22 SAC B	2.0”	2.0”
HMA Base Course	D-GR HMA TY B PG 64-22	12.0”	10.0”
Flexible Base Section**			
HMA Surface Course	D-GR HMA TY D PG 76-22 SAC B	1.5”	1.5”
HMA Base Course	D-GR HMA TY B PG 64-22	3.0”	3.0
Flexible Base Course	FLEXIBLE BASE Type A Grade 5	10.0”	8.0”

*If the temporary pavement will be used for more than 2 years, the surface layer should be changed to a “high-friction” mix based on the surface mix selections map.
**Section can be used in rural areas with not right-of-way or construction time restrictions.

<u>**Intersections**</u>: In many cases when constructing or reconstructing intersection on roadways open to traffic, a fast-track pavement design is required. This is often accomplished by using full depth HMA pavement sections. Perform a FPS 21 design as stated for Flexible Pavement Design section of the SOP using the same traffic, design parameters and subgrade support, but use either a Type 3 or 7 pavement design to derive a full depth HMA pavement design. This process can also be used for other fast track pavements such as cross streets and driveways.

<u>**Widening or Turn Lanes**</u>: Before proceeding to design a notch and widen section greater than 500 feet, the condition of the existing travel lanes must be considered before building new adjacent pavement. If the existing travel lanes are in poor condition and require extensive repair and level-up, cost analyses have shown it is as economical to reconstruct and widen the full width of pavement when looking at life cycle cost. The initial construction cost may be about 20% higher, but the future reduction in maintenance cost benefit will exceed this expense in initial construction costs.

From a performance perspective, under these circumstances, full reconstruction resets the pavement service for the entire roadway and exhibits better long-term performance and lower future maintenance costs.

If the existing travel lane condition is in good structural condition for the projected 20-year service life or there are budgetary constraints preventing full width reconstruction and widening, then the pavement design process for widening falls into two categories.

Safety Widening (≤ 4 feet): Historically, full depth HMA sections have been utilized to construct narrow pavement width, as it is difficult to construct unbound layers or flexible base in these narrow areas. Full depth HMA is acceptable if the following criteria and constraints are adhered to:

1. Determine the existing section of the adjacent pavement structure.
2. For non-trafficked safety widening, a pavement design is not required.
3. For the construction of shoulders for roads that are not expected to have an actual widening and no future traffic will be on shoulders, DPE can recommend the usage of no more than 8” asphalt stabilized base for the widening section (Item 292, Grade 2, PG 64-22) allowing 40% RAP maximum. Hamburg requirement of 20,000 passes.
4. Do not design an HMA thickness thicker than the total thickness of the adjacent pavement structure. The ideal option is for the widening to have the same typical section as the adjacent pavement. If not possible, the bottom of the HMA in the widening must not reach the bottom of the base course of the adjacent pavement to maintain positive drainage.
5. Mill, notch and tie into the adjacent pavement to place the construction joint is between the wheel paths, as seen in Figure 1. This will prevent longitudinal cracking along the construction joint and water infiltration into the pavement. It will also promote proper load transfer across this joint.
6. Overlay or seal coat the full width of the final pavement structure. When overlaying, utilize an underseal course prior to overlaying to assure all construction joints and pre-existing cracks are sealed.

Additional Pavement (> 4 feet): Perform the following steps when designing a notch widened section for additional pavement width, as seen in Figure 1:

1. Determine the existing section of the adjacent pavement structure. When constructing additional pavement (whether a shoulder and/or additional travel lanes), utilize the existing pavement material when possible.
2. Determine if the existing pavement section is structurally sufficient by performing a FPS 21 design as stated in Flexible Pavement Structural Design section of the SOP. Falling Weight Deflectometer (FWD) should be used to evaluate the adequacy of any existing structure.
3. If the existing section is structurally sufficient for the projected 20-year traffic, then match the adjacent pavement section, if economical. For thicker existing pavements, optimize the widened section by reducing the section or use strong materials and still meet all FPS 21 requirements for 20-year traffic.
4. If the existing section is not structurally sufficient for projected 20-year traffic and the subgrade soil is expansive (PI > 25), the following can be done to improve structural capacity:
    a. Reclaim a portion of the existing pavement and construct a cement stabilized subbase (CSS) with this road-mix to the final subgrade width (minimum CSS of 6”).

b. Microcrack CSS according to specifications in Item 275.

c. When the subgrade has a PI greater than 25, place geogrid reinforcement on top of the cement stabilized road-mix subbase, as seen in Figure 1.

d. Construct a flexible pavement on top of this reinforced or stabilized subbase using a combination of HMA and flexible base, as seen in Figure 1.

5. If the existing section is not structurally sufficient for projected 20-year traffic and the subgrade soil is non-expansive (PI ≤ 25), the following can be done to improve structural capacity:

   a. Reclaim a portion of the existing pavement and construct a cement stabilized subbase (CSS) with this road-mix to the final subgrade width. (Minimum CSS of 6")

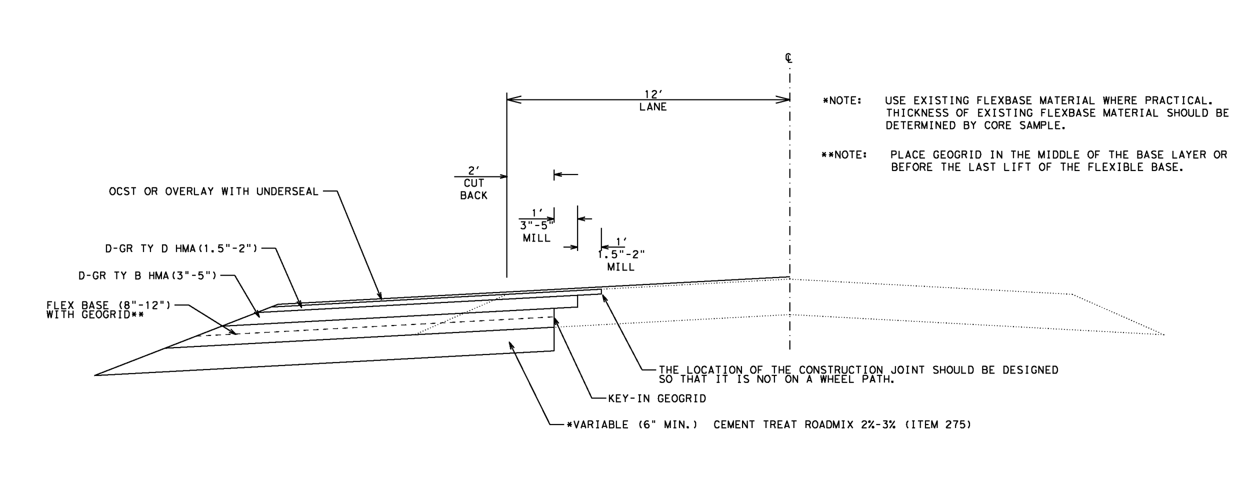
   b. Microcrack CSS according to specifications in Item 275.

   c. Construct a flexible pavement on top of this reinforced or stabilized subbase using a combination of HMA and flexible base, as seen in Figure 1.

   d. Mill, notch and tie into the adjacent pavement where the construction joint is between the wheel paths, as seen in Figure 1. This will prevent longitudinal cracking along the construction joint and water infiltration of into pavement. It will also promote proper load transfer across this joint.

   e. Overlay or seal coat the full width of the final pavement structure. When overlaying, utilize an underseal or bonding course prior to overlaying to assure all construction joints and pre-existing cracks are sealed.

Figure 1: Generic Example of Notch and Widened Section with Minimum One Foot Milled Notch



__**Shared-Used Path (SUP):**__ If a SUP will not serve emergency or maintenance vehicles, use the District standard for sidewalk. If a SUP will serve emergency or maintenance vehicles, use the pavement section standard provided by the local municipality.

Rigid Pavement Structural Design

Perform all rigid pavement designs in accordance to the latest version of the Department's Pavement Manual. If the traffic and soil conditions vary, this will require segmenting the roadway and the need to perform multiple designs. All designs must be developed in the most cost-effective method while meeting all design requirements. All phases of work will be taken into consideration in developing the most effective design. The latest applications, materials and methods will be used to improve the design and construction process.
The following details the design process for analysing and developing the structural design in the overall pavement design process.

Concrete Thickness Design: For new rigid pavement designs, use the latest approved design method, TxCRCP-ME.

The maximum concrete pavement thickness is 13" and the minimum concrete pavement thickness is 9" for new pavements. It is allowed to select a concrete pavement thickness less than 9, but no less than 7", when the gradation is optimized in accordance with Tex-470-A. Any design thicknesses outside this range must have substantial justification and documentation. Round the calculated design thickness to the nearest full or half-inch. Table 8 provides the design parameters for rigid thickness design when using TxCRCP-ME.

Table 8: District Material Parameters for TxCRCP-ME Rigid Pavement Design

Parameter	Input	Comment
Design Life (year)	30	A performance period other than 30 years may be utilized with justification
Number of Punchouts per Mile	10	
28-day Modulus of Rapture (Mr), psi	570	Only for CRCP designs
Modulus of Base Layer (ksi)	400	a) Subbase = 4" HMA
	500	b) Subbase = 6" CTB + 1" HMA

Concrete Pavement Standards: Use the following design standards for the appropriate applications. These standards are available from TxDOT's internet web site at http://www.dot.state.tx.us/insdtdot/orgchart/cmd/cserve/standard/rdwylse.htm

- CRCP (1)-20, Continuously Reinforced Concrete Pavement, One-Layer Steel Bar Placement - applies to CRCP that is from 7" to 13" thick. (CRCP120).
- CRCP (2)-2020, Continuously Reinforced Concrete Pavement, Two-Layer Steel Bar Placement –applies to CRCP that is from 14" to 15" thick (CRCP220).

Stabilized Base Course: Use a non-erodible stabilized base course to support rigid pavements. Do not require prime coating and microcracking the cement stabilized layer for rigid pavement structures. As a District policy, use a minimum 1" HMA bond breaker over 6" of cement stabilized base as a default. Justification and documentation must be provided to use 4" of HMA. For cement stabilized base, specify Item 276 Class N, with a minimum UCS of 500 psi. and maximum UCS of 750 psi. Also, specify a minimum cement content of 4% by weight dry weight.

Subgrade: The subgrade must be able to provide a stable working platform for the compaction of the subbase and uniform support to the rigid pavement structure. If the subgrade soils are weak or vary to the degree that load transfer may be negatively impacted, soil stabilization is needed. Refer to the Foundation Design section of this SOP for more guidelines.

Joints: Research Project 0-6323 conclusively found that stresses generated in the soil surrounding terminal anchor lugs are large enough to permanently deform the soil, resulting in voids between the soil and the lugs. Thus, anchor lugs are not effective in restraining slab movement. A simple expansion joint or the more expensive wide-flange systems are effective in accommodating the slab movement that will inevitably occur. Simple expansion joints are inexpensive and easy to install. Wide-flange terminals should be used only when deemed necessary by the DPE.

Material Selection: Refer to Attachment 1, "District Surface Selection Guide" and Attachment 2 "District Material Selection Summary" for selecting materials for the initial 30% plans pavement section. Final material selection will be approved by the DPE at 60% PS&E review.

Flexible Pavement Design for Preventative Maintenance and Rehabilitation of Existing Roadways

Network Level Assessment of Pavement Condition

To identify critical pavement segments in the District, the first step is to utilize the Austin District Network Level Project Screening Tool. This tool imports at least two fiscal years of PMIS data to perform a network level analysis.

The tool then extracts substandard 0.5-mile pavement segments and their rate of deterioration, based on established levels of criteria. All sequential substandard 0.5-mile pavement segments are then stitched together to create a final continuous segment, which can be assessed for a Preventative Maintenance (PM) or rehabilitation (Rhb) project. Finally, this tool will rank all final segments based a weighted average of the relative range of condition scores and rates of deterioration of all 0.5-mile pavement segments within each continuous segment. This list of projects will be verified and compared to the recommended by Pavement Analysis (PA).

The Roadway Safety Performance Index (RSPI) will calculate and skid and CRIS data will be downloaded to analyse effective surface friction and localized density of wet weather crashes. Sections of roadway requiring resurfacing to maintain serviceable skid levels will be compiled.

After vetting and verifying with PA and performing the wet weather analyse, a final list of critical sections and projects will be compiled, prioritized and present to Area Office and Maintenance Section for review. All roadways issues determined by multiple drive-along with maintenance sections and area offices throughout the year should be incorporated into this final list.

With the critical segments of pavement identified for the District, a structural, functional, and safety evaluation must be conducted to determine if a PM or Rhb is required and to prescribe and schedule the applicable scope of work in the Austin District 4-year Pavement Management Plan (PMP).

Pavement Evaluation Process

Various levels of evaluation are required to determine the proper level of PM or Rhb work for each pavement segment. The following are the three levels of evaluation in order.

Structural Analysis: The structural condition of the pavement segment must be evaluated to determine if a moderate (MRhb) to heavy (HRhb) rehabilitation is required to restore structural adequacy of the pavement for projected ESALs. The Structural Condition Index (SCI) is utilized to determine the level of structural adequacy of the pavement segment.

The SCI is a ratio of the existing structural capacity to the required structural capacity for projected 20-year ESALs. This ratio is determined by deriving the structural number for the existing pavement and the structural number required for the projected 20 year ESALs, as seen below:

$$SCI = SN_{eff} / SN_{req}$$

$$SN_{eff} = f(\text{total thickness, FWD deflections})$$

$$SN_{req} = f(\text{20-year ESALs, subgrade Mr})$$

The required information to derive the structural numbers is generated from Falling Weight Deflectometer (FWD) and Ground Penetrating Radar (GPR) testing.

GPR imaging is utilized to determine the total pavement thickness and the approximate thicknesses of HMA and base course layers. FWD testing provides the deflection data and the means to determine back-calculated subgrade moduli. The 20-year ESALs numbers are obtained from the PMIS database.

With this information, the SCI can be calculated for each 0.5-mile PMIS section in the District and provide insight into the structural capability for each roadway.

If SCI ratio is greater than one (1), then the pavement is structurally sufficient to handle the 20-year ESALs projected for the roadway and may only require safety and functional evaluations.

If SCI is less than one (1), Table 9 provides a scale of SCI scores and the suitable category of work required to restore the structural capability of the roadway.

Table 9: PM & RHb Category by Structural Capacity Index

SCI Scores (SCI*100)	PM & Rhb Category
90 – 100	Do Nothing
80 – 89	PM
65 – 79	LRhb
50 – 64	MRhb
0 – 49	HRhb

Functional Analysis: If a pavement is structurally sound, then a functional analysis of critical pavement segments must be conducted. This type of analysis encompasses evaluating the types and severity of observed distresses and the ride quality of the pavement. Unlike structural issues, functional pavement issues are typically superficial and only involve the top 4” to 6” of the pavement structure.

The raw visual PMIS distress data is summarized and analysed for each critical pavement segment. This provides an understanding of the predominant distresses occurring.

If the pavement is primarily exhibiting cracking and rutting issues, field visits and possibly high-definition visual imaging will be conducted to develop the amount and type of spot repair or resurfacing required. Coring may be required to assist in determining appropriate depth of repair.

If the pavement is exhibiting ride quality issues, areas requiring level-up or planing will be identified using the IRI information from profiler testing collected for PMIS.

With all this information, the proper scope of preventative maintenance (PM) or light rehabilitation (LHrb) can be developed.

Safety Analysis: A District-wide safety analysis will be conducted on all pavement sections, annually, regardless of their functional or structural conditions.

First, crash data from CRIS and skid values from PMIS will be merged to identify areas with a concentrated number of crashes on roadways with marginal to substandard surface friction.

Second, the Austin District Roadway Safety Performance Index (RSPI) will be utilized to predictively identify segments of roadways with attributes which lead to a high risk for crashes. The RSPI utilizes multiple attributes, such as traffic, geometrics, surface friction, and roadway characteristics, to perform a regression model which provides the risk for crashes on all pavement segments within the Austin District network. The RSPI not only identifies critical areas but can help identify which attributes may contribute to the high RSPI or high risk for crashes.

Both processes will aid in identifying roadways requiring resurfacing to restore surface friction or other safety strategies, such as pavement widening.

Flexible Pavement Rehabilitation and Maintenance Methods

Once a pavement evaluation has been conducted to assess the structural, functional, and safety condition of existing roadways, the applicable PM or rehabilitation technique should be implemented.

Table 9 lists applicable preventative maintenance and rehabilitation techniques for restoring the required serviceability of the roadway.

Table 10: PM & RHb Techniques

Roadway Type	PM or Rhb Category	Typical PM & Rehab Techniques
Low Volume (≤ 1 million ESALs)	Safety	Level-up (Ride Quality)
		Surface Texturing or Planing (Temporary)
		Seal Coats
		High-friction Overlays
	PM or LRhb	Level-up/Spot Repairs
		Profile Millings (Correct cross slope & eliminate rutting of accumulated seal coats)
		Seal Coats
		*Ultra-Thin Overlays
	MHrb or HRhb	*Structural Overlays
		*Flexible Base Thickening

		*Flexible Base Overlays
		*Full Depth Reclamation (Distress typically due to soil movement; not load induced)
Moderate Volume (1 million < ESAL ≤ 5 million)	Safety	Level-up (Ride Quality)
		Surface Texturing (Temporary)
		Seal Coats
		High-friction Overlays (TOM-C, TOM-F, or PFC-F)
		Full Width Widening with Geosynthetic
	PM or LRhb	Level-up/Spot Repairs
		Seal Coats
		*Thin Overlays
		*Mill, Underseal & Thin Inlays
	MHrb or HRhb	*Structural Overlays
		*Flexible Base Thickening
		*Flexible Base Overlays
		*Full Depth Reclamation
		*Full Width Widening with Geosynthetic Reinforcement
High Volume/ESAL (ESAL > 5 million)	Safety	Level-up (Ride Quality)
		Surface Texturing (Temporary)
		High-friction Overlays (TOM-C, TOM-F, SMA-F, SMA-D, or PFC-F)
		*Full Width Widening with Geosynthetic
		*Adding Turn Lanes
	PM or LRhb	Level-up/Spot Repairs
		*Thin Overlays (SMA-F, TOM-C, or PFC-F)
		*Mill, Underseal & Thin Inlays
	MHrb or HRhb	*Structural Overlays
		*Flexible Base Overlays
		*Full Depth Reclamation
		*Full Width Widening with Geosynthetic Reinforcement
		*Concrete Overlays ("Whitetopping")
*Requires a pavement design		

Pavement Design Approach for Preventative Maintenance & Rehabilitation

This section provides guidance on the pavement design of PM or Rhb techniques. For more direction and guidelines, refer the latest version of the TxDOT Pavement Manual.

<u>**HMA Overlay Pavement Design**</u>: A FPS 21 design must be conducted for all overlays to determine whether a structural or PM overlay is suitable. Whether a pavement requires a structural or PM overlay, <u>the final surface</u>

layer must be a high- friction surface mixture for skid resistance purposes. Refer to District Surface Mixture Selection guide in Attachment 1 when selecting the final surface course.

The following is the design process for HMA overlays:

1. Determine the typical pavement sections of the existing roadway. Perform Ground Penetrating Radar (GPR) testing and analyse the images to determine the total pavement thickness and the thickness of the asphaltic and base courses. Also, inspect the GPR reflection data for the potential of stripped HMA layer in the existing roadway requiring repair and removal.
2. Perform FWD testing or use historical network level FWD testing data to determine the back-calculated modulus of the subgrade and the existing pavement structure.
3. Perform FPS 21 pavement thickness design and use the design parameter stated in the TxDOT Pavement Manual. Use Pavement Design Type 6, “Overlay Design” to place a new HMA overlay on the existing pavement section. Use the back-calculated moduli for the existing pavement layers and the subgrade support. Use the defaults overlay thickness range of 0 to 6” and fix the thickness of the existing pavement structure as determine from GPR imaging.
    a. If the recommended overlay thickness is 0 to 2”, then the pavement is structurally sufficient and only requires a PM overlay. Verify the SCI for the roadways to check its structural adequacy. A high-friction thin overlay, such as a TOM, PFC, or SMA can be selected. Refer to District Surface Mixture Selection guide in Attachment 1 for more guidance. A survey of the existing surface conditions, such as cracking and rutting, must be conducted to determine if the existing surface needs to be milled. If milling is required, place an underseal or bonding course to seal the milled surface prior to placing a high-friction overlay surface mixture. If milling is not required, prior to tack coating, ensure pre-existing cracks are sealed and failed areas are repaired to prevent moisture infiltration.
    b. If the recommended overlay thickness is > 2”, then the pavement requires a structural overlay.
        i. For low to moderate volume roadways, place the total recommended thickness with a final seal coat surface. For example, if FPS 21 recommends a 3” structural overlay, place 3” of D-GR HMA Type C. A one course seal coat will be required as the final wearing course. The HMA layer will be considered as the “surface layer” when selecting the asphalt grade (PG 76-22) and allowable recycled binder ratio (10% max.)
        ii. For high volume roadways, the total recommended thickness must include a high-friction surface course. For example, if FPS 21 recommends a 3” structural overlay, place 2” of D-GR HMA Type D with 1” high-friction surface course, such as TOM, SMA, or PFC. The HMA layer under the high-friction surface course will also be considered as “surface layer” when selecting the asphalt grade (PG 76-22 with no binder substitution) and allowable recycled binder ratio (10% max).

HMA Overlay over Existing HMA Pavement

Milling: Do not mill the existing surface before placing a HMA overlay unless the following conditions exist:

- Existing surface has cracks deeper than 1 inch or wider than ¼ inch
- Cross slope issues
- Rutting greater than ¼ inch
- Ride quality IRI >100
- Clearance issues
- Excessive flushing
- Tolerance issues with the guard rail height
- FEMA floodplain overtopping locations to maintain existing roadway profile

For TOM overlays in curb and gutter sections, the default is to edge mill (micro mill) from 0 to 1" using the district detail.

Bonding Course: Apply a bonding course prior to placing a new surface lift to improve the adhesion or bond of the new surface to the existing structure. The recommended application rate is listed in Table 11.

Bonding course is the default option when placing a HMA overlay over new HMA lifts and existing pavement. An underseal course is required due to the following conditions:

- Existing surface with cracks deeper than 1" or wider than ¼"
- Milled surfaces with visible cracking
- PFC overlays
- SMA overlays when approved by DPE
- and notch and widen projects when approved by DPE

Underseal Course: Apply an underseal course prior to placing a new surface lift of HMA over an existing pavement. The purpose of the course is to underseal the old surface, which can have small to moderate amounts of cracking or is otherwise permeable because of poor compaction. The recommended application rate is listed in Table 11. When overlaying a rigid pavement, require an A-R Ty II or AC 20-5TR Seal Coat (Item 316) as the underseal instead of using this specification.

Table 11. Minimum Application Rates (gallons per square yard)

	Bonding Course	Underseal Course
TRAIL – Emulsified Asphalt	0.06	-
TRAIL – Hot Asphalt	0.12	0.15
Spray Applied Underseal Membrane	0.12	0.20
Seal Coat – Tier II emulsion	--	0.25

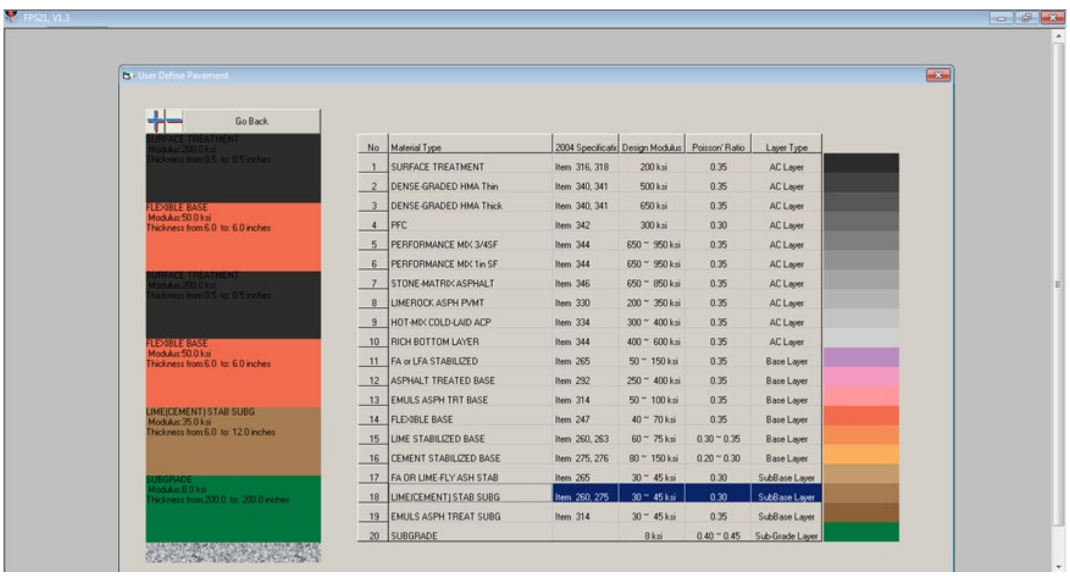
Seal Coat – Tier II asphalt	–	0.23

Flexible Base Overlay: Flexible base overlays can be used to improve the structural capacity of low to moderate volume highways. This will raise the profile of the pavement, so this technique should only be used on roadways without FEMA flood restrictions and on roadway with minimal impact to drainage structures and access. The existing pavement structure becomes a good, uniform subbase for the new base overlay pavement structure.

The following is the design process for flexible base overlays:

1. Determine the typical pavement sections of the existing roadway. Perform Ground Penetrating Radar (GPR) testing and analyse the images to determine the total pavement thickness.
2. Perform FWD testing or use historical network level FWD testing data to determine the back-calculated modulus of the subgrade and the existing pavement structure.
3. Perform FPS 21 pavement thickness design and use the design parameters stated in the Department's Pavement Manual. Use Pavement Design Type 7, "User Defined" pavement and place a new flexible base course with a seal coat surface on the existing pavement section, as seen in Figure 2.
4. Fix the thickness of the existing section in the FPS 21 design and allow the new flexible base layer to adjust to structurally a stable state. Use the material properties stated in Table 12.
5. Removal of the old asphalt surface may be considered to avoid trapping moisture between the old and new surface layers.

Figure 2: Example of a Flexible Base Overlay using User Defined Ty 7 in FPS 21



Flexible Base Thickening: Flexible base thickening can be used to improve the structural capacity of low to moderate volume highways by adding additional new base material to the existing base course. This will raise the profile of the pavement, so this technique should only be used on roadways without FEMA flood restrictions and on roadways with minimal impact to drainage structures and access.

The design process is the same as a flexible base overlay. The only difference is the new flexible base will be combined with the existing base course and surface course through reclaiming processing. Use the material properties stated in Table 12 and the design parameter stated in the Department's Pavement Manual.

Full Depth Reclamation (FDR): FDR is typically used to increase the overall structural capacity of low to moderate volume FM or SH roadways with heavy truck loading. The following is the design process for full depth reclamation:

1. Determine the typical pavement sections of the existing roadway. Perform Ground Penetrating Radar (GPR) testing and analyse the images to determine the total pavement thickness and the thickness of the asphaltic and base courses. Roadways that are candidates for FDR normally experience a large amount of routine maintenance over its service life, such as level-up courses or full depth HMA repair. Given this, the pavement typical section will vary widely, so this may require segmenting the roadway and requiring multiple designs and construction phasing.
2. Perform FWD testing or use historical network level FWD testing data to determine the back-calculated modulus of the subgrade.
3. Perform FPS 21 pavement thickness design and use the design parameters stated in the Department's Pavement Manual. FDR is usually driven by the Texas Triaxial Design Check for low to moderate ESAL roadways. This is especially true for roadways with highly expansive subgrade soils. Perform the FPS 21 linear elastic design and Texas Triaxial Design Check to determine the minimum stabilized FDR thickness required, given the subgrade support and traffic characteristics for the roadway. Use the material properties stated in Table 12. At least 1.5" Type D layer and a seal coat should be utilized for the surface when performing the design.
4. Determine if there is sufficient material for cement, foamed asphalt, or emulsion stabilization and to meet the minimum thickness determine in Step 2. No more than 50% of the road mix (combination of asphaltic and base materials) should be recycled asphalt pavement (RAP). The minimum unconfined compressive strengths cannot be achieved if more than 50% RAP is incorporated. If there are sections of roadway exceeding 50% RAP, these sections will have to be milled and additional base material will have to be incorporated to meet this ratio, prior to FDR. Also, if there is not enough material for FDR, additional base material should be added.
5. Determine the quality of the existing materials. Obtain representative RAP and base material from the existing roadway. Perform a mix design to determine the optimal stabilizer content.
    a. Cement Stabilized FDR – Determine the target cement content in accordance with Tex-120-E. The minimum unconfined compressive strength is 200 psi. after moisture conditioning.
    b. Emulsion Treated FDR - Determine the target emulsion content using the Materials and Tests Division (MTD) mixture design procedure in accordance with the special specification. The minimum unconfined compressive strength is 120 psi. after moisture conditioning.

c. Foamed Asphalt FDR – Determine the target foamed asphalt content using the MTD mixture design procedure in accordance with the special specification. The minimum unconfined compressive strength is 120 psi. after moisture conditioning.

Table 12: District Material Parameters for Rehabilitation Flexible Pavement Design

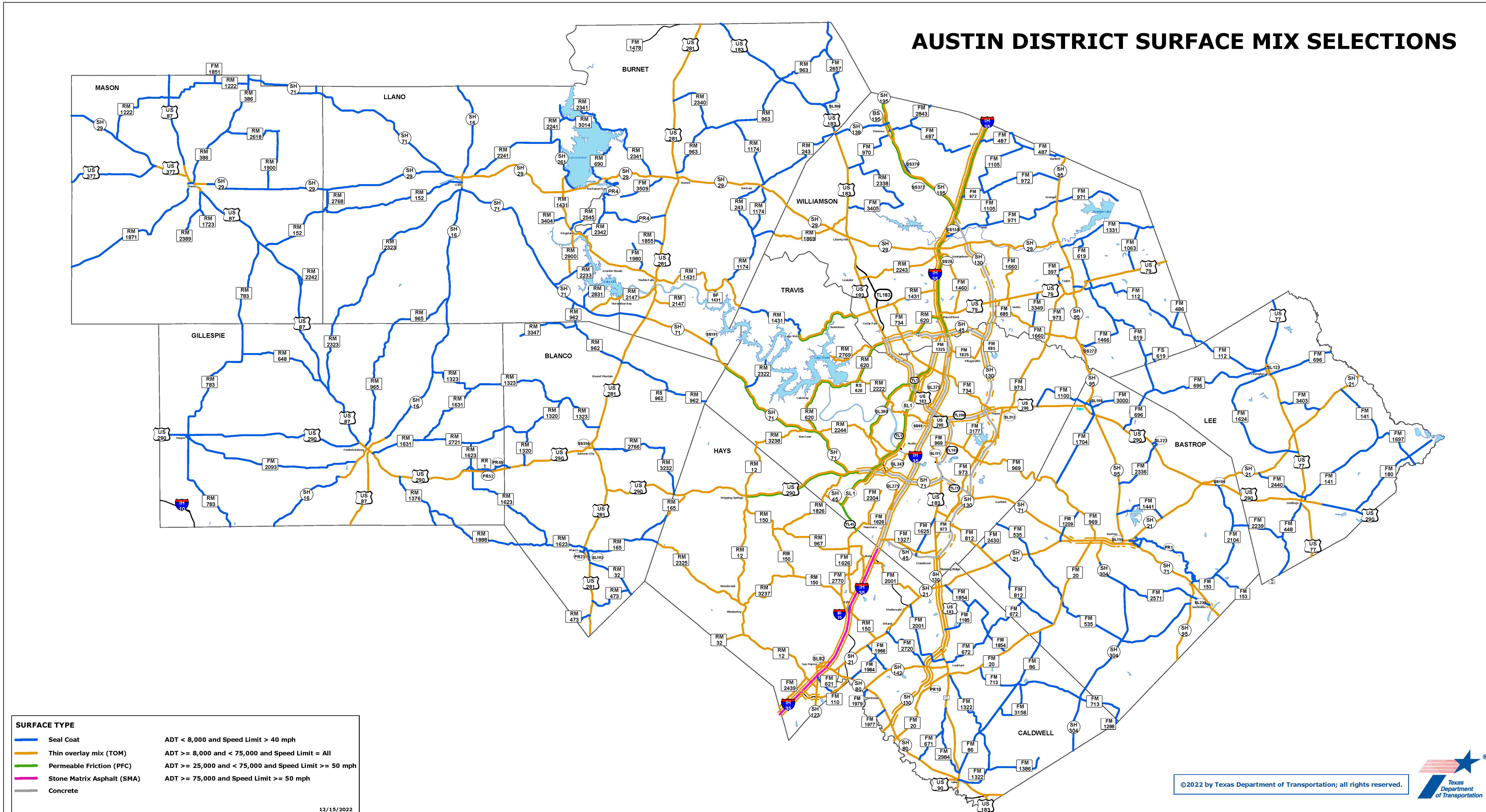
Material Property	Design Modulus	Poision's Ratio	Other Considerations
Natural Subgrade	Back-calculated moduli from FWD or DCP	0.35	o Historical FWD data in the area can be used, if the new construction is near and the same soil formation/classification. o Typical range is 8 to 20 ksi. o DCP or FWD data must be obtained to apply a modulus outside this range. However, the subgrade's back-calculated modulus must be reduced by 50% as a safety factor.
Lime Treated Subgrade (Item 260)	3 times the modulus of the natural subgrade	0.30	o Must have a UCS ≥ 100 psi. after moisture conditioning for structural credit. Otherwise, all lime treated layers are not given structural credit. o Minimum of 8" for construction purposes o Minimum of 8" for soil movement mitigation o Maximum thickness of 12" o Cohesionmeter value of 250
Cement Treated Subgrade (Item 275)	40 ksi.	0.30	o Must have a UCS ≥ 100 psi. for structural credit. Otherwise, all cement treated layers are not given structural credit. o Minimum thickness of 6" o Maximum thickness of 12" o Cohesionmeter value of 300
Existing Pavement (Item 251) and Overlay Projects	Back-calculated moduli from FWD or DCP	0.35	o Use for flexible base overlays o Assumes the existing pavement will be scarified, reshaped, and re-compacted. o For overlay projects, the back-calculated HMA and base moduli must be reduced by 10% as a safety factor.
Stabilized Reclaimed Road-mix (Item 275)	100 ksi.	0.30	o Use for cement stabilized full depth reclamation. o Consider emulsion or foamed asphalt option for pavement with expansive clays. When using emulsion or foam, let both as options. o Assumes a minimum of unconfined compressive strength (UCS) of 200 psi. o Minimum 3% cement when used for full depth reclamation of road mix materials o Default target cement content is 4% for estimate purposes.

			o Minimum thickness of 6" and maximum of 16" o Maximum of 50% RAP of total road mix by weight o Microcracking is required using for all FDR applications
Cement Treated Base Plant-mix (Item 276)	150 ksi.	0.25	o Use for cement stabilized full depth reclamation o Minimum UCS for flexible pavement – 300 psi. o Minimum 3% cement when used for full depth reclamation of road mix materials o Default target cement content is 4% for estimate purposes. o Minimum thickness of 6" and maximum of 16"
Emulsion and Foamed Asphalt Treatment	150 ksi	0.30	o Use emulsion or foamed asphalt option for pavement with expansive clays. When using emulsion or foam, let both as options. o Minimum thickness of 8" and maximum of 12" o Default target emulsion content 4% (residual ~ 2.5%) for estimate purposes. o Small percentages of lime or cement (typically ≤ 1.5%) o When high PI soils are likely, the design process should include a preliminary recycling pass using lime. o No prime is needed.
Flexible Base (Item 247)	40 ksi.	0.35	o Use this modulus level when first lift compacted on natural subgrade or for flexible base thickening. o Maximum thickness of 13" for weak natural subgrades (≤ 12 ksi.)
	50 ksi.	0.35	o Use this modulus level when compacted on existing pavement or stabilized subbase. o Maximum thickness of 13" for weak natural subgrades (≤ 12 ksi.)
Seal Coat (Item 316)	200 ksi.	0.35	o Do not assign structural credit to seal coats if used as an underseal.
Dense Graded HMA (Item 340, 341/3076)	500 ksi. (≤ 4" Total HMA) 650 ksi. (> 4" Total HMA)	0.35	o Minimum total dense graded HMA thickness of 4.5" when placed on flexible base. o Use only for Intermediate, Level-up or Base HMA courses. Do not specify as surface course, unless the DPE approves it. o Allowable Layer Thickness: o TY B – 3" or greater o TY C – 2" to 4". 6" Type C is only allowed for FDR. o TY D – 1.5" to 2"
Permeable Friction Course (Item 342/ SS3079)	500 ksi. (PFC-C) 300 ksi. (PFC-F)	0.35	o Must override default modulus level in FPS 21 for PFC-C o Use PFC-C at 1.5" o Use PFC-F at 1" (needs DPE approval)

Thin Overlay Mixtures (TOM) (Item 347/ 3081)	650 ksi. (TOM-C) 500 ksi. (TOM-F)	0.35	○ Use TOM-C at 1” and TOM-F at ¾”
Stone Matrix Asphalt (Item 346/ 3080)	650 ksi. (≤ 6" Total HMA) 750 ksi. (> 6" Total HMA)	0.35	○ Only allowed when the 20-year ESALs are over 25 million. ○ Use SMA-D from 1.5” to 2.0” and SMA-F at 1.25” ○ Do not specify SMA-C, as it tends to have construction issues.

ATTACHMENT 1: DISTRICT SURFACE MIXTURE SELECTION GUIDE

Surface Mixture	Lift Thickness	ADT	% Truck	ESALs (20 year)	Speed	Pavement & Traffic Considerations
Item 316 Seal Coat	-	< 8000	< 10%	≤ 2.0 million	> 40 mph	o Pavement must be structurally sound o Ideal for 2R FM roadways or low volume/truck traffic US or SH roadways o Optimal for roadways with steep grades and horizontal curves (Hill Country) o Do not use on urban sections with turning or stopping motions, such as intersections, short radius exit ramps, turnouts, etc., as seal coats are not resistant to high shearing force. Use TOM-C (any speed limit) or D-GR Type D (speed limit <= 45mph) for these sections. o Do not use on roadways with curb and gutter or do not use on roadways with heavy truck traffic o May require level-up course prior to placement to obtain good drainage and ride quality o Use TIER system for maintenance projects only (TIER I for ADT ≥ 4000, < 8000; TIER II for ADT < 4000; TIER III is prohibited for use) o For construction project, use pre-coated aggregate with AC asphalt.
Item 341/3076 Dense Graded Mixtures	1.5” – 2.0”	≥ 8,000	< 10%	> 2 million	≤ 45 mph	o Use EXEMPT option for small quantities o Use on low-speed roadways when approved by DPE o Do not use in areas with rapid deceleration or stopping motions o Can be used as a temporary surface course for phased construction
Item 347 Thin Overlay Mixtures (TOM)	0.5" - 1.0"	≥ 8,000; < 75,000	≥ 7%	> 2 million; < 25 million	All Speeds	o Viable for all roadways classification meeting the minimum traffic criteria o Requires good cross slope for adequate positive drainage o May require level-up course prior to placement to obtain good drainage and ride quality o Perform edge milling and/or micromilling in urban sections with curb and gutter o Use in combination with PFC in areas with turning motions combined with braking such as intersections, short radius exit ramps, turnouts, etc. o Difficult to compact and construct during cold weather, so let projects within warm weather seasons
Item 342 Permeable Friction Course (PFC)	1.0" - 1.5"	≥ 25,000; <75,000	< 10%	≥ 4 million; < 25 million	≥50 mph	o An underseal course is required underneath all PFC layers o Optimal for roadways with steep grades and horizontal curves (Hill Country) o Requires good cross slope for adequate positive drainage; may require level-up course prior to placement of PFC o Do not use on urban sections with turning and stopping motions as PFC mixtures are not resistant to high shearing forces. PFC-F may be used in select situations like frontage roads, consult DPE o Do not use on roadways with curb and gutter or in mill and inlay operations; PFC-F may be used in curb & gutter sections in select situations, consult DPE o Do not use on roadways which are difficult to manage ice events, as PFC freeze faster than other mixtures and can cause deterioration o Although PFC can improve the quality of storm water runoff and reduce noise levels, it is not recommended to meet TCEQ requirements, as these properties may not be sustainable over the life of the surface course
Item 346 Stone Matrix Asphalt (SMA)	1.25" - 2.25"	≥ 75,000	≥ 10%	≥ 25 million	≥50 mph	o An underseal course is required underneath all SMA layers o Primarily used for heavy volume and truck traffic roadways, such interstates o Ideal for roadways with both high-speed and stop-and-go traffic and heavy trucks o Difficult to compact and construct during cold weather, so let projects within warm weather seasons


AUSTIN DISTRICT SURFACE MIX SELECTIONS
MASON
LLANO
BURNET
WILLIAMSON
TRAVIS
GILLESPIE
BLANCO
HAYS
LEE
BASTROP
CALDWELL
SURFACE TYPE
Seal Coat — ADT < 8,000 and Speed Limit > 40 mph
Thin overlay mix (TOM) — ADT >= 8,000 and < 75,000 and Speed Limit = All
Permeable Friction (PFC) — ADT >= 25,000 and < 75,000 and Speed Limit >= 50 mph
Stone Matrix Asphalt (SMA) — ADT >= 75,000 and Speed Limit >= 50 mph
Concrete
12/15/2022
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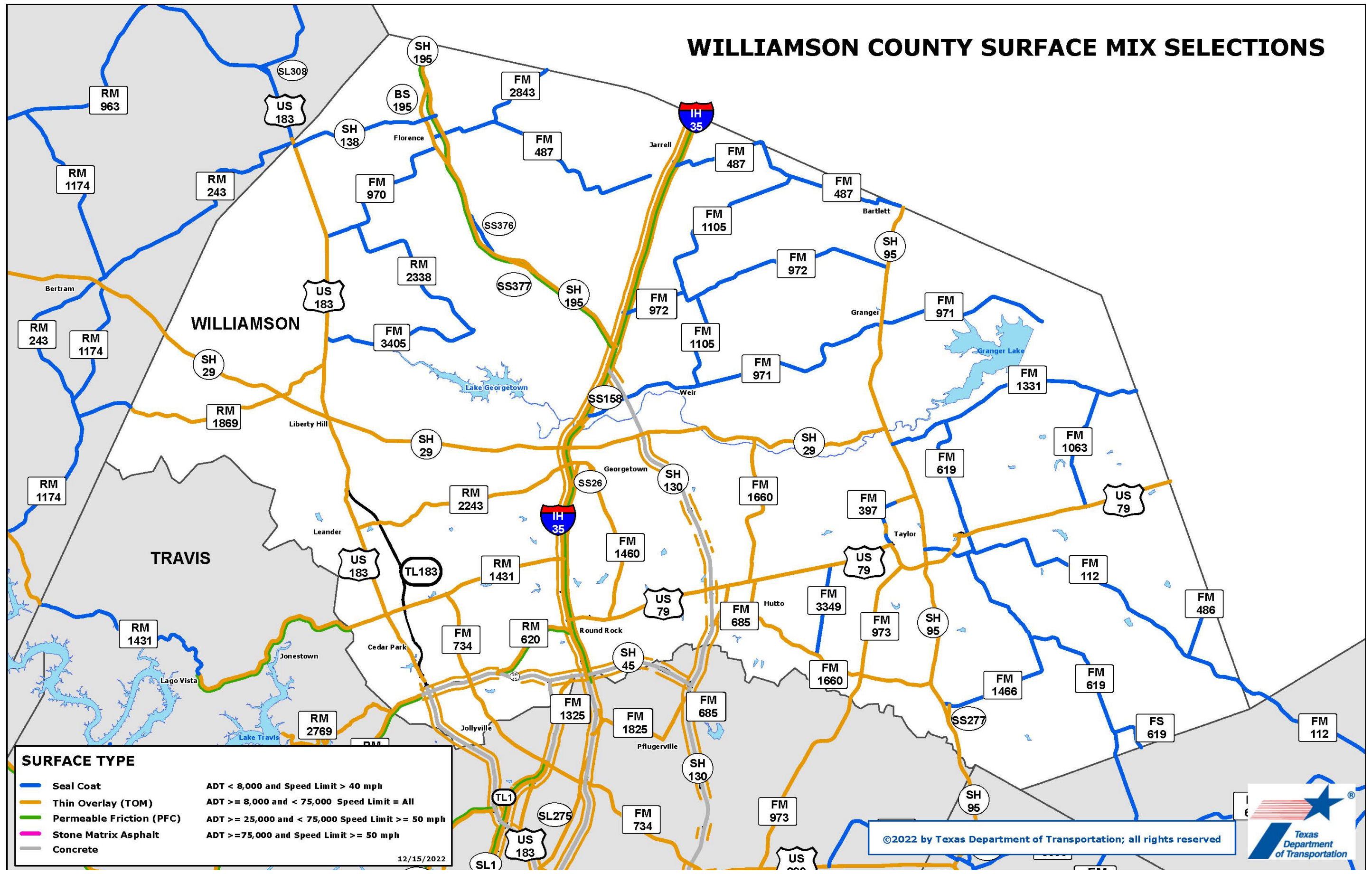
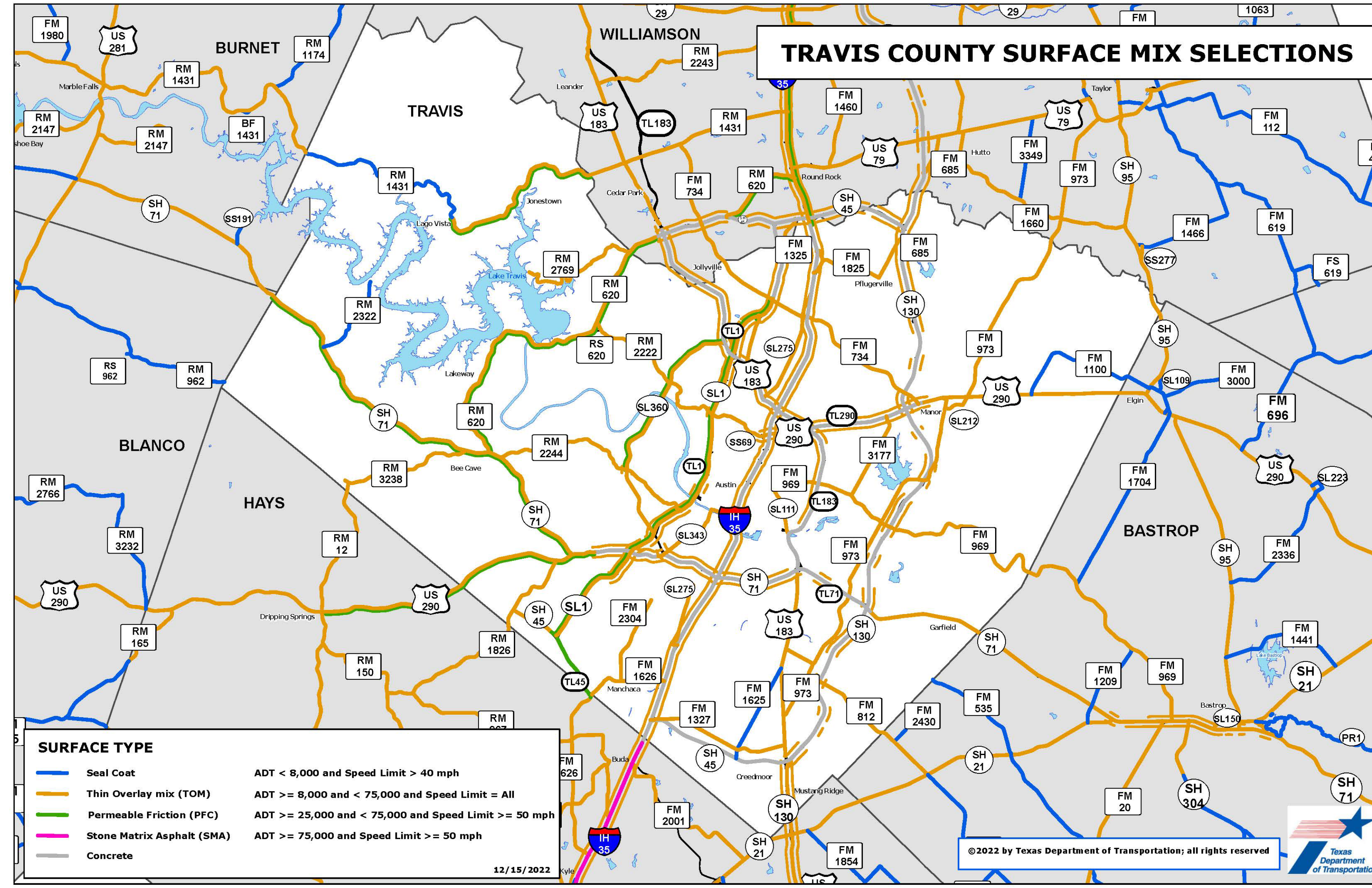
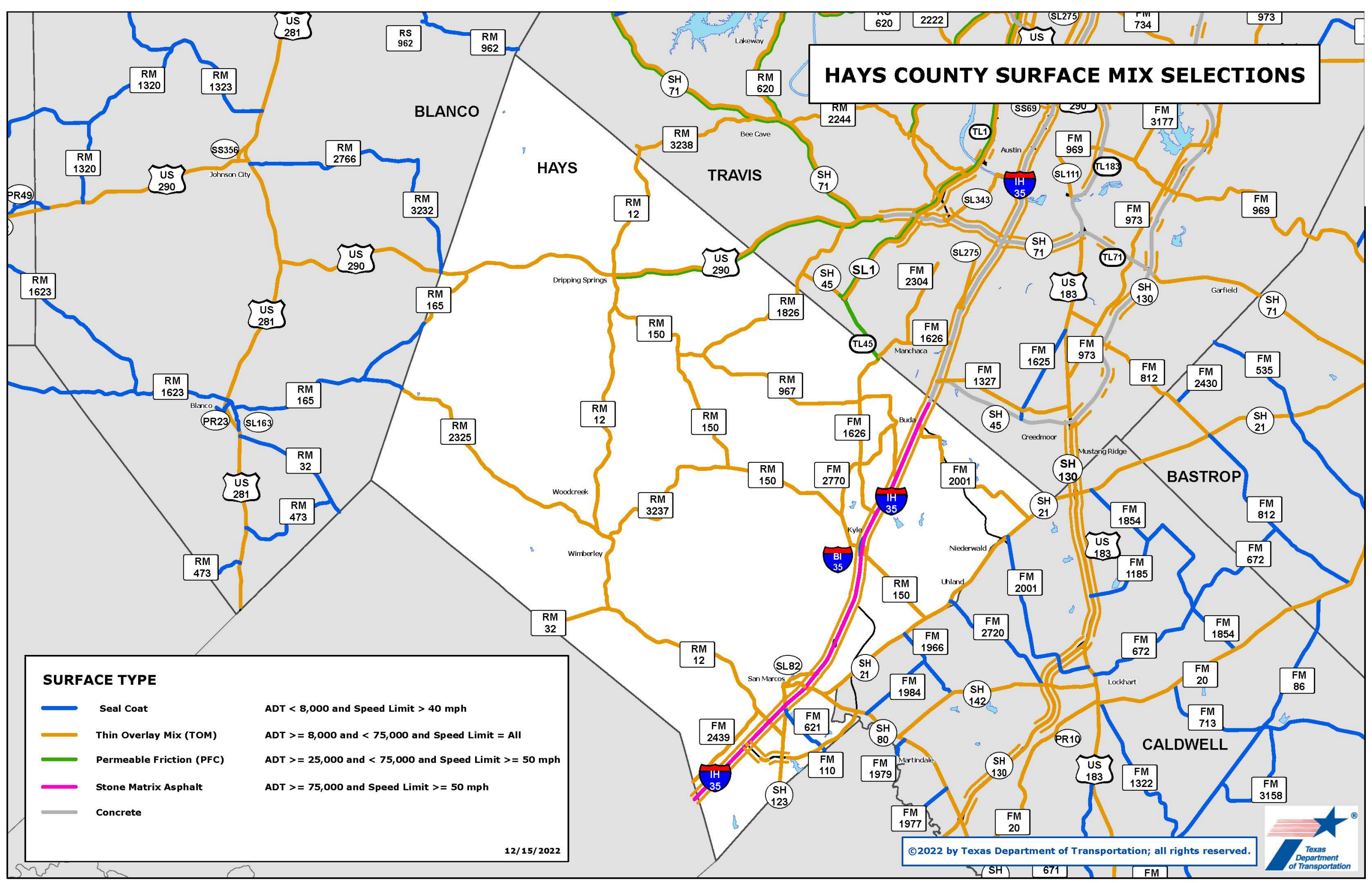
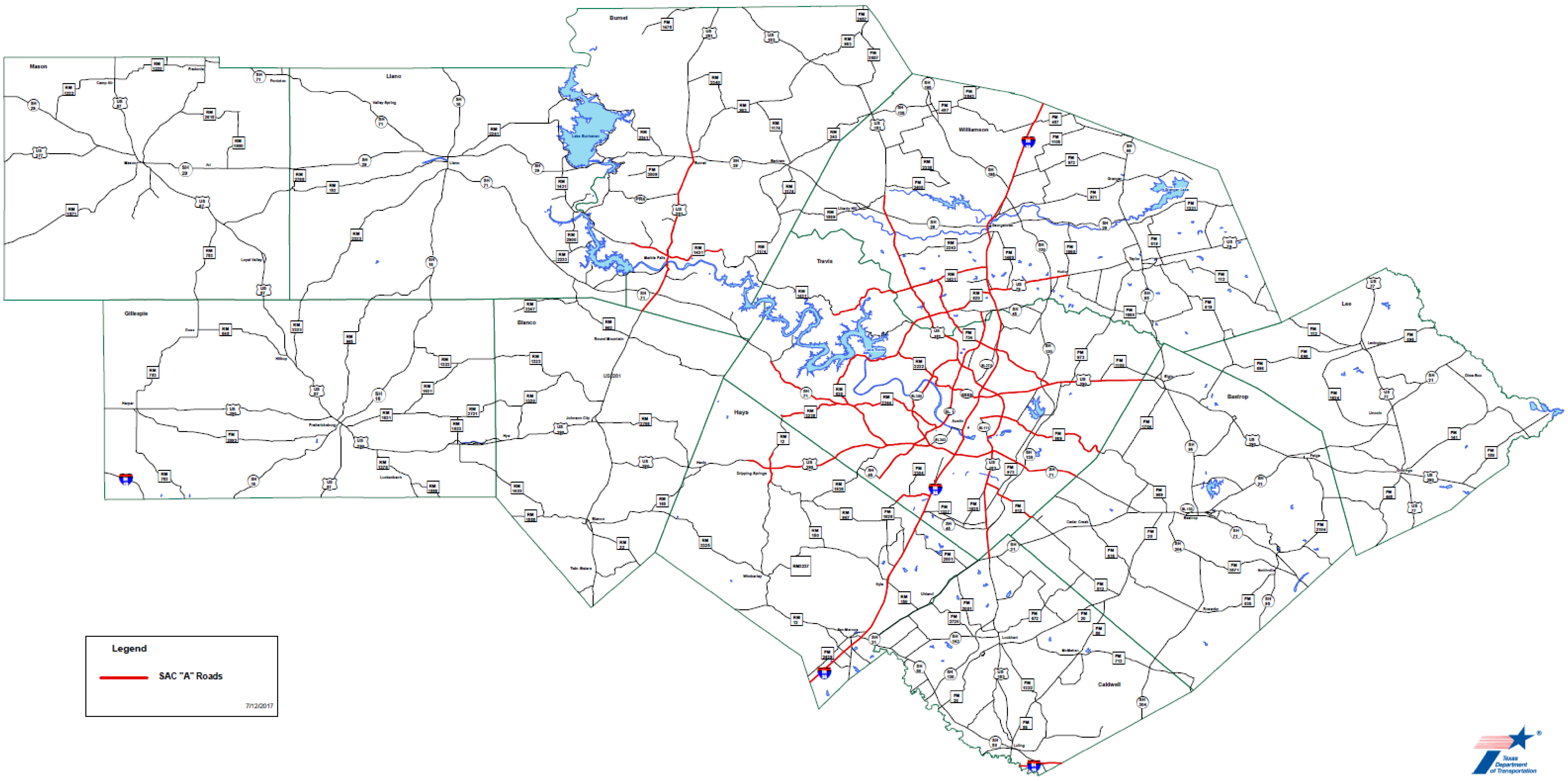






Austin District Surface Aggregate Classification (SAC) "A"



ATTACHMENT 2: DISTRICT MATERIAL SELECTION GUIDE

Material	Spec Item	Selection Criteria	Types/ Grades	Rate	Guidelines or Notes
Embankment	Item 132	TBD by DPE	Type C	Unit Wt. ~ 1.22 TONS/CY (90 pcf. assumed)	○ Refer to SOP for material requirements and locations.
Geogrid Reinforcement	DMS-6240	TBD by DPE	Type II	-	○ Install the geogrid in the middle of the base course layer. ○ Install to the full width of the base course
Flexible Base	Item 247	-	FLBS TY A GR 5	1.823 TONS/CY (CMP IN PLC 132 pcf. assumed)	○ Minimum thickness of 8" and maximum of 13". ○ When used for Item 276, compressive strength (Tx117) requirements can be waived.
Lime Treated Subgrade	Item 260	Subgrade PI ≥ 25	Hydrated or Quicklime	36 lbs./SY (assuming 100 pcf. dry density)	○ Default target lime content is 6% ○ Minimum of 4% ○ Minimum thickness of 8" and maximum of 12". ○ Use slurry only when treating soil with sulfate concentration < 8000 ppm.
Cement Treated Subgrade	Item 275	PI < 25	Dry	26.5 lbs./SY (assuming 110 pcf. dry density)	○ Minimum 4% cement ○ Default target cement content is 5% for estimate purposes. ○ Minimum thickness of 8" and maximum of 12".
Cement Treated Road Mix (Full Depth Reclamation)	Item 275	PI < 20	Dry	26.5 lbs./SY (assuming 110 pcf. dry density)	○ Minimum 3% cement when used for full depth reclamation of road mix materials ○ Default target cement content is 4% for estimate purposes. ○ Minimum thickness of 6" and maximum of 16". ○ Maximum of 50% RAP of total road mix by weight ○ Microcracking is required using for all FDR applications
Cement Treated Base	Item 276	Flexible Pavement	Class N	Min. of 2% cement	○ Minimum thickness of 6". ○ When used for Item 276, compressive strength (Tx117) requirements can be waived for the untreated flexible base or salvage road material. ○ Min. UCS for flexible pavement – 300 psi. ○ Min. UCS for rigid pavement – 500 psi.
		Rigid Pavement	Class N	Min. of 3% cement	
Seal Coat (ADT> 4,000)	Item 302, 316	Refer to Surface Selection Guide	TY PD GR 4 AC-15P, AC-20-5TR, or AC-20XP	AGG: 1/120 CY/SY ASPH: 0.38 GAL/SY	○ Default aggregate grade is 4. ○ For 2-CST, use grade 4 for both layers. ○ Rates specified are for estimate purposes only. ○ Actual rates must be engineered accounting for existing roadway conditions and seasonal corrections. ○ Specify SAC B as default, unless otherwise directed.

Seal Coat (ADT<4,000)	Item 302, 316	Refer to Surface Selection Guide	TY PD GR 4 AC-15P, AC20-XP, AC10-2TR	AGG: 1/120 CY/SY ASPH: 0.38 GAL/SY	○ Default aggregate grade is 4. ○ Rates specified are for estimate purposes only. ○ Actual rates must be engineered accounting for existing roadway conditions and seasonal corrections. ○ Specify SAC B as default, unless otherwise directed.
Underseal	SS3085 Item 316	Default Option for mill & inlay ≤ 1"	TY D GR 4 TY D GR 5	1/150 CY/SY 1/200 CY/SY	○ Rates specified are for estimate purposes only. ○ Actual rates must be engineer accounting for existing roadway conditions and seasonal corrections. ○ Use SAC B aggregate only. ○ Fractionated RAP (FRAP) is allowed for aggregate as long as it meets the grade requirements.
Prime Coat	Item 310	All base courses	AEP, MC 30, or EC 30	0.20 GAL/SY	○ Half of the whole rate must be applied prior to final compaction. ○ Do not use MC-30 in restricted watershed or recharge zones.
Inverted Prime	Item 316	See Notes	RC-250 with TY D GR 5	1/180 CY/SY 0.20 GAL/SY	○ Do not use MC-30 in restricted watershed or recharge zones. ○ Use only when needing to open reconstructed section to traffic immediately
HMA Level-Up	Item 3076	When Used Under HMA Surface	D-GR HMA TY D PG 76-22	110 lbs/SY/in	○ Specify level-up in the bid item. ○ 0 – 2”: D-GR HMA TY-D PG 76-22 (LEVEL-UP) ○ 1” – 3”: D-GR HMA TY-C PG 76-22 (LEVEL-UP) ○ > 3”: D-GR HMA TY-B PG 64-22 (LEVEL-UP) ○ Bonus/Penalty for in-place air voids is waived for level-up application.
HMA Bond Breaker	Item 3076	For rigid pavements only	D-GR HMA TY D PG 64-22	110 lbs/SY/in	○ Use exempt option. ○ A maximum ratio recycled binder of 25% can be used for this purpose.
HMA (Intermediate Course)	Item 3076	-	D-GR HMA TY D or TY C PG 76-22	110 lbs/SY/in	○ Allowed total layer thickness of 1.5" to 2.0” for Type D. ○ Allowed total layer thickness of 2.0” to 4.0” for Type C.
HMA (Base Course)	Item 3076	-	D-GR HMA TY B PG 64-22	110 lbs/SY/in	○ Minimum 3".
	Item 3079	Refer to Surface Selection Guide	PFC-C PG 76-22 SAC A	90 lbs/SY/in	○ Default thickness is 1.5". ○ Coarse aggregate must have a RSSM less than 10.

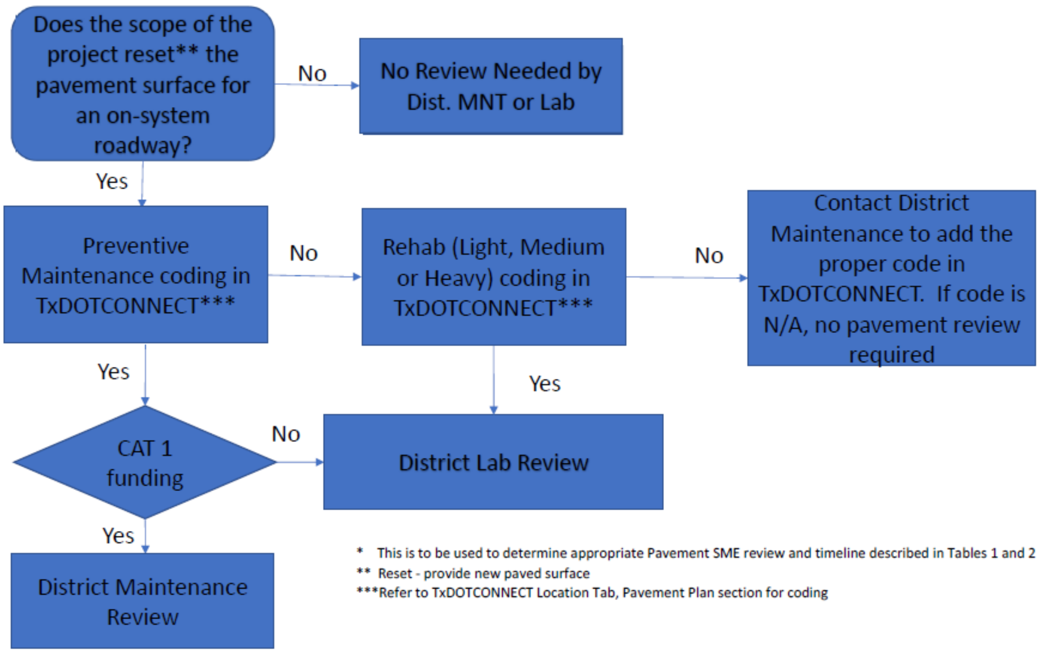
Permeable Friction Course (PFC)			PFC-F PG 76-22 SAC A	90 lbs/SY/in	o Use only when specified by DPE. o Default thickness is 1.0". o Coarse aggregate must have a RSSM less than 10.
Stone Matrix Asphalt (SMA)	Item 3080	Refer to Surface Selection Guide	SMA-D PG 76-22 SAC A	113 lbs/SY/in	o Default thickness is 2.0" for IH35. Use 1.5" in other roads when approved by the DPE. o Coarse aggregate must have a RSSM less than 10.
			SMA-F PG 76-22 SAC A	113 lbs/SY/in	o Default thickness is 1.25". o Coarse aggregate must have a RSSM less than 10.
Thin Overlay (TOM)	Item 3081	Refer to Surface Selection Guide	TOM-C PG 76-22 SAC A	119 lbs/SY/in	o Default thickness is 1.0". o SAC B must be specified by the DPE.
			TOM-F PG 76-22 SAC A	119- lbs/SY/in	o Default thickness is 3/4". o SAC B must be specified by the DPE.
Pavement Repair	Item 351	-	See Notes	110s/SY/in	o Default thickness is 6". The DPE or District Maintenance will provide FDR thickness in pavement design report or during plan review. Repair over 6" will require a pavement evaluation or approval by the DPE. o For up to 2" deep repairs, use Type D PG 76 -22 SAC B. o For up to 6" deep repairs, use Type C PG 76 -22 SAC B. o For greater than 6" deep repairs, use 2" Type C or D PG76 -22 SAC B surface and Type B 64 -22 for the bottom lifts. o When the repair area will have a final surface of PFC, use Type D or C as the final lift of the repair area. This may require undercutting or leave the repair depth short 1.5".
Concrete Pavement	Item 360	-	Class P	-	o Concrete must be air entrained. Require coarse aggregate with a coefficient of thermal expansion (COTE) no greater than 5.5 X 10-6 in/in/F. High early strength (HES) concrete allowed only for paving areas like intersection or driveways.
Ride Quality	Item 585	Refer to the Guidance Document for Item 585, "Ride Quality for Pavement Surfaces"			

ATTACHMENT 3: PAVEMENT SME REVIEW TIMELINE & PAVEMENT DESIGN REQUEST GUIDE

PAVEMENT SME REVIEW AND TIMELINE

Pavement SMEs Determination - All Review Milestones

To be used by Project Managers and Engineering Services*



* This is to be used to determine appropriate Pavement SME review and timeline described in Tables 1 and 2
** Reset - provide new paved surface
***Refer to TxDOTCONNECT Location Tab, Pavement Plan section for coding

Table 1. For CAT 1 Projects - District Maintenance SME Review (Preventive Maintenance Projects only, for Rehabs see Table 2)		
Project Manager & Eng Services (DDGN)	**District Maintenance Operations Timeline**	
Timeline	**Minimum of 8 months before letting**	**5 months before Letting**
Kick-off/Initial Submittal	Titlesheet, Typicals, Pavement Section Details, and preliminary estimate due to District MNT (Tommy Blackmore) directly from PM	
Final Submittal		Complete PS&E submittal to Engineering Services for final review and processing MNT Ops SME will be contacted by Engineering Services

Note:
1. Unless otherwise noted, the PM is responsible for coordinating project deliverables with the appropriate offices and SMEs.

Table 2. For PS&E Projects requiring pavement design - District Lab SME Review (CAT 1 Rehab, CAT 8 and all other state let projects)				
Project Manager & Eng Services (DDGN)	**District Lab Timeline**			
Timeline	**1 month before Kick-Off**	**3 months after Request for Pavement Design**	**No later than 6 months after Request for Pavement Design**	**Per Engineering Services Prescribed Deadline**
Project Kick-Off	Project Manager request pavement design from District Lab. Submit the attached Pavement Design Request Guide. Lab will request additional data collection as needed PM will request traffic numbers from TPP and provide them to the lab			
30% Deliverable		Pavement Engineer provides Preliminary Pavement Design Report to Project Manager Project Manager incorporates preliminary design in 30% deliverable Project Manager makes Pavement Engineer aware of any areas where one cannot achieve the full pavement section proposed		
60% Deliverable			Pavement Engineer provides Final Pavement section by 60% milestone Project Manager incorporates design in 60% submittal	
90% Deliverable				District Lab will verify pavement section on typicals matches final pavement design. Engineering Services/PM will verify in cross sections.

Note:
1. Unless otherwise noted, the PM is responsible for coordinating project deliverables with the appropriate offices and SMEs.
2. Discrepancies between District Lab and PM/Engineering Services Timelines will be coordinated on a project by project basis by the PM.

Pavement Design Request Guide

CSJ	0015-09-194	if CCSJ, include all individual CSJ's that need a pavement design	Page 1 of 1
County:	Williamson		
Highway/Location:	IH 35		
Project Limits From:	US 79		
To:	SH 45N		
Project Description:	Add 1 Southbound Aux lane		
Project Type:	Construction		
Estimated Let Date:	Aug-21		
30% PS&E Review Date			
60% PS&E Review Date			

Email this form to the District Pavement Engineer and AUS_Pavements@txdot.gov; cc Area Office when applicable. Include CSJ, Highway, and County in the email subject header (example: CSJ 0015-09-194, IH35 Williamson Co., Pavement Design Request).

Include this information in the email if available.

Y	N	N/A	Determine if necessary; "Y", "N","N/A"
☑	☐	☐	Map with project limits
☑	☐	☐	Project's schematics
☑	☐	☐	Existing typical sections or as-builts plans from previous projects
☑	☐	☐	TPP traffic report
Dec-21			If TPP traffic report request was submitted, when is it expected?
☑	☐	☐	Geotechnical report
Feb-22			If geotechnical investigation will be performed, when is the report expected?
☐	☑	☐	Roadway cores available

Additional Project information

Y	N	N/A	Determine if necessary; "Y", "N","N/A"
☐	☑	☐	Is this a Maintenance (PM) project?
☐	☑	☐	Is this an overlay project to restore skid or ride?
☑	☐	☐	Is milling expected?
☑	☐	☐	Is the project in a floodplain zone? (Milling is required prior to an overlay to avoid raising roadway elevation.)
☑	☐	☐	Does existing pavement have edge restrictions such as curb & gutter?
☐	☑	☐	Safety widening (<= 4')?
☑	☐	☐	Additional pavement (> 4')?
☑	☐	☐	Does the widening include a full-width overlay (HMA or Seal coat)?
☑	☐	☐	Is there nearby project(s) with same/similar project description?
0015-09-190			If yes, list the CSJ(s) of the project(s)
☑	☐	☐	Temporary pavement section needed?
12 months			If yes, how long will the temporary pavement be used for?
☑	☐	☐	Full depth repair thickness needed?
☑	☐	☐	Pavement sections for cross streets needed?
☑	☐	☐	Pavement section for frontage roads needed?
☑	☐	☐	Is a Value Engineering Study (VE) required?
			Additional project information:

Checklist for DPE

Y	N	N/A	Determine if necessary; "Y", "N","N/A"		
☑	☐	☐	Folder created for project	Folder Address:	
☑	☐	☐	GPR data available	File Name:	
☑	☐	☐	FWD data available	File Name:	
☑	☐	☐	PMIS data		
☑	☐	☐	Soils (PI, Sulfates, Organics)		
☑	☐	☐	Traffic		
☐	☑	☐	PVR needed?		
☐	☑	☐	Concrete Design needed?		
☑	☐	☐	SAC-A		
TOM			Surface Mix		