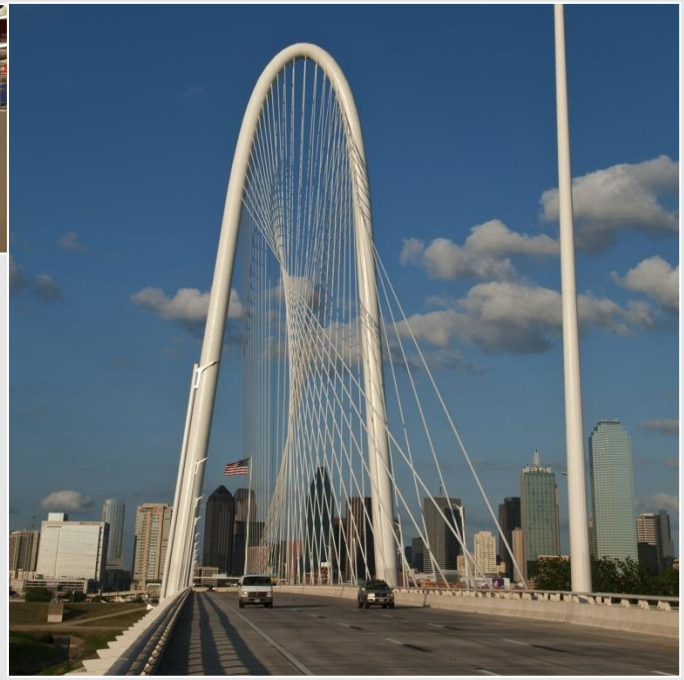
TEXAS DEPARTMENT OF TRANSPORTATION





Tying It All Together

Travis Patton, P.E.

Texas Department of Transportation

Table of Contents

Material Selection

Aggregates

- Use aggregates from pre-approved sources listed in the Department's *Bituminous Rated Source Quality Catalog (BRSQC)*
- *Ensure that aggregates meet the specification requirements*

Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	Tex-499-A (AQMP)	As shown on the plans
Deleterious material, %, Max	Tex-217-F, Part I	1.0
Decantation, %, Max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %	Tex-461-A	Note 1
Los Angeles abrasion, %, Max	Tex-410-A	35[2]
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	25[3]
Crushed face count,[4] %, Min	Tex-460-A, Part I	85
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, Max	Tex-107-E	3
Sand equivalent, %, Min	Tex-203-F	45

Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

Asphalt Binder

- Use an approved asphalt from the TxDOT Quality Monitoring Program or provide TXDOT Materials and Tests Division with a sample to fulfill this testing requirement
- *Furnish the type and grade of performance-graded (PG) asphalt specified on the plans*
- *Decide on the type and rate of additive, lime, WMA additive when specified or when intending to use (assuming it is approved).*
  - *Determine rates and determine if there are any incompatibilities amongst additives and the asphalt*

Recycled Materials

- If RAP or RAS is permitted, decide content based on performance and economics in accordance with the specification
- RAS is not allowed for most surface mixtures
- RAP must be fractionated with a minimum of 95.0% passing the 3/8-in. or ½-in. sieve before burning in the ignition oven
- Determine if the specification allows a binder grade dump and verify the maximum allowable amounts of recycled material

Allowable Substitute PG Binders and Maximum Recycled Binder Ratios

Originally Specified PG Binder	Allowable Substitute PG Binder for Surface Mixes	Allowable Substitute PG Binder for Intermediate and Base Mixes	Maximum Ratio of Recycled Binder[1] to Total Binder (%)		
			Surface	Intermediate	Base
76-22[4,5]	70-22	70-22	15.0	25.0	30.0
70-22[2,5]	N/A	64-22	15.0	25.0	30.0
64-22[2,3]	N/A	N/A	15.0	25.0	30.0
76-28[4,5]	70-28	70-28	15.0	25.0	30.0
70-28[2,5]	N/A	64-28	15.0	25.0	30.0
64-28[2,3]	N/A	N/A	15.0	25.0	30.0

1. Combined recycled binder from RAP and RAS. RAS is not permitted in surface mixtures unless otherwise shown on the plans.
2. Binder substitution is not allowed for surface mixtures.
3. Binder substitution is not allowed for intermediate and base mixtures.
4. Use no more than 15.0% recycled binder in surface mixtures when using this originally specified PG binder.
5. Use no more than 25.0% recycled binder when using this originally specified PG binder for intermediate mixtures. Use no more than 30.0% recycled binder when using this originally specified PG binder for base mixtures.

Maximum Allowable Amounts of RAP[1]

Maximum Allowable Fractionated RAP (%)		
Surface	Intermediate	Base
20.0	30.0	35.0

1. Must also meet the recycled binder to total binder ratio shown in Table 5.

Testing

Aggregate Gradations

- Determine which type of mix you are attempting to design (i.e. Superpave C)
- Sample in accordance with Tex-221-F from each aggregate stockpile
  - Perform washed gradations on each stockpile sample in accordance with Tex-200-F and record the % passing for each respective sieve on the Tx2MixDes14 template. The Tx2MixSolver can also be extremely useful at this point

STOCKPILE GRADATIONS								
Sieve Size	Bin No. 1	Bin No. 2	Bin No. 3	Bin No. 4	Bin No. 5	Bin No. 6	Bin No. 7	Bin No. 8
	Please type-in the aggregate type ↓							
	C-Rock	Grade 5	Man Sand	Field Sand		LIME	RAP	RAS
Class (A) Rock (Y/N)	YES							
1 in	100.0	100.0	100.0	100.0			100.0	
3/4 in	97.1	100.0	100.0	100.0			100.0	
1/2 in	60.4	100.0	100.0	100.0			98.2	
3/8 in	26.5	99.8	100.0	100.0			92.2	
#4	2.6	23.9	96.5	100.0			67.5	
#8	1.8	2.1	62.8	100.0			47.5	
#16	1.7	1.4	36.7	99.7			37.1	
#30	1.6	1.4	22.4	98.1			28.2	
#50	1.6	1.3	15.1	66.4			19.7	
#200	1.1	1.1	9.0	3.1			6.1	

Combined Gradation

- Using the “Optimize Gradation” feature on the Tx2MixSolver template, or by trial an error on the Tx2MixDes14 template, design a combined gradation that meets the specification requirements

  - Verify gradation limits are met,
  - Total recycle content and recycled binder ratio is within limits (don’t design close limit in case virgin AC% needs to be adjusted)
  - Total SAC A requirements are met

Sieve Size	Master Gradations				
	OPTIMIZE Blend 1	Blend 2	Blend 3	Blend 4	Blend 5
1 in	100.0 ✓				
3/4 in	99.4 ✓				
1/2 in	91.6 ✓				
3/8 in	83.4 ✓				
#4	52.0 ✓				
#8	31.3 ✓				
#16	20.7 ✓				
#30	14.3 ✓				
#50	10.0 ✓				
#200	4.6 ✓				

	Aggregate Type	OPTIMIZE Blend 1	Blend 2	Blend 3	Blend 4	Blend 5
Bin No. 1	C-Rock	20.4%				
Bin No. 2	Grade 5	26.9%				
Bin No. 3	Man Sand	31.8%				
Bin No. 4	Field Sand	0.9%				
Bin No. 5		0.0%				
Bin No. 6	LIME					
Bin No. 7	RAP	20.0%				
Bin No. 8	RAS					
		100.0%				

Mix and Mold Specimens

- Once you have a working gradation that appears to meet the specification, follow test procedures Tex-204-F and Tex-205-F to batch material for density verification
  - Mixtures with identical gradations, but with varying amounts of virgin asphalt should be prepared. This should cover a range (i.e. 5.0%, 5.5%, and 6.0%).
  - Prepare enough material to perform Rice Gravity testing in accordance with Tex-227-F at each binder content
- Cure and mold in accordance with Tex-206-F or Tex-241-F (use specified compactor in accordance with plans)
  - If using the Superpave gyratory compactor, it is beneficial to plug in a printer or data logger while compacting specimens. This way the Level 2 Technician can see compaction vs height plots. This helps when making minor adjustments to the design.
- Verify density of each sample in accordance with Tex-227-F and Tex-207-F.
- Using the Tx2MixDe14 template, input the calculated Ga, Gr, asphalt content, asphalt specific gravity, and the design target.

Target Density, %:	**96.0**
Number of Gyrations:	**50**

TEST SPECIMENS							
Asphalt Content (%)	Binder Ratio (%)	Specific Gravity Of Specimen (Ga)	Maximum Specific Gravity (Gr)	Effective Gravity (Ge)	Theo. Max. Specific Gravity (Gt)	Density from Gt (Percent)	VMA (Percent)
4.5	0.0	2.270	2.456	2.627	2.445	92.8	17.1
4.8	0.0	2.330	2.450	2.631	2.436	95.6	15.1
5.0	0.0	2.336	2.445	2.636	2.428	96.2	15.1
5.2	0.0	2.340	2.440	2.638	2.421	96.7	15.1
5.5	0.0	2.345	2.350	2.539	2.410	97.3	15.2

Effective Specific Gravity:	2.614
Optimum Asphalt Content :	**4.9**
Binder Ratio @ OAC:	0.0
VMA @ Optimum AC:	15.1

Verify Design

- Repeat mix and molding procedure at the proposed optimum asphalt content.
- Verify the Rice and bulk gravity at the optimum asphalt content. Verify that the design density is met.
- Batch up material to verify correction factors in accordance with Tex-237-F
  - This will require 2 samples at optimum AC% in the ignition oven and,
  - 1 sample to perform a “blank” (washed gradation in accordance with Tex-200-F)
- If applicable for the mix type, ensure all performance tests are satisfied prior to Trial Batch (i.e. Overlay, Hamburg, Cantabro, IDT, etc)
- Once everything passes; contractor and TxDOT need to work together to produce a Trail Batch and verify that the plant mix still meets the specification requirements.

Failing Design

Failing Design

- What happens if you are producing a mix and the material starts to fail gradation?
  - Common Issues
    - Verify lab equipment. Both calibration and ensure it is properly functioning.
    - Verify technician procedures. Especially check for sampling and splitting. Segregation can easily affect laboratory results.
    - Verify design gradation vs production gradation. Is the drum excessively breaking down the aggregate? This will most likely affect production density as well. You should correct for this in your bin percentages, not by decreasing virgin asphalt.
      - Verify correction factors to help diagnose this issue. Some dolomitic aggregates degrade excessively at higher temperatures.
    - Verify moisture contents in stockpiles. Excessive moisture can/will throw off weigh belts and tends to clump sands which make it difficult to feed the drum accurately.
    - Check the loader operator. How are they loading the feeder bins? Is there cross contamination? Are the stockpiles being treating properly or are they cross contaminated and being sampled improperly?
    - Check the belts to ensure proper alignment and that the proper amount of material is being fed to the drum.
    - Check lime silo, fiber feed, baghouse, etc to ensure everything is operating properly and nothing is clogged.

Failing Design

- What happens if you are failing the Hamburg requirements?
  - Common Issues for Hamburg
    - Sometimes there are incompatibilities with particular additives and binders. Try changing binders and see if this helps.
    - Verify your current gradation vs the design gradation. If your Hamburg did pass, but now it does not, the gradation can contribute to this. Also, a stone on stone design typically helps to resist deformation.
    - Is the material stripping?
      - If so, consider an anti-strip or lime if it does not already contain it.
      - Another solution to this is the use of a polymer modified binder. Not only is it stiffer (helps Hamburg), but it also has better stripping resistance. Typically much better than anti-strip and lime.
      - Is the binder content adequate or could it be increased? The higher film thickness helps to resist stripping.
      - Test the mineral filler, natural sand, and manufactured sand using Tex-252-F, Methylene Blue. This will determine the clay reactivity of the material with water.

Failing Design

- What happens if you are failing the overlay requirements?
  - Common Issues for overlay
    - While severe segregation can cause some issues, particularly with sample preparation, the main issue is with the binder.
      - Severe segregation can mean lower asphalt content than intended. Ensure you have adequate binder content. Add more virgin binder and see if this fixes the overlay issue.
    - Excessive recycled binder and not enough virgin binder. Consider taking some recycled material out of the mix and adding more virgin binder.
    - Try different binder sources. Some tend to perform better. In addition, additives can sometimes react adversely with certain binder chemistry.

Questions?