

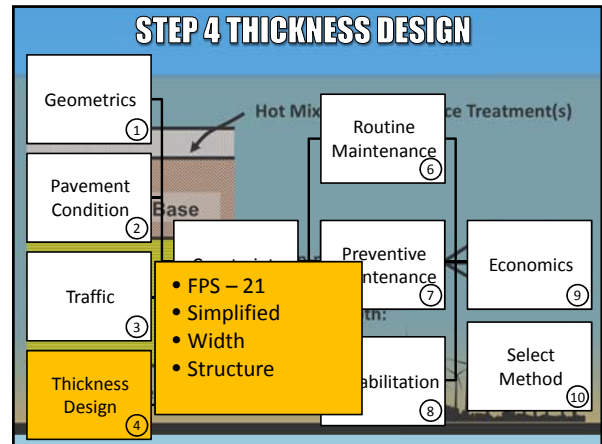
Thickness Design

PP-16-06

**Maintenance Division
Inter Agency Contract**

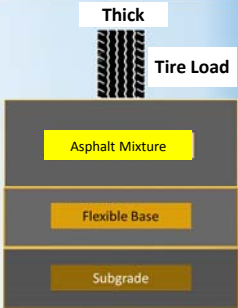
Summer 2016





STEP 4 THICKNESS DESIGN

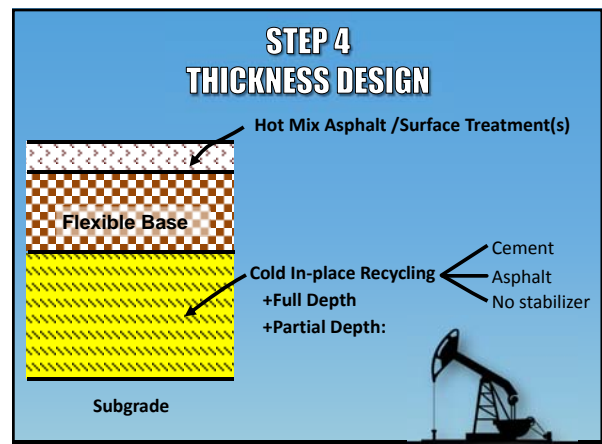
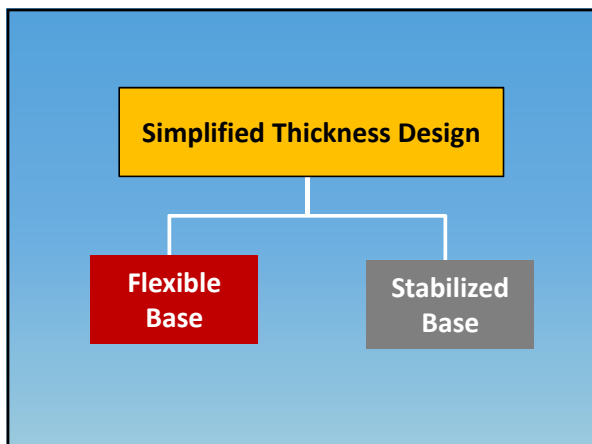
- Traditional method
 - FPS
 - ATHWLD Check
 - Mechanistic
- Simplified method



STEP 4 THICKNESS DESIGN



- Reconstruction operations
- Shoulder/ edge repair
- Deep patches



Thickness Design Inputs

Design Live	10 years
Minimum time to 1 st overlay	8 years
Performance criteria	4.5 to 2.5
Average daily traffic	4,500 to 7,000
Traffic	Variable

STEP 3 TRAFFIC

Total Traffic =
Typical/existing traffic
+
Oil development/production traffic



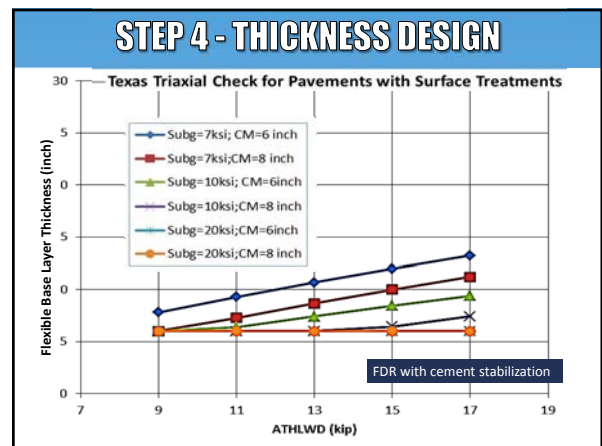
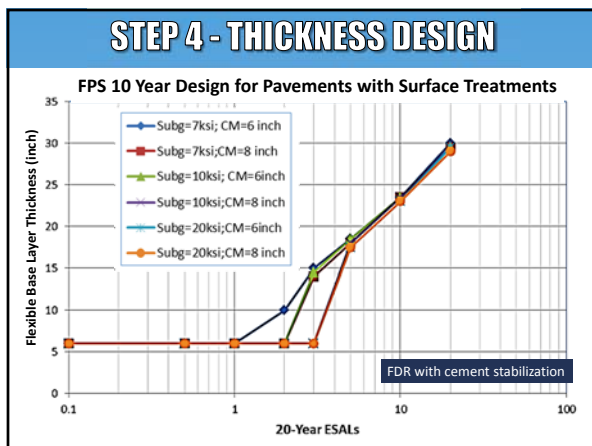
STEP 4 THICKNESS DESIGN

- Surface
 - Surface treatment
 - HMA - 4, 6, 8 inches
- Flexible Base – Variable
- Subbase (FDR)
 - 6 or 8 inches



Material Property Inputs for Pavement Structural Design Curves

Layer	Material	Properties	
		Resilient Modulus, psi	Triaxial Class
Surface	Surface Treatment		
	Hot Mix Asphalt	500,000	
Base	Flexible Base	50,000	
	FDR-salvaged	50,000	
Subbase	FDR-PC	150,000	
	FDR-Asphalt	100,000	
Subgrade		7,000	5.8
		10,000	5.0
		20,000	3.0



**Energy Sector Pavement Design Catalog for 4-Layer
(Surface, Flex Base, FDR, Subgrade) Pavement (Flex Base Thickness in Inches)**

Traffic, ESAL	<0.5 Million			0.5-1.5 Million			1.5-3.0 Million			3.0-4.0 Million			4.0-5.0 Million			>5.0 Million		
EF #Wells	<10			10-90			90-200			200-270			270-340					
PB #Wells	<20			20-110			110-250			250-340			340-440					
BS #Wells	<40			40-210			210-470			470-640			640-810					
Eagle Ford (Subgrade Modulus < 7ksi)																		
Surface	2	4"	6"	2	4"	6"	2	4"	6"	2	4"	6"	2	4"	6"	2	4"	6"
	CST	HMA	HMA	CST	HMA	HMA	CST	HMA	HMA	CST	HMA	HMA	CST	HMA	HMA	CST	HMA	HMA
CM 6"	11	7	6	12	8	6	12	9	7	12	10	7	12	10	7	12	10	7
CM 8"	9	6	6	10	6	6	10	7	6	10	7	6	10	7	6	10	7	6
AE/NS 6"	12	8	6	12	9	7	12	10	7	12	10	7	12	10	7	12	10	7
AE/NS 8"	12	6	6	12	7	6	12	10	7	12	10	7	12	10	7	12	10	7
Medium Subgrade (Subgrade Modulus < 7 - 15 ksi)																		
CM 6"	7	6	6	10	6	6	12	6	6	12	6	6	12	6	6	12	6	6
CM 8"	6	6	6	7	6	6	10	6	6	10	6	6	10	6	6	10	6	6
AE/NS 6"	12	6	6	12	6	6	12	6	6	12	6	6	12	6	6	12	6	6
AE/NS 8"	12	6	6	12	6	6	12	6	6	12	6	6	12	6	6	12	6	6
Permian Basin (Subgrade Modulus > 15 ksi)																		
CM 6"	6	6	6	6	6	6	6	10	6	6	10	6	6	12	6	6	12	6
CM 8"	6	6	6	6	6	6	6	10	6	6	10	6	6	12	6	6	12	6
AE/NS 6"	6	6	6	9	6	6	12	6	6	12	6	6	12	6	6	12	6	6
AE/NS 8"	6	6	6	8	6	6	12	6	6	12	6	6	12	6	6	12	6	6

Use Formatted Design

BS # Wells: Number of wells serviced by road in Barnett Shale; PB = Permian Basin; EF = Eagle Ford Shale
 CM 6" = Cement Modified FDR, 6 in. thick CM 8" = Cement Modified FDR, 8 in. thick
 AE/NS 6" = Asphalt Emulsion FDR or Non-Stabilized FDR, 6 in. thick
 AE/NS 8" = Asphalt Emulsion FDR or Non-Stabilized FDR, 8 in. thick
■ Not Recommended - Premature Failure Expected

Example

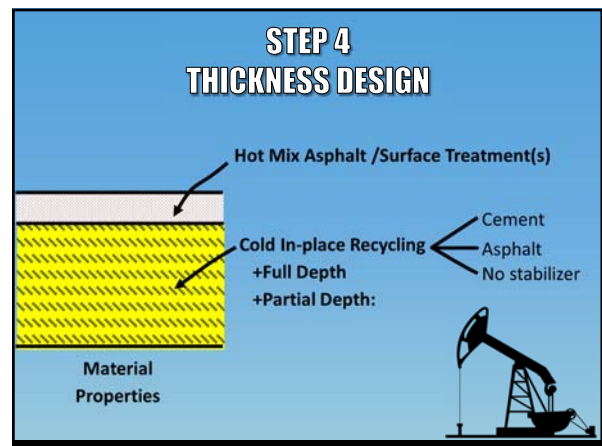
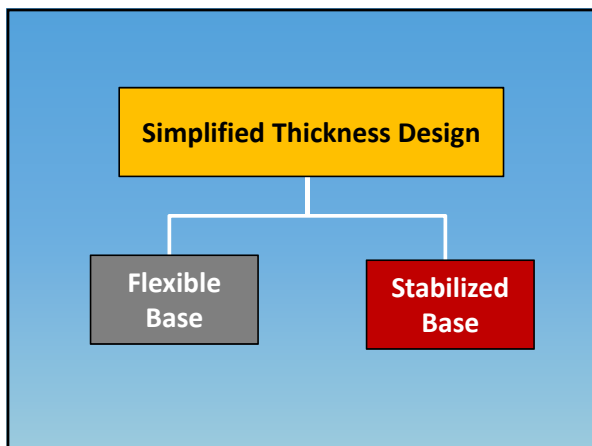
- Project Located in South Texas Subgrade Modulus of 7,000 psi
- 50-90 wells to be served by roadway 0.5 – 1.5 million ESAL's
- Existing materials pulverized and portland cement modified 6 inches thick
- Two course surface treatment used as surfacing material

Example

- Project Located in South Texas Subgrade Modulus of 7,000 psi
- 50-90 wells to be served by roadway 0.5 – 1.5 million ESAL's
- Existing materials pulverized and portland cement modified 6 inches thick
- Two course surface treatment used as surfacing material

The required new flexible base course thickness of 12 inches.

District Example



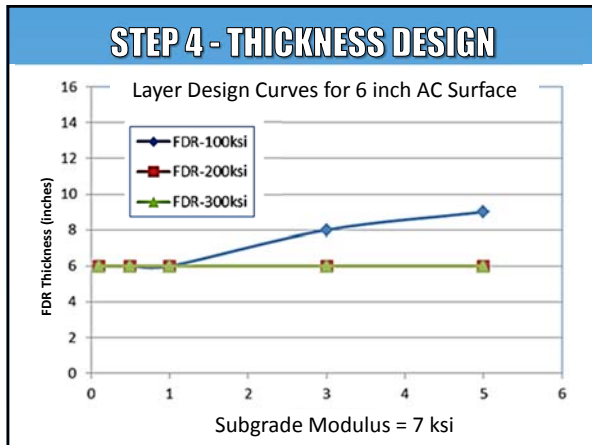
Layer Thickness

- Surface
 - Surface treatments
 - HMA - 2, 4, 6 inches
- Base(FDR) – Variable



Material Properties

Layer	Material	Properties	
		Resilient Modulus, psi	Triaxial Class
Surface	Surface Treatment		
	Hot Mix Asphalt	500,000	
	High Stiffness	300,000	
Base	Medium Stiffness	200,000	
	Low Stiffness	100,000	
	Clay	7,000	5.8
Subgrade		10,000	5.0
	Sand, silty sand, caliche	20,000	3.5



Energy Sector Pavement Design Catalog for 3-Layer (Surface, FDR, Subgrade) Pavement (FDR Base Thickness in Inches)

Traffic, ESAL	<0.5 Million		0.5-1.5 Million		1.5-3.0 Million		3.0-4.0 Million		4.0-5.0 Million		>5.0 Million	
BS #Wells	<10		10-90		90-200		200-270		270-340			
PB #Wells	<20		20-110		110-250		250-340		340-440			
EF #Wells	<40		40-210		210-470		470-640		640-810			
Eagle Ford (Subgrade Modulus < 7 ksi)												
Surface	2CST	4" HMA	4" HMA	2CST	4" HMA	4" HMA	2CST	4" HMA	4" HMA	2CST	4" HMA	4" HMA
Stiff Base	8	6	6	9	7	6	10	8	6	8	7	6
Med. Base	9	7	6	11	9	6	11	9	7	10	8	6
Soft Base	11	9	7	14	11	9	15	12	10	14	12	9
Medium Subgrade (Subgrade Modulus < 7 - 15 ksi)												
Stiff Base	7	6	6	8	7	6	9	7	6	8	6	6
Med. Base	8	6	6	10	8	6	10	8	6	9	7	6
Soft Base	10	8	6	13	10	8	13	11	9	12	10	7
Permian Basin (Subgrade Modulus > 15 ksi)												
Stiff Base	6	6	6	7	6	6	7	6	6	7	6	6
Med. Base	7	6	6	8	7	6	8	7	6	8	6	6
Soft Base	8	6	6	10	8	6	10	8	6	9	7	6

Use Formalized Design

BS # Wells: No. of wells serviced by road in Barnett Shale Stiff: E_{FDR} = 300 ksi
 PB # wells: No. of wells serviced by road in Permian Basin Medium: E_{FDR} = 200 ksi
 EF # Wells: No. of wells serviced by road in Eagle Ford Shale Soft: E_{FDR} = 100 ksi
■ Not Recommended – Premature Failure Expected

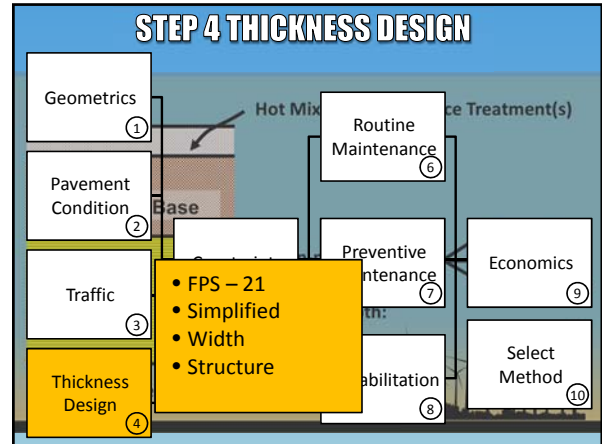


- Project located in South Texas Subgrade modulus 7,000 psi
- 50 – 90 wells to be served by road 0.5 – 1.5 million ESAL's
- Two course surface treatment Used as surface course



- Project located in South Texas Subgrade modulus 7,000 psi
- 50 – 90 wells to be served by road 0.5 – 1.5 million ESAL's
- Two course surface treatment Used as surface course
- The required soft FDR base required is 6 inches

District Example



Thickness Design Documents

Document Number	Title
ESB-16-04	Pavement Thickness Design Catalog with Flexible Base Layer
ESB-16-05	Pavement Thickness Design Catalog with Stabilized Base Layer
IR-15-01	Pavement Design Catalog Development for Pavements in Energy Affected Areas of Texas
RR-14-01	Maintenance and Rehabilitation Strategies for Repair of Road Damage Associated with Energy Development and Production

Documents available on TxDOT Maintenance Division SharePoint site at <https://txdot.sharepoint.com/sites/division-mnt/site/pages/home.aspx>