

# **Opportunity and Challenge of Use of RAP/RAS Mixes in Texas**

A stylized graphic of a road with white dashed lines receding into the distance, set against a dark red background.

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# Outline



- Introduction: RAP/RAS
  - Opportunities
  - Challenges
- Approaches for addressing the challenges
  - Best practices for RAP/RAS processing
  - Ways to improve cracking resistance
- Balanced mix design method
- Summary

# Introduction: Opportunities

- In 2013 Texas used
  - RAP: >1,000,000 tons
  - RAS: >150,000 tons
- TxDOT specification allow:
  - 20% RAP in surface mixes, combining that with up to 5% RAS in most mixes
- Great Opportunities for Economics and Environment!



# Introduction: Engineering Challenges

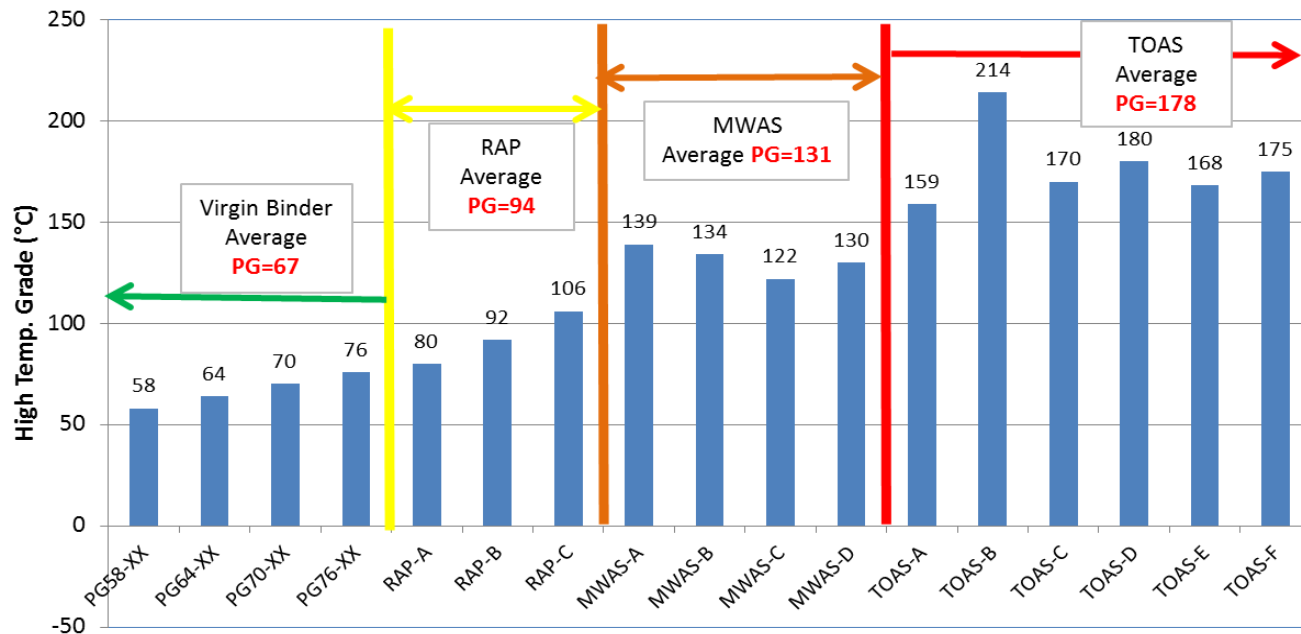
- RAP/RAS variability
- Durability of RAP/RAS mixes (early cracking)
- Unknown blending
  - ▣ Virgin/RAP/RAS binders
- Workability and compaction of RAP/RAS mixes



# Address RAP/RAS Variability

## □ RAP/RAS Variability

- ▣ Gradation, asphalt content, PG
- ▣ RAP: Fresh/"young"/old pavements
- ▣ RAS: Manufacture waste/Tear-off



# Six steps of best practice for RAP process



- 1. Eliminate contamination**
- 2. Separate RAP stockpiles from different sources**
- 3. Blend or mix before processing RAP stockpiles**
- 4. Crush or fractionate RAP stockpiles (Avoid over crushing)**
- 5. Store the processed RAP using paved, sloped surface**
- 6. Characterize the processed RAP and mark stockpiles**

# 1. avoid contamination



# 2. Separate stockpiles



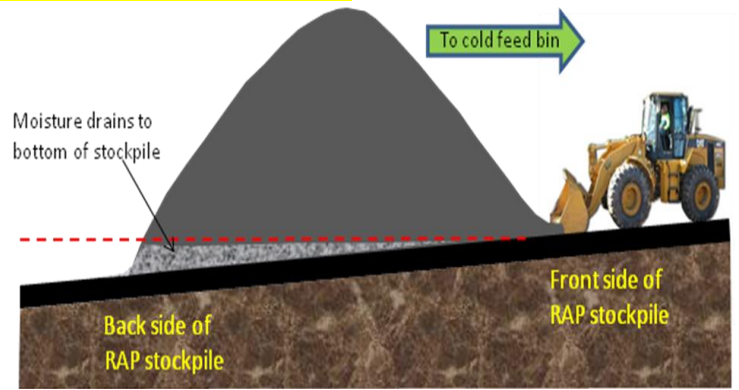
# 3. blend stockpiles



# 4. Avoid over crushing



# 5. Store it right



# 6. Mark it



# Six steps of best practice for RAS process



Step 1: Collecting



Step 2: Asbestos testing for TOAS



Step 3: Sorting



Step 4: Grinding



Step 5: Screening



Step 6: Storing



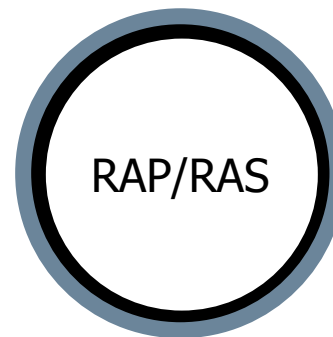
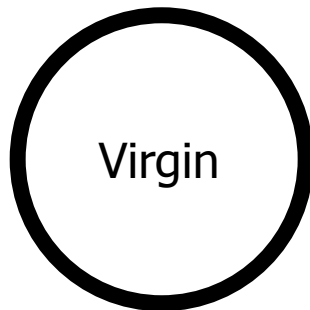


# Address durability/cracking issue

- We tried all the following approaches in the field
  - Set up upper limit for RAP/RAS
  - Reduce design air voids
  - Use soft virgin binders, especially on the low-temperature grade (i.e., PG XX-28, PG XX-34)
  - Rejuvenate RAS binder in the mix design process
- We found out the first three approaches worked. Rejuvenator test sections are still under evaluation.

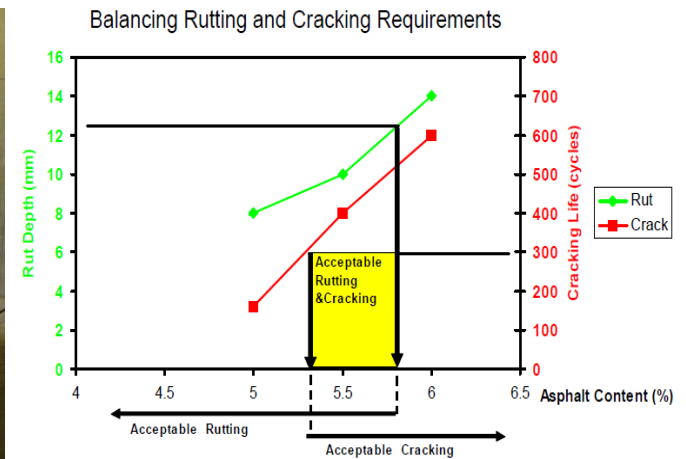
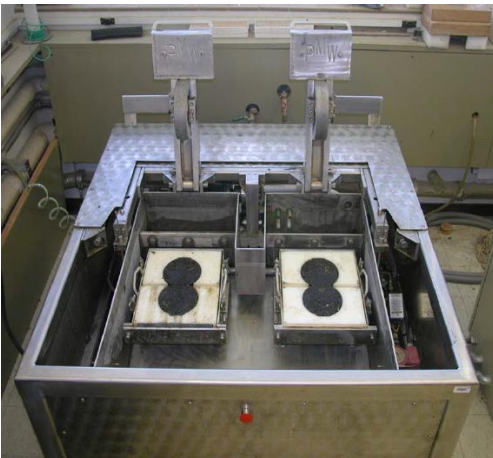
# Balanced RAP/RAS Mix Design

- Current mix design methods
  - ▣ Volumetrics based approach
  - ▣ VBE to control cracking
  - ▣ Hamburg/APA to control rutting
- Feature of RAP/RAS mixes: Unknown VMA (VBE)
  - ▣ Because we don't know how RAP/RAS binder blends with virgin binder.



# Balanced RAP/RAS Mix Design

- Hamburg test for rutting/moisture damage
- Overlay test for cracking (**cracking requirement**)
- Max. density-98% for controlling potential bleeding



# Why project-specific design:

## RAP/RAS field test sections and performance

### □ Amarillo-Overlay: (Aug 2009)

- IH40: Heavy traffic; Cold weather; Soft binder
- RAP: 0, 20, 35%

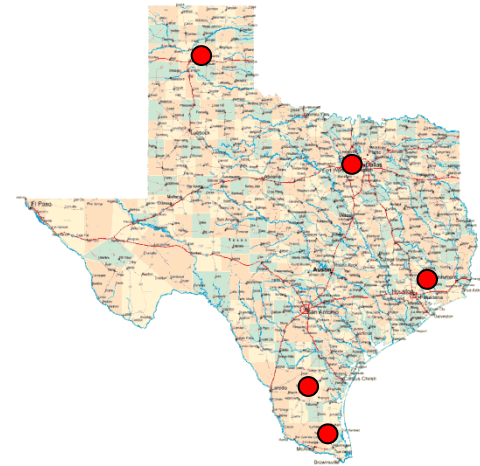
### □ Pharr district-New Const.: (April 2010)

- FM1017: low traffic; Hot weather; stiff binder
- RAP: 0, 20, 35%

### □ Laredo-Overlay: SH359, 20%RAP (Mar. 2010)

### □ Houston-New Const.:SH146, 15%RAP/5%RAS (Oct. 2010)

### □ Fort Worth-AC/CRCP: Loop 820 (July 2012)



# Why project-specific design:

## RAP/RAS field test sections and performance

Test sections		Highway	Overlay/ new const.	Weather	Traffic MESAL	OT cycles	Performance
Amarillo	0%RAP	IH40 (severely cracked thick asphalt pavement)	4 inch/ overlay	Cold	30	95	3 yrs: 100% refl. cracking
	20%RAP					103	
	35%RAP					200	3 yrs: 57% refl. cracking
Pharr	0%RAP	FM1017-Very good support	1.5 inch/ new const.	Very hot	0.8	28	3yrs: overall - good conditions
	20%RAP					6	
	35%RAP					7	
Laredo	20%RAP	SH359-regular support	3 inch/ overlay	Very hot	1.5	3	3yrs: No cracking
Houston	15%RAP/ 5%RAS	SH146-Very good support	2 inch/new const.	hot	3.0	3	2.5yrs: No cracking
Dalhart	5%RAS	US87	3 inch/ Overlay	Cold	3.0	48/96	96 cycles-20% RCR; 48 cycles-50%RCR

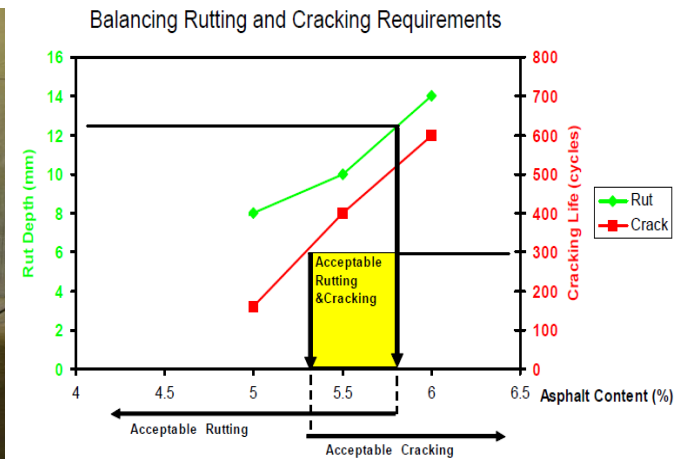
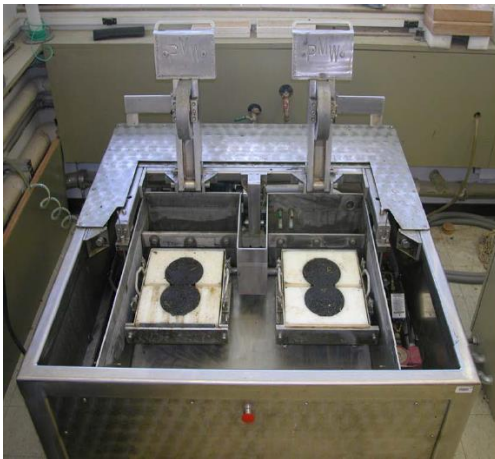
# Why project-specific design:

## RAP/RAS field test sections and performance

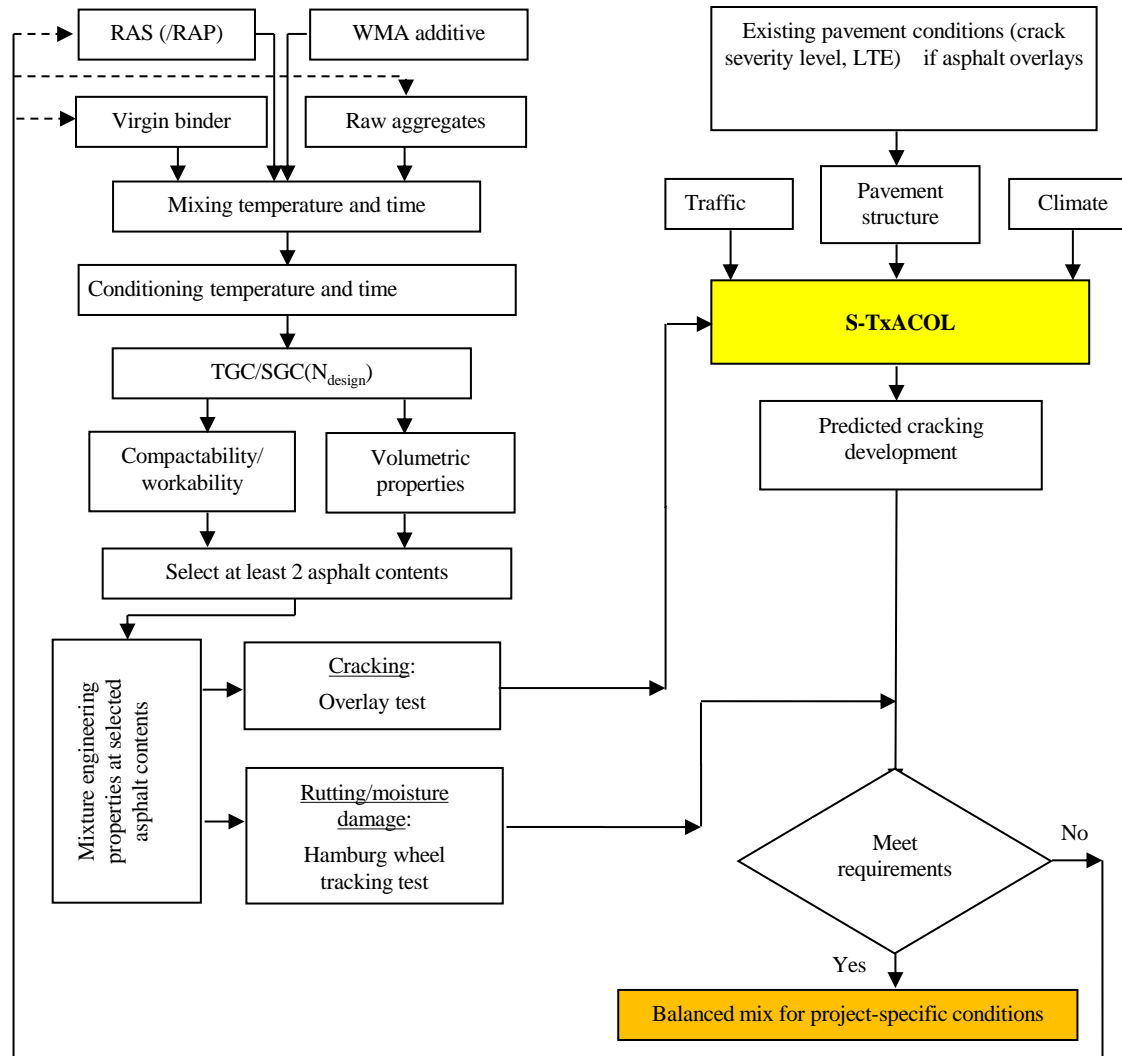
1. RAP/RAS mixes can perform well at certain locations.
2. One OT requirement cannot fit for all.
3. Successful use of RAP/RAS mixes depends on
  - Weather/Traffic
  - AC overlay
    - Overlay thickness, Existing pavement structure (AC/AC; AC/PCC)
    - Existing pavement conditions
  - New construction
    - Pavement structure and which layer (surface, base, etc.)
4. **Design the mix for project-specific conditions**

# Balanced RAP/RAS Mix Design for Project-Specific Service Conditions

- Hamburg test for rutting/moisture damage
- Overlay test for cracking
- OT requirement determined by Overlay program
- Max. density-98% for controlling potential bleeding



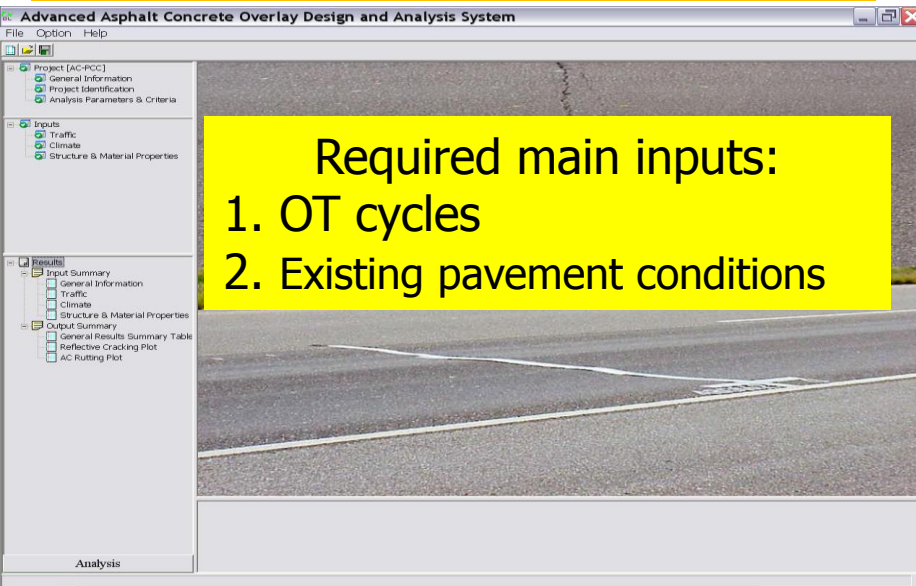
# Balanced RAP/RAS mix design for project specific condition





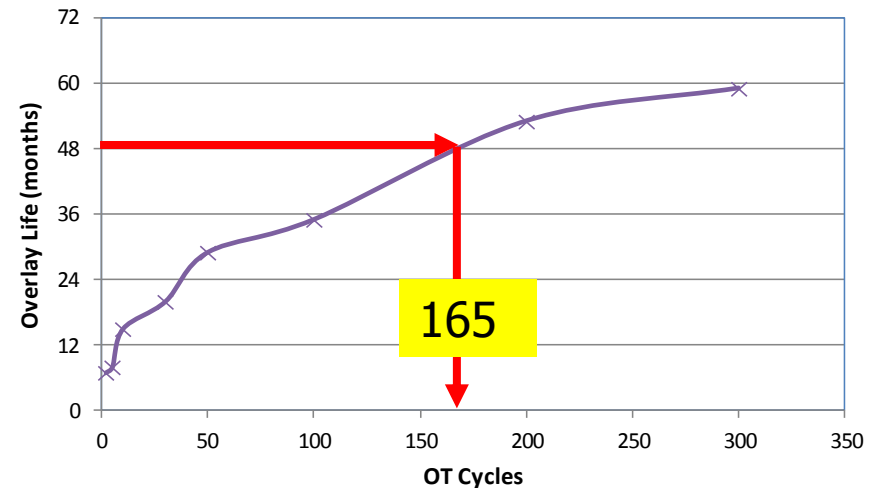
# Balanced RAP/RAS Mix Design for Project-Specific Conditions

## Simplified Overlay design system



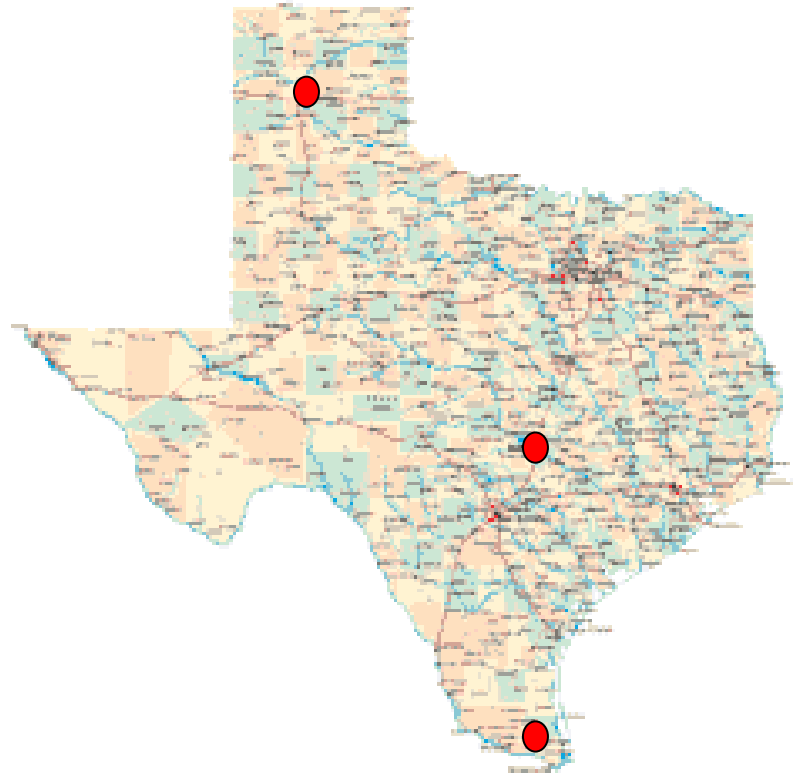
## Determination of Min. OT cycles

2" Overlay over 10" JPCP  
under 3 MESALs/20 Years



# Demonstration of project-specific OT requirement

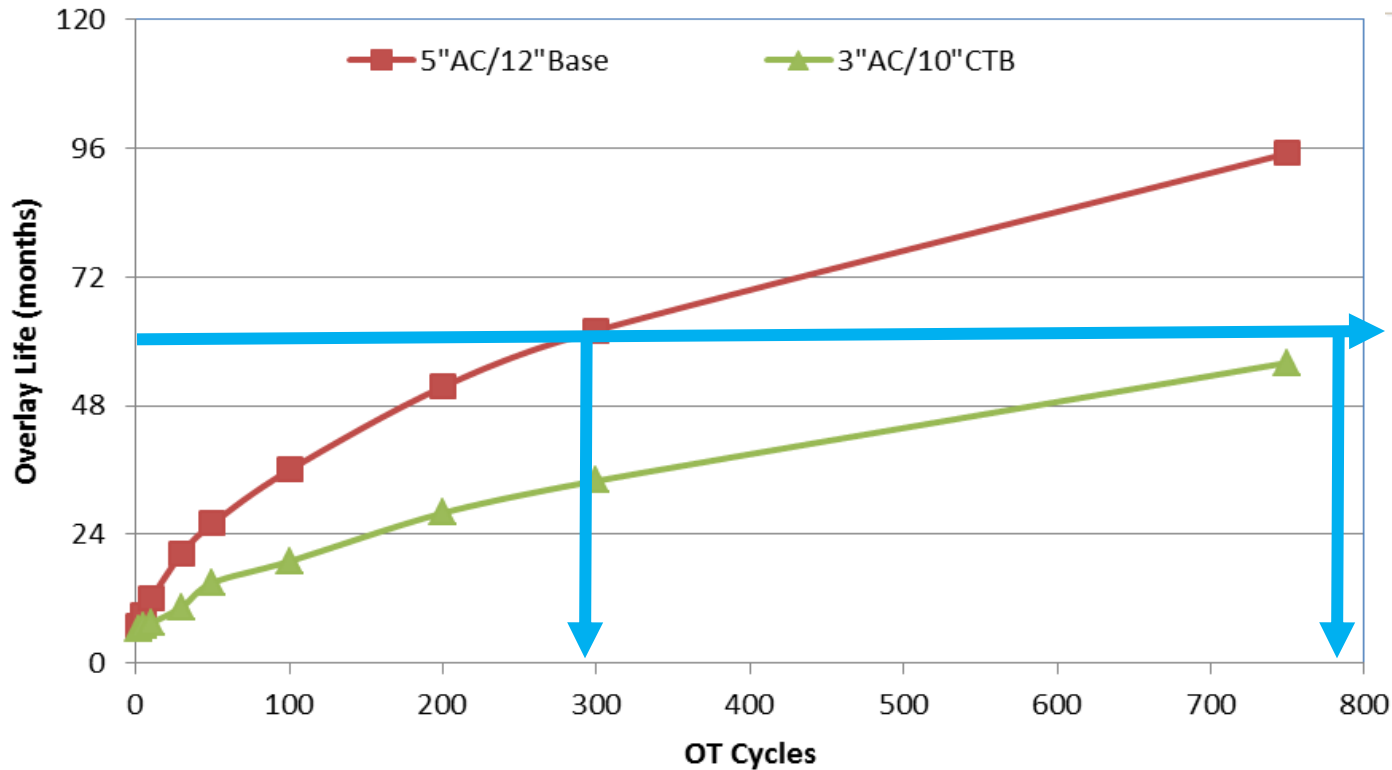
- AC overlay scenarios
  - AC/PCC
  - AC/AC/CTB
  - AC/AC/granular base
- Traffic level: 3 MESAL
  - **SH/US: 3-5 MESAL**
- Weather:
  - Amarillo
  - Austin
  - McAllen



# Demonstration of project-specific OT requirement

## □ Amarillo

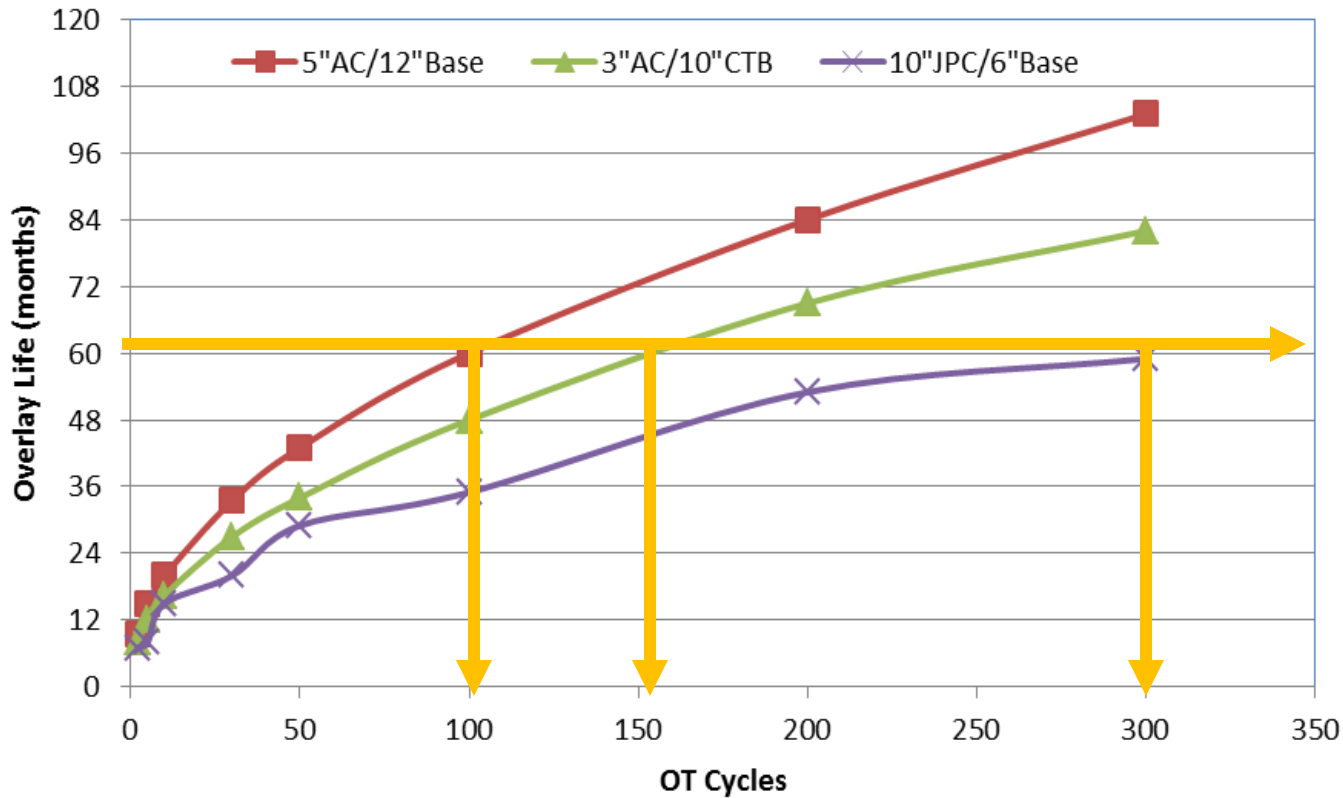
### 2" Overlay under 3 MESALs/20 Years



# Demonstration of project-specific OT requirement

## □ Austin

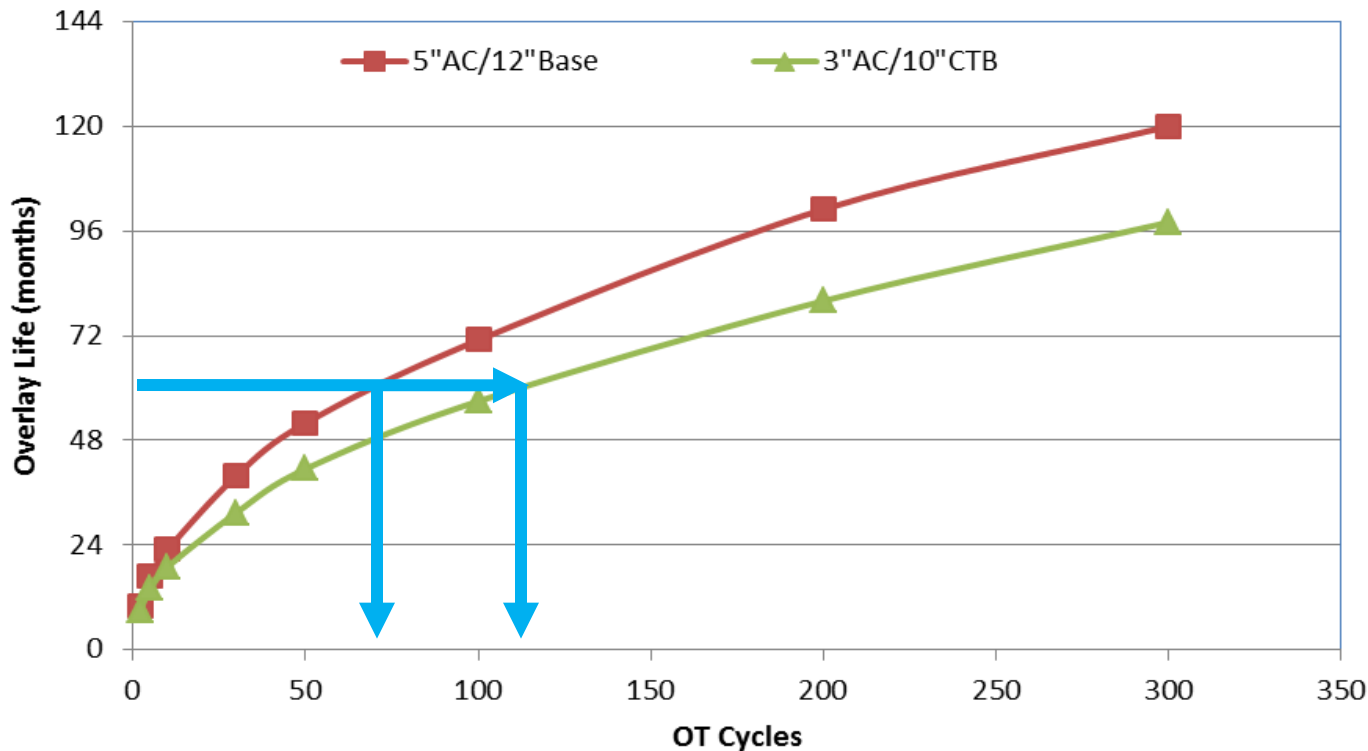
### 2" Overlay under 3 MESALs/20 Years



# Demonstration of project-specific OT requirement

## □ McAllen

### 2" Overlay under 3 MESALs/20 Years



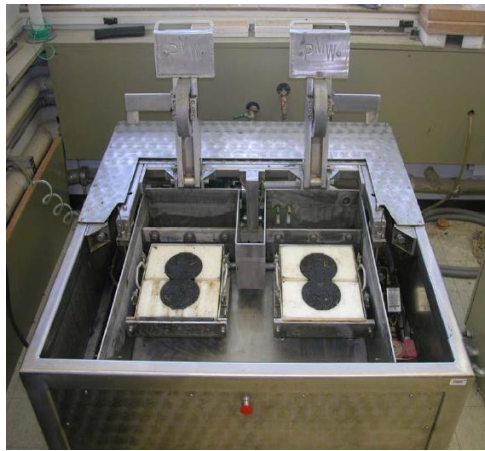
# Summary



- Best practices for RAP/RAS process are available.
- RAP/RAS mixes can have similar or even better performance with proper design.
- Balanced RAP/RAS mix design is established:
  - ▣ Hamburg test for rutting/moisture damage
  - ▣ OT for cracking; Project-specific OT requirement
  - ▣ Max. density to control potential bleeding
- Different approaches are available for improving RAP/RAS mix performance if needed.

# Thank You All!

## Design the mixes for project-specific condition!



2" Overlay over 10" JPCP  
under 3 MESALs/20 Years

