# 0-6748-P2

# BEST PRACTICES FOR FLEXIBLE PAVEMENT STRUCTURE WIDENING: WORKSHOPS


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Manuel Trevino
Jorge Prozzi
Mike Murphy


*TxDOT Project 6-6748: Best Practice for Flexible Pavement Structure Widening Projects*

**JULY 2013**



| **Performing Organization:**<br>Center for Transportation Research<br>The University of Texas at Austin<br>1616 Guadalupe, Suite 4.202<br>Austin, Texas 78701 | **Sponsoring Organization:**<br>Texas Department of Transportation<br>Research and Technology Implementation Office<br>P.O. Box 5080<br>Austin, Texas 78763-5080 |
|---|---|
| Performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration. | |

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## Introduction

This document presents a summary of the two half-day workshops/webinars that took place at CTR July 2, 2013. The workshops constitute Product 2 (P2) of the research project and correspond to Task 3. The purpose of the workshops was to obtain expert opinions from TxDOT personnel, contractors, and construction equipment and materials manufacturers with experience in pavement widening projects. For logistical and practical reasons both workshops were conducted on the same day.

The workshop was conducted to facilitate face-to-face participation for those who could travel to Austin; the webinar component was added to increase the participation of those who could not attend due to limited travel budgets or time restrictions. The morning workshop focused on contractors and suppliers presenting their experience while the afternoon workshop focused on TxDOT experience. The details of the workshops and the workshop materials follow:

## Workshop Webinar 1: Contractors and Suppliers Experience

The participants in the morning workshop included contractors, construction equipment and materials manufacturers and suppliers, and construction industry representatives. This workshop focused on construction methods and considerations, practical problems encountered during construction of narrow widening projects, modified or specialized equipment that has been successfully implemented, and suggested improvements to construction plan details, specifications, and standards. Discussion topics and points included the following:

a. It would be beneficial in terms of project costs and construction duration for TxDOT to standardize widening project designs to fit the sizes and widths of existing equipment and materials (geotextiles, geogrid, etc.). Improve preliminary project testing to ensure that information such as pavement thicknesses and material types are up to date.

b. Milling machines provide an excellent joint cut face that is clean and uniform; remove the scarified material from the cut trench and place the material into a dump truck using a conveyor system; and allow for adjustment of the cut width and depth depending on the machine type and size. In addition, milling machines can cut the trench along the entire length of the project as required by some districts or can stop the milling operation at drives or intersections, climb out of the trench, and cross to the road to begin the trench on the opposite side. Districts currently use both of these widening methods depending on circumstances.

c. TxDOT currently sets the maximum construction distance at 1 mile for widening projects. Some contractors might be able to successfully construct more than 1 mile per day. It is recommended that TxDOT consider allowing the contractor to demonstrate their equipment and capabilities to maximize construction efficiency.

d. TxDOT does not let a steady number of widening projects for statewide letting. For this reason, some contractors might be reluctant to invest in specialized equipment for constructing road widening projects, although the equipment could improve construction quality and efficiency.

e. TxDOT has successfully used geotextiles, fabrics, and grids to reinforce subgrade and base courses. However, placement of these materials varies from district to district. TxDOT may want to consider further studies to evaluate the best placement of these reinforcing materials within the pavement structure.

f. No guidance is provided regarding placement of geogrid or fabrics with regard to the vertical cut face of the widening section or overlap into the adjacent existing lane. It is suggested that further study address the benefits of wrapping the grid or fabric over the joint face and providing overlap within the lane to strengthen the joint and reduce the potential for reflective cracking.

g. When constructing the widened section using a Weiler or Midland road widener, it is unclear whether the contractor should set the widener screed at an elevation that places an additional thickness of material to allow for compaction and densification of the base layer. Further guidance is needed in this regard.

h. Manufacturers make narrow width steel wheel or pneumatic tired rollers that can fit in a narrow widening section to properly compact the subgrade and each subsequent pavement lift. Further study is needed to identify the appropriate type and weight of these smaller rollers, considering that the contractor will want to make use of this equipment for other applications.

i. Widening the pavement with asphalt-stabilized base (ASB) is preferred by many districts and contractors since this material is easy to place and compact and can be opened to traffic at the end of each day's construction. However, TxDOT design guidance warns that ASB should not be placed full-depth against a flexible base layer due to blockage of sub-surface drainage. A test site has been constructed on SH 21 in the Austin District to investigate the use of drainage layer fabric placed under a 3-in. stone base layer to accommodate drainage under the ASB base layer. Further study and monitoring of this and similar sites is recommended to determine the value of this installation.

j. The contractors and equipment suppliers requested additional information regarding the average widening amount on TxDOT projects, including the distribution of widening sections. This information would be helpful in determining equipment sizes during purchase.

k. Additional guidance is needed regarding the optimum moisture content of various base types for use in geogrid applications.

## Workshop Webinar 2: TxDOT Experience

The participants in the afternoon workshop included personnel from TxDOT and other transportation agency and industry representatives. The afternoon workshop focused on design considerations, design details, standards and specifications, construction problem areas and solutions. Discussion topics included the following:

a. Some districts have found that the cost of constructing a full-depth reclamation of the entire roadbed is from 15 to 22% higher than constructing a narrow widening section on each side of the roadway. Though slightly more expensive, full-depth reclamation results in total rehabilitation of the roadway and eliminates the widening joint lines and potential variability in material stiffness and moisture contents, which improves construction quality and pavement performance.

b. TxDOT funding guidelines for Category (CAT) 8 Highway Safety Improvement Program (HSIP) funding may restrict best practices for widening projects. There is some confusion and disagreement whether rehabilitation of the existing lanes can be performed using CAT 8 funding during a widening project. For this reason, deteriorated roadways might be selected as widening project candidates, although deteriorated roadways are better candidates for full-depth reclamation or rehabilitation (including lane widening). Further study is needed to clarify the selection criteria for HSIP criteria and funding.

c. Variations among districts regarding materials, climatic conditions, truck loading, and average daily traffic suggests that a more detailed study of recommended, standardized designs is needed to address these variations while providing consistency.

d. Variations from district to district occur regarding whether projects are constructed through statewide letting by contractors, through routine maintenance contracts or by state maintenance forces. Due to variations in available equipment, materials, personnel, and other factors, the resulting variability in construction quality and performance of widening projects may occur. Further study is needed to determine how resources can be made available to all districts to ensure the best quality and performance of widening projects.

e. Approximately 40,000 center line miles of FM roads exist on the state system. A large percentage of these roadways have narrow 9-, 10-, and 11-foot lanes and often do not have a paved shoulder. Districts in which oil and gas exploration is occurring are experiencing increased problems with pavement failures, rutting, edge-drop offs, cracking, and related distresses, raising concerns about safety and pavement structural capacity.

f. Pavement widening projects funded with CAT 8 money do not qualify for structure widening. This limits the ability of the district to provide the safest possible road cross section and clear zone widths in some cases. Further consideration should be given to the criteria and conditions established for HSIP funding for widening projects.

g. Some districts have purchased milling machines to construct narrow widening projects and to perform other functions in the district. Further consideration should be given to the value of purchasing self-propelled pavement widening equipment for maintenance sections to further expand in-house capabilities.

h. Further consideration should be given to the use of a water truck to control dust during construction. Often water trucks will spray the base material after placement in the trench, which might result in higher-than-optimum moisture content just prior to surface or prime placement. Higher-than-optimum moisture contents might result in later settlement, rutting, or dry land shrinkage cracking as the base dries out and/or moisture is drawn from the widened section into the existing pavement and subgrade layers.

i. Further study is needed to evaluate the use of dust palliatives during full-depth reclamation and narrow widening projects to hold down dust and enhance safety. Contractors use motorized brooms on certain projects to remove dust after base placement, causing dust clouds that obscure the roadway and may cause safety concerns for traffic and construction workers within the work zone.

j. Further work is needed to evaluate the specific mechanisms that cause cracking of the joint line within a narrow widening project. Failure of the joint line can occur due to poor joint construction, traffic loads, dry land shrinkage cracking, or a combination of these factors. Quite often extensive and continued maintenance activities are required to address joint failure problems.

k. The most common joint design is a vertical cut joint face at the pavement widening line. Further study is needed to determine if other designs that involve tapers or a stepped construction might improve joint density and reduce the potential for reflective cracking. However, the joint design should also address contractor equipment capabilities and construction efficiency.

## Workshop Presentations and Materials

Six presentations were made in the morning workshop and another six presentations were given in the afternoon workshop. In addition, a recap discussion took place at the end of the afternoon workshop. To start the workshop, the first presentation was given to introduce the topic of narrow widening and explain the purpose of the workshop. Morning presentations included perspectives from RoadTec (equipment manufacturer), APAC (contractor), Allen Keller (contractor), and Tencate and Tensar (geosynthetic materials manufacturers). Presentations during the second workshop included perspectives from TxDOT's Austin, Waco, San Angelo, Bryan, and Atlanta Districts and an overview of pavement widening equipment. The final portions of the workshops were reserved to recap and further discuss important issues identified during the presentations. Appendix A contains the agenda on the full day and Appendix B lists the individuals who attended both workshops, both in person and online. On the accompanying CD, Appendix C provides the industry presentations from Workshop 1 while Appendix D presents the TxDOT presentations from Workshop 2.

## Summary and Conclusions

The workshops were organized to obtain opinions and additional knowledge about narrow widening projects from experienced professionals involved in the construction, equipment, materials, and design aspects of these projects. Presenters came from different areas of Texas; some suppliers came from out of state.

During the workshops, knowledge was shared on the types of equipment available for narrow widening projects and the advantages and disadvantages of different equipment pieces. The size of the equipment used should match the work being done, and there are different options for the different types of work. For example, to cut the joint of the existing pavement, a milling machine or a road saw (attached to a skid steer or front end loader) could be used. To spread the base material, a road widener (self-propelled or non-self-propelled) or a belly dump could be used.

Geosynthetic manufacturers discussed the products they offer that could be used for narrow widening projects. In particular, they emphasized how geosynthetics could help provide reinforcement for the road and retard movement of cracks rising to the surface. Geosynthetics could also help with drainage issues. Participants noted the lack of standards for the use of pavement inter-layers, and indicated a study is needed.

Contractors and TxDOT representatives from District offices shared their current practices that work well, as well as lessons learned from experiences that did not provide acceptable results. Flex base was compared to ASB in multiple presentations: flex base is cheaper and allows to better drainage, but ASB is faster (allowing the traffic to return to the road sooner) and reducing dust. A pilot car is usually needed for narrow widening projects, as the narrow width presents a safety issue. Some solutions for narrow widening issues depend on the source of funding (safety versus rehabilitation funds).

In summary, the workshop/webinar met the project objectives. Based on the sign-in sheet and number of webinar logins, 17 individuals attended the workshop in person and an estimated 70–90 TxDOT personnel attended all or a part of the webinar through the TxDOT Webex system.

The researchers plan to follow up on the issues and questions raised during the workshops and will document new information in the final project report.

# Appendix A – Workshop Agenda

**Webinar-Workshop Agenda**

## Project 0-6748 'Narrow Pavement Widening'

**University of Texas – at Austin Center for Transportation Research**
**Large Conference Room**
**1616 Guadalupe, Suite 4.202**
**Austin, Texas 78701**

**Tuesday July 2, 2013 9:00 – 4:30 PM**

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The Texas Department of Transportation has initiated project 0-6748 to develop a compendium of best practices for narrow pavement widening. The project addresses design, construction, equipment, materials and related issues associated with projects involving widening of narrow pavements by from 1' – 6'.

The research team has conducted interviews of Districts, Construction Equipment manufacturers and sellers, Contractors and Material Suppliers to obtain first-hand information about the challenges and best practices associated with narrow pavement widening. The purpose of this Webinar-Workshop is to allow Districts, Contractors, Equipment and material suppliers to discuss their methodologies and products as applied to narrow pavement widening projects to facilitate discussion and share information about best practices and 'lessons learned'.

### Webinar – Workshop Arrangements

#### Location

The Webinar – Workshop will be conducted from the University of Texas at Austin – Center for Transportation – Large Conference Room. Map attached to Email, park on the 10th floor of the parking garage – parking validated.

CENTER FOR TRANSPORTATION RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN

## Webinar-Workshop Agenda

**Project 0-6748 'Narrow Pavement Widening Webinar-Workshop'**

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**PART I: 9:00 AM – 12:00 PM**

| | | |
|---|---|---|
| 1. Introductions and Purpose of the Workshop | Mike Murphy | 15 m |
| 2. **RoadTec** | David Zuehlke | 25 m |
| a. Discussion | dzuehlke@roadtec.com | |
| b. Lessons learned and 'take-aways' | (512) 638-2429 | |
| 3. **APAC Trotti and Thompson** | Maria Burton CTR | 25 m |
| a. Discussion | Manuel Trevino CTR | |
| b. Lessons learned and 'take-aways' | maria_christina.86@hotmail.com<br>Manuel.trevino@mail.utexas.edu | |
| 4. **Allen Keller** | Kory Keller | 25 m |
| a. Discussion | kkeller@allenkellerco.com | |
| b. Lessons learned and 'take-aways' | (830) 997-2118 | |
| 5. **Tencate Geosynthetics** | Mike Samueloff<br>Katie Strain | 25 m |
| a. Discussion | m.samueloff@tencate.com | |
| b. Lessons learned and 'take-aways' | (248) 302-8806<br>k.strain@tencate.com | |
| 6. **Tensar** | Stephen Archer | 25 m |
| a. Discussion | sarcher@tensarsorp.com | |
| b. Lessons learned and 'take-aways' | | |

**Lunch Break 12:00 – 1:00 pm**

**PART 2: 1:00 – 4:30 PM**

| | | |
|---|---|---|
| 7. **Austin District** | Mike Arellano | 25 m |
| a. Discussion | miquel.arellano@txdot.gov | |
| b. Lessons learned and 'take-aways' | (512) 832-7093 | |
| 8. **Waco District** | John Jasek | 25 m |
| | Don Miller | |
| a. Discussion | john.jasek@txdot.gov | |
| b. Lessons learned and 'take-aways' | (254) 867-2770 | |
| | Don.miller@txdot.gov | |
| | (254) 867-2730 | |
| 9. **San Angelo District** | Lewis Nowlin | 25 m |
| a. Discussion | lewis.nowlin@txdot.gov | |
| b. Lessons learned and 'take-aways' | (325) 446-9603 | |
| **10.Bryan District** | Darlene Goehl | 25 m |
| a. Discussion | Darlene.goehl@txdot.gov | |
| b. Lessons learned and 'take-aways' | (979) 778-9650 | |
| **11. Atlanta District (Survey Summary)** | Andre Smit | 10 m |
| | **Asmit@mail.utexas.edu** | |
| | (512) 906-5495 | |
| **12. Pavement Widening Equipment (**overview) | Mike Murphy | 20 m |
| | Maria Burton | |
| 13.**Recap of presentations Questions & Answers** | Jorge Prozzi | 45 m |
| | Prozzi@mail.utexas.edu | |
| | (512) 905-2435 | |

## Appendix B – List of Attendees

**Project 0-6748 'Narrow Pavement Widening'**

**Webinar/Workshop**

**Center for Transportation Research**

**University of Texas at Austin**

**Tuesday July 2, 2013**

**SIGN-IN SHEET**

| | | Name | Email | Affiliation |
|---|---|---|---|---|
| | 1 | Mike Murphy | murphymr@mail.utexas.edu | CTR |
| | 2 | ANDRE' SMIT | ASMIT@MAIL.UTEXAS.EDU | CTR |
| | 3 | Katie Strain | K.Strain@tencate.com | TenCate Mirafi |
| | 4 | DEREK WIATREK | dwiatrek@tensarcorp.com | TENSAR |
| | 5 | Dan Baker | dbaker@tensarcorp.com | Tensar |
| | 6 | Steve Archer | sarcher@tensar-corp.com | Tensar |
| | 7 | Mark McDaniel | mark.mcdaniel@txdot.gov | TxDOT |
| | 8 | Magdy Mikhail | Magdy.Mikhail@txdot.gov | TXDOT |
| | 9 | Bennett Closner | bennett@closner.com | Closner Equipment |
| | 10 | David Zuehlke | dzuehlke@roadtec.com | Roadtec, Inc |
| | 11 | JORGE PROZZI | prozzi@mail.utexas.edu | UT AUSTIN |
| | 12 | Manuel Trevino | manuel.trevino@mail.utexas.edu | CTR |
| | 13 | Hui Wu | phuiwing@gmail.com | CTR |
| | 14 | Maria Burton | maria_christina.86@hotmail.com | UT Austin |
| | 15 | DARRIN JENSEN | darrin.jensen@txdot.gov | TxDOT |
| web | 16 | Joe Leidy | joe.leidy@txdot.gov | TXDOT - CST |
| web | 17 | Lewis Nowlin | Lewis.Nowlin@txdot.gov | TxDOT-San Angelo |
| web | 18 | Steve Smith | stephen.smith@txdot.gov | TXDOT - Odessa |
| web | 19 | Tim Hertel | tim.hertel@txdot.gov | TxDOT - Wichita Fall |
| web | 20 | CAROLYN Fink | Carolyn.Fink@txdot.gov | Houston-District MNT |
| web | 21 | Peter Jurgen | peter.jurgen@txdot.gov | Tyler District |
| web | 22 | Michael Schnieder | michael.schneider@txdot | Tyler District |
| web | 23 | DArlene Goehl | Darlene.goehl@txdot.gov | Bryan District |
| web | 24 | Allan Moore | Allan.moore@txdot.gov | Wichita Falls |

present Jorge Zornberg zornberg@mail.utexas.edu UT

| | | Name | Email | Affiliation |
|---|---|---|---|---|
| web | 25 | Richard Holder | richard.holder@txdot. | San Angelo |
| web | 26 | Robert Moya | robert.moya@txdot | Laredo |
| web | 27 | John Jasek | john.jasek@txdot | WACO |
| web | 28 | TOMAS SAENZ | tomas.saenz@txdot | EL PASO |
| web | 29 | Mike Sameloff | | Tencate |
| web | 30 | Kory Keller | | Allen Keller |
| web | 31 | PAUL Norman | | Abilene |
| web | 32 | Romualdo Mena | | Pharr design |
| web | 33 | SARAH Horner | | Brownwood - East Area |
| web | 34 | Danny DeLeon | | Corpus Christi - Des. |
| web | 35 | Don Miller | | WACO - CST Dir |
| web | 36 | Daniel Worden | | San Antonio - Desig |
| web | 37 | Lonnie Ragsdale | | San Antonio - CST |
| web | 38 | Jose Gaytan | | Corpus Christi - CST |
| web | 39 | Larry Smith | | |
| web | 40 | Montgomery Area Office | | |
| web | 41 | DALLAS District | | |
| web | 42 | Houston Construction | | |
| web | 43 | Andrew Kissig | | Fort Worth - Des. |
| web | 44 | Brownwood District | | |
| web | 45 | Lufkin District | | |
| web | 46 | Pharr District | | |
| web | 47 | SAN Antonio Distr | | |
| web | 48 | Atlanta District | | |
| web | 49 | Kyle ______ | | |
| web | 50 | Greg GRANATO | | SAN Antonio District Desig. Eng |
| web | 51 | Wendy Simmons | | Tyler District Maintenance Engineer |
| web | 52 | Robert Moya III | | Laredo - Construction |
| web | 53 | Scott ______ | | |
| web | 54 | Tony Moran | | San Antonio (contracts) |
| web | 55 | Felix Lerma | | |
| web | 56 | Richard Izzo | | CST-Soils & Aggr |

| | | | |
|---|---|---|---|
| 57. Ken Davenport | | ______ | San Antonio (Maint) |
| 58. Hui. Wu | | ~~plutoiry@gmail.com~~ | CTR |
| 59. Hondo | ______ | ______ | ______ |
| 60. Michael Van Winkle | | ______ | San Angelo<br>Maint Sect<br>Supervisor |

# Appendix C – Contractor and Supplier Presentations

# 0-6748: Best Practice for Flexible Pavement Structure Widening Projects

## Introduction

# Project Purpose

- **Objective**: identify best practices for improving pavement performance on projects involving widening of narrow pavement structures

# Reasons for Widening

- **<u>Reasons</u>:**
  - Improve safety
    - Edge failures & vehicle control
    - Greater traffic separation
  - Enhance pavement performance
    - Edges deteriorating from softening due to poor drainage
    - Reduce rutting due to tire loads at edges

    Other Reasons?

- Narrow widening: adding 1 - 6 ft. width to shoulder

# Construction Challenges

- Narrow work areas
- Variable subgrade support
- Surface and subsurface drainage
- Potential need for acquisition of additional ROW
- Keeping time short per task to maintain traffic flow
- Narrow widening equipment not worth purchase
- Project choices can depend on funding source
  - CAT1, CAT8, RMC, In House

# Failures

- **Difference between old and new structure**
  – Differences in thickness, material properties, and compaction
  – <u>Can result in</u>:
    - Rutting in existing or new pav’t
    - Uneven settlements
    - Cracking
    - Different load bearing capacities for both structures

(Varin & Saarenketo, 2012)

# Failures

- **Joint construction and location**
  - Should not be placed under/near wheel path
  - Traffic loading can cause <u>reflection cracking</u>

# Failures

- **Settlement**
  - Sufficient compaction of new structure else, <u>differential settlement</u> could occur

**(Varin & Saarenketo, 2012)**

# Failures

(Varin & Saarenketo, 2012)

- **Moisture penetration**
  - Should:
    - Maintain lateral drainage within pavement structure
    - Proper Selection of base materials key
    - Good Construction Inspection
  - Else, can cause:
    - Moisture penetration - base, subgrade softening
    - Swelling and heave of heavy clays

# Failures

- **Drainage**
  - Maintain sufficient pavement surface drainage
  - Can result in:
    - decreased bearing capacity
    - Edge deformation
    - Ponding of water (accelerates deformation - safety)

# Failures

- **Slope stability**
  - Should ensure stability of side slopes (inner & outer)
  - Problems if ROW space is limited
  - **If steep inner slope**:
    - Could result in poor compaction of widened section
      - cause shear failure & edge deformation
      - Structure widening a challenge

# Workshop Webinar

- **Webinar Purpose**:
  - – Obtain expert opinions
  - – Experience in pavement widening projects
    - TxDOT personnel & transportation agencies
    - Industry representatives
    - Contractors
    - Construction equipment manufacturers

# Workshop Webinar

- **Contractors, construction equipment manufacturers & suppliers, & construction industry representatives**
  – Identify construction projects performed well/not well
  – Good practices
  – Guidelines, specifications, standards
  – Equipment
- **TxDOT Districts**
  – Discuss projects that performed well/not well
  – Good practices
  – Guidelines, specifications, standards

# Equipment for TXDOT Shoulder Widening

David Zuehlke,  Roadtec Inc.

# AGENDA

Introduction

Historical Equipment

Current Equipment

Challenges

# ASTEC INDUSTRIES, INC.

ENERGY

INFRASTRUCTURE

MINING

ASTE
NASDAQ
LISTED

# Family of Companies

## Aggregate and Mining Group

TELSMITH
Mequon, Wisconsin USA

OSBORN
Johannesburg, South Africa

BTI
Ontario, Canada
Solon, Ohio USA
Riverside, California USA

KPI-JCI ASTEC COMPANIES
Yankton, South Dakota USA
Eugene, Oregon USA

ASTEC MOBILE SCREENS
Sterling, Illinois USA

Astec do Brasil Fabricação de Equipamentos Ltda.
Minas Gerais, Brazil

## Asphalt Group

ASTEC
Chattanooga, Tennessee USA

DILLMAN
Prairie du Chien, Wisconsin USA

HEATEC
Chattanooga, Tennessee USA

CEI ENTERPRISES
Albuquerque, New Mexico USA

## Mobile Asphalt Paving Group

ROADTEC
Chattanooga, Tennessee USA

CARLSON
Tacoma, Washington USA

ASTEC MOBILE MACHINERY GmbH
Hameln, Germany

## Underground Group

ASTEC UNDERGROUND
Loudon, Tennessee USA

GEFCO
Enid, Oklahoma USA

## Other Group

ASTEC AUSTRALIA
Brisbane, Australia

Peterson
an Astec Industries Co.
Eugene, Oregon USA

# CHATANOOGA, TN

**Manufacturers Road**

– 216,500 sq. ft. –

Company HQ

New equipment manufacturing

**Riverside Drive Location**

– 54,009 sq. ft. –

Parts, Rebuild, and Used Equipment

- **359 Employees Total**

# ROADTEC PRODUCT LINES




ROADTEC

# Historical – Custom Equipment

# SIDE-CUTTER ATTACHMENT

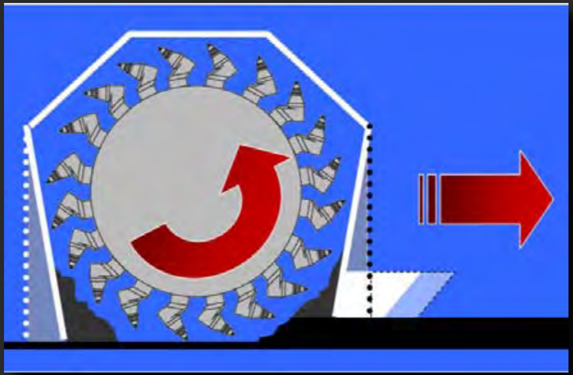
- Old Option – none in Texas
- RX-60C now RX-900
- Soft Shoulders / Deeper Cuts
- Economic Feasibility
- Lane Closure

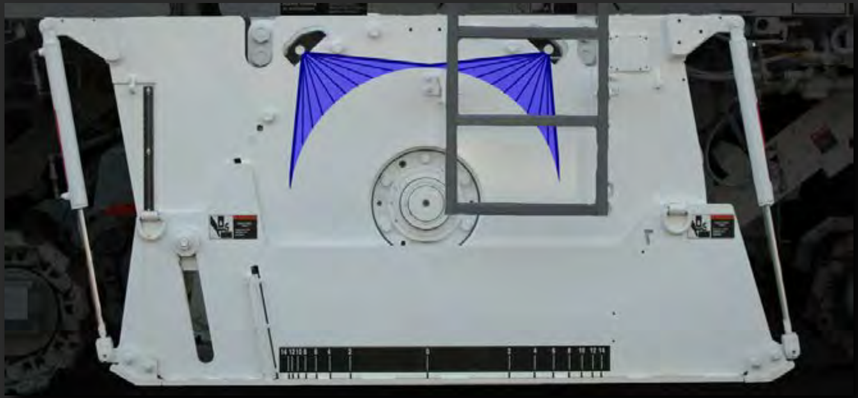

# SHUTTLE BUGGY WIDENER

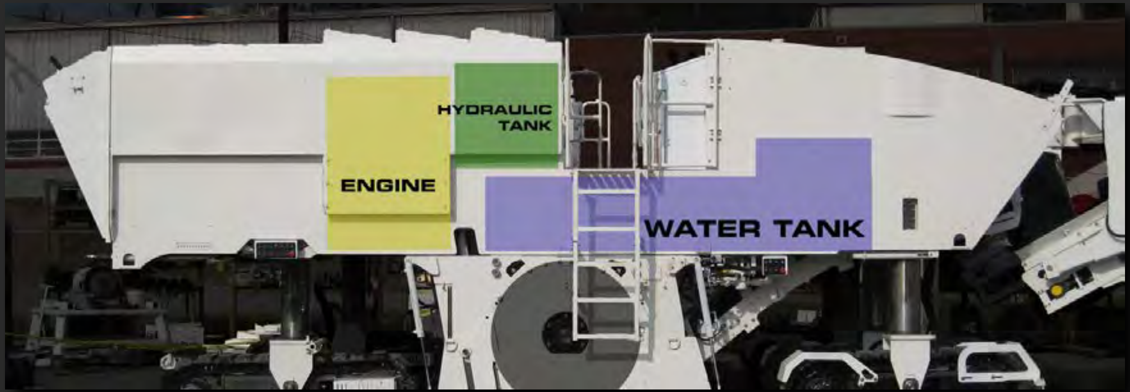
- **Limited number**
- **Buggy Utilization 2000 vs. Now**

# ROADTEC MILLS

# MILLING CONCEPT





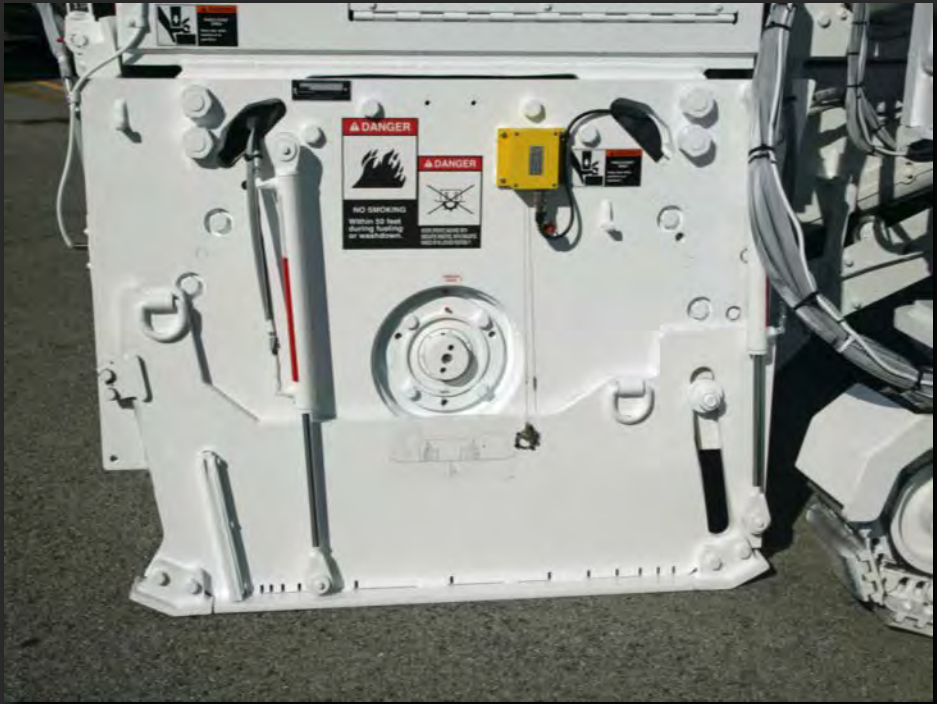


# AUTOMATED GRADE & SLOPE


# RX-400e

# CUTTER OPTIONS

1. 12” Max Depth
2. Standard 4’ Fixed Width
3. Variable Cutter System – VCS



# Variable Cutter System - VCS

## VCS

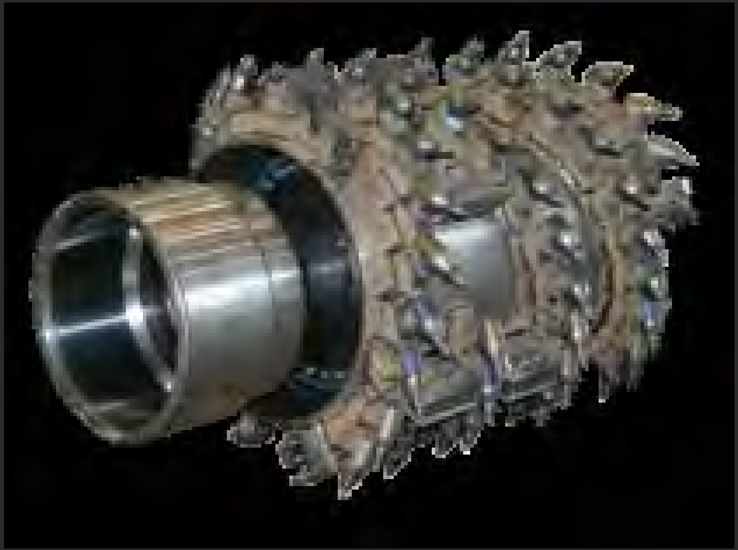
**1 Housing – 3 Widths**

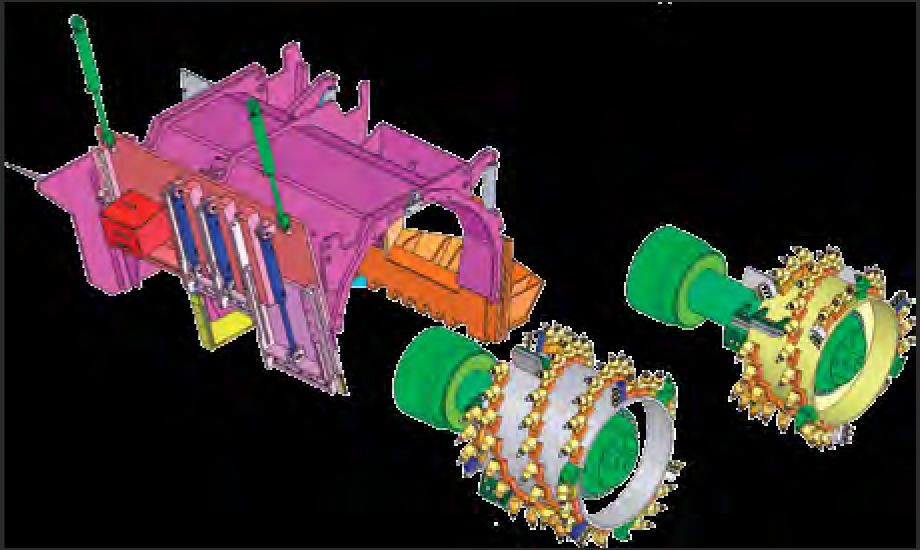
24” Cutter

36” Cutter

48” Cutter

# AUTOMATED GRADE & SLOPE





# One Person Operation

Exceptional visibility and controls allow the machine to be operated by one person

# RX-400e

- Right Hand Flush Cut
- Rear Flush Cut
- No legs in cut
- Minimal lane intrusion

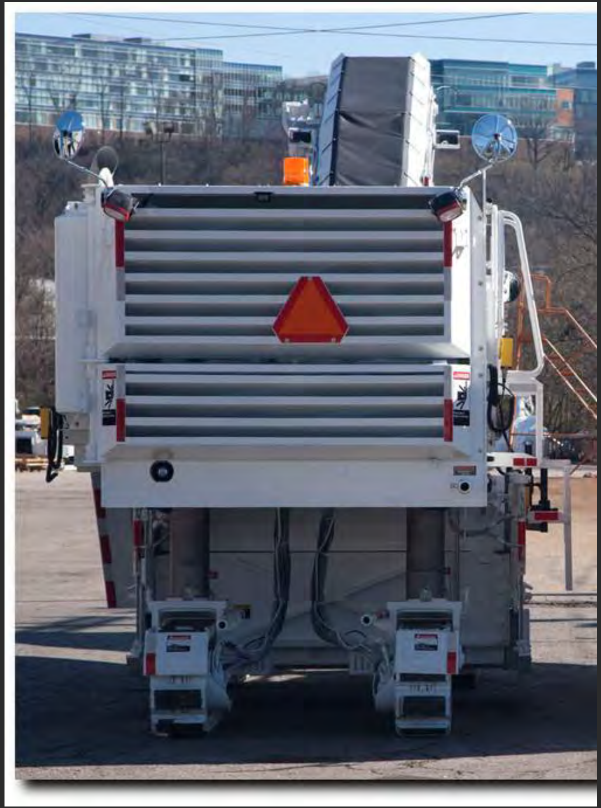
# RX-400e

12” Deep Cut - 24” Wide

# RX-400 District Usage

Atlanta
Beaumont
Bryan
Houston
Lufkin
Paris
Waco


# RX-600e



# RX-600e

- 6’ 7” or 7’ 2” Cutter
- VCS Capable with
  - 24” Cutter
  - 36” Cutter
  - 48” Cutter

# Real County – FM 336

# Real County – FM 336

**Grade depth set on the left side**
**Slope set on the right**

**Slope matched to existing grade**

# Real County – FM 336

# SHOULDER MILLING ADVANTAGES

- Clean Joints & Sub-Grade Surface
- Accurate sub-grade depth and slope
- Full Recovery and Recycle RAP & Aggregates
- More productive – faster construction cycle
- One machine operation allows for tighter job footprint

# SHOULDER WIDENING CHALLENGES / ISSUES

# SHOULDER WIDENING CHALLENGES / ISSUES

- Contractor Work Volume & Timing
- In-consistent widths among Districts
  - Example 2’ 6” vs. 2’, 3’, or 4’
  - Max Depth 12”
- Most common size mill cut width is 6’ 7” followed by 7’ 2”
- Under/Over cut vs. specialty size cuts

# THANK - YOU

ROADTEC

# QUESTIONS

# 0-6748: Best Practice for Flexible Pavement Structure Widening Projects

## APAC Site Visit & Commentary
## (Beaumont District – FM 1414)

Maria Burton
Manuel Trevino

# Project Description

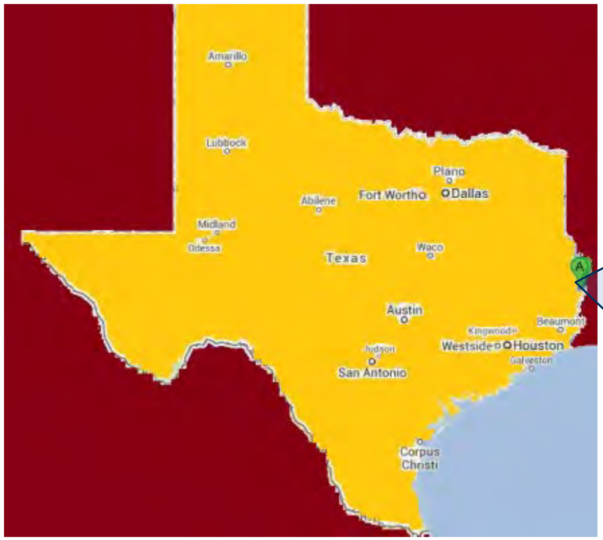
- APAC – Ashland Paving and Construction
  - Regional Office in Beaumont, TX


**<u>Highway Routine Maintenance Contract</u>**:
- Beaumont District – Newton County
- FM 1414

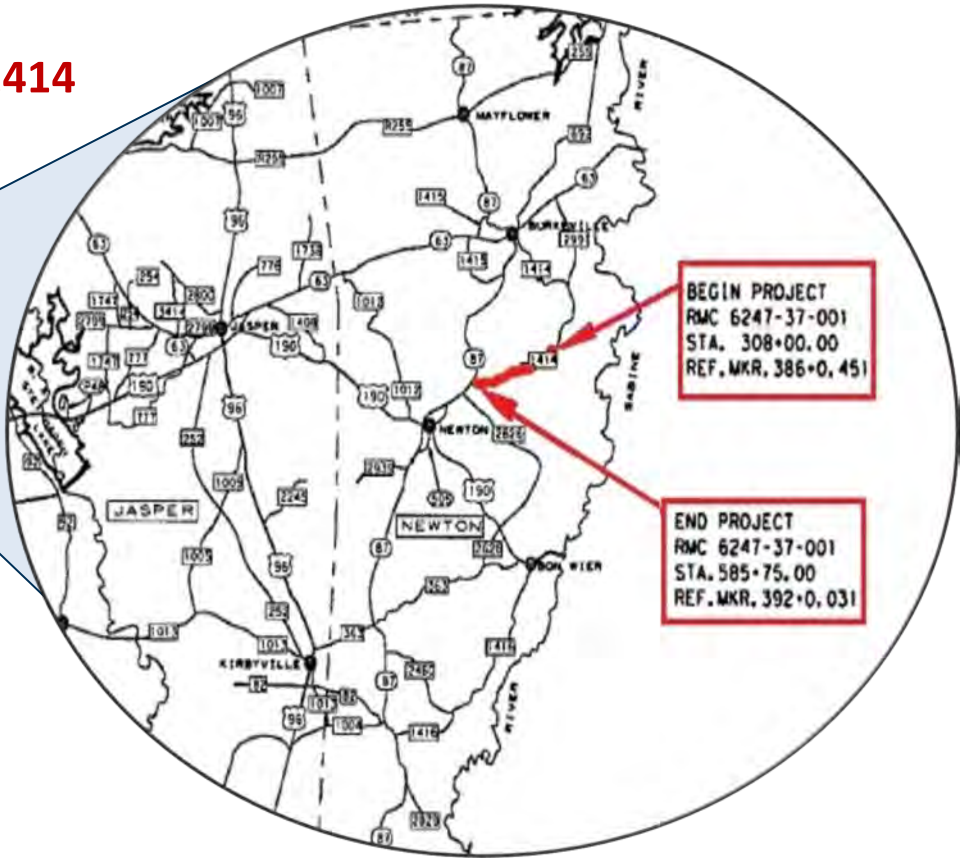
- **Type/Work**:
  - Pavement Widening (4 ft), Structure Extension, Seal Coat and Restripe

- **Project Length**: 5.260 miles

- **Limits of Work**:
  - From 10.439 miles South of SH 63 in Burkeville, South to SH 87




FM 1414



# Reasons for Widening

- <u>**This Project**</u>**: widening for Safety**
  - Roads tight on traffic, 10.5’ – 11’ wide
  - Collisions
  - Logging trucks – too long for turning on road
    - put slope on it to help

(East Texas logging trucks)

- **Common narrow widening projects:**
  - FM roads
  - Widening for safer access to mailboxes for mail carriers

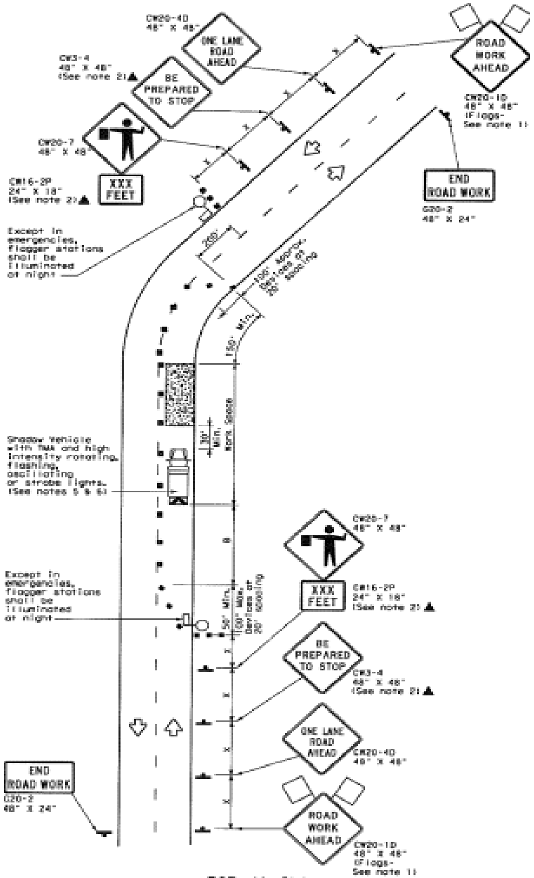
(FM 1414)

# Challenges with Narrow Widening

- **Tighter area to work in**
  - Use smaller equipment
    - smaller mill with variable drum
    - smaller roller to proof roll
    - smaller dozer

(photos from this project)

- **Challenges widening with traffic; it is already narrow as-is**
  - Curves & line of sight issues: use pilot car (this project)
  - If flat: use flagger station


(photos & drawing plan from this project)

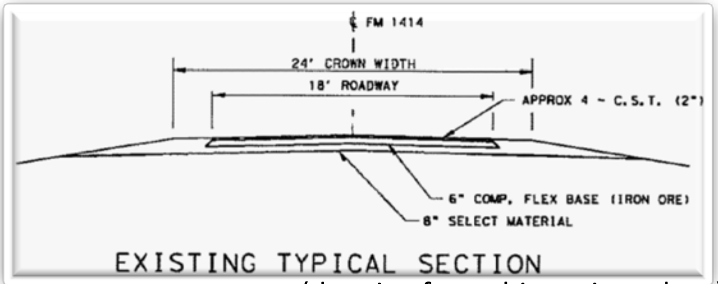
- **Sometimes dust problem**
  - Have to spray with water
  - Asphalt stabilizer base better than flex base – get compaction & don't have to worry about dust control

(photo from this project)

# Narrow Widening – Past Experiences

- **Previous projects**:
  - <u>Lesson Learned</u>: should seal joint so don't have base failures
  - Roots discovered in original material after milling – caused base failures

- **Information desired in plan set**:
  - Need existing road condition (sometimes information unknown)
    - e.g. Challenge making slope on something already there
      - Condition of existing road based on surveys done years in advance
      - Road changed since surveys (wheel ruts, etc.)



(drawing from this project plans)

# Narrow Widening – Practices

- Work on a mile at a time, one side at a time

- **For Good Results**:
  - Use quality materials
  - Use modern machines
  - Check grades as go
  - Check compaction (TxDOT does it as well)

(photo from this project)

- **Safety & Training**:
  - Safety meeting every morning
  - All signs put up etc. before machines come out
  - Training class for machines

- Will make sure **residents have access** to their driveways – will tell them ahead of time


(FM 1414)

- **Drainage**:
  - Box Culverts: TxDOT Standards, Standard Width
  - Match existing slopes of roads
    - make drain naturally
    - some cross-structures need to be extended

(photo from this project)

- **Subgrade** prior to base placement – typically proof-roll it
- **Compaction process**: smaller roller to compact subgrade
  - calculate to get one pass

(photo from this project)

# Narrow Widening - Materials

- All material shipped in (Brownwood for this project)
- All material tested and TXDOT-approved

(photo from this project)

- Don't have option of choosing **base material**; just bid what's specified in plans
  - Sometimes use flex base (this project)
  - Sometimes use black base from hot mix plant
    - Quicker
    - Better ride
    - Get public back on sooner

# Narrow Widening - Equipment

- **Sawing existing pavement**: milling machine – cuts smooth edge
- **Excavating or cutting trench**: milling machine
- **Treating subgrade**: don't do it
- **Compacting subgrade**: double drum asphalt roller, 4'
- **Cleaning trench prior to base placement**: maintainer with custom-made piece on mouldboard
- **Placing new base material**: road widener/shoulder machine, self-propelled, levels & spreads at same time
- **Treating base with stabilizer**: don't do it
- **Compacting base**: 12-ton roller
- **Placing hot mix**: asphalt paving machine
- **Compacting hot mix**: asphalt roller
- **Other**: backhoe, broom, water truck, dozer for edges

# Photos from this project
## (Narrow Widening Construction Process)


**Equipment for <u>first</u> process:**

- Milling Machine
- Maintainer
- 4’ Asphalt Roller

# Photos from this project
## (Narrow Widening Construction Process)

- Smooth edges cut
- Widened section subgrade compacted

# Photos from this project
## (Narrow Widening Construction Process)

**<u>Next</u> process, following in order:**

- Dump truck
- Road Widener
- Front Loader Backhoe
- Water Truck
- Broom
- 12-ton Roller
- Dozer


# Photos from this project
## (Narrow Widening Construction Process)

- Dump truck applying base material
- Road Widener spreading material
- Backhoe replacing dropped material

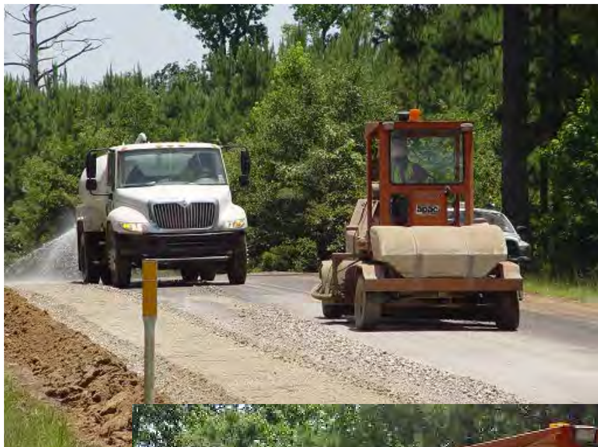
# Photos from this project
## (Narrow Widening Construction Process)

- Road widener continuing to spread new base, as backhoe follows behind

# Photos from this project
## (Narrow Widening Construction Process)

- Water truck follows behind backhoe
- Water is sprayed on new base

# Photos from this project
## (Narrow Widening Construction Process)



- Broom is following close to Water truck
- Broom sweeping excess material


# Photos from this project
## (Narrow Widening Construction Process)

- 12-ton roller follow behind water truck
- Roller making multiple passes to compact base

# Photos from this project
## (Narrow Widening Construction Process)

- Dozer following last for edges

# Photos from this project
## (Narrow Widening Construction Process)

- Erosion control
  - culvert

# Acknowledgement

Thanks to:

- APAC
- Scott Blanchard,
- Ace Mathews
- Mike Weible

# Thank You!

(FM 1414)

Questions?

# Narrow widening projects

Kory Keller
Allen Keller Company

# Intro

- Ranch Road, and Farm to Market experience.
- Parameters
  - Constructability
  - Efficiency
  - Construction Safety

# Topics

- Safety Slopes
- Flex Base vs. HMAC
- Aggregate Prime
- Widening vs. Rehabilitation

# Safety slopes – the enemy

- Work that is not gainful to the progress of the project.
- Quality Control issues
- Permeates Runoff

# Slopes (cont)

- While safety slopes are an obvious and necessary hazard abatement, the elimination of the hazard is even better.

# How can we avoid the safety slope hazard?

- Avoid the use of multiple layers in pavement design
  - Multilayer Example: 6 in flex base, prime, and 2”hmac

# How can we avoid the safety slope hazard (cont)?

- Consider using a single layer, or "monolithic" approach.
- Monolithic example, 6 or 8" of flex base over subgrade, or 4-8'' of hmac that fills to final surface.
- The need for the safety slope is eliminated.

# Flex base vs. hot mix

- Flex base is considerably cheaper, especially as we move farther away from the hmac plants.
- HMAC is seasonal
- Unsuitable subgrade risk

# Benefits of aggregate prime

- Quick and reliable protective cover
- Finished base under Traffic
- Adheres very well to base course
- Low maintenance under traffic in comparison
- Protects ride quality on finished base

# Benefits of aggregate prime (cont)

- Traffic uses the widened road immediately
- Cheap base slope protection
- All season application

# Aggregate prime recommendations

- RC-250 with Grade 5 aggregate
  - 0.2-0.23 g/sy
  - Grade 5-Grade 6
    - dry screened
    - Non-coated

# Widening vs. Rehabilitation

- Benefit/Cost Ratio
  - Labor
  - Equipment
  - Project Duration

is comparable between widening and Rehabilitation

# Widening vs. Rehabilitation

- Major components of increase
  - Cement
  - extra base
  - second full width chip seal

# RM 336 Real


CAUTION
NEXT 10 MILES
SINCE JAN 2006
6 KILLED
IN MOTORCYCLE
RELATED CRASHES
STAY ALERT
SAVE A LIFE

# Completed Project RM 783 Gillespie

# Rehabilitation Project US 83 Kerr

# Widening RM 336 –Post Agg. Prime

# Widening RM 336 –Post Agg. Prime

# Widening RM 335 –Before Agg. Prime

# Typical Milling Machine

# Finishing Base RM335 Real

# WELCOME


## Katie Strain

### TenCate Mirafi – Roadway Reinforcement

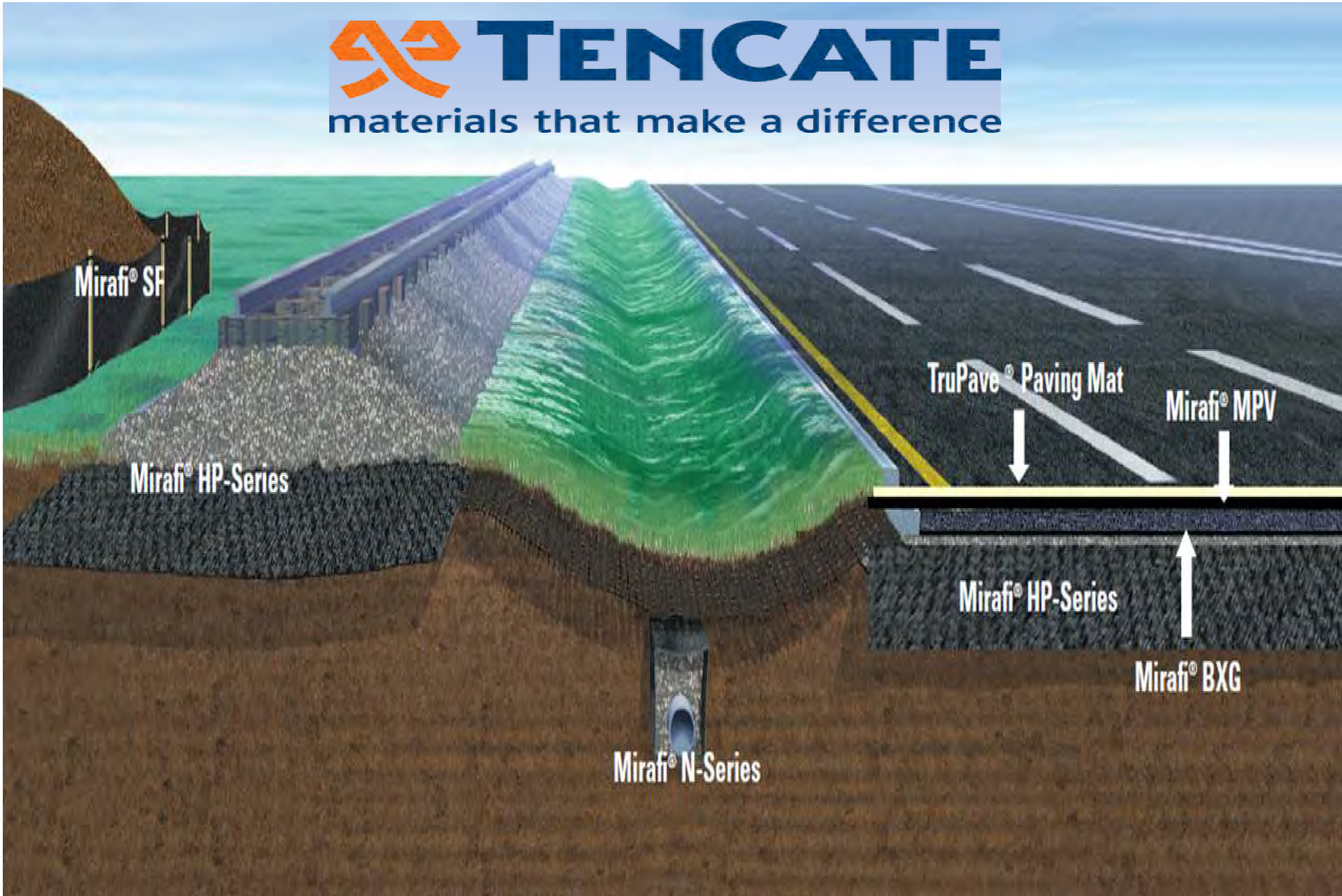
Enhancing the Performance and Design Life of Roadways

## Michael Samueloff

### TenCate Mirafi - Pavement Solutions

Narrow Pavement  Widening Using Interlayers

# Geosynthetics In Construction



# Geosynthetic Functions


- Separation


- Filtration


- Drainage


- Confinement

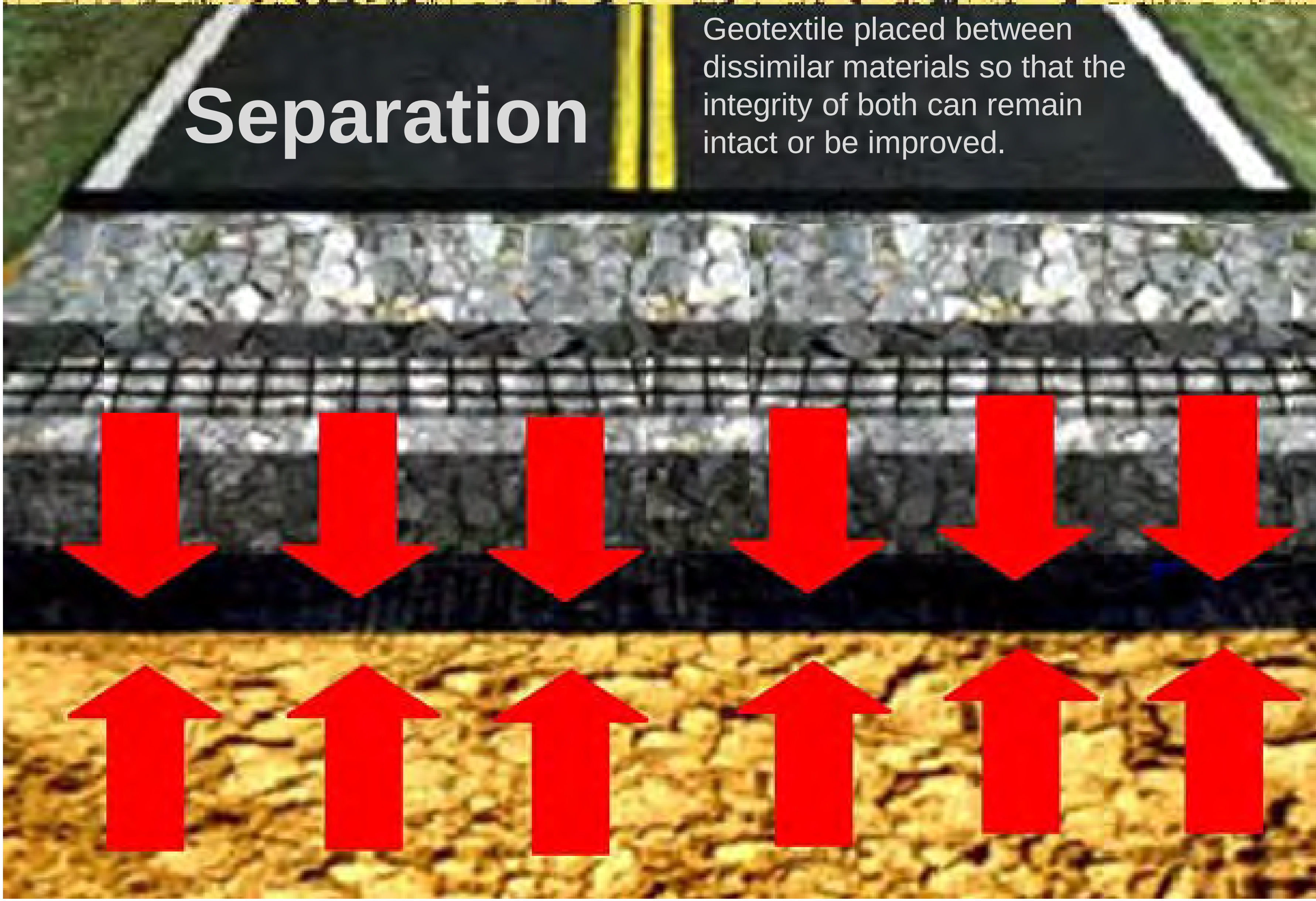

- Reinforcement



TENCATE
materials that make a difference

# Separation

Geotextile placed between dissimilar materials so that the integrity of both can remain intact or be improved.




Mirafi RS280i

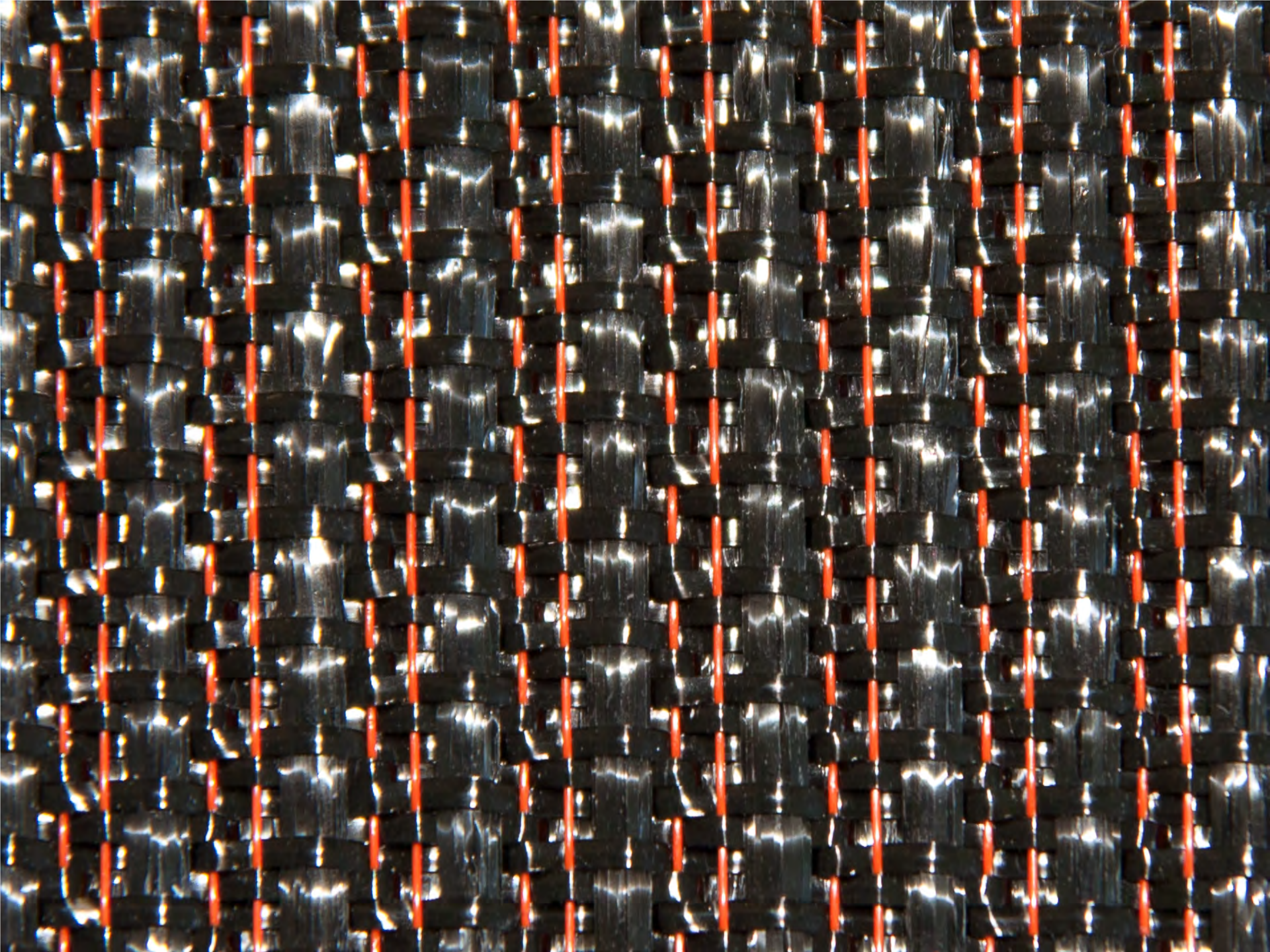
# Filtration / Drainage

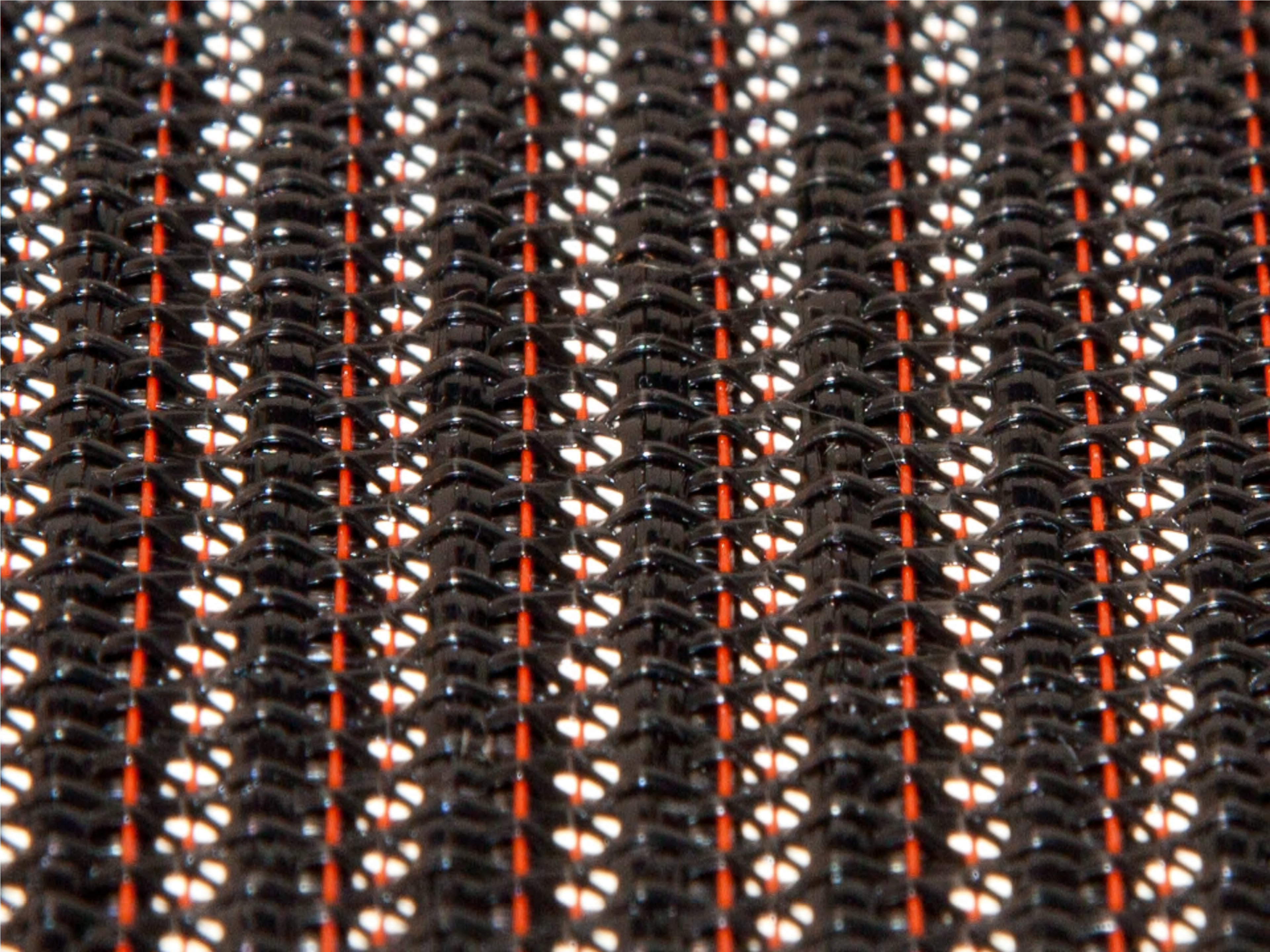
# Product Comparisons

| | RS580*i* | RS380*i* | HP570 | HP270 | 600X |
|---|---|---|---|---|---|
| AOS | 40 | 40 | 30 | 30 | 40 |
| Flow Rate | 75 | 75 | 30 | 50 | 4 |
| Permittivity | 1.0 | 0.9 | 0.4 | 0.7 | .05 |

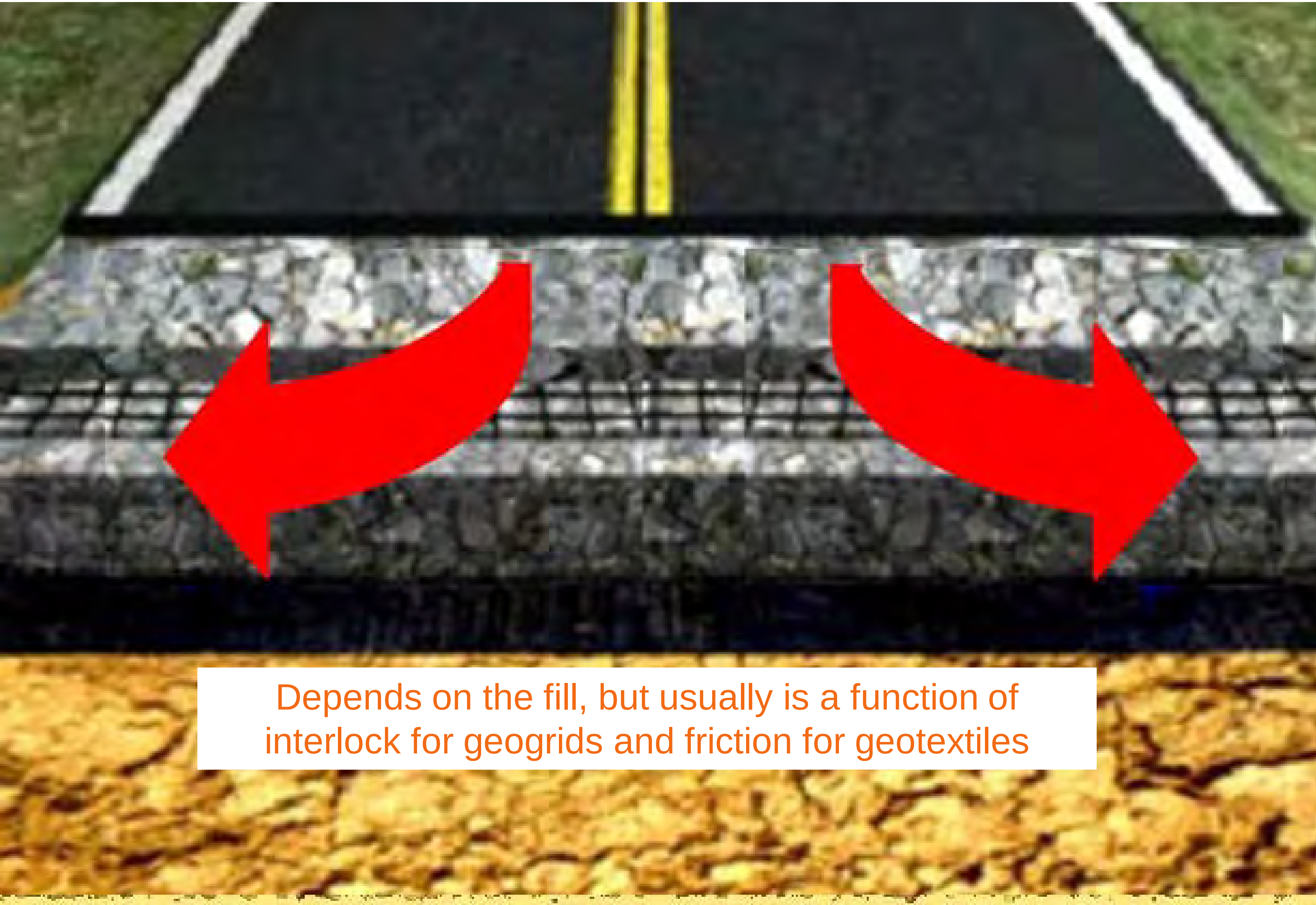


TENCATE
materials that make a difference





# Confinement



Depends on the fill, but usually is a function of interlock for geogrids and friction for geotextiles

# Product Comparisons


| | **RS580*i*** | **RS380*i*** | **HP570** |
|---|---|---|---|
| Ci | .90 | .89 | .85 |



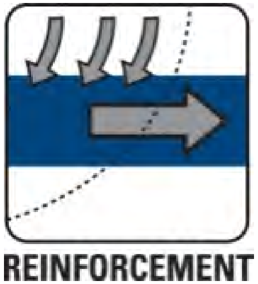
TENCATE
materials that make a difference


Mirafi RS580i

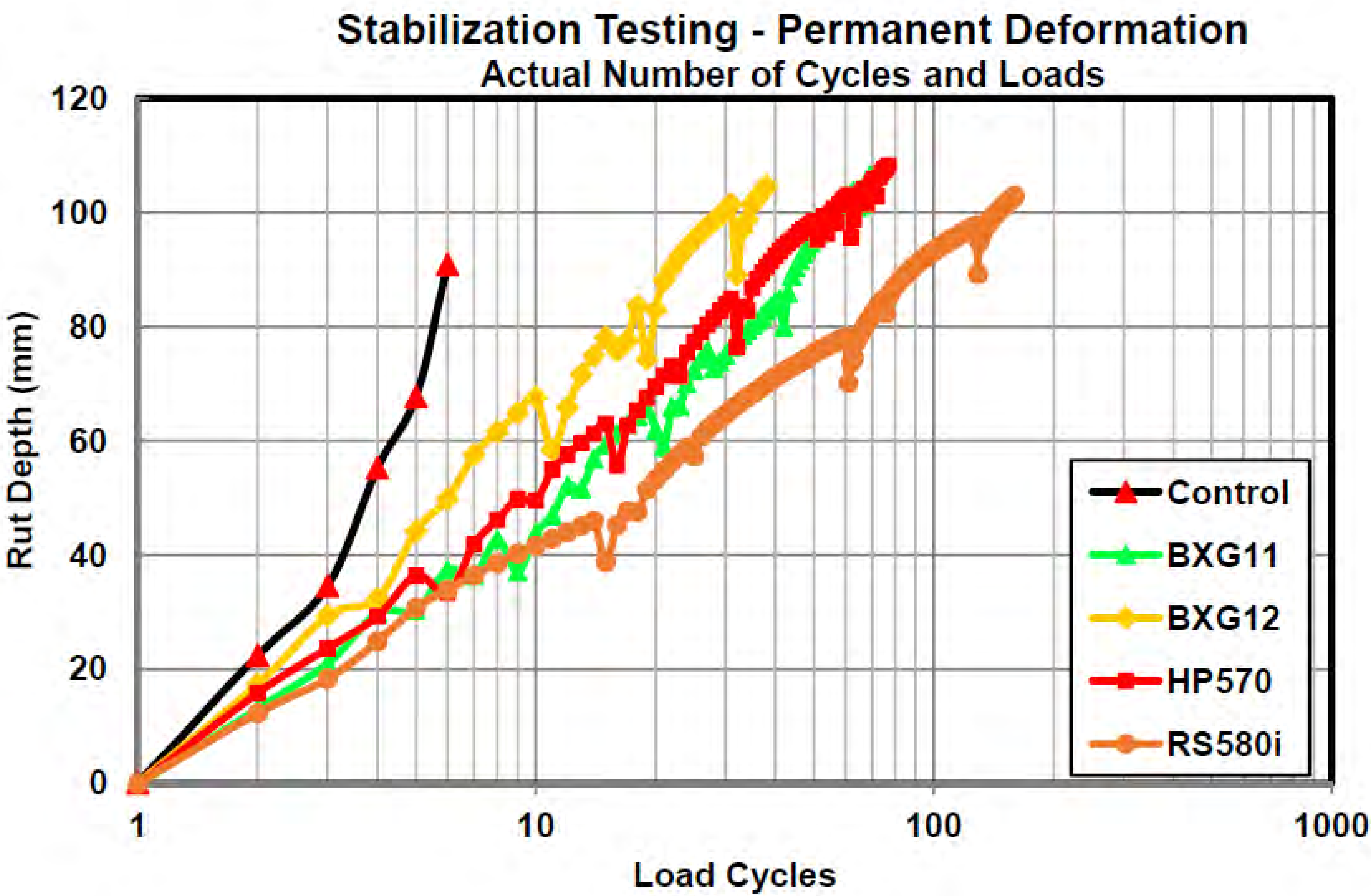
# Reinforcement

Improvement of the system strength created by the introduction of a geosynthetic into a soil/aggregate system

# Product Comparisons




| | RS580*i* | HP570 | RS380*i* | HP370 |
|---|---|---|---|---|
| 2% XD (#/ft) | 1800 | 1320 | 1020 | 540 |
| 5% XD (#/ft) | 4380 | 2700 | 2255 | 1560 |



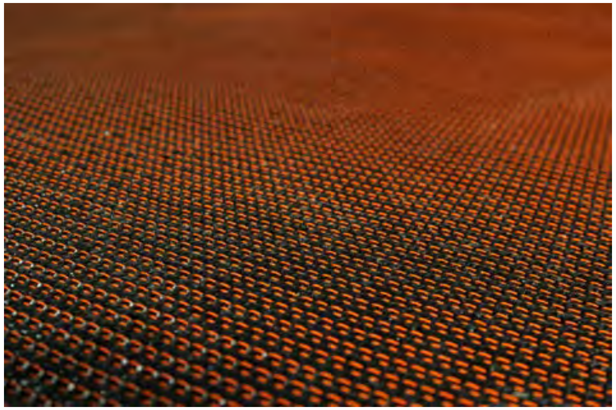
Stabilization Testing - Permanent Deformation
Actual Number of Cycles and Loads
Rut Depth (mm)
0
20
40
60
80
100
120
1
10
100
1000
Load Cycles
Control
BXG11
BXG12
HP570
RS580i


SEPARATION
FILTRATION
DRAINAGE
CONFINEMENT
REINFORCEMENT

# Mirafi® RS580i, RS380i & RS280i

Integration of 5 Key Properties for Base Reinforcement and Subgrade Stabilization

- High Modulus especially in CMD
- High Water Flow/Permittivity
- Separation (US sieve #40)
- High Interaction Coefficient (Confinement)
- Product Identification





TENCATE materials that make a difference

# Geosynthetics Pavement Interlayers


# Base Preservation – Crack Mitigation

# Geosynthetic Pavement Interlayers

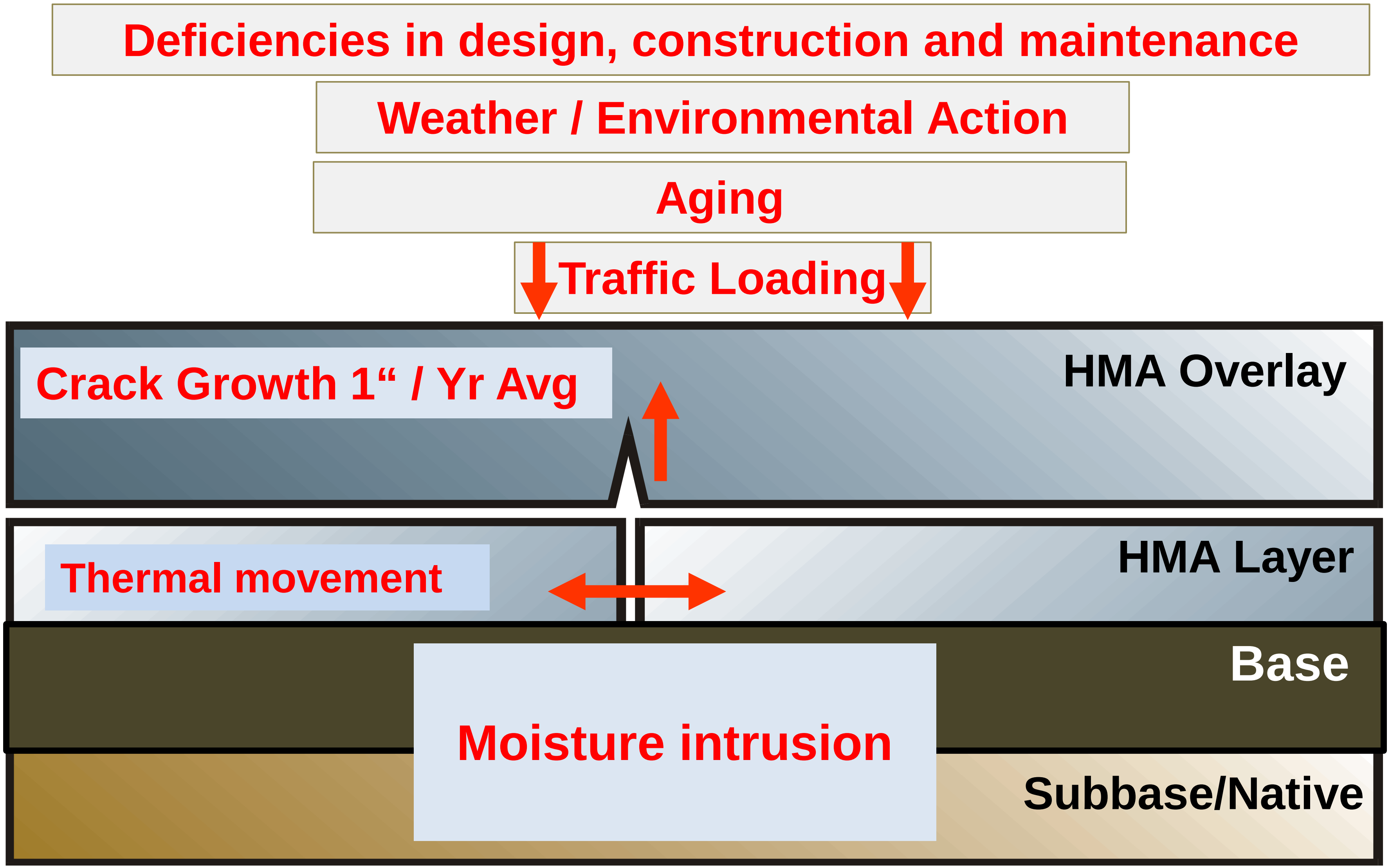
- Deterioration Causes & Delay
- Interlayer Types & Functionality
- Cost/Benefit

# Pavement Deterioration

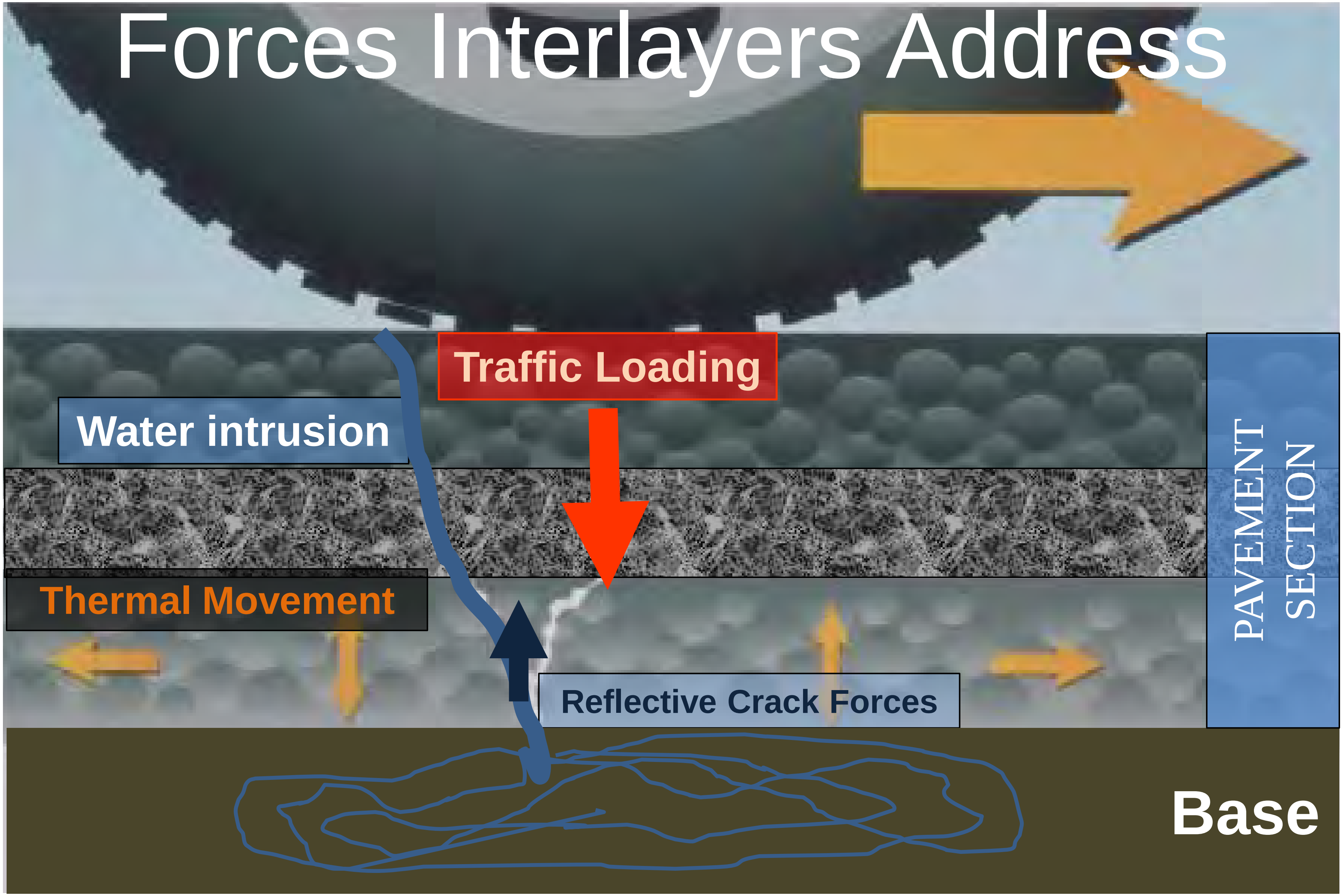
**Distressed Pavements**

# Pavement Deterioration

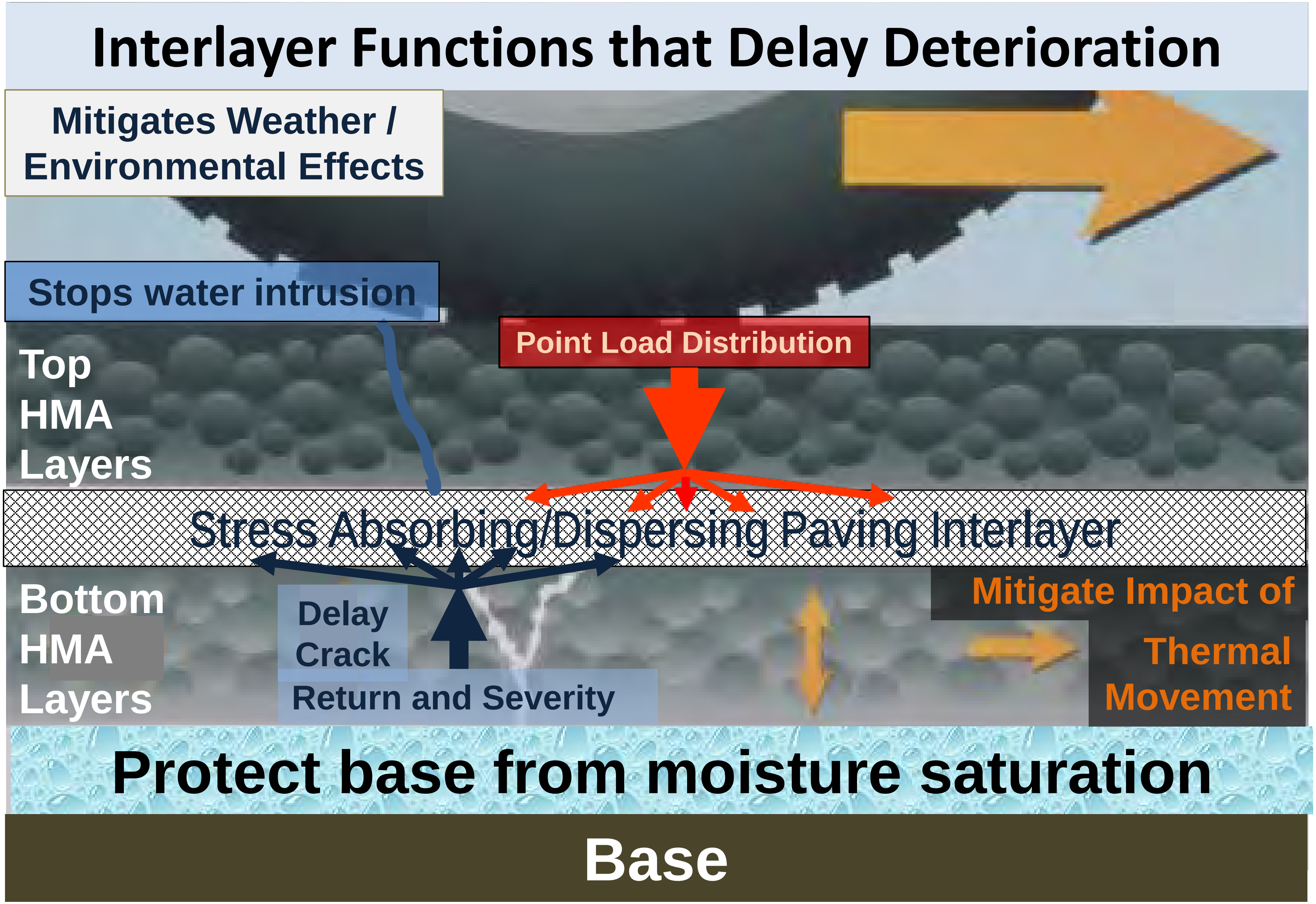
## From day ONE these forces are at work



# Pavement Deterioration



# Pavement Interlayer Functionality

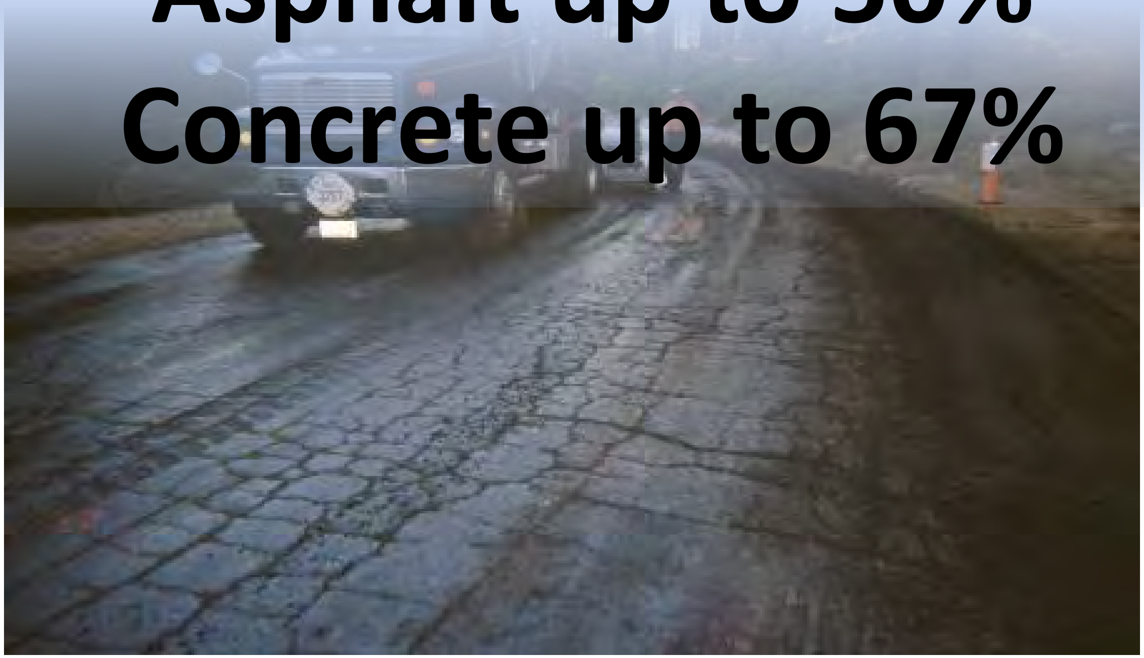


# Deteriorating Impact of Moisture Intrusion

**FHWA - Moisture intrudes through pavement:**

**Asphalt up to 50%**

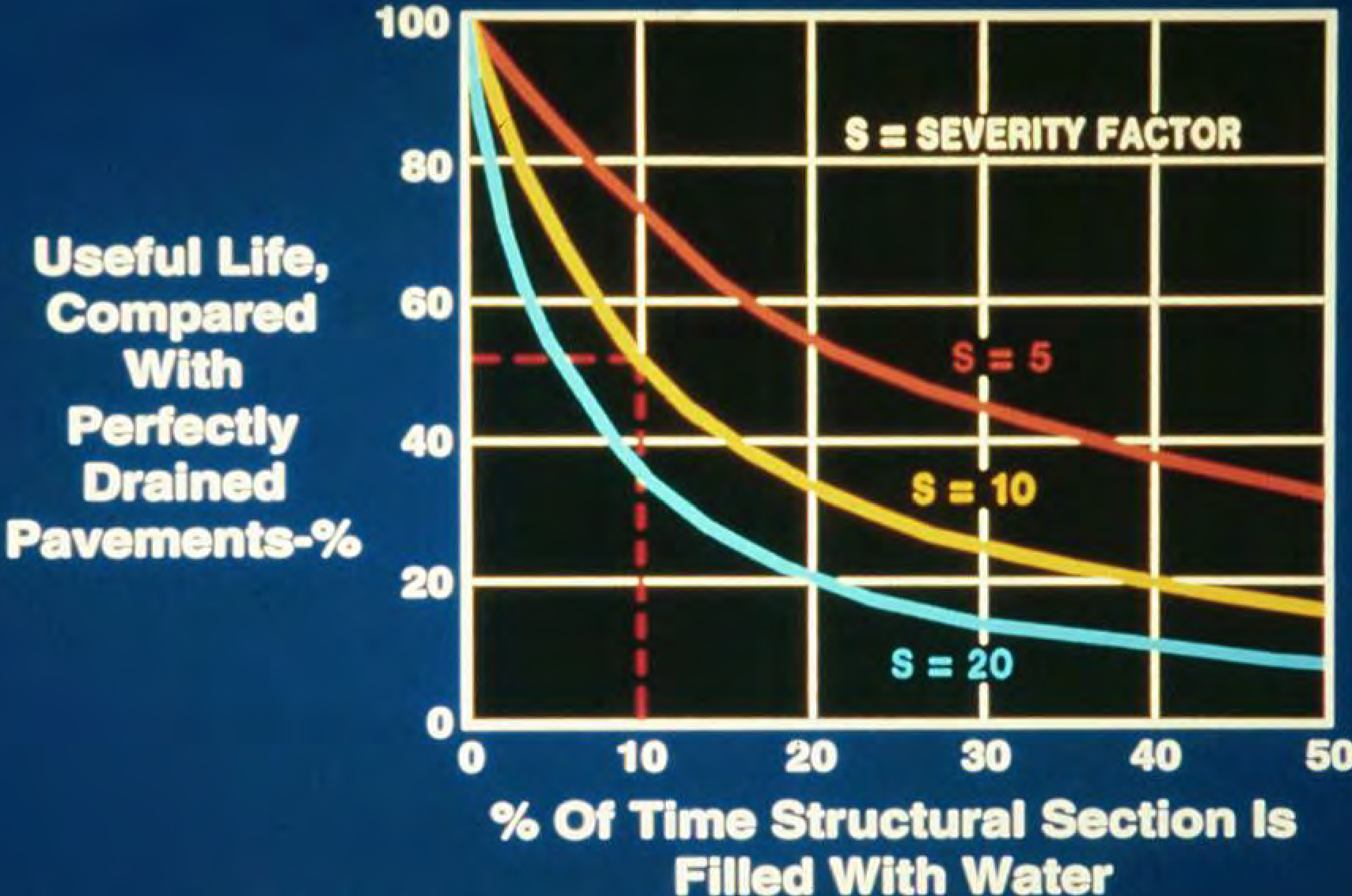
**Concrete up to 67%**



***"One major factor that degrades a roadbed's ability to function is the infiltration of water into the base material."***

Caltrans Pavement Evaluation Manual
Pavement Condition Survey
John Poppe

# Deteriorating Impact of Moisture Intrusion




*From Drainage Of Highway And Airfield Pavements*
*By Harry R. Cedergren*

# Deteriorating Impact of Moisture in Base

## AASHTO DESIGN: IMPACT OF WATER ON AGGREGATE BASE

| Drainage Quality | Time | Drainage Coefficient |
|---|---|---|
| Excellent | 2 hours | 1.2 |
| Good | 1 day | 1.0 |
| Fair | 1 week | 0.8 |
| Poor | 1 month | 0.6 |
| Very Poor | Doesn't drain | 0.4 |

# Pavement Interlayer Value

HOW?

## …Extend Life:

- ✓ Preserve base structural value
- ✓ Delay crack return & severity
- ✓ Add flexural strength to HMA

## …Greater Value:

- ✓ Reduce impact of asphalt cost

  i.e In Dec. 07, $175/ton, today…$650+

- ✓ Greater benefit at less cost

# Pavement Interlayer Evolution

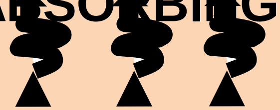
## NEW?...Interlayer evolution to higher levels of performance

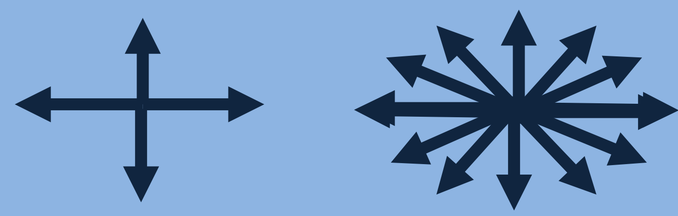
- ✓ to multifunctional, Moisture barrier *Plus* reinforcement
- ✓ to multi-axial reinforcement
- ✓ to focus on in-place functionality

# Pavement Interlayer Functionality

## How Interlayers Work

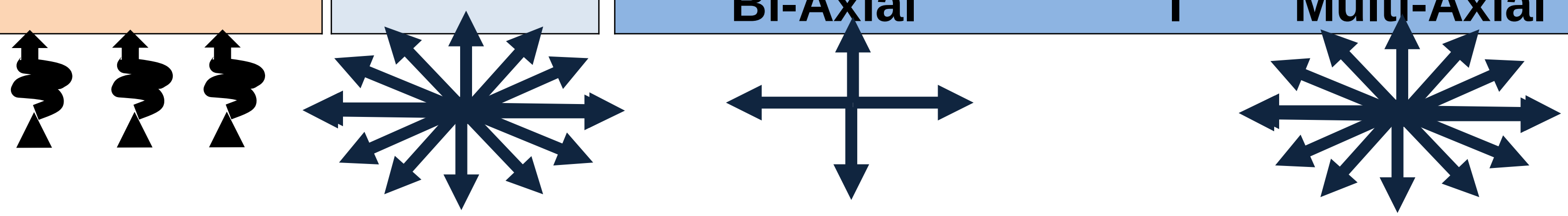
| STRAIN ABSORBING | STRESS DISSIPATING |
|---|---|
| Mass to soak up (Sponge) | Tensile strength and efficiency to disperse low strain crack energy (Rebar) Multi-Axial strong all directions |
| Tighter bond, thicker/more mass = greater ability to absorb = better reflective crack retardation | Tighter bond, higher, more efficient tensile strength, more homogeneous the structure = greater ability to dissipate crack energy = better reflective crack retardation |





## Interlayers Types

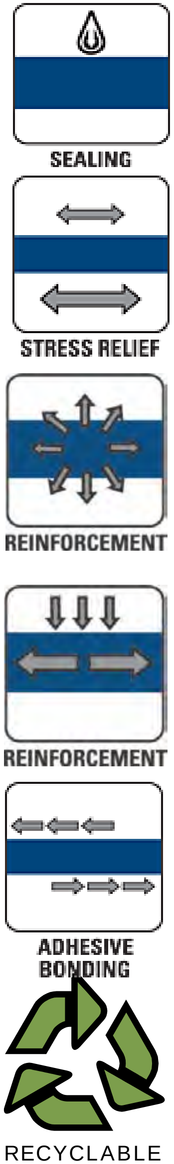
| FABRICS | MAT Multi-Axial | GRIDS<br>Continuous Strand Fiberglass<br>Bi-Axial I Multi-Axial |
|---|---|---|



# Pavement Interlayer Functionality

Function

## Description




**With Asphalt forms Moisture Barrier**

**With Asphalt absorbs and/or disperses crack forces**

**Multi-Axial, multi-directional reinforcing**

**Bi-Axial, 2 way reinforcing, weak at bias angle**

**With Asphalt tack forms a strong bond between layers**

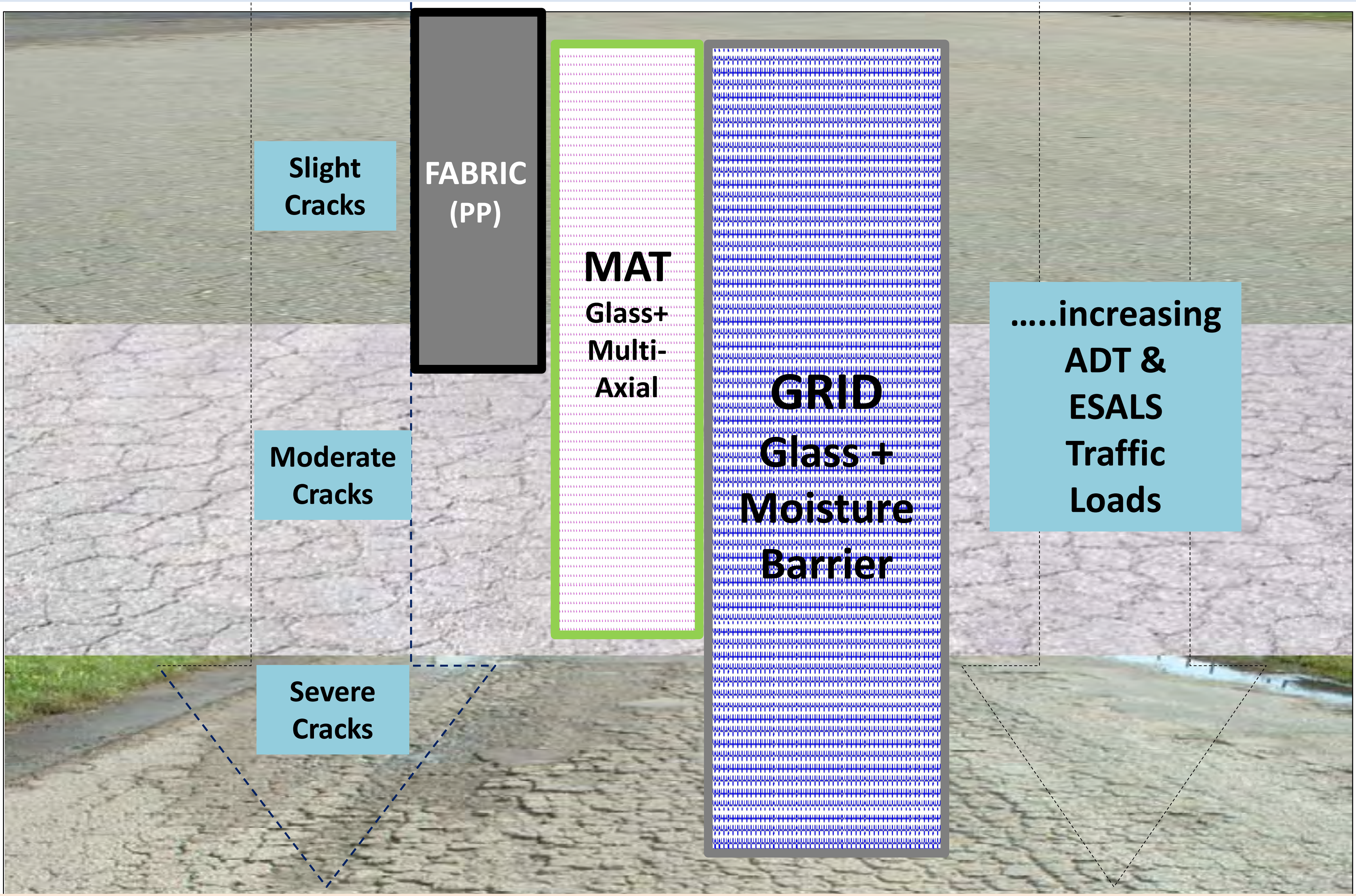
**Mills completely and can be added back into new mix**

# Interlayer Functionality Summary

| TenCate Products | | FUNCTIONALITY | SEALING | STRESS RELIEF | REINFORCEMENT | REINFORCEMENT | ADHESIVE BONDING | | Constructibility Ease of Installation | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Crack Stress Relief and Delay | | | | | | |
| | | | | | Tensile to Reinforce | | | | | |
| | | Description | Moisture Barrier Membrane | Stress Absorbing | Bi-Axial | Multi-Axial | Monolithic bond | Mills + Recycles into new mix | Wide Vs Narrow Rolls | Uncoated, Flexible Rolls |
| **Stress Absorbing Geosynthetic Interlayer** | | | | | | | | | | |
| MPV | Fabric | Polypropylene Fabric | YES | YES | NO | NO | YES | Can Be | YES | YES |
| **Fiberglass Tensile Reinforcing Geosynthetic Interlayers** | | | | | | | | | | |
| Tru Pave | Mat / Multi-Axial | Multi-Axial Mat | YES | YES | YES | Up to 80N | YES | YES | YES | YES |
| PGM G4 | Grids / Multi-Axial | Multi-Axial Composite | YES | YES | YES | Up to 100kN | YES | YES | YES | YES |
| PGM G2 | Grids / Bi-Axial | Composite | YES | YES | Up to 100kN | NO | YES | Can Be | YES | YES |
| FG[1] | Grids / Bi-Axial | PreCoated Self Stick/Scrim | NO | NO | Up to 100kN | NO | NO | YES | NO | NO |
| FGC[2] | Grids / Bi-Axial | PreCoated Composite | YES | YES | Up to 100kN | NO | YES | Can Be | NO | NO |

[1] Replaced by G4, [2] Replaced by G2

# Interlayer Selection by Functionality




Over Stable Base

# Pavement Interlayer Installation

# Interlayer Functionality Study

## The Asphalt Pavement Analyzer - Wheel Track

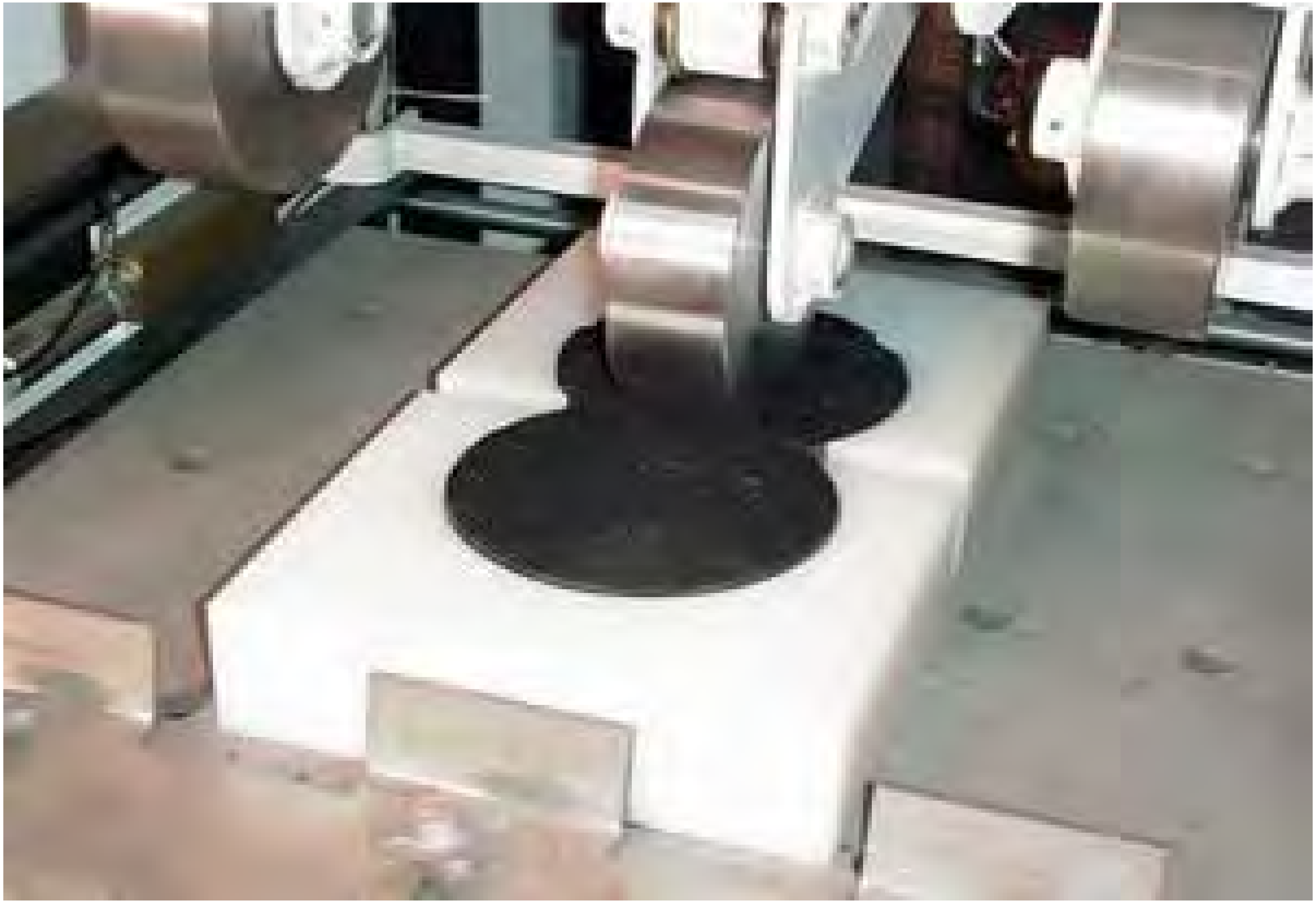
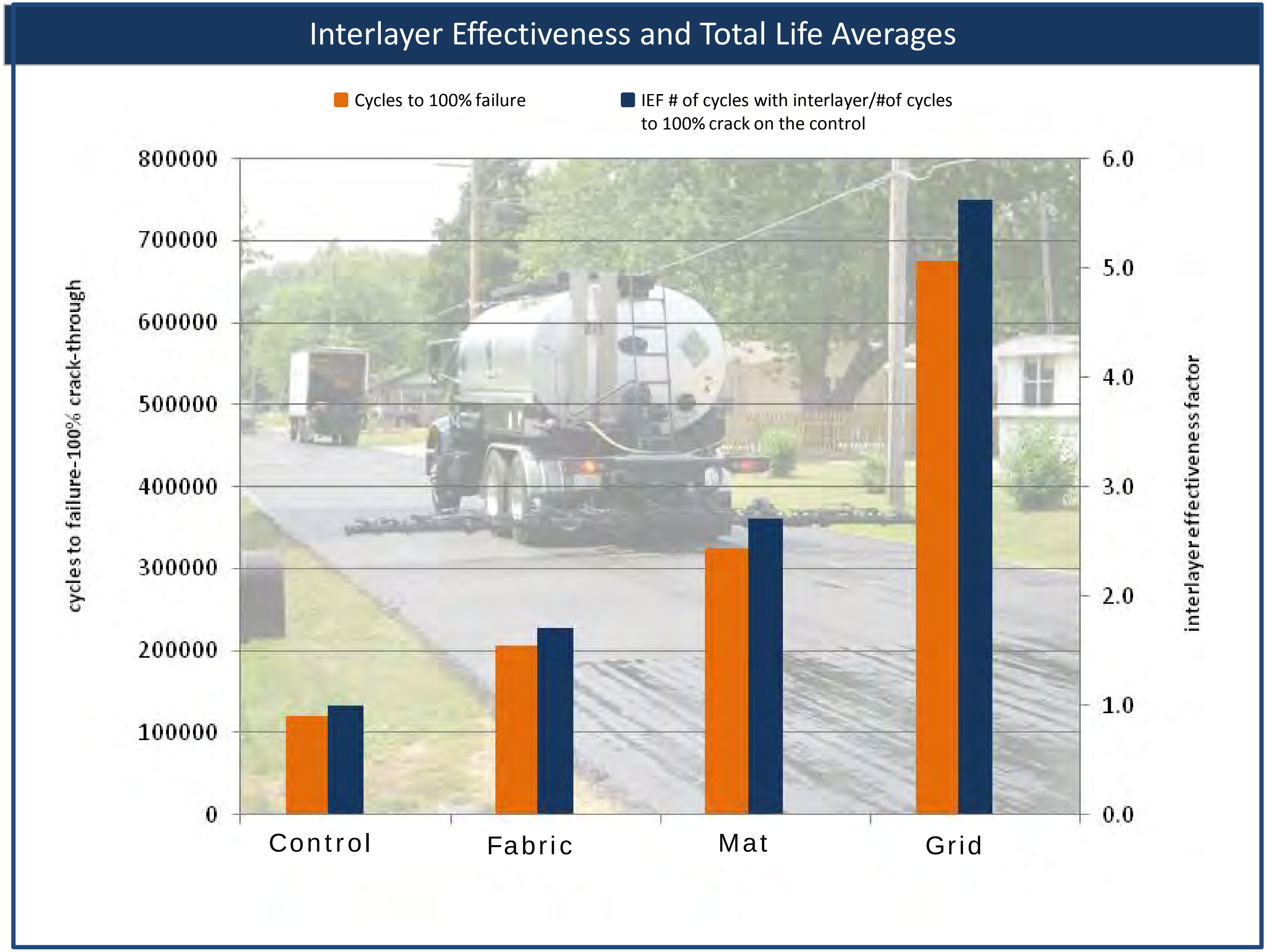


**Figure 5:** Asphalt Pavement Analyzer – Wheel Track

# Interlayer Functionality Capability

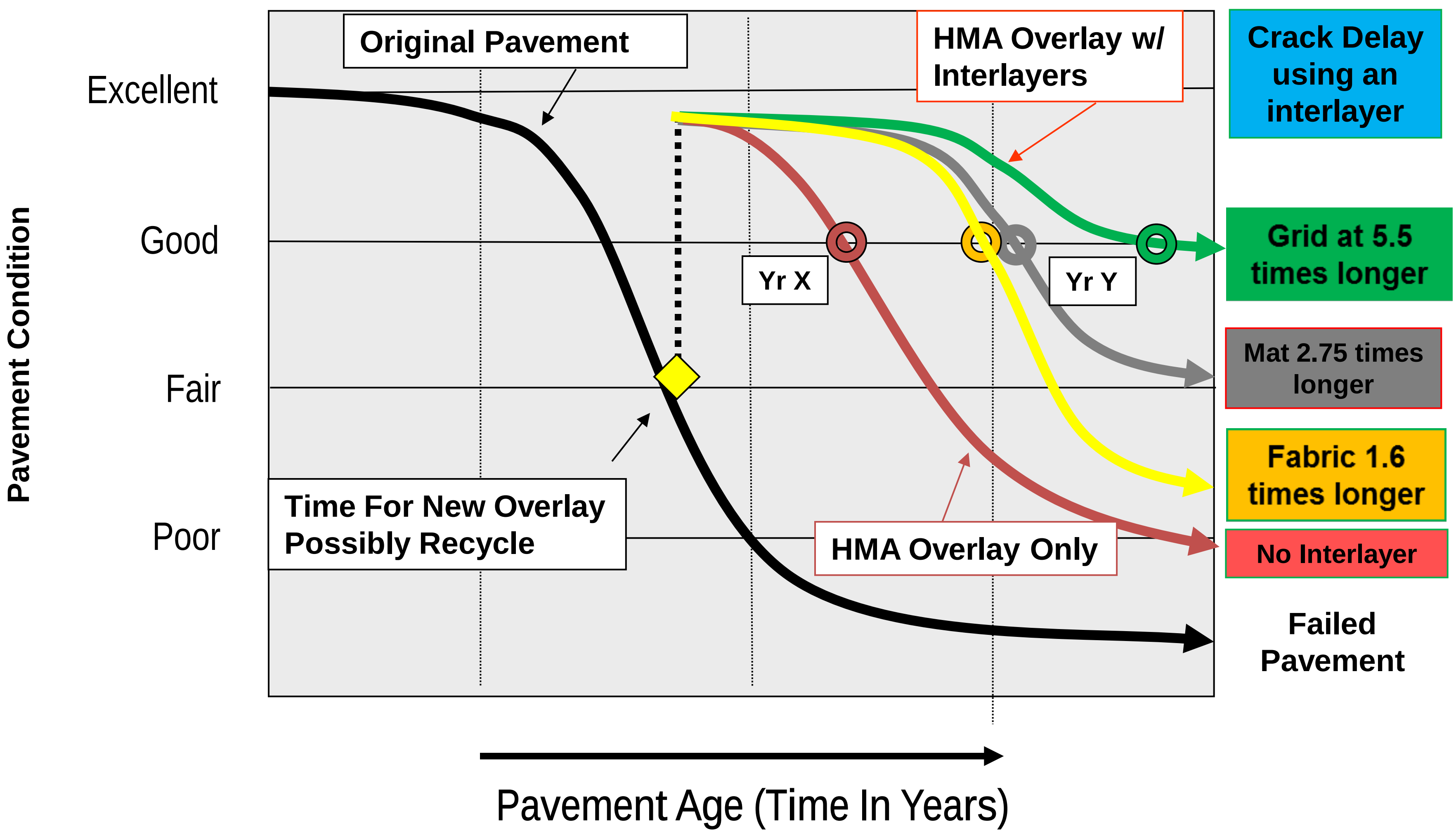


# Selection by Type/Functional Impact

## Interlayer Impact on Pavement Deterioration Curve

**REHAB – OVERLAY PAVEMENT**

Delay Deterioration - Extend Life (Yr Y – Yr X):



# Interlayer Cost/Benefit Calculation

## Crack Mitigation

## Cost of Hot Mix Asphalt

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| HMA Cost: | $75.00 | Ton | HMA Density | 140 | Lbs/Inch | Tons | 0.07 | Inch/ SY | **$5.25** | Cost |
| | | | | | $ SY | **% Added Cost** | **IEF^*** | **Yrs to Crack Return^** | **% Added Perf.** | **SY Cost Per Year** |
| **Hot Mix Asphalt** | | | Inch Thickness: | 2.0 | $10.50 | 0 | 1 | 2 | | $5.25 |

## Added Value of Crack Mitigation

| Interlayer Type | AVG | Total | Added value based on performance Vs cost | | | | |
|---|---|---|---|---|---|---|---|
| MPV500 4.1 Oz PP Fabric | $2.10 | $12.60 | 20% | 1.6 | 3.2 | 60% | $3.94 |
| TruPave Multi-Axial Fiberglass Mat | $2.50 | $13.00 | 24% | 2.75 | 5.5 | 175% | $2.36 |
| PGM G4 Multi-Axial Fiberglass Grid | $6.00 | $16.50 | 57% | 5.5 | 11 | 450% | $1.50 |

# Interlayer Cost/Benefit Calculation

## Crack Mitigation PLUS Base Saturation Protection

**Pavement interlayers that provide crack delay AND added preservation of base structure by creating a moisture barrier to prevent base saturation can add over 50% life over one with base saturation as little as 10% of the time, per theCedergren study. There is also less maintenance cost for crack filling and less road closure.**

## Cost of Hot Mix Asphalt

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| HMA Cost: | $75.00 | Ton | HMA Density | 140 | Lbs/Inch | Tons | 0.07 | | Inch/ SY | **$5.25** | Cost |
| | | | | | $ / SY | **% Added Cost** | **IEF^*** | 50% Added Life | **Yrs to Crack Return^** | **% Added Perf.** | **SY Cost Per Year** |
| **Hot Mix Asphalt** | | | Inch Thickness: | 2.0 | $10.50 | 0 | 1 | 0 | 2 | 0 | $5.25 |

## Added Value of Crack Mitigation PLUS Base Protection

| **Interlayer Type** | **AVG** | **Total** | **Added value based on performance Vs cost** | | | | | |
|---|---|---|---|---|---|---|---|---|
| **MPV500 4.1 Oz PP Fabric** | $2.10 | $12.60 | 20% | 1.6 | 2.4 | 4.8 | 140% | $2.63 |
| **TruPave Multi-Axial Fiberglass Mat** | $2.50 | $13.00 | 24% | 2.8 | 4.1 | 8.25 | 313% | $1.58 |
| **PGM-G4 Multi-Axial Fiberglass Grid** | $6.00 | $16.50 | 57% | 5.5 | 8.3 | 16.5 | 725% | $1.00 |
| 50% Added life of keeping base structure dry and protection load bearing capacity | | | | | 150% | | | |

# Interlayer Performance Compromised

## Expectation Not Met

**1. Incomplete Interlayer System:**

**Includes Interlayer WITH asphalt**

**2. Installation quality**

- **a. Asphalt tack**
- **b. Overlay too thin**
- **c. Lack of base prep**
- **d. Uncut wrinkles**

**3. Site selected exceeds functionality**

- **a. Unstable base**
- **b. Unstable underlying surface**
- **c. Wide cracks with excessive thermal movement**

# Performance Compromised: Site Selection

## Extreme Pavement and Base Failures



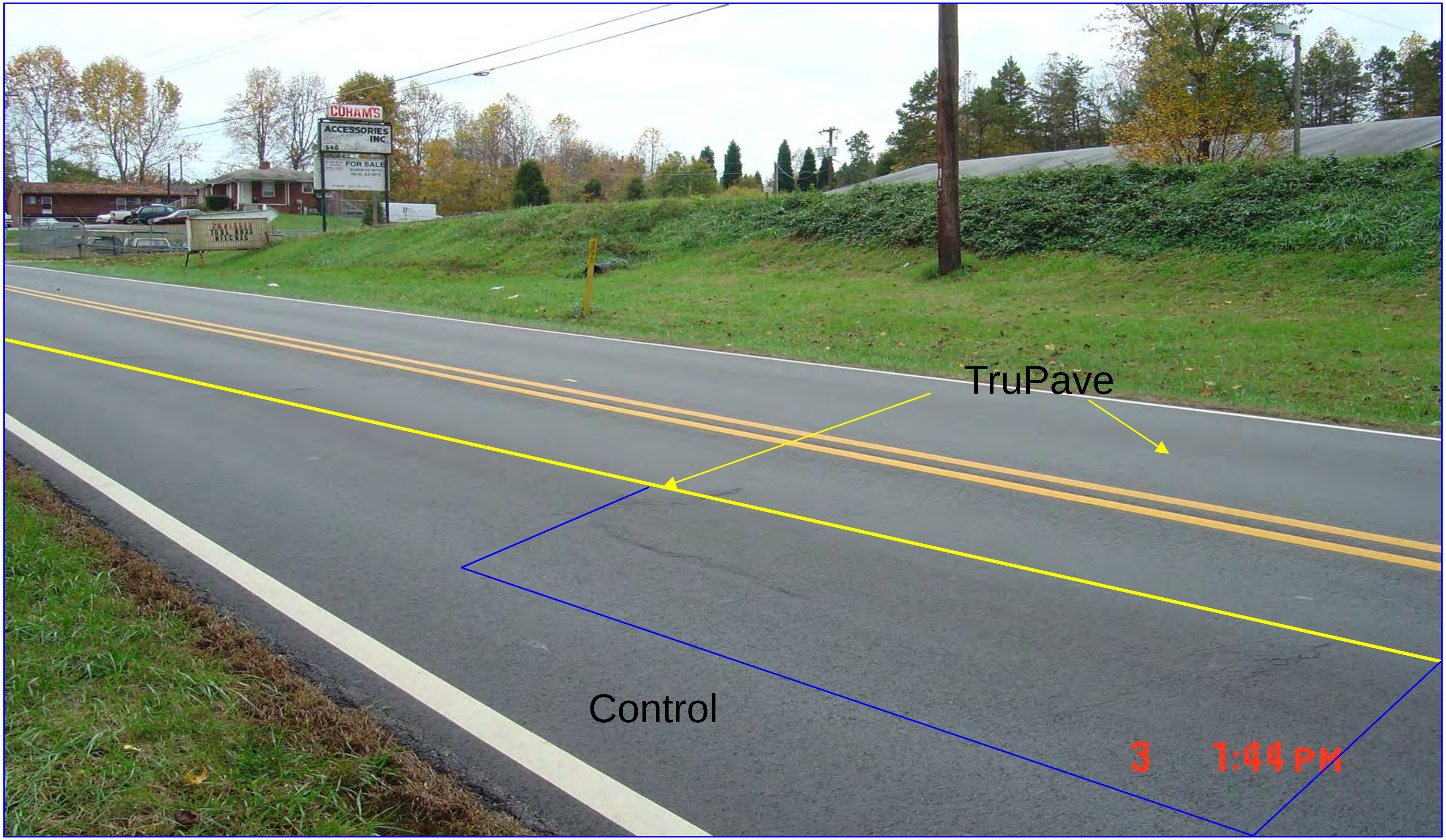


Caution!  Not all conditions interlayer appropriate!

# NC Old Rt. 52


COHAM'S
ACCESSORIES INC
FOR SALE
Landsaver
A DIVISION OF A.C.F. INC.
1-800-577-9223
USDOT 364314
136
MAR 29 2004

# NC Rt. 52 April 19, 2005 (14 months)




Expansion crack “reflected” through…..after 14 mo.

# Arkansas Route 67-Hope, AR

# Arkansas Route 67-Hope, AR

# Arkansas Route 67-Hope, AR

# Arkansas Route 67-Hope, AR

# Interlayer Use Summary

*CHEAPEST INSURANCE TO:*

- **Extend pavement life**
- **Maximize base performance**
- **Delay crack return & severity**
- **Reduce impact of asphalt cost**
- **Reduce maintenance & road closure**

TENCATE

materials that make a difference

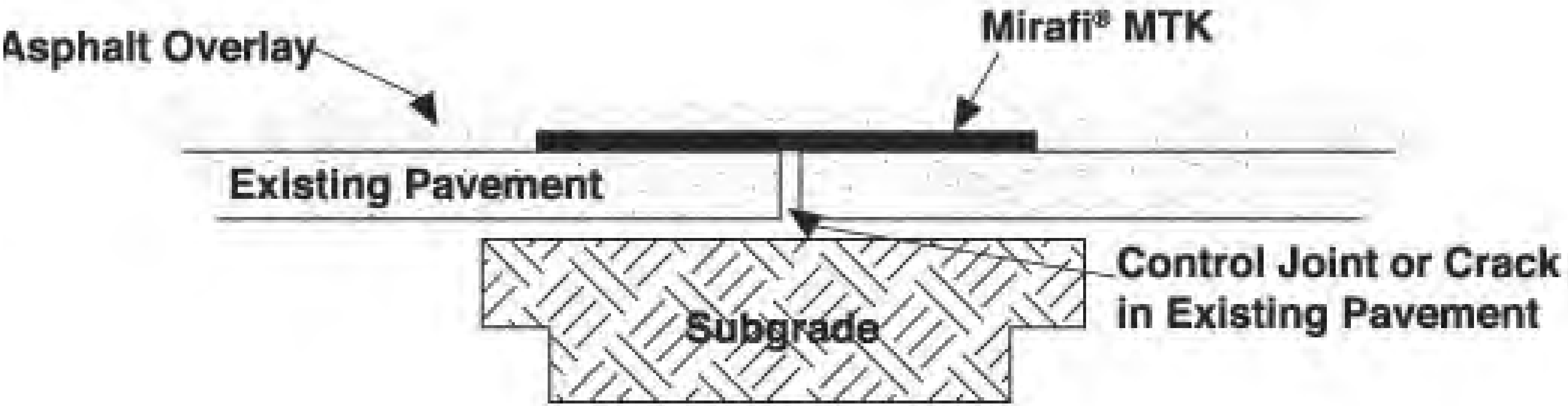
# Mirafi® MTK Crack Solution

- **Seals crack –Keeps water out**
- **Flexes to keep cracks sealed**
- **Delays reflective cracking**
- **Slows pavement deterioration**
- **Fast, easy to install**
- **Adheres to cleaned surface**
- **Used in wide temperature range**
- **Reduces traffic disruption**

.

**Mirafi® MTK Roll Dimensions**
.30 m x 15.2 m (12 in x 50 ft)
.46 m x 15.2 m (18 in x 50 ft)
.60 m x 15.2 m (24 in x 50 ft)
.91 m x 15.2 m (36 in x 50 ft)

# Mirafi® MTK Crack Solution



# Thank You

# QUESTIONS?

## TenCate Mirafi

**Katie Strain**
Roadway Engineer
Cell: (512) 534-9028
k.strain@tencate.com

**Michael D. Samueloff**
Pavement Engineer
Cell: (248) 302-8806
m.samueloff@tencate.com

www.tencate.com

TENCATE
materials that make a difference

# Geosynthetic Reinforcement for Shoulder Widening & Rehabilitation
## Project 0-6748 Best Practices

Texas Department of Transportation
Austin, TX

**July 2, 2013**

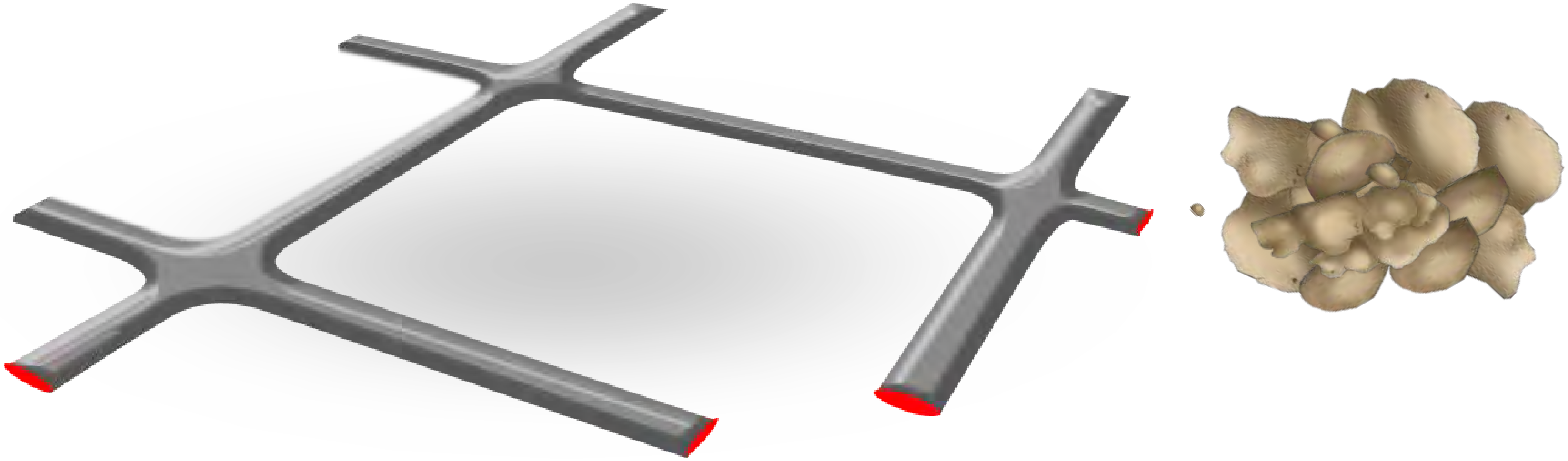
**Tensar International Corporation**
**Stephen Archer, P.E. – Frisco, TX**

# Agenda

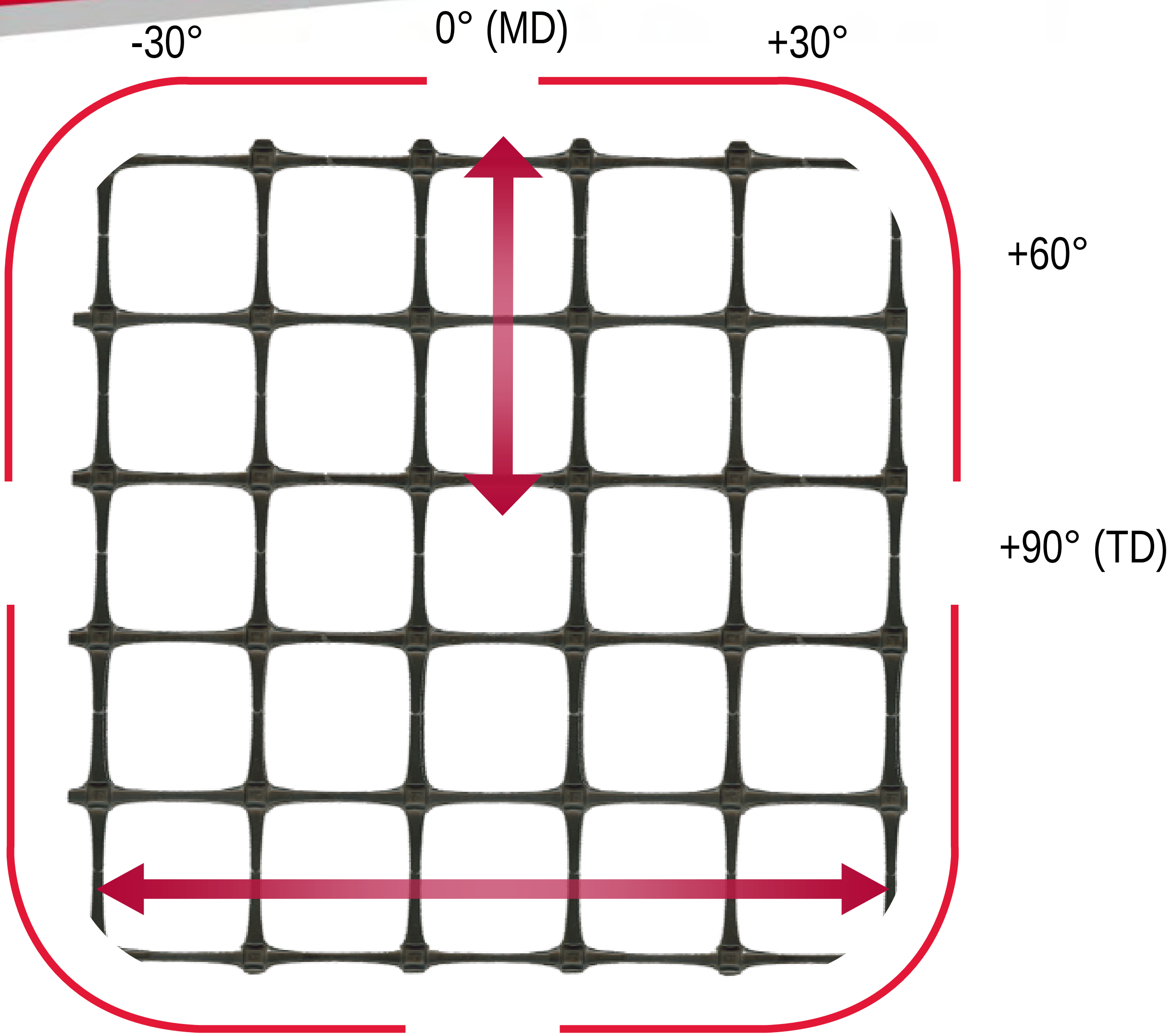
Tensar

- Product Description/Historical Usage
- Geogrid Mechanisms
- Application Definition
- TxDOT Specifications for Geogrids in Roadways
- TxDOT Narrow Widening Examples – Typical Sections
- Pavement Interlayers for Narrow Widening

# Rib Profile- Typical Biaxial Geogrid



# Tensile Stiffness in Two Directions



# Lateral Restraint - TEXAS Aggregate Sources


Uvalde, TX  Limestone - Source Material


Laredo, TX  Caliche - Source Material

# TxDOT Departmental Material Spec (DMS)

## DMS 6240 – Geogrid for Base/Embankment Reinforcement

Tensar



**Table 1**

**Geogrid Requirements**

| Property | Type 1 | Type 2 |
|---|---|---|
| Aperture Size, mm (in) | 25 - 51 (1.0 - 2.0) | 25 - 51 (1.0 - 2.0) |
| Percent Open Area, % | 70 minimum | 70 minimum |
| Thickness, mm (in)<br>MD ribs<br>CMD ribs<br>Junctions | 0.77 (0.03) minimum<br>0.64 (0.025) minimum<br>1.50 (0.06) minimum | 1.27 (0.05) minimum<br>1.15 (0.045) minimum<br>2.54 (0.10) minimum |
| Tensile Modulus @ 2% elongation *, N/m (lb/ft)<br>MD & CMD<br>CMD | 204,260 minimum<br>(14,000) minimum | 291,000 minimum<br>(20,000) minimum |
| Junction Efficiency, % of rib ultimate tensile strength<br>MD & CMD | 90 minimum | 90 minimum |
| *Determined as a secant modulus without offset allowances. | | |

# TxDOT Departmental Material Spec (DMS)

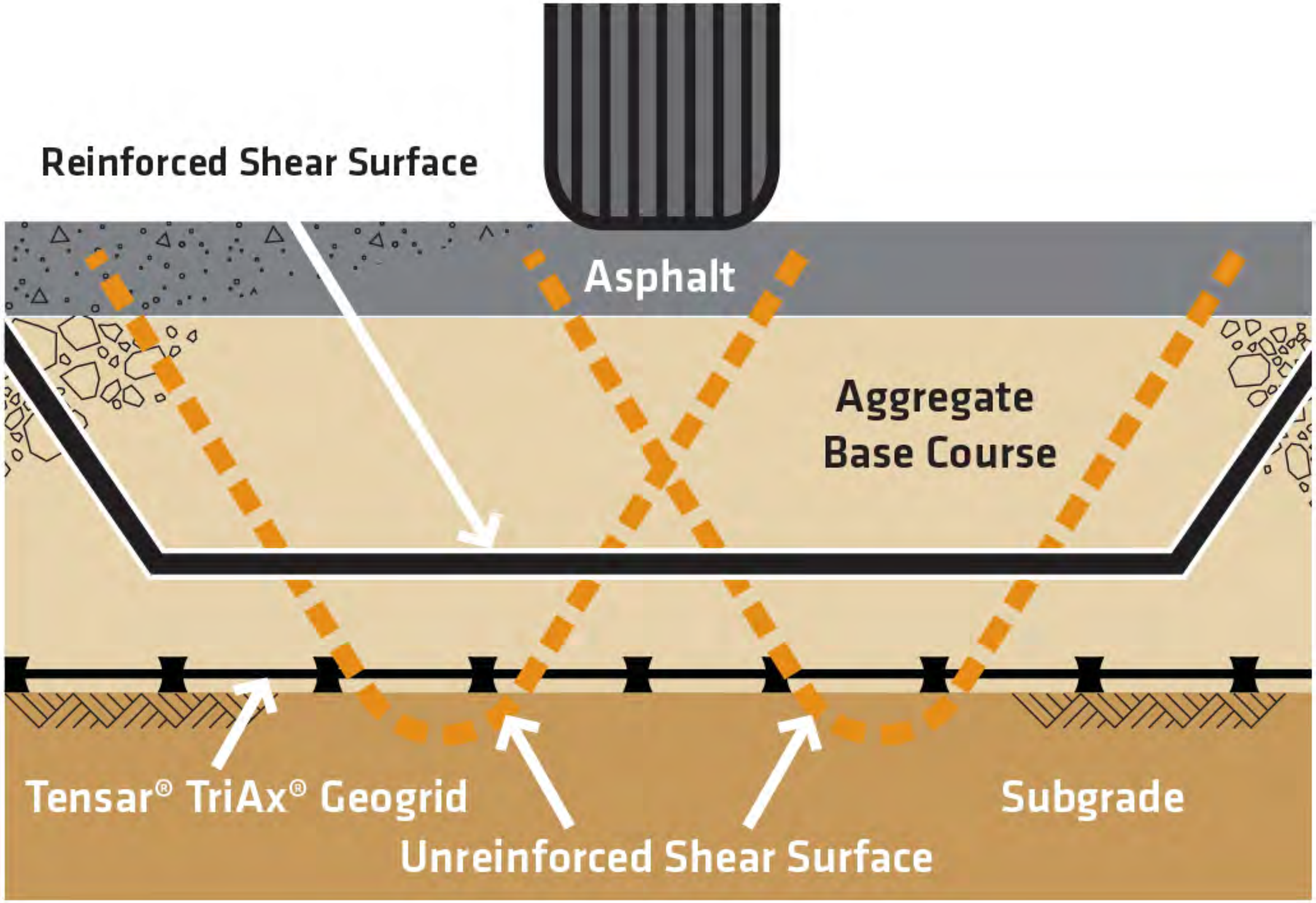
## DMS 6270 – Biaxial Geogrid for Environmental Cracking

**Table 1**

**Geogrid Requirements**

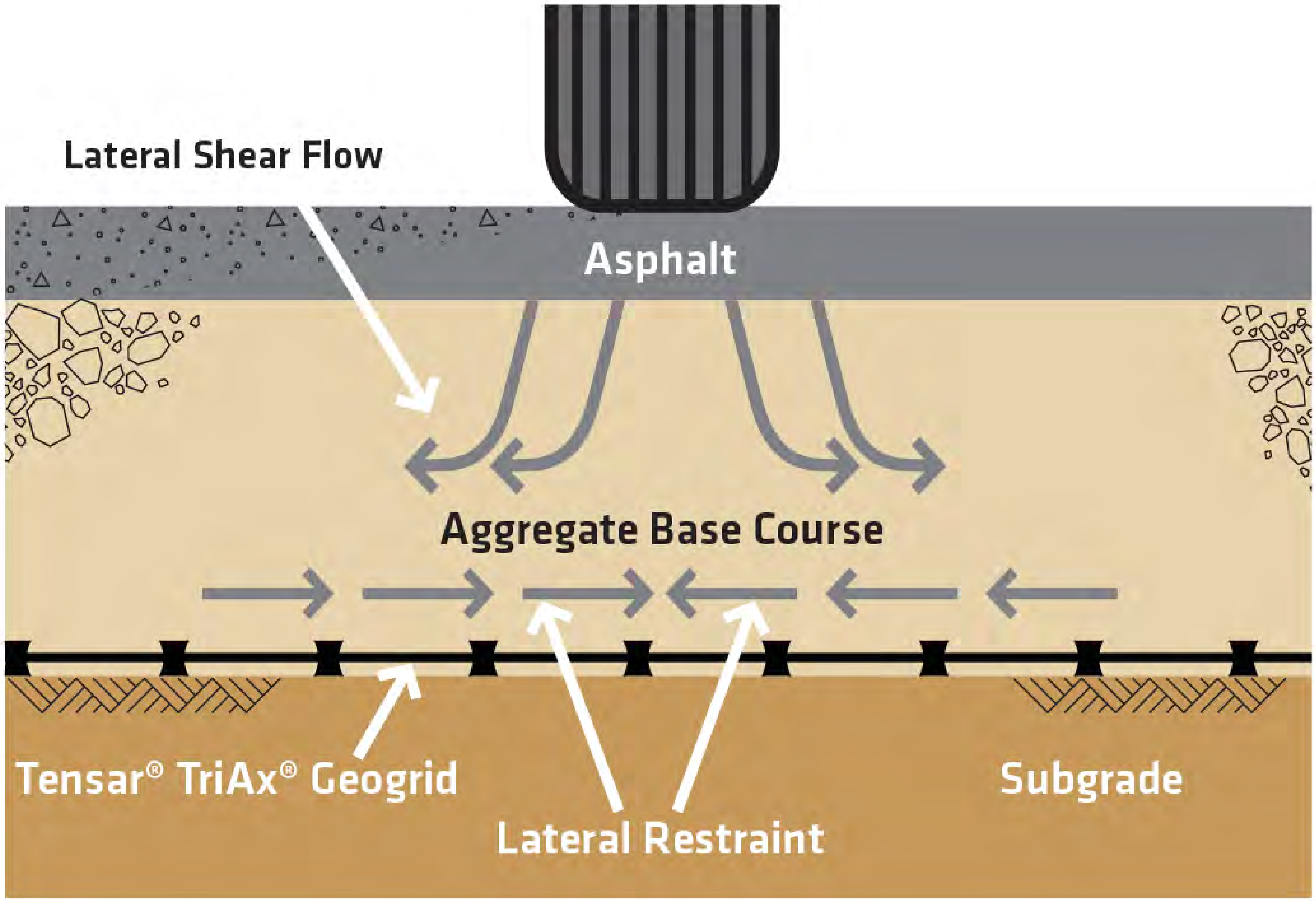
| Property | Test Method | Requirements |
|---|---|---|
| **Ultimate Tensile Strength (lb/ft)**<br>MD[2] and CMD[2] | Tex-621-J | 850 minimum |
| **Tensile Strength at 2% strain (lb/ft)**<br>MD and CMD | Tex-621-J | 270 minimum |
| **Junction Strength (lb/junction)**<br>MD and CMD | Tex-621-J | 20 minimum |
| **Aperture Size (in.)**<br>Range in either MD or CMD | Tex-621-J | 0.5–2.0 |
| **Percent Open Area** | Tex-621-J | 60% minimum |
| **Resistance to Installation Damage**<br>a. Ribs<br>b. Junctions<br>c. Retained tensile strength ratio | Tex -629-J | <br>≤ 2 ruptured<br>≤ 2 displaced or ruptured<br>75% |

# Mechanisms – Improved Bearing Capacity




*Source: USACOE ETL 1110-1-189*

# Mechanisms – Lateral Restraint




*Source: USACOE ETL 1110-1-189*

# TxDOT Usage Protocol

Tensar

- Texas does not have a formal guideline for the use of geogrid. We have had a significant usage of geogrid in three primary applications: **reduce environmental cracking from subgrade desiccation, construction platforms in subgrade soils with high sulfate content, and construction expediency over soft soils**.

  Geogrid has been used to mitigate the effects of cracking due to soil movement. **One rule of thumb that has been applied is to place grid where the PI of the subgrade has exceeded 35**. This has reduced desiccation cracking often observed on shoulders or in the roadway if shoulders are not present or are narrow. Grid has also been placed between stabilized base (recycled roadway materials) and new granular base to reduce cracking from both soil movement and shrinkage cracking often observed in stabilized bases.

  Until we have more experience and better control of techniques to incorporate calcium based stabilizers into subgrade soils with high levels of sulfates, **some regional offices have chosen to use geogrid as a substitute to provide a working platform if not a support layer substitute**. There are also the projects of the more typical construction expediency application, establishment of a construction platform.

  Texas has taken a cautious approach to geogrid application to ensure there is a measurable benefit to installation. **No structural credit is offered in pavement design at this time** and is not anticipated until there is more research and quantification of its structural benefits.

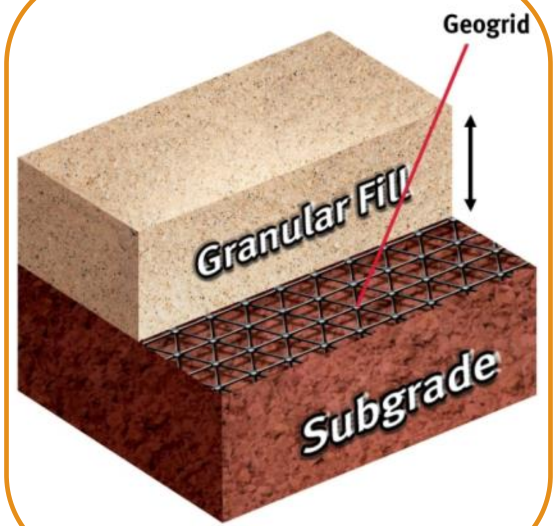
Texas Department of Transportation

# Mechanisms Differ for Application Types

Tensar

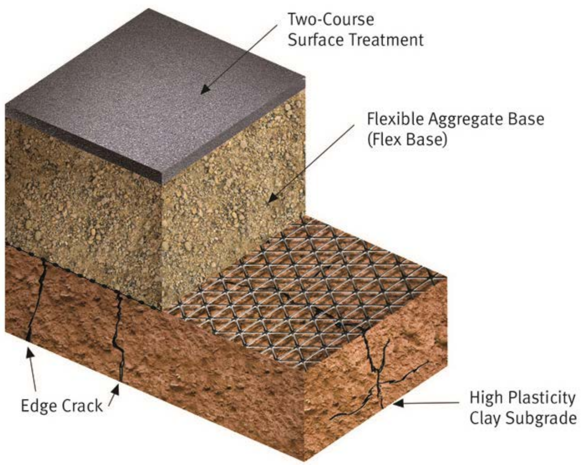
| *Subgrade Stabilization* | *Environmental Cracking* | *Pavement Optimization* |
|---|---|---|

*Subgrade Stabilization*



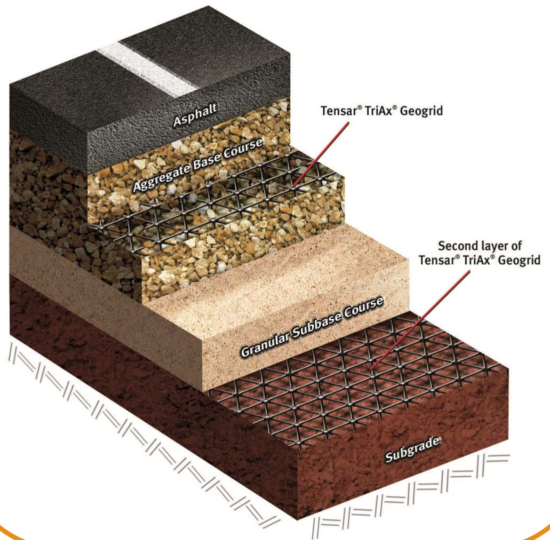

- Bearing Capaity

*Environmental Cracking*



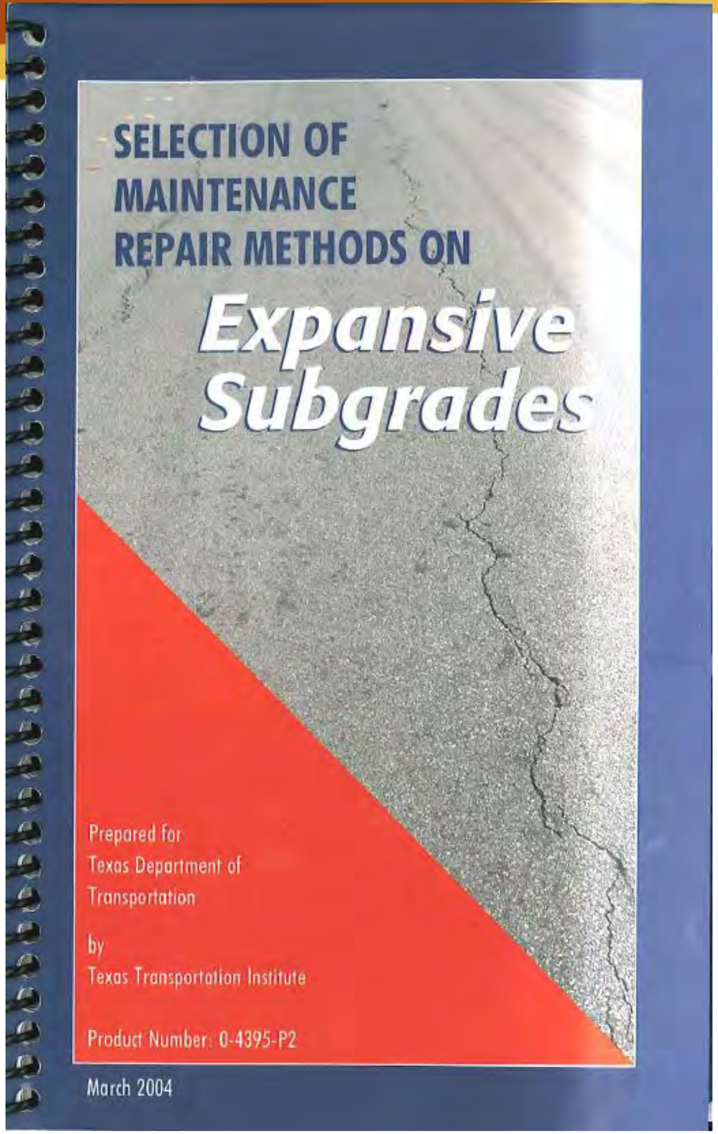

- Lateral Restraint

*Pavement Optimization*

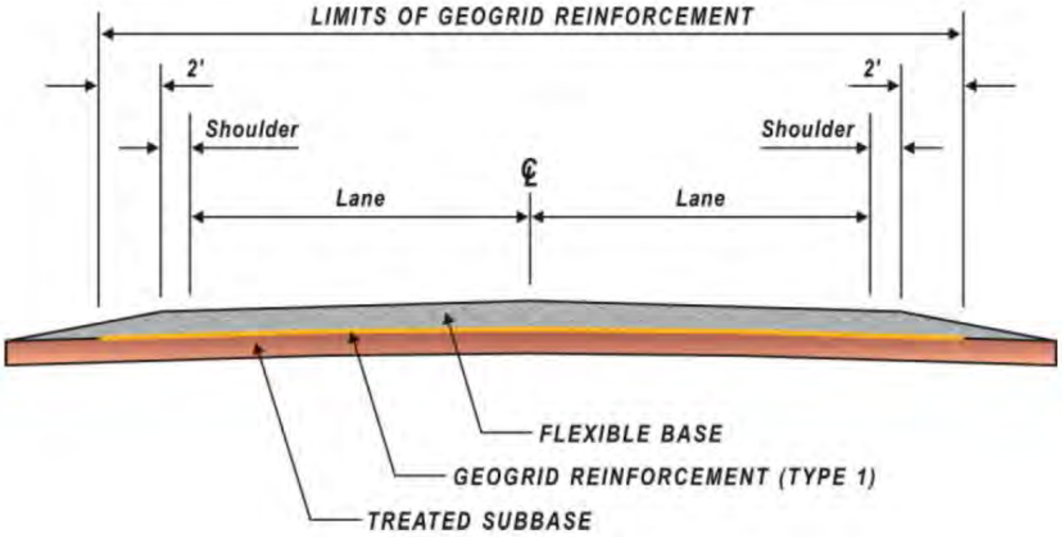



- Lateral Restraint
- Bearing Capacity

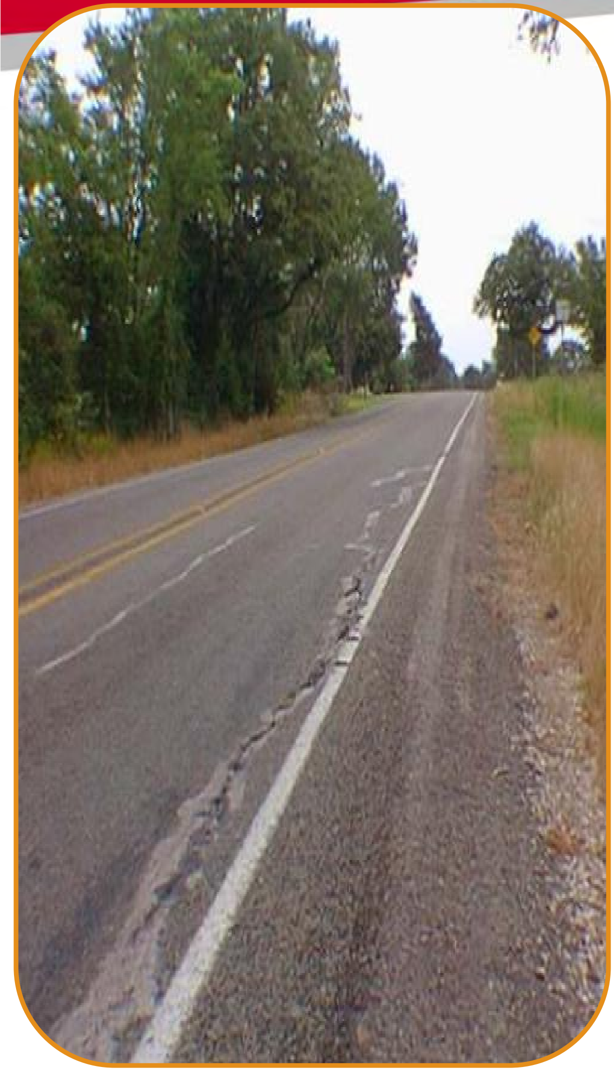
# TxDOT Guidance – Environmental Cracking




- PI > 35: Consider geogrid at Base-Subgrade interface



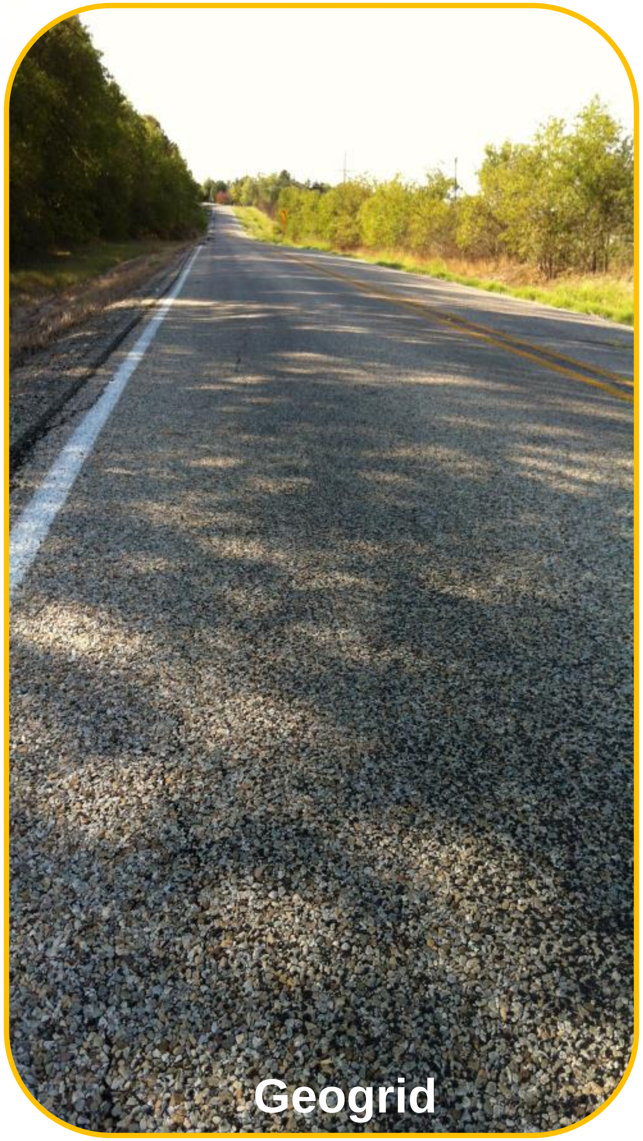
# Environmental Cracking



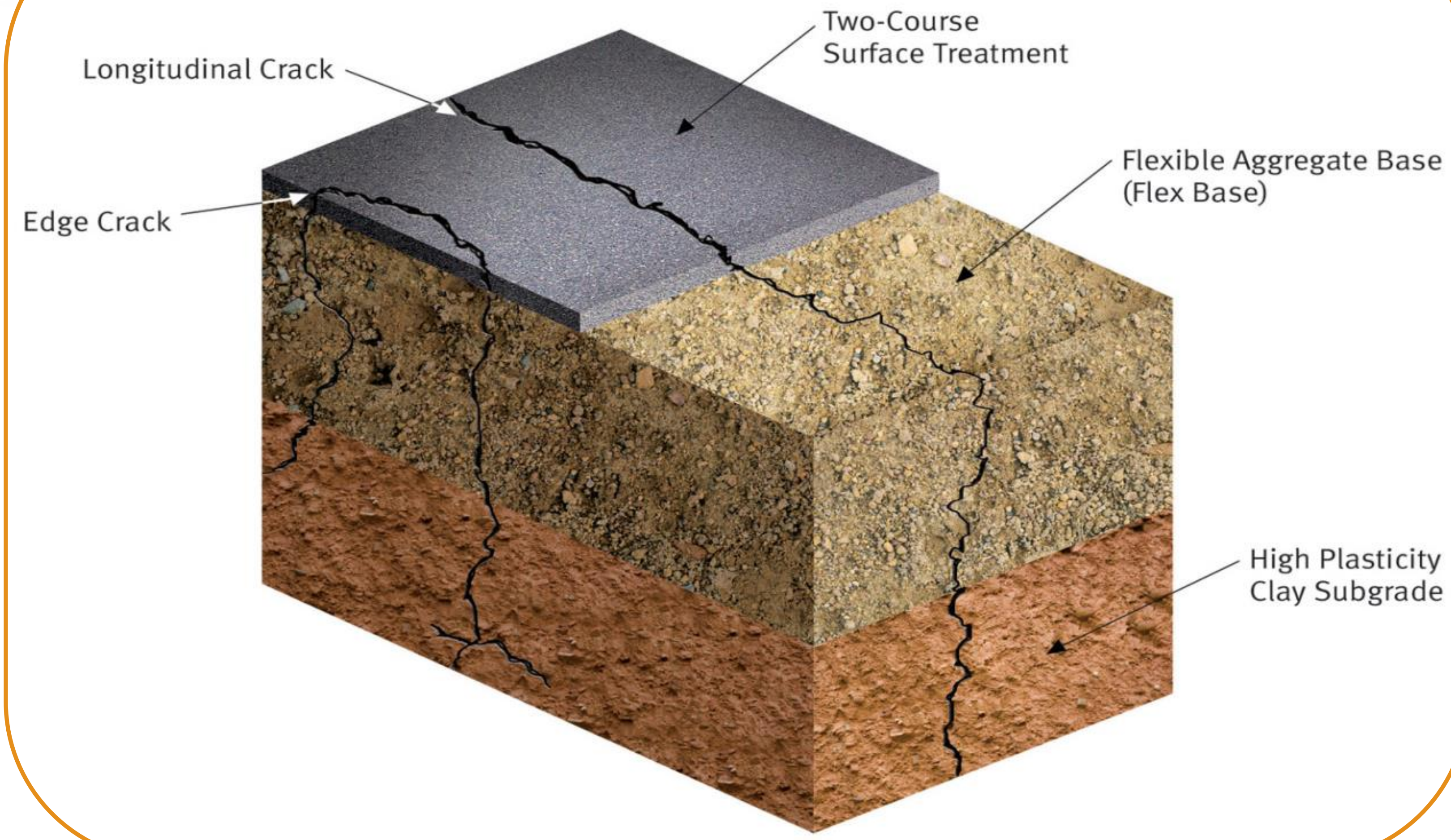
# FM 1563 – Hunt Co. (Sept 2012)

Tensar



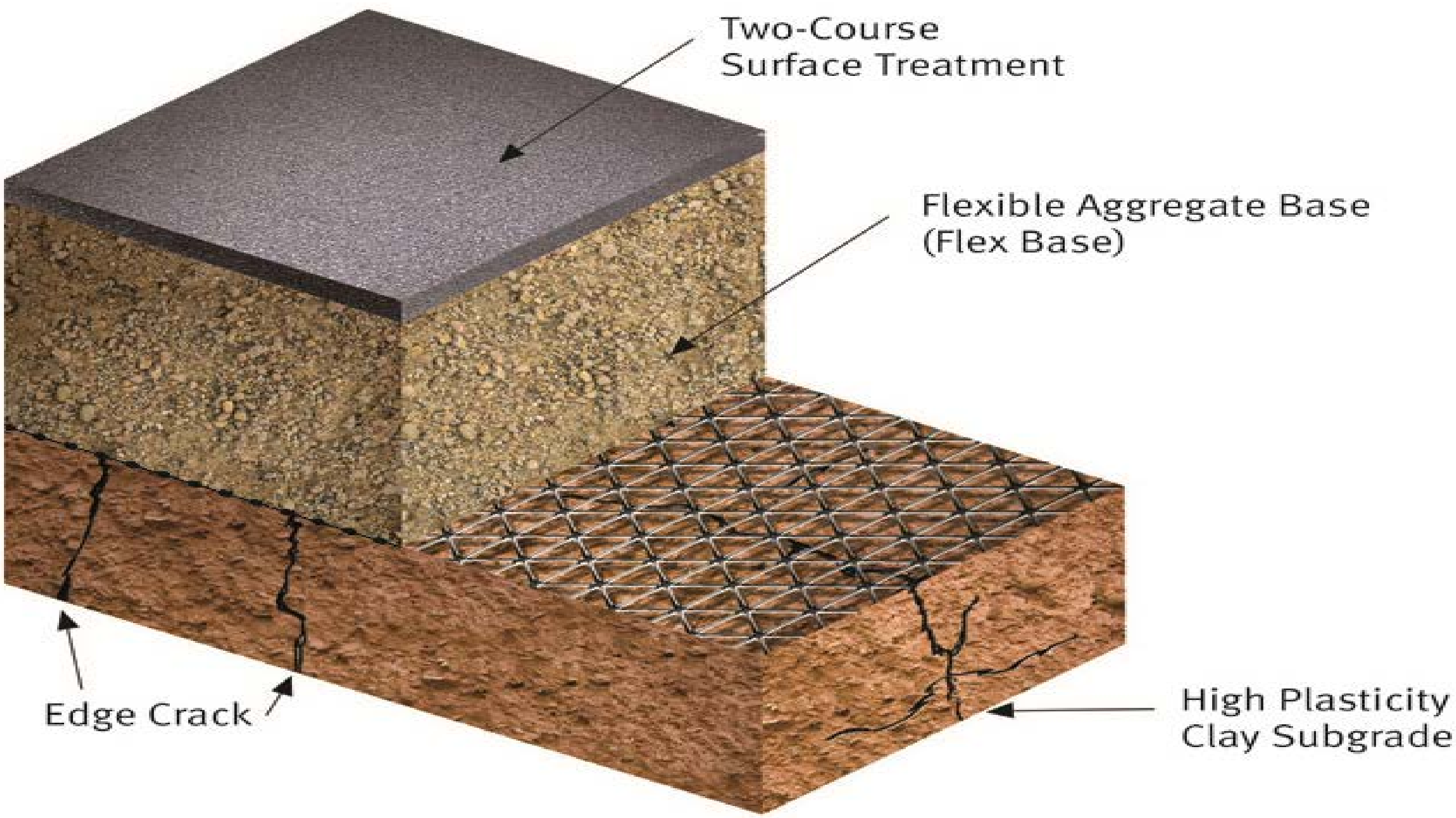


# Environmental Cracking




*Unreinforced Road on high PI Clay*

# Practical Application in Narrow Widening




*Geogrid-Reinforced DBST Road on high PI Clay*

# Materials Cost Snapshot

*(Source: TxDOT Average Low Bid Unit Price – Jul 2012 through Jun 2013)*

HMA (Asphalt): $3.98 / SY-in

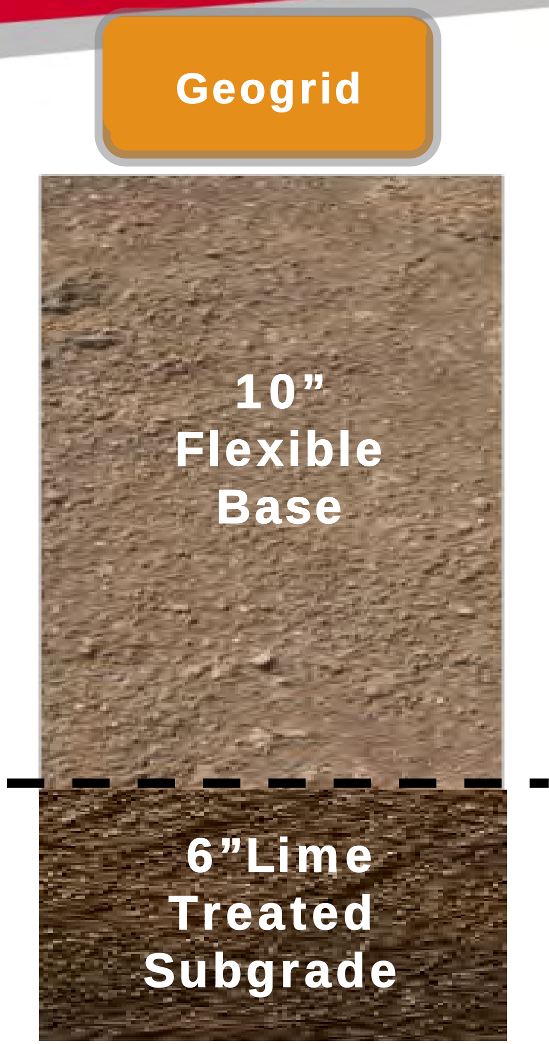
Flexible Base: $1.12 / SY-in

Lime Treatment: $0.54 / SY-in

Cement Treatment: $0.39 / SY-in

Geogrid: $1.58 / SY

# Cost Benefit – Environmental Cracking




- Pavement sub-layers cost:

  (10" x \$1.12/SY-in) + (6" x \$0.54/SY-in) + (\$1.58 / SY) =

  **\$16.02/SY (w/ geogrid)**

  **\$14.44/SY (w/o geogrid)**

- Life-Cycle Cost Analysis:

  Design Life: 15 years

  Discount Rate: 4%

  Maintenance Cost: \$85,000

  Rehabilitation Cost: \$170,000

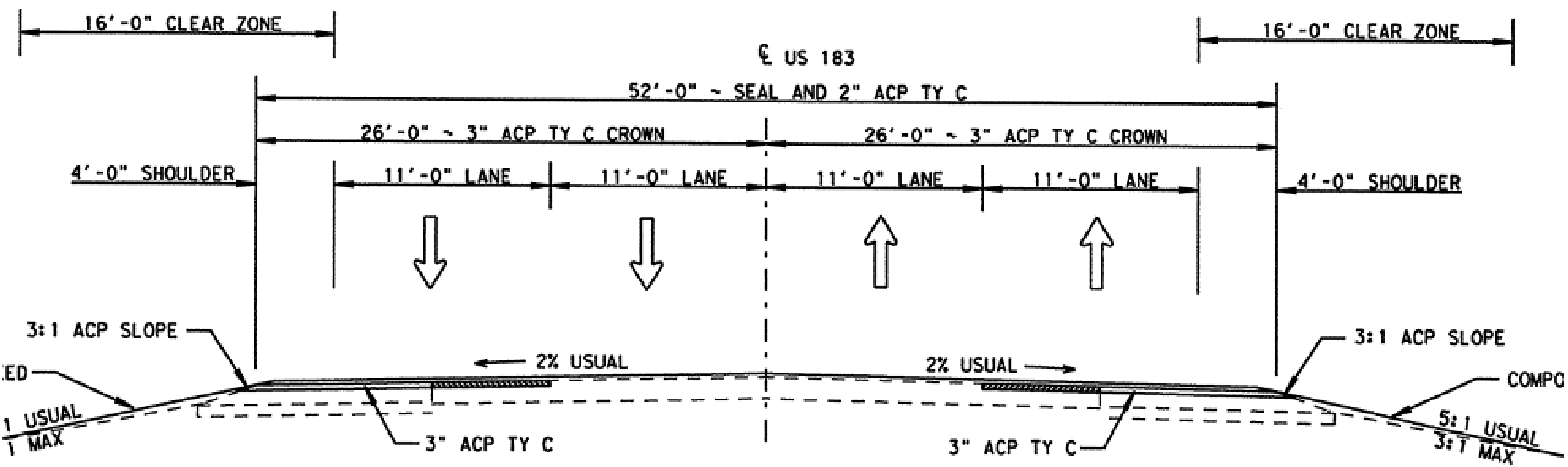
  **PWOC (Life-Cycle Cost Savings): \$196,000**

*(Calculations based upon 1993 AASHTO Empirical Pavement Design Method)*

# Pavement Profiles

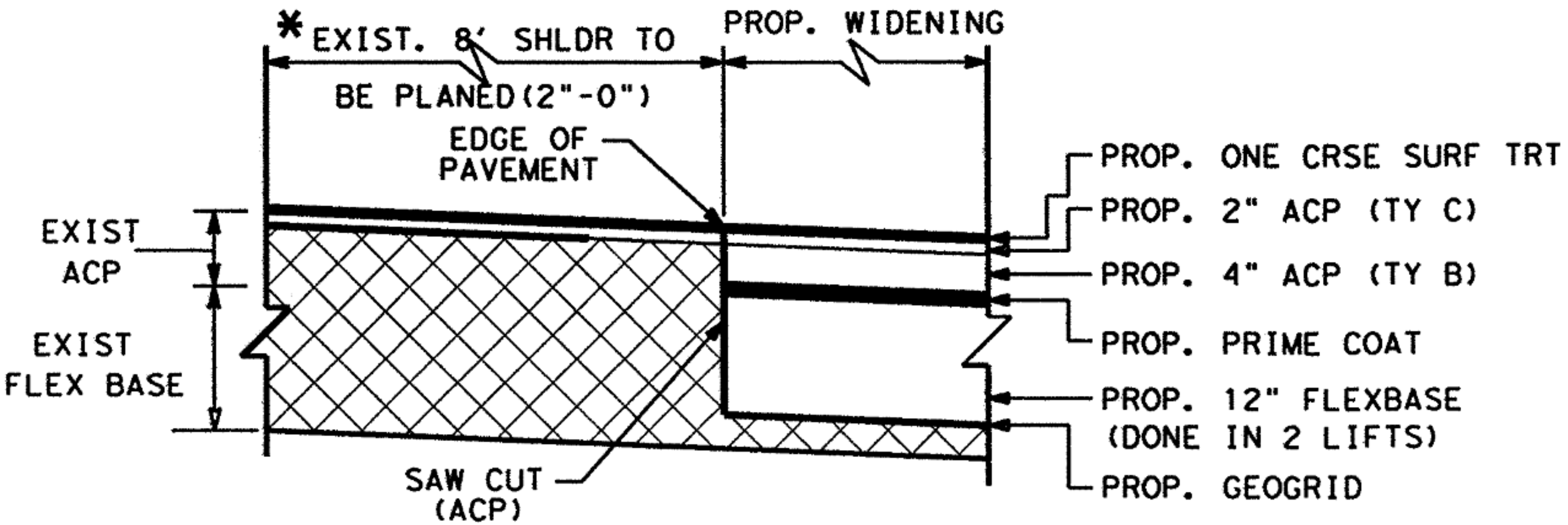
**Recent installations of Geogrid for Narrow Widening Applications**

# US 183 – Caldwell Co.




PROPOSED ACP & COMPLETED SECTION

# US 277 – Maverick Co.



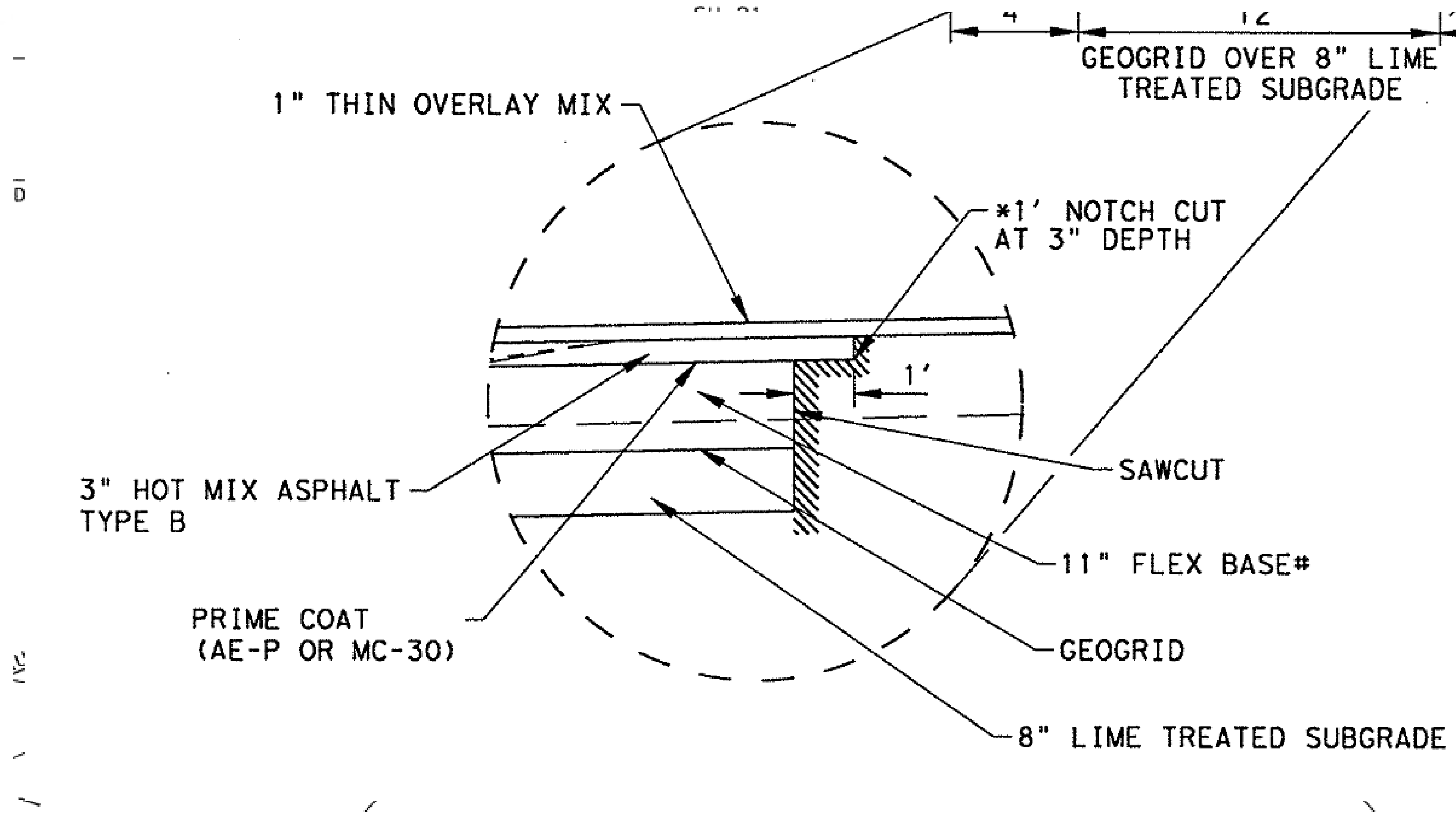

**DETAIL- 2**

PASSING LANE 10

PLANING MUST FOLLOW EXISTING TRAVEL LANE CROSS SLOPE WHICH VARIES REFER TO CROSS SECTIONS SHEET(S) FOR MORE INFORMATION

# SH 21 – Hays Co.

Tensar

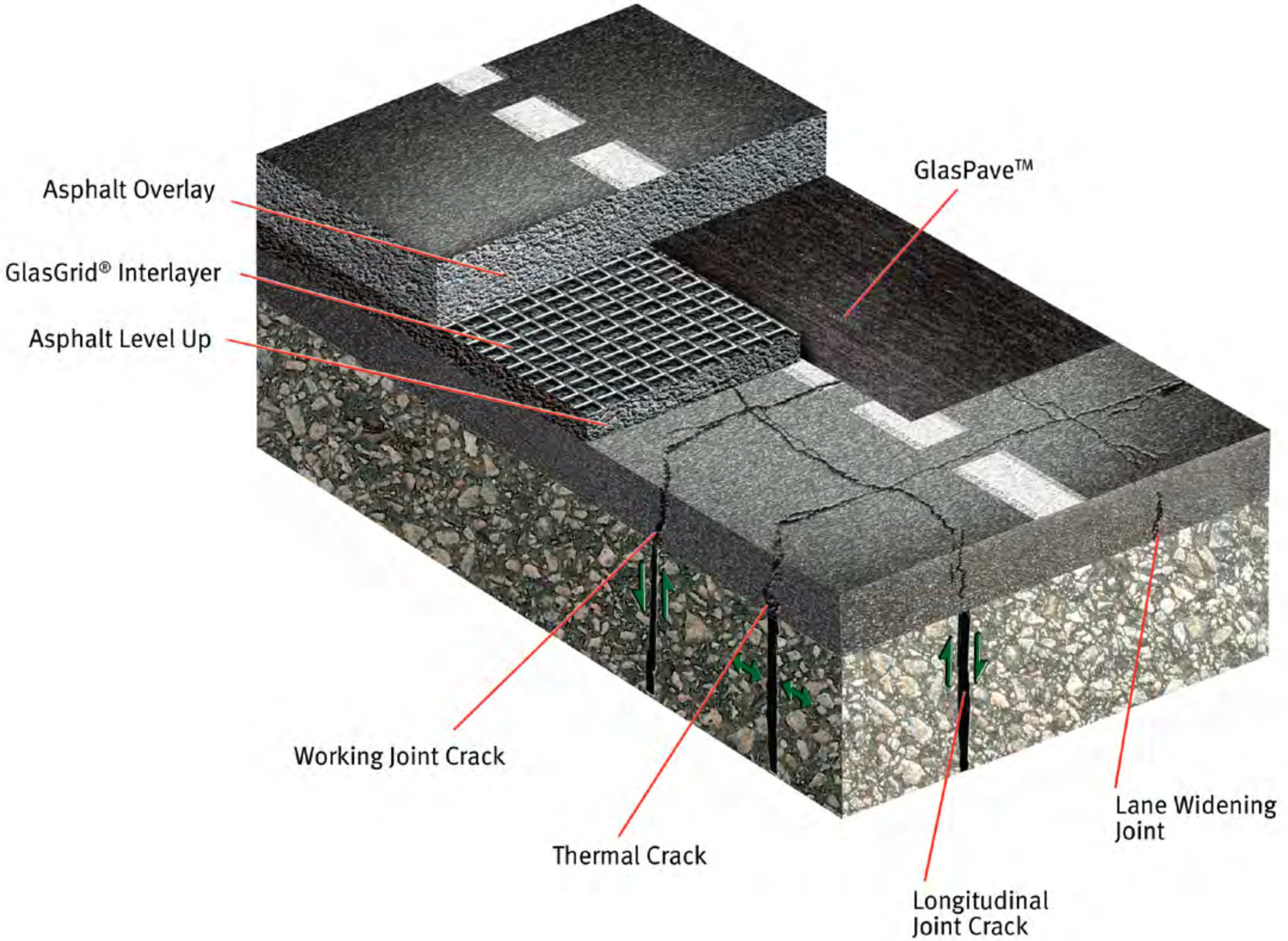


# SH 76 – Carter Co., OKDOT

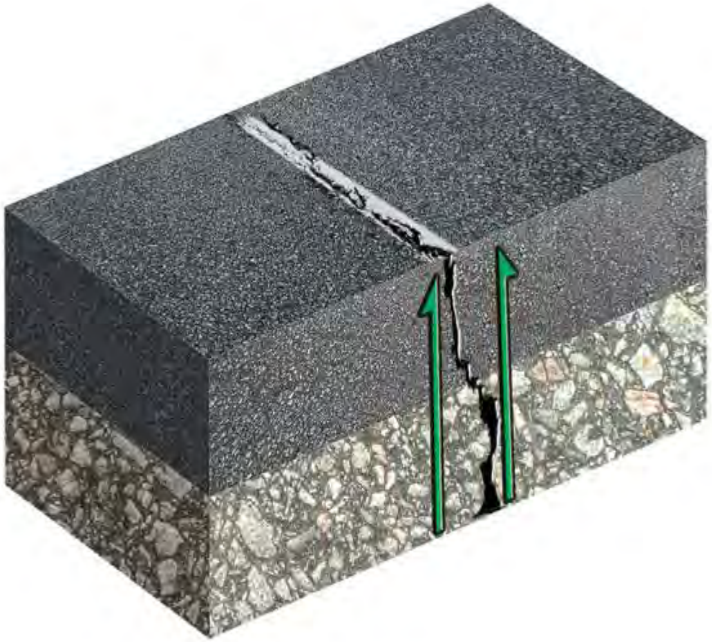
# Pavement Interlayers for Narrow Widening

**Geosynthetic Interlayers for Pavement Rehabilitation Applications**

# Introduction to Pavement Interlayers



# Geosynthetic Interlayers for Pavements

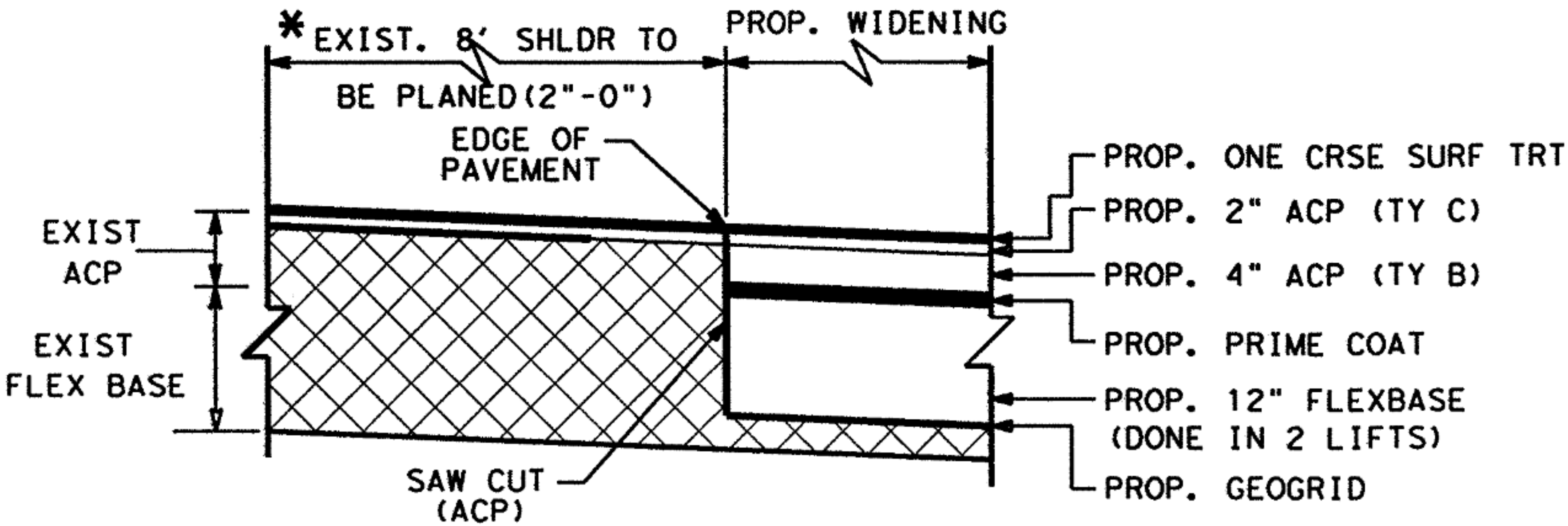


Conventional Overlay

Overlay w/ Geosynthetic

# US 277 – Maverick Co.

Tensar




**DETAIL- 2**

PASSING LANE 10

PLANING MUST FOLLOW EXISTING TRAVEL LANE CROSS SLOPE WHICH VARIES REFER TO CROSS SECTIONS SHEET(S) FOR MORE INFORMATION

# Texas Case Studies – Shoulder Repair

# Texas Case Studies – Shoulder Repair

# Agenda

- Product Description/Historical Usage
- Geogrid Mechanisms
- Application Definition
- TxDOT Specifications for Geogrids in Roadways
- TxDOT Narrow Widening Examples – Typical Sections
- Pavement Interlayers for Narrow Widening

# Geosynthetic Reinforcement for Shoulder Widening & Rehabilitation
## Project 0-6748 Best Practices

Texas Department of Transportation
Austin, TX

**July 2, 2013**

**Tensar International Corporation**
**Stephen Archer, P.E. – Frisco, TX**

# Appendix D – TxDOT Presentations

# Austin District Pavement Widening

Project 0-6748, “Narrow Pavement Widening Webinar-Workshop”
July 2, 2013
Mike Arellano, P.E.

# Historical Practices

- “Narrow Widening”: 3 to 6 foot safety widening
  - Flexible Pavement
    - Match adjacent section with HMA and flexible base
    - Compaction issues – equipment wider than the section
    - Differential consolidation of pavement between existing and widened section
    - Differential consolidation or movement of subgrade
    - Start to use geogrids for reinforcement and improve compaction

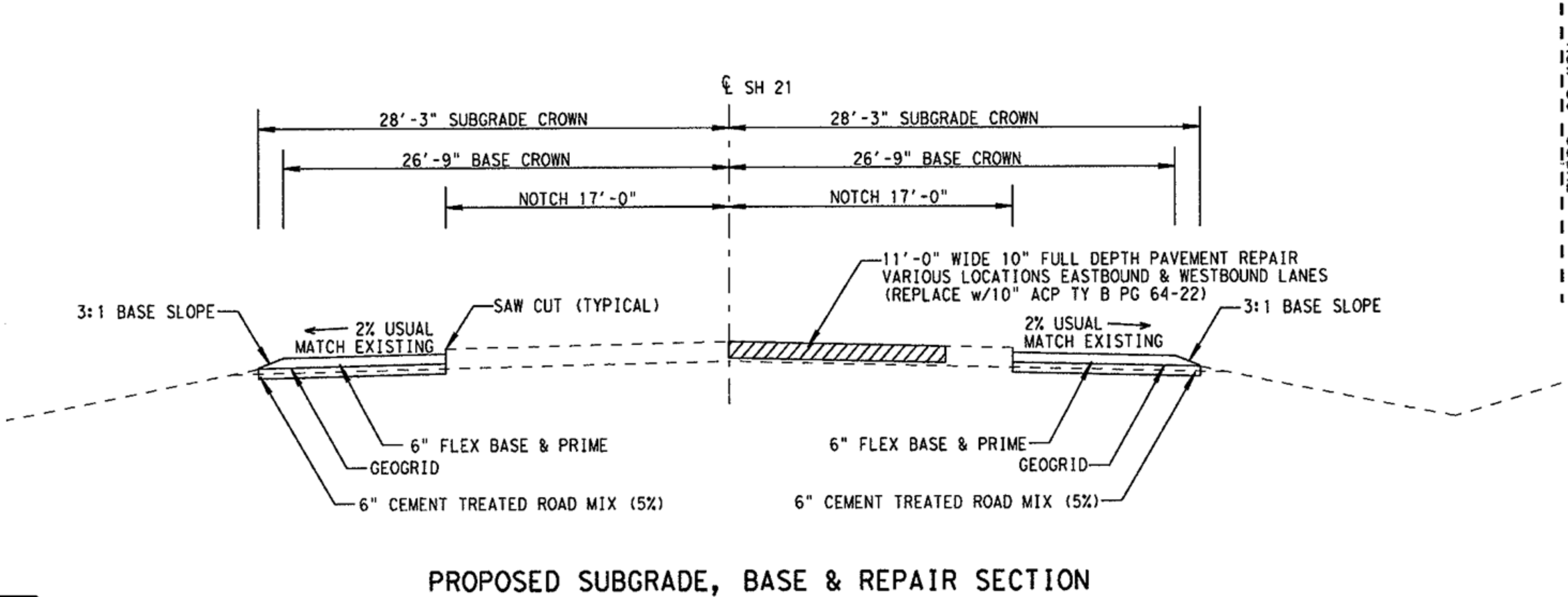
# Historical Practices

- Full Depth HMA or Cement Treated Base (Plant)
  - No lateral drainage
  - With stiffer shoulder ~ load transfer issues with less stiff existing pavements
  - Impermeable barrier, especially in super elevation sections
  - Water infiltration at construction joint
    - Use underseals, but water always finds a way
  - Accelerated damage to existing section
  - Long-term issues = Full rehabilitation
  - Still use deep HMA, but not full depth,
    - Insure drainage at depth with good subgrade conditions
    - In urban areas (super-street or turn-lanes) with thick pavement structures

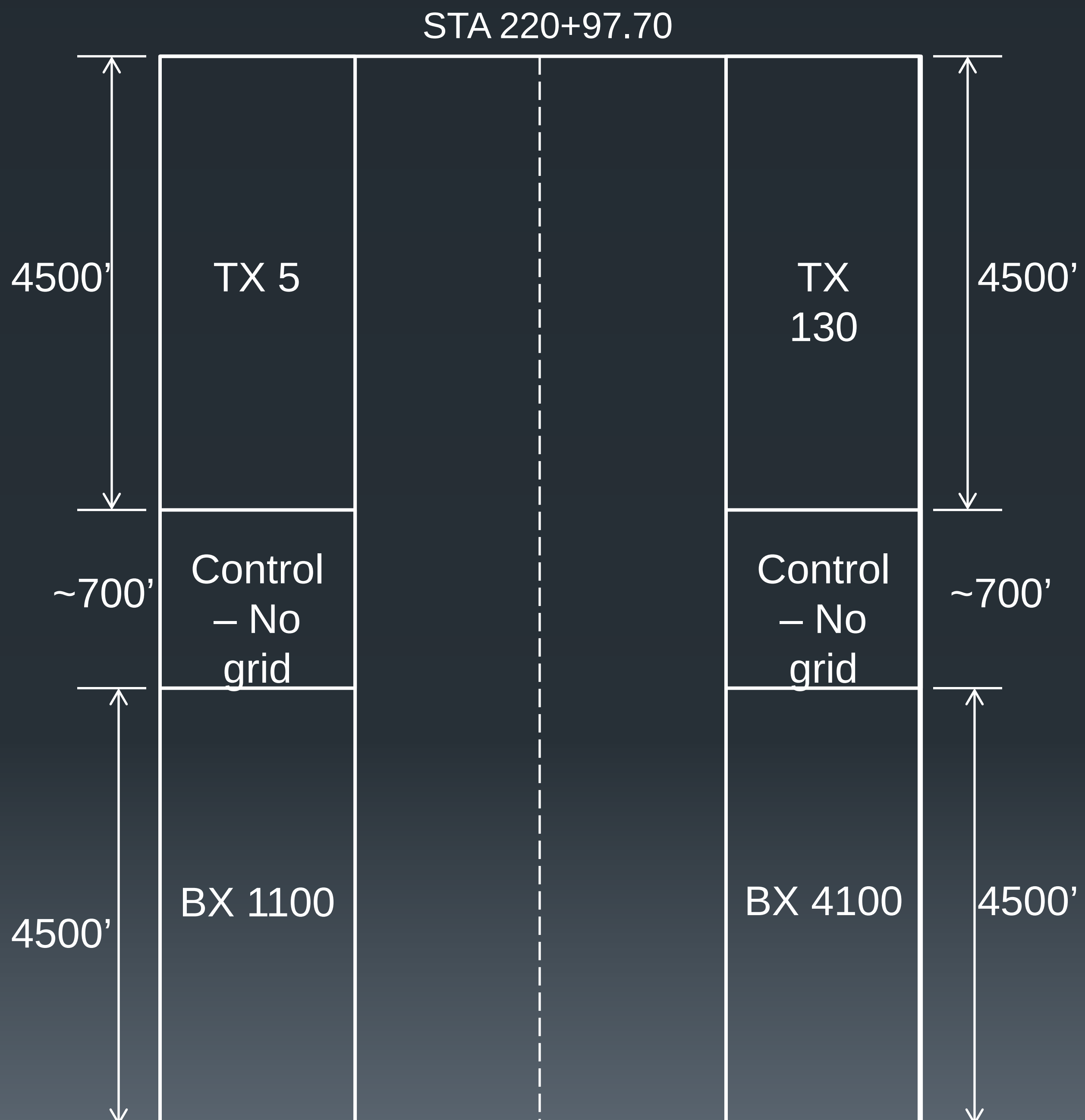
# Current Practices

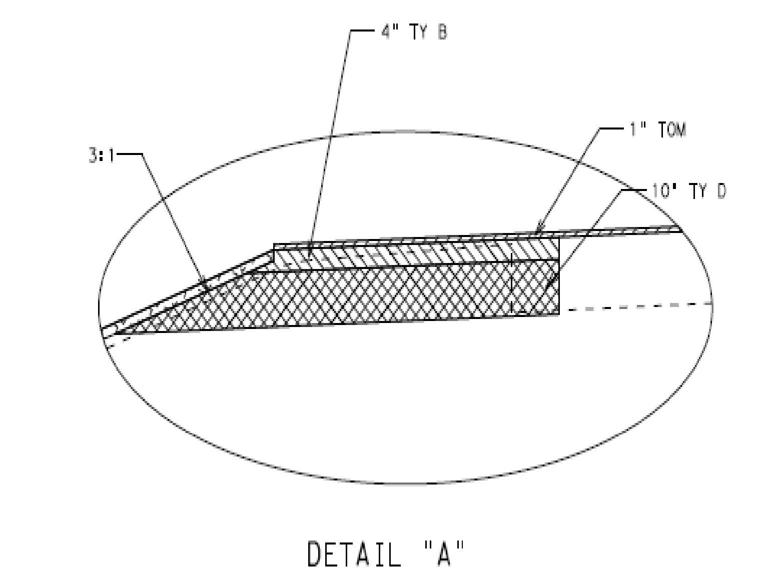
- No narrow widening…if possible
  - Benefit/Cost ratio better to rehab or widen wider than widen narrow and incur long-term maintenance costs
- Widen wider!
  - Uniformity
  - Better Construction = High Probability of Success
  - Salvage Existing Material
  - Address other issues like edge failures from drought damage

# Conventional Widening



# SH 21 – Lee County

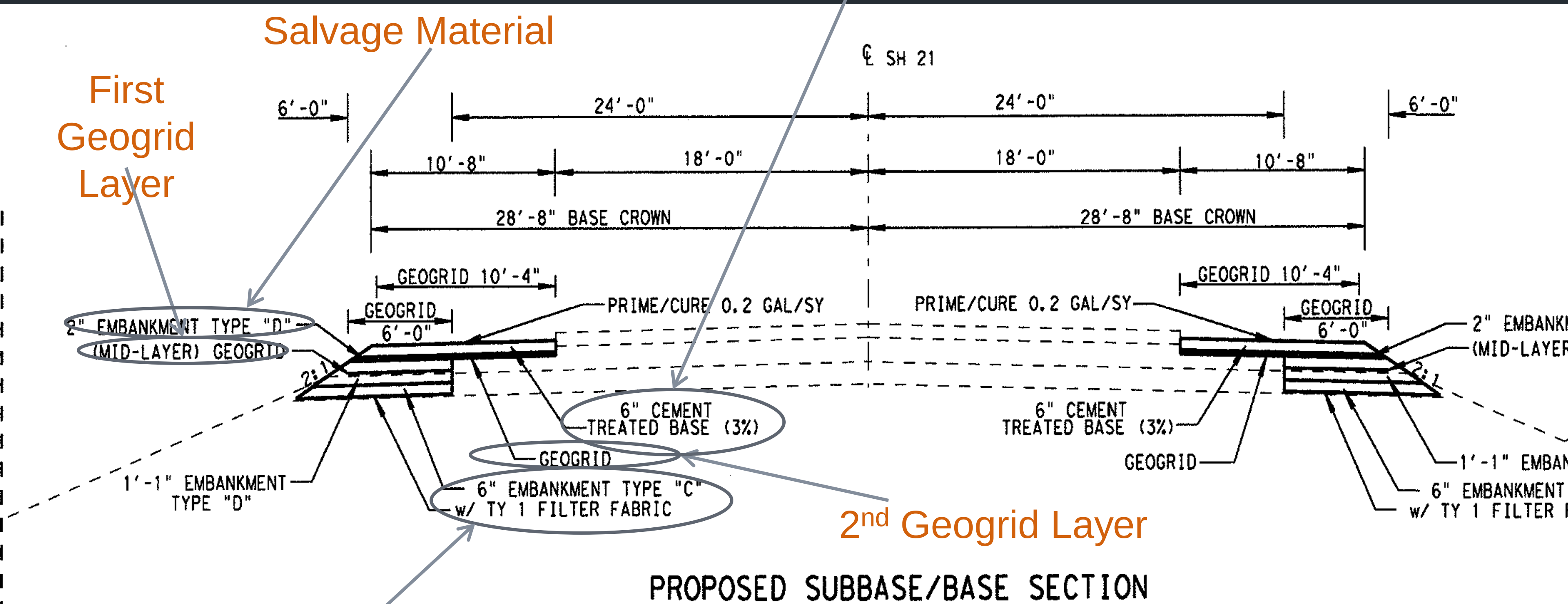

STA 220+97.70
4500’
TX 5
TX
130
4500’
~700’
Control
– No
grid
Control
– No
grid
~700’
BX 1100
BX 4100
4500’
4500’




# Alternative Widening

- Accelerated Construction Section
  - Urban areas
  - Alternate to Full Depth HMA
  - Flexible Pavement with inverted prime coats (RC-250 w/ Grade 5)
  - Use of geosynthetic (separation/reinforcement layer)
  - 3” Aggregate (Similar to TY D Backfill)
    - Maintain lateral drainage
    - Easy compaction with little to no secondary consolidation, especially in a 3-4 foot trench
    - Widen section move similar to the adjacent existing section

Cement Treated Salvage




3" Rock Drainage Layer with Geosynthetic Separation

# SH 21 – Bastrop County

- TenCate Mirafi® woven geosynthetic
- Wicking Capability
- Special hydrophilic and hygroscopic yarn that provides wicking action through the plane of the geosynthetic.

# SH 21 – Bastrop County

- CTR is monitoring the moisture levels and migration in this test section using moisture probes.
- Goal is to see if there is any benefit to this new woven geosynthetic product
- If the moisture can be controlled, this may diminish the soil movement at the edge of pavement.
- May allow denser material adjacent to the existing pavement

# Questions

# Waco District Experience

Project 0-6748:
Narrow Pavement Widening

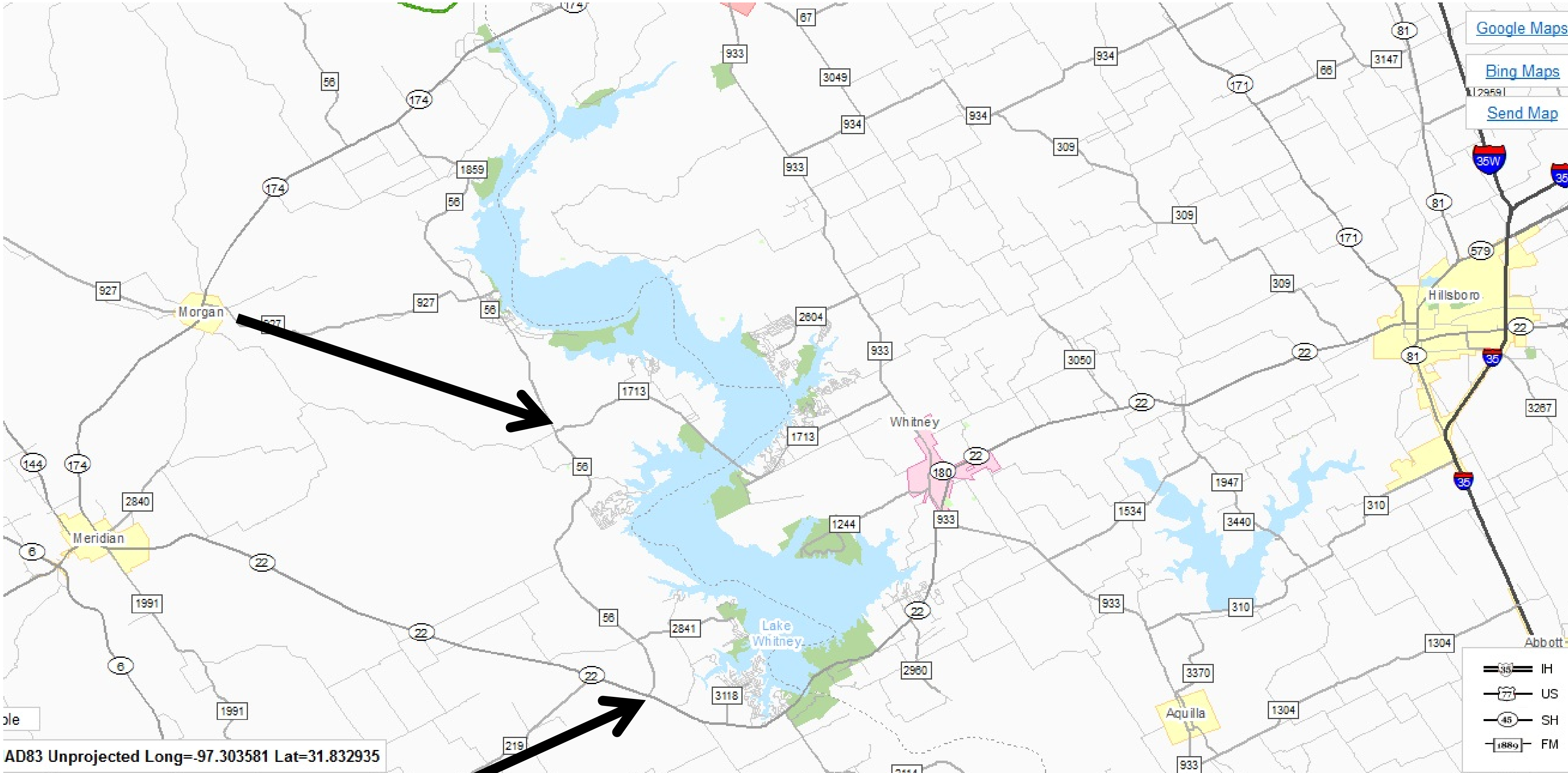
Don Miller, P.E. – Waco Design
John Jasek, P.E. – Director Construction


# Waco District ‘Mixed Climate’

30 – 35 inches rain
(when not in drought)
Hot in summer
Cold in winter

Some sulfate soils
Heavy clays
Heavy trucks

TEXAS DEPARTMENT OF TRANSPORTATION




# FM 56 Bosque County

Hillsboro AO

| FED. RD. DIV. NO. | FEDERAL AID PROJECT NO. | | SHEET NO. |
|---|---|---|---|
| 6 | STP 2011 (188) SB | | 1 |
| STATE | STATE DIST. | COUNTY | |
| TEXAS | WACO | BOSQUE | |
| CONT. | SECT. | JOB | HIGHWAY NO. |
| 0398 | 05 | 011 | FM 56 |

ETC.

RECEIVED
JUL 22 2010
HILLSBORO AO

# STATE OF TEXAS
## DEPARTMENT OF TRANSPORTATION

## PLANS OF PROPOSED
## STATE HIGHWAY IMPROVEMENT

FEDERAL AID PROJECT: STP 2011 (188) SB

BOSQUE COUNTY

FM 56

INDEX OF SHEETS



| CSJ | ADT | YEAR |
|---|---|---|
| 0398-05-011 | 1250 | 2008 |
| | 1875 | 2028 |
| 1852-03-011 | 720 | 2008 |
| | 1080 | 2028 |

NET LENGTH OF PROJECT= 67,458.080 FT. = 12.766 MI.

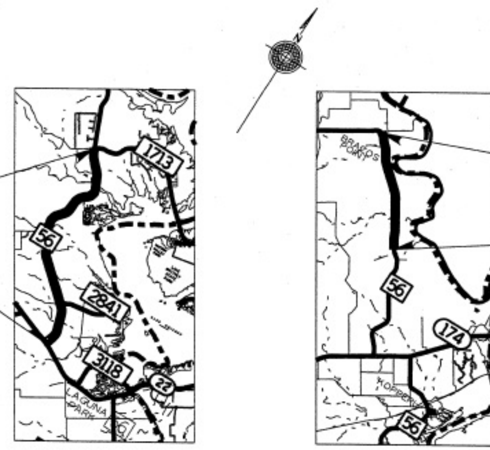
| | ROADWAY | BRIDGES | TOTAL |
|---|---|---|---|
| 0398-05-011 | 44,665.000 FT = 8.460 MI. | 310.000 FT. = 0.058 MI. | 44,975.000 FT. = 8.518 MI. |
| 1852-03-011 | 22,273.080 FT = 4.218 MI. | 210.000 FT. = 0.040 MI. | 22,483.080 FT. = 4.258 MI. |

FINAL PLANS

DATE CONTRACTOR BEGAN WORK:
DATE WORK WAS COMPLETED & ACCEPTED:
FINAL CONTRACT COST: $

LIMITS: FROM FM 1713 TO SH 22, ETC.

FOR THE CONSTRUCTION OF HAZARD ELIMINATION & SAFETY
CONSISTING OF PROVIDE ADDITIONAL PAVED SURFACE WIDTH




BEGIN PROJECT
CSJ: 0398-05-011
STA 486+00.00
REF. MRKR. 352+00.367

END PROJECT
CSJ: 0398-05-011
STA 935+75.00
REF. MRKR. 360+00.980

BEGIN PROJECT
CSJ: 1852-03-011
STA 397+26.40
REF. MRKR. 330+01.451

END PROJECT
CSJ: 1852-03-011
STA 622+09.48
REF. MRKR. 334+01.736

TEXAS DEPARTMENT OF TRANSPORTATION

EXCEPTIONS: NONE
EQUATIONS: NONE
RAILROAD CROSSINGS: NONE
SCALE: 1" = 4 MI.

RECOMMENDED FOR LETTING 6/23/2010
Anthony [signature], P.E.
AREA ENGINEER

RECOMMENDED FOR LETTING 6/23/10
Allen A. Petter, PE
DIRECTOR OF TRANSPORTATION PLANNING & DEVELOPMENT

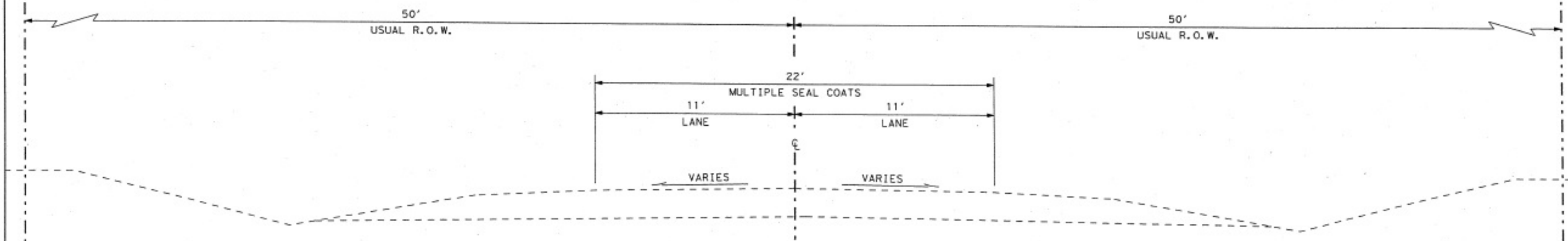
RECOMMENDED FOR LETTING 6/28/2010
[signature], P.E.
DISTRICT ENGINEER

APPROVED FOR LETTING
DIRECTOR, TRAFFIC OPERATIONS DIVISION

APPROVED FOR LETTING
DIRECTOR, DESIGN DIVISION

SPECIFICATIONS ADOPTED BY THE TEXAS DEPARTMENT OF TRANSPORTATION, JUNE 1, 2004 AND SPECIFICATION ITEMS LISTED AND DATED AS FOLLOWS, SHALL GOVERN ON THIS PROJECT: REQUIRED CONTRACT PROVISIONS FOR ALL FEDERAL-AID CONSTRUCTION CONTRACTS (FORM FHWA 1273, MARCH 1994).

STP 2011(188)SB
HILL
FILE LOCATION AND NAME
LEVELS DISPLAYED
COUNTY
HWY. NO.
DATE ACCEPTED
PROJ. NO.
LETTING DATE

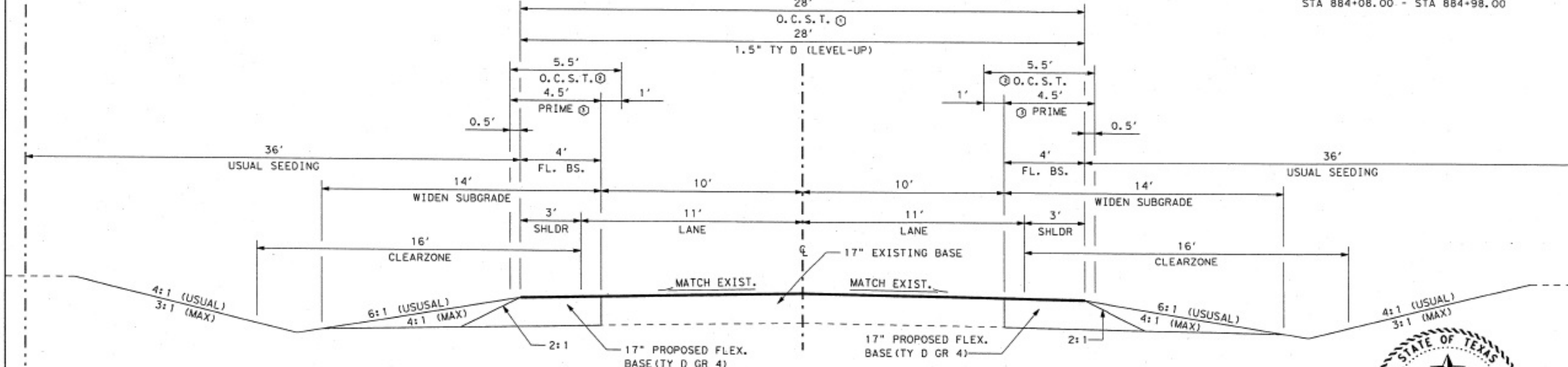



## EXISTING TYPICAL SECTION

STA 486+00.00 - STA 935+55.00

## BRIDGE

STA 558+40.00 - STA 560+60.00
STA 884+08.00 - STA 884+98.00




## PROPOSED TYPICAL SECTION

STA 486+00.00 - STA 558+40.00
STA 560+60.00 - STA 884+08.00
STA 884+98.00 - STA 935+55.00

STATE OF TEXAS
DON L. MILLER
70906
LICENSED
PROFESSIONAL ENGINEER

Don L. Miller, P.E.
6-23-10

① ASPH - AC-15P, AC-20XP, AC10-2TR, AC-12-5TR
AGGR - TY-PD GR-4 OR TY PL GR-4

② ASPH - CRS-2
AGGR - TY-D GR-4 OR TY-L GR-4

③ MC-30 OR AE-P

Texas Department of Transportation
© TxDOT 2010

SCALE = 1"=10'

## TYPICAL SECTIONS

0398-05-011

| STATE | DISTRICT | COUNTY | | SHEET NO. |
|---|---|---|---|---|
| TEXAS | WACO | BOSQUE | | 3 |
| CONTROL | SECTION | JOB | HIGHWAY NO. | |
| 0398 | 05 | 011 ETC. | FM 56 | |


FM 56 Before Widening

# FM 56 Before Widening


FM 56 Before Widening

# FM 56 During Construction

# FM 56 During Construction

FM 56 During Construction

# FM 56 During Construction

# FM 56 During Construction

# FM 56 During Construction


After level-up

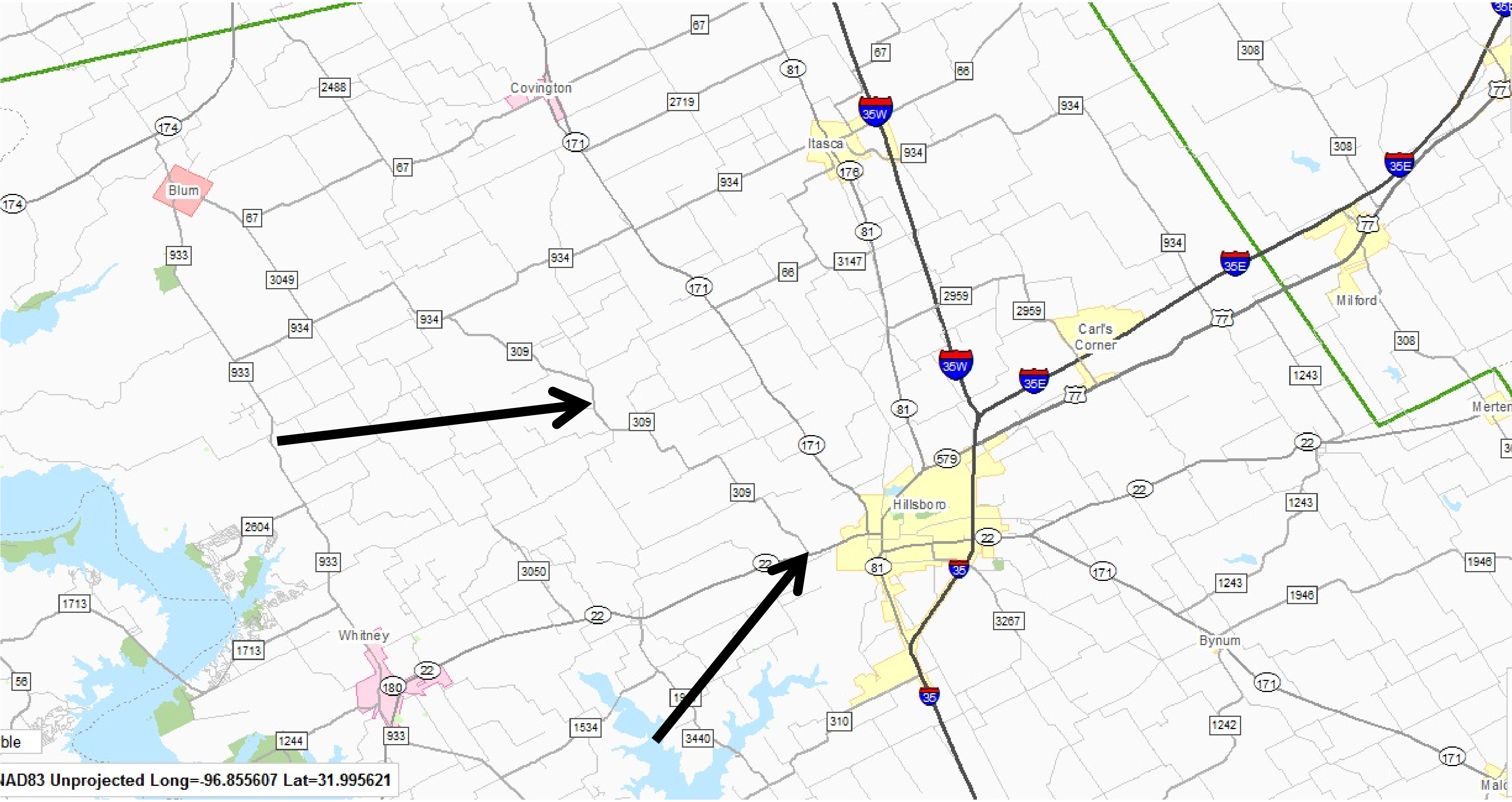
# After Seal Coat

# FM 56 Finished Product


FM 56 Finished Product


Have Experienced Problems with pavement failures

TEXAS DEPARTMENT OF TRANSPORTATION




# FM 309 Hill County

HILLSBORO AO

| FED. RD. DIV. NO. | FEDERAL AID PROJECT NO. | | | SHEET NO. |
|---|---|---|---|---|
| 6 | STP 2010 (644) SB | | | 1 |
| STATE | STATE DIST. | COUNTY | | |
| TEXAS | WACO | HILL | | |
| CONT. | SECT. | JOB | HIGHWAY NO. | |
| 0888 | 02 | 021, ETC. | FM 309, ETC. | |

# STATE OF TEXAS
## DEPARTMENT OF TRANSPORTATION

## PLANS OF PROPOSED
## STATE HIGHWAY IMPROVEMENT

PROJECT NO: STP 2010 (644) SB

HILL COUNTY

FM 309, ETC.

LIMITS: SH 22 TO CR 1361, ETC.

**INDEX OF SHEETS**

| SHEET NO. | DESCRIPTION |
|---|---|
| 1 | TITLE SHEET |
| 2 | INDEX OF SHEETS |

| CSJ | ADT | YEAR |
|---|---|---|
| 0888-02-021 | 560 | 2007 |
| 1830-01-011 | 700 | 2007 |

FINAL PLANS

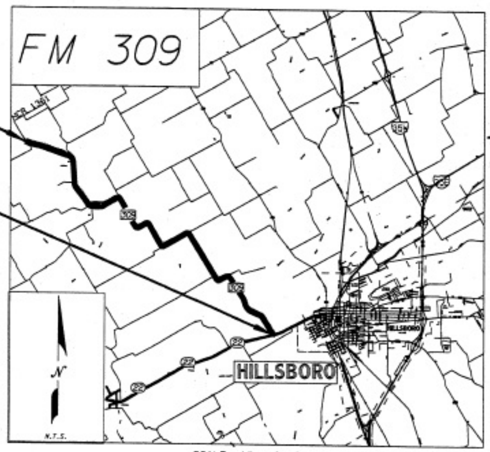
DATE CONTRACTOR BEGAN WORK:
DATE WORK WAS COMPLETED & ACCEPTED:
FINAL CONTRACT COST: $

| | ROADWAY | BRIDGES | TOTAL |
|---|---|---|---|
| 0888-02-021 (FM 309) | 51,121.080 FT = 9.682 MI | 285.000 FT = 0.054 MI | 51,406.080 FT = 9.736 MI |
| 1830-01-011 (FM 1947) | 28,409.980 FT = 5.381 MI | 1,275.000 FT = 0.241 MI | 29,684.980 FT = 5.622 MI |
| NET LENGTH | 79,531.060 FT = 15.063 MI | 1,560.000 FT = 0.295 MI | 81,091.060 FT = 15.358 MI |

FOR THE CONSTRUCTION OF HAZARD ELIMINATION AND SAFETY CONSISTING OF PROVIDE ADDITIONAL PAVED SURFACE WIDTH.

BEGIN PROJECT
CSJ: 0888-02-021
STA 514+06.08
REF. MRKR. 560+0.407

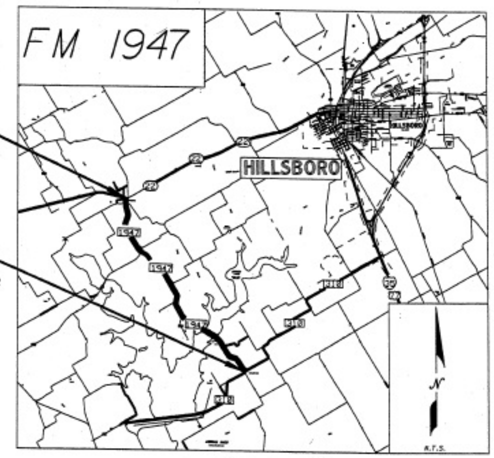
END PROJECT
CSJ: 0888-02-021
STA 0+00.00
REF. MRKR. 570+0.030




SCALE: 1" = 2 MI.

BEGIN PROJECT
CSJ: 1830-01-011
STA 313+42.64
REF. MRKR. 322+0.069

END PROJECT
CSJ: 1830-01-011
STA 0+09.00
REF. MRKR. 326+1.632




SCALE: 1" = 2 MI.



STP 2010 (644) SB

HILL

COUNTY ______ PROJ. NO. ______
HWY. NO. ______ LETTING DATE ______
DATE ACCEPTED ______

SPECIFICATIONS ADOPTED BY THE TEXAS DEPARTMENT OF TRANSPORTATION, JUNE 1, 2004 AND SPECIFICATION ITEMS LISTED AND DATED AS FOLLOWS, SHALL GOVERN ON THIS PROJECT: REQUIRED CONTRACT PROVISIONS FOR ALL FEDERAL-AID CONSTRUCTION CONTRACTS (FORM FHWA 1273, MARCH 1994).

EXCEPTIONS: NONE
RAILROAD CROSSINGS: NONE
EQUATIONS: 1830-01-011 -- STA 114+80 BK = 131+28.66 FWD (-1648.66 FT)

TEXAS DEPARTMENT OF TRANSPORTATION

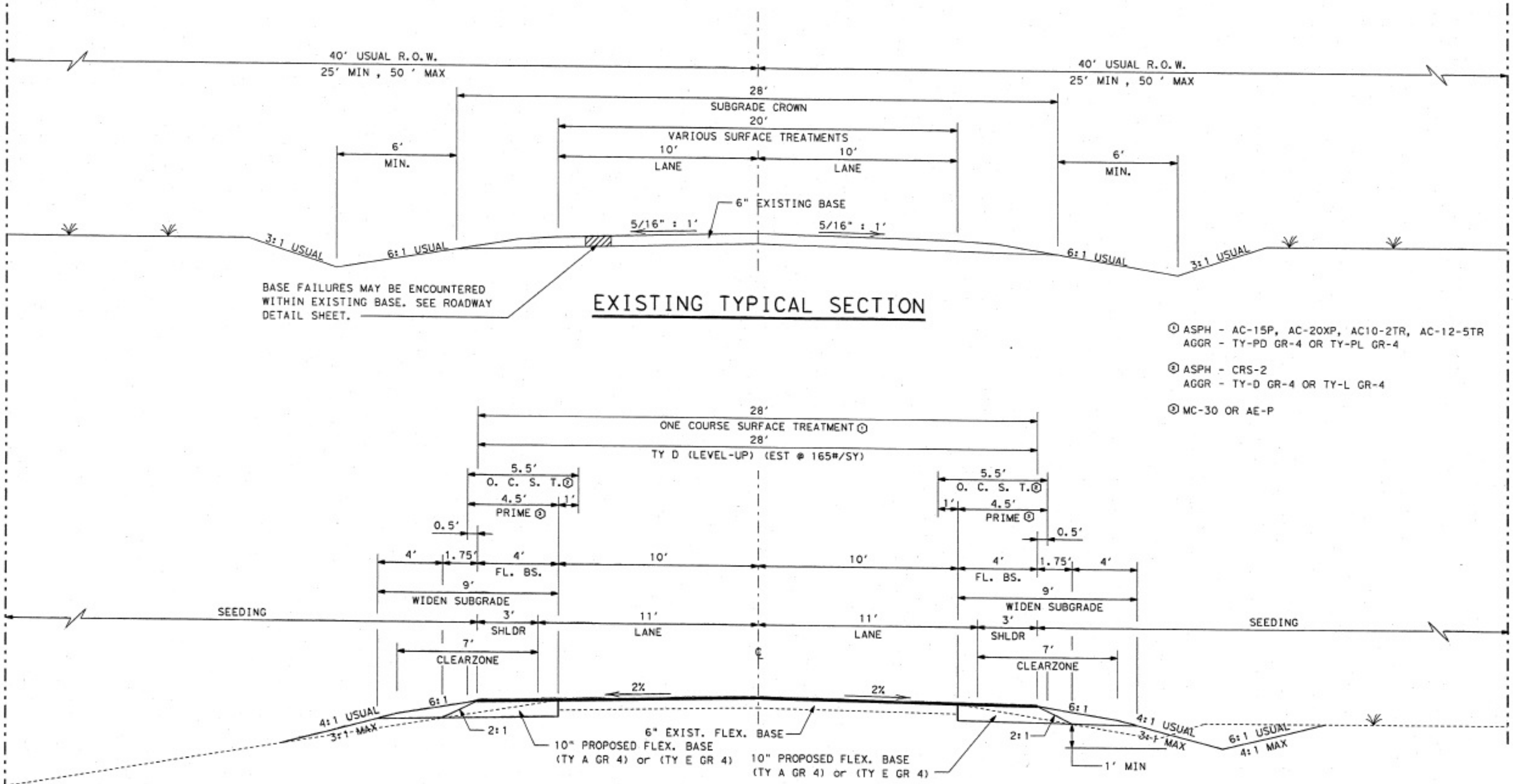
RECOMMENDED FOR LETTING 1/12/2010
Anthony J. [signature], P.E.
AREA ENGINEER

RECOMMENDED FOR LETTING 1/12/10
Allin A. Petter, P.E.
DIRECTOR OF TRANSPORTATION PLANNING & DEVELOPMENT

RECOMMENDED FOR LETTING 1/14/2010
Richard [signature] Sazick, P.E.
DISTRICT ENGINEER

APPROVED FOR LETTING
DIRECTOR, TRAFFIC OPERATIONS DIVISION

APPROVED FOR LETTING
DIRECTOR, DESIGN DIVISION




## EXISTING TYPICAL SECTION

① ASPH - AC-15P, AC-20XP, AC10-2TR, AC-12-5TR
AGGR - TY-PD GR-4 OR TY-PL GR-4

② ASPH - CRS-2
AGGR - TY-D GR-4 OR TY-L GR-4

③ MC-30 OR AE-P

## PROPOSED TYPICAL SECTION

STA 0+20.00 - STA 346+60.00
STA 347+35.00 - STA 455+35.00
STA 456+60.00 - STA 514+06.08

STATE OF TEXAS
DON L. MILLER
70906
LICENSED
PROFESSIONAL ENGINEER

Don L. Miller, P.E.
1/20/2010



# TYPICAL SECTIONS
# FM 309

SCALE = 1"=5'

| FED. RD. DIV. NO. | FEDERAL AID PROJECT NO. | | | SHEET NO. |
|---|---|---|---|---|
| 6 | | | | 3 |
| STATE | DIST. | COUNTY | | |
| TEXAS | WACO | HILL | | |
| CONT. | SECT. | JOB | HIGHWAY NO. | |
| 0888 | 02 | 021, ETC. | FM 309, ETC. | |

FM 309 Finished Product

FM 309 Finished Product

# FM 309 Experiencing joint cracking due to drought

# FM 309 Experiencing joint cracking due to drought

# Questions ???

# San Angelo District Experience

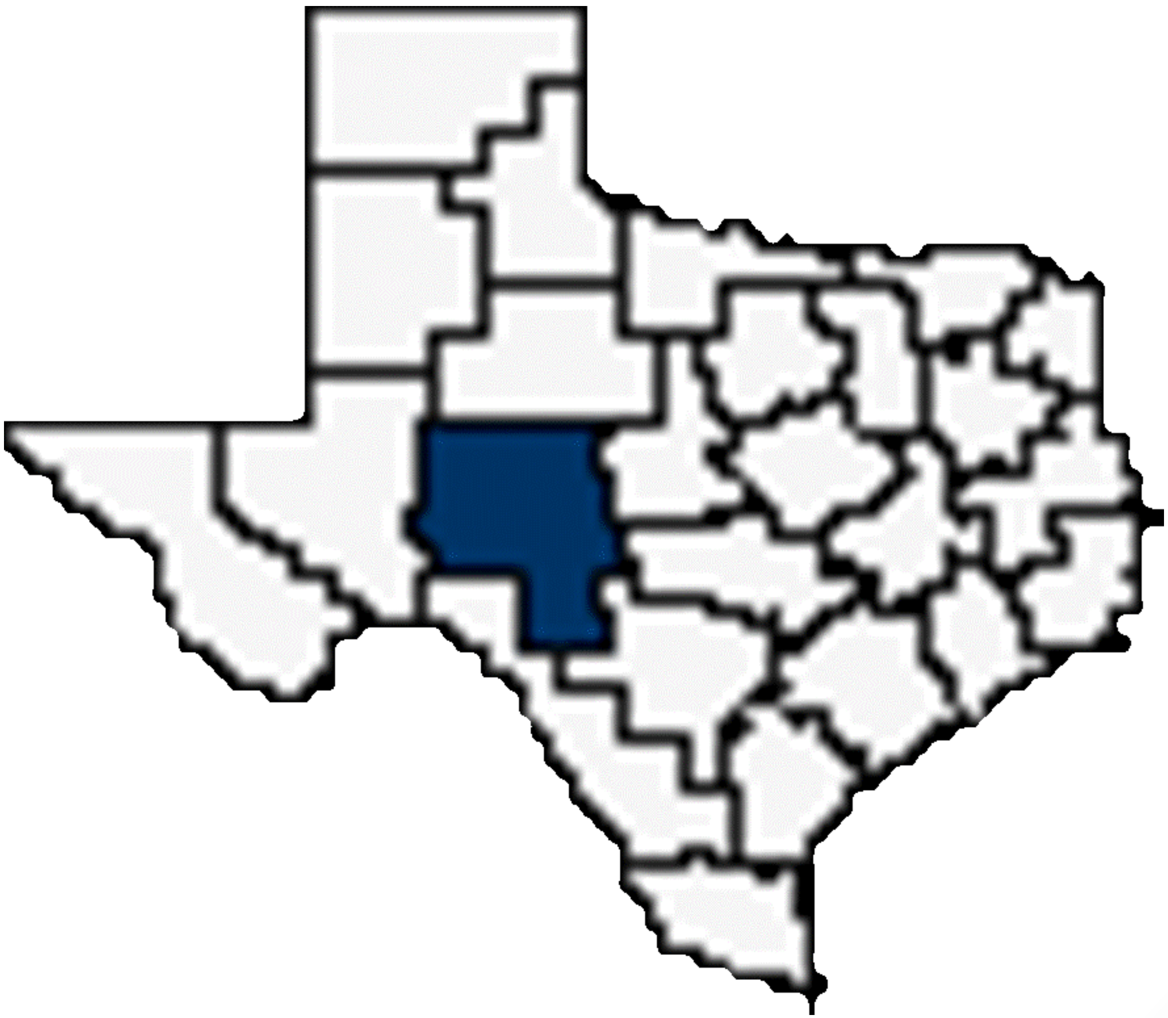
Project 0-6748:

Narrow Pavement Widening

# Overview

- **Maintenance Experience**
- **Construction Projects**

# San Angelo District



# Energy Sector

# Energy Sector

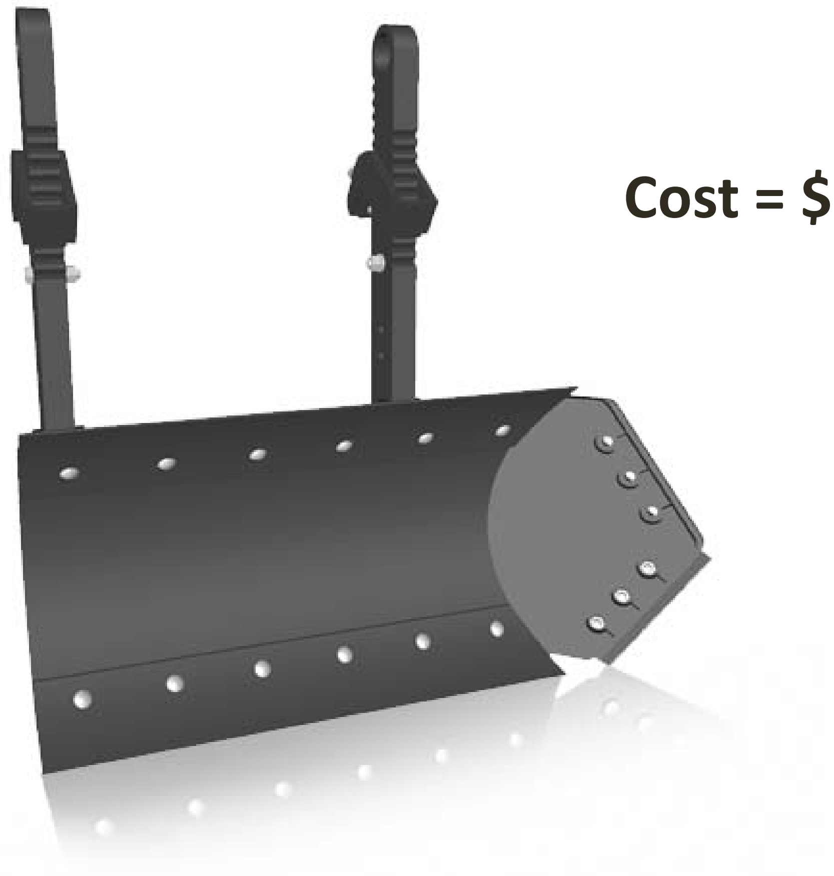
# Edge Drop Offs

# Edge Drop Offs

# Traditional Method

# Scope of Work

# Bonnell Road Widener



**Cost = $2000**

# Road Widener

# In-House Device

# Road Widener

# Road Widener

# In-House Device

# In-House Device

# Belly Dump

# Side Discharge Conveyor

# Side Discharge Conveyor

# Side Discharge Conveyor

# Side Discharge Conveyor

# Level Material

# Compaction

# Compaction

# Compaction

# Compaction

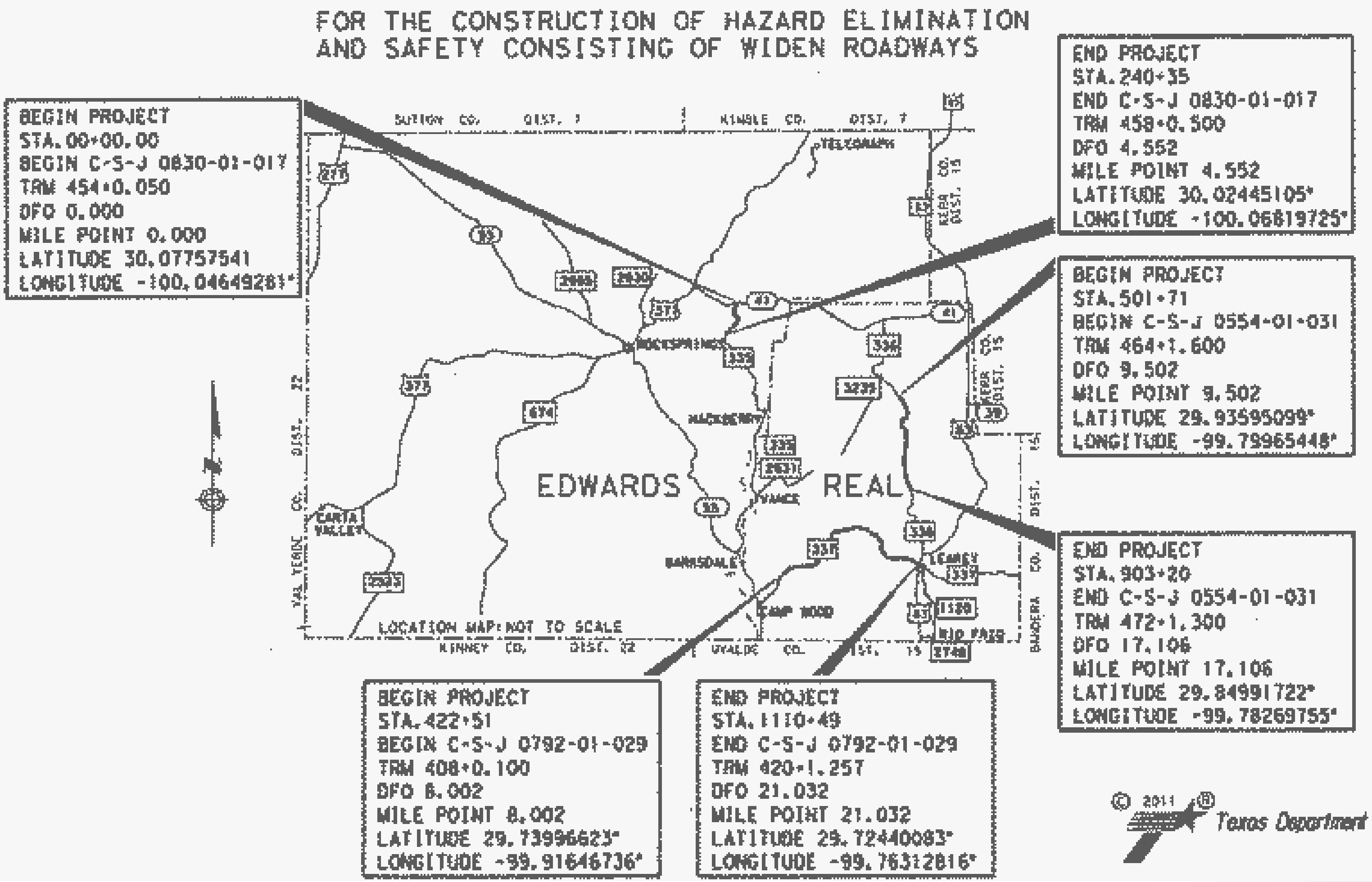
# Finished Product

# Finished Product

# Maintenance Experience

- **Material Cost: $20,000 / Lane Mile**
- **Production: ½ Lane Mile / Day**

# Construction Project



# Project STP 2012(456) HRR, ETC.

**CSJ: 0554-01-031, ETC.**

**Highway: RM 336, ETC.**

**County: Real**

**Length: 24.673 mi**

**Cost: $3,573,173.63**

**Area Engineer: R. Lewis Nowlin, P.E.**

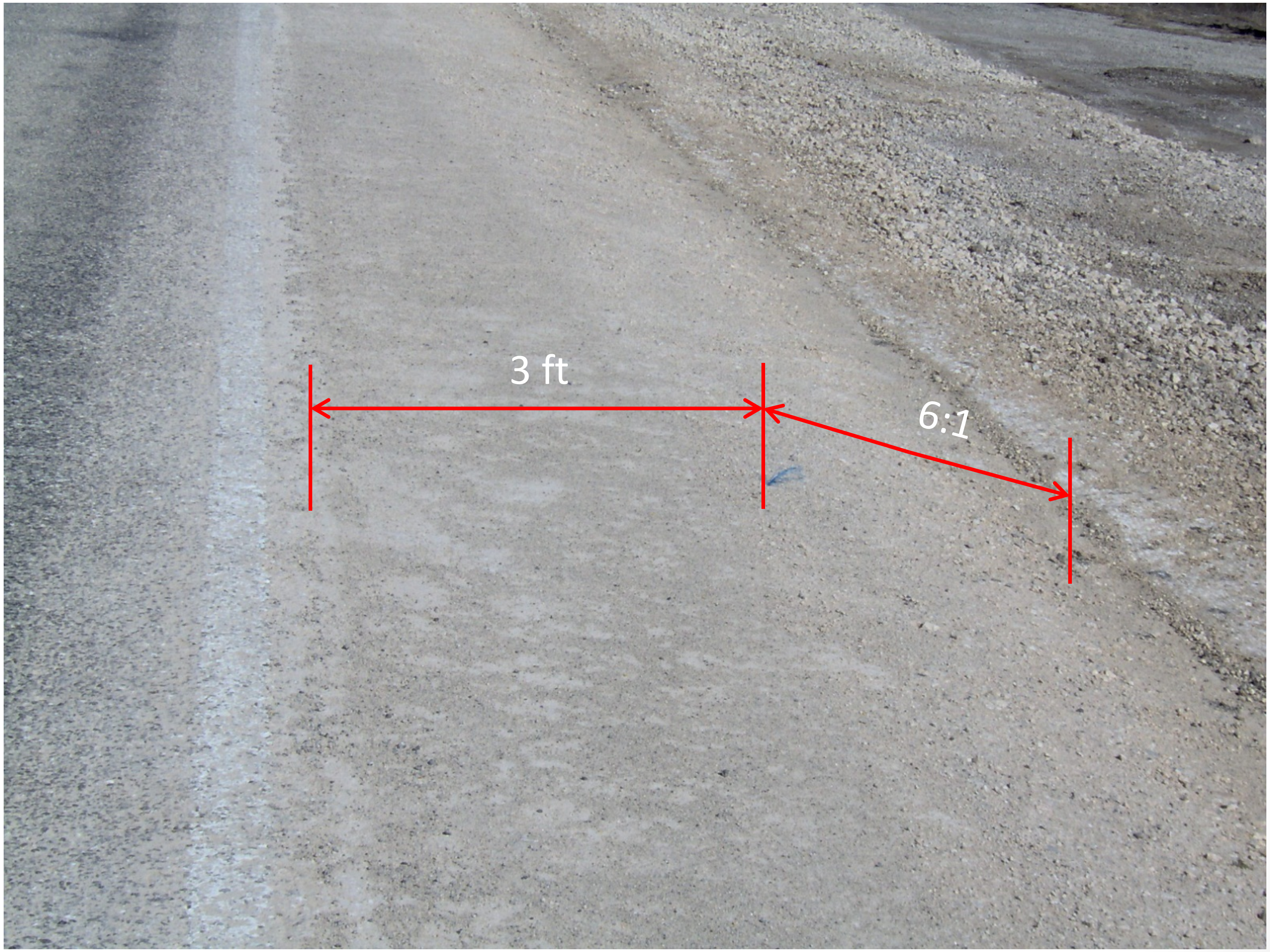
**Contractor: Allen Keller Company**

# Limited Work Area

# Limited Work Area

# Existing: 18 ft to 20 ft Wide

# Scope of Work: Add 3’ w/ 6:1 Base Taper



# ROADTEC RX-600e

# Step 1: Mark Cut Line

# Step 2: Mark Cross Slope

# Step 3: Blade Existing Grass Off

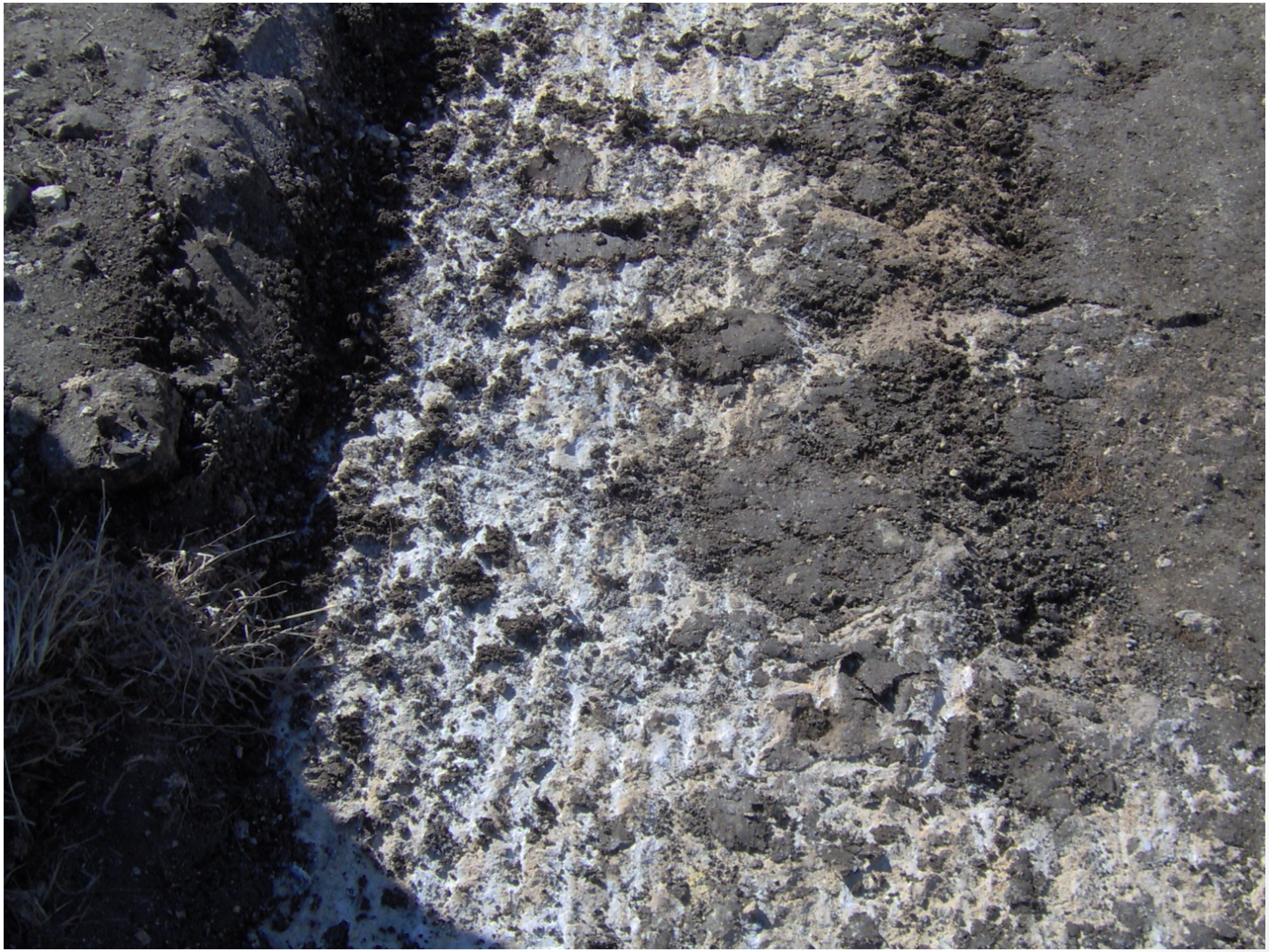
# Step 4: Remove Existing Material 6” Deep and 6.5’ Wide

# ROADTEC Miller in Operation

# Provides Clean Cut

# Mills Through Existing Rock

# Mills Through Existing Rock



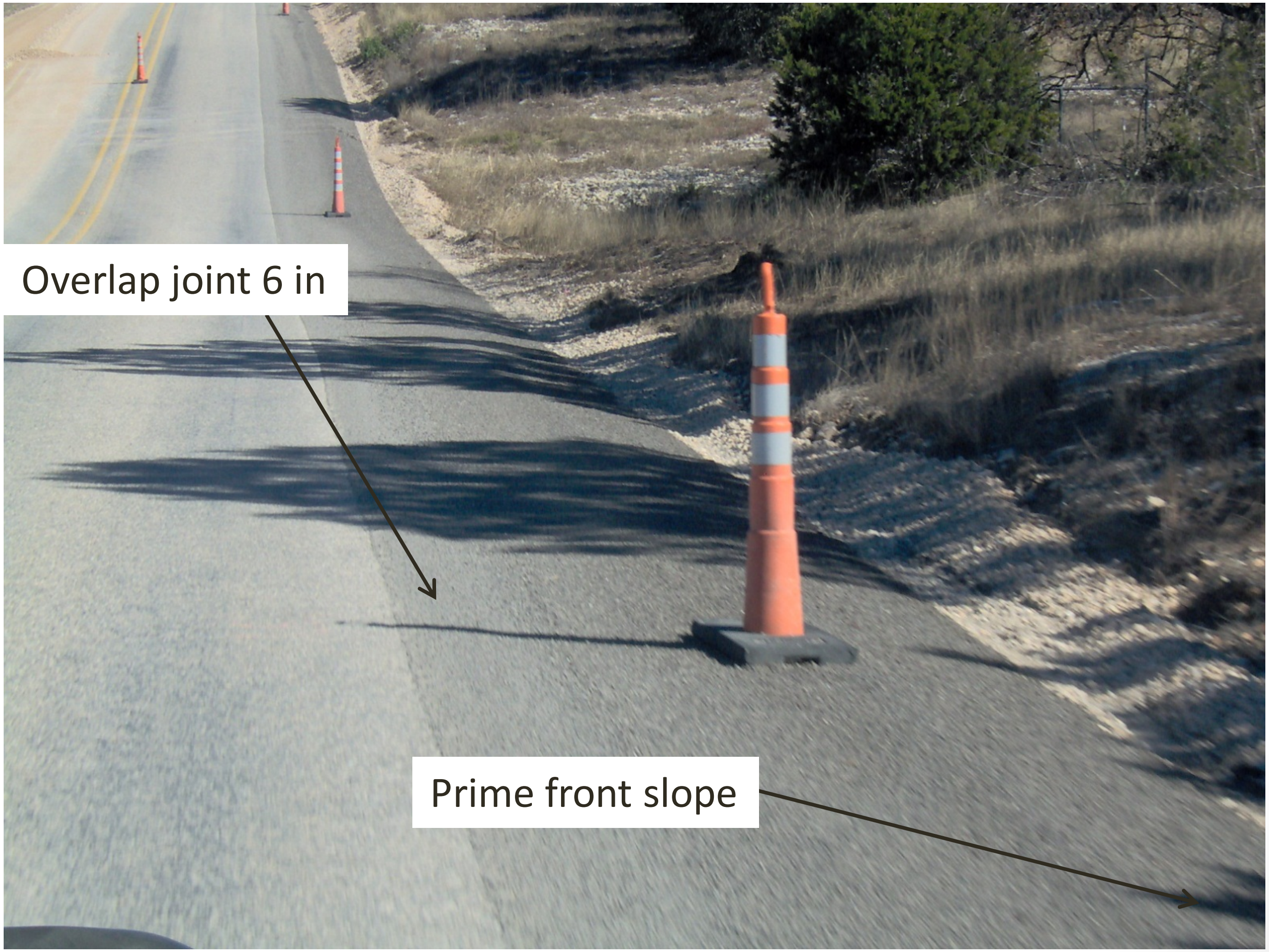
# Step 5: Haul Off Excavated Material

# Step 6: Compact Existing Subgrade

# Step 7: Dump Pre-Wet Flexbase

# Step 8: Process Flexbase

# Step 9: Prime with RC-250 Asphalt and Gr 5 Aggregate



# Remaining Work: Place Final Seal Coat

# Remaining Work: Place Final Seal Coat

# Project STP 2012(456) HRR, ETC.

**Project Cost: $145,000 / Mile**

TEXAS DEPARTMENT OF TRANSPORTATION

# BRYAN DISTRICT - PAVEMENT WIDENING

Project 0-6748, “Narrow Pavement Widening Webinar-Workshop”

July 2, 2013

Darlene Goehl, P.E.

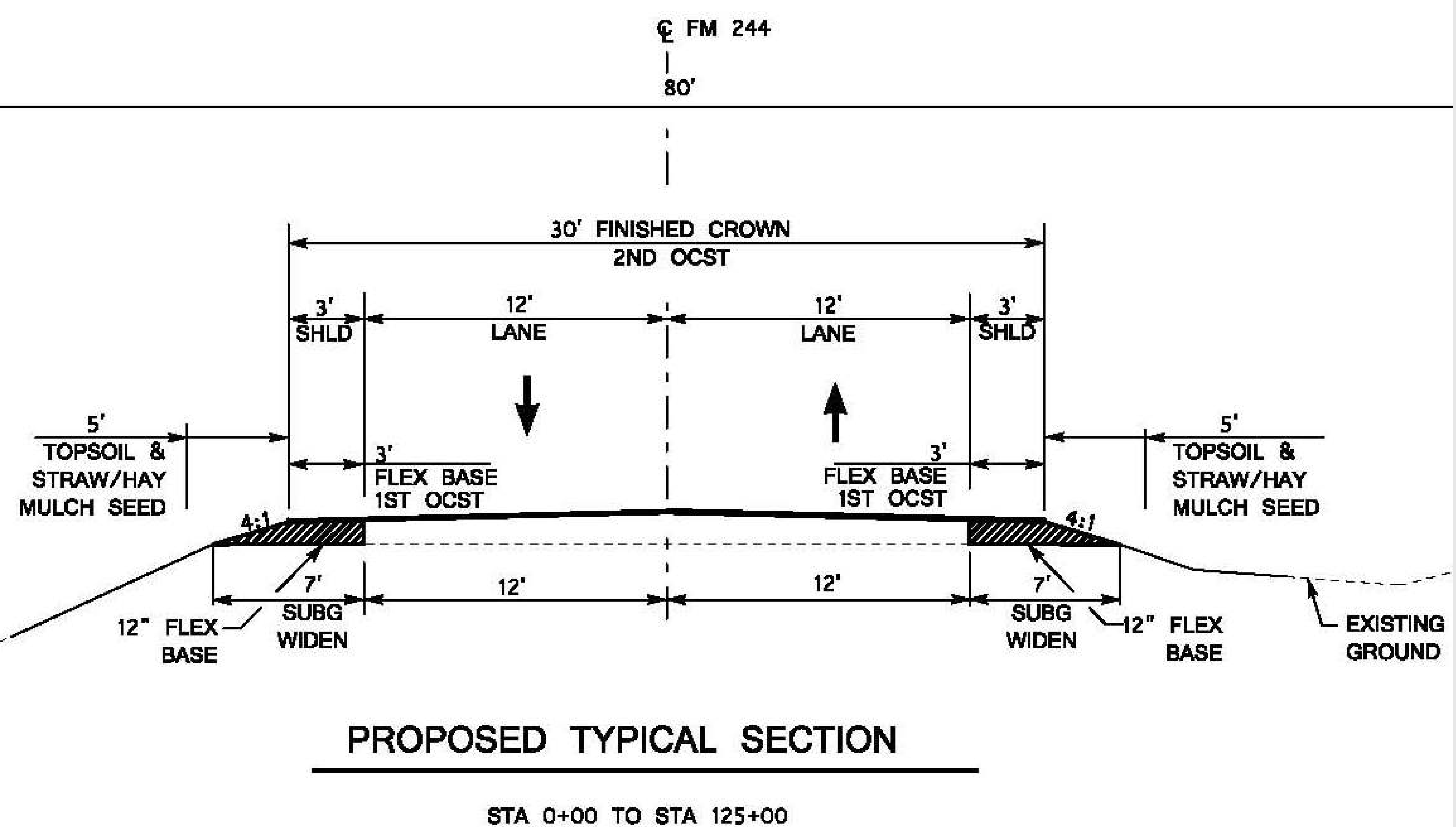
# Outline

- Widening Projects
  - 3’ Shoulders for safety projects
- Initial Design philosophy
- Problems during construction
- Cost Analysis and Design Change
- Current design Philosophy

# Initial Design Philosophy

- Select Roadways with good existing pavement condition
- Widen to each side with thick flexible base
  - Widening with denser material than existing causes "bathtub" effect, which increases the deterioration rate of the existing pavement.
  - Future rehabilitation projects  would recycle the new base into the old pavement
  - Minimize subgrade and front slope work

# Typical Section – FM 244



# Construction Problems

# Construction Problems



# Problems

- Compacting narrow widening
- Early Maintenance of deteriorated construction Joint

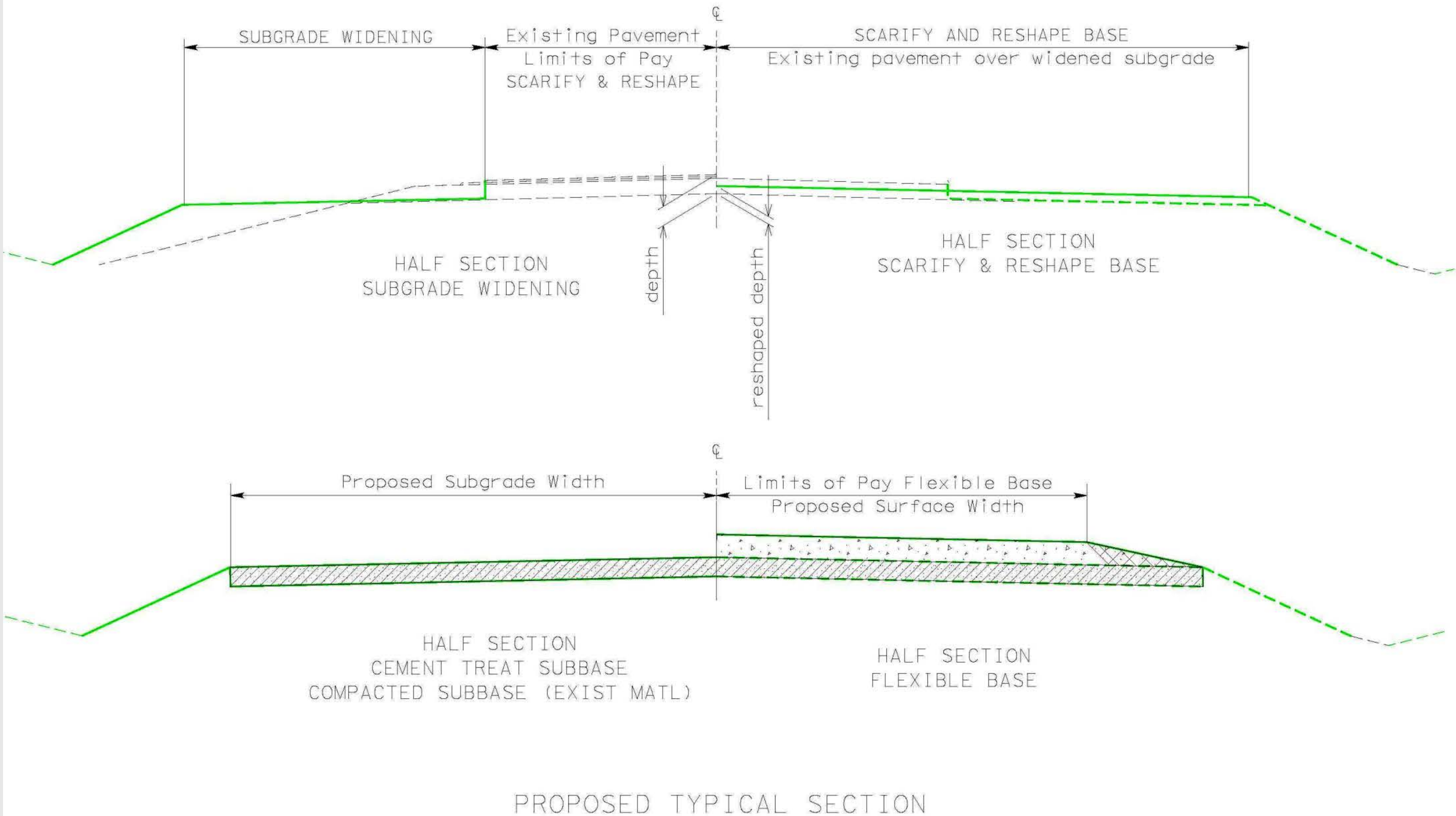
- Can we design a cost effective widening that is competitive with the other projects in the State based on the benefit-cost ratio?

# Cost Effective Solution

- Pavement Design
  - Uniform Pavement Structure
  - Eliminate the narrow area compaction problems
  - Cost competitive design

| County | Highway | csj | LOW BID | SY | cost/sy | miles | Typ Sec | comments |
|---|---|---|---|---|---|---|---|---|
| Milam | FM1712 | 0210-03-021 | $ 1,046,654.75 | 56047.79 | $ 18.67 | 3.412 | Uniform | |
| Milam | FM487 | 0210-03-022 | $ 276,144.74 | 17313.71 | $ 15.95 | 1.054 | Narrow | Additional Maintenance |
| Milam | FM1600 | 1519-01-030 | $ 1,064,841.04 | 58528.21 | $ 18.19 | 3.563 | Uniform | |
| | | | | Avg Uniform | $ 18.43 | | | |
| | | | | Narrow | $ 15.95 | | | |
| | | | | Difference | $ 2.48 | ~$ 40,750 per mile more for Uniform pavement structure | | |

# Typical Section



# Uniform Pavement Structure

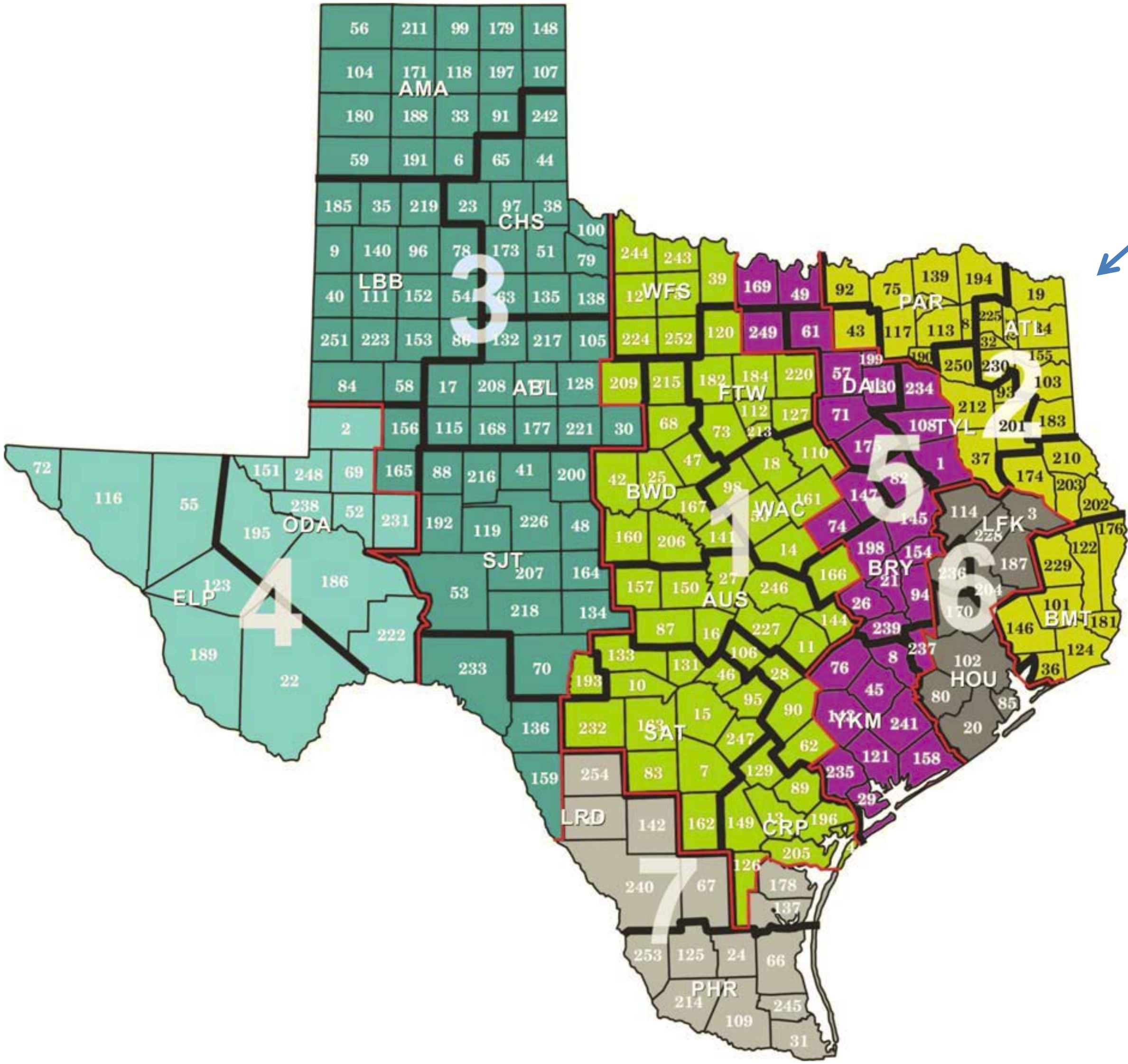
# Uniform Pavement Structure

# Questions

# 0-6748: Best Practice for Flexible Pavement Structure Widening Projects

## Atlanta District Experience

André de Fortier Smit
Miles Garrison




ATLANTA
DISTRICT

“Wet & Cold”

# Widening Construction

- Fast moving:
  - Subgrade + Flexbase = 0.5 mile/day/side
  - Flexbase + Prime = 1 mile/week
- No pavement drop-off at the end of the day
- Equipment (contractor) :
  - Modify grader for subgrade widening
  - Use smaller milling machine
  - Don’t disturb existing side slope

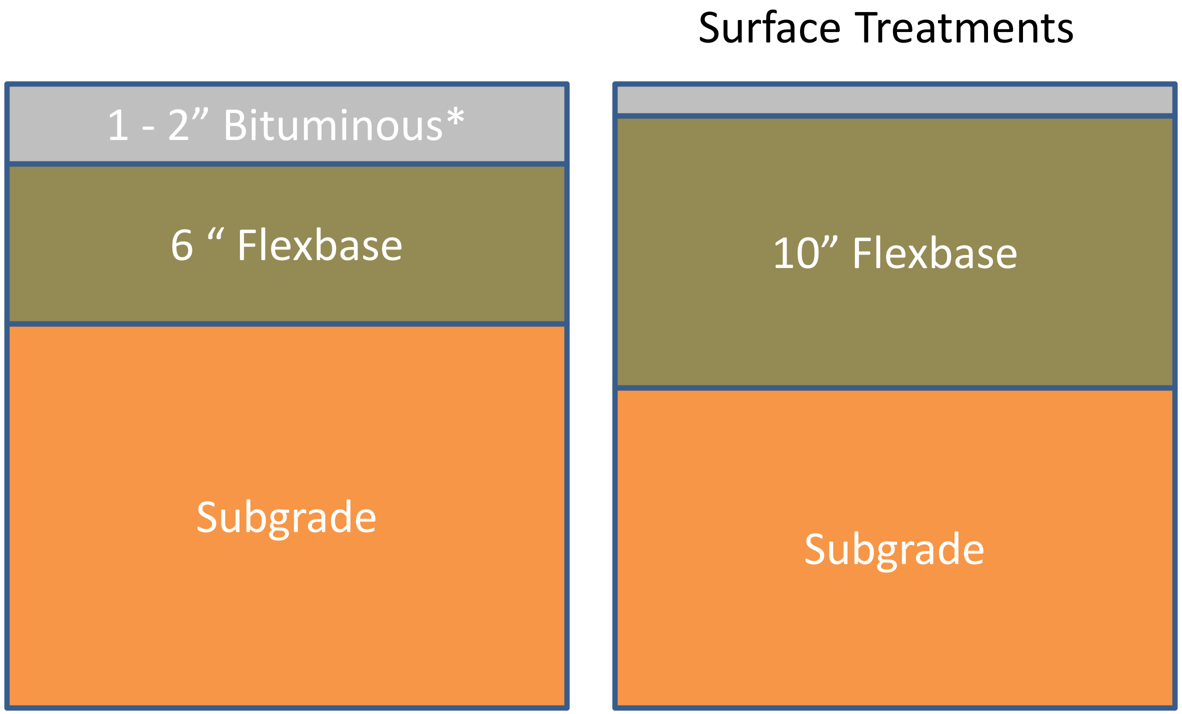
# Widening Construction

- Longitudinal construction joint:
  - Compaction issues
  - Flexbase settlement
  - Patch prior to OCST
  - If severe, overlay problem areas with HMA using drag box
- Not always possible to extend or widen existing drainage structure with road widening due to timing of funding

# District Interview

- Most of the widening of roads in Atlanta district is completed, 95% - 98%, so very few projects are planned or ongoing
- Atlanta is particularly wet (compared to other districts) with very few HMA plants, hence their widening projects differ significantly from their neighbor, Tyler, which uses a lot of HMA for widening.

# Pavement Widening Design




* Seal coats, blade on LRA and ACP

# Widening

- Widening typically involves 10 inches of un-stabilized flexbase, a level-up and seal coat covering the entire roadway - decision could be dictated by age of last seal and when scheduled for next District Wide seal.
- 6” to 8” of cement stabilized subgrade when widening 4 feet or more.  Helpful when widening out over old ditch line.  When used minimum width of cement treatment is 7 feet.

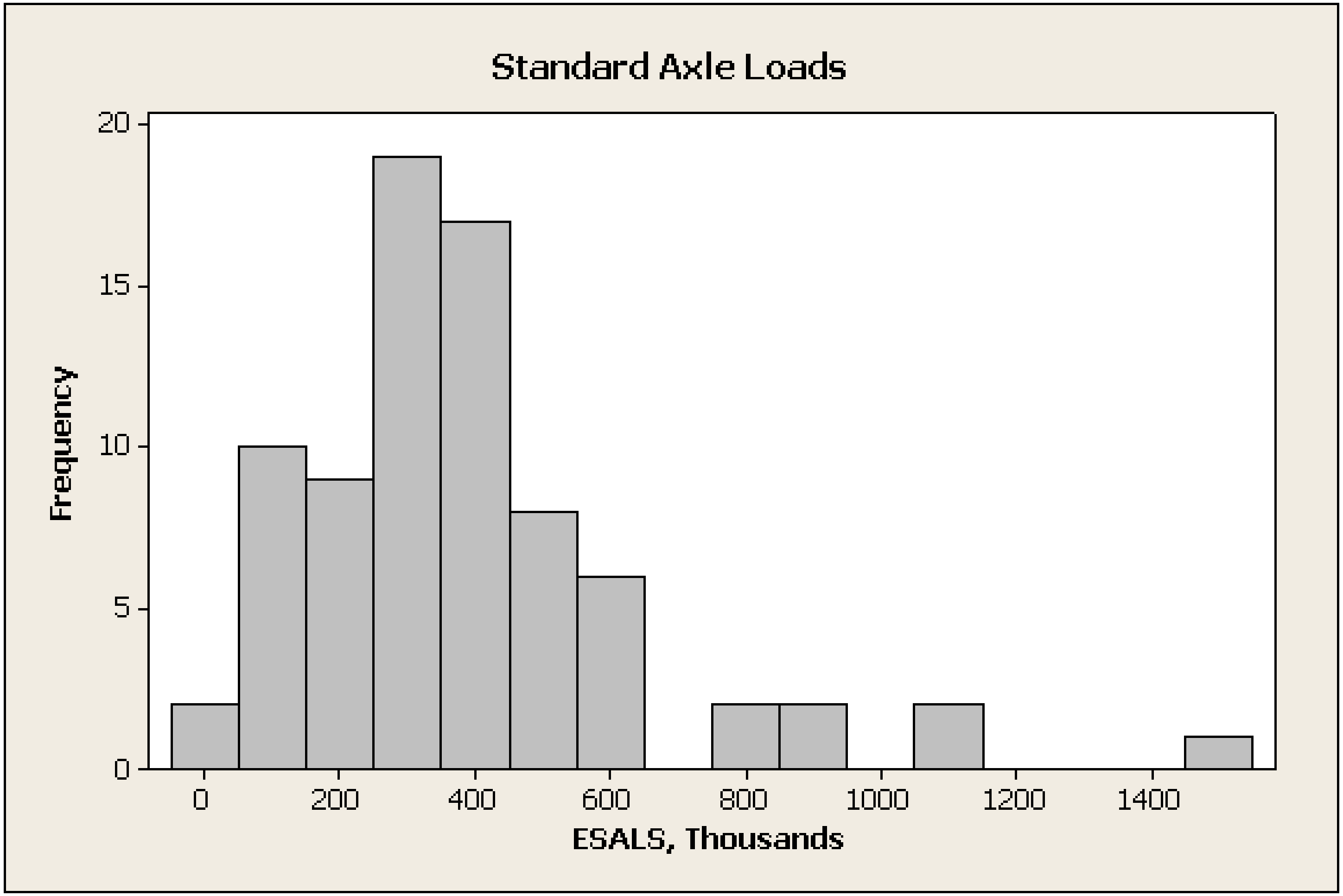
# Widening

- If the road is under the district wide seal coat program then the widening will receive a second surface treatment as well. Lots of attention to ensure adequate drainage – Atlanta is a wet district!

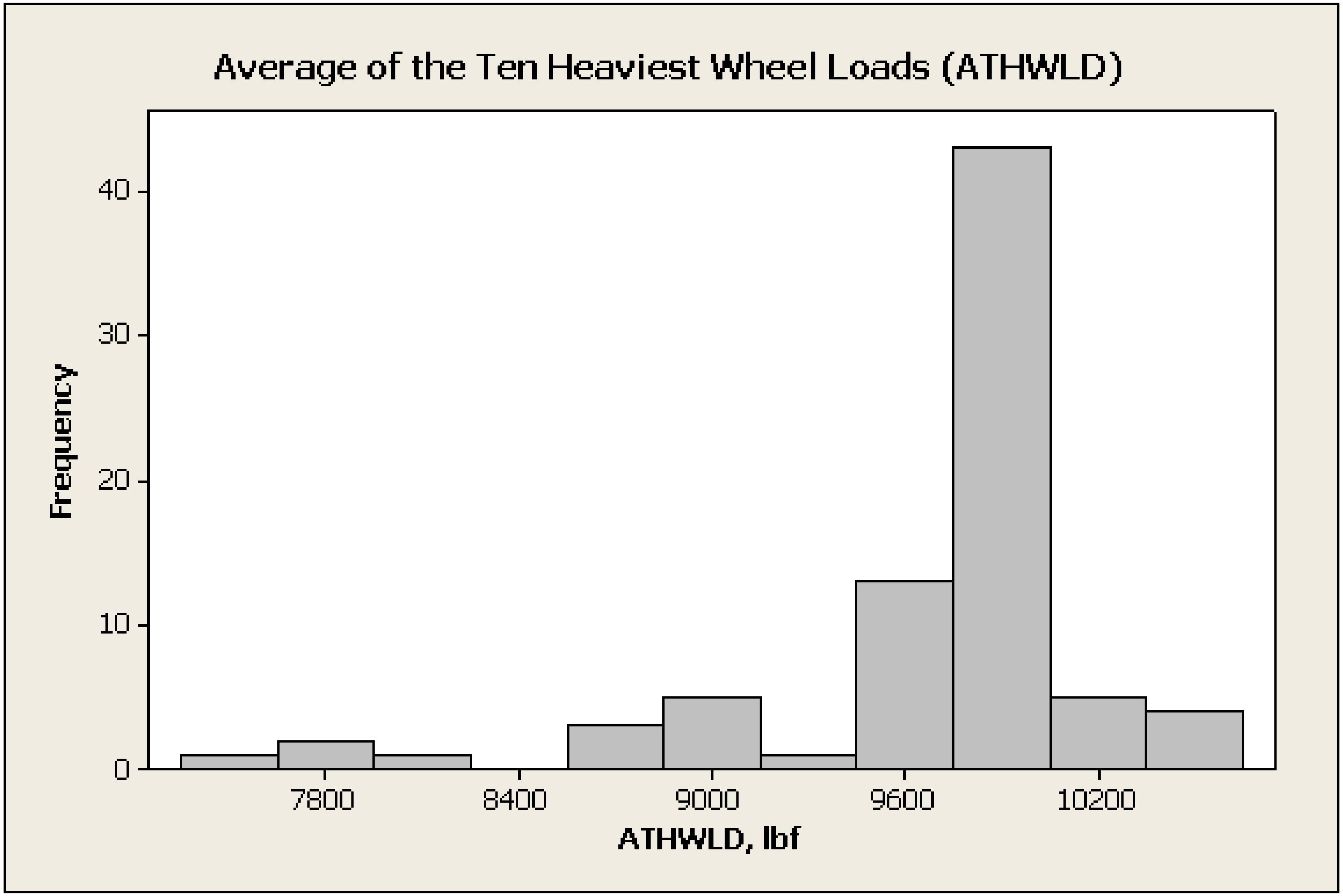
# Design per Funding

| | | ESALS (1,000s) | ATHWLD (lbf) | % Tandems | Texas Triaxial, in |
|---|---|---|---|---|---|
| **Safety Bond (78 projects)** | AVG | 384 | 9,682 | 53 | 15 |
| | MIN | 41 | 7,600 | 10 | 10 |
| | MAX | 1,519 | 10,500 | 80 | 28 |
| **HES (60 projects)** | AVG | 469 | 9,941 | 58 | 16 |
| | MIN | 41 | 7,600 | 10 | 10 |
| | MAX | 1,335 | 11,500 | 90 | 25 |

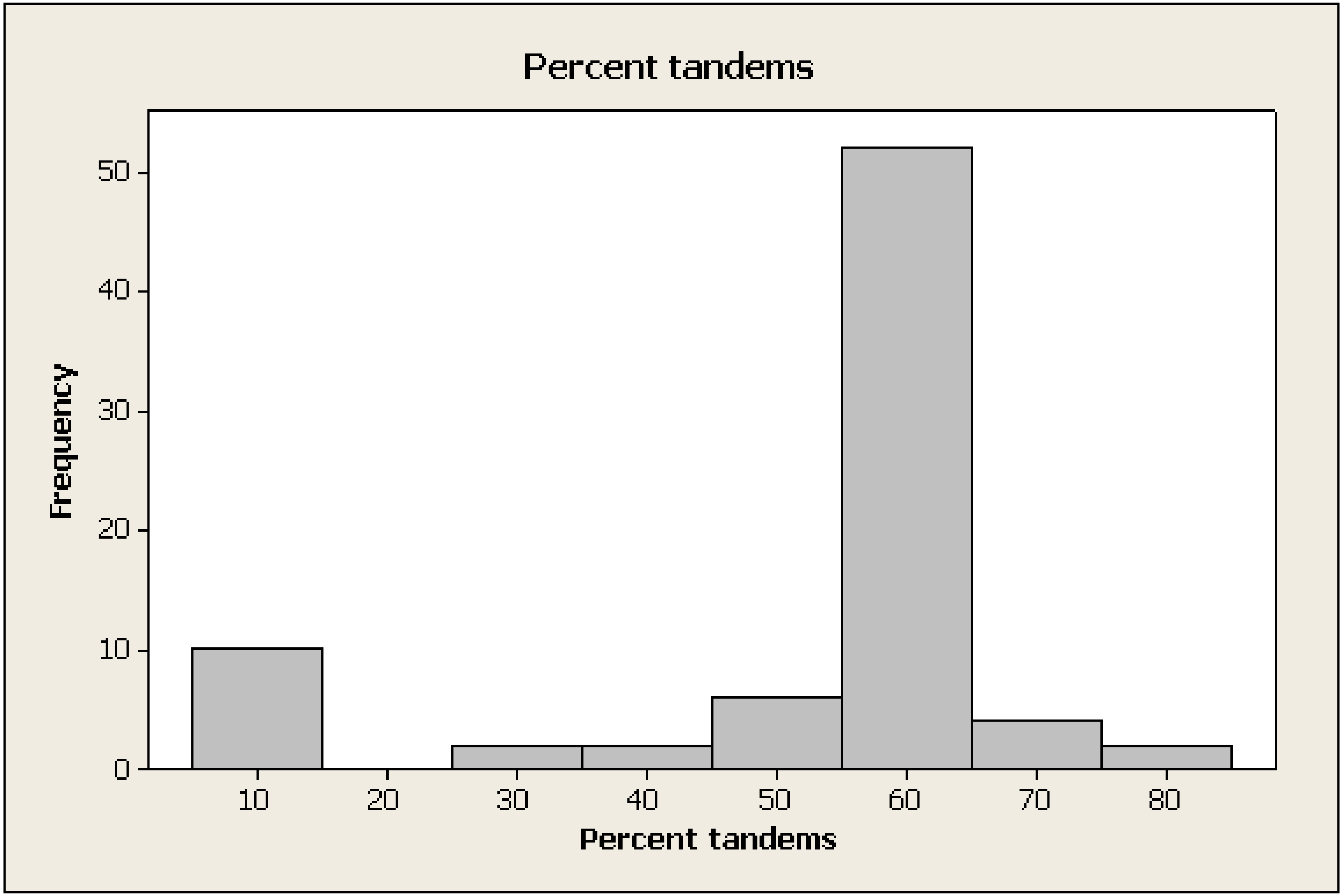
# Safety Bond: Design ESALS



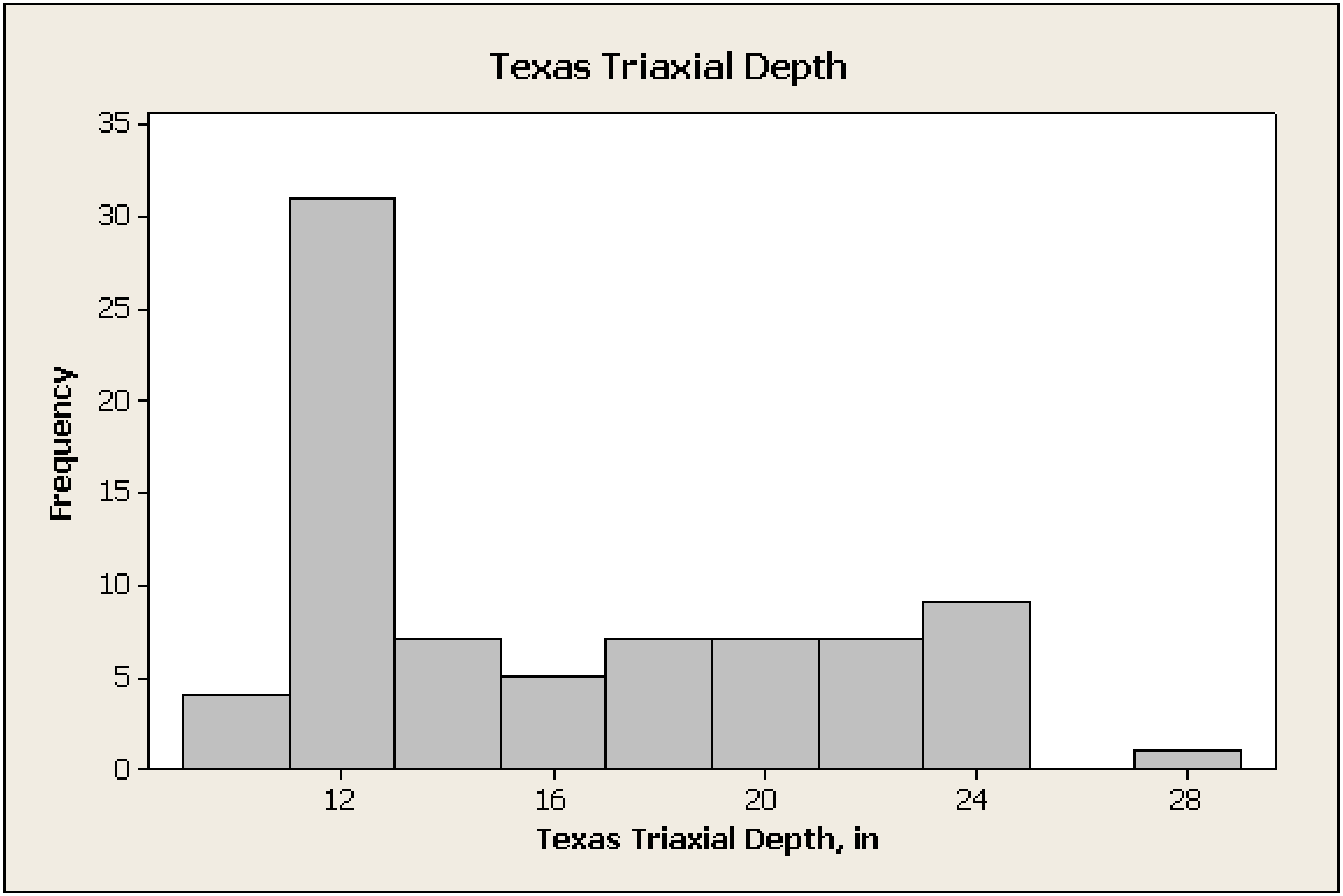
# Safety Bond: ATHWLD



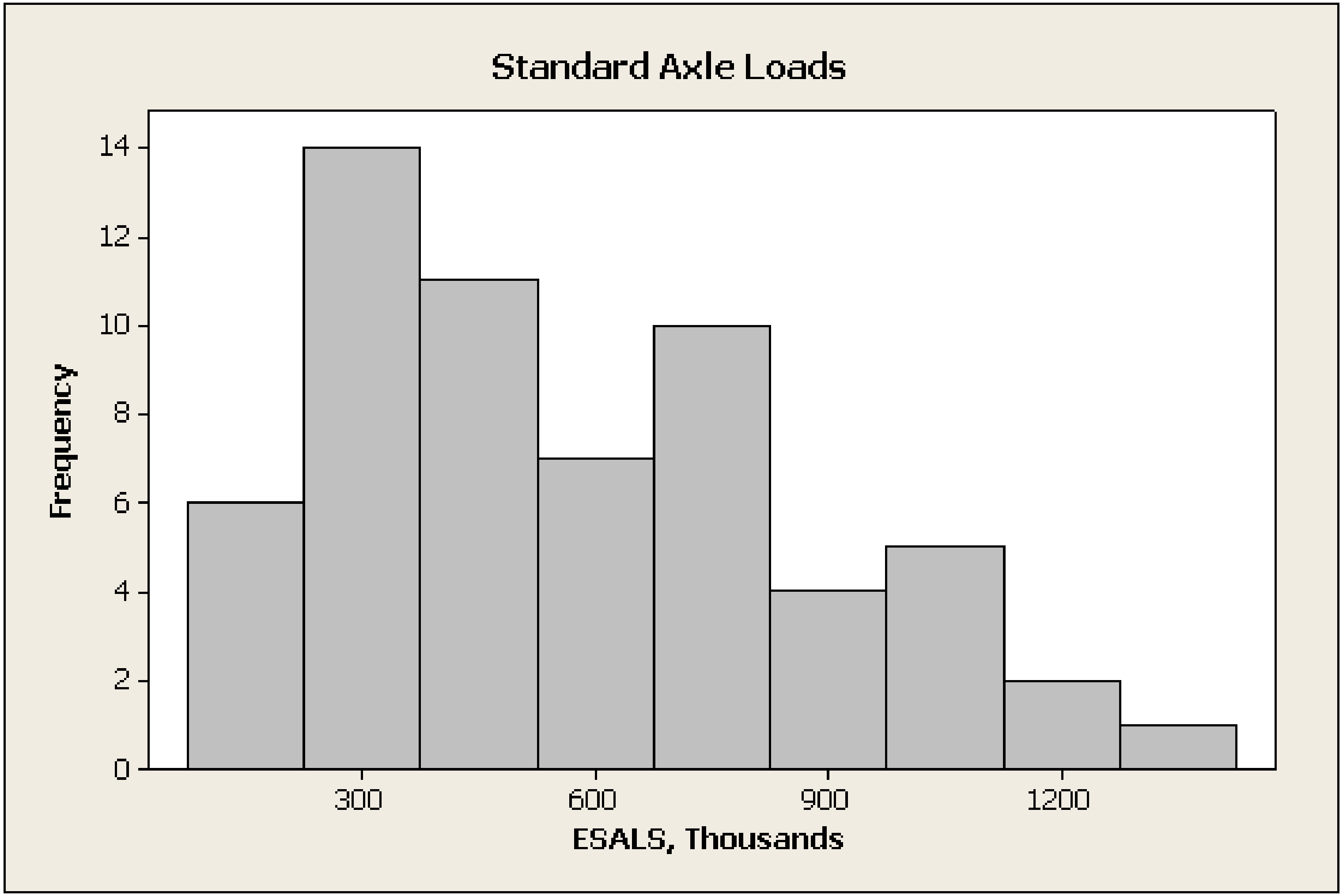
# Safety Bond: Percent tandems



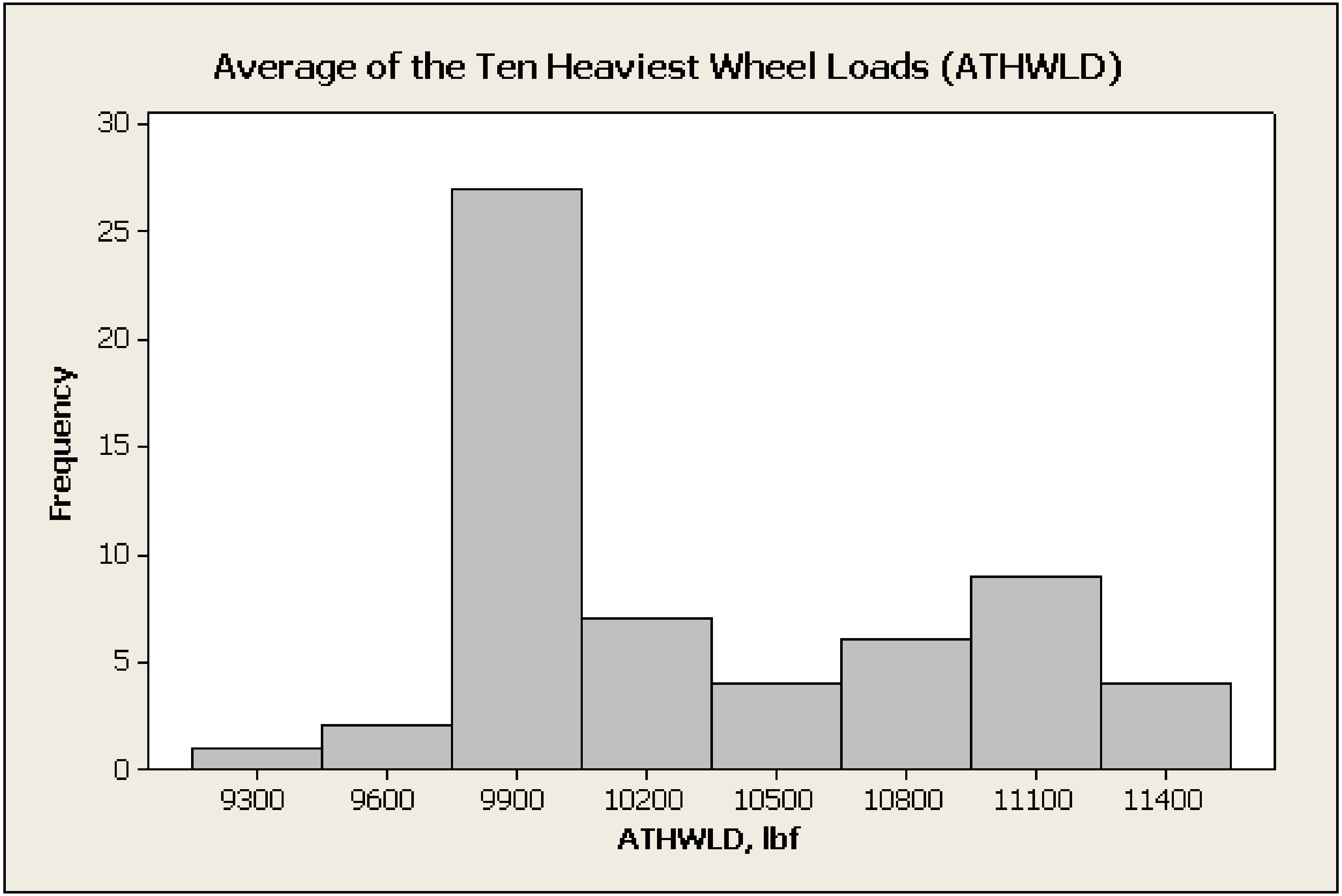
# Safety Bond: Texas Triaxial



# HES: ESALs

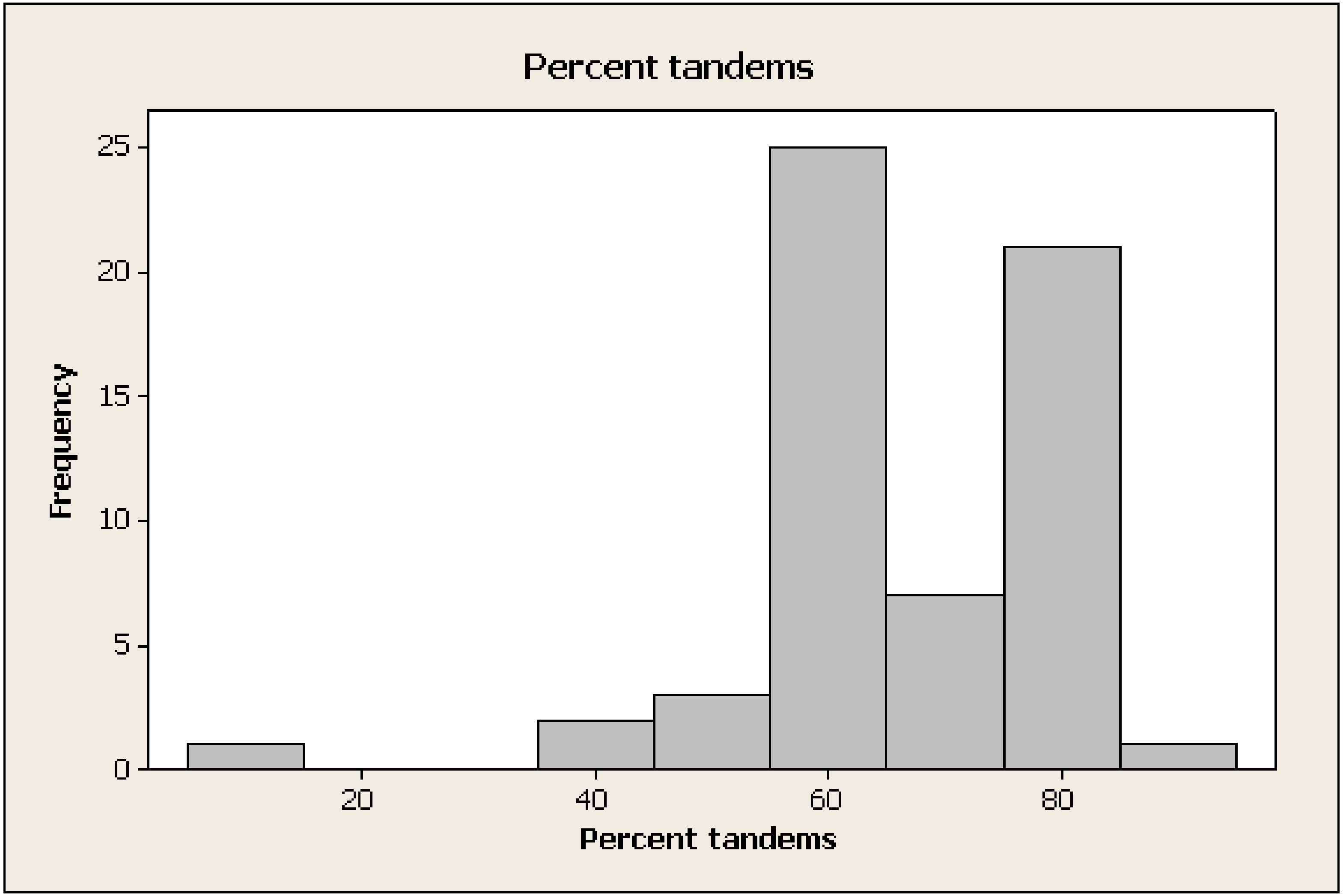

Standard Axle Loads
Frequency
14
12
10
8
6
4
2
0
300
600
900
1200
ESALS, Thousands

# HES: ATHWLD

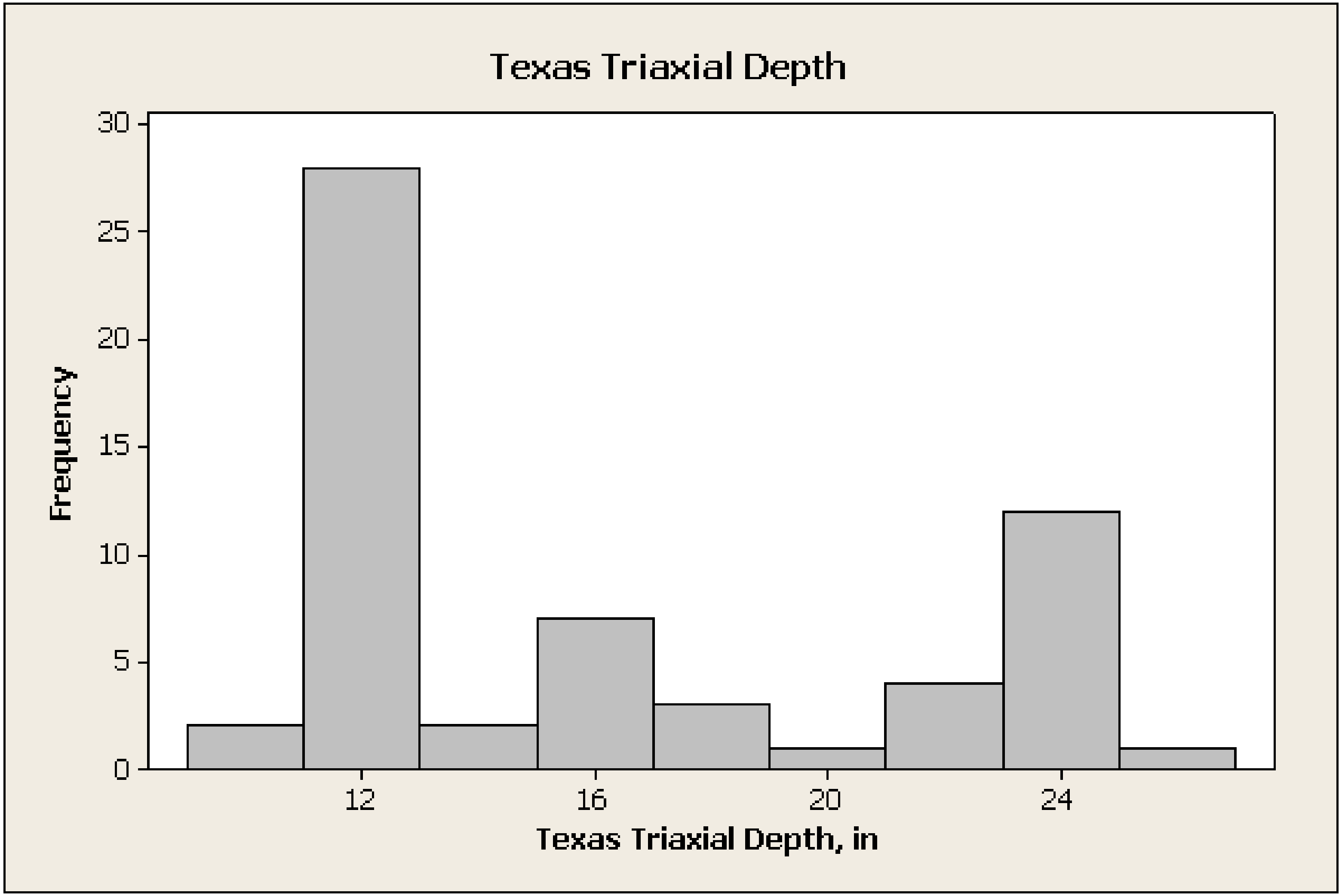


Average of the Ten Heaviest Wheel Loads (ATHWLD)
Frequency
30
25
20
15
10
5
0
9300
9600
9900
10200
10500
10800
11100
11400
ATHWLD, lbf

# HES: Percent tandems



# HES: Texas Triaxial



CENTER FOR TRANSPORTATION RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN

# 0-6748: Best Practice for Flexible Pavement Structure Widening Projects

## Pavement Widening Equipment

Mike Murphy
Maria Burton

# Pavement Widening Equipment

- **Equipment types**:
  - Milling machines
  - Attachments for skid steer and front end loaders
  - Road wideners
    - Non self-propelled & self-propelled
  - Full depth reclamation equipment
  - Small compactors and other devices to ensure good quality projects

# Milling Machines

**Roadtec**
**RX-400e Cold Planer**


**Roadtec**
**RX-700 Cold Planer**


**Caterpillar**
**PM-201 Cold Planer**


**Roadtec**
**RX-600e Half-Lane Cold Planer**


**Roadtec**
**RX-900 Cold Planer**

**Wirtgen**
**Cold Milling Machine W 150/W 150i**

# Attachments
## (for Skid-Steer Loaders)


**Skid steer with Road Hog Self Power Cold Planer attached**

- Hydraulic tilt, depth, and sideshift controls
- Options for narrower drums
- Models 18” - 40” cutting width

# Attachments
## (for Skid-Steer Loaders)



**Skid steer with a Road Widener attached**

- Easy to maneuver around obstructions (e.g. guardrails, sign posts)
- Shoulder widths 1 – 3.5’
- Trench repairs
- Bicycle trails and paths

# Attachments
## (for Skid-Steer Loaders)


**RoadHog**
Road Saws



**PowerAttachments – Zanetis**
Cold Planers (Spain)

# Attachments
# (for Front-End Loaders)



**Front-end loader with Road Hog Self Powered Cold Planer attached**

- Models 30" - 72" cutting width
- Shoulder milling, pothole milling
- cuts for utility pipe installation
- In place pavement recycling
- Full depth reclamation

# Attachments
## (for Front-End Loaders)



Front-end loader with Asphalt Zipper attached

# Attachments
## (for Road Graders)

- Some districts / contractors use:
  - motor graders to cut the trench
  - a plow mounted to the front of the grader to clear the trench
  - a belly dump to place the base material

# Attachments
## (for Road Graders)

Road grader with a Bonnell Road Widener attachment


Road grader with a Bonnell Flow Gate attachment

# Attachments
## (for Road Graders)



Road grader with a Maddock rotary cutter attachment

CAT Motor Grader Scarifier

# Non Self-Propelled Road Wideners

## Midland Machinery Widener Attachment

- Spread width: 1′ – 8′
- Spread depth: 12′ above to 12′ below grade
- Heavy duty caster wheels – don't deflect under load as pneumatic tires do

# Non Self-Propelled Road Wideners

**<u>Lessons Learned</u>**:

- Non self propelled & skid steer/front end loader equipment:
  - Used successfully for short projects, edge repairs & patching
  - Not of sufficient strength to handle a full size (longer) construction project
  - Front end loader devices are mounted too far away from the operator
    - Hard to feel cutting depth
    - Hard to control line of cut

# Self-Propelled Road Wideners

- **<u>Lessons learned</u>**:
  - Important to match the size of the self propelled road widener to the project
    - light weight machines might not provide adequate quality or may break down due to overload

# Self-Propelled Road Wideners


Model SP-12

SPD-10


SP-8

## Midland Machinery Co. Self Propelled Road Wideners

- spread width: 1 to 12' max, 10' max., 8' max.
- 12" above to 12" below grade
- Trench fill option, broom option

- **Converts left or right side spreading**

# Self-Propelled Road Wideners


Model W430


W530

**Weiler Road Wideners**

- 1′ – 8′ widening
- optional weight kits – can widen up to 10′
- working depth: 12″ above to 12″ below grade

- **optional rear steering for maneuverability**

# Self-Propelled Road Wideners

**Mid-State Equipment Company – Wilspread road widening machine**

- Build road shoulders 1' – 5' width
- Operator controls flow of materials and spread speed

# Self-Propelled Road Wideners

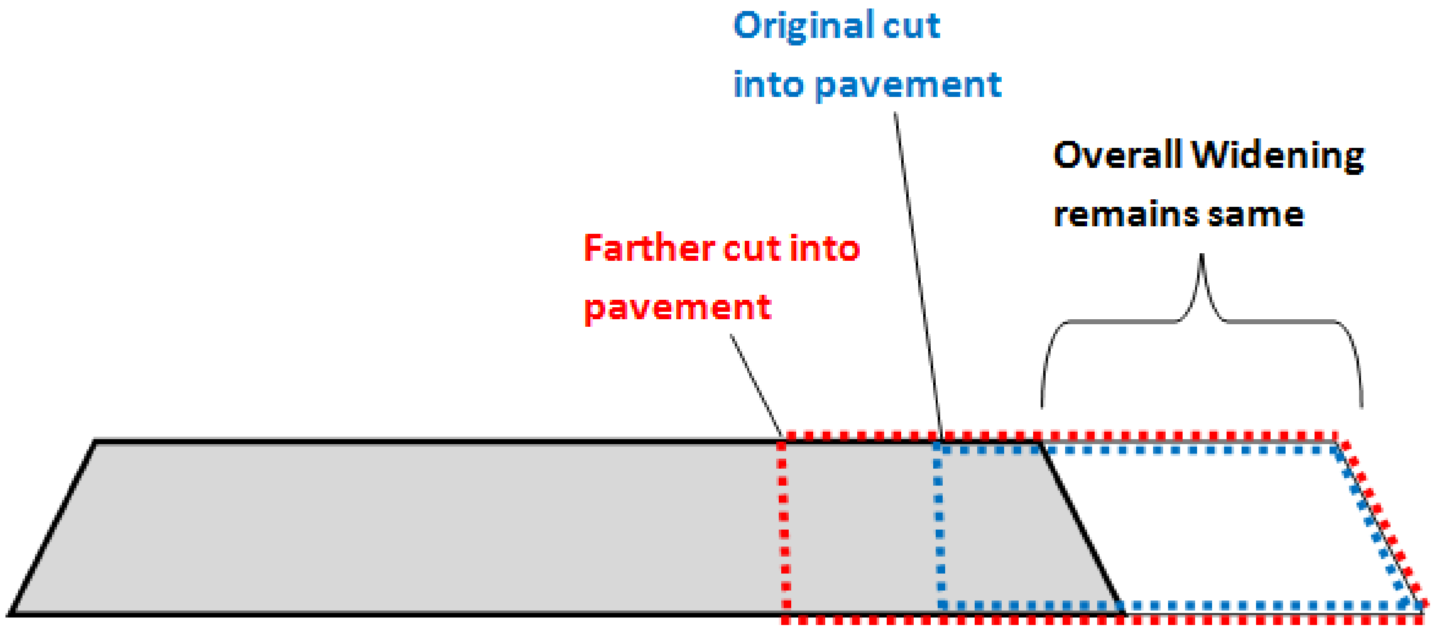

**Blaw Knox**
RW-100B Road Widener

(France)

**Franex**
Self-Propelled Road Widener EL1000

# Full Depth Reclamation (FDR)

- **<u>Lessons Learned</u>**:
  - Recommended: cutting the joint further into the pavement
  - Gain more good base material and to stabilize the pavement with emulsion
  - Overall added width remains same
    - Amount used in widening will be greater
    - End product of higher quality



# Full Depth Reclamation (FDR)

## Example:

**Narrow widening project:**

- Reclaimer linked to Emulsion Tank Truck
- Included larger portion of existing pavement
  - ensured base material available for widening
- Additional material added, scarified with Wirtgen with Emulsion
- Worked with a grader, rolled with a sheep's foot, then flat wheel and pneumatic tired roller
- Overall added width remained same
  - but allowed use of full size equipment & got better quality

# Full Depth Reclamation (FDR)

- Some Districts own a BOMAG or CAT tiller which can be used to perform Full Depth Reclamation on narrow widening projects.


**BOMAG Recycler**


**CAT RM300 Road Reclaimer**

# Other Equipment - Rollers


Mauldin Paving Products
4700 Pneumatic Roller

Broons
Square Impact Rollers

(Australia)

Broons
BH-1300 Impact Roller

Hamm (German)
CompactLine HD 8 – HD 14, The flexible all-rounder


Sakai SW/TW300-1 Series
Vibratory Asphalt Rollers

Sakai R2H-2 Series
Three-Wheel Static Roller

# More Equipment
# (from around the world)

(Germany)

Midland Europe
(SPR 6 shown)

(Sweden)

Dynapac - Equipment
(Compact Planer – PL350T shown)

Flocon
Road Base Grader Attachment

(Australia)

(Australia)


Sharpe Brothers
Sidewinder

(U.K.)

UK Sidewinder
Widening Machine