Performance of Stone & RAP Interlayers Under Accelerated Load Testing

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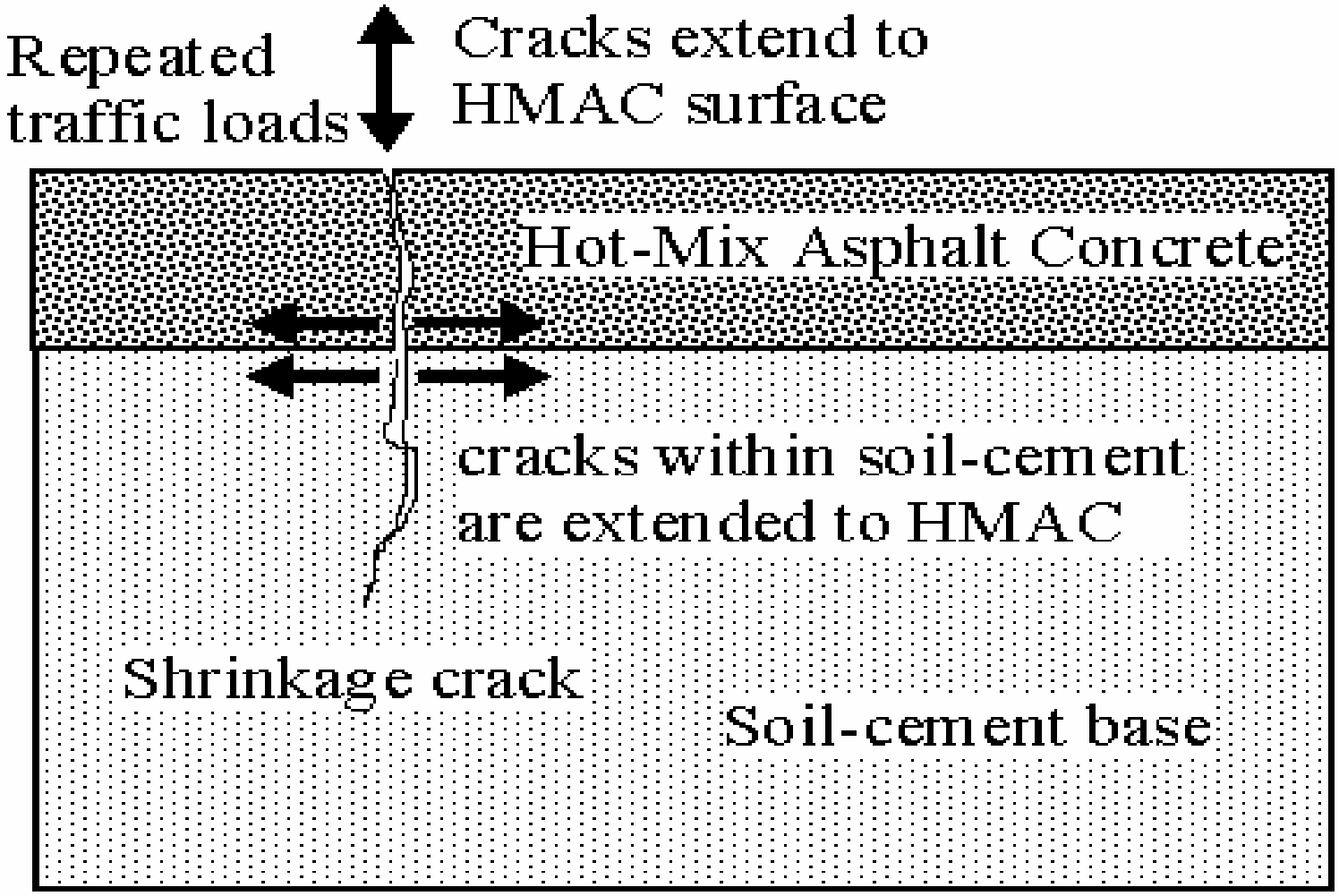
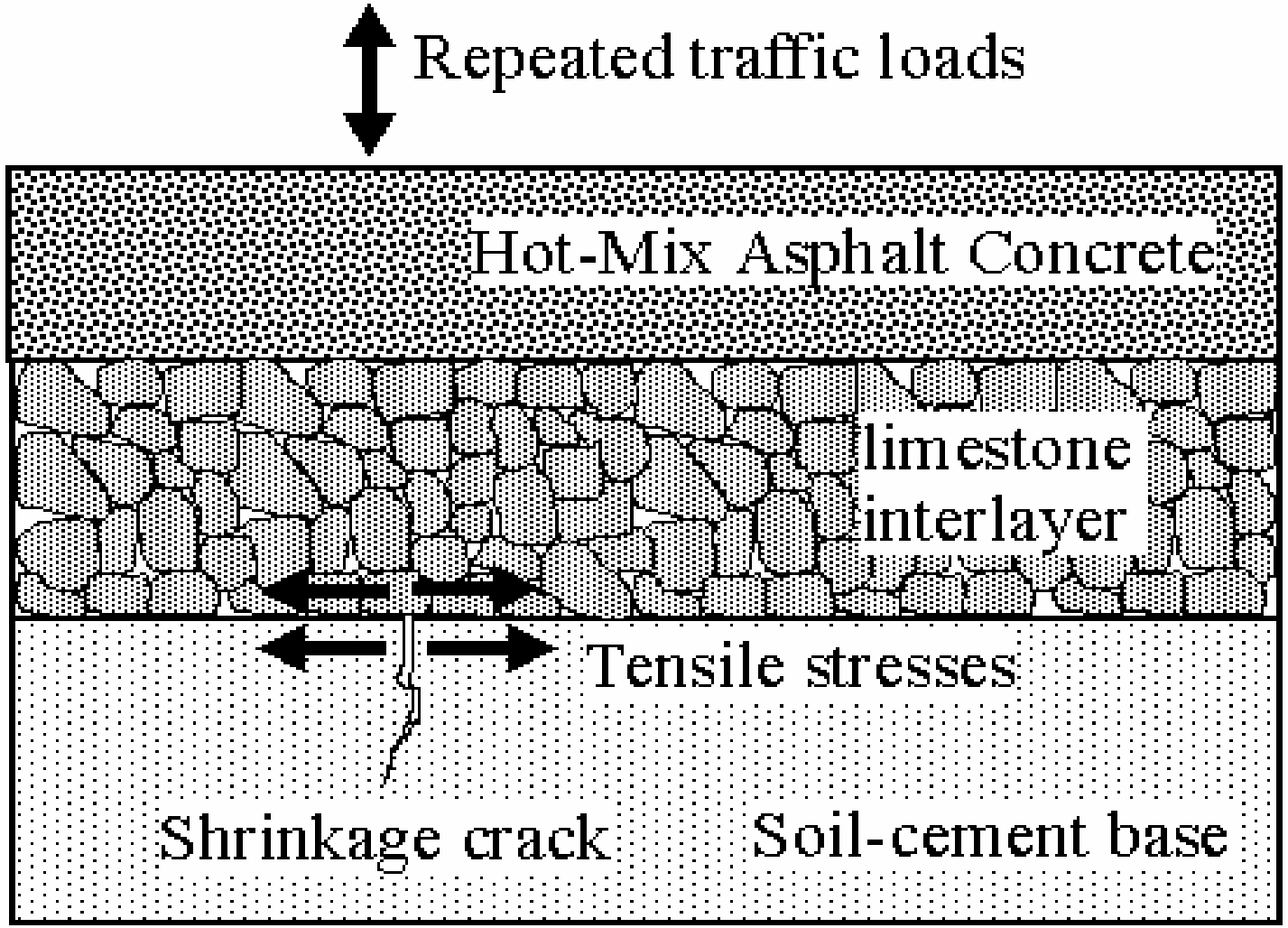
Presentation

- Background
- Objective
- Experimental Design
- Laboratory Performance
- Field Performance
- Summary & Conclusion

Background
Interlayer Design Concept



Background
Stone Interlayer Design Concept



Background

- Question: Can untreated RAP be used in lieu of stone?
  - Base Course Layer?
- Use of untreated RAP as a granular base material has been limited
  - lack
    - » laboratory performance
    - » field performance data

Objectives

- **Determine the effectiveness of using untreated RAP as a base material in lieu of crushed stone**
  - **soil-cement asphalt pavement structure**

ALF 3 EXPERIMENTAL DESIGN

<table>
<tr><th>Lane 1</th><th>Lane 2</th><th>Lane 3
Control</th></tr>
<tr><td>3.5″ Type 8
HMA</td><td>3.5″ Type 8
HMA</td><td>3.5″ Type 8
HMA</td></tr>
<tr><td>3.5″ RAP</td><td>3.5″ RAP</td><td>3.5″ Stone</td></tr>
<tr><td rowspan="2">10″ Cement
Treated
5%</td><td>6″ Cement
Stabilized
10%</td><td>6″ Cement
Stabilized
10%</td></tr>
<tr><td colspan="2">4″ Select Soil</td></tr>
<tr><td colspan="3">Select Soil</td></tr>
</table>

ALF 3 EXPERIMENTAL DESIGN

Lane 2	Lane 3
3.5″ Type 8 HMA	3.5″ Type 8 HMA
3.5″ RAP	3.5″ Stone
6″ Cement Stabilized 10%	6″ Cement Stabilized 10%
4″ Select Soil	4″ Select Soil

ALF 3 EXPERIMENTAL DESIGN

Lane 1	Lane 2
3.5″ Type 8 HMA	3.5″ Type 8 HMA
3.5″ RAP	3.5″ RAP
10″ Cement Treated 5%	6″ Cement Stabilized 10%
	4″ Select Soil

Materials
Hot Mix Asphalt Layer

- 1.5″ Wearing Course
- 2.0″ Binder Course
- ¾″ NMS
- Type 8, Marshall Mix Design
- PAC – 40

Materials
Base Course Layer

- 3.5″ Thick
- Stone Base
  - 100 percent crushed limestone
    - Wopt. = 5.9%, γ_m= 138.7 pcf
- RAP
  - Aged pavement
    - Wopt. = 8.6%, γ_m= 117.1 pcf

Performance

Laboratory Mixture Characterization

Field Accelerated Loading Evaluation (ALF)

Performance
Lab Mixture Characterization Tests

- Indirect Tensile Strength Test, 25C
- Indirect Tensile Resilient Modulus Test, 5-,25-, 40C
- Indirect Tensile Creep Test, 40C
- Axial Creep Test, 40C
- Frequency Sweep at Constant Height Test, 60C
- Repeated Shear at Constant Height Test, 60C

Permanent Deformation

Fatigue Cracking

Summary
Lab Mixture Characterization Tests

- HMA mixture showed good performance
  - rut resistant
  - endurance
- Crushed stone and RAP showed similar stiffness values
  - Resilient Modulus

Field Performance

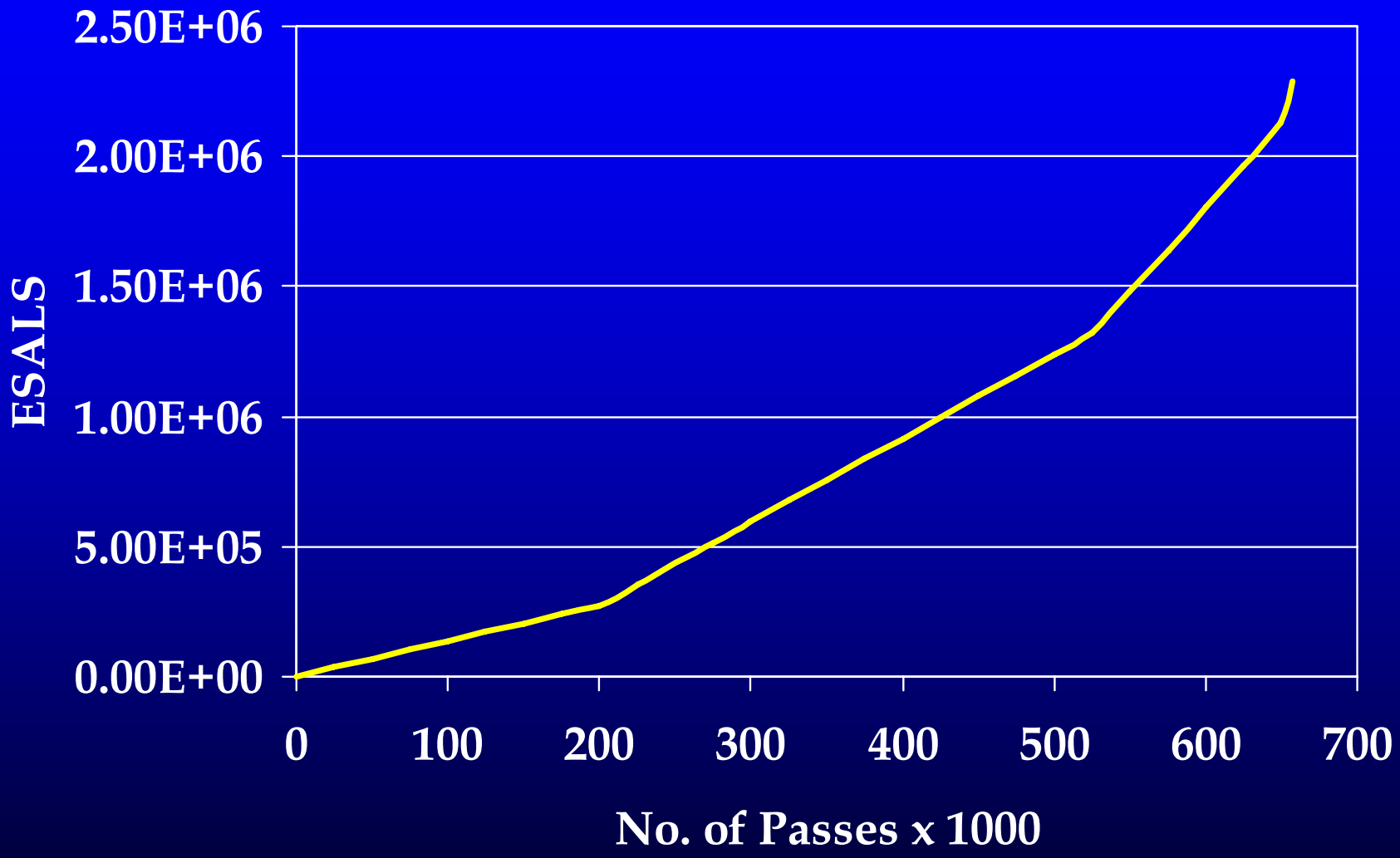
- LTRC Accelerated Loading Facility

- Test Lane
  - Length = 198 ‘ (60 m)
  - Width = 13’ (4 m)
  - Loading Length = 40’ (12m)
  - Rut Depth : 30’ (9m)

ALF Loading

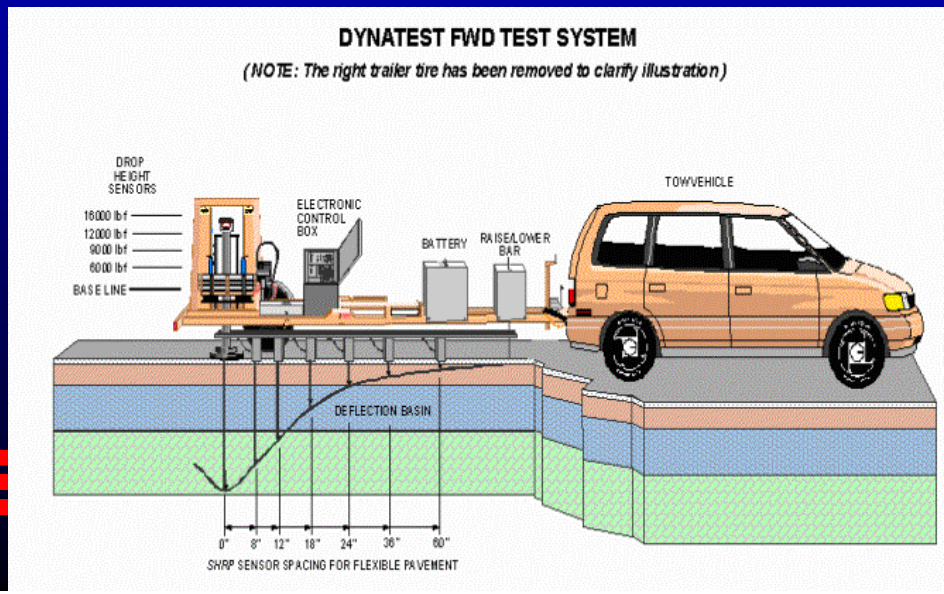
- One direction
- Normally distributed : 32” (813 mm)
- Load Magnitude
  - Dual tires, 105 psi (724 Kpa)
  - 9,750 Lbs (43.0 kN) up to 200,000 Cycles
  - 12,050 Lbs (53.6 kN) up to 525,000 Cycles, I Plate
  - 14,350 Lbs (63.6 KN) up to 675,000 Cycles, II Plates
  - Completed July 2004
- Alternative Load application: 25,000 Cycles

ALF Loading

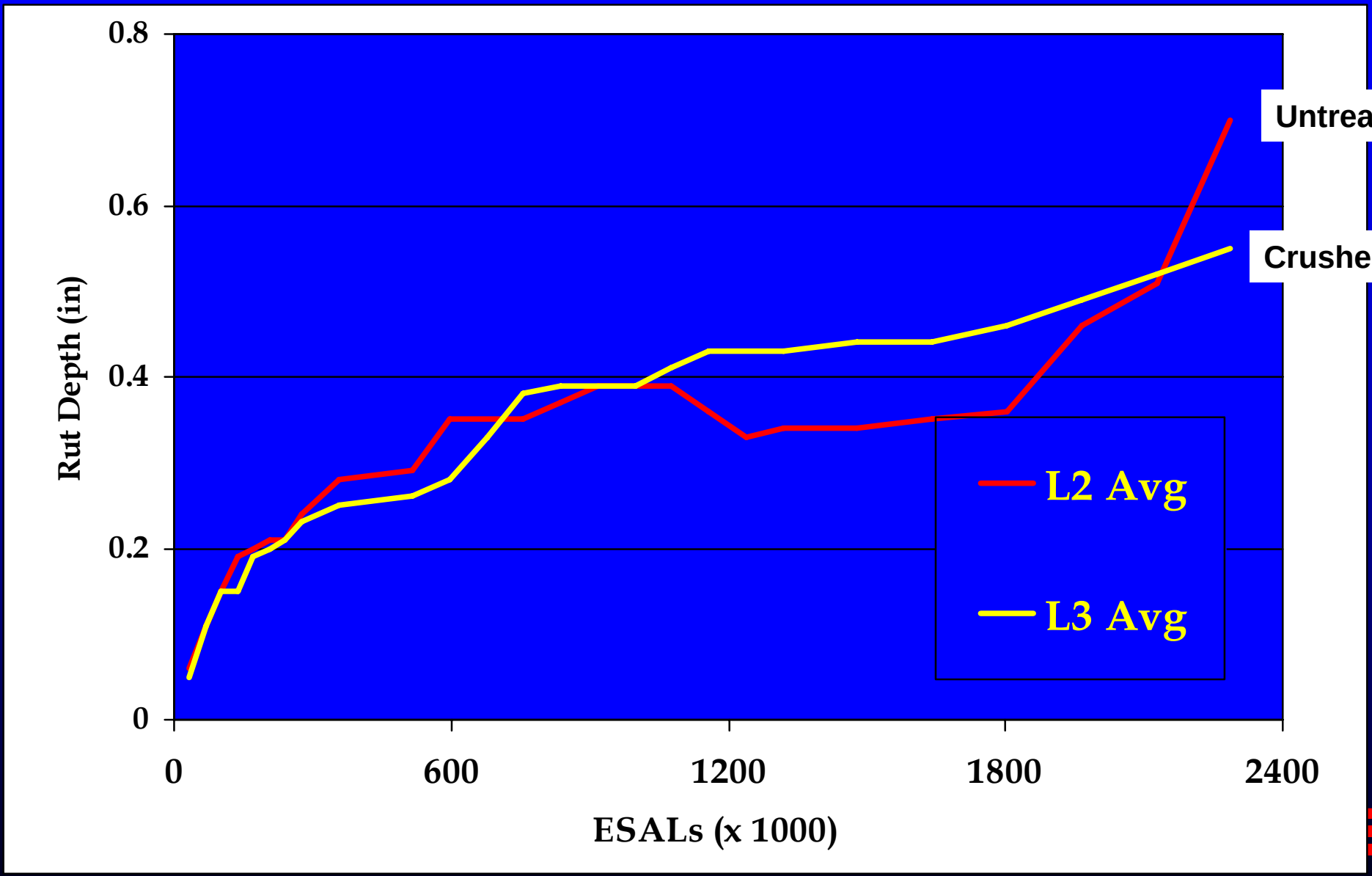

2.50E+06
2.00E+06
1.50E+06
1.00E+06
5.00E+05
0.00E+00
ESALS
0
100
200
300
400
500
600
700
No. of Passes x 1000

Field Insitu Measurements

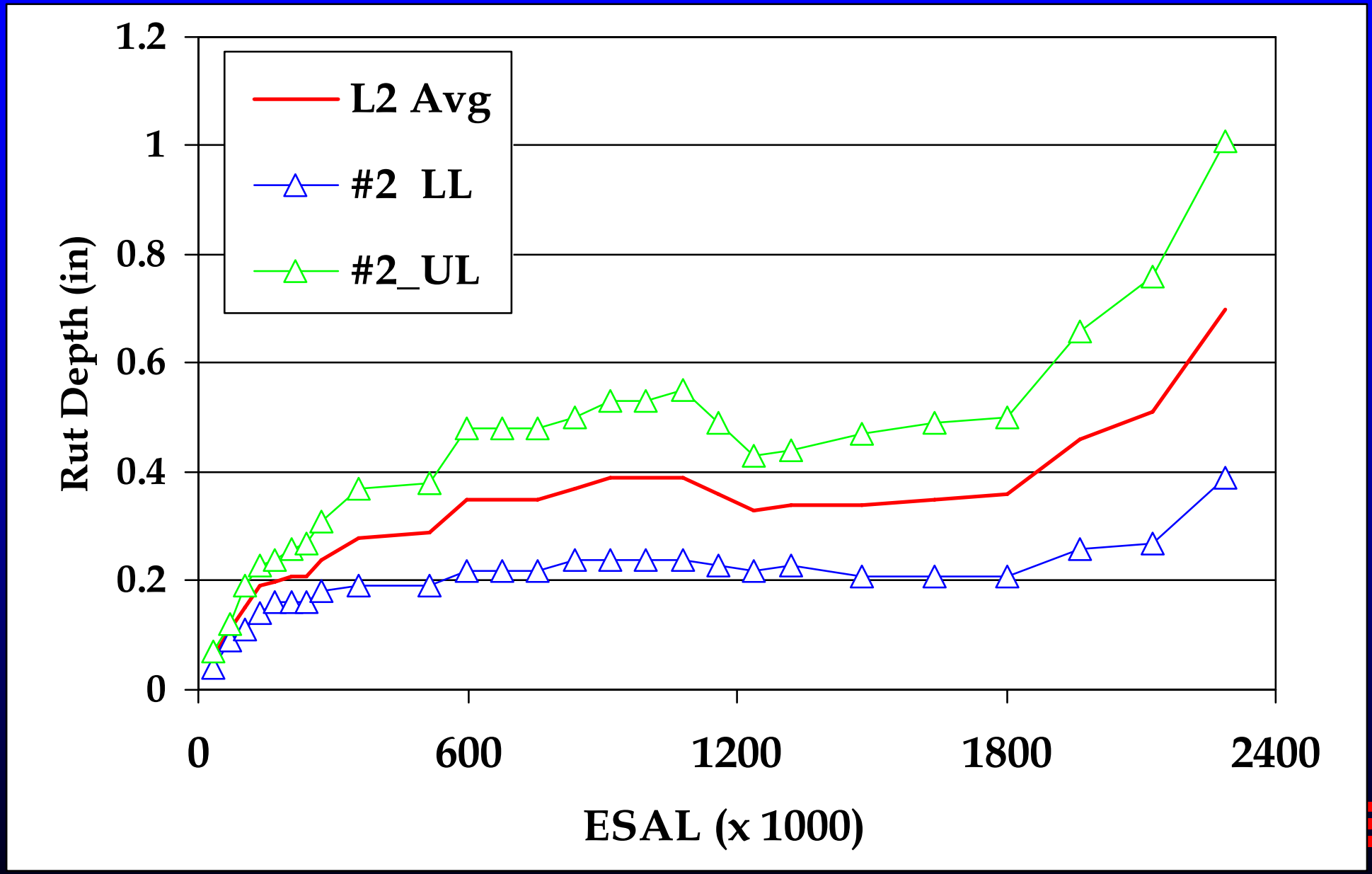
- Rut depth
  - 8 measurements
  - 30′ (9m)
- Fatigue cracking
- Dynaflect
- FWD
- Density



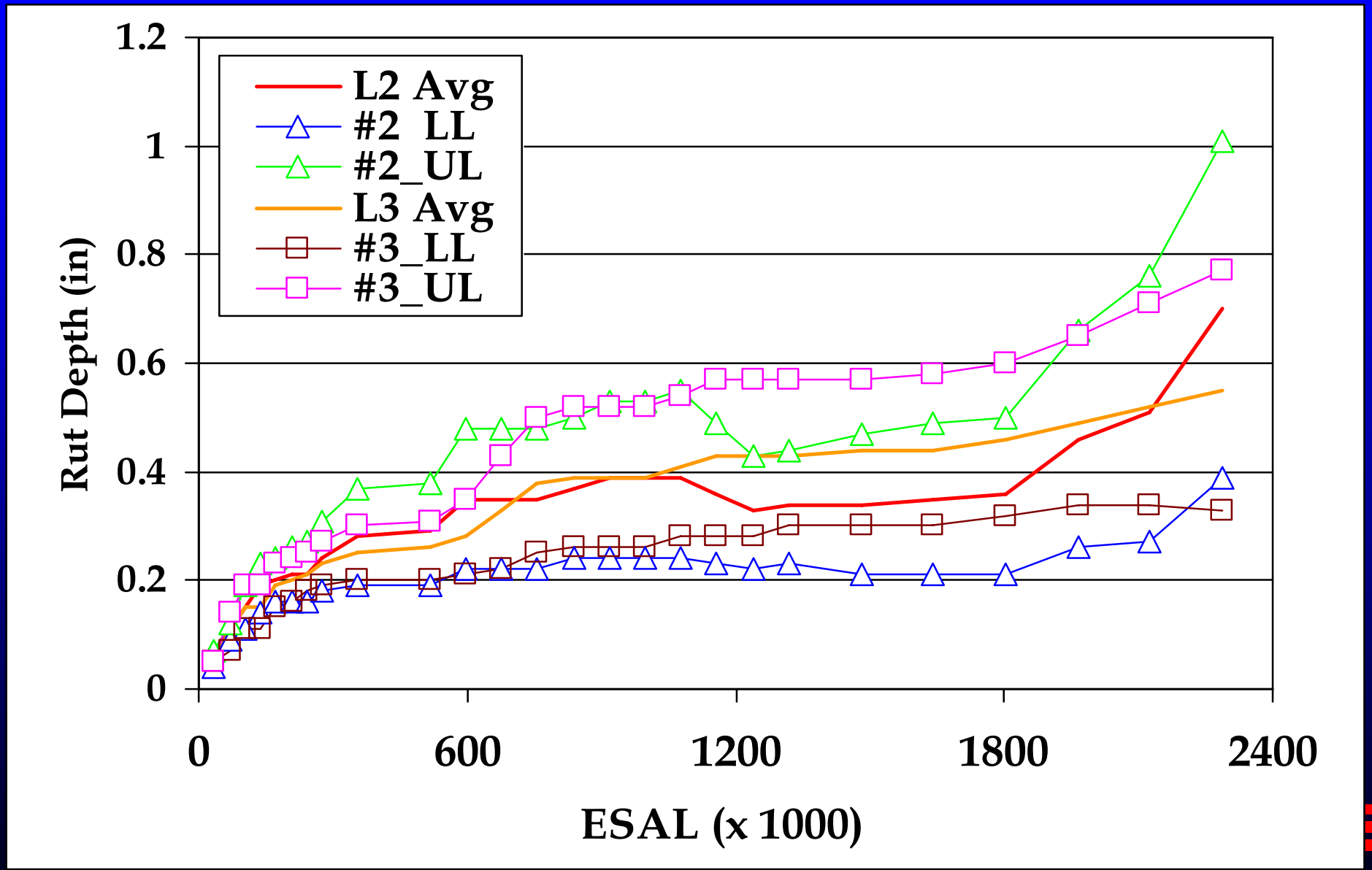
Rut Depth Measurement (Lane 2 and Lane 3) Untreated RAP vs. Crushed Stone



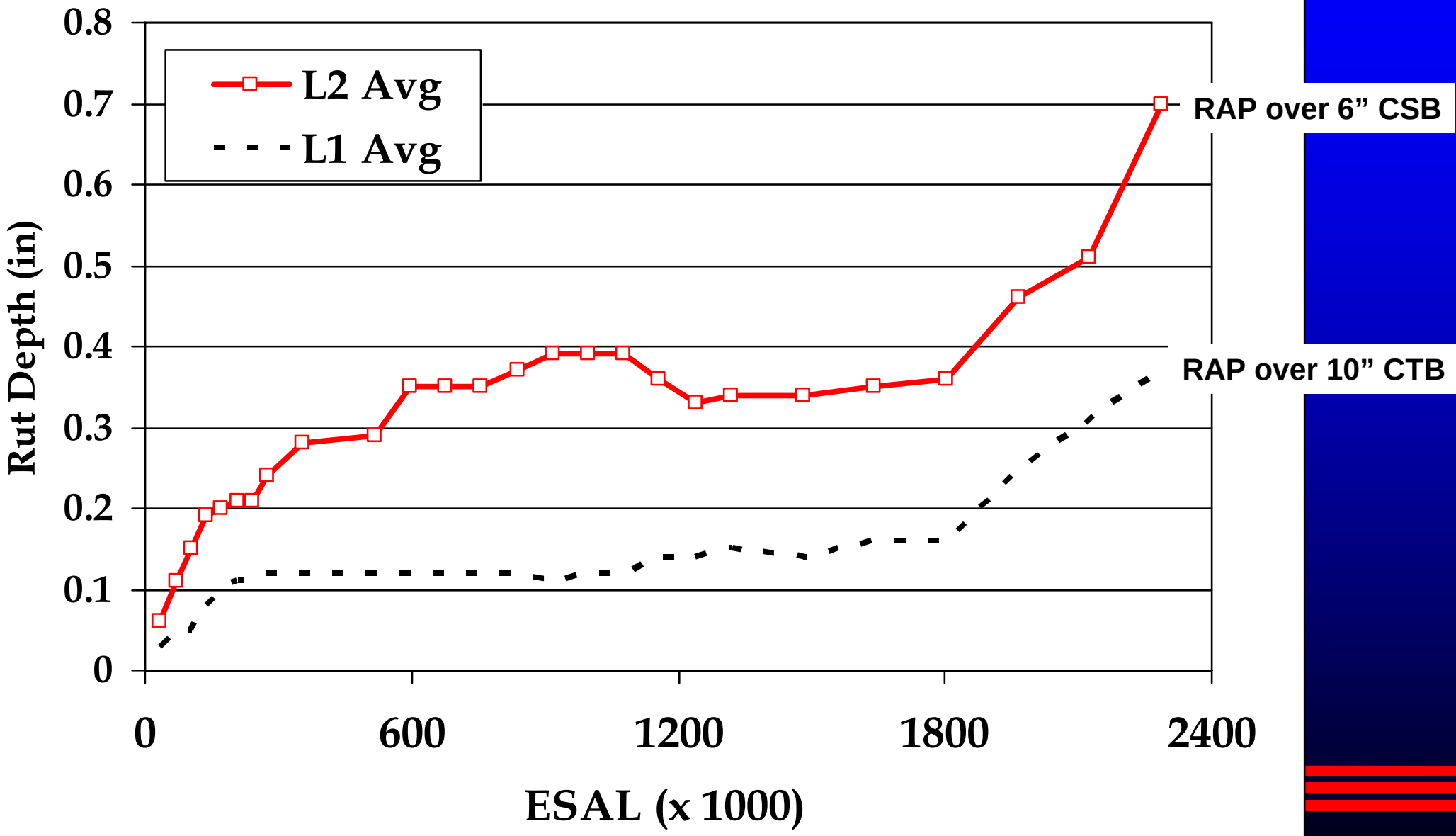
Rut Depth Measurement (Lane 2) -- RAP



Rut Depth Measurement (Lane 2 and Lane 3)
Untreated RAP vs. Crushed Stone



Rut Depth Measurement (Lane 1 and Lane 2)
10”, 5% CTB vs. 6”, 10% CSB



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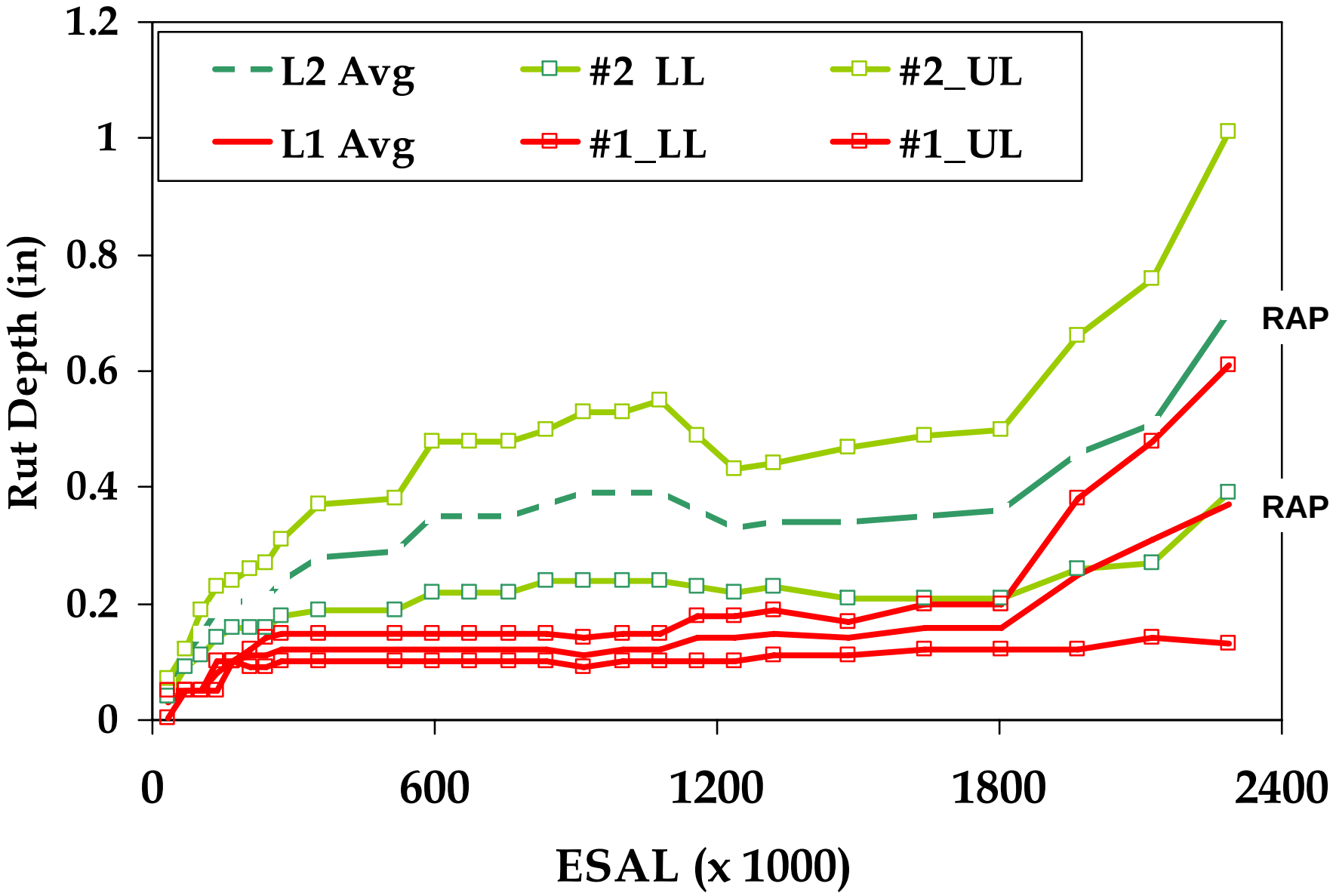
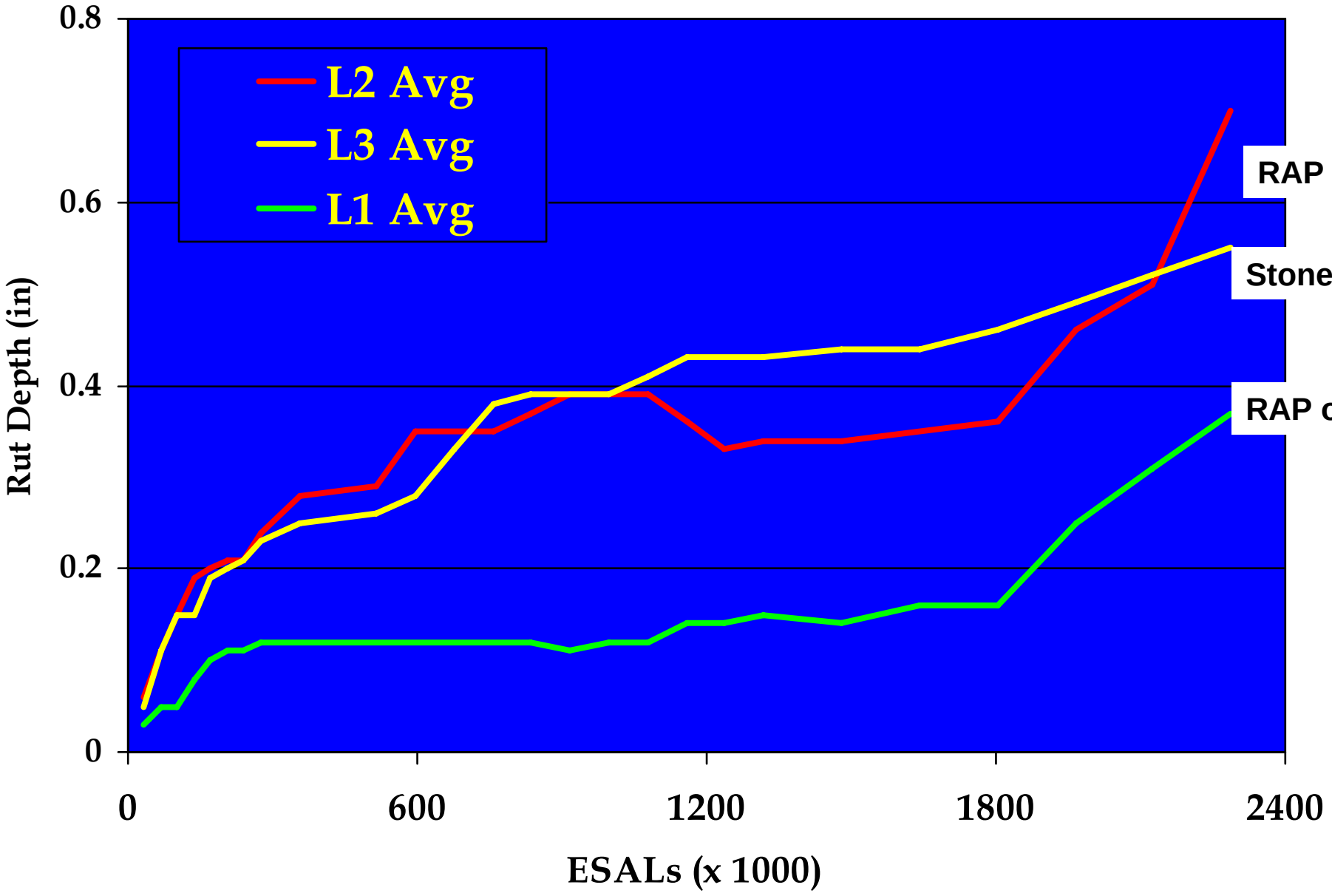


Overall Comparison - Rut Depths

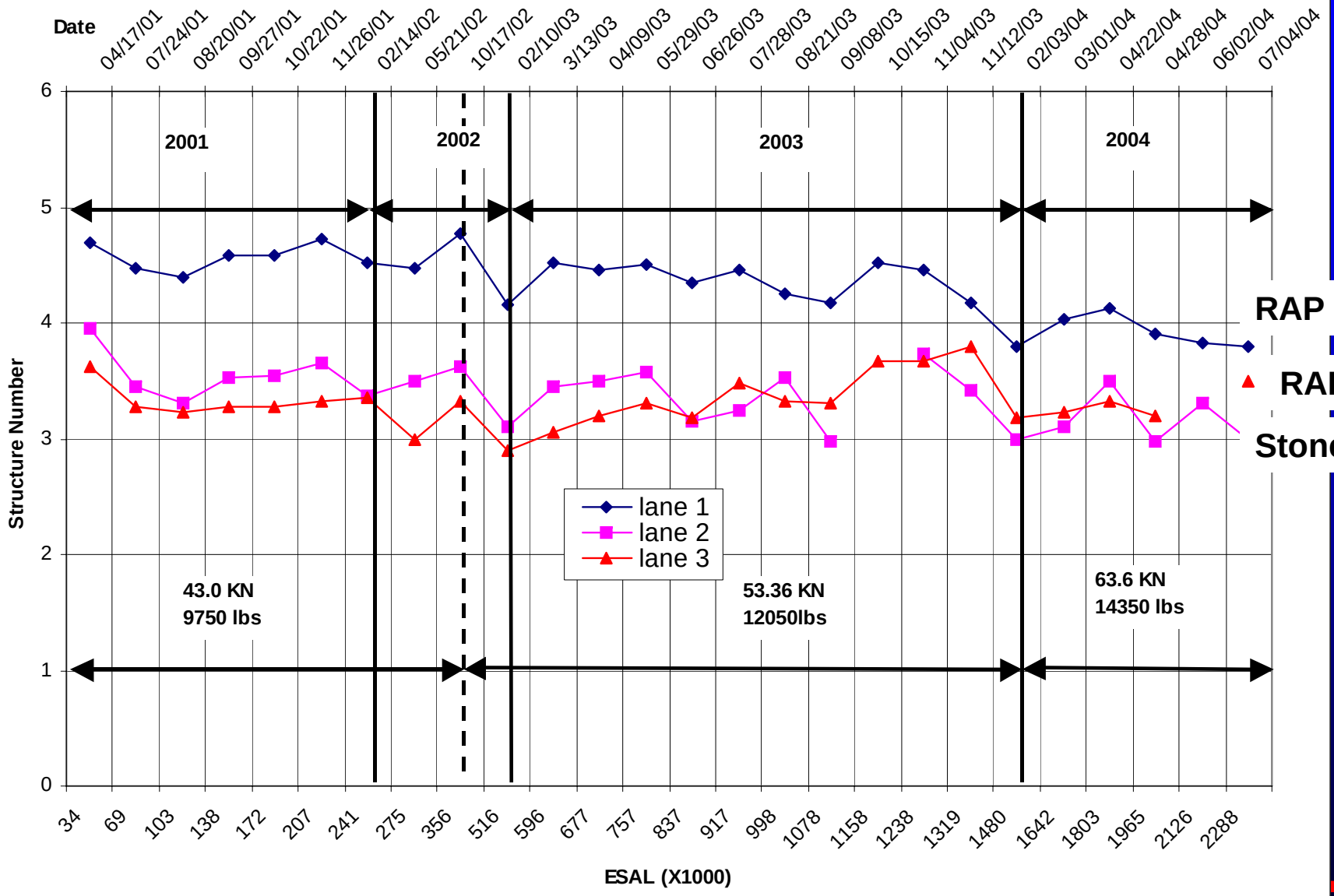


RAP over 6” CSB

Stone over 6” CSB

RAP over 10” CTB

Dynaflect Measurements -- SN



RAP over 10” CTB

RAP over 6” CSB

Stone over 6” CSB

Conclusions

Laboratory Evaluation

- HMA mixture showed good performance
  - rut resistant
  - Endurance
- Crushed stone and RAP showed similar stiffness values
  - Resilient Modulus

Field Performance

- Lane 2 (*untreated RAP*) and Lane 3 (*Stone*) showed similar rut performance
- Lane 1 (10”, 5% CTB) presented better rut performance than Lane 2 (6”, 10% CSB)
- There was no visible fatigue cracks for all three lanes

Field Implementation

- RAP has been used as interlayer in HMAC overlay project in US 190
  - Livonia and LA 1
  - Modulus = 50 ksi
  - SN = 0.14

Final Report

- WWW.LTRC.LSU.EDU

Thank You !