1.0 Introduction

Training Course Objectives and Content

Outline

- Course Objectives
- Course Content
- History of Asphalt Rubber (AR)
- Caltrans Experience with RAC
- Advantages of AR
- Primary References
- Summary

Course Objectives

- Basics of RAC
  - History of Asphalt Rubber
  - What is RAC and why use it?
- Design and Construction of RAC
  - Structural and material design
  - Construction
- Inspection and Basic Trouble Shooting
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Course Content
- Structural Design
- Materials
- Construction
- Inspection Guide
- Summary
- Assessment of Learning (Jeopardy)
- Course Evaluation

History of Asphalt Rubber
- Used since the 1960’s
- Used in chip seals, inter-layers, and hot mix asphalt
- Used extensively in Arizona, California, Florida and Texas
- Design and construction guides now available from some agencies

History of Asphalt Rubber (Cont.)
- Applications
  - Asphalt rubber chip seals and interlayers
  - Overlays and wearing courses
- Performance
  - Variable results in early years
  - Most effective in retarding reflection cracking as a thin surface layer
  - Mixes perform satisfactorily if properly designed and constructed
Caltrans Experience with RAC

- 1970’s – Used for chip seals and hot mix
- 1983 – Ravendale project - reduced thickness
- 1995 – Over 100 RAC projects constructed
- 2001 – Over 210 RAC projects constructed
- 2003 – CIWMB/Caltrans partnership
- 2005 – AB338 mandates increased RAC use (20% AC in 2007 to 35% in 2013)

Caltrans Use of RAC

- Largest Use
  - Thin overlays (RAC-G)
  - Mitigate reflective cracking
  - Reduced thickness
- Other Uses
  - Friction course (RAC-O)
  - Durable sacrificial course (RAC-O-HB)
- Performance
  - Successful in all applications
  - Problems generally due to construction issues

Tires Used in RAC

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Tires Used in RAC</th>
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<tbody>
<tr>
<td>1997</td>
<td>914,700</td>
</tr>
<tr>
<td>1998</td>
<td>913,400</td>
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<tr>
<td>1999</td>
<td>1,143,000</td>
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<tr>
<td>2000</td>
<td>3,967,900</td>
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<td>2001</td>
<td>1,733,300</td>
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<td>2002</td>
<td>703,900</td>
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<tr>
<td>2003</td>
<td>1,126,500</td>
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<tr>
<td>2004</td>
<td>1,788,900</td>
</tr>
<tr>
<td>Total</td>
<td>12,291,800</td>
</tr>
</tbody>
</table>
**Caltrans RAC Usage (% of AC Used)**

- 1997: 0%
- 1998: 5%
- 1999: 10%
- 2000: 15%
- 2001: 20%
- 2002: 25%
- 2003: 30%
- 2004: 35%
- 2005: (data not presented)

**Caltrans Research with RAC Products**

- 1999 – HVS confirmed “1/2 - thickness”
- 2003 – HVS on 8 field constructed overlays (6 Test Sections)
- 2004 – Fre-33 (9 Test Sections)
- 2005 – Men-20 (4 Test Sections)
- 2005 – SJ-5 and Ker-99 (rubberized bonded wearing course, RBWC)

**RBWC on I-5**

- Images of road surfaces and materials.
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Caltrans Challenges with RAC

- 1997 – 00: 10 pilot projects using MB
- 2002 – 04: Five RAC (5-year warranty) projects throughout the State
- 2004 – 05: Full-scale field experiments

MB and HVS

- 10 pilot projects using RMB (1997 - 2000)
- Performance: 8 good, 1 fair*, and 1 poor*
- HVS Sites – UC Berkeley
  - □45 mm RAC-G, Field Blend
  - □45 mm Type G (MB), TB
  - □90 mm Type G (MB), TB
  - □45 mm MB 15%, TB
  - □90 mm MB 15%, Term. Blend
  - □90 mm DGAC Type A (Control)
- HVS Performance: Exceeding expectations
  * Not materials related

RAC 5-Year Warranty Projects

- 5 Projects Constructed in 2002 - 04
  - □4 – Wet Process (Fre-33, Van-150, Mer-140, SD-75)
  - □1 – MB-D (terminal) (Las-395)
- Level Playing Field
  - □15% CRM
  - Open specifications
  - □5-Year Performance Warranty Criteria
    - > Rutting > Cracking > Delamination
    - > Bleeding > Potholing
- Regular Review and Evaluation
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### Fre-33 and Men-20 Projects

- **Fre-33** (Firebaugh, 9 test sections, June 04)
  - DGAC (90 mm)
  - RAC-G (45 mm, 90 mm)
  - RUMAC (45 mm, 90 mm)
  - MB-G (45 mm, 90 mm)
  - MB-D (45 mm, 90 mm)

- **Men-20** (Dist. 1, 4 test sections, August 05)
  - DGAC (105 mm)
  - RAC-G (60 mm)
  - RUMAC (60 mm)
  - MB-D (60 mm)

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### Advantages of AR

- Good durability – in terms of resistance to cracking and aging
- Environmental friendly – make value-added use of a waste material, reduce traffic noise
- Versatility – can be used in most maintenance and rehabilitation activities, often at reduced thickness for resistance to reflective cracking
- Longer lasting color – for better contrast with striping and marking
- Reduced maintenance – for both chip seals and hot mix

### Primary References

- Asphalt Rubber Usage Guide
- Use of Scrap Tire Rubber – State of the Technology and Best Practices
- Synthesis of Caltrans Rubberized Asphalt Concrete Projects
- Feasibility of Recycling Rubber-Modified Paving Materials
- Study on Structural Design Considerations
- Flexible Pavement Rehabilitation Manual
- Asphalt Rubber Design and Construction Guidelines
- RAC-G SSP Version (12-12-05)
- RAC-O SSP Version (12-12-05)

http://www.dot.ca.gov/hq/esc/Translab/translab/CALTRANS_CIWM indicates Projects/1202/DELIVERABLES.html
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Summary of Module 1

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