IDENTIFYING AND PREVENTING PROBLEMS WITH PAVING CONTRACTS

STEVE MARVIN

April 13, 2005

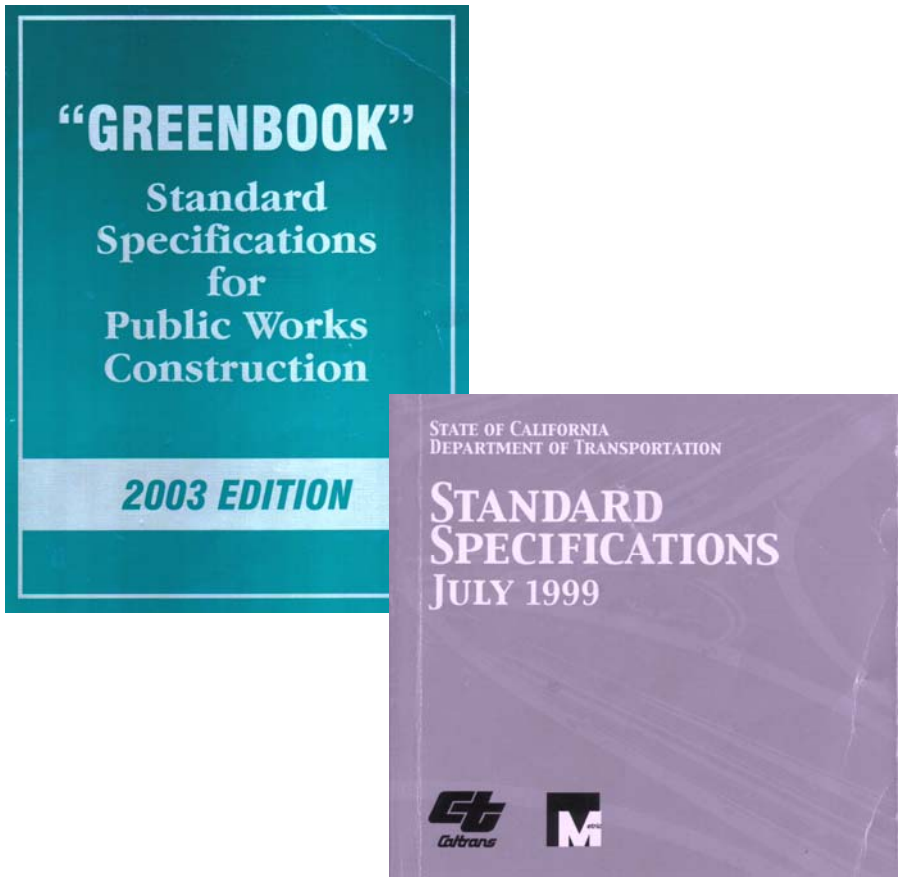
Southern California Chapter

APWA

American Public Works Association

Current Safeguards

- Existing Standard Specifications
  - Standard Specifications for Public Works Construction – Greenbook
  - Caltrans Standard Specifications



LABELLE MARVIN

Technical Committees

- User/Producer Meetings
  - Statewide
    - State and Local Agencies
    - Aggregate producers
    - Asphalt binder producers
- Greenbook Committee
  - Local representatives
    - State and Local Agencies Southern California
    - Aggregate producers
    - Asphalt binder producers

LABELLE MARVIN

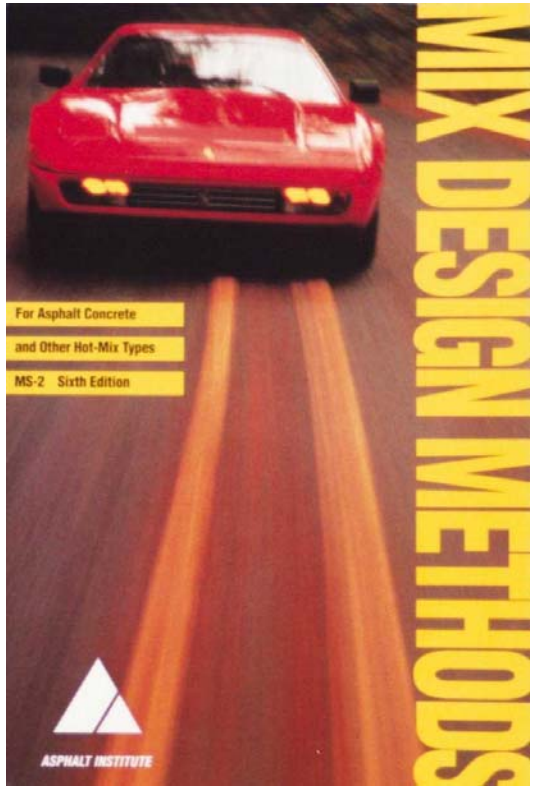
Technical Committee Purviews

- Materials
  - Aggregates
  - Asphalt Concrete
  - Portland Cement Concrete
- Construction
  - Methods
  - Finished product
- Quality Control/Quality Assurance
  - Inspection
  - Testing

LABELLE MARVIN

MATERIALS

- Mix Design
  - Material Source
    - Aggregate and binder source
  - Complete design data
    - Current and complete
    - 30 Day Time Limit
    - 2 year Maximum
  - Stability (strength)
  - Air voids
  - VMA (Specified if ARHM)



LABELLE MARVIN

MATERIALS

- MIX DESIGN RELEVANCE
  - BASIS FOR GRADATION CONTROL
  - BASIS FOR BINDER CONTENT CONTROL
    - With Mix Design
      - +5% and -10% From Design
    - Without Mix Design
      - Total Specification Band

LABELLE MARVIN

BINDER CONTENT EXAMPLE - GREENBOOK

- Type C2 (1/2” Maximum)
  - Target Asphalt Content 5.5%
    - WITH MIX DESIGN +5% OF DESIGN AND -10% OF DESIGN
      - 4.95% to 5.78%
    - WITHOUT MIX DESIGN
      - 4.6% to 6.0%

LABELLE MARVIN

REVOLUTION VS. EVOLUTION

"This limited amount of asphalt cement is less than the actual voids in the sand, …the mixture becomes too plastic, and forms waves when rolled, if the attempt is made to wholly fill the voids"

City Roads and Pavements, Fourth Edition 1909

LABELLE MARVIN

REVOLUTION VS. EVOLUTION

Volume relationship material design (Superpave)

"…indicates an over-sanded mixture…This gradation often results in a mixture that poses compaction problems.. and offers reduced resistance to permanent deformation" "These gradations…can easily become plastic with even minor variations in asphalt content"

Asphalt Institute Superpave Level 1 Mix Design

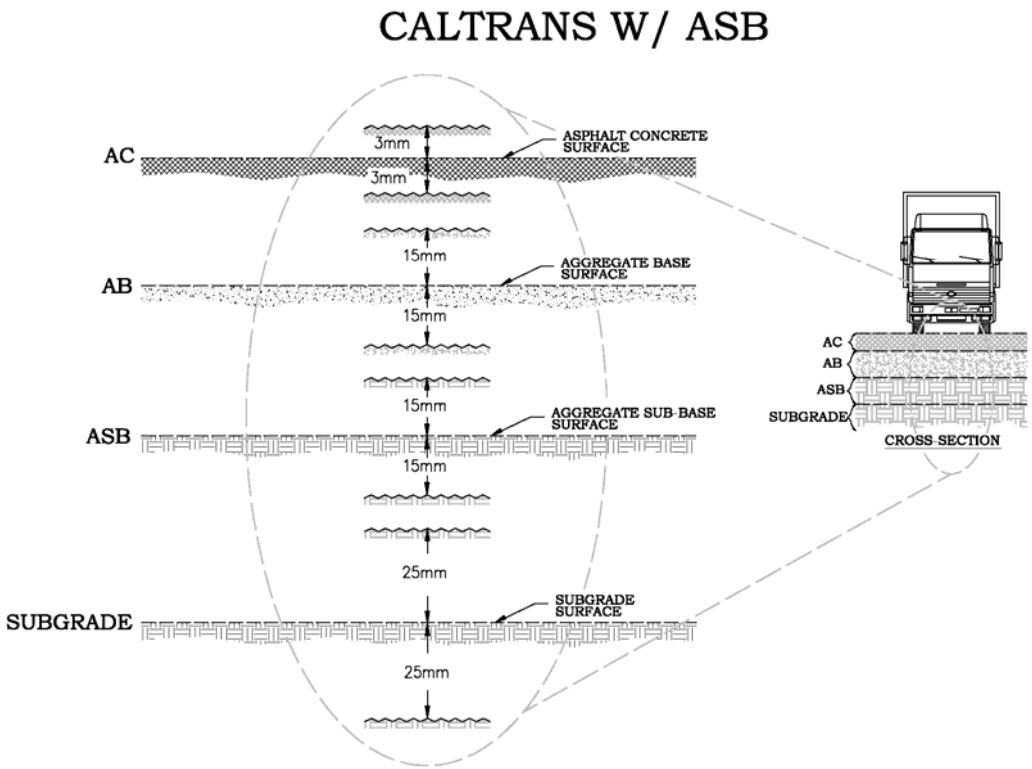
LABELLE MARVIN

Construction

- Grade tolerances v. Thickness tolerances
- Greenbook
  - Subgrade +/- 12 mm (1/2”; 0.04’)
  - Aggregate base +/- 6 mm (1/4”; 0.02’)
  - Asphalt concrete +/- 3 mm (1/8”; 0.01’)
- Caltrans
  - Subgrade +/- 15 mm (5/8”; 0.05’)
  - Aggregate base +/- 15 mm (5/8”; 0.05’)
  - Asphalt concrete +/- 3 mm (1/8”; 0.01’)

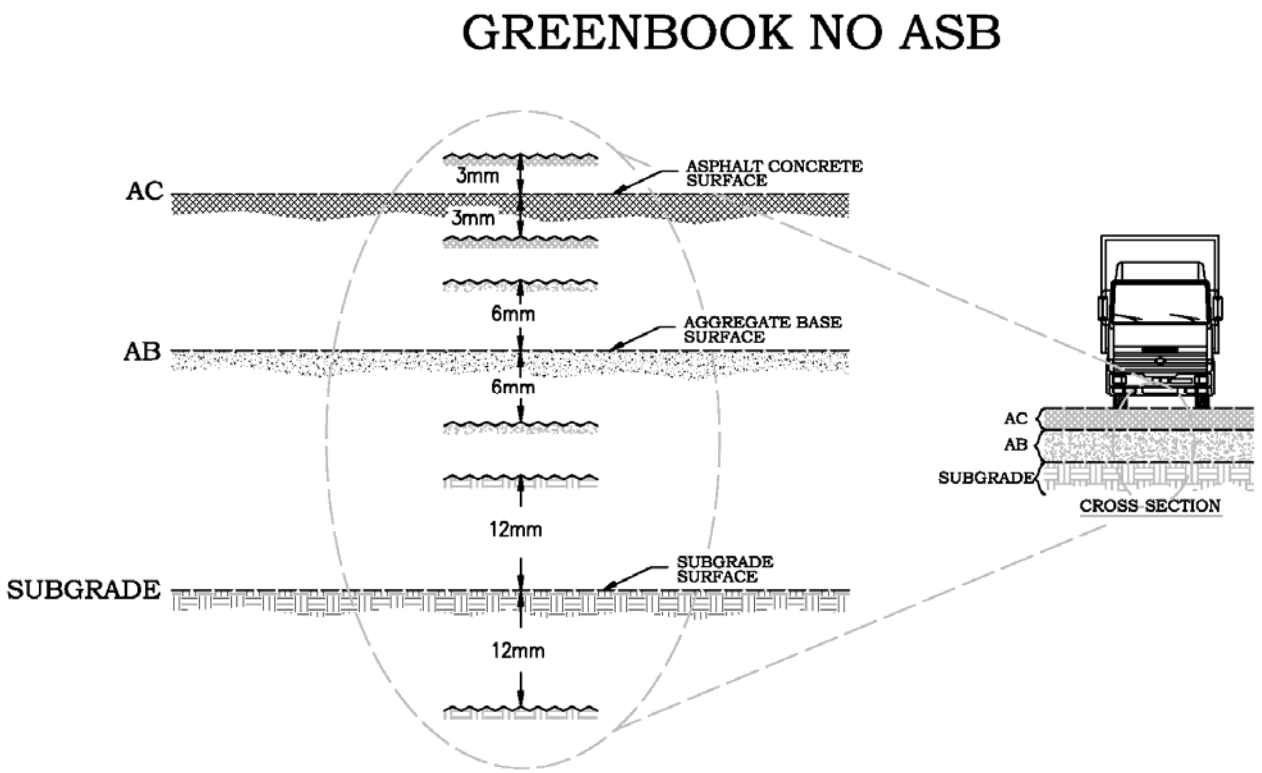
LABELLE MARVIN

CALTRANS GRADE TOLERANCES



LABELLE MARVIN

GREENBOOK GRADE TOLERANCES



LABELLE MARVIN

THICKNESS IMPACT EXAMPLES

- ASSUMPTIONS
  - Traffic Index 8.0
  - Subgrade R-value 10
- CALTRANS GRADE TOLERANCES
- GREENBOOK GRADE TOLERANCES

LABELLE MARVIN

Tolerance Impacts

- Greenbook
  - 3/4” shortage aggregate base
  - 3/8” shortage asphalt concrete
- Caltrans
  - 1 ¼” shortage aggregate base
  - ¾” shortage asphalt concrete

LABELLE MARVIN

CALTRANS SPEC EXAMPLE

- CALTRANS
  - Potential 46 mm Ge (>1 ¾”) Shortage
  - Solve standard T = 0.975(100-R)TI for TI
  - Resulting Section Traffic Index 7.5
  - Compare Traffic Index 8.0 ESAL to 7.5 ESAL
    - 216,210/371,801 ESAL
    - Therefore 42% Design Reduction

LABELLE MARVIN

GREENBOOK SPEC EXAMPLE

- GREENBOOK
  - Potential 25 mm Ge (1”) Shortage
  - Solve standard T = 0.975(100-R)TI for TI
  - Resulting Section Traffic Index 7.7
  - Compare ESAL
    - 269,702/371,801 ESAL
    - Therefore 27% Design Reduction

LABELLE MARVIN

CONTRACTOR SAVINGS V. AGENCY LOSS

- CALTRANS
  - 2 ½% to 15% ASPHALT CONCRETE
  - 2 ½% to 10% AGGREGATE BASE
- GREENBOOK
  - 7 ½% ASPHALT CONCRETE
  - 1 ½% AGGREGATE BASE
- AGENCY LOSS
  - 27% TO 42% DECREASE IN USEFUL LIFE

LABELLE MARVIN

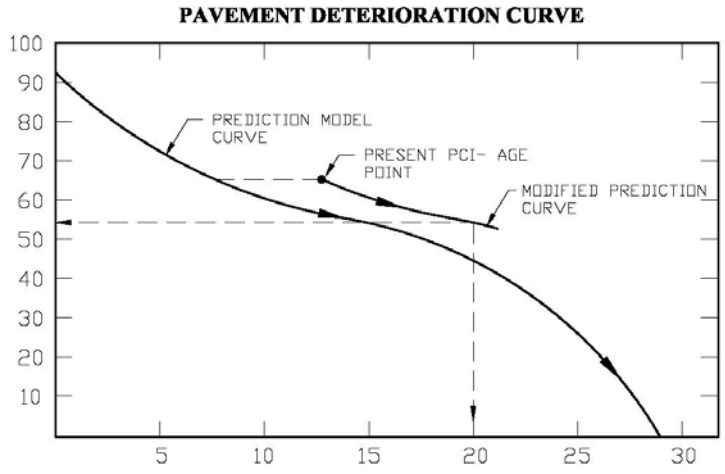
RELAXED SPECIFICATIONS - GREENBOOK

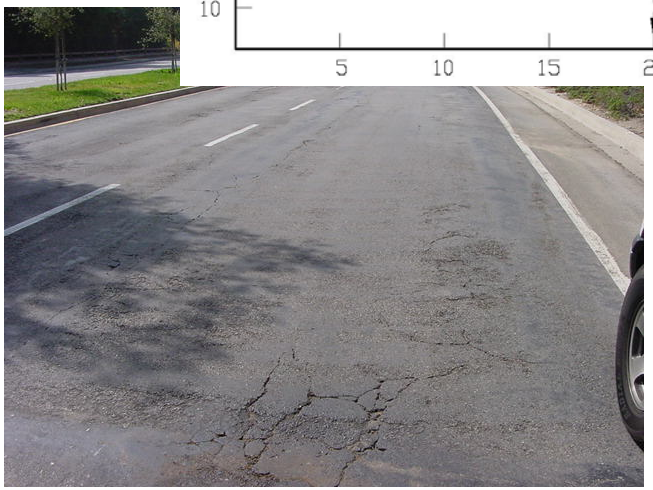
- ALLOW ¼” GREATER TOLERANCE ON SUBGRADE AND BASE
  - Potential 45 mm Ge (>1 ¾”) Shortage
  - Resulting Section Traffic Index 6.9
  - Compare Traffic Index 8.0 ESAL to 6.9 ESAL
    - 108,047/371,801 ESAL
    - Therefore 71% Design Reduction

LABELLE MARVIN

Compaction

- Thickness
- Grade
- Texture
- Permeability
- Durability
- Aging characteristics

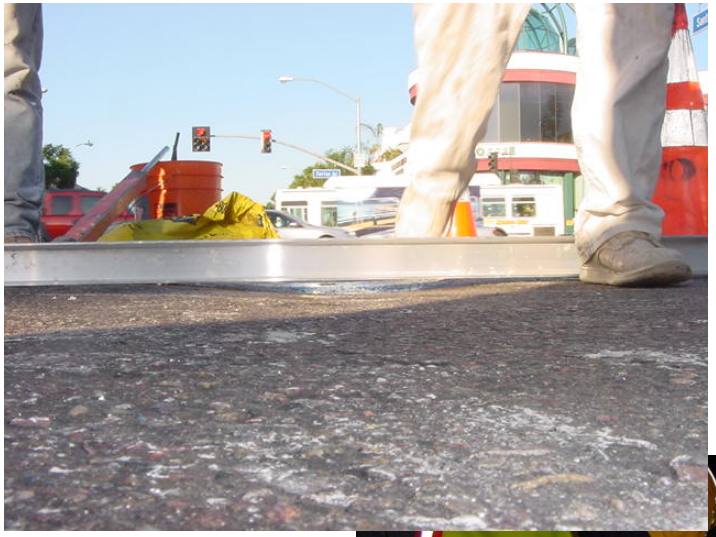




LABELLE MARVIN

Asphalt Concrete Materials

- Binder content
- Aggregate gradation
- Strength
- Air voids
- Variable characteristics



LABELLE MARVIN

What is Quality Control/Quality Assurance?

- Any combination of documentation, inspection, observations or sampling that increases the understanding of the final product, individual components, and production variability

LABELLE MARVIN

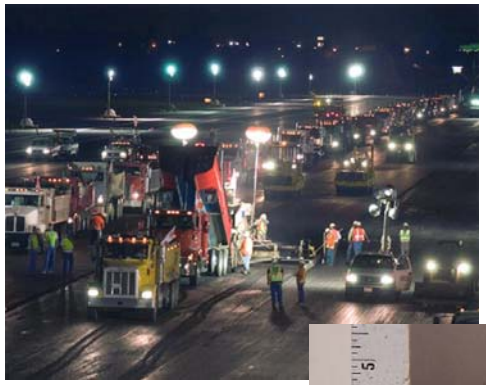
Why Quality Control ?

- Increase probability of contract compliance
- Protect City, Contractor and Material Supplier
- Better understand performance issues over time
- Provide improved basis for future project design

LABELLE MARVIN

Quality Control v. Failure Investigation

- Proactive production control
  - Inspection
  - Quality Control



- Reactive production examination
  - “Failure” review
  - Forensic Investigation

LABELLE MARVIN

ALTERNATIVE TO QC

- TRUST EVERYTHING WILL BE ALL RIGHT
- ACCEPT VARIABLE PERFORMANCE WITHOUT EXPLANATION
- ACCEPT VARIABLE PERFORMANCE WITHOUT POTENTIAL FOR IMPROVEMENT OF FUTURE PERFORMANCE

LABELLE MARVIN