Flexible Pavement Design Methods

- Heuristic Methods (early 1900s)
- Empirical Based on Soil Class (1920s)
- Empirical Based on Soil Strength (1930s)
- Limiting Shear Stress (1940s)
- Limiting Deflection (1950s)
- Regression-Based (1960s)
- Mechanistic-Empirical (21st Century)
7133 Earth Structures

- Analysis, design, and construction of earth dams, levees, embankments and slopes; soil stabilization; seepage, drainage, and flow nets.
Rigid Pavement Design Methods

• 1919 – Goldbeck’s Formula
• 1926 – Westergaard’s Equations
• 1951 – Pickett’s Equations
• 1965 – Finite Element Methods
• 1979 – ILLI-SLAB
• 1981 – WESLIQUID & WESLAYER
• 1985 – KENSLABS
Road Tests

• Bates Road Test (rigid & flexible)
• Maryland Road Test (rigid)
• WASHO Road Test (flexible)
• AASHO Road Test (flexible & rigid)
• WesTrack (flexible)
• NCAT Test Track (flexible)
• SHRP LTPP (flexible & rigid)
AASHO Road Test

Source: Highway Research Board Special Report 61A-G
AASHO Road Test
AASHO Road Test

Source: Highway Research Board Special Report 61A-G
AASHO Road Test

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AASHO Road Test

Source: Highway Research Board Special Report 61A-G
WesTrack
WesTrack
WesTrack

Axle 1: 3.8m (12.4')
Axle 2: 1.3m (4.25')
Axle 3: 5.2m (17')
Axle 4: 5.2m (17')
Axle 5: 5.2m (17')
Axle 6: 5.2m (17')
Axle 7: 5.2m (17')
Axle 8: 5.2m (17')

Wheel base 174'

Truck Configuration
(not to scale)

Axle loading
53.4kN (12k)
89kN (20k)
89kN (20k)
89kN (20k)
89kN (20k)
89kN (20k)
89kN (20k)
NCAT Test Track
NCAT Test Track

Source: Better Roads, November 2006
NCAT Test Track
SHRP LTPP
Pavement Design Factors

- Traffic
  - Axle Loads
  - Contact Pressure
  - Load Repetitions
  - Vehicle Speed
- Environment
  - Temperature
  - Moisture
  - Freeze/Thaw
- Materials
  - Elastic Modulus
  - Poisson’s Ratio
  - Resilient Modulus
  - Creep Compliance
  - Fatigue Life
  - Subgrade Reaction
  - Modulus of Rupture
  - Strength
Failure Criteria

• Flexible Pavements
  – Fatigue Cracking in Asphalt
  – Rutting in Asphalt and Base
  – Permanent Strain in Subgrade
  – Thermal Cracking in Asphalt

• Rigid Pavements
  – Fatigue Cracking in Slab
  – Permanent Strain in Subgrade
Highway vs. Airport

• Load Magnitudes
• Load Durations
• Contact Pressures
• Traffic Volume
• Tracking / Wander
• Gear Configurations
• Edge Effects
Highway Wander
Airport Wander
Gear Configurations
Dual Wheel – Single Axle