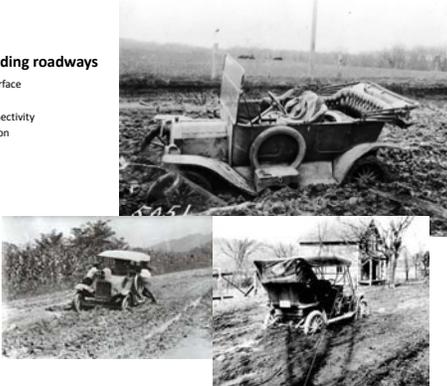


**Innovative and Sustainable
Pavement**

League of California Cities
March 21, 2012
Steven R. Marvin, P.E.

Understanding roadways

- All Weather Surface
- Public Safety
- Economic Connectivity
- Social Interaction
- Flood control
- Utility conduits



Evolving Priorities
Socially driven design assignments



- All weather surface
 - Protect subgrade from water
- Flood control
 - Increased curb heights
- Landscaped medians
 - Introduced water into subgrade
- ADA requirements
 - Reduced curb heights
- “Sustainable” roadways
- “Green” technologies
 - Saturate subgrade with water

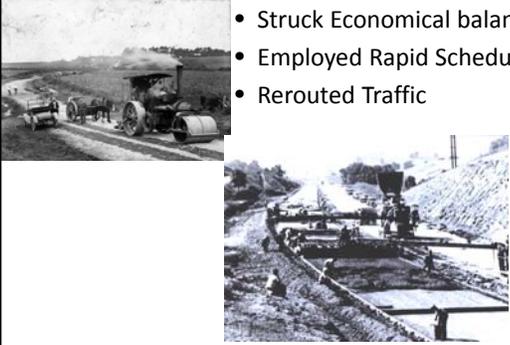
How did we build our roadways

- Locate materials
- Existing Quarries
- Develop quarries
- Develop Borrow Sites



How did we build our roadways

- Exploited resources
- Exploited environment
- Struck Economical balance
- Employed Rapid Schedules
- Rerouted Traffic



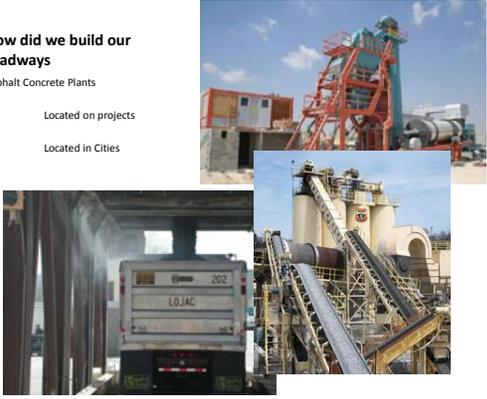
How did we build our roadways

- Portland Cement Concrete Plants
 - Portable Plants
 - Fixed locations within Cities



How did we build our roadways
Asphalt Concrete Plants

Located on projects
Located in Cities



How did we build our roadways

- Hauled materials to site
 - Used and abused existing roadways

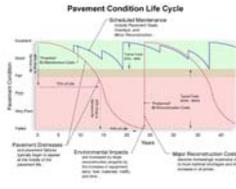


How have we maintained our roadways

- Pavement seals
 - Chip Seals to Slurry Seal
- Asphalt concrete overlays
 - Conventional materials
 - Engineering fabrics
 - Rubberized asphalt concrete
- Reconstruction
 - Grade limitations



Understanding Conditions



- Pavement Management
 - Reactive budgeting projected into future use periods
 - Managing Liability
 - Monitoring deterioration
 - Budget response to wear and tear

Understanding Use



- Protecting Resources
 - 1 tractor trailer gravel truck = >10,000 automobiles
 - 1 Articulated bus carries up to 90 people
 - 1 articulated bus removes up to 90 automobiles and related wear and tear
 - 1 fully loaded articulated bus = wear and tear of >50,000 automobiles

Understanding Resources

Constructed Vast Roadway Network

- Exhausted natural resources
- Exhausted economic resources
- Exhausted environment
- Transferred our aggregate stockpile



Time to recognize a change in asset value

Asset protection
Traffic recognition
Weight Control
Balance use with 'cost'
Resource recovery
Material reuse



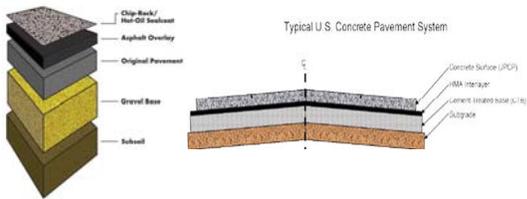
Existing vast network of linear stored aggregate supplies

- Existing asphalt concrete
- Existing aggregate base
- Existing aggregate subbase
- Existing Portland cement concrete pavement



Mining our Roadways

Failed Pavements or Valuable Resource Mining our Roadways?



Understanding your Asset



- Conventional Asphalt Concrete over aggregate base/subbase
- Full Depth Asphalt Concrete
- Portland Cement Concrete
- Composite Section

What is Sustainable?



- Meets current needs?
 - Satisfies current social agenda
 - Provides service level
- Utilizes recycled materials?
 - Reuse of rubber tires
 - Reuse of old aggregates
- Designed for future maintenance?
 - Attention to detail

Design Challenges



- Buried Utilities
- 'Wet' Subgrade
- Grade Restrictions
- Existing Traffic Use
- Construction Schedules

- Cold In-Place Recycling
- Hot In-Place Recycling

Current Solutions



The first photograph shows a long line of yellow recycling machines on a road. The second photograph shows a yellow machine with workers in safety vests. The third photograph shows a yellow machine with a large hopper.

- Cold In-Place Recycling

Current Solutions



The first photograph shows a yellow machine with a large hopper. The second photograph shows a blue machine with workers. The third photograph shows a blue machine on a road.

- Hot In-Place Recycling

Current Solutions



The first photograph shows a yellow machine with workers in safety vests. The second photograph shows a long line of yellow machines on a road.

Current Solutions



- Full Depth Reclamation
 - Full section pulverization
 - Possible inclusion of stabilization additive
 - Portland cement
 - Asphalt emulsion
 - Foamed asphalt

Current Solutions



- Central Pavement Recycling
 - 15% current rate in practice
 - Increased rates of 25% and greater in use within certain jurisdictions
 - Specialty recycling rates > 50%
 - Increases currently being considered
 - >15% typically includes use of 'softening' agent with binder

Current Solutions



- Resurfacing Technology
 - Slurry Seals
 - Rubberized slurry seals
 - Micro Surface
 - Conventional Asphalt Concrete
 - Rubberized asphalt concrete
 - Polymer modified materials

Forward Thinking Design



- Median Design
- Edge Design
- Sacrificial Pavement Layers
 - Perpetual pavements
- Dedicated Bus Lanes
- Dedicated Truck Lanes

Entering the Debate



- Curb Height
- Cross slope
- Axle weight impacts
- Pervious pavements
- Transit costs v benefits
- Recycling criteria
- Utility location

Conclusions



- Pavement design must consider interim maintenance options
- Pavement reuse requires understanding of existing conditions
- Everything old is new again
- Preservation is cost effective
- Preserve, maintain, rehabilitate, reuse, recycle
