



**CONSTRUCTION
MANAGEMENT
COLORADO STATE UNIVERSITY**

Introduction to Asphalt Pavement Construction



October 29, 2020

Thomas Peterson, P.E. Executive Director,
Colorado Asphalt Pavement Association

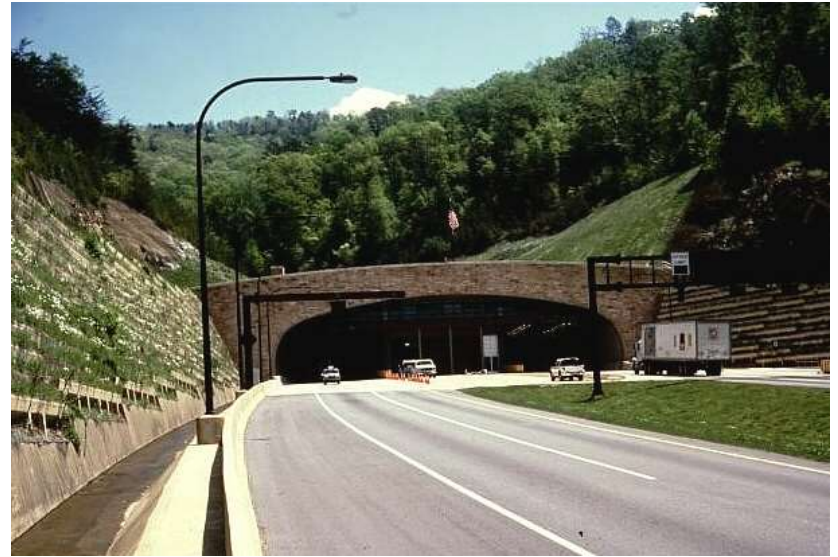


TOPICS:

- Overview of Industry**
- Specifications**
- Contracting**
- Innovation in Materials**
- Innovation in Construction**
- Public Policy**









PURDUE
UNIVERSITY



**Natchez Trace
Parkway**

National Park Service
U.S. Department of the Interior
Natchez Trace Parkway
Alabama, Mississippi, Tennessee

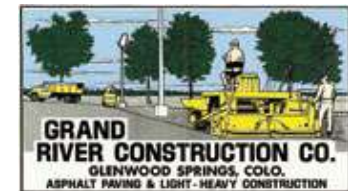




A CRH COMPANY



SIMON

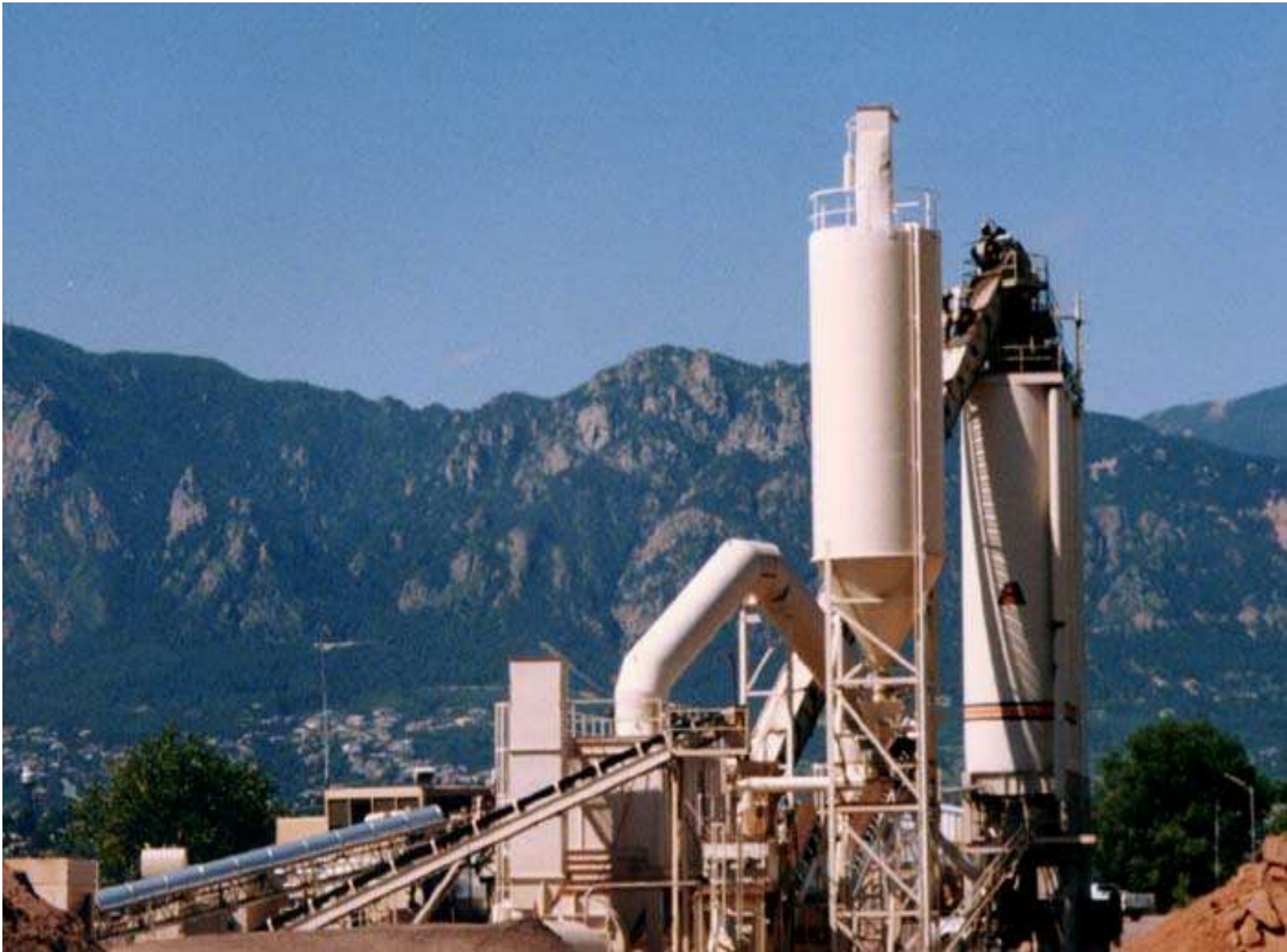


HOLLYFRONTIER



7040 W. Hwy. 100 Alamosa, Co. 81101 (719) 589-6871

65 stationary asphalt plants in Colorado



Schmidt Construction Co. Yard B Asphalt Plant, production facility, Colorado Springs, Colorado

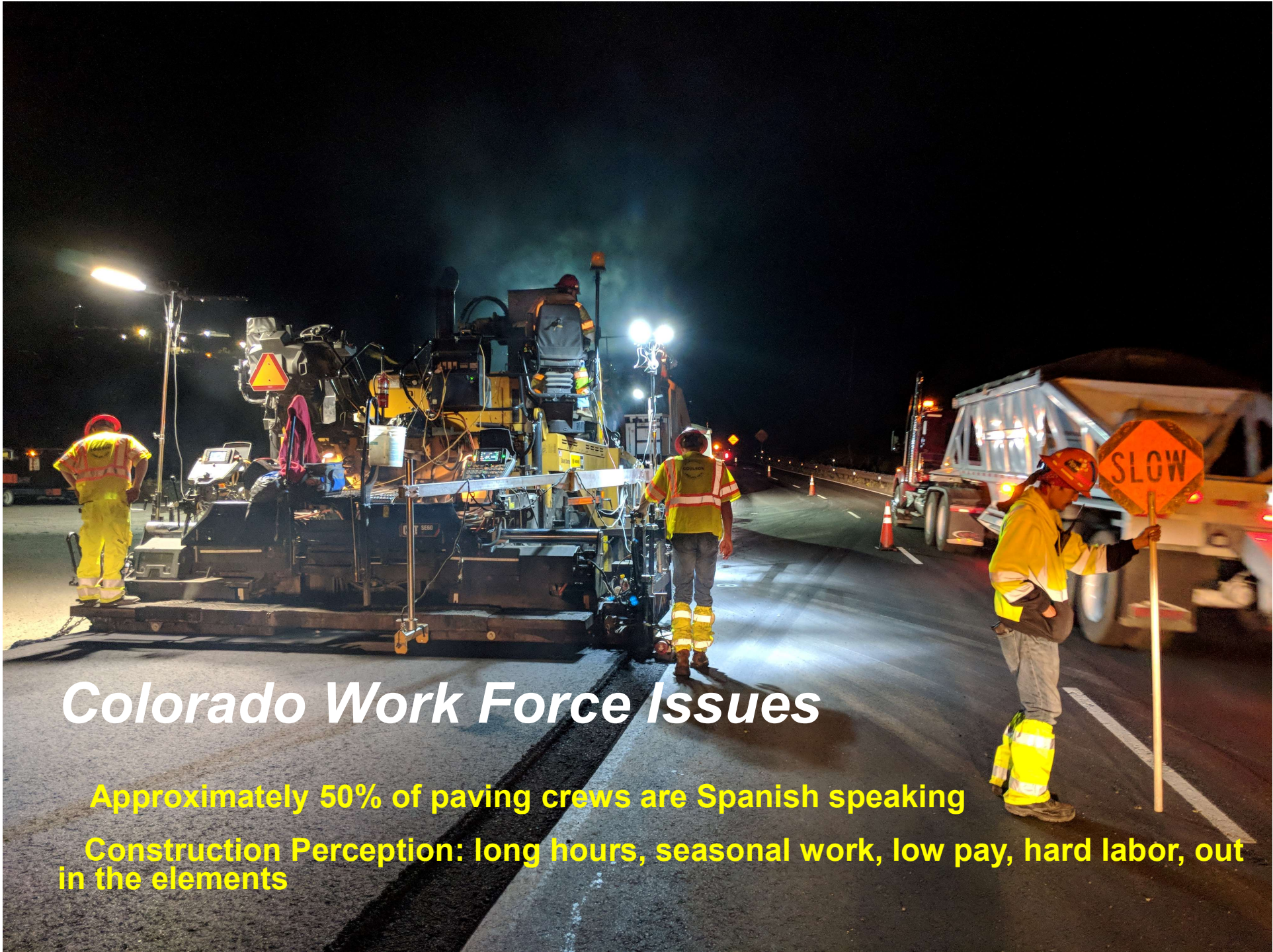






“KEY ECONOMIC INDICATORS OF THE ASPHALT INDUSTRY OF COLORADO”

- **9 million tons Annual Production**
- **Gross Revenue - \$700 million**
- **Market Value of Industry - \$900 million**
- **Number of Employees - 5,000**



Colorado Work Force Issues

Approximately 50% of paving crews are Spanish speaking

Construction Perception: long hours, seasonal work, low pay, hard labor, out in the elements



THINK YOU KNOW PAVING?



Pay + advancement = ideal career path



Annual salary, U.S. worker with only high school degree:
\$30,000¹



Annual salary, paving equipment operator:
\$39,887²

And with a high degree of advancement from laboring/equipment to other roles...

Paving project manager:
\$65,812.



Foreman:
\$66,120³



Compared to these average U.S. salaries:



Teacher: **\$56,383.**



Police officer: **\$61,270.**

Think about outcomes

36%

of millennials live at their parents' home.



Establishing a solid career while young creates long-term financial stability.



Unlike many jobs, paving and road construction aren't going away.

Think about striving for more

Crucial to our economy and communities

Visible results of your work every day

Increasingly attractive benefits

Lifestyle of freedom – goodbye boring office, hello winter time off

THINK AGAIN.

co-asphalt.com

¹ <http://work.chron.com/average-salary-college-degree-1861.html>
² <https://www1.salary.com/Paving-Surfacing-and-Tamping-Equipment-Operator-salary.html>
³ https://www.payscale.com/research/US/Industry=Paving_Construction/Salary

⁴ <https://articles.niche.com/teacher-salaries-in-america/>
⁵ http://www.discoverpolking.org/why_polking/fair_financial_stability

YOU'RE WELCOME.

Without the roads and workers in the asphalt and paving industry, we wouldn't have roads, bridges, parking lots, and the infrastructure we depend on every day. That's why we're the construction and job team — and look a long, successful career. Explore your opportunities at www.ppglobal.com.

There are many opportunities to explore
U.S. PPG Global Construction Division
www.ppglobal.com



WERE YOU A DREAMER?

Now you're a doer.

Put your career dreams and road to reality. We have the resources, the know-how, and the experience. The chance to work in a dynamic environment with diverse and great opportunities for you. www.ppglobal.com



DO YOU LIVE FOR CAMARADERIE?

Then we've got a team for you.

It takes a committed effort to build the infrastructure services that help us do what we do. All employees contribute, and that's why we've got our team. The world isn't just a place to get a job. It's a place to live. We're a team, and we need you. www.ppglobal.com



Construction Management (CON 370) Principles of Asphalt Construction & Materials



Civil Engineering – Construction Management – Construction Engineering



City Street Paving, Ft. Collins,

07/11/2011

Public Policy Issues Impacting the Construction Industry #1

- *Energy*
- *Health Care*
- *Labor*
- *Regulations*
- *Environmental*
- *Taxes*
- *Funding*
- *Marijuana*
- *Trucking – Hours of Work*



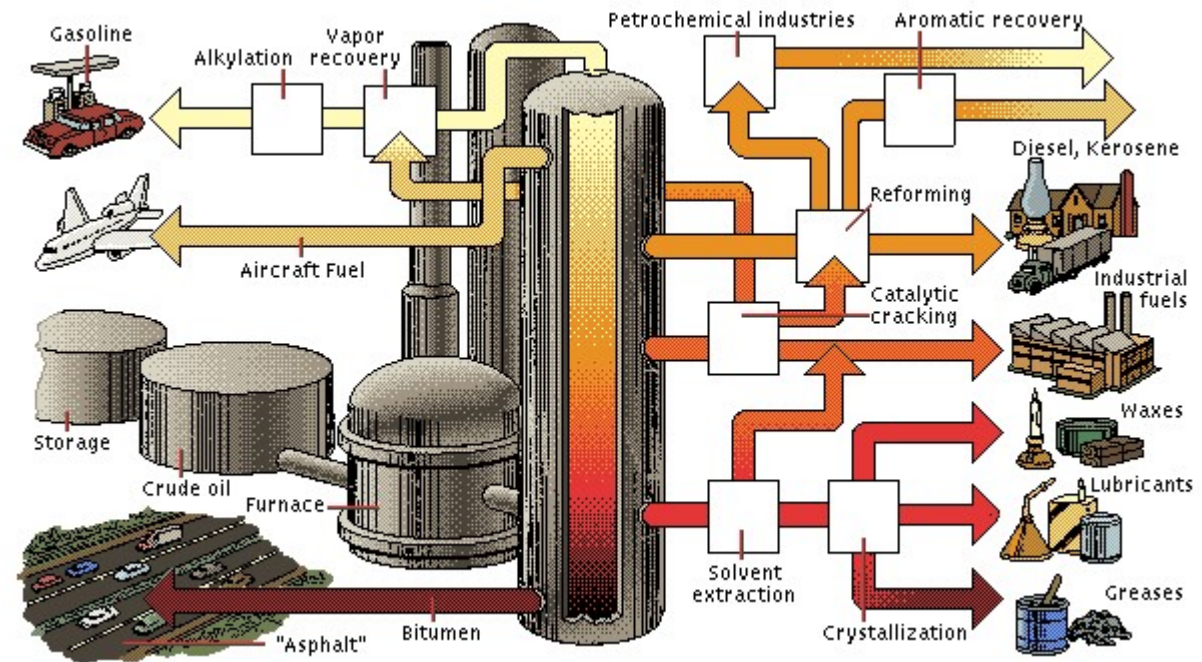
INVESTOR'S BUSINESS DAILY®

EDITORIALS

Trump Just Achieved What Every President Since Nixon Had Promised: Energy Independence

**THE BIDEN PLAN FOR
A CLEAN ENERGY
REVOLUTION AND
ENVIRONMENTAL
JUSTICE**

Crude Oil Refining Process



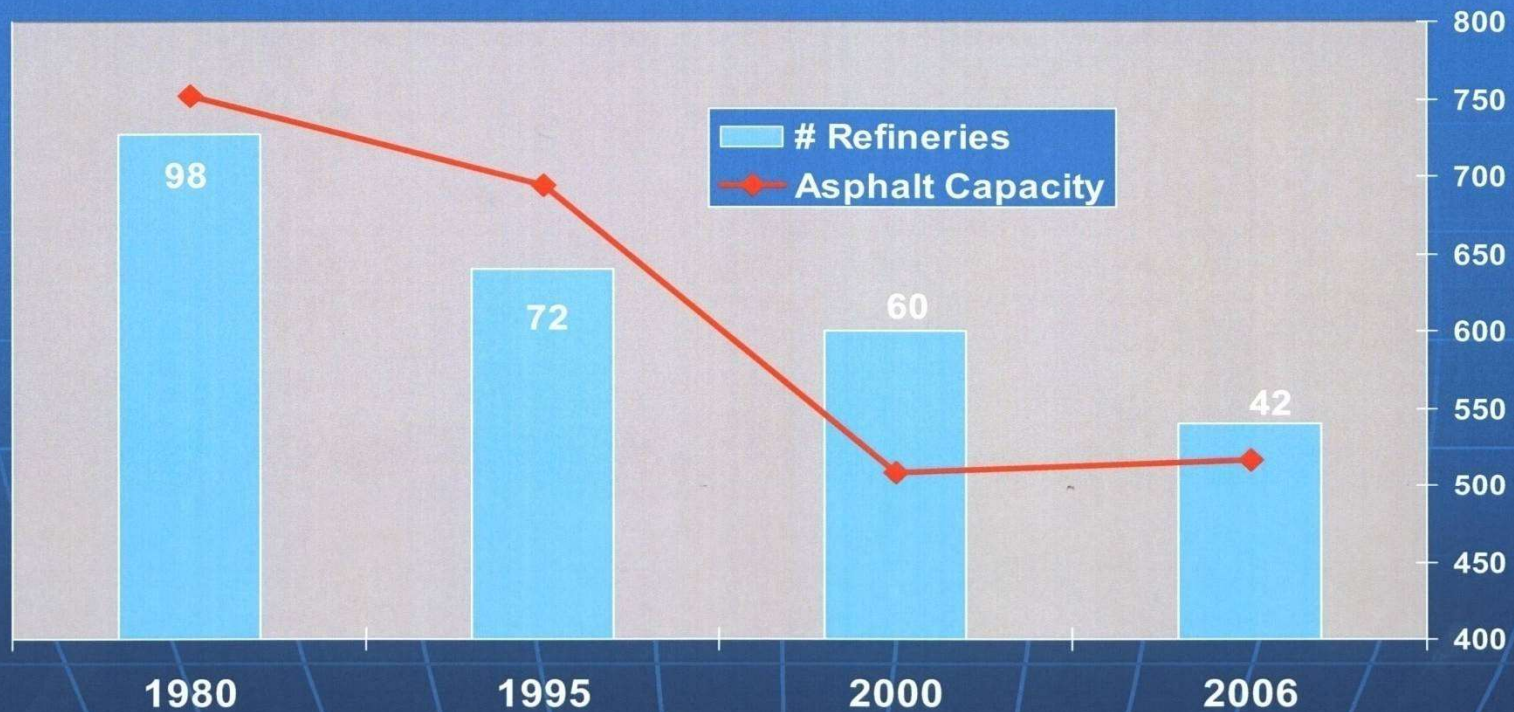
Crude oil is refined into products such as gasoline, asphalt, and waxes by a process.



HOLLYFRONTIER



U. S. Asphalt Refining Capacity



Production Range: 600 B/D to 60,000 B/D

Source: Oil & Gas Journal

- The refineries in the U.S. are running at about 95 percent capacity.
- Disruptions in supply can dramatically affect supply and cost.

100% of all paved streets, roads, highways, runways, parking lots, driveways, etc. are either asphalt or concrete.

Asphalt is produced through the crude oil refining process and is a fossil fuel.

Coal, a fossil fuel, is the energy source to produce cement. Cement is the primary ingredient of concrete.

There aren't any mass produced, economical, constructable alternatives to asphalt or concrete for pavements.

You cannot use wind and solar energy to fix potholes and pave roads.

Promoting the public policy of phasing out or eliminating fossil fuels from a heavy civil construction standpoint is

1. progressive and exciting
2. premature and ill advised
3. other

Types of Specifications:

Method Based Specifications: type of equipment, temperatures, methodology, material properties

End Result Specifications: quality levels, testing of final product, test results correlated to performance, I/D clauses

Performance Related Specifications: long term warranty, design build projects

#2





SPECIFICATION REVISIONS

ASPHALT

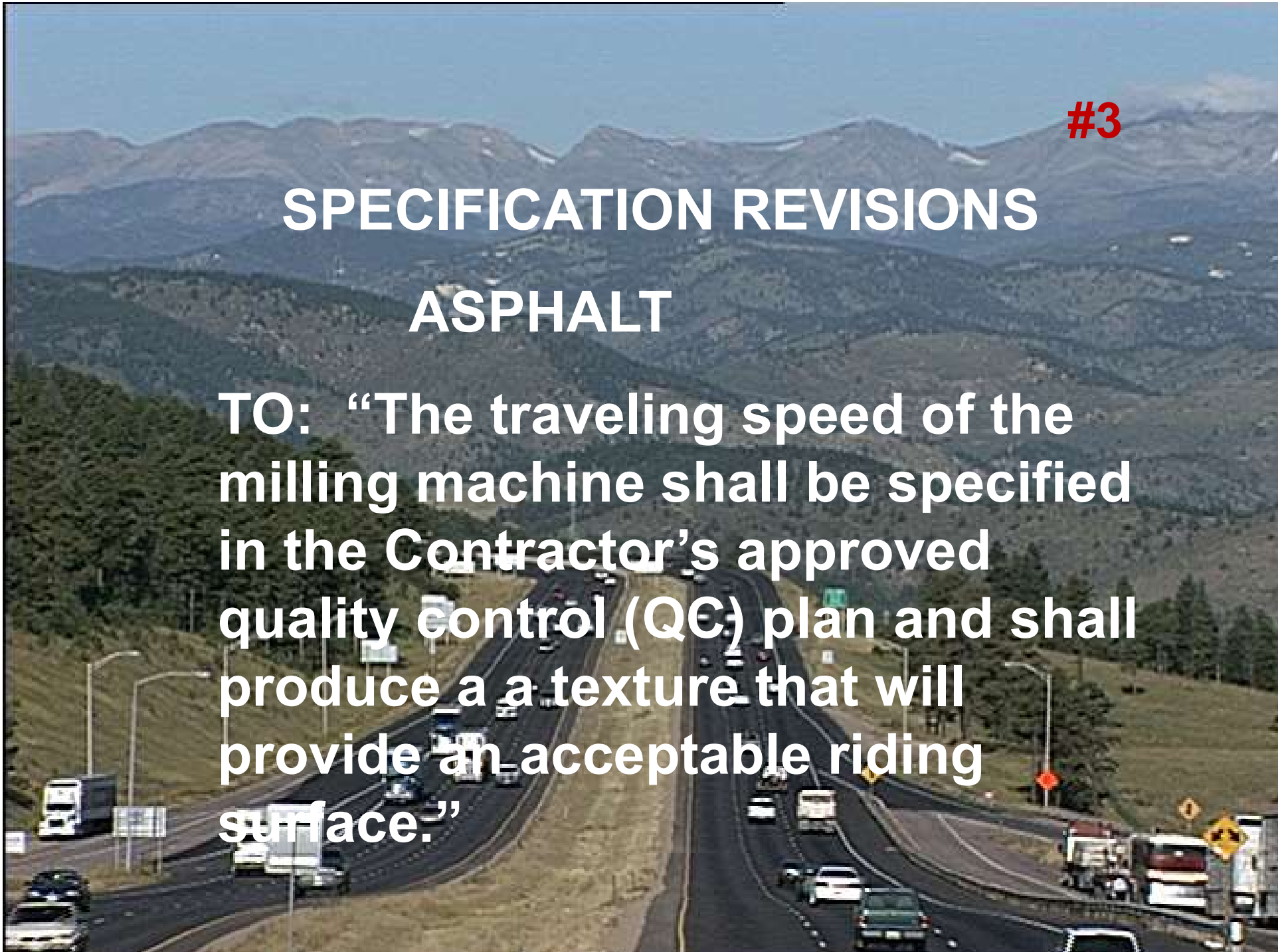
FROM: “The Project Engineer will control the traveling speed of the milling machine to produce a texture that will provide an acceptable riding surface.”

#3

SPECIFICATION REVISIONS

ASPHALT

TO: “The traveling speed of the milling machine shall be specified in the Contractor’s approved quality control (QC) plan and shall produce a texture that will provide an acceptable riding surface.”



Agency (engineer) Drivers: plans and specifications, contract requirements, quality



- Communication
- Developing trust
- Joint problem solving
- Being Reasonable

Contractor (CM) Drivers: cost, schedule, production, efficiency, constructability



“The testing technicians are often considered the most important people on a project. Their results determine if the construction is in specification, full incentive pay, deduct, or remove/replace. The results are only as good as the sampling and testing.”

Key to Success: Use proper procedures when sampling and testing so as to ensure that the test results are representative of the in-place material.

Contracting Issues Impacting Project Cost #5

- *Bidding – Time of Year*
- *Prompt Pay*
- *Material Requirements*
- *Reputation of Agency (reasonableness factor)*
- *Traffic Control Requirements*
- *Hours of Work*





I/D Incentive/Disincentive Clauses

I. material quality

- a. AC content
- b. aggregate gradation
- c. voids in the mineral aggregate

II. Construction Quality

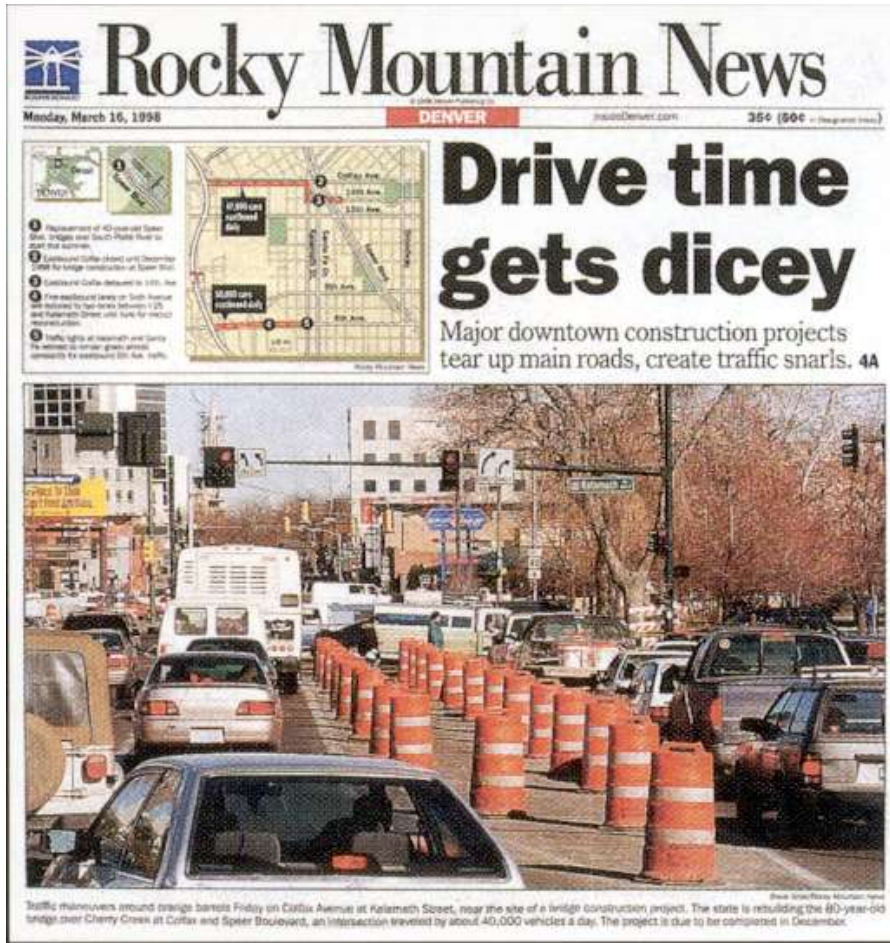
- a. pavement density, mat, joints
- b. smoothness



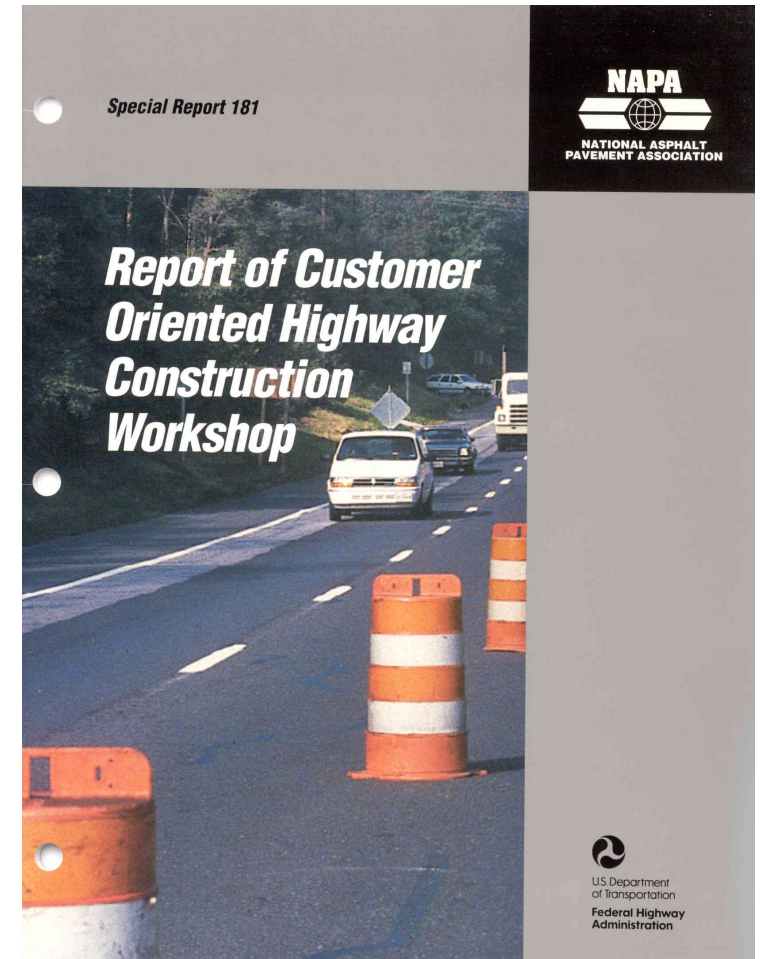




Advanced **W**arning **A**nd **RE**sponse (AWARE) Technology



Get In, Get Out, and Stay Out!!!



- Longer Life Pavement Designs
- Time Reducing Construction Practices
- Time Critical Contract Provisions

Asphalt Pavement Attributes

#7

- *Lower Initial Cost*
- *Competitive Life Cycle Costs*
- *Improved Smoothness*
- *Lower Pavement Noise/Quiet pavement*
- *Faster Snow Melt*
- *Enhanced Pave Green - Sustainability*
- *Ease of Maintenance*
- *Reduced Time of Construction, Less Traffic Disruption*



ASPHALT
THE SMOOTH QUIET RIDE



Central 70 Corridor: I-70 in Denver, \$1.2 B

Design/Build/Maintain/Operate/Finance

- budget constrained
- managing traffic during construction a primary goal
- D/B Team sets the business model (financial inputs) for cost effectiveness, interest rate

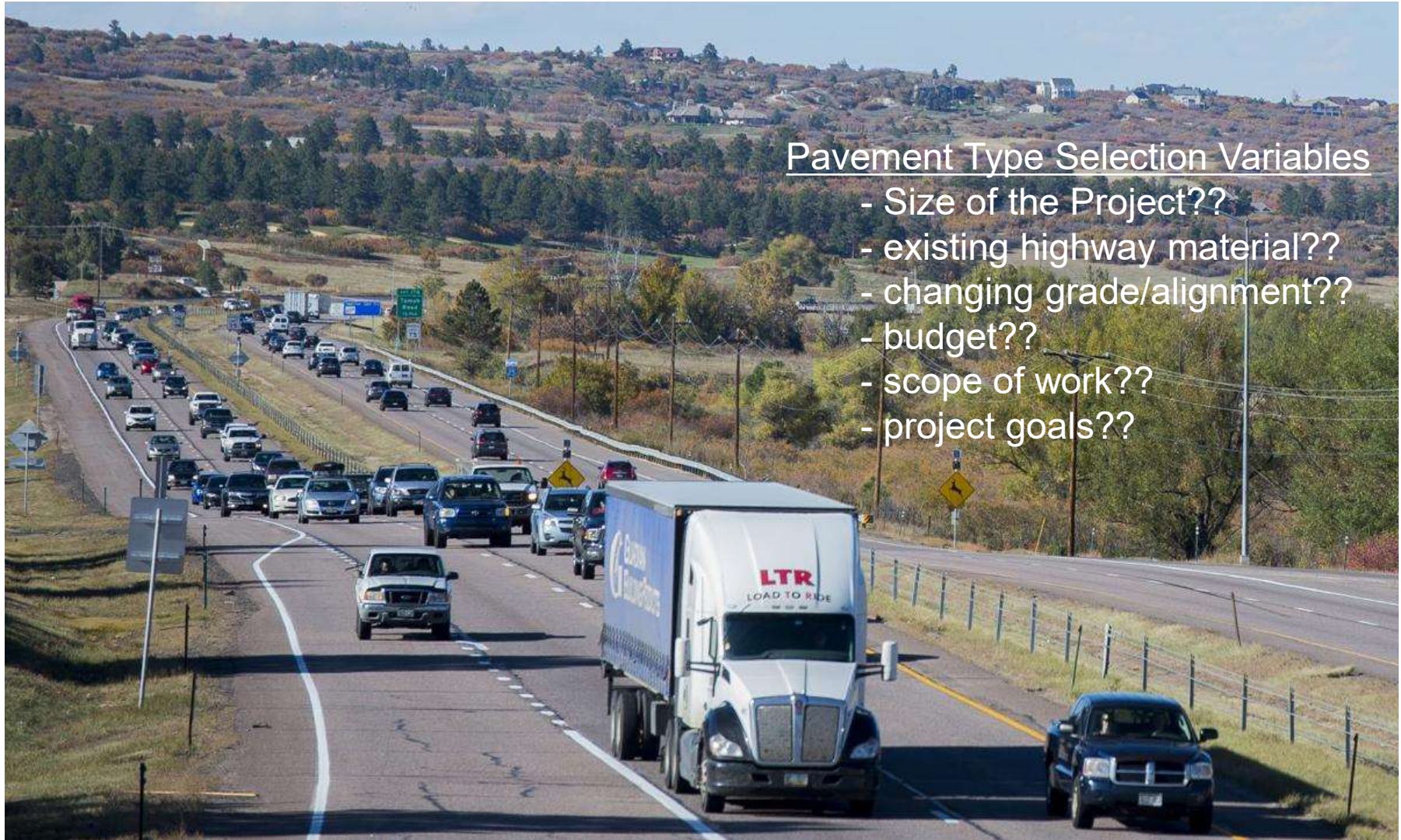
Pavement Selection: initial construction cost, scheduling, phasing, condition at 30 years, 800,000 tons of ASPHALT!

ASPHALT
THE SMOOTH QUIET RIDE



I-25 The Gap: \$350 M

4 lanes to 6 lanes, 18 miles, Monument to Castle Rock, 800,000 tons of asphalt



Pavement Type Selection Variables

- Size of the Project??
- existing highway material??
- changing grade/alignment??
- budget??
- scope of work??
- project goals??

D/B Goal: Optimize scope of improvements within the project budget

- Over 90% of all pavements in Colorado are asphalt.
- Asphalt is the best value solution in nearly all cases and is a viable solution for at least a portion(s) of this project.



- On schedule
- On budget
- Reduce time of construction
- Reduce impact to motorists
- Maximize scope

I-25 Colorado Springs North, Woodmen Rd. to Monument Rd.

\$60 M Design/Build Project, 8 mile widening from 2 lanes to 3 lanes

“... maximizing scope of the project was the primary goal of the project and this favored asphalt.” CDOT Chief Engineer, April 12, 2012





Allowing alternate pavement types in the RFP

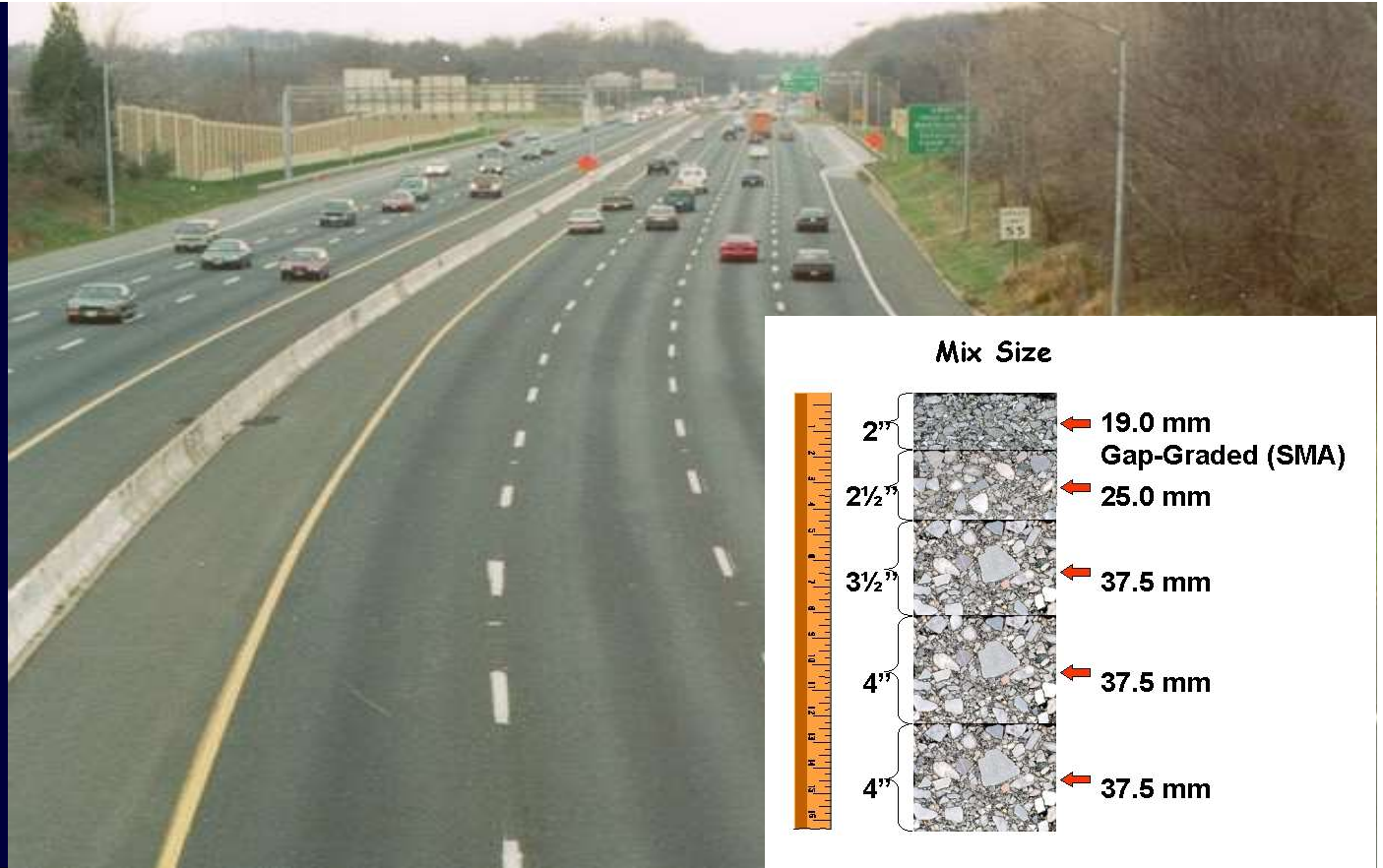
- *increases the opportunity to optimize the improvements of the project and better serve the taxpayers.*

LOCATION
I-695, NBL,
Baltimore Beltway

COMPLETION DATE
1993

19 mm GG
AC-20 w/ fibers

TRAFFIC
AADT - 175,000
Trucks - 19%



PERFORMANCE DATA - 1999

<u>DENSITY</u>	
<u>Wheelpath</u>	<u>Centerline</u>
99.0	98.4
98.0	96.0
97.5	95.5

PG BINDER GRADE

70-22

PAVEMENT DEFORMATION

ARAN average, 0.12
ARAN change, 0.04 (4 yr.)

Measurement, 1/8"

The type of asphalt mixture used depends on the application – road, parking lot, city street , highway, airport, trail, etc.

#9



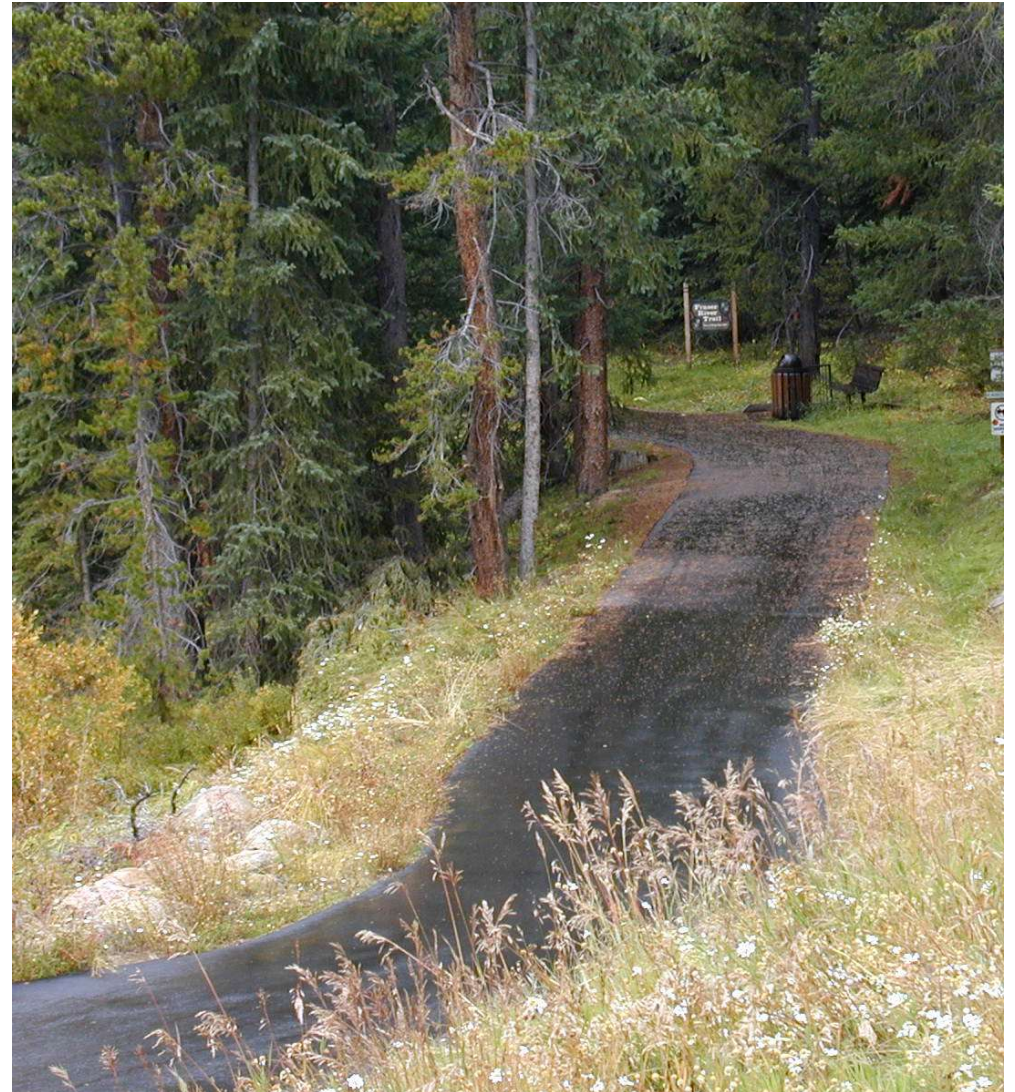
The type of asphalt mixture used depends on the application – road, parking lot, city street, highway, airport, trail, etc.



The Use of Asphalt Materials for #8 Colorado Trails & Paths

KEY TO PERFORMANCE

“Proper design and construction together with the proper thickness and proper base preparation will help ensure a high quality hot mix asphalt trail or path.”



















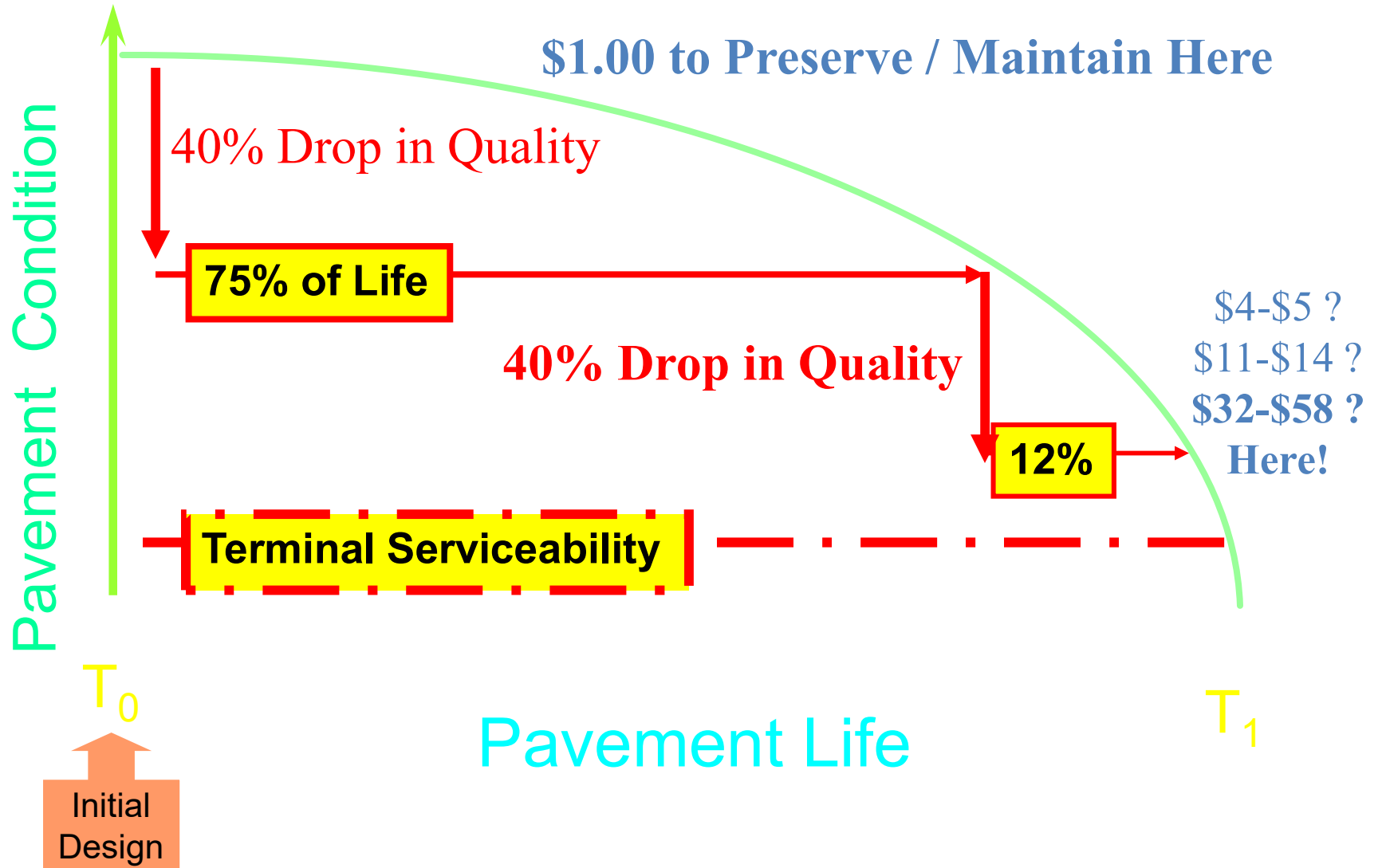






#9

Performance Curves / Costs of Repairs



#10

Coalition for SAFE – Safe Asphalt for Everyone

Information you need to make informed decisions about asphalt in your Colorado community

The logo features the word "SAFE" in large, bold, black capital letters. The letter "A" is stylized with a yellow vertical bar. Below "SAFE" are two horizontal lines. Between these lines, the words "COALITION FOR" are written in a smaller font. Below the second line, the words "SAFE ASPHALT FOR EVERYONE" are written in a larger font, matching the size of "SAFE".

SAFE
COALITION FOR
SAFE ASPHALT FOR EVERYONE

Asphalt and our Colorado Communities: Be informed

Asphalt pavement is an important element of Colorado's transportation infrastructure. It offers a safe, cost-effective and green solution for our streets, bridges and parking structures.

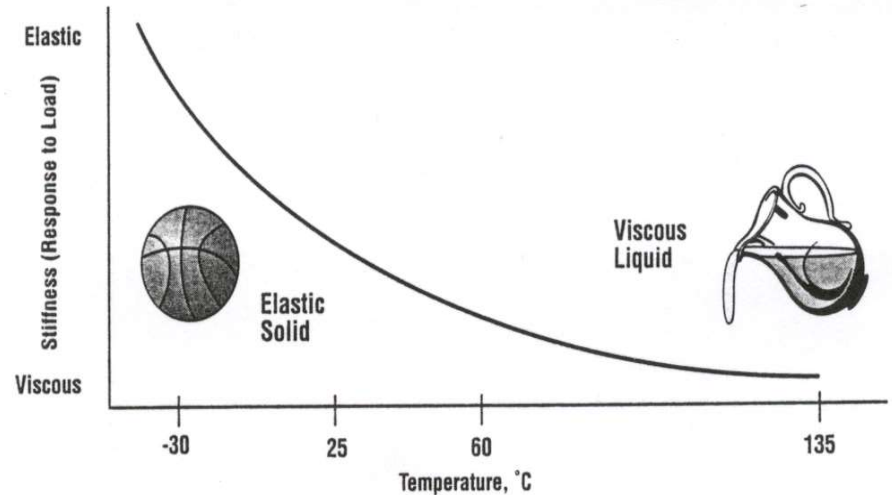
It plays an important role in our communities.

“While the production of asphalt has increased by over 250% in the past 40 years, the emissions from asphalt plants has been reduced by 97%.”

Performance Grades

Asphalt is a:

- Spring (Elastic)
at low temperatures or
fast loading
- Shock absorber (Viscous)
at high temperatures or
slow loading



PG System: Similar to multi-graded engine oils. ie. Performance ability at temperature extremes – both hot and cold



AMERICA RIDES ON US

Asphalt.

Asphalt Mixture Aggregates

Improved material technology

- Superpave has virtually eliminated rutting in Colorado

#11

New Superpave technology with rut resistant coarse crushed stone. Note stone on stone matrix.



Intermediate mix designs gave marginal results.

outdated mix with high percent of fines and AC tended to rut and shove.



Q: How long do asphalt pavements last?

A: Longer than most people think. Don't confuse the number of years to the next resurfacing (10, 12, or 15 years or more) with how long the pavement is in place. Most asphalt pavements have been in place since the original construction.

Pavement Core, I-25 N. of Pueblo, original construction - 1962

Rehabilitation

Possible Distresses

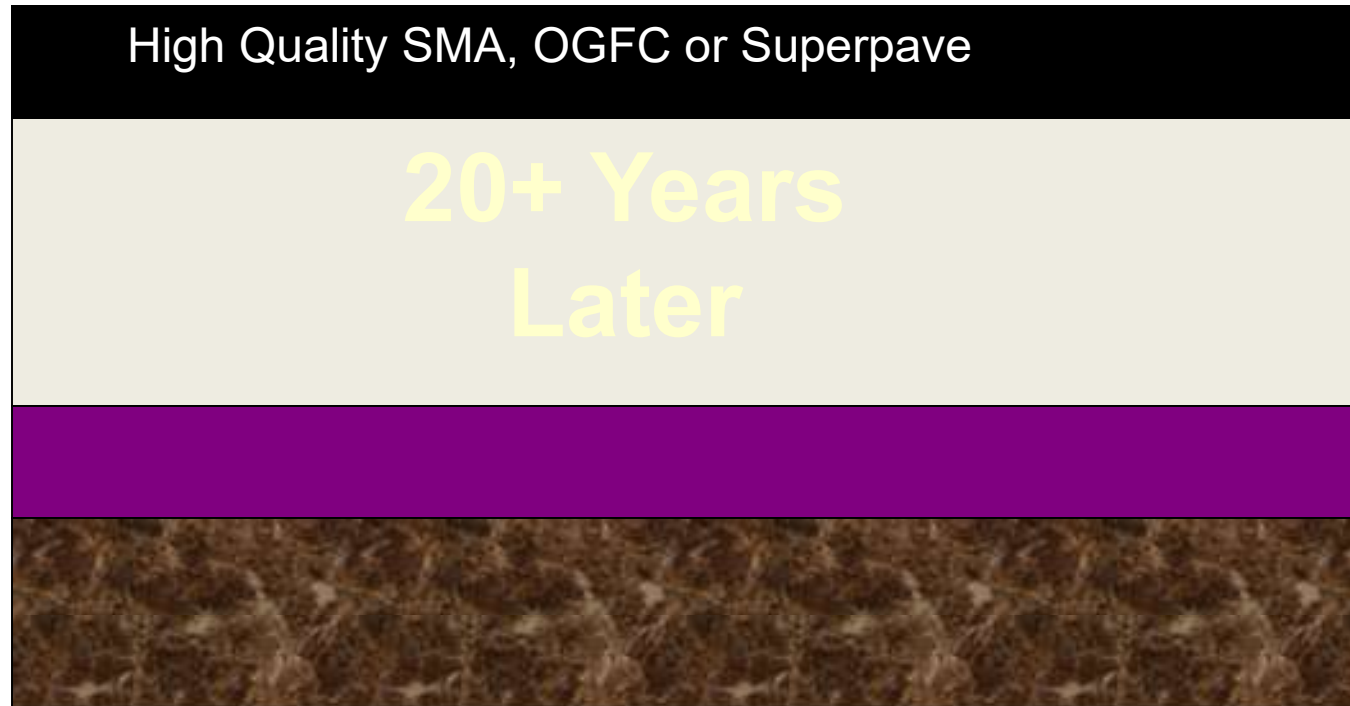
- › *Top-Down Fatigue*
- › *Thermal Cracking*
- › *Raveling*

Solutions

- › *Mill & Fill*
- › *Thin Overlay*

Structure Remains Intact

2 - 4"





AMERICA RIDES ON US

Asphalt.

New Developments in Asphalt Technology

Possibilities with Warm Mix Asphalt

- *Extend the paving season (compact at lower T)*
- *Improve workability (easier to get compaction)*
- *Reduce fuel consumption at the plant*
- *Reduce emissions at the plant*
- *Increase haul distance*
- *Reduce fume and improve safety at paver*
- *Reduce aging of the binder (improve performance)*
- *Pave at lower temperatures*



CDOT, Sept. '09



Warm Mix Asphalt – Mesa County

2015 – 15,000 tons (by Change order)

2016 - allowed







YMCA of the Rockies, Fall 2009
Connell Resources, WMA produced with additive at Ft.
Collins asphalt plant.



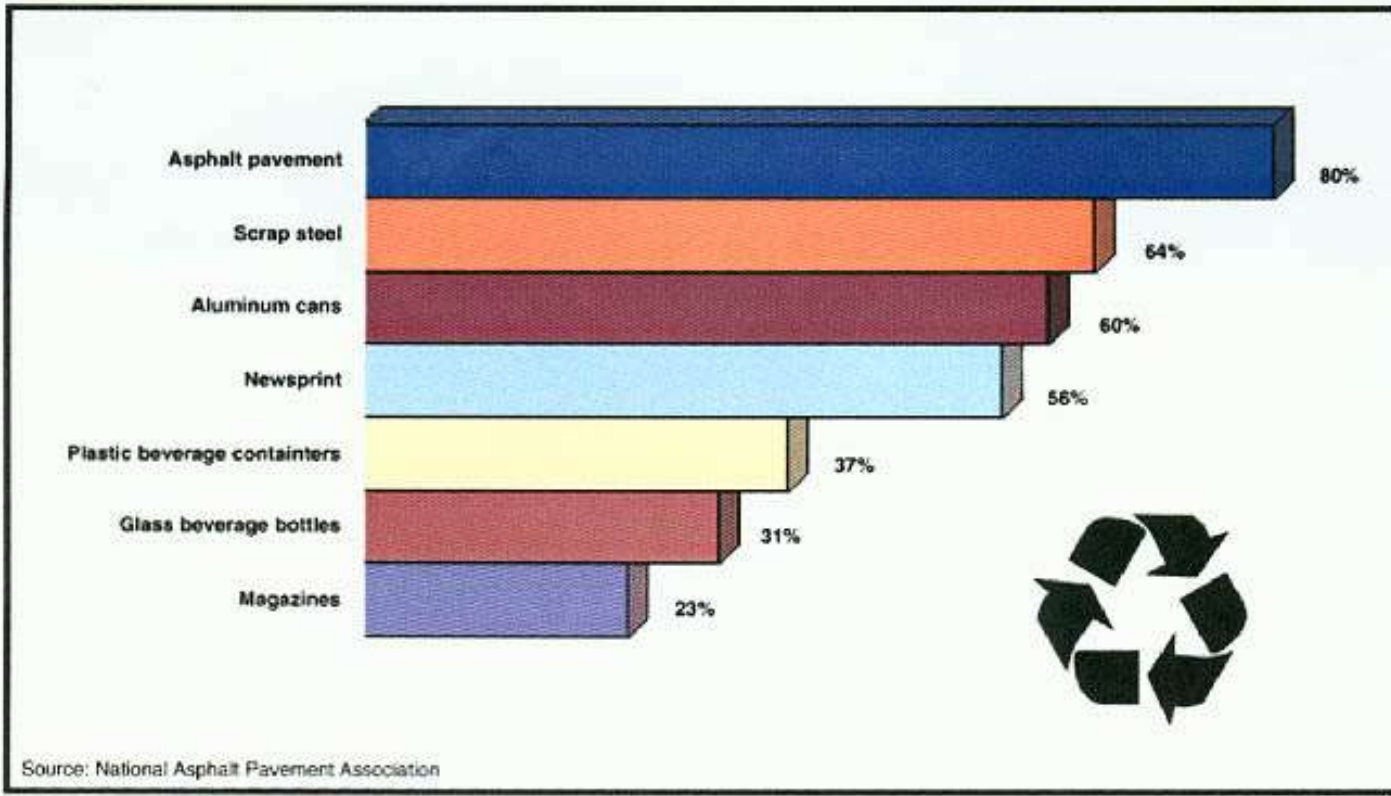
37th St. – Loveland, 2011, WMA (additive),
Coulson Excavating Co. Inc.

Recycling



- 80% of RAP is Recycled
- 73 Million Tons Per Year
- Industry Leader

How much is recycled?



References:
For asphalt pavement: Turner-Fairbank Highway Research Center, Division of Federal Highway Administration. See <http://www.tfhrc.gov/pubrds/fa194/p94au32.htm>
For scrap steel: Steel Recycling Institute. See <http://www.recycle-steel.org/database/index.html>. Then click on factsheet.
For all other materials: Environmental Protection Agency. See <http://www.epa.gov/epaoswer/non-hw/muncpl/mwrspt96/9charac.pdf>

Material Conservation – Utilize More Recycled Asphalt Pavement



Asphalt pavements are 100% recyclable and are the #1 product recycled in the U.S. each year.



Specify for innovation



Recycled Asphalt Shingles - Issues

- availability
- cost
- performance
- gradation
- percent maximum
- amount of deleterious material

Asphalt pavements are designed and engineered for quality and performance. Material components need to be evaluated with respect to the cost/benefit. We cannot consider our pavements as linear landfills.



Sustainability

#12

- Recycled Asphalt Pavement (RAP)
- Warm Mix Asphalt
- Perpetual Pavements
- Porous Pavement



The Construction Industry of Colorado - Faith Family Freedom





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