



# RIBBONS



# ACROSS THE LAND

By Sue De Pasquale, with David Holzel



# Are we there yet?

These four words, emanating from the back seat of a minivan, are enough to send modern parents scrambling for their iPods.

But today's highway travails are nothing compared to what a young Dwight D. Eisenhower experienced back in the summer of 1919, when he set out from Washington, D.C., on a transcontinental convoy to assess the United States' fledgling road system. "In those days, we were not sure it could be accomplished at all," Ike would later recall. "Nothing of the sort had ever been attempted."

With World War I just ended, military leaders were eager to find out how quickly troops could move across the United States in the event of another war. The answer? At a snail's pace. The convoy of trucks, which crawled across the nation's "Lincoln Highway" at speeds averaging just 5 miles per hour,

took more than two months to reach San Francisco from the East Coast, according to Dan McNichol, author of *The Roads That Built America*. Along the way, McNichol notes, the expedition lost 21 men to injury, damaged or destroyed 88 bridges, and left nine trucks behind on the road—in muddy ditches and at the bottom of embankments.

"It's not possible to exaggerate how bad roads were back then," says Roger White, an associate curator at the Smithsonian Institution's National Museum of American History, in Washington. "Automobile development was way ahead of the roads of the time." Once past Illinois, the convoy encountered only dirt paths and trails nearly all the way to California.

For the young Army lieutenant Eisenhower, the arduous 3,200-mile trek left an indelible impression. More

than two decades later, when World War II took him to Germany, he looked with marvel at the autobahn. "Hitler's Road" was a model for the modern superhighway, with its high-speed, multi-lane, limited-access, divided roadways. In fact, once the Allies gained control of the autobahn, the defeat of the Germans came within six weeks. "The old convoy had started me thinking about good, two-lane highways, but Germany had made me see the wisdom of broader ribbons across the land," Eisenhower wrote in his 1967 book *At Ease: Stories I Tell to Friends*, in which he shared memories of his life up to the end of his military career.

In June 1956, Eisenhower saw his dream for these "broader ribbons" realized when, as president of the United States, he signed into law the



largest public works project in the history of the world: the Interstate and Highway Defense System. The ambitious program (later renamed to honor the president) aimed to connect the entire country—East and West, North and South—with the federal government footing 90 percent of the construction bill. Originally estimated to cost \$37.62 billion, the project would balloon to a whopping \$128.9 billion by the time it was completed in 1991, according to the American Road & Transportation Builders Association (ARTBA).

“Today, this nearly 47,000-mile road network is a symbol of the freedom that we enjoy as Americans,” notes U.S. Secretary of Transportation Norman Y. Mineta, as the 50th anniversary of the interstate system approaches. Though the interstates account for just 1 percent of the nation's roadways, these highways carry 24 percent of all traffic, including 41 percent of truck traffic.

The punishing loads have left their mark, on the interstates and the legions of other highways constructed in the United States and throughout the world during the same period, points out William Buechner, Ph.D., vice president for economics and research at ARTBA. “Most highways built during the 1950s and 1960s were constructed for a 40-year life span,” he says. “But traffic has certainly been

heavier than anyone could have anticipated.”

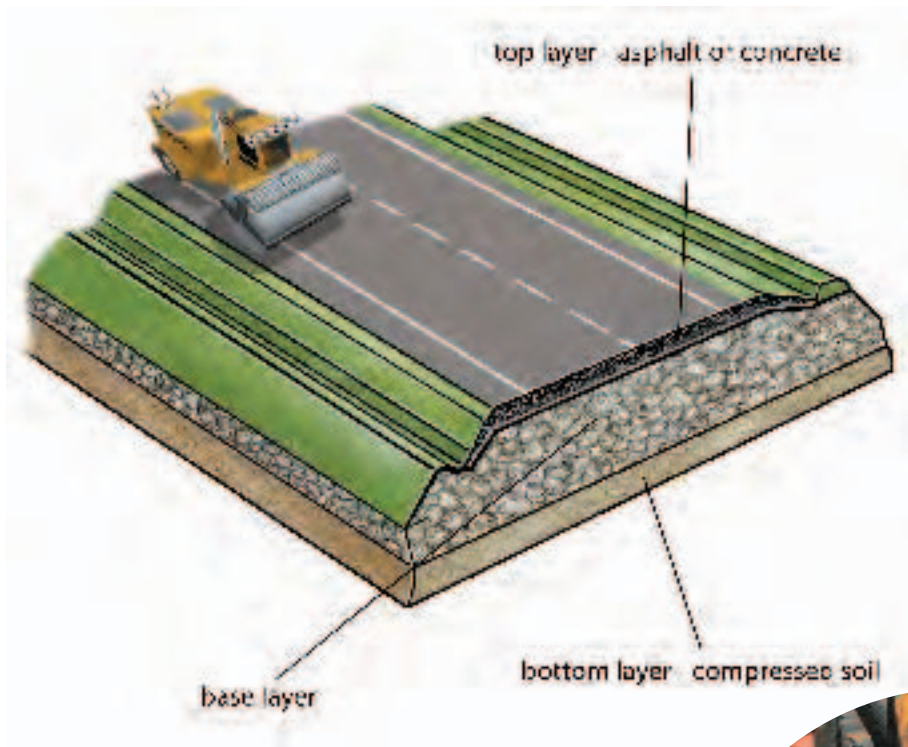
In 1960, for example, the number of registered U.S. vehicles stood at 74 million. By 2003, that number had skyrocketed to 231 million vehicles. (See “U.S. Highways by the Numbers,” p.17.) It should come as no surprise, then, that many of the nation's roadways today are buckled, cracked and riddled with potholes.

## Construction Zone



- Highway workers spent 246.4 million hours working on the National Highway System in the U.S. during the year 2001.
- Between 1982 and 2000, the number of roadways considered congested grew from 34 percent to 58 percent.
- More than 40,000 people are injured each year as a result of motor vehicle crashes in work zones in the United States.

*Source: U.S. Department of Transportation—Federal Highway Administration*



## Layers of Roadway

Think of a highway as a layer cake. Highway engineers begin their cake with a bottom layer of soil, which must be compressed and stabilized to hold the layers that follow. The compression process “usually involves blending and grading it to the approximate proper elevation,” explains Steven M. Waalkes, managing director of technical services for the American Concrete Pavement Association. “Then the soils are compacted with rollers to achieve the proper density.” Sometimes the soil is poor (think: clay and silts) and must be improved. In the case of concrete paving, road builders typically add chemical stabilizing agents.

These agents can include cement, cement kiln dust, lime or fly ash. “These chemicals act as binders and drying agents, which makes the soil stronger and able to support the subsequent layers,” Waalkes says.

The next layer in the cake is the base layer, made of rock, crushed stone, asphalt hot mix or recycled concrete. The busier the road, the thicker the base will be, says Bill Davenport, vice president of communications and membership for the American Concrete Pavement Association.

Once this is set, workers can create the main, top layer—which can range from 8 to 13 inches thick—of asphalt or concrete. While concrete is considered a rigid pavement (offering smoothness, durability and safety, Davenport notes), asphalt is petroleum-based and more flexible.

In the case of concrete, workers either truck in a concrete mixture from a processing plant or mix it using central mix plants on or near the paving site. The cement is then placed on the roadway. Much the way a baker uses a spatula to smooth and even a cake’s icing, construction workers operate a slipform paver, which uses sensors to make sure the concrete it is laying is straight and level. A screw-like apparatus under the paver spreads the concrete, while the sensors guide the track and define the width of the road. The paver is also able to adjust to curves and changes in grade—the angle of the highway.



“That assures that they are laying down a consistent thickness,” explains Davenport. “Behind the paver, people are smoothing the pavement—finishing it with hand tools and helping to cure [dry] the pavement.” To control cracking, the pavement is saw-cut into slabs, and often reinforced with smooth steel bars—dowels—across transverse joints. “These bars are used to ensure that neighboring slabs can assist in carrying traffic loads that are applied on an individual slab,” Davenport says.

When traffic engineers opt for asphalt as the top layer of their cake, their cooks must fire up the ovens. That’s because asphalt is made by mixing asphalt (black, petroleum liquid) with aggregate (crushed stone, gravel and sand) and then heating it to temperatures of 275 to 300

degrees Fahrenheit.

In the most common process for laying an asphalt road, the mixture is heated at the plant and then trucked to the roadbed, where it’s dumped into the hopper of a paver and placed onto the roadway. Workers use

augers to spread the asphalt evenly. Then a steel bar, called a screed, passes over the area, making sure the material is an even height and thickness across the road. In the final step, workers use rollers to compress the asphalt surface.

Along the nation’s aging highway infrastructure, it’s this top layer—whether asphalt or concrete—that first shows signs of wear and can be a tip-off to damage below.

That’s why the big story in highway construction these days lies in repair, maintenance and preservation, according to the ARTBA’s Buechner. He estimates that 97 percent of all federal money is dedicated to preservation efforts. “There are no more than 300 to

400 miles of road each year built new with federal funds,” Buechner says.

Last August, President Bush signed into law a sweeping transportation funding bill that authorizes some \$286.4 billion to be spent from 2004 through 2009, on highways, highway safety and transit programs. Known as SAFETEA-LU (for Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users), the law guarantees just over \$36 billion for highways for 2006 alone.

As policymakers allocate these funds to road repairs, they are looking to highway engineers to use the latest technology—including recycled materials—to cut costs, reduce disruption to traffic, and minimize environmental impact.

According to David Newcomb, vice president of research and technology for the National Asphalt Pavement Association, most “mill and fill” highway renovations currently enable contractors to reuse about 20 percent of the original asphalt. In addition, says Newcomb, “People are constantly looking for ways of introducing recycled materials into asphalt.”

He notes that discarded tires have become a popular source of “crumb rubber” that is ground into granular bits, blended with liquid asphalt, heated and stirred for several hours until “digested,” then combined with aggregate. The asphalt recycling strategy, first used in Arizona during the 1970s, is popular in warm-weather states like Florida, Texas and California. Other contractors are using recycled roofing shingles with great success, Newcomb says.

Davenport, of the American Concrete Pavement Association, points out that concrete is the most recycled building material in the world. “Typically, a concrete pavement that has served past its design life may be crushed and the steel reinforcements separated and recycled in their own right,” he says. “The crushed concrete is then used for base materials, but also may be used in other applications. One example is known as “rip-rap,” which are large pieces of concrete typically used on an embankment as erosion control and protection



## International Highway Facts

### **Stocking Up Down Under -**

Motorists intrepid enough to traverse the Eyre Highway, which links Western to Southern Australia, are advised to stock up on extra water and gas. The highway passes some of the hottest and most remote places in Australia—where settlements are few and far between.

### **Built on Blood, Sweat, and Tears -**

More than 400 road-builders reportedly died during the 20 years it took to complete the great, winding Karakoram Highway, which follows 800 miles of ancient trade routes linking Kashgar in Western China with the Pakistani capital, Islamabad.

**The Need for Speed -** Most people know that Germany's acclaimed Autobahn has no blanket speed limit, technically making it legal for motorists to zip along at speeds exceeding 125 miles per hour (200kph). But the country does have a minimum speed requirement: Vehicles that can't reach 37 mph (59kph) are prohibited.

**Ring Around the Island -** For tourists intent on seeing Iceland, Route 1 (known as the “Ring Road”) is the way to go. The 1,339-kilometer-road (832 miles) runs around the entire island. While most of the Ring Road is two lanes wide and

paved in asphalt, there are stretches that are unpaved and lined only with gravel.

### **International Highways by the Numbers**

**80 mph (128 kph):** speed limit on French autoroutes under normal driving conditions. France's speed limits for its limited access highways is the highest set speed limit in Western Europe or North America.

**2008:** The year when a modern “Via Egnatia” is expected to be completed in Greece—a 680-kilometer highway (422 miles) that begins at the Greek-Turkish border and ends at the western Greek port of Igoumenitsa. Known as E-90, the highway will have 76 tunnels and 1,650 bridges.

**20,000 kilometers (12,427 miles):** The length of the longest numbered highway in the world. Highway 1 in Australia is a coastal highway that connects all the mainland's state capitals and coastal towns and circumnavigates the entire continent.

**58,000 kilometers (36,039 miles):** The length of the road system that constitutes the National Highway system in India. It represents just 2 percent of the roads in India, yet carries some 40 percent of total road traffic.

against water damage or flooding.”

He says the concrete industry is also working hard to come up with ways to lessen disruption to traffic. One current promising strategy is known as “fast-track paving technology.”

“Many people assume concrete must cure for 14 or 21 days, but fast-track methods allow same-day reopening to traffic,” Davenport says, adding, “A few years ago, a section of paving was closed after the morning rush hour in mid-town

Manhattan, New York, repaired, and re-opened for the [afternoon] rush hour.”

Those in the highway construction industry say that innovations like these are just the tip of the iceberg of what’s to come in highway construction and maintenance.

Notes Newcomb: “Technological innovation is the key to producing the longer-lasting, more economical and environmentally friendly roadways of the future.”

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**Suction Hose Fittings**  
**In-Line Lubricators**  
**Air Receiver Manifolds**  
**Internal Expansion Fittings**



## Famous Roads of the World

By David Holzel

### The Appian Way

The Via Appia, the first well-constructed Roman road, is named after the man who is believed to have begun its construction in 312 B.C., Appius Claudius. It started in the center of Rome and headed southeast. By 244 B.C. it had been extended as far as Brindisi on the Adriatic coast, some 300 miles from Rome.

In their attempt to connect to continually expanding dominions for communications and administration, the Romans constructed roadways all over the empire—some 6,000 miles of roads in Britain alone. As the Roman empire declined, the roads fell into disrepair. But some routes are still followed today, such as Watling Street, which runs from Dover to London.

### Route 66

Begun as a two-lane highway in 1926, Route 66—which took Americans between Chicago and Los Angeles—was reported as “continuously paved” in 1938, and widened to four lanes in the 1950s, according to Roger White, of the National Museum of American History.

Route 66 provided truckers with a livelihood and was a catalyst for roadside business. Families migrated west to California on Route 66, hitchhikers thumbed rides and outlaws escaped pursuit along the concrete ribbon. And it gave advertisers a new medium—the billboard.

“It had a great deal of personality from the get-go,” says White. Although it was decommissioned in 1984, Route 66 shows no sign of disappearing. There’s a Route 66 historical society in every state it once passed through.

### The Pan-American Highway

Proposed at the Fifth International Conference of American States in 1923, the Pan-American Highway was to be a continuous road running 16,000 miles from Alaska to the southern tip of Chile. What eventually emerged is not as grand as its original idea, but no less impressive.

Carretera Panamericana in Spanish and Estrada Panamericana in Portuguese is a network of roads that aids transportation and communications between the hemisphere’s countries and within them.

Today it is possible to drive from above the Arctic Circle down to Puerto Montt (which sits nearly 600 miles south of Santiago, Chile) with the exception of a 54-mile stretch between the Panama Canal and northwest Colombia. That stretch, called the Darien Gap, is a mountainous rain forest. Disagreement and controversy remain over paving that last link of a route that touches an entire hemisphere.

# U.S. Highways by the Numbers

**3.9 million:** Number of miles of roads and highways in the United States

**2.9 trillion:** Personal vehicle miles driven in 2003

**231 million:** Number of registered vehicles in the United States in 2003

**74 million:** Number of registered vehicles in the United States in 1960

**72 percent:** Percent of the total value of commodities shipped annually in the U.S. that are transported via highways—more than \$4.4 trillion worth of products.\*

**721 billion:** Number of miles traveled by Americans on interstates in 2004

**3 million tons:** Average amount of concrete in one mile of interstate

**Longest interstate route in the United States:** I-90, Seattle to Boston, which runs 3,020 miles

**Shortest interstate route in the United States:** I-73, which spans 12 miles in North Carolina

*SOURCES: Federal Highway Administration; Dwight D. Eisenhower Library, ARTBA, \*T. Peter Ruane of ARTBA*