1917 – 2016 TxDOT: A Century of Concrete Progress

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The More Things Change....
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The More They (Sometimes) Stay the Same
1905 **Office of Public Roads** - The Office of Public Roads (OPR) is established, successor to the Office of Road Inquiry established in 1893.

1910 **Asphalt manufactured from oil-refining byproducts** - Gulf Oil, Texas Refining, and Sun Oil introduce asphalt manufactured from byproducts of the oil-refining process. Garrett Morgan, an inventor with a fifth-grade education and the first African-American in Cleveland to own a car, invents the electric, automatic traffic light.

1913 **First highway paved with portland cement** - The first highway paved with portland cement, or concrete, is built near Pine Bluff, Arkansas, 22 years after Bellefontaine, Ohio, first paved its Main Street with concrete.

1930s **Air-entrained concrete introduced** - Air-entrained concrete, is introduced. The addition of tiny air bubbles in the concrete provides room for expansion when water freezes, thus making the concrete surface resistant to frost damage.

1949 **First concrete pavement constructed using slipform pavers** - The first concrete pavement constructed using slipforms is built in O’Brian and Cerro Counties, Iowa. (Commercial manufacturing of slip-form pavers circa 1955)

1952 **Walk/Don’t Walk signal** - The first "Walk/Don’t Walk" signal is installed in New York City.

1956 **New Federal Aid Highway Act** - President Dwight D. Eisenhower signs a new Federal Aid Highway Act, committing $25 billion in federal funding.

1962 **Pavement standards** - The AASHO road test near Ottawa, Illinois, establishes pavement standards for use on the interstate system and other highways.

1938  
All-entrained concrete introduced - All-entrained concrete, or air-entrained concrete, is a type of concrete that contains tiny air bubbles in the concrete. These bubbles prevent the concrete from freezing, thus making the concrete surface resistant to cold weather.

1949
First concrete pavement constructed using slipform paving - Slipform paving is a method of constructing concrete pavements. It was first used in the United States in 1949. Slipform paving allows for the construction of concrete pavements without the need for traditional forms. (Commercial manufacturing of slip-form pavers)

1952
Walk/Don’t Walk signal - The first “Walk/Don’t Walk” signal was installed in San Antonio, Texas, in 1952.

1956
New Federal Aid Highway Act - President Dwight D. Eisenhower signed the New Federal Aid Highway Act in 1956, committing $25 billion in federal funds to the construction of a national highway system.

1962
Pavement standards - The AASHO (American Association of State Highway and Transportation Officials) developed pavement standards for use on the interstate system.

1966
Highway Safety Act - The Highway Safety Act established the National Highway Program Safety Standards to reduce traffic accidents.
Control 204-4-2 Hwy. U.S. 79 Wmson. Co. Salvaging and replacing old gravel base course. Summer 1936 TxDOT Photo Library

Construction on Interstate 20, Tyler District 8/14/1963. TxDOT Photo Library
Cameron County paving operation. Dump truck unloading aggregate to plant.
TxDOT Photo Library
TxDOT Photo Library
The Concrete Highway System of Wichita County, Texas

A Reprint of an Article by C. O. Wilson in the Wichita Falls Record-News, August 21, 1921

Concrete pavement on the Colorado to Gulf Highway between Wichita Falls and Iowa Park

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WICHITA FALLS CHAMBER OF COMMERCE
WICHITA FALLS, TEXAS
1922

Wichita County Lifted Out of Mire of “Country” Roads by Modern Concrete Highways

From a county of dirt roads, poorly kept for the most part, apparently laid out by the horse hoof of the meandering cowboy, to a county of concrete highways constructed under the supervision of federal, state, and county engineers in such a manner as to delight the eye of the most fastidious is usually a long journey for any community realizing the benefits and desires of improved means of highway transportation.

In many counties of the state and in practically all of the more settled states of the east and north the improved road history is one of experiments covering a period of several years resulting in waste and dissatisfaction, with no real progress made toward a permanent highway system until the past few years.

Wichita County has escaped all this. Profiting by the experience of others as it has in many phases of its development the county has partially completed a highway system second to none with a minimum of that experimental waste which has been the too common experience of other communities. Her experience is expected to be valuable to her neighbors.

At the end of the next twelve months the tourist or driver of a commercial vehicle of any kind, whether he comes from the north, east, south or west, will enter the county on a concrete highway and leave in the same manner if he so desires. He will be able to go to every important distributing point in the county on the same concrete pavement. In short, Wichita County within the year will complete its part in every national or state highway system that has been proposed.
Bids for the construction of the concrete pavement which at that time was for a 45-mile program were then asked for with only one bid received. The bid was at the rate of $88,000 a mile and was rejected as being far too high. Bids were again asked for and this time the county awarded the contract at $66,000 a mile, the only competitive bid being $66,000.

Making the subgrade ready for the pavement. This device trims the dirt surface to exact shape required.

Laying the concrete pavement on a Wichita County Highway.
TxDOT Concrete Mix Developments in the Past Century – Materials

- Chemical Admixtures
  - Air-Entraining Agents
  - Accelerators/Retarders
  - Water Reducers/Super Plasticizers
  - Viscosity Modifiers, Anti-Washout Agents
- Mineral Admixtures
  - Fly ash, Slag Cement (GGBFS), Silica Fume
- Hydraulic Cement Maturation
  - Chemistry
    - High Early Strength
    - Low/Moderate Heat Generation
    - Sulfate Resistance
  - Fineness
  - Process and Mineral Additions
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TxDOT Concrete Mix Developments in the Past Century – Materials (continued)

• Aggregates
  • Durability
  • Workability (size, cleanliness)
  • Alkali-Silica Reactivity
  • Internal Curing
  • Coefficient of Thermal Expansion
  • Inclusion of higher fines content
  • Use of Recycled Crushed Concrete
  • Acid Insolubility/Long-Term Skid Resistance

• Membrane-Forming Spray-Applied Curing Compounds
TxDOT Concrete Mix Developments in the Past Century – Mix and Testing

- Optimized Graded Mixes ➔ Gap-Graded Mixes ➔ Optimized Graded Mixes
- Advanced Petrography
- Permeability and w/cm improvements
- Air-Entrained Concrete for Freeze-Thaw Durability
- High Strength and High Performance Concrete Capabilities
- Early Strength
- Ready-Mix Plant and Truck Mixer – Bigger, Better, Faster
- Central Plant Mixers – Bigger, Better, Faster

2016 Texas Transportation Short Course
Advance Planning for the Future: Estimating Future Costs

Figure 1. Bureau of Labor Statistics Price Indexes from 1971 to 2010. (CAGR = Compound Annual Growth Rate)

Source: NRMCA 2011 08—SEPTEMBER 2011
TxDOT Concrete Pavement Developments in the Past Century

• Equipment
  • Concrete Plant
  • Concrete Delivery
  • Slip-Form Pavers
  • Auto-Floats
  • Texture/Cure Machines
  • Diamond Grinding
    • Initial Construction Smoothness
    • Rehabilitation
  • Diamond Grooving

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TxDOT Concrete Pavement Developments in the Past Century

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    • Rehabilitation
  • Diamond Grooving (NGCS)
TxDOT Concrete Pavement Developments in the Past Century

- Pavement Design (AASHO/AASHTO93, Texas MEPDG)
- CRCP (BPR Experiment 1921-1925; Indiana State Highway Commission 1938; TDH 1951)
- Concrete Overlays (Bonded, Thin-Bonded, Unbonded)
- Steel Layout
- CoTE Requirements
- Use of Recycled Concrete Aggregate
System Characteristics

- What Has Changed
- What Has Not Changed Enough
Public Road Mileage - VMT - Lane Miles
1920 – 2013
TxDOT Concrete Pavement Developments in the Past Century

- Pavement Design
- CRCP (BPR Experiment 1921-1925; Indiana State Highway Commission 1938; TDH 1951)
- Concrete Overlays (Bonded, Thin-Bonded, Unbonded)
- Steel Layout
- CoTE Requirements
- Use of Recycled Concrete Aggregate
- High Pavement Reliability – Long Life
Summary

• There have been widespread changes to improve the durability, constructability, and economy to the Concrete and Concrete Pavement Industry in the Last 100 years
• Many TxDOT Concrete Pavements still in service decades after their design life was surpassed
• TxDOT Research and Innovation Key to Concrete and Concrete Pavement Success, In Texas and Nationwide
• TxDOT Poised to Lead the Next Century