# AN IOWA STORY

***Of National Significance***

- Ours is an incredible story of about a need, innovations, partnerships, and passion for high quality, long-lasting pavement solutions.

DESIGN OF
CONCRETE MIXTURES
BY
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Engineer, Materials and Tests, Iowa Highway Commission
EXTRAIT DE "CONGRÈS INTERNATIONAL POUR L'ESSAI DES MATÉRIAUX,
AMSTERDAM 14–17 SEPTEMBRE 1927" — LA HAYE — MARTINUS NIJHOFF

CONCRETE
MATURITY METER
SYSTEM 4101
SETUP
OFF
COM
ON
MADE IN CANADA
CH1
CH2
CH3
CH4
COMMUNICATION PORT

# IOWA'S PCC PAVING MARKETS

# ROADS AND STREETS FACTS

- Iowa ranks 14th in the nation in number of miles of roadway. (2013)
- There are approximately 38 miles of road for every 1,000 people in Iowa.

# 2014 PUBLIC ROAD LENGTH - MILES BY OWNERSHIP

| Ownership | Miles |
|---|---|
| Iowa DOT | 8,871* |
| Counties | 89,818 |
| Municipalities | 15,037 |
| Parks and institutions | 622 |
| Federal agencies | 138 |
| Total miles | 114,486* |

*Totals exclude ramps. The Iowa DOT maintains 9,403 miles of roadway, including 532 miles of ramps.

# THE IOWA SYSTEM BASED ON 2015 DATA
## Primary and Interstate

- PCCP – 32%
  - 3,590 miles
  - 326 miles 50 plus years old

- **Composite** – 52%
  - 5,777 miles
  - 4,122 miles over 50 years old

- **HMA** – 16%
  - 1790 miles
  - Less than 2 miles 50 plus years old

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# IOWA COUNTIES

- 5,528 miles of Iowa's County Roads are paved with concrete on top today.

- 34 Iowa Counties have built more than 100 miles of concrete pavement on their network of hard surfaced roads.

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POCAHONTAS COUNTY
100TH MILE AWARD
FIRST COUNTY IN U.S. TO COMPLETE 100 MILES
OF CONCRETE SLIP-FORM PAVING
1955 - 1956
PORTLAND CEMENT ASSOCIATION

# IOWA'S 100 MILE COUNTIES

# THE CITIES IN IOWA

More than 1 million SY of concrete paving annually (Avg. 1.35M)

More than 100 projects per year.

A Leader in the Nation.

# OUR IOWA AIRPORTS

- 99 General Aviation Airports
- 8 Commercial Airports

- 70% PCC
- 4% Composite (AC/PC)
- 24 PCC Overlays

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# PCC OVERLAYS AT IOWA AIRPORTS

- Storm Lake 1971
- Centerville 1979
- Clarion 1982
- Waverly 1983
- Burlington 1985
- Corning 1987
- Carroll 1988
- Pocahontas
- Fort Madison 1991
- Sibley 1992
- Spencer 1992
- Oelwein 1993
- Muscatine 1994
- Spencer 1994
- Clarinda 1996
- Dubuque 1996
- Hampton 1996
- Keokuk 1996
- Oskaloosa 1998
- Denison 1997
- Airport (Allied) 1998
- Sioux City 1998
- Des Moines 2003
- Clinton 2010

# CONCRETE OVERLAYS IN THE USA

- National perspective
  - ACPA overlay project explorer:

# PCC OVERLAYS IN IOWA

| | WT | BOL | UBOL | |
|---|---|---|---|---|
| Secondary | 1108.6 | 88.4 | 454.50 | **1651.5** |
| Primary | 81.8 | 52.7 | 144.3 | **278.8** |
| | **1190.40** | **141.11** | **598.8** | **1930.3 miles** |
| | | | | |
| Municipal | 230,000 SY approximate | | | |
| Airport | 739,840 SY (24 Runways) | | | |

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# THE TRANSITION TO THE CONCRETE OVERLAY ERA

# YES, IOWA EVEN HAS CONCRETE PARKING LOTS

- In 2016, an annual assessment in Iowa's 21 largest cities revealed that concrete was the pavement of choice for 82% of parking area paved.

# EVOLUTION

## IN THE ART AND SCIENCE OF CONCRETE PAVING

# THE IOWA STORY

Robert G. Huber, P.E. – Technical Consultant
William B. Oglesby – Producer and Director
Marlin J. Knutson/Matt Ross – ICPA (Resources)

# 100 Years of Concrete Pavements In Iowa

Final Report
for
MLR-07-01

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Office of Materials
Highway Division
Iowa Department of Transportation
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March 2009

# IN THE BEGINNING . . . . .

# 1838

Dubuque
Cascade
Fork
Cedar R.
Buffalo Cr.
Maquoketa R.
North
Wapsipinicon R.
Iowa R.
Iowa City
English R.
Mississippi R.
Bloomington (Muscatine)
Cedar R.
Long Cr.
Skunk R.
Crawfordsville
Crooked Cr.
Cedar Cr. (Little Cedar)
ILLINOIS
Agency City
Mt. Pleasant
Danville
Washington
Burlington
Keosauqua
Ft. Madison

# A ROADWAY NETWORK FOR IOWA

Iowa Needs Concrete

# HOW CONCRETE PAVEMENT- GOT IOWA OUT OF THE MUD !

# 1904 –A CONCRETE STREET IN LEMARS, IOWA

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# 1908 - EDDYVILLE CEMETERY RD

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# 1913 – IMPORTANT IOWA LEGISLATIVE ACTIONS

# 1918 – IOWA'S SEEDLING MILE ON US 30 IN LINN COUNTY

- Northwestern States Cement donated 3,000 barrels of cement
- Ford Paving Company bid of $3.15/yd$^2$
- The Highway Commission talked them down to $2.84/yd$^2$

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# 1925 - MIXING BY WEIGHT

- Variable concrete produced due to sand bulking - moisture variations
- Roy W. Crum, Materials & Tests Engineer conducted considerable work on concrete proportioning
- This method became the universal standard method worldwide

# MATERIALS TESTING

any change?

# CONCRETE PAVING IN THE EARLY 20th CENTURY

A.7
KOSS CONST. CO.

Iowa's first paving job using asphalt was done in 1928. The contractor required a "royalty fee" be paid on the project. F. R. White, Chief Engineer said that would never happen again. It wasn't until the 1950s that asphalt was considered for primary road construction – through regular lettings.

# IOWA'S EARLY PRIMARY ROAD SYSTEM

- From 1918 to 1933 Iowa constructed over 5,000 miles of concrete pavement on its primary road system, most of which was 18 feet wide, reinforced and with curbs.

- In 1928 the people of the State of Iowa approved a $100,000.00 primary road bond bill.

- From 1927 to 1932 a total of 3,717 miles of primary road was paved with concrete. This was an average of 620 miles per year. In the year 1930 there were 1,030 miles placed (8,383,000 square yards)

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# PREPARATION OF SUBGRADE

1920's

- Sprinkle with water or cover with tar paper

1960

- Plastic

1980

- Granular Subbase

# 1960'S

## THE IOWA SPECIAL – TRIMMER/PLACER

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# THE STEAM MIXERS

- Mixed by volume at1:2:3 with 1.7 bbl of cement per CY.
- Aggregates proportioned with a 1ft. X 3 ft. box in a wheelbarrow.
- Shovels loads were counted
- Water was added until it sounded just right.

# 1921 – THE DRY BATCH PLANT

# THE SELF PROPELLED MIXER

# MATERIALS DELIVERED BY TRUCK

# INDUSTRIAL RAIL CARS

# 1965 – CENTRAL MIX PLANT

**CONCRETE** BATCH PLANTS

# FINISHING MACHINE

# LONGITUDINAL FINISHING

# IOWA'S SLIP FORM PAVER

- 1947 – James Johnson and Bert Myers - Office of Materials - conceptualized extrusion process

- 1949 – Full scale prototype placed 1st slip form pavement in Obrien & Cerro Gordo counties
  - Two 10 ft passes
  - 3-4" gap filled with AC

# A REVOLUTION FOR OUR COUNTY ROADS

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# 1955 – THE QUAD CITY SLIP FORM PAVER

# SLIPFORM PAVER EVOLUTION

# CURING - 1 DAY WET BURLAP

# 7 DAY -2" WET EARTH CURE

TATE
MACO
MANATTS

# TINING/TEXTURE

- 1969 - Test sections on US 63 in Tama county
- 1976-AASHTO Guidelines for Skid-Resistant Pavement Design - to provide safe wet weather friction
- Turf or burlap drag and ¾" spaced transverse tining
- 1999 - longitudinal tining to improve noise characteristics and accommodate timely placement of cure

# JOINTING

- Prior to 1920 transverse joints at 12 to 35 ft intervals
- 1920 to 1925 – No transverse or longitudinal joints
- 1925 to 1929 – Steel or mastic longitudinal joint, No transverse

# OLD US 20

# EXPANSION JOINTS

- 1930 & later – transverse expansion joints placed at 80 to 100 ft. intervals

# JOINTING - 1956

- Sawing of transverse and longitudinal joints were required.

# 1970s – CONTINUOUSLY REINFORCED CONCRETE PAVEMENT

# LOAD TRANSFER

- 1958 to 1969 – Aggregate interlock with 20 foot joint spacing
- Load transfer with dowels
  - ADTT >500 -1969
  - ADTT>300 -1995
- Joints perpendicular until 1980
- Skewed joints @ 6:1 1981 to 2004
- Perpendicular joints - 2005

# ADVANCEMENTS IN JOINTING TECHNOLOGY

Early Entry Sawing

Longitudinal Joint Former (Bobsled)

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# SMOOTHNESS

Check with a 10 ft. straightedge

- 1921 to 1933
  - 1/4" in 10 ft.
- 1933 to 1976
  - 1/8" in 10 ft.
- Correction with carborundum brick

# RIDE QUALITY

- 1977 - Correction of high spots by diamond grinding
- 1981 -1st use of the California type, 25 foot profilograph
  - 100% <15 in./mi.
- 1985 -Contractor testing
  - Incentives applied
- 2008 – Zero blanking band
- Today - IRI

# SMOOTHNESS AND THICKNESS MONITORING

# 1937 - VIBRATION

- No less than 3,500 vpm

# VIBRATION LESSONS LEARNED IN THE 90s
# No more than . . . .

# ON BOARD - VIBRATOR MONITORING

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# CONCRETE DURABILITY

Air Entrained Concrete

- 1952 3-5%
- 1956 4-6%
- 1960 6±1%
- 1995 7±1.5%

- Well graded aggregate – Shilstone – QM-C – Performance Engineered Mixtures

# 1971

# AGGREGATE DURABILITY CLASSIFICATION

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# WATER REDUCERS & FLY ASH

- 1974 - water reducing admixtures allowed
- 1978 -1st use of fly ash
- 1984 – Fly Ash at the contractors option
  - 15 to 20%

# SLAG AND BLENDED CEMENTS

- First use of slag in a project - 1995
- Type IP cement - 1995
- Iowa has the most miles of ternary mixes in the country
  - >600 miles Type IS & fly ash
  - >225 miles Type IP & fly ash

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# 1977 – RECYCLED CONCRETE

- Existing PCC pavements began to be recycled as coarse aggregate for concrete mix.

# GRANULAR SUBBASE - CONCRETE RECYCLING

- 1976 ATB or CTB – ADTT > 700
- 1985 – First section existing concrete recycled as granular subbase
- 1989 - Granular Subbase
- 1993 – First use of mobile crushing operation – The Paradigm Crushing System

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# PAVEMENT DESIGN

- Uniform depth until 1926
- Thickened edge design 1926-1957
- 18 ft. wide until mid-1930's
- 20 ft. wide until 1948
- 22 ft. wide until 1959
- 24+ ft. wide today with paved shoulder.

# CONCRETE OVERLAYS

- 1971 Storm Lake Airport concrete overlay on asphalt

US 30 Benton Co 1949 - 6 inch PCC resurfacing

# IOWA'S CONCRETE OVERLAYS

- 1973 - Greene County -
  Bonded and un-bonded
  Steel fibers
  CRC & mesh Reinforced

- 1976 – Woodbury & Blackhawk thin bonded overlays

- 1977 – Boone, Dallas, Washington counties placed whitetopping overlays

# *1976 FIRST MUNICIPAL STREET BONDED OVERLAY*
## *Waterloo, IA Hammond Ave, Prospect and Section of US 20*

- Contractors brought equipment at their Expense
- Tried Different Types of Surface Prep
  - Sand Blasters
  - Galion Grinders and Rotomill
- Tried Different types of Reinforcement
  - Steel Mats
  - Welded Wire Fabric

INTERNATIONAL

# IOWA OVERLAY MILESTONES:

*1979 First bonded PCC overlay on an interstate highway*

*1986 Fast Track Concrete*

*1993 UTW*

*2011 – Resurfacing under traffic*

*Numerous county, city and airport PCC overlay projects, unsurpassed nationwide.*

# FAST TRACK CONCRETE

- Fast Track Projects
  - Buena Vista US 71
  - Dallas County
  - 1988 Dubuque US 20
  - 1989 Linn IA 100
  - 1994 Franklin IA 3

# AND MATURITY

- Prior to utilizing maturity method – opening strength was determined by beam break at 5 to 7 days
- 1995 - Lee County Research with Class C mixes
- 1997 - Contractor's option to use maturity method of opening
- Iowa one of the first states to implement the method for opening

# STRINGLESS PAVING

- Washington County Research - 2003
- Developmental Specification – 2011
- Standard Specifications - 2014

# STRINGLESS CONTROL

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# PAVEMENT PRESERVATION

Critical work in progress

ICPA
IOWA CONCRETE PAVING ASSOCIATION

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IOWA DOT
SMARTER | SIMPLER | CUSTOMER DRIVEN

CITY

COUNTY

U.S. Department of Transportation
Federal Highway Administration

CONSULTANT

# CONCRETE PAVEMENT RESEARCH

- Iowa Highway Research Board/MLR - 211
- The Cable Works – 44 Studies
- Taylor-Ceylan-Wang and others

National Concrete Pavement Technology Center

Tech Center

IOWA STATE UNIVERSITY

Institute for Transportation

# CORE SUPPORT
# OUR INDUSTRY SPONSORS

- American Concrete Pavement Association
- ACPA Chapters/State Associations
- Portland Cement Association
- Iowa Concrete Paving Association
- Iowa DOT

# WHY IS IOWA THE CONCRETE STATE?

- THE RECOGNIZED NEED FOR A LONG LASTING, ECONOMICAL PAVEMENT SOLUTION
- OPPORTUNITY FOR INNOVATION
- COMMITMENT TO PARTNERSHIPS IN ADVANCING OUR ART AND SCIENCE
- PASSION FOR CONCRETE PAVEMENT

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INC
Iowa Needs Concrete

# OUR FUTURE

Where do we go from here? In the past 100+ years we've seen significant, progressive change in the paving industry in Iowa and across the nation. We can only assume that the future promises more change. By working together, our task is that of assuring that Portland cement concrete pavement remains the long lasting, economical investment for our roads, streets and airports.

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# IOWA

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*Thank You*