Introduction

Larry Stevens, PE
- Project Director, HR Green, Inc.,
- City Engineer for multiple communities
- Past SUDAS Director
- APWA National Past President
- Served on the ISI Board of Directors
Overview of Today’s Topic

You will have a better understanding of:

- Clive’s pavement management study – why and how
- Clive’s approach to improve the sustainability of its pavement system
- Clive’s policy changes to extend the life and serviceability of its PCC pavements
- Potential benefits of the pavement design improvements
Clive, Iowa - Background

- Incorporated on October 9, 1956
- Population: 17,506 (2015 Special Census)
  - 1960  752
  - 1970  3,005
  - 1980  6,064
  - 1990  7,515
  - 2000 12,809
  - 2005 13,985
  - 2010 15,447
- Landlocked
- Projected Population: 27,000 – 28,000
Why change how Clive streets are managed?

- Unique situation
- No really old infrastructure
- Time to begin considering replacement/No large backlog
- What is the cost of ownership for SUSTAINABLE infrastructure
Why Change?

There’s a Looming Problem!
City Responsibility

- Developer constructs infrastructure
- City accepts improvements with obligation to maintain in PERPETUITY
- City provides all maintenance
- City is responsible for reconstruction when necessary
  - May use assessments, may be big impact on home owners (25% of value of home)
  - Future reconstruction costs include removal of existing in addition to reconstruction costs.
Dellwood Drive – 3 years old
(west of Berkshire)
Airline Drive – 4 years old
Dellwood Drive - 4 years old

(East of Berkshire)
Tanglewood Drive – 10 years old
Hammontree Court – 15 years old
Sheridan Avenue (20 years old)
Rosewood Drive – 25 years old
Woodcrest Drive – 25 years old
How Do We Solve the Problem?

- Starts with creating long-lasting sustainable streets.
- What is the cost to increase pavement life, and does it make economic sense?
11 year Street – Current

12 year Street – Proposed
Summary – City Position

- **Why should we make a change?**
  - Longer life pavements
    - Sustainable
  - Prolonged higher service level reduces traveling public’s cost of vehicle maintenance
  - Reduced disturbance to property owners due to reconstruction and maintenance
  - Reduced Maintenance Cost

- **How?**
  - HR Green to review and recommend changes
    - Council approval of new standards.

- **When?**
  - Prior to addition of new streets in 2018
Clive Pavement Management Study Goals

- Review City Standards
  - Street Construction
  - Street Maintenance
- Develop inventory of streets in Clive
- Determine rehabilitation and reconstruction alternatives and trigger thresholds for improvements
- Develop 2 pavement replacement schedules for existing and future streets (existing and proposed standard)
- Develop sustainable maintenance replacement schedules for the following scenarios
  - Maintaining different levels of PCI
  - Using various funding levels
Study Goals – This Presentation

- Review City Standards
  - Street Construction
  - Street Maintenance
- Develop inventory of streets in Clive
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Pavement Standards Study

Analysis of the following components

- PCC Pavement foundation – why and how
- PCC Pavement – proper design principles
- Current Clive design standards for pavements
- Recommended Clive design standards
- Cost/Benefit Comparisons
Study Sources

Appendix A: References


Proper design, construction, and maintenance of the various components of the pavement system are critical to the performance of long-life pavements.
Performance of pavements depends on the quality of its subgrade and subbase layers

Quality Pavement Foundation Guidelines

- Subgrade soils
  - Prepared subgrades with minimum CBR of 10
  - Iowa soils generally provide poor support
    - Stabilized subgrades
      - Chemical
      - Reinforced, geosynthetics

- Subbases
  - Necessary for subsurface drainage in Iowa’s cold, wet climate
  - Longitudinal subdrains necessary
  - Drainage helps to prevent early pavement joint deterioration
PCC Pavement Guidelines

- Pavement thickness
  - Thickness design tables
  - Default thickness
  - Iowa experience
- Pavement jointing
  - Proper transverse and longitudinal spacing
  - Plain (JPCP) and reinforced (JRCP)
- Pavement mix
  - Provide durability and resistance to degradation (primarily due to de-icing)
  - C-SUD Mix
Current Residential Standard

- **Pavement Foundation**
  - 12” subgrade prep below pavement

- **Pavement**
  - Concrete – Varies
  - Jointing - Varies
    - 7” Jointed Plain Concrete Pavement (JPCP) w/ CD baskets, or
    - 6” Jointed Reinforced Concrete Pavement (JRCP)
  - Gutterline Jointing
PCC Pavement Foundation

PCC Pavement Foundation Recommendations:

- Conduct geotechnical study
  - Typical Iowa soils have CBR of 1 to 3
  - Recommendation(s) to achieve prepared subgrade CBR of 10
- Improve pavement foundation
  - Ensure prepared subgrade has CBR of 10
  - Construct a drainable, stable granular subbase
  - Install longitudinal subdrains
PCC Pavement Recommendations - Residential

- Pavement thickness
  - 7” Jointed Plain Concrete Pavement (JPCP)
  - 6” Jointed Reinforced Concrete Pavement (JRCP)

- Pavement jointing
  - Transverse, ‘C’
    - 14’ for 7” JPCP
    - 12’ for 6” JRCP
  - Longitudinal
    - Quarter point for both 26’ and 31’-wide pavements

- Pavement mix
  - Class C-SUD
    - 6% to 8% air content in placed concrete
    - W/C of 0.40 to 0.45
  - Replace cement with SCMs to decrease permeability
  - Assure air content is 6% to 8%, after placement
Cost/Benefit Analysis

- Typical residential street segments analyzed
- Average cost of pavement system increase approx. 24.3% due to higher standards
  - $56.11/SY to $71.63/SY
- Life expectancy of pavement increased by 42.8%
  - 35 years to 50 years
- B/C of 1.8:1
- Average cost to each lot about $2500 for improved standards, initially
  - Over a 100-year cycle, this additional investment reduces future reconstruction costs by $9,745, in present day dollars
SUMMARY

- Why should we make a change?
  - Longer life pavements
  - Prolonged higher service level reduces traveling public’s cost of vehicle maintenance
  - Reduced disturbance to property owners due to reconstruction and maintenance
  - Reduced cost for sustainable streets
City of Clive Pavement Design Policy

- Adopted on 6/22/17
- Geotechnical investigations and report with actions necessary to provide prepared subgrade (top 12”) with minimum CBR of 10
- 6” of modified subbase with subdrains
- Class C mix (C-SUD), no slag
- Air – 6-8%
- W/C ratio shall be 0.40 with a max of 0.45
- Flyash - 20% Class F or Class C
- 7” Jointed Plain Concrete (JPCP) or 6” Jointed Reinforced Concrete Pavement (JRCP)
- Quarter Point Jointing for 26’ and 31’
- Transverse Joint Spacing – 14’ for 7” pavement and 12’ for 6” pavement
- Collectors and Arterials – designed for 50 year pavement life
Implementation Observations

- Experienced difficulty achieving subgrade CBR of 10 without modification/stabilization
  - Normally use fly ash modification
- Contractor experienced difficulty with finishing C-SUD mix for hand pours
Contact Information

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Questions?
Average PCI by Budget

Scenario 6: Average Condition by Budget

Network Average Pavement Condition Index

Year

- $7.0M
- $6.5M
- $6.0M
- $5.5M
- $5.0M
- $4.5M
- $4.0M
- $3.5M
- $3.0M
- $2.5M
- $2.0M
- $1.5M
- $1.0M
- $0.5M
- $0.0M