

PERFORMANCE OF IOWA'S CONCRETE OVERLAYS

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- ✘ Full report to be published through Iowa Highway Research Board/Iowa DOT **this Spring**



IOWA STATE
UNIVERSITY

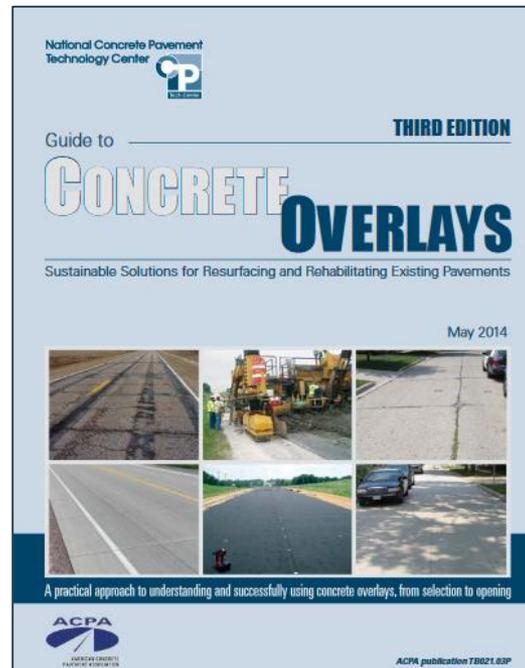


OUTLINE

- × **Concrete Overlays in Iowa**
- × **Project Background & Objectives**
- × **Data Compilation & Collection**
- × **Results and Analysis**
- × **Field Reviews**

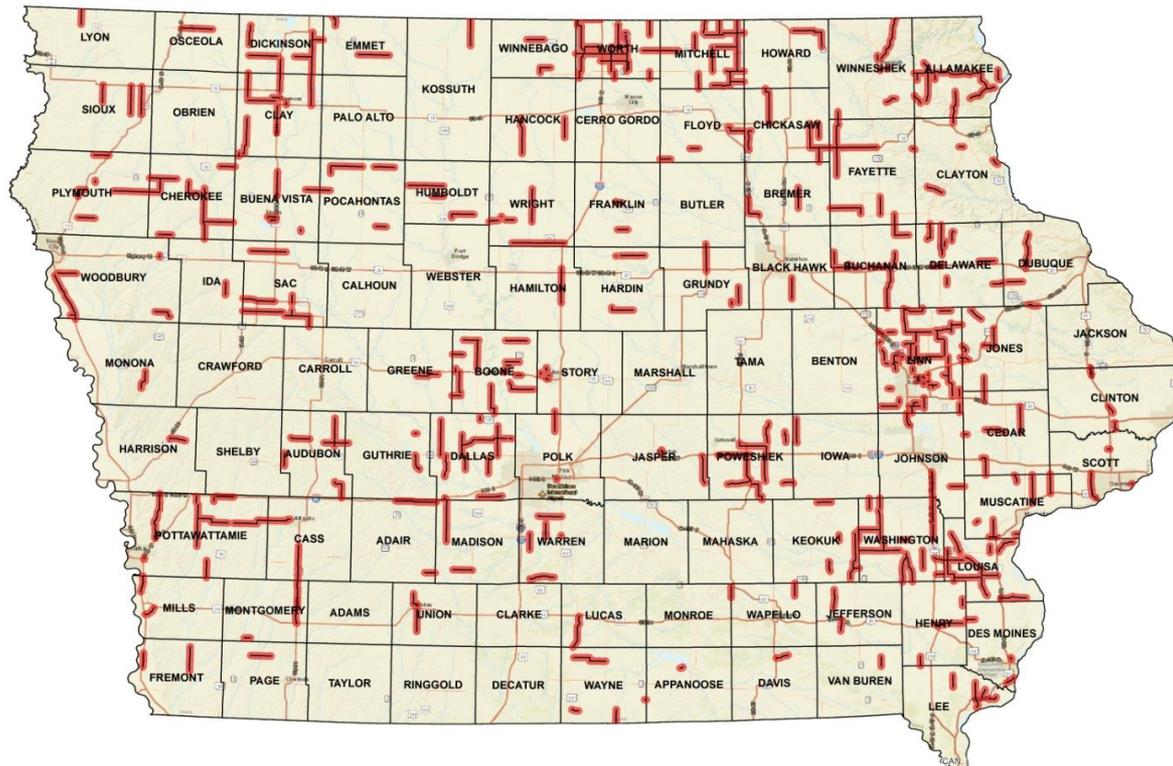
CONCRETE OVERLAYS IN IOWA

- ✘ **Concrete overlays: increasing use and acceptance nationwide over past few decades**
 - + **Thin concrete overlays starting in 1990s**
 - + **CP Tech Center Guide:**



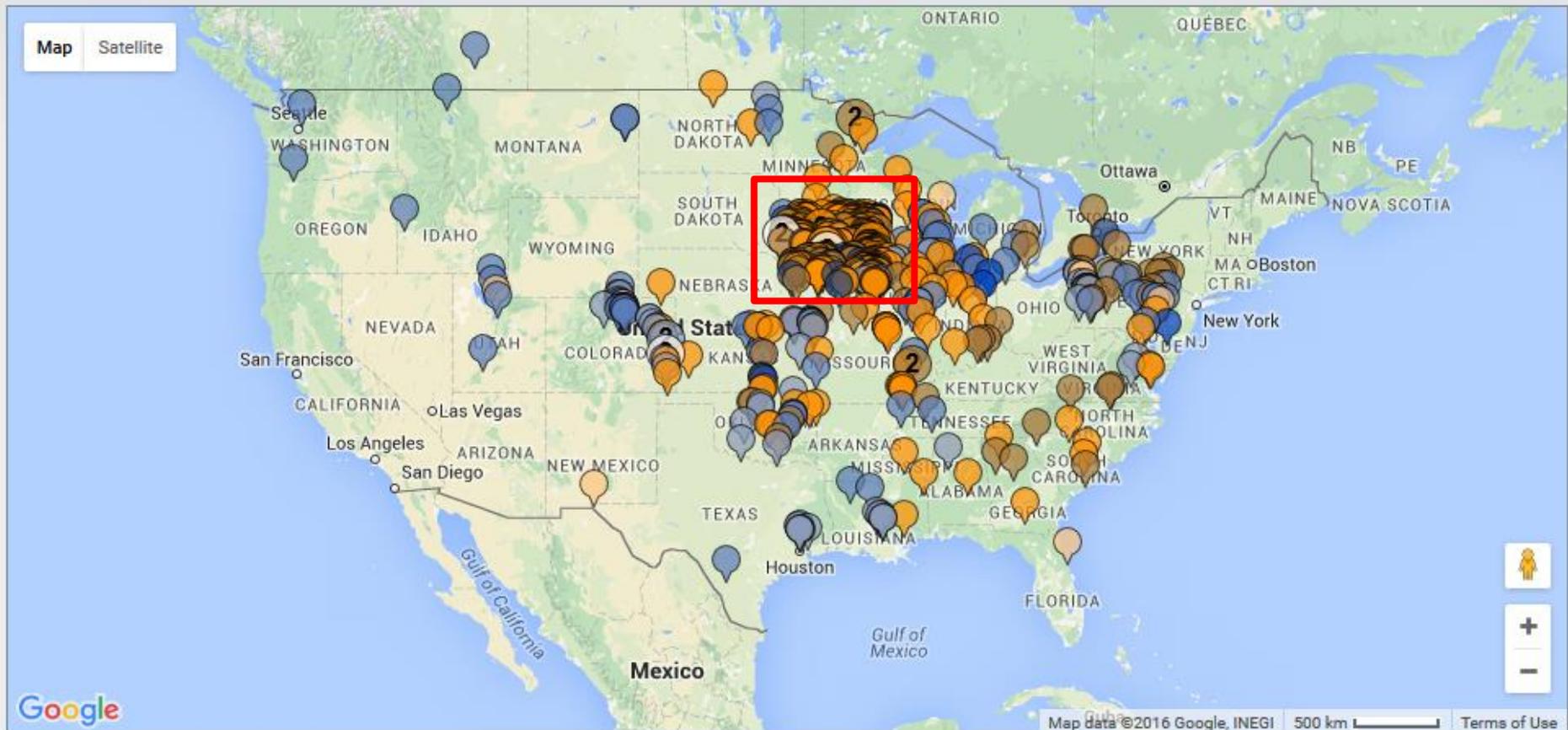
CONCRETE OVERLAYS IN IOWA

- ✘ Iowa: over **2,000** centerline miles of concrete overlays have been constructed since the late '70s
 - + Over half constructed since 2005
 - + Mostly on rural county highway system



CONCRETE OVERLAYS IN IOWA

✖ National Perspective:



PROJECT BACKGROUND

- ✖ **How well have Iowa's overlays performed?**
 - + **Approximately 470/506 overlay projects are still in service today**
 - + **Includes 68/96 constructed before 1990**



Dallas County, IA, Constructed 1977

PROJECT BACKGROUND

- ✘ **However, as of 2015 there was a lack of condition assessment data & no organized attempt at understanding performance**



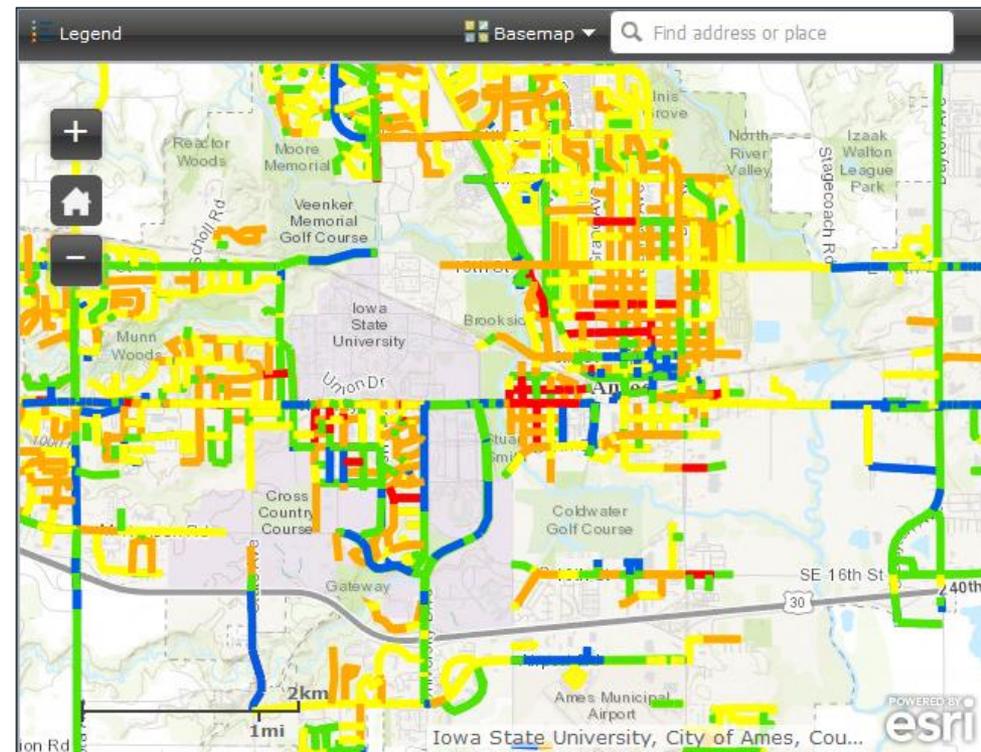
Dallas County, IA, Constructed 1992

PROJECT OBJECTIVES

- × **Define performance of Iowa's concrete overlays**
 - + **Create performance curves—rich data set**
 - + **Analyze specific design choices and characteristics and link to performance**
 - × **Thickness**
 - × **Joint spacing**
 - × **Traffic**
 - × **Overlay type (thin bonded, unbonded)**
- × **Incorporate lessons learned to improve overlay design and performance**

DATA COMPILATION & COLLECTION

- ✘ Automated pavement condition data: Iowa Pavement Management Program (IPMP)
 - + Opt-in program for local agencies
 - + Data collection began in 1996
 - + All streets & roads every other year since 2013
- ✘ This data then combined with ICPA overlay project info to produce data set

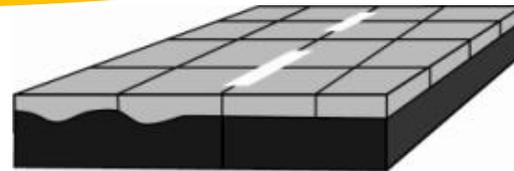


OVERLAY TYPES

× **Bonded Concrete Overlay of Concrete (BCOC)**

× **Bonded Concrete Overlay of Asphalt (BCOA)**

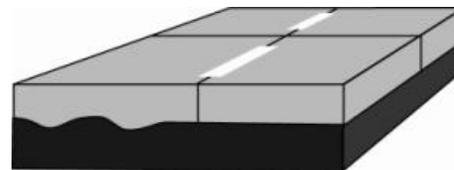
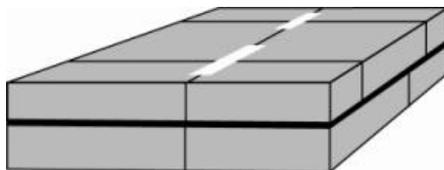
+ **Defined as thickness ≤ 6 inches**



× **Unbonded Concrete Overlay of Concrete (UBCOC)**

× **Unbonded Concrete Overlay of Asphalt (UBCOA)**

+ **Defined as thickness > 6 inches**



DATA DISTRIBUTION

- × **Typical designs in Iowa**
 - + **Early on: 6 inches on asphalt (“classic whitetopping”) or 6+ inches unbonded on concrete**
 - × **Performance data for projects up to 40 years old**
 - + **Thin (3-5”) overlays: '00s**
 - × **Advent of overlay-specific design procedures**
 - × **About 10 years worth of data, with some exceptions**



Washington County, IA, Constructed 1977

DATA DISTRIBUTION

✖ Full data set contains all overlay types/designs:

Type of overlay	Total number of projects	Percent of data based on number of projects (%)	Project length (mile)	Percent of data based on length of projects (%)
Bonded concrete on concrete (BCOC)	13	3	67	4
Unbonded concrete on concrete (UBCOC)	125	32	506	34
Bonded concrete on asphalt (BCOA)	180	47	671	45
Unbonded concrete on asphalt (UBCOA)	69	18	255	17
Total	387	100	1,499	100

DATA DISTRIBUTION

✖ Distribution based on slab thickness:

PCC slab thickness (in.)	Total number of projects	Percent of data based on number of projects (%)	Project length (mile)	Percent of data based on length of projects (%)
>3	8	2	20	1
4	50	13	283	19
5	36	9	178	12
6	186	48	621	41
7	42	11	177	12
8	52	13	165	11
9	8	2	45	3
10	4	2	9	1
12	1	0	1	0
Total	387	100	1,499	100

PERFORMANCE METRICS

- × Performance characterized by PCI & IRI
 - × IPMP PCI equation incorporates:
 - + **IRI** (accounts for 40% of PCI)
 - + Transverse Cracking
 - + Joint Spalling
 - + D-cracking
- (no faulting)**

PERFORMANCE METRICS

× Performance charts:

× PCI scale:

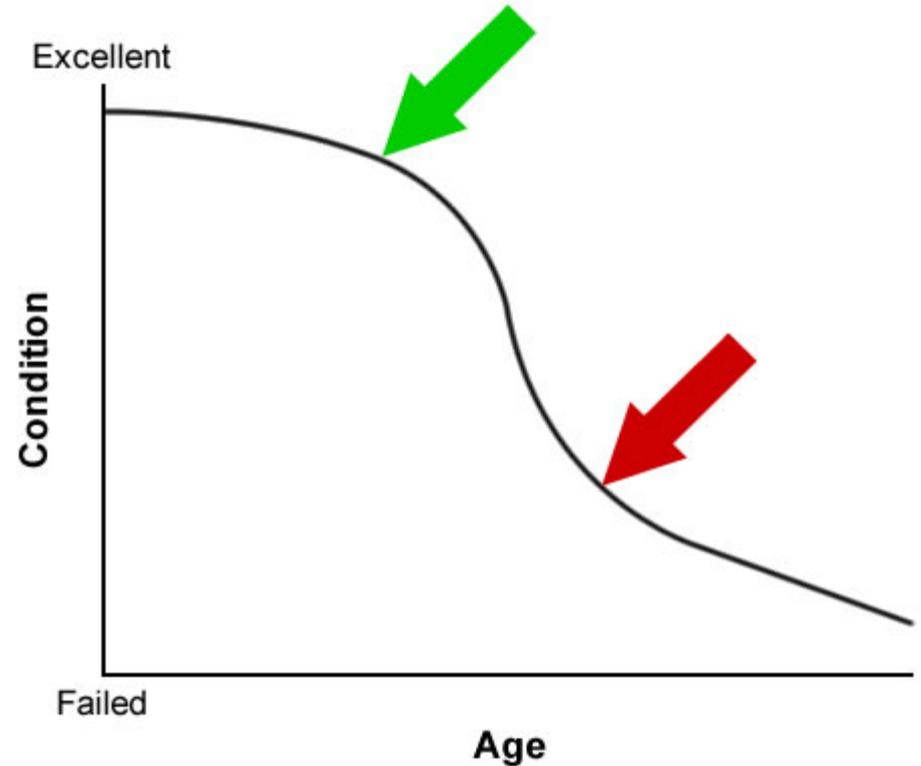
+ Excellent: 81-100

+ Good: 61-80

+ Fair: 41-60

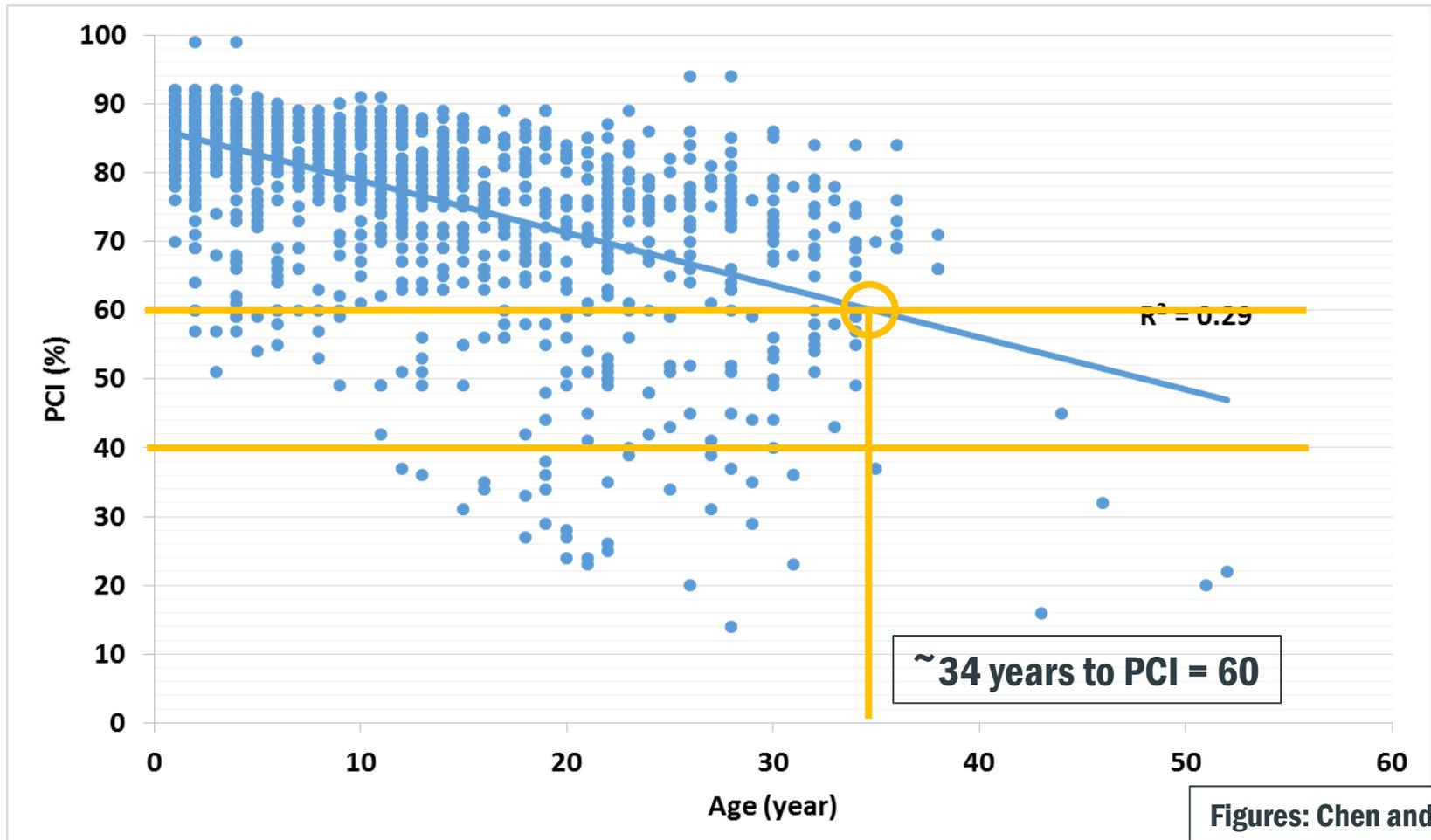
+ Poor: 21-40

+ Very Poor: 0-20



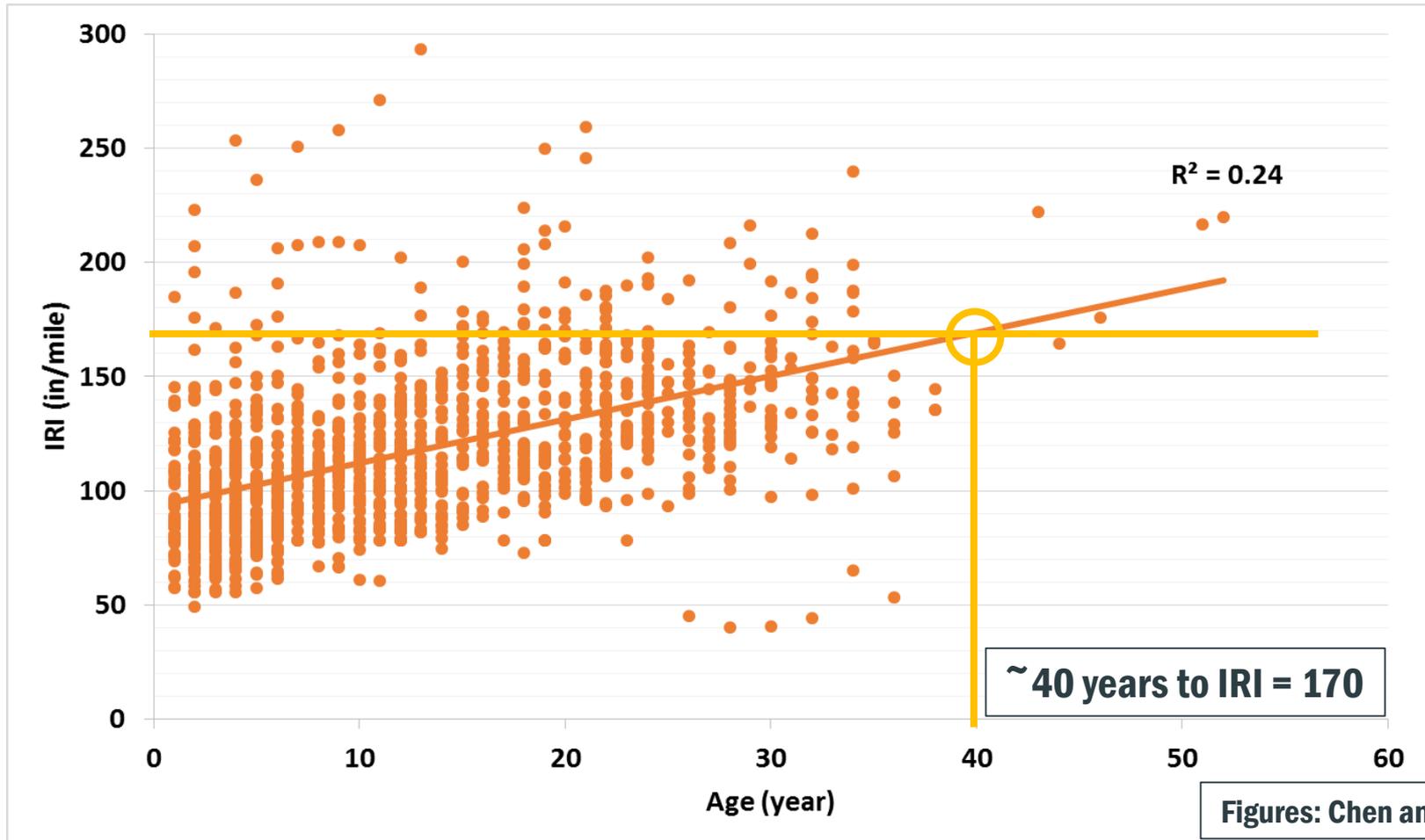
RESULTS AND ANALYSIS

✖ Data set as a whole:



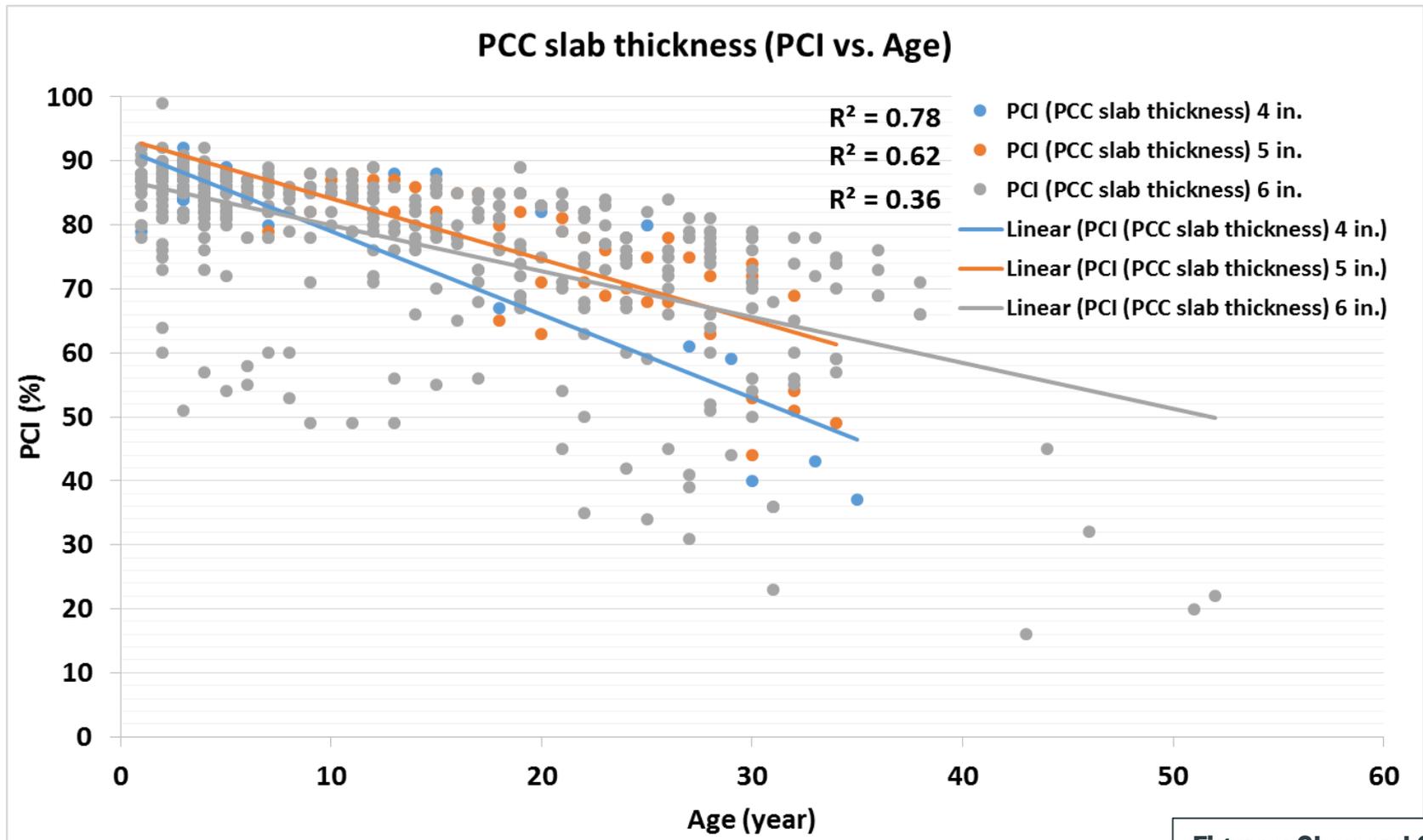
RESULTS AND ANALYSIS

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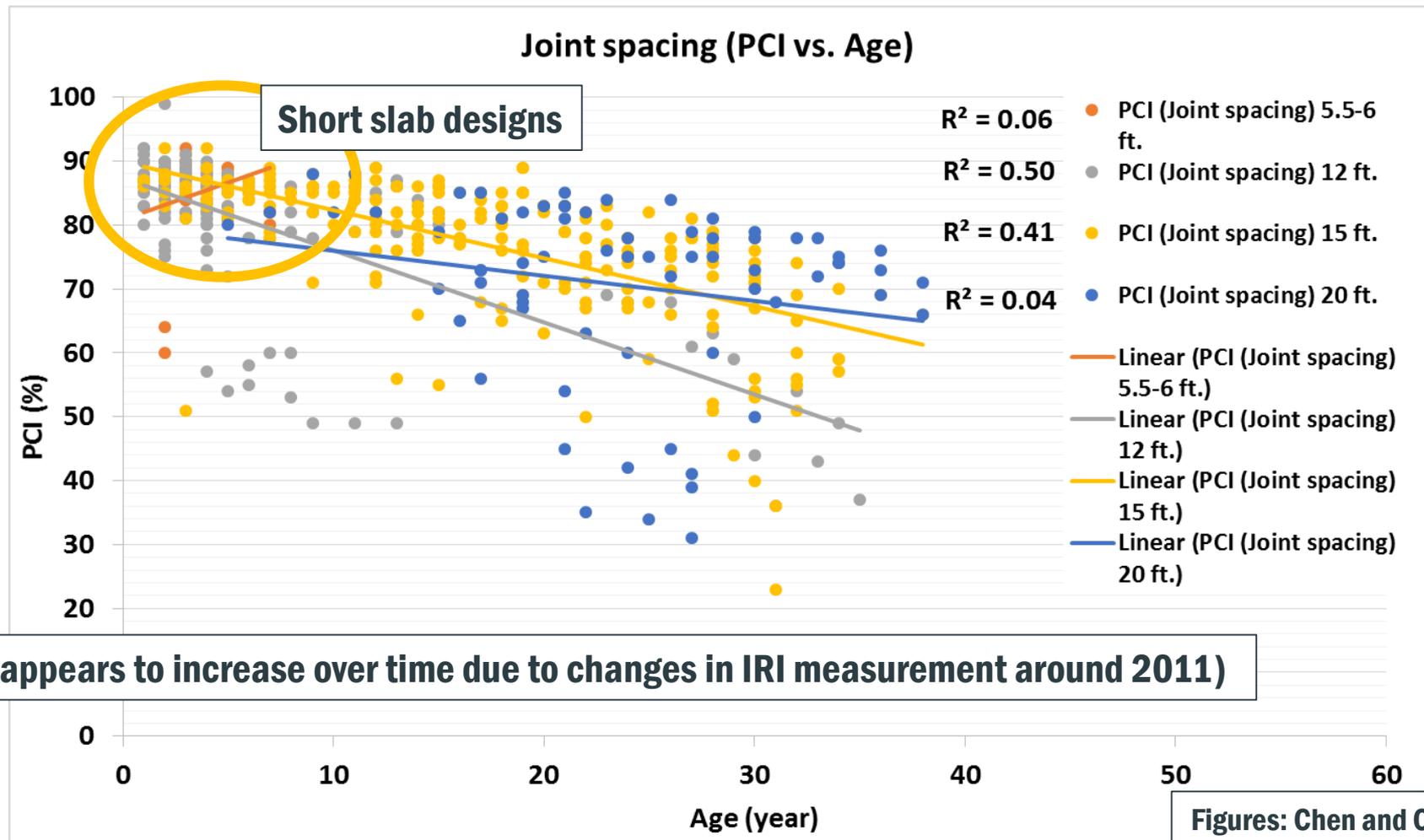
RESULTS AND ANALYSIS

✖ BCOA only (organized by thickness):



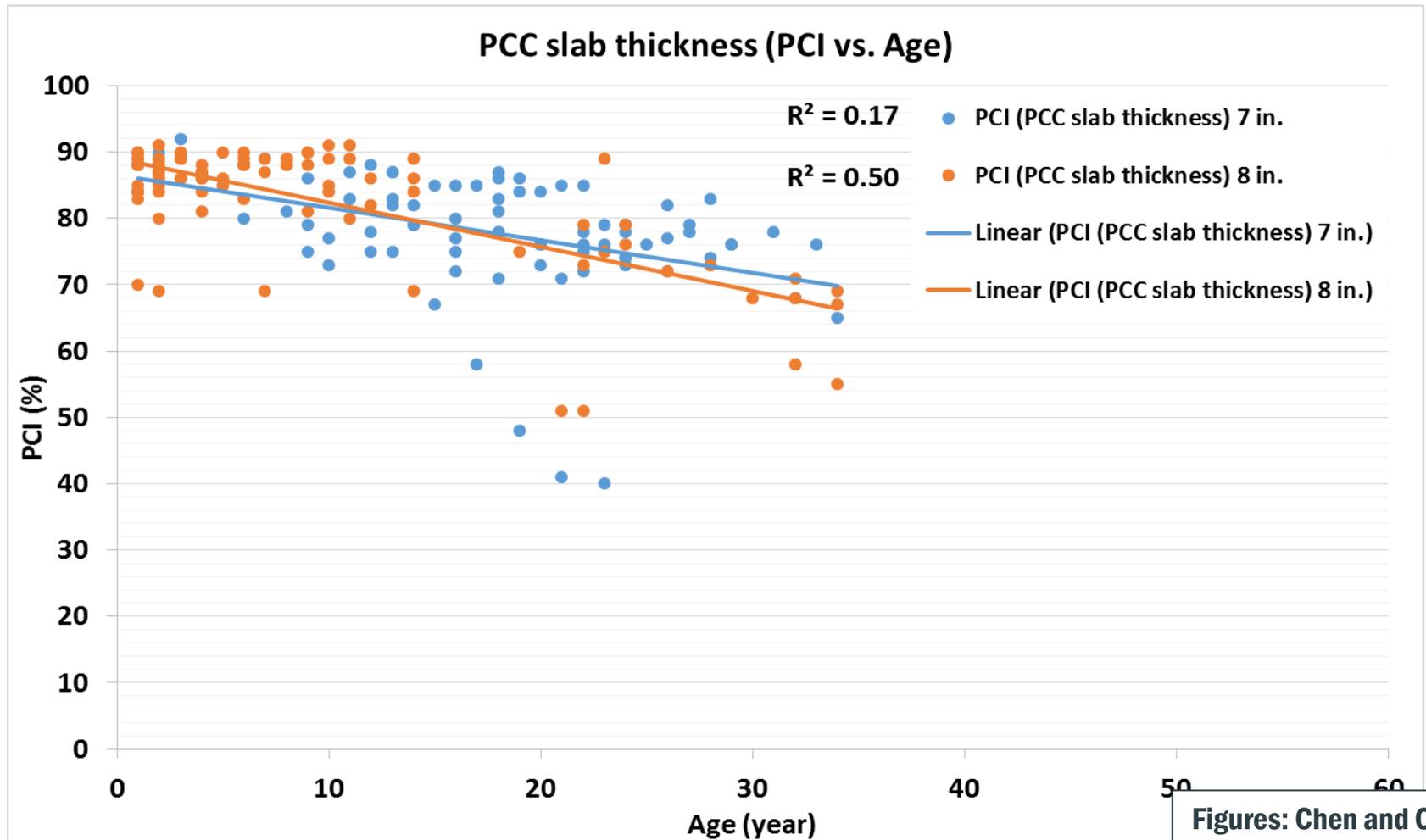
RESULTS AND ANALYSIS

✖ BCOA only (organized by joint spacing):



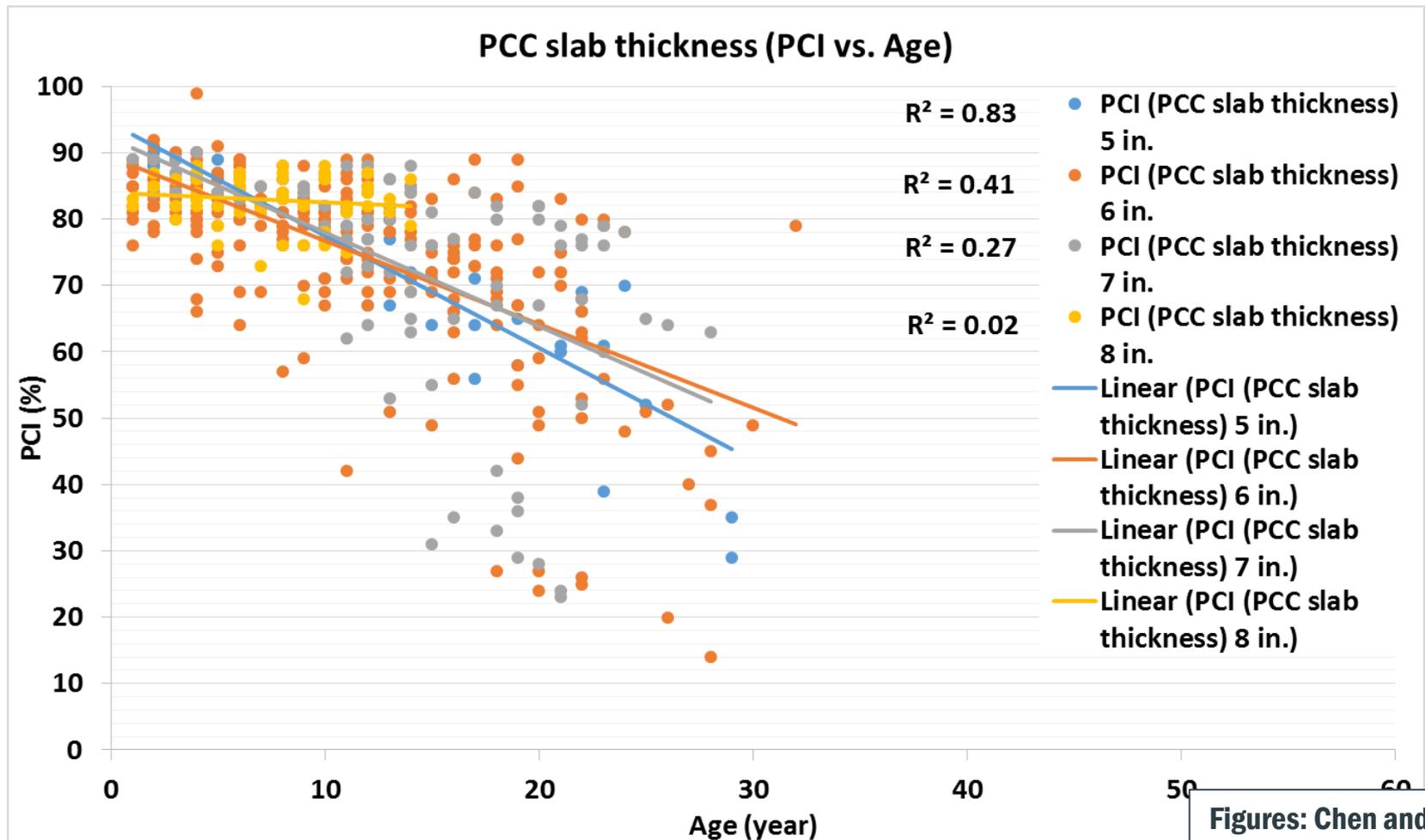
RESULTS AND ANALYSIS

✖ UBCOA only (organized by thickness):



RESULTS AND ANALYSIS

✖ UBCOC only (organized by thickness):



RESULTS AND ANALYSIS

× Key findings and trends:

- + Overall performance of Iowa's concrete overlays has been excellent
 - × As a whole: about 34 years to PCI = 60
 - × About 40 years to IRI = 170
- + Good performance from each of BCOA, UBCOA & UBCOC
 - × Overlays of asphalt slightly better than UBCOC
 - × BCOC: less successful overall, but performed well in context of design life expectations

RESULTS AND ANALYSIS

× Key findings and trends:

+ Thickness

- × In general: thicker overlays have performed better for all overlay types (e.g. for BCOA, 6" > 5" > 4")

+ Transverse joint spacing

- × Good early performance from short slab designs (6") on BCOA/thin overlays
- × Older designs with 15-20 foot slabs performed well long-term
- × 12 foot slabs—inconclusive

+ Traffic—inconclusive

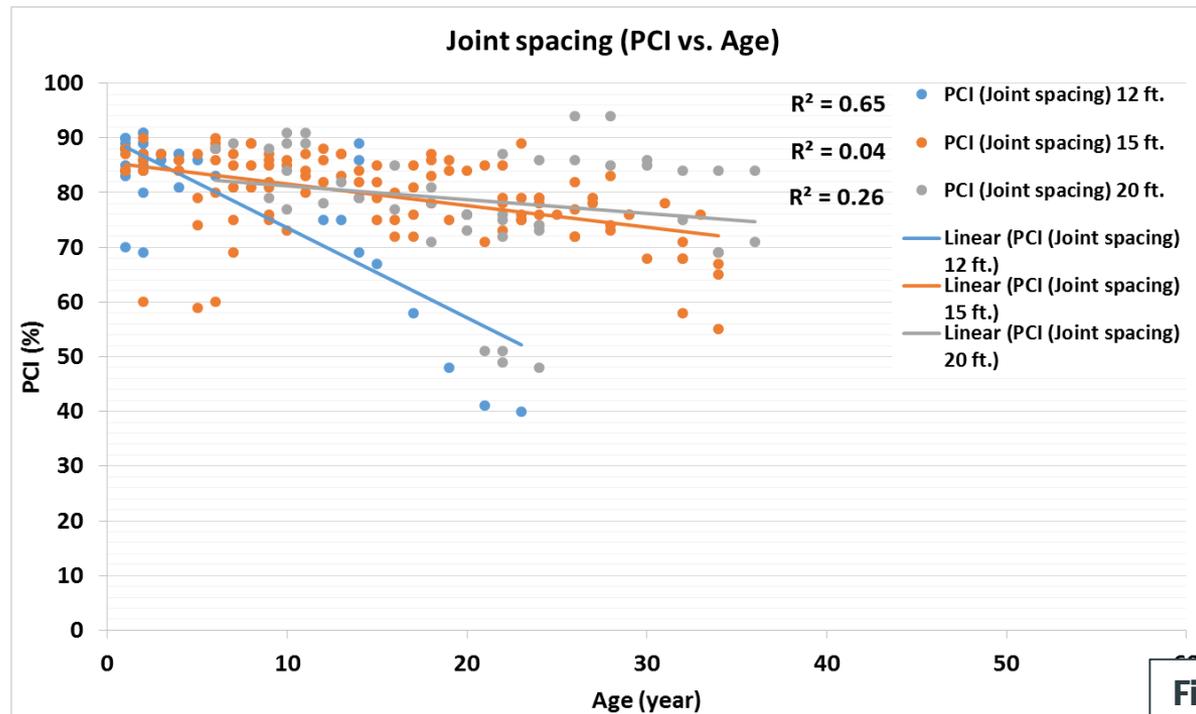
- × Most of these projects are low-volume, <1,000 vpd
- × Not enough truck traffic data available from local agencies

RESULTS AND ANALYSIS

✘ 12 foot transverse joint spacing

+ Across multiple splits, apparent decline in performance of overlays with 12 foot joint spacing

+ UBCOA (organized by joint spacing):



FIELD REVIEWS

- ✘ **To supplement data analysis, field reviews were performed**
 - + **Verify findings and investigate trends, outliers**



Pottawattamie County, IA, Constructed 1993

FIELD REVIEWS

× Observed distresses:

+ Materials-related



Pottawattamie County, IA, Constructed 1999

FIELD REVIEWS

× Observed distresses:

- + Rough ride—construction or curling/warping
- + Occasionally faulting



Buchanan County, IA, Constructed 1996

FIELD REVIEWS

- × **Observed distresses:**
 - + **Load-related, possibly mis- or under-designed**



Dallas County, IA, Constructed 2006

FIELD REVIEWS

× Key takeaways:

- + Observed performance generally matches

- + Poor performing outliers & early failure causes:

 - × Materials-related

 - × Load-related/under-design

 - × Rough ride

- + In short... mostly the same issues that we run into with conventional PCC pavements

 - × No direct observations to explain apparent trend with 12 ft joint spacing

CONCLUSIONS

- × **Overall performance of Iowa's concrete overlays has been excellent**
 - + **As a whole: about 34 years to PCI = 60**
 - + **About 40 years to IRI = 170**
 - + **Overlays very well-suited to rural highways**
- × **Thin overlays & BCOA**
 - + **Excellent longevity for classic 5-6" BCOA**
 - + **Newer 4-5" overlays with short slabs performing well over first 10 years**

Thank you!
