CONCRETE TRAILS GUIDE: LEVERAGING A PROMOTION OPPORTUNITY

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CP Tech Center

IOWA STATE UNIVERSITY
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National Concrete Pavement Technology Center

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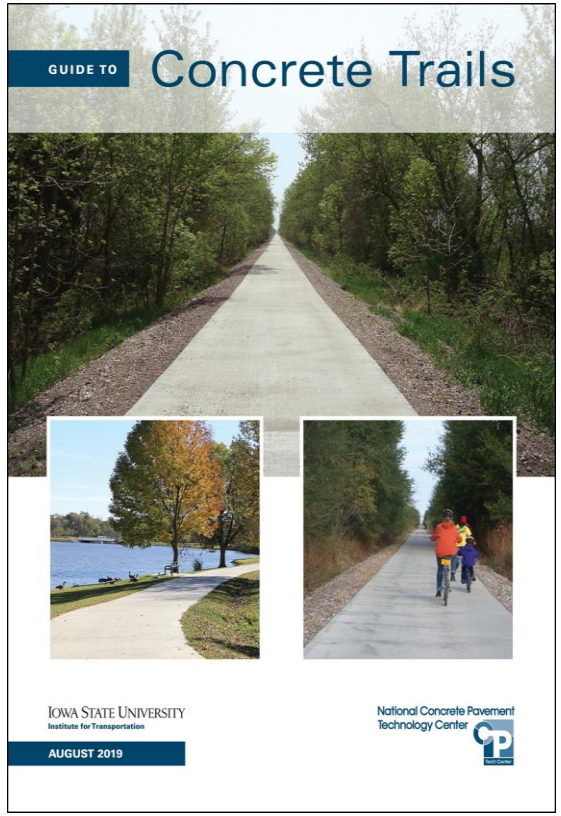

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NRMCA

NATIONAL READY MIXED CONCRETE ASSOCIATION

WHY DO WE NEED THIS GUIDE?

- There was no standardized design and construction document that addressed concrete trail construction.
- References to concrete trail design and construction were on a project specific basis. Often, specifications for trails mirror state DOT specifications. **(Overdesign!)**
- Internet searches found 3 good design and construction documents on asphalt trails, none on concrete.

WHY DO WE NEED THIS GUIDE?

- Most default references to trails are asphalt paving material.
- Hard surface recreational trails are an ever-increasing “assumed” public utility that people expect in a community.
- Funding sources for recreational trails with inclusion in roadway projects is common.
- Stand alone trail funding is available.

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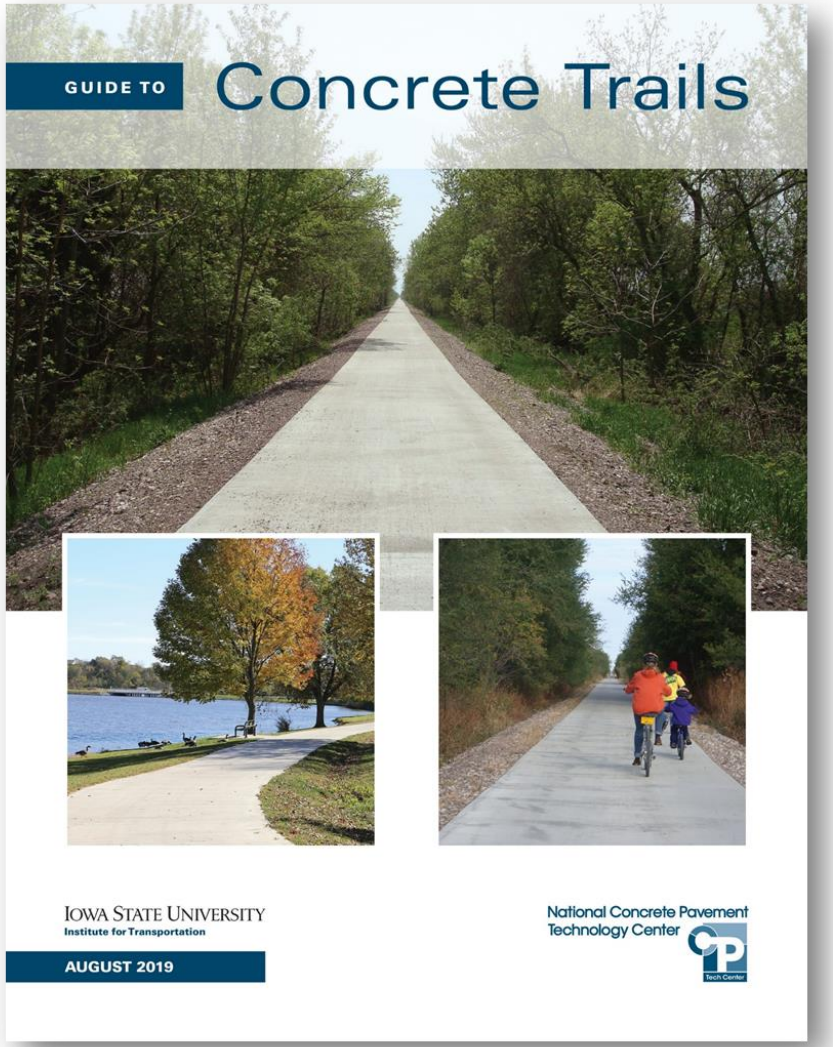
OUTLINE OF YOUR GUIDE TO CONCRETE TRAILS



Contents

Figures

Tables

INSIDE THE GUIDE TO CONCRETE TRAILS

- Twenty two pages of concrete trail knowledge and guidance for industry, the engineering community and trail owners
- Sixty four photos of trails, design features and construction equipment and methods
- Six reference tables
- Five case studies from around the country
- Appendices addressing concrete overlays on asphalt trails and use of fiber reinforcement
- Support assistance of the NRMCA and CP Tech Center

LET’S EXPLORE THE HIGHLIGHTS OF THE GUIDE!

TRAIL TYPES

Figure 1. Rail trail

Greg Smith, Kentucky Concrete Pavement Association

Figure 2. Greenway (follows a waterway) or park trail

Figure 3. Circumferential lake trail

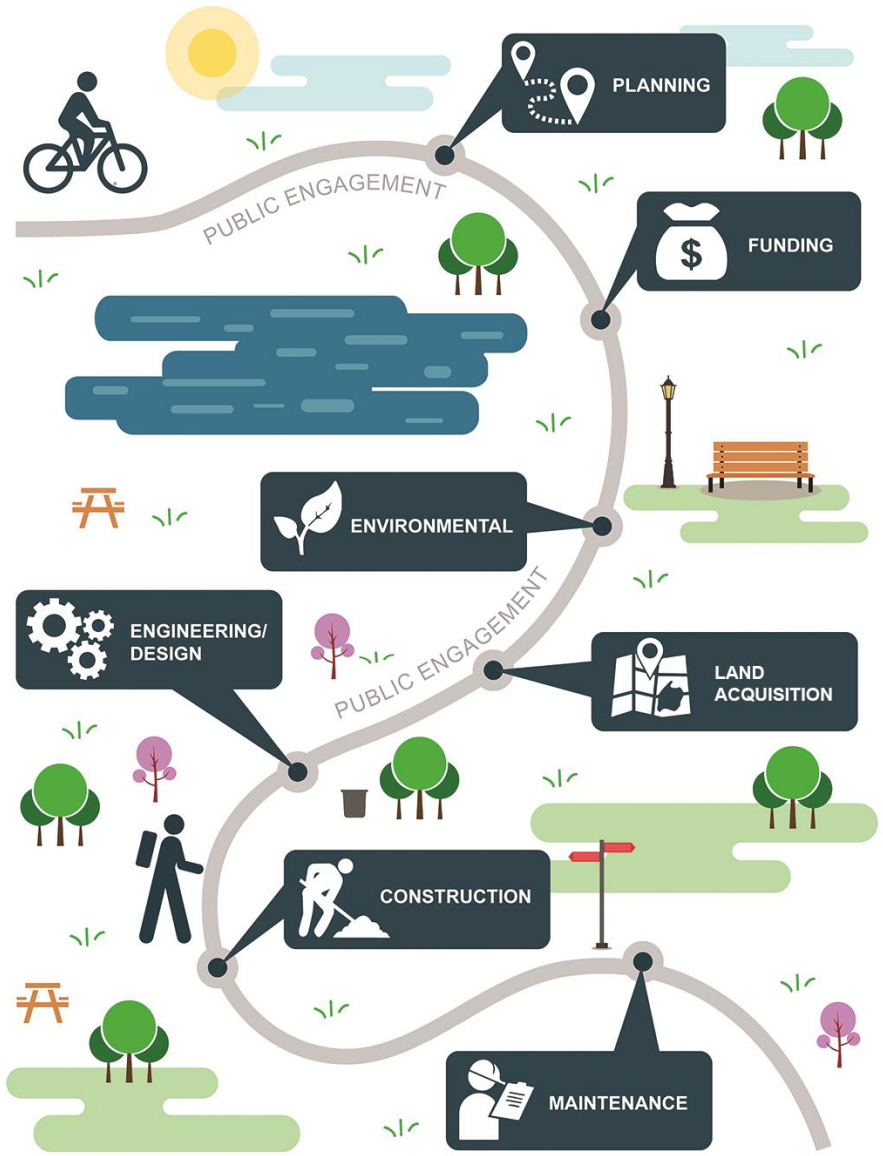
Figure 4. Urban sidepath

Figure 5. Rural sidepath

Figure 6. Utility corridor trail

TRAIL DEVELOPMENT IS A PROCESS

- **Planning**
- **Funding**
- Environmental Review
- Land Acquisition
- Engineering/Design/Contract
- Construction
- Maintenance



A BRIEF HISTORY OF TRAIL FUNDING SOURCES

- 1956 Federal Aid Highway Act – Highway Trust Fund
- 1968 National Trails System Act
- 1976 Rails-to-Trails Grant Program
- 1980 Stagger's Act - Railbanking
- 1991 ISTEA – Transportation Enhancements and Federal Recreational Trails Program

- 1998 TEA-21; SAFETEA-LU; MAP-21; FAST Act (2015)

→ Surface Transportation Block Grant Programs

- State-County-Municipal-Private Resources

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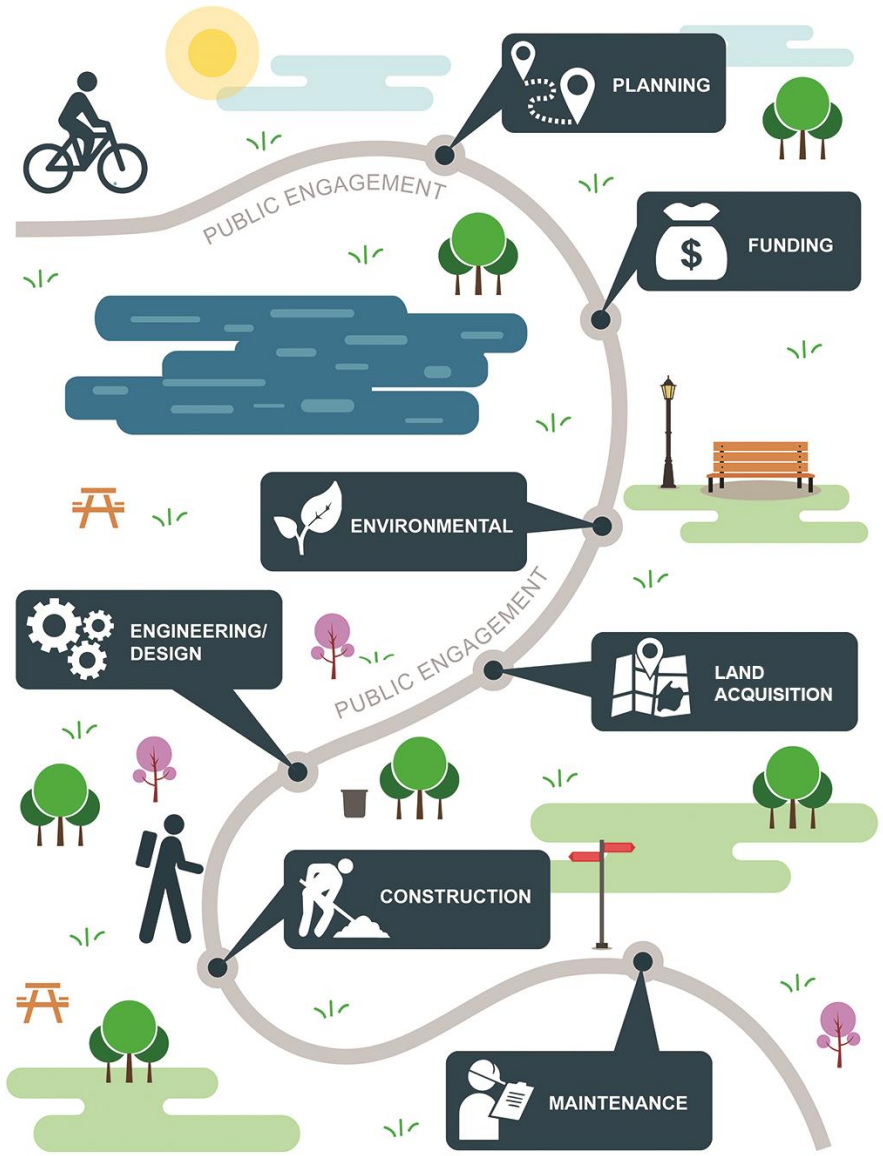


REASONS TO USE CONCRETE FOR TRAIL PAVING

- Durability
- Competitiveness
- Ease of construction
- Minimal maintenance
- No steel required
- Pave directly on uniform subgrade
- Life-cycle value
- Longevity

CONCRETE TRAIL CONDITION OVER TIME

- Top Photos: Constructed 2018
  - New Condition
- 2nd Row Photos: Constructed 2008
  - 99% Good/1% Fair
- 3rd Row Photos: Constructed 1998
  - 95% Good/5% Fair
- 4th Row Photos: Constructed 1988
  - 90% Good/10% Fair

Figure 9. Concrete trail conditions over time

CONCRETE TRAIL DESIGN PARAMETERS

- Trail Width-Types

- Concrete Thickness
- Subgrade Soil and Support

Table 1. Recommended trail widths

Trail width	Trail use
8 ft	• Neighborhood connector trails • Low bicycle traffic • Occasional pedestrian use • No regular maintenance vehicles
10 ft	• Two-way bicycle traffic • Maintenance vehicle use
12 to 14 ft	• Higher capacity trails • Maintenance vehicle use • Bicycle passing use, while allowing room for oncoming traffic • High user volume (>300 in peak hour) and high pedestrian use (≥30%)

Data source: *Guide for the Development of Bicycle Facilities* (AASHTO 2012)

Table 2. Subgrade soil and support values

Type of soil	Support	*k*, psi/in.	CBR
Fine-grained soils with high amount of clay and silt	Low	75 to 120	2.5 to 3.5
Sands and sand-gravel mixtures with fair amount of clay and silt	Medium	130 to 170	4.5 to 7.5
Sands and sand-gravel mixtures with low amount of clay and silt	High	180 to 220	8.5 to 12

Data source: *Guide for the Design and Construction of Concrete Parking Lots* (ACI-330R-01/ACI 2008)

Table 3. Minimum trail thickness based on width and support condition

Trail width	Support condition		
	Low	Medium	High
Less than 10 ft	5.5 in.	5.0 in.	4.0 in.
10 ft or greater	6.0 in.	5.5 in.	5.0 in.

Minimum 28-day compressive strength: 4,000 psi

*Thickness recommendations are consistent with tables in ACI 330 of soil support value and concrete thickness of slab on grade parking lots.

CONCRETE TRAIL DESIGN PARAMETERS

Trail Width-Types

- 8’ Wide
  - Neighborhood Connector
  - Low Bicycle Traffic
  - 2 Way Pedestrian
- 10’ Wide
  - 2 Way Bicycle Traffic
  - Maintenance Vehicle
- 12’ Wide
  - High Capacity
  - Bicycle Passing while allowing on-coming traffic
  - Heavier Maintenance Vehicle

Concrete Thickness*

- 8’ Wide Trail
  - 4”--High Soil Support
  - 5”--Medium Soil Support
  - 5.5”--Low Soil Support
- 10’-12’ Wide Trail
  - 5”--High Soil Support
  - 5.5”--Medium Soil Support
  - 6”--Low Soil Support

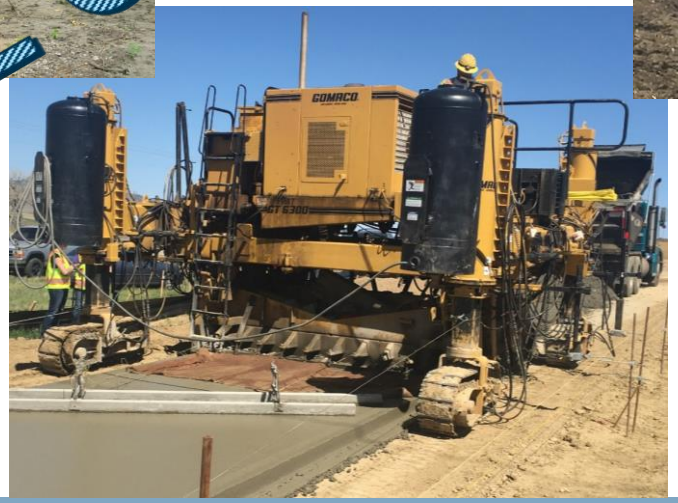
*Thickness recommendations are consistent with tables in ACI 330 of soil support value and concrete thickness of slab on grade parking lots.

CONCRETE TRAIL DESIGN-PLANNING SECTION

- Concrete overlay of existing asphalt trails
- Cross slope guidelines
- Longitudinal profile
- Clear Zone (Separation of trail from natural and artificial structures)
- Trail crossing of roadways

- Subgrade preparation
- Fiber reinforcement
- Edge details and drainage
- Paving details at structures, bridges, and culverts
- Retaining walls next to trails
- Planning for construction, identifying narrow corridors, or other obstacles

TRAIL CONSTRUCTION



CONCRETE TRAIL-CONSTRUCTION SECTION

- Concrete mixes
- Concrete delivery
- Fixed-Form paving
- Slipform paving
- Other types of specialized paving equipment (box paver, dedicated trail pavers, skid steer equipment)
- Equipment paths during paving

- Surface finishing-burlap drag or broom
- Smoothness
- Curing
- Control, construction, and isolation joints. Joint sealant.
  - Trails 8’-12’ wide should be cut into square panels. Longitudinal joints are not required. Joint sealant not typically used.

CONCRETE TRAIL MAINTENANCE SECTION

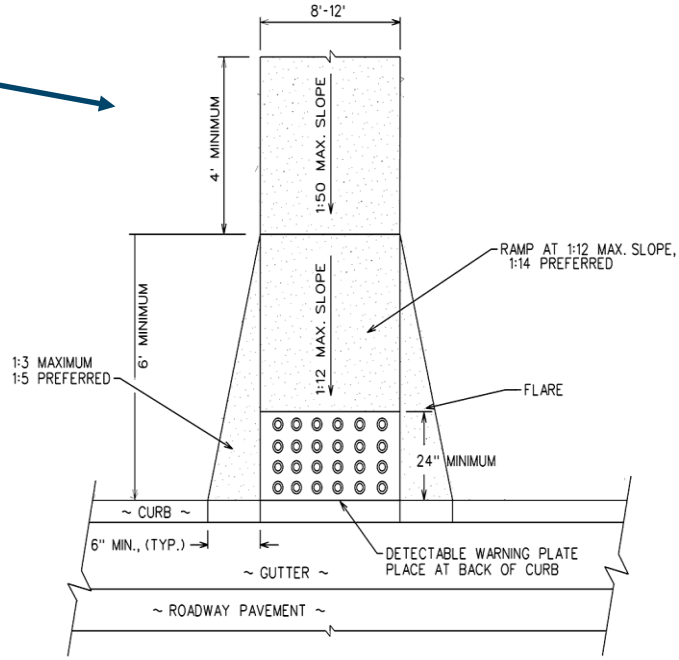
- Common Repairs
  - Random Cracking
  - Transverse Joint Faulting
  - Longitudinal Cracks
  - Divided Slabs

Table 5. Concrete trail distress, causes, and repair

Distress	Example	Cause	Repair
Random cracking		Poor subgrade support, subgrade freeze/thaw, or differential subgrade movement	If crack is not working (no vertical movement or horizontal separation), routing and sealing is recommended If crack is working, remove and replace panel
Transverse joint faulting		Subgrade freeze/thaw or differential subgrade movement	If less than ¼ in., do nothing If from ¼ to ½ in., grind with rotomill or other small equipment If more than ½ in., perform a full-depth repair or slab jacking (raising the settled panel) with pressure grout
Longitudinal crack		Excessive panel width, poor subgrade support, or differential subgrade movement	If tight (less than ¼ in.), do nothing If moderate (¼ to ½ in.), fill with sealant If open (more than ½ in.), replace panel
Divided slabs	 Panel is divided into three or more pieces	Poor subgrade support or deficient pavement thickness	Replace panel

SPECIAL DETAILS SECTION

- Utility Access Casting
  - Trails often share utility routes
- Truncated domes and ADA transitions
- Pervious Concrete Trails
- Colored Concrete Trails

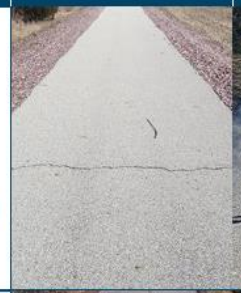


Appendix A: Concrete Overlay on Hot-Mix Asphalt Trails

Appendix B: Fiber Reinforcement

Figure 64. Concrete pavement with fibers and hairline crack

Table 6. Asphalt distress causes and repair prior to concrete overlay

Distress	Definition/causes	Preoverlay repair	Low severity	High severity
Thermal cracking	Temperature drop causes thermal cracking in asphalt pavement as asphalt binder contracts and shrinks faster than the aggregate. It usually occurs in transverse direction.	Cracks between ½ and ¾ in. wide should be sealed. When cracks are between ¾ and 1½ in., fly ash slurry, concrete grout, or other nonasphalt material can be used to fill. If subgrade or drainage is causing vertical movements in the cracks that are 1½ in. wide, then the asphalt pavement should be stabilized and drained before filling the cracks.		
Random cracking	Random cracking consists of diagonal, transverse, and longitudinal cracks. It could be caused by any of the reasons: poorly constructed lane joint, hardening of asphalt, subgrade failure, etc.	Cracks between ½ and ¾ in. wide should be sealed. When cracks are between ¾ and 1½ in., fill them with fly ash slurry, concrete grout, or other nonasphalt material. If the subgrade or drainage is causing vertical movements in the cracks that are more than 1½ in. wide, then the asphalt pavement should be stabilized and drained before filling the cracks.		
Block cracking	Block cracking is interconnected cracks that divide the pavement up into rectangular pieces. It is typically caused by the inability of asphalt binder to expand and contract with temperature cycles because of asphalt binder aging or poor choice of asphalt binder in the mix design.	If the cracks are less than ½ in. wide and there are no loose pieces, no repair is required. If severe cracks (more than ½ in. wide) are present in isolated areas, then remove and replace those locations with a concrete patch covering and nonwoven fabric interlayer. If severe block cracking is present throughout the trail, then consideration should be given to constructing new pavement, including repairs to the support layer where necessary.		
Raveling	Raveling is the wearing away of the pavement surface caused by the dislodging of aggregate particles. The cause can be the hardening of the asphalt binder, poor quality mix, or poor compaction. The progressive disintegration from raveling occurs from the surface downward as a result of the dislodgement of aggregate particles.	If the binder/aggregate is worn with loss of fine aggregate and some loss of coarse aggregate, but the surface is not too rough, remove all loose material by power cleaning the asphalt surface, followed by cleaning with compressed air. If the binder/aggregate is worn away, and surface texture is very rough and pitted with loss of coarse aggregate, then additional milling can be completed for a uniform profile and support. The minimum remaining thickness of the asphalt is 3 in.		

Source: *Guide to Concrete Overlays of Asphalt Parking Lots* (Harrington et al. 2012)

Images: Thermal cracking and Random cracking images were provided by Snyder & Associates, Inc. Block cracking and Raveling images were provided by J. Dewayne Allen, Allen Engineering Corporation; Bryan Birdwell, Structural Services, Inc.; Jon Hansen, National Ready Mixed Concrete Association; and Randy Riley, formerly Illinois Chapter, Inc. – American Concrete Pavement Association originally for the 2012 *Guide to Concrete Overlays of Asphalt Parking Lots* from the National CP Tech Center

CASE STUDIES

- Dam West Subdivision, Aurora, CO
- Sauk River Trail Reconstruction, Swan Lake, Carroll, IA
- Legacy Trail, Lexington, KY
- Parkland of Floyds Fork Trails, Jefferson County, KY
- Wingate South Park Trail, Littleton, CO

Case Study #3: Legacy Trail

Project Information

Construction Year(s)	2010
Location	Lexington, Kentucky
Trail Type	Conventional—shared path Pervious—shared path
Width	9 to 12 ft
Length	Conventional—approximately 8 mi Pervious—approximately 4 mi
Thickness	Conventional—6 in. for 3 mi and 4.5 in. for 5 mi Pervious—6 in.
Subgrade System	Native ground
Contractor	Conventional—FOX Enterprises, Richmond, Kentucky Pervious—Bluegrass Contracting Corporation, Lexington, Kentucky
Type of Paver	Conventional—four-track Power Curber Pervious—triple-roller screed
Special Accomplishments	—
Total cost	Average price—$36 yd^2

DAM WEST SUBDIVISION, AURORA, CO
6-year long project replacing asphalt trail with concrete
1991-1997

SAUK RIVER TRAIL RECONSTRUCTION, SWAN LAKE, CARROLL, IA

Existing asphalt trail recycled and used as base for concrete

LEGACY TRAIL, LEXINGTON, KY

8 miles plain concrete and 4 miles pervious concrete

PARKLAND OF FLOYDS FORK TRAILS, JEFFERSON COUNTY, KY
8 Miles in flood plain

WINGATE SOUTH PARK TRAIL, LITTLETON, CO

Overlay of old asphalt trail-4000 LF

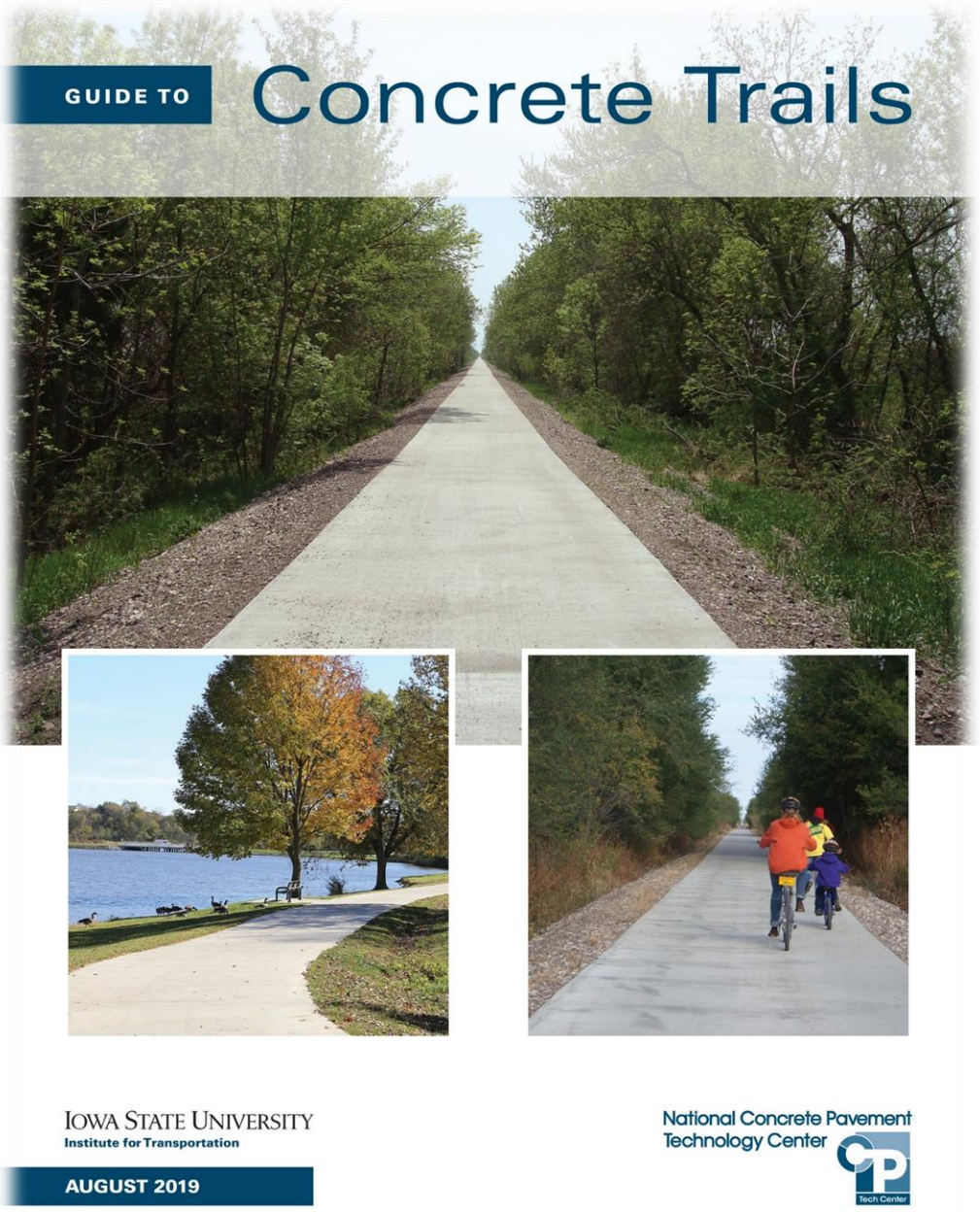
- Before

- After

Additional case studies are coming on ConcreteTracker.com

- Free PDF downloads of Guide to Concrete Trails on the RMC Foundation web site:
  - https://rmc-foundation.org/concrete-applications/

- Printed copies of Guide to Concrete Trails also available. Talk to any member of the NRMCA Pave Ahead team or RMC Research and Education Foundation staff.



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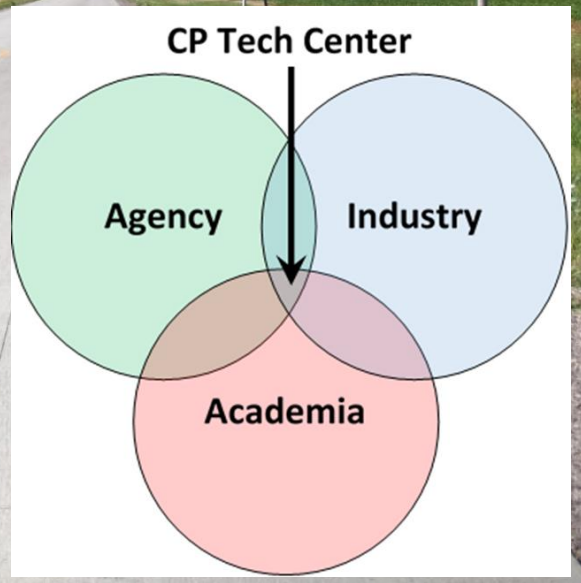
MAKING A DIFFERENCE . . . . .

Collaboration
Engagement
Research
Resources
Implementation and Deployment



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Questions/Discussion/ Strategies?