Concrete Intersections: A Guide for Design and Construction

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Robert Rodden
Director of Technical Services

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Benefits of Concrete Intersections

- A long-term pavement solution.
- Low maintenance costs.
- No softening or deterioration caused by slow moving maneuvering vehicles and/or fuel/oil dripping.
- Better light reflectivity than asphalt, enhancing pedestrian and vehicle safety at night and in inclement weather.
- A durable and skid resistant surface.

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Concrete Intersections: Planning

- Identify problematic intersections.

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Concrete Intersections: Planning

- Coordinate traffic management strategy/plan with:
  - Construction methods/sequence to be employed.
  - Materials, and test methods for opening to traffic.
  - Traffic congestion profile.
  - Availability of alternate routes to manage user costs.
  - Local business access considerations.

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Concrete Intersections: Planning

- If the project warrants, develop coordinated public relations and media campaign to keep driving public informed.
  - Radio
  - Local Tabloids/Newspapers
  - Local church meetings
  - Dedicated Web Site
  - Site Signage
  - Local Chamber

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Concrete Intersections: Basics

- Thickness
- Jointing
  - Spacing
  - Type: contraction, construction, isolation
  - Layout
- Traffic management (phasing)
- Fast track
- Other considerations not discussed (i.e., reconstruction versus inlay, subgrade and subbase requirements, concrete materials, traffic detection systems, construction processes, etc.)

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Concrete Intersections: Thickness

- Design may be based on AASHTO, PCA, StreetPave, etc.

Class	ADT	ADTT	Thickness
Light residential	< 200	2-4	4.0-5.0 in.
Residential	200-1,000	10-50	5.0-6.0 in.
Collector	1,000-8,000	50-500	5.5-8.0 in.
Business	11,000-17,000	400-700	6.0-8.0 in.
Industrial	2,000-4,000	300-800	6.5-9.5 in.
Arterial (minor)	4,000-15,000	300-600	6.5-9.5 in.
Arterial (major)	4,000-30,000	700-1,500	7.0-10.0 in.

Concrete Intersections: Thickness

Physical Area

Functional Area

Concrete Intersections: Thickness

Physical Area Functional Area

Roadway 1	Roadway 2	Physical Area Thickness
Low ADTT (T1)	Low ADTT (T2)	T2
Low ADTT (T1)	High ADTT (T3)	T3
High ADTT (T3)	High ADTT (T3)	T3 + 0.5 to 1 in.

T3>T2>T1

Concrete Intersections: Jointing

- Control natural transverse & longitudinal cracking from internal slab stresses.
- Divide pavement into construction lanes or increments.
- Accommodate slab movements.
- Provide load transfer.
- Provide uniform sealant reservoir.

Concrete Intersections: Jointing

- Maximum joint spacing:
  - $ML = T \times C_s$

ML = Maximum length between joints (in.)

T = Slab thickness (in.)

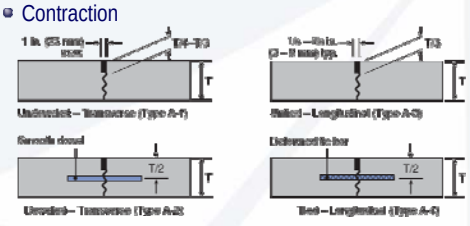
C_s = Support constant (24 for subgrades or unstabilized [granular] subbases; 21 for ATB, CTB, lean concrete [econocrete], or existing concrete or asphalt; 12 to 15 for UTW on asphalt)

* Maximum spacing of transverse joints in plain (unreinforced) concrete should be 15 ft for slabs less than 10 in. thick.

* Keep ratio of transverse to longitudinal spacing at less than 1.5

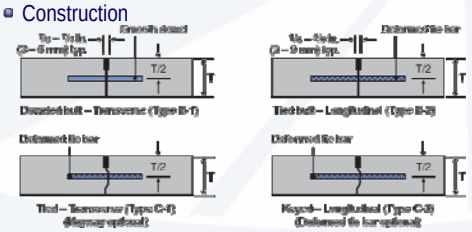
Concrete Intersections: Jointing

- Joint types:
  - Contraction



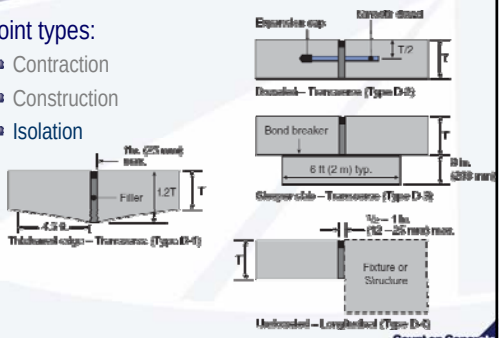
Concrete Intersections: Jointing

- Joint types:
  - Contraction
  - Construction



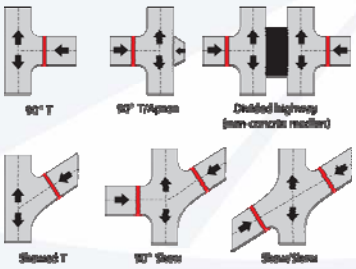
Concrete Intersections: Jointing

- Joint types:
  - Contraction
  - Construction
  - Isolation



Concrete Intersections: Jointing

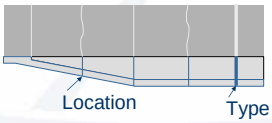
- Where do you put isolation joints?



Concrete Intersections: Jointing

Things to Do

- Match existing joints or cracks
- Cut joints at the proper time
- Place joints to meet in-pavement structures
- Remember maximum joint spacing
- Place isolation joints where needed
- Understand that joint locations can be adjusted in the field!
- Be Practical



Concrete Intersections: Jointing

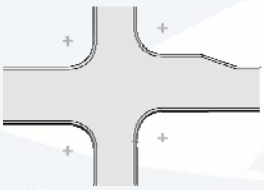
Things to Avoid

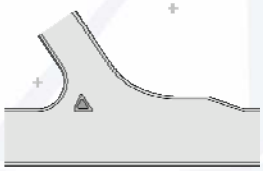
- Slabs < 2 ft wide
- Slabs > 15 ft wide
- Angles < 60º (90º is best)
  - Do this by dog-legging joints through curve radius points
- Creating interior corners
- Odd Shapes (keep slabs near-square or pie-shaped)

Concrete Intersections: Jointing

The Ten Step Method for Intersections

Step 1: Draw all pavement edge and back-of-curb lines in the plan view.

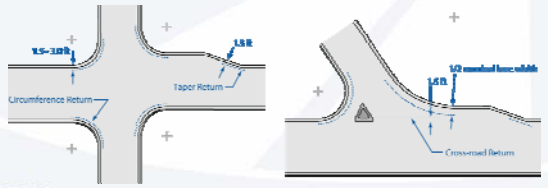




Concrete Intersections: Jointing

The Ten Step Method for Intersections

Step 2: Lightly draw circumference-return, taper-return, and crossroad-return lines as offsets of 1.5 – 3.0 ft



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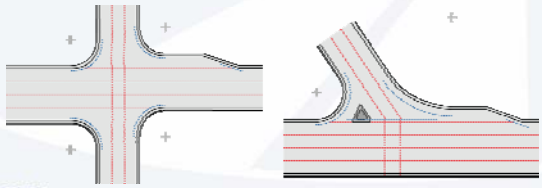
Concrete Intersections: Jointing

The Ten Step Method for Intersections

Step 3: Draw all lane lines on the mainline roadway and crossroad. Do not extend through return lines (offsets).



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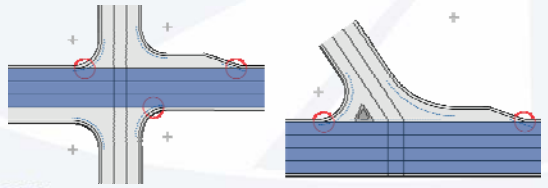
Concrete Intersections: Jointing

The Ten Step Method for Intersections

Step 4: Define mainline lanes for paving. Extend *only* these lane lines through return lines (offsets) to allow for slipform paving. Blockouts & doglegs will occur in the gutter pan at these locations.



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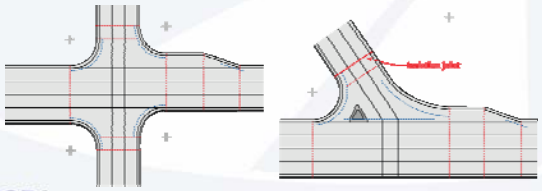
Concrete Intersections: Jointing

The Ten Step Method for Intersections

Step 5: Add transverse joints locations where a width change occurs in the pavement (begin & end of tapers, tangents, curves, curb returns, etc.) and extend these joints through the curb & gutter.



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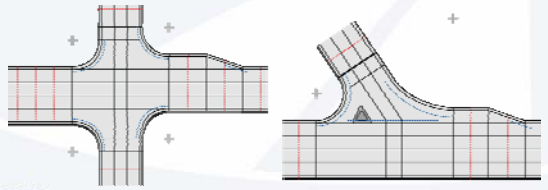
Concrete Intersections: Jointing

The Ten Step Method for Intersections

Step 6: Add transverse joints between and beyond the joints defined in Step 5, but not to the center of the intersection. Attempt to keep the distance between joints less than ML.



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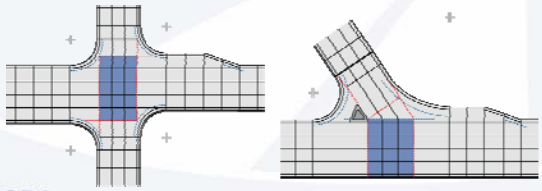
Concrete Intersections: Jointing

The Ten Step Method for Intersections

Step 7: By extending the edge of pavement lines for the cross road and any turning lanes, define the intersection box.



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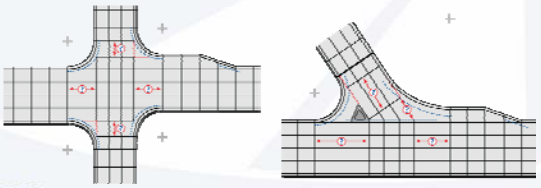
Concrete Intersections: Jointing

The Ten Step Method for Intersections

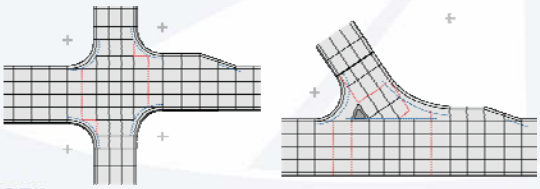
Step 8: Check the distances between the "intersection box" and the surrounding joints.



Concrete Intersections: Jointing

The Ten Step Method for Intersections

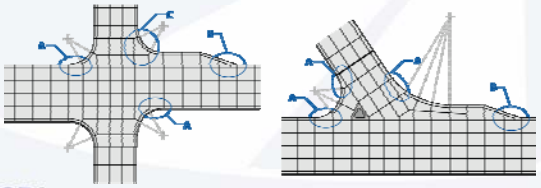
Step 9: If the distance is more than the maximum desirable joint spacing, then add transverse joints at an equal spacing. Do not extend these joints through return lines.



Concrete Intersections: Jointing

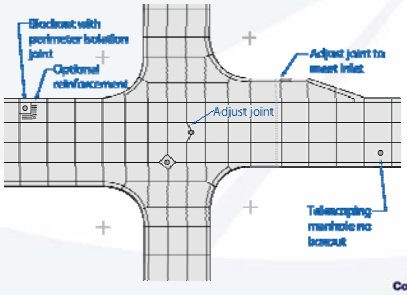
The Ten Step Method for Intersections

Step 10: Extend lines from center of curb return radii to corners of intersection box panels. Draw joints along these "diagonal" lines. Make adjustments to eliminate doglegs in pavement edges.



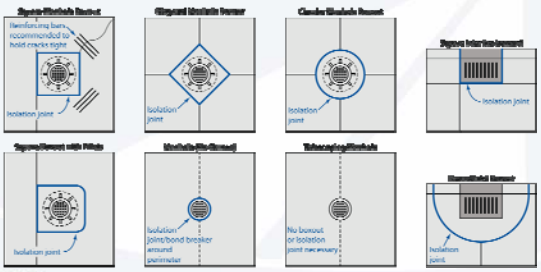
Concrete Intersections: Jointing

Adjust joints that are within 5 ft of a utility!



Concrete Intersections: Jointing

Box Out Fixture Details



Concrete Intersections: Jointing

If you don't box fixtures correctly...

Concrete Intersections: Jointing

Good practice.

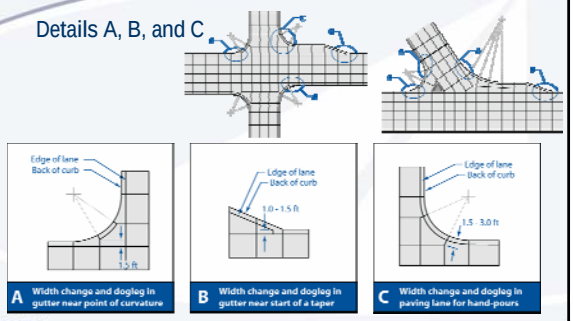
Concrete Intersections: Jointing

Where there's a will, there's a way…

… visibly old, but no cracks!

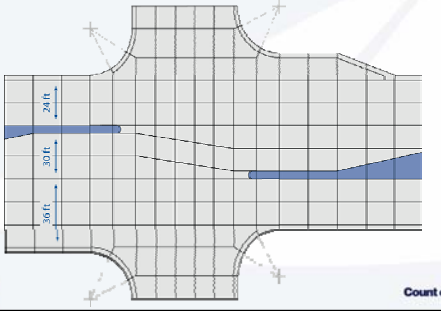
Concrete Intersections: Jointing

Details A, B, and C



Concrete Intersections: Jointing

Same rules apply to wide medians and dual left-turn…



Concrete Intersections: Phasing

- Optimizing plan:
  - Project cost
  - Societal cost
  - Highway safety
  - Traffic management
- Construction phasing options:
  - Complete closure with detours
  - Partial closure with detour
  - Complete closure during time windows
  - Construction under traffic

Concrete Intersections: Phasing

- Complete closure with detours

- Clear and understandable signing
- Sign indicating when reopens

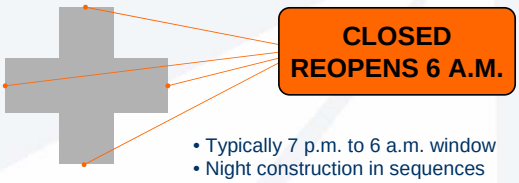
Concrete Intersections: Phasing

- Partial closure with detour

- Only one-leg closed
- Allow traffic on major roadway

Concrete Intersections: Phasing

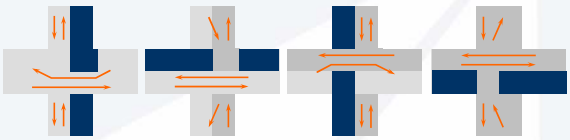
- Complete closure during time windows



- Typically 7 p.m. to 6 a.m. window
- Night construction in sequences
- May require temporary pavement

Concrete Intersections: Phasing

- Construction under traffic by lane

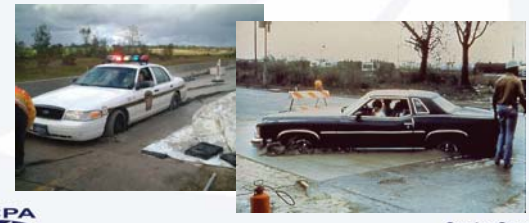


Concrete Intersections: Phasing

- Construction under traffic by quadrant

Concrete Intersections: Fast Track

- Mixtures that develop strength rapidly and are beneficial when early opening of the pavement is necessary… consider sequencing.



Concrete Intersections: Fast Track

- Standard technology for mixture design
- Important to understand it is also sequencing methodology
  - Planning & specifications
  - Concrete materials
  - Jointing & sealing procedures
  - Concrete curing & temperature management procedures
  - Strength testing methods
  - Traffic opening requirements

Concrete Intersections: Fast Track

- Typical fast track mixture proportions

Material	Type	Quantity*
Cement	ASTM C150 Type I	700 – 800 lb/yd³ (415 – 475 kg/m³)
	ASTM C150 Type II	700 – 800 lb/yd³ (415 – 475 kg/m³)
	ASTM C150 Type III	600 – 750 lb/yd³ (360 – 450 kg/m³)
Fly ash	ASTM C618	10 – 20% by weight of cement
Water	ASTM C94	See note below
Air-entraining admixture	ASTM C260	As necessary
Accelerating admixture	ASTM C494	As necessary
Water-reducing admixture	ASTM C494	As necessary

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Concrete Intersections: Fast Track

- Typical opening strength requirements

Slab thickness	Foundation support*	Opening strength** Compressive*** psi (MPa)	Flexural (3rd-point) psi (MPa)
6.0 in. (150 mm)	Unstabilized	3600 (24.8)	540 (3.7)
	Stabilized	1690 (11.7)	370 (2.6)
8.0 in. (200 mm)	Unstabilized	1350 (9.3)	330 (2.3)
	Stabilized	1100 (7.6)	300 (2.1)
10.0 in. (250 mm)	Unstabilized	1100 (7.6)	300 (2.1)
	Stabilized	1100 (7.6)	300 (2.1)

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Upcoming Webinars and Courses

- Upcoming webinars and training courses include the following:
  - Webinar #2, Texturing Concrete Pavements, January 31.
  - Webinar #3, Introduction to the M-E PDG, February 18.
  - Webinar #4, Joint Layout and Design, March 4.
  - Concrete Pavements 101, April 8-10, Tampa Florida.
  - 2008 Professor's Seminar, June 16-19, Chicago, Illinois.
- Please refer to the ACPA website at www.pavement.com for a complete listing of upcoming courses for 2008.

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Questions?

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