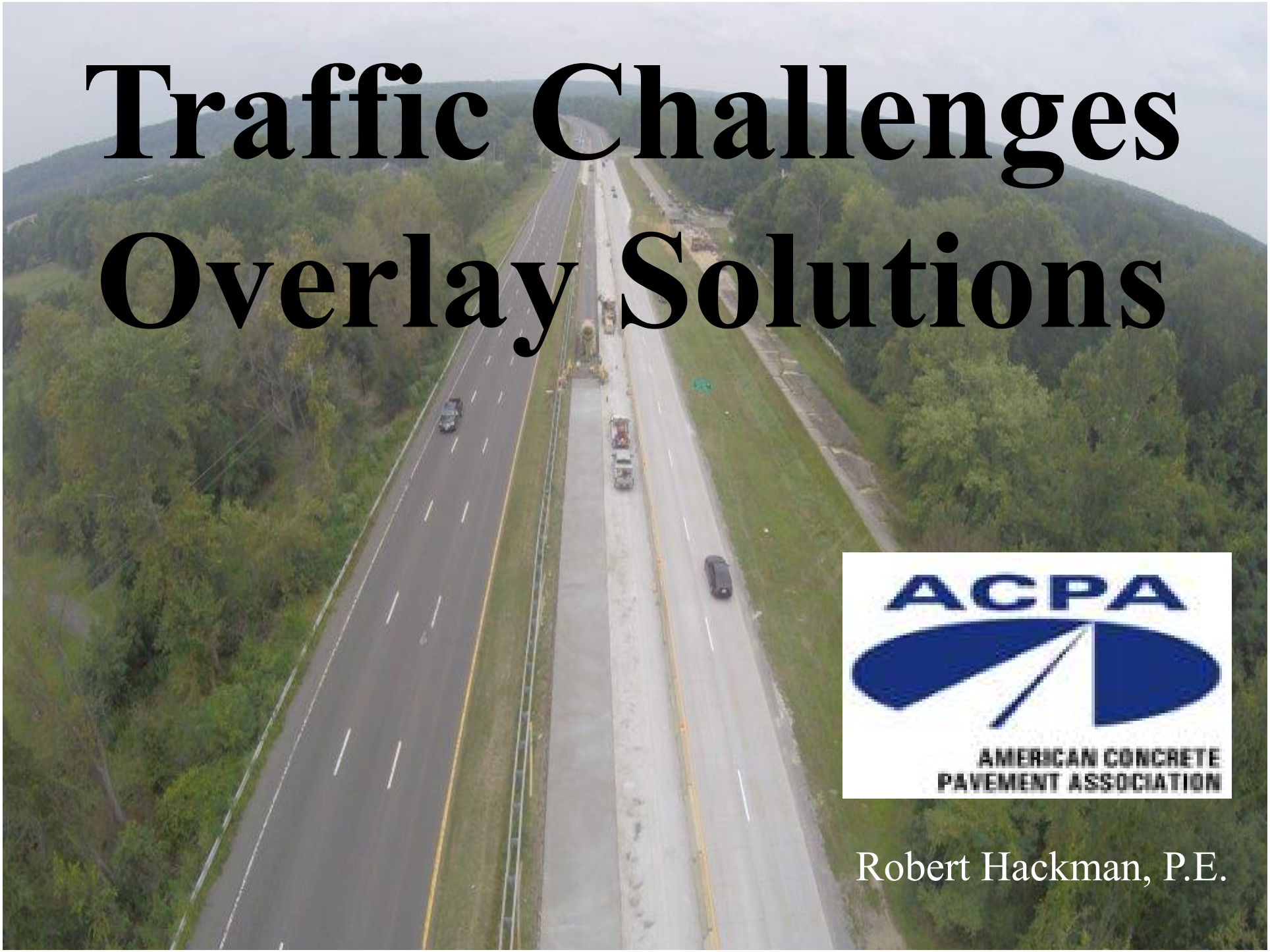
Traffic Challenges Overlay Solutions



ACPA
AMERICAN CONCRETE PAVEMENT ASSOCIATION

Robert Hackman, P.E.


ONLY

Highways, Roads, Streets, Ramps, Intersections, and Roundabouts

❖ Pavement Concerns:

- Steep slopes for trucks
- Starting and stopping
- Slow & heavy loads
- Turning movements
- High shear stresses
- Vehicle safety
- *Repeated repairs*

➢ Typical Asphalt Pavement Failures at Intersections

- Slippage/Cracking, Shoving, Rutting, Raveling
  - Generally caused by high shearing forces.

Concrete Paving

Solution: Concrete Overlays (aka "whitetopping")

- Economical long lasting, durable surface
  - Don't have to return to "fix" road
  - Less construction rehabs – less traffic disruption
  - 20+ year life
- Suitable over concrete or asphalt pavements
- Thin Layers 4 to 6 inches over existing base
- No reinforcing steel/wire mesh
  - Maybe dowels/tie bars depending on traffic loads
- Concrete overlays have a proven track record with millions of SQ YDs across the U.S.

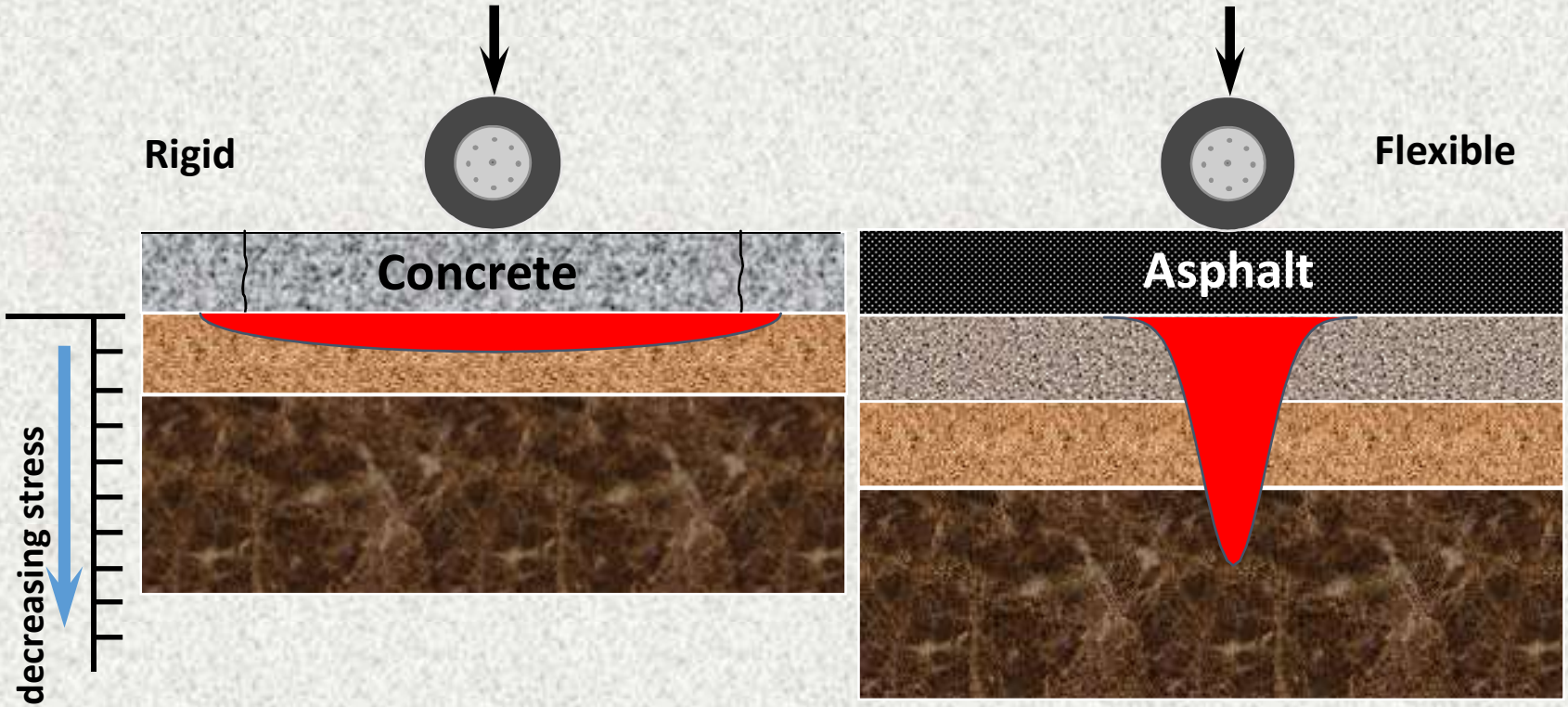
Concrete Paving

Solution: Concrete Overlays (aka “whitetopping”)

- All the **BENEFITS** of concrete pavement
  - Long life with low maintenance costs
  - Durable and skid resistant surface
  - Better light reflectivity, enhances pedestrian safety.
  - No Softening Deterioration – vehicle safety; less liability
  - Better Fuel Efficiency (trucks)

Concrete Paving

Stress distribution is very different

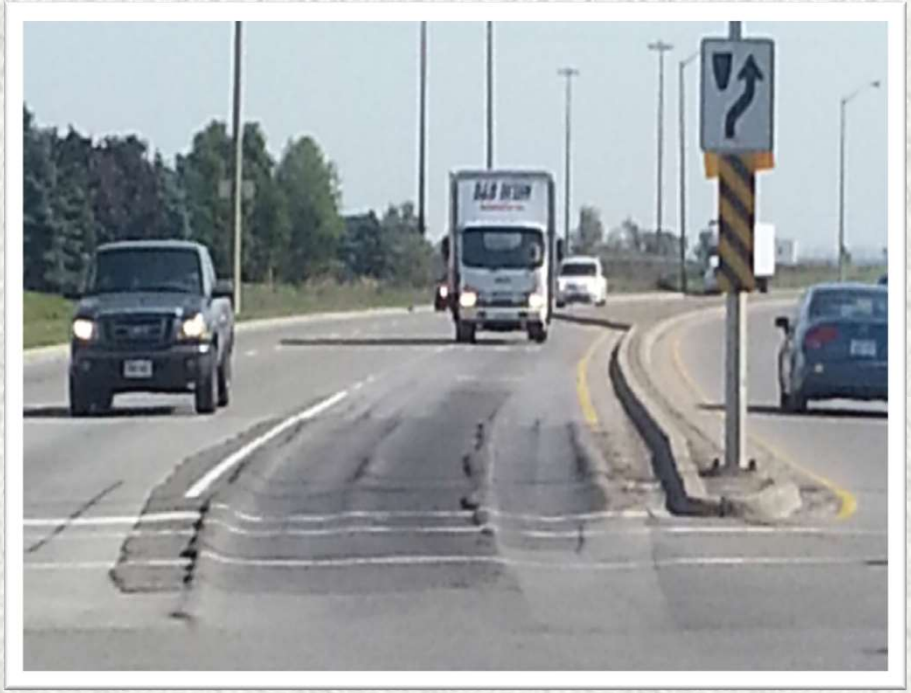


The load capacity parameter for pavements is primarily thickness.

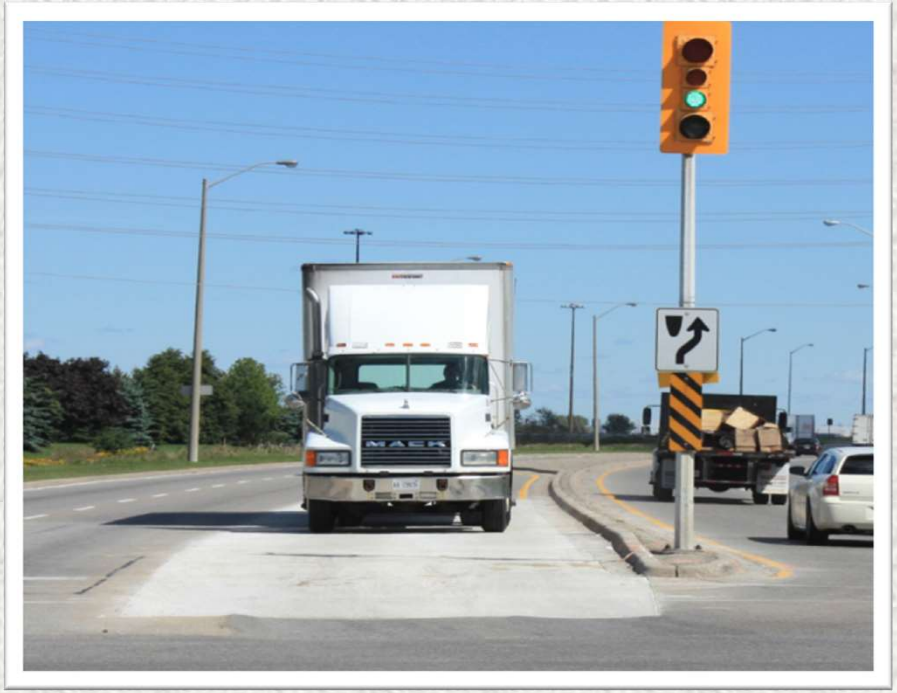
Concrete Paving

Concrete overlay provides a rigid pavement surface able to withstand heavy traffic loads improving performance and reducing the need for constant repairs

Single Lane Repair



Before



After

Concrete Paving

Multiple Lane Repair

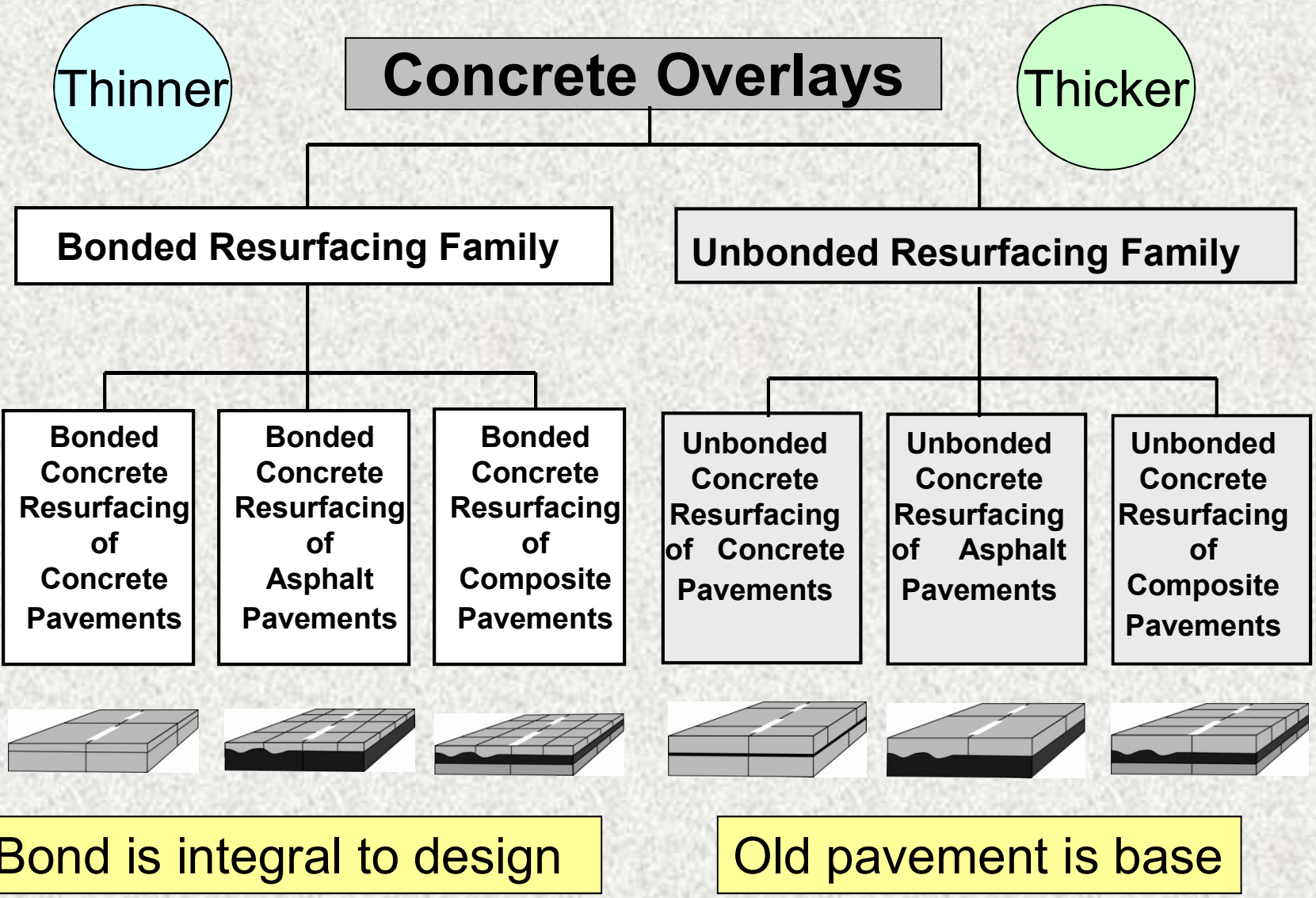
Design Considerations

- **Evaluate Causes of Distress along with Existing Pavement Materials, Subgrade, and Drainage**
- **Overlay Solution - Bonded vs Unbonded Design (thickness varies)**
- **Are Transverse Joint Dowel Bars and/or Longitudinal Joint Tie Bars Required?**
- **Choosing Limits of Work – functional/distress area plus? steep grades?**
- **Determine Saw Cut Joint Pattern for Geometry**

Design Considerations

- Concrete Curing Time to achieve Opening Strength
- Understand Traffic Patterns for Timing/Sequencing of Placements
- Limited or NO Options for Detours
- Limited Road Width and Congestion – MOT
- Coordination with Local Agencies/First Responders/Businesses/Homes

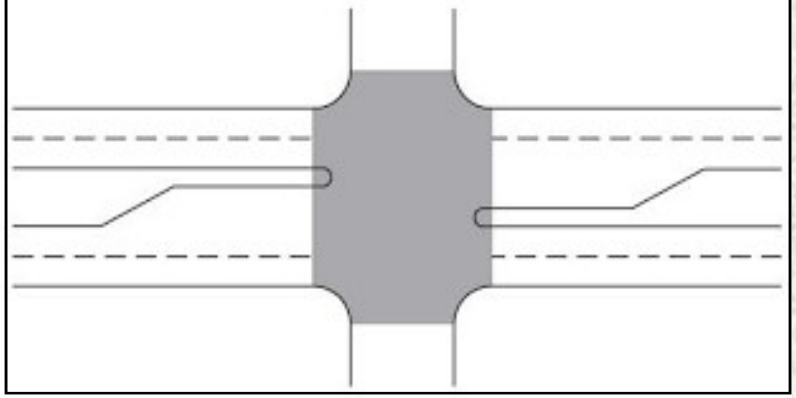
Family of Concrete Overlays



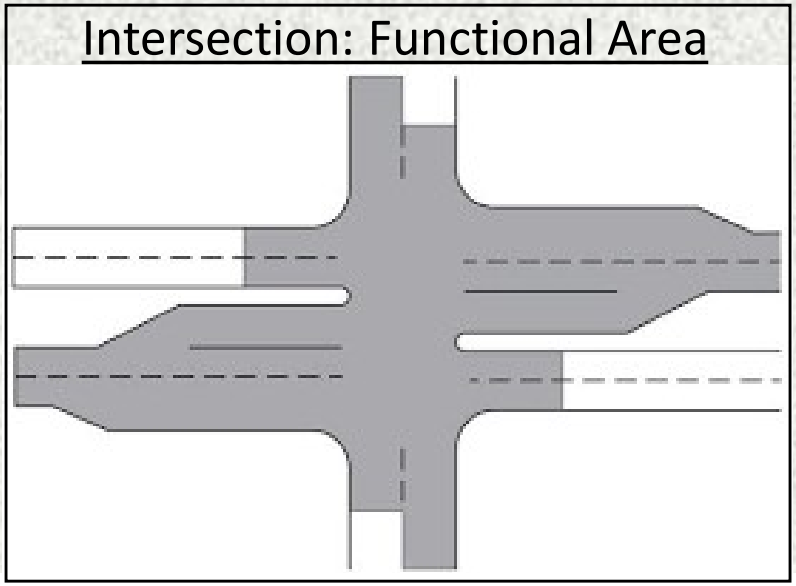
Concrete Paving

- Existing asphalt serves as compacted base for concrete pavement (bonded or unbonded overlay)
- SHA has an approved "whitetopping" mix designation

Intersection: Physical Area

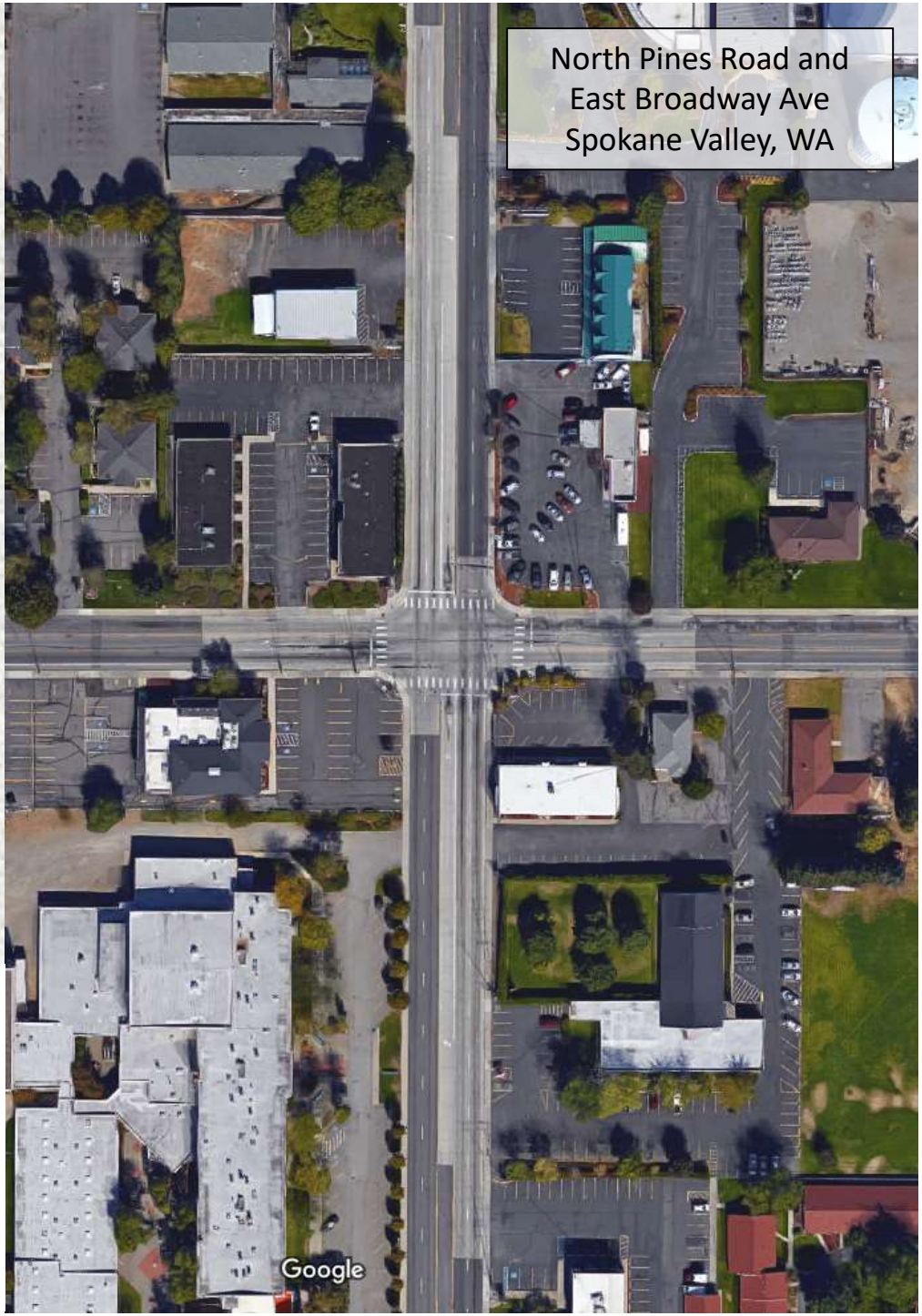


Intersection: Functional Area



Note 1: Physical area carries the combined traffic from both roadways. Therefore, thickness design must account for both.

Note 2: Functional area must account for stopping distances and turning/accelerating movements.



Concrete Paving

❖Specifications (Public)

- Maryland DOT Policy Manual – SHA
  - Section 520 Plain and Reinforced Portland Cement Concrete Pavements
  - Section 521 Continuously Reinforced Portland Cement Concrete Pavement
  - Section 522 Portland Cement Concrete Pavement Repairs
  - Section 523 Joint Sealing of Portland Cement Concrete Pavements
  - Section 525 Portland Cement Concrete Spall Repair
  - **Section 528 Resurfacing Asphalt Pavements Using Portland Cement Concrete**
  - Section 902 Portland Cement Concrete and Related Products
  - Sections 908 (reinforcing steel), 911 (joint materials), 915.03(concrete plants), 917.02 (epoxy coating)
  - Special Provisions - Permeable Pavement System, FDR, RCC

❖Specifications (Private)

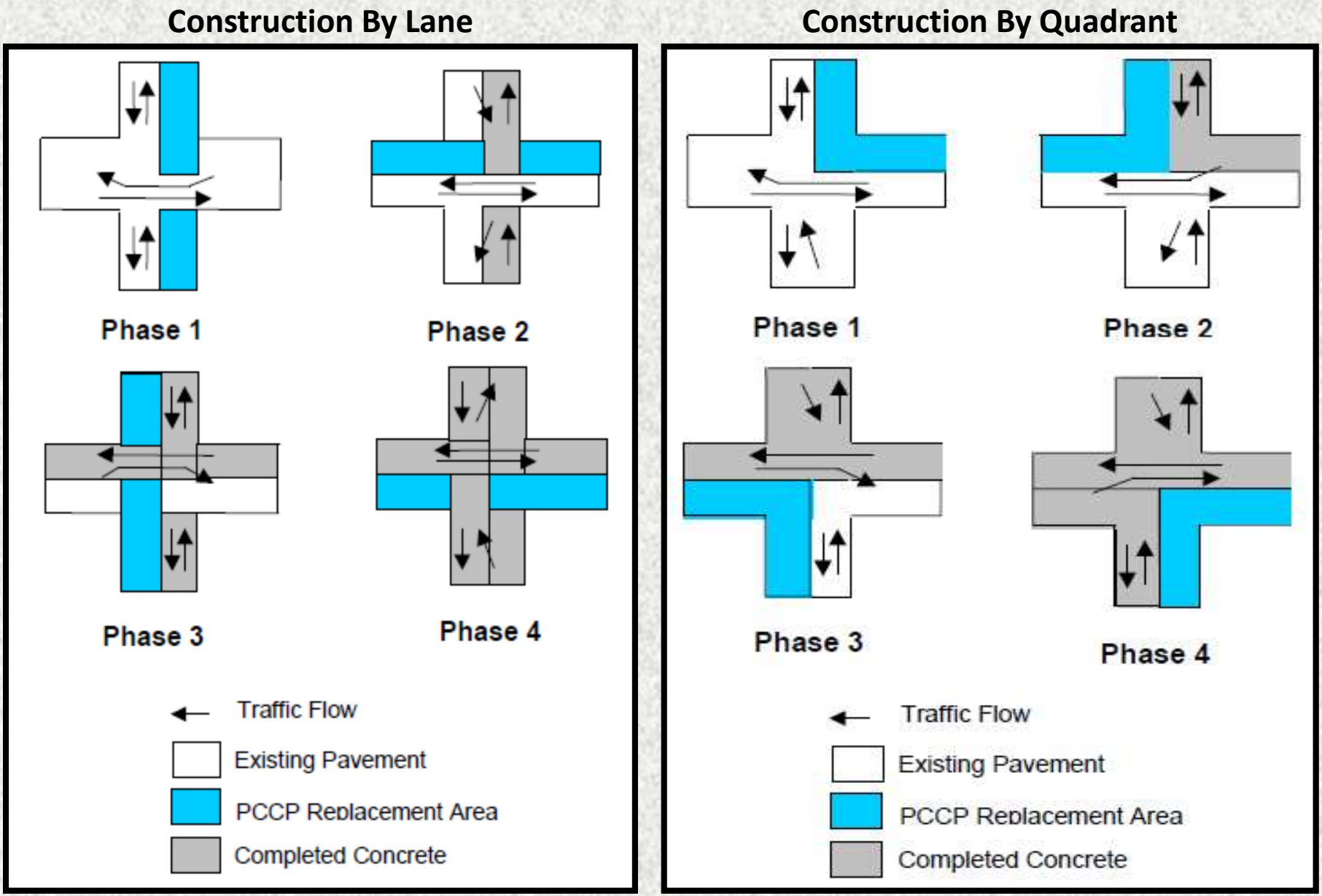
- Typically Section 3300 referencing ACI, PCA methods, procedures, and guidelines with specific comments

Concrete Paving
SHA Table 902 A

PORTLAND CEMENT CONCRETE MIXTURES										
MIX NO.	SPECIFIED ACCEPTANCE COMPRESSIVE STRENGTH psi	COMPRESSIVE STRENGTH ACCEPTANCE TEST AGE days	STD. DEV. psi	CRITICAL VALUE psi	MIN CEMENT FACTOR lb/yd^3	COARSE AGGREGATE SIZE M 43 / M 195	MAX WATER/ CEMENT RATIO by wt	SLUMP RANGE in.	TOTAL AIR CONTENT %	CONCRETE TEMP. °F
1	2500	28	375	2430	455	57, 67	0.55	2 - 5	5 - 8	50 - 95
2	3000	28	450	3010	530	57, 67	0.50	2 - 5	5 - 8	50 - 95
3	3500	28	525	3600	580	57, 67	0.50	2 - 5	5 - 8	50 - 95
4	3500	28	525	3600	615	57, 67	0.55	4 - 8	N/A	50 - 95
5	3500	28	525	3600	580	7	0.50	2 - 5	5 - 8	50 - 95
6	4500	28	675	4770	615	57, 67	0.45	2 - 5	5 - 8	50 - 80
7	4200	28	630	4420	580	57	0.50	1½ - 3	5 - 8	50 - 95
8	4000	28	600	4180	750	7	0.42	2 - 5	5 - 8	50 - 80
9	3000	(a)	N/A	N/A	800	57, 67	0.45	4 - 8	5 - 8	60 - 100
10	4500	28	675	4770	700	¾" – No. 4	0.45	2 - 5	6 - 9	50 - 80
11	4200	28	630	4420	—	57, 67	0.45	2 - 5	5 - 8	50 - 80
12	4200	28	630	4420	—	¾" – No. 4	0.45	2 - 5	6 - 9	50 - 80
HE	3000	(b)	N/A	N/A	N/A	N/A	N/A	3 - 9	5 - 8	60 - 100
PC (c)	N/A	N/A	N/A	N/A	450	7, 8	0.45	N/A	15 - 25	N/A
WT	2500	(d)	NA	NA	650	57	0.45	5 max	5 - 8	50 - 95

Refer to Explanation Notes for SHA Table 902 A

Staging: Intersection Under Traffic



Source: ACPA

Project Solutions

- **Design/Construction/Traffic Team**
  - Planning for Successful Project!!
  - Each location has different, unique issues
  - MOT options – involve contractor?
  - Dollars and Time
- **Be Creative, Use Innovative Ideas**
  - Think outside the Box!
- **Public Information Program - Stakeholders**
  - Unhappy/Aggravated Public using the road
  - Business/residential needs may supercede project engineering/construction needs

Innovative?

Construction Issues

- Safety for Traveling Public and Work Crews
- Tight Schedule – Weather for Concrete Operations
- Changing Traffic Patterns for Phases – Continuous PR
- Limited Road Width – MOT to reduce congestion
  2 Lanes needed – one work zone & one safety zone
- Surface Preparation, Forms, Concrete Placement
- Restore Utilities and Vehicle Detection Loops
- Concrete Curing Time to achieve Opening Strength
- Timing of Saw Cut Joints

Concrete Paving

Maintenance of Traffic

- Options
  - Complete closures with detours
  - Partial closures with detours
  - Construction under traffic
  - Complete closures during limited time periods
  - Combinations of the above
- Early and Often PR Program for public information and acceptance of MOT option
  - **Change the Mindset of Public Perception**

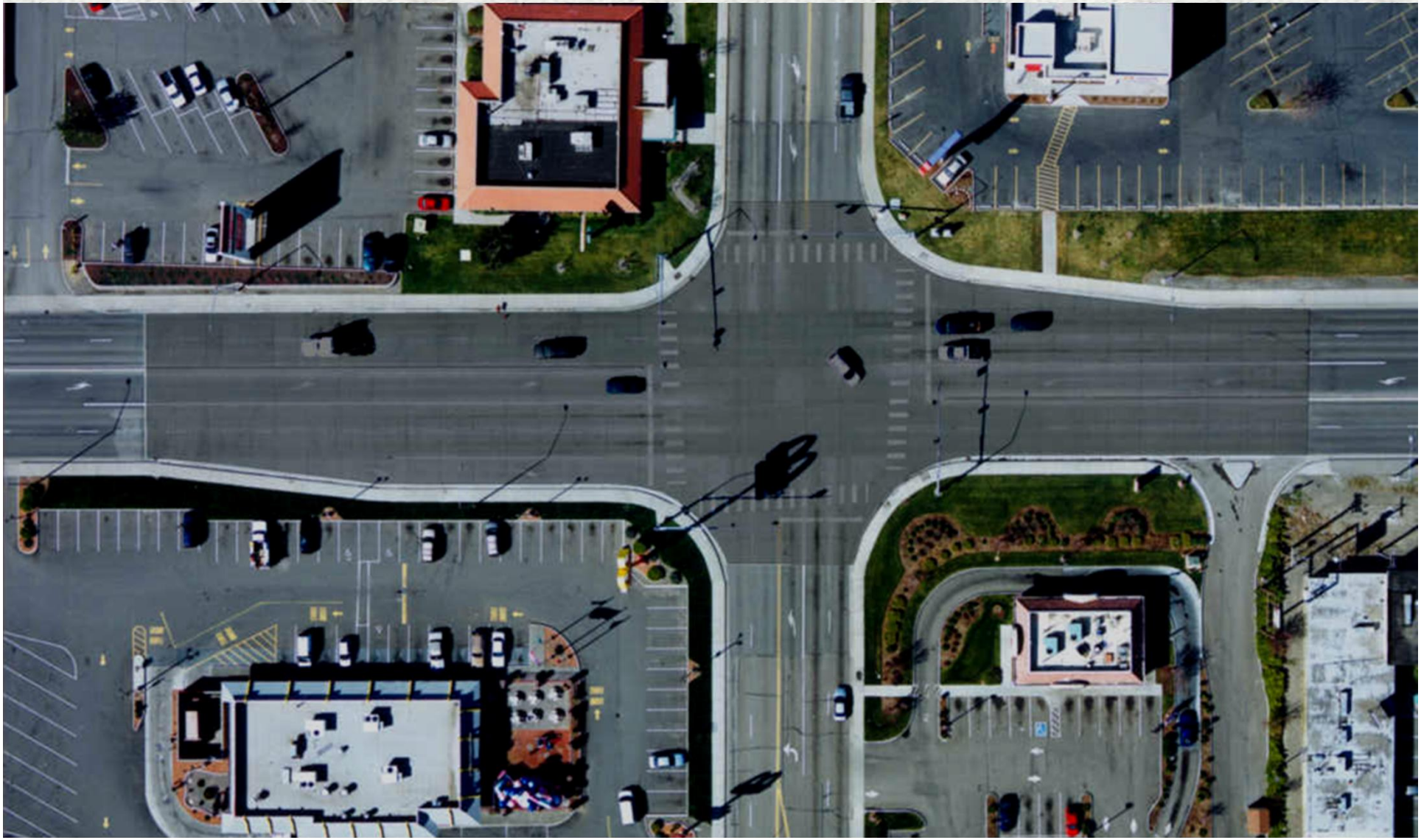
Existing Roadway before Milling with Traffic Control

Concrete Paving

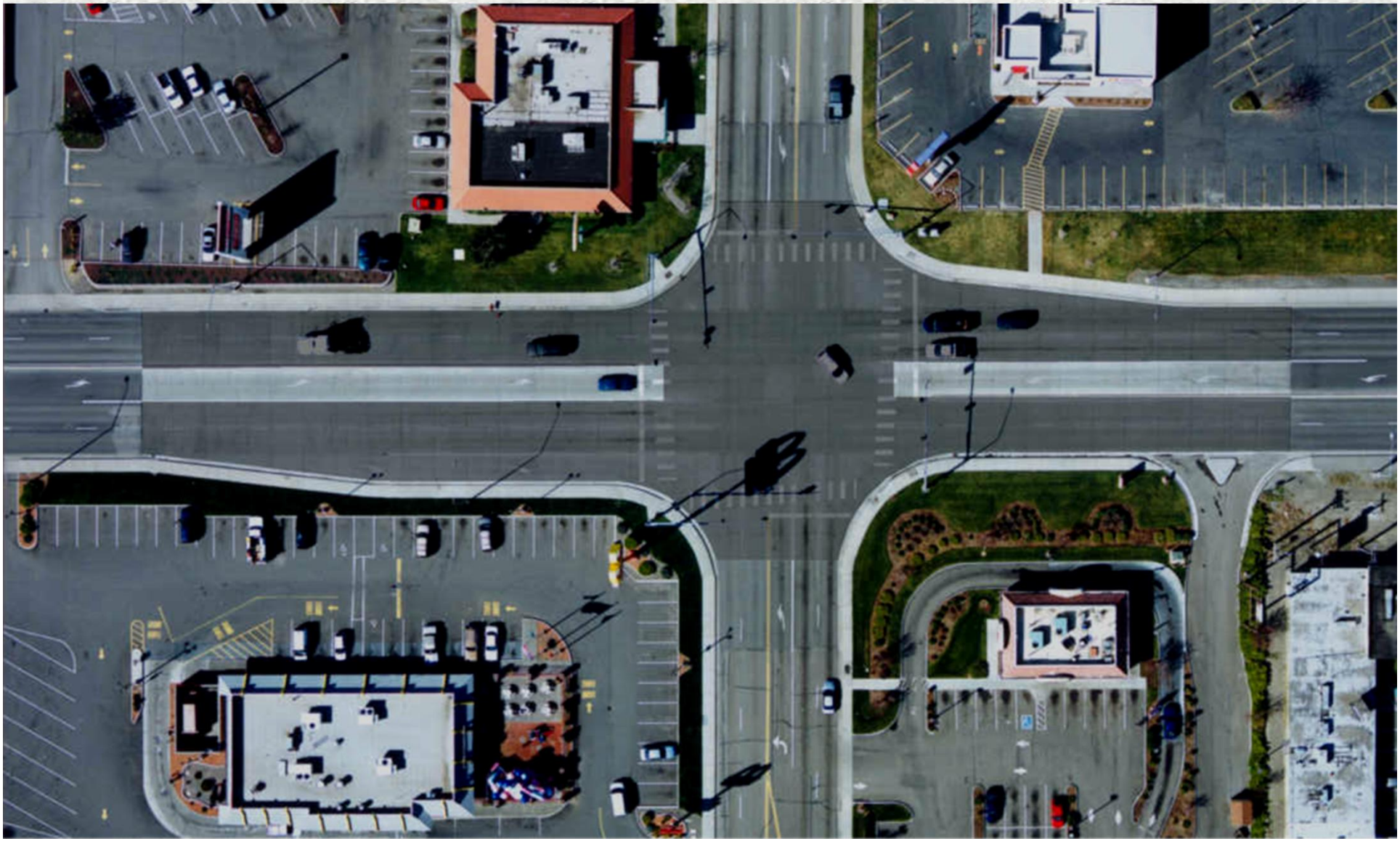
Traffic Control – Lessons Learned

- Can **manage** traffic throughout the project
  - ***Continuous Public Relations notifications – sign boards, social media, TV, radio, papers***
- Closed to thru traffic with local access only - BEST
  - One way through work zone
  - Contractor must aggressively **manage** traffic
    - Flaggers, cones, barrels, stop lights, pilot vehicle
  - Need adequate signage & early warning
  - Combinations of the above

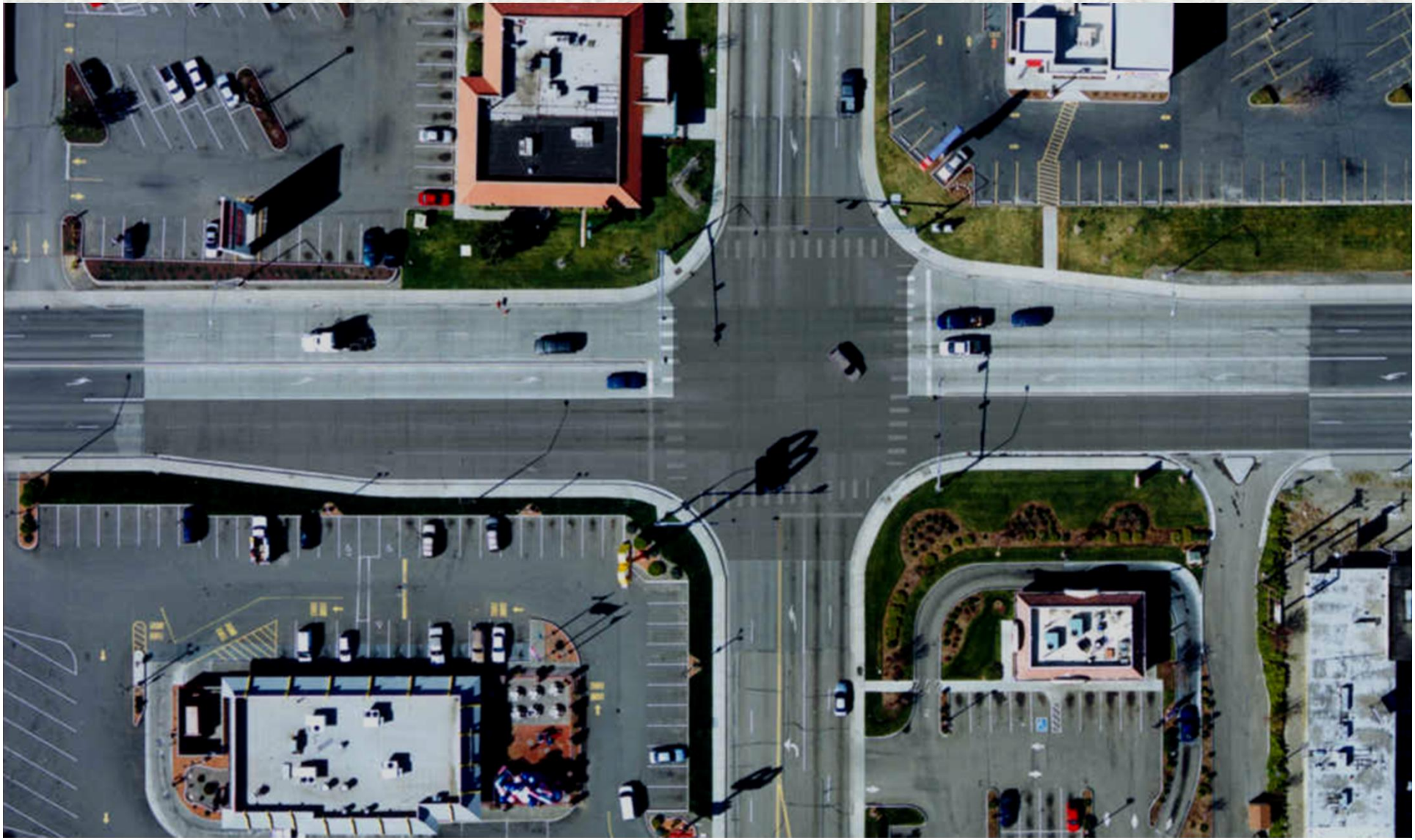
Concrete Intersections – Staging (Start)



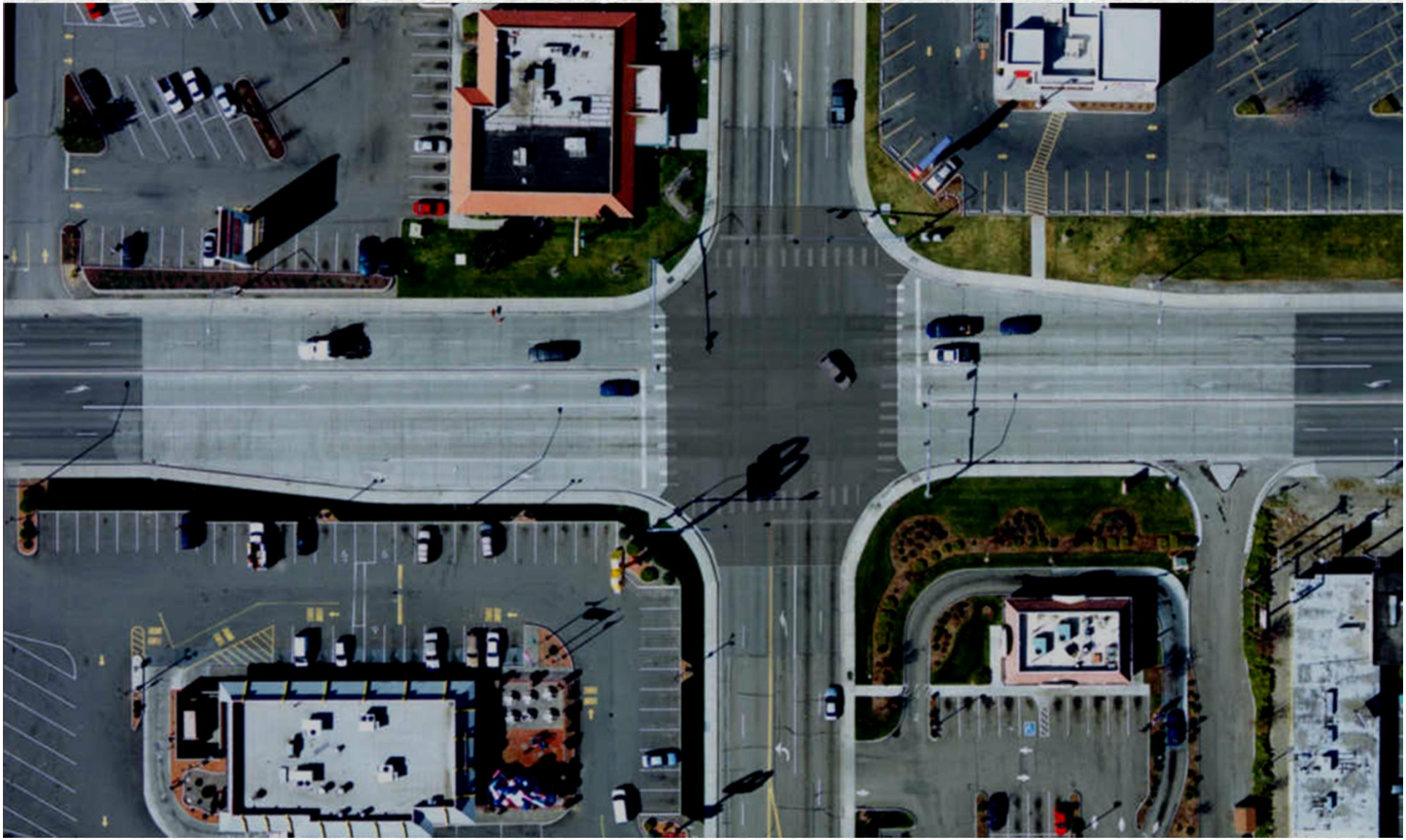
Concrete Intersections – Staging (Stage 1 Under Traffic)



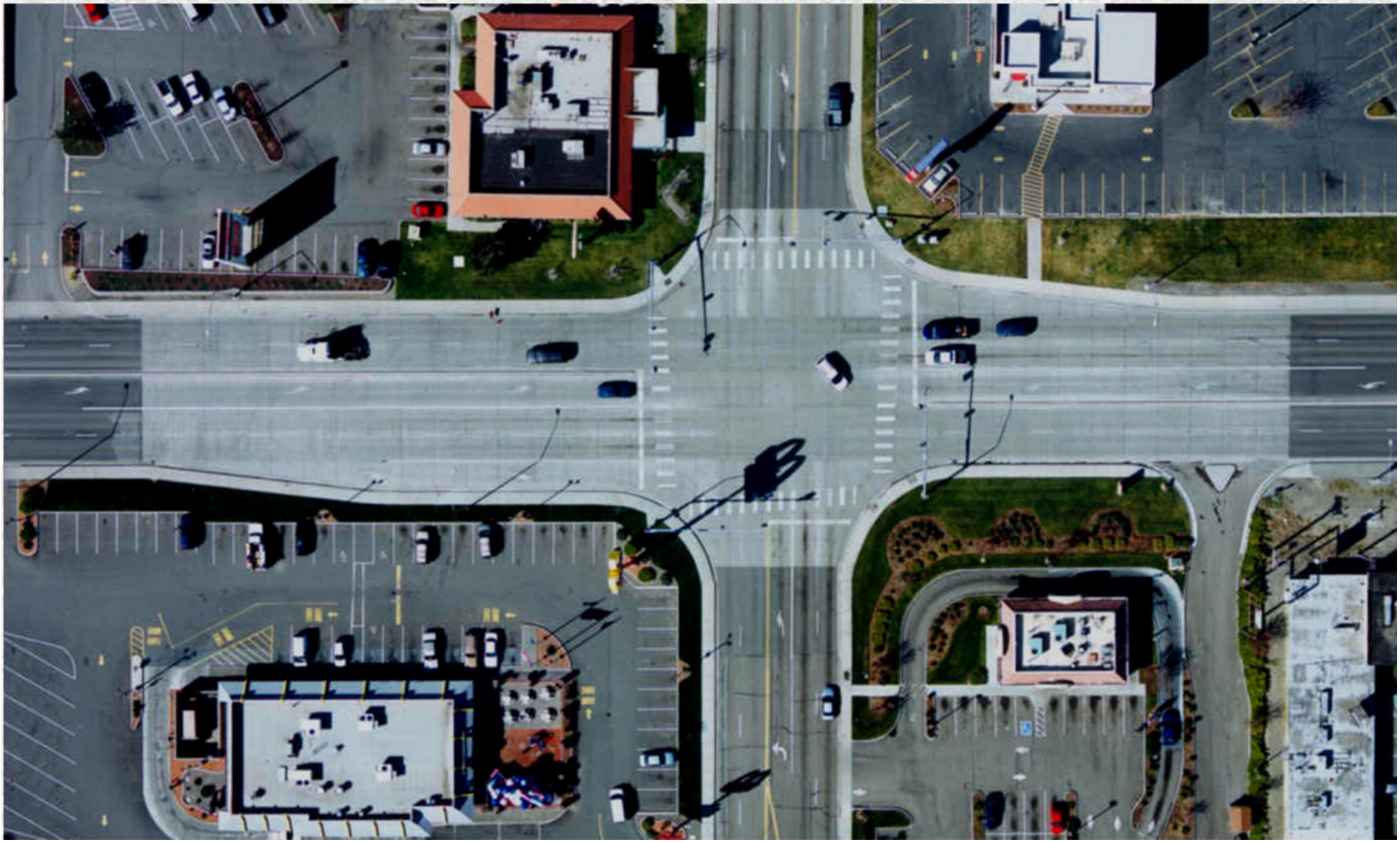
Concrete Intersections – Staging (Stage 2 Under Traffic)



Concrete Intersections – Staging (Stage 3 Under Traffic)



Concrete Intersections – Staging (Stage 4 Under Closure Over Weekend)



Weekend Closure Solution

- **Friday evening to Saturday evening**
  - 9:00 pm to 10:00 pm – Install Traffic Controls
  - 10:00 pm to 3:00 am – Remove existing pavement
  - 3:00 am to 9:00 am – Grade, repairs, prep base
  - 9:00 am to 5:00 pm – Form and place concrete
  - 1:00 pm – Start joint sawing
  - 9:00 pm– Clean concrete surface
  - 10:00 pm - Apply curing to concrete
- **Sunday Evening**
  - 10:00 pm– Restart work after 24 hour cure
  - 10:00 pm to 12:00 am – Complete asphalt tie-in
  - 12:00 am to 1:00 am – Clean roadway
  - 1:00 am to 3:00 pm – Prep roadway and stripe
  - 3:00 am to 4:00 am – Remove Traffic Controls
  - 4:00 am - Open to traffic

Design opening strength = 2500 psi. Concrete mix *WT* (whitetopping) from SHA Table 902A provides for minimum compressive strength of 2500 psi in 24 hours!

Concrete Pavement Websites

PavementDesigner.org

www.nrmca.org
Design Assistance Program (DAP)
PaveAhead.org
PerviousPave software

www.cptechcenter.org/
Free Downloads (**Overlay** and FDR Guides)

www.rmc-foundation.org
Research Information Guides
MIT Research Findings

www.rollercompacted.org
www.RCCPavementCouncil.org

www.acpa.org
StreetPave software
AirPave software
WinPas software

www.marylandconcrete.com
Contractor Referrals
Certification Programs
Concrete Parking in Practice
Maryland Projects

www.concreteparking.org

Questions?

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acpapave@gmail.com

Concrete Pavement

Urban Street Reconstruction

Broening Highway Baltimore City

MOT Challenges

- **Options - Overlay Intersection/Highway (3 lanes wide)**
  1. **Total Closure of Road during Weekends**
     - **Detour was not practical**
  2. **Double Lane Closure and Maintain only One Lane on Road during weekends**
     - **Longer Construction Duration**
     - **Maybe Excessive Queues**
     - **Weekend Weather Constraints**
  3. **Double Lane Closure counting Outside Shoulder as lane for 7 days/week**
     - **Shorter Construction Duration than Option 2**
     - **Less Queue than Option 2**

MOT Solution

MOT Option 3 was selected

- **Less Queue**
- **Shorter Construction Duration**
- **Phase 1 – Slow Lane and Outside Shoulder to be Closed. Maintain Traffic on the Existing Middle and Fast Lane**
- **Phase 2 – Fast Lane and Middle Lane to be Closed. Maintain Traffic on the already Constructed Slow Lane and Outside Shoulder**

Other Issues

- **Concrete Construction Barrier**
- **Getting Saw Cut Joints close to the Final Lane Markings**
- **Heavy PR campaign from Agency**

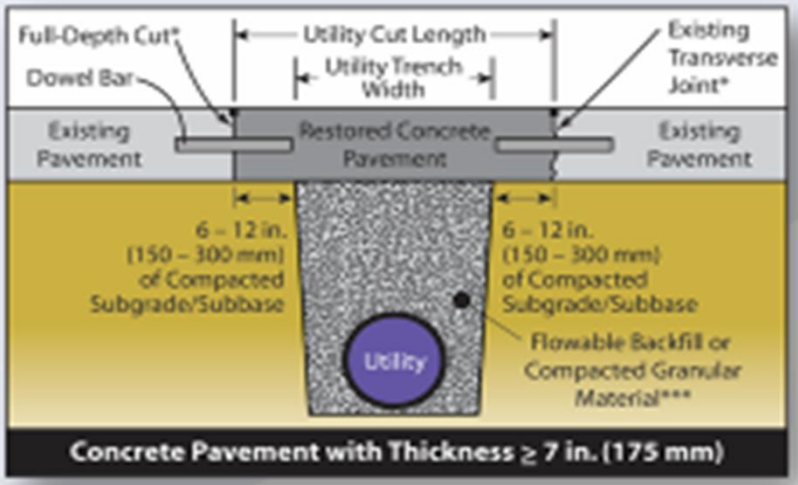
Concrete Paving for Overlays

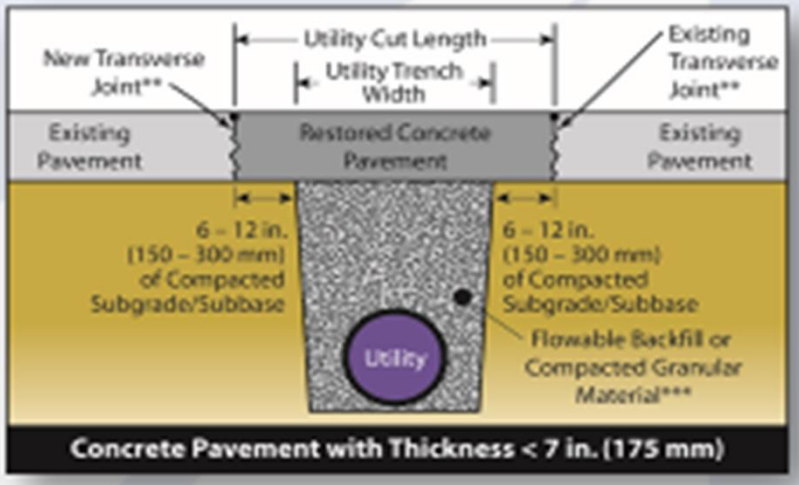
Solution: Concrete Overlays (aka “whitetopping”)

- Suitable over concrete or asphalt pavements
  - Bonded or Unbonded
- Economical solution with long lasting durable surface
- All the typical benefits of concrete pavement
- Concrete overlays have a proven track record with millions of SQ YDs across the U.S.

Concrete Pavement

Common Utility Cut Details





* A full-depth cut should be made at any utility cut boundary that is not an existing joint for thicknesses of 7 in. (175 mm) and greater.

** For pavements thinner than 7 in. (175 mm), utility cut boundaries that are not at an existing joint should be cut to a depth of about one third of the slab thickness and the remainder of the depth removed with a jackhammer.

*** Some agencies have had success with up to a 2 ft (0.6 m) layer of natural soil above the backfill but below the restored concrete pavement surface course.

Concrete Pavement

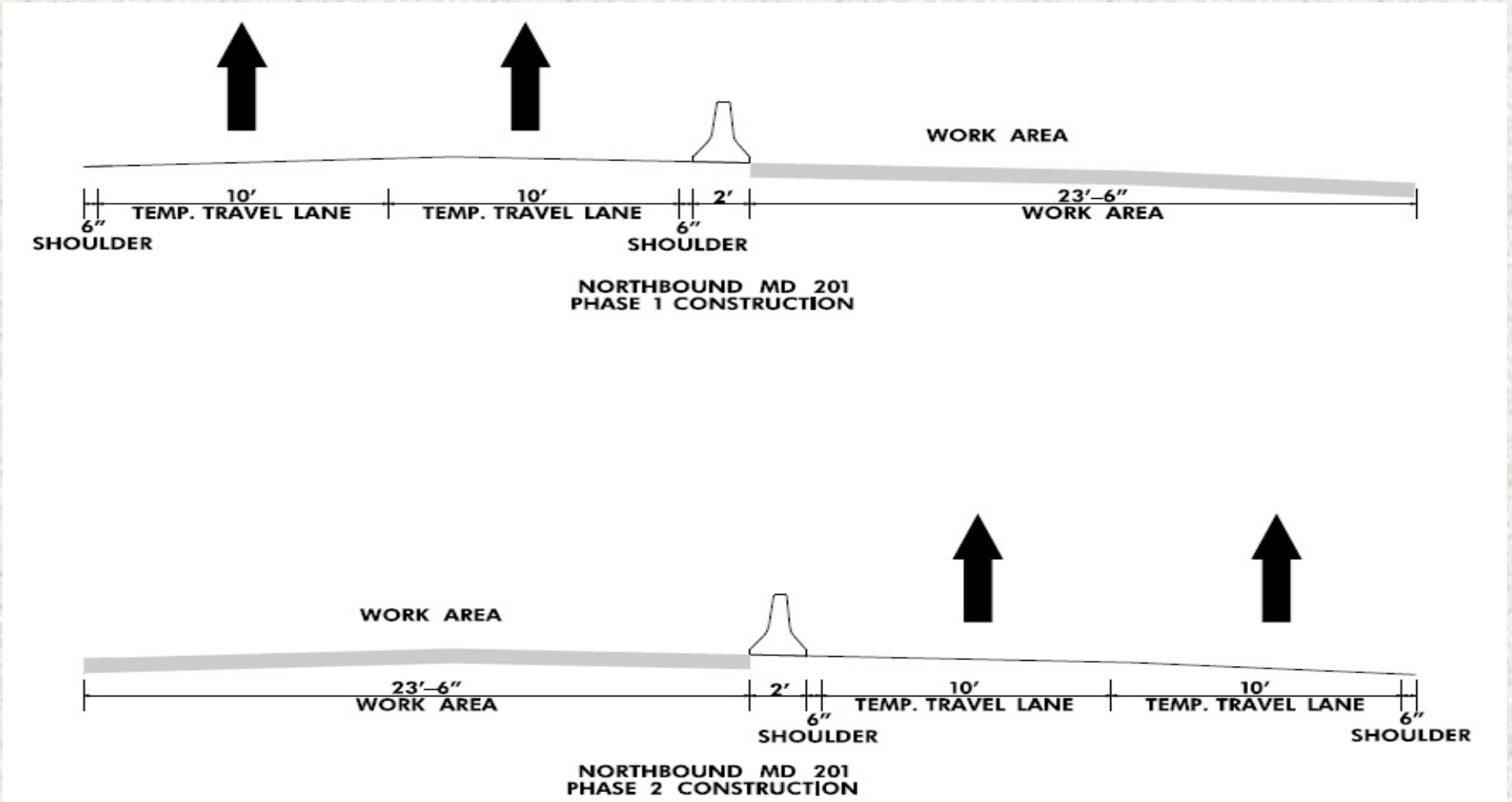
Early Saw Cutting

Joint Action

M-5 and Pontiac Trail - Michigan

MOT Challenges

Typical for MOT Phase 1 and 2



Milled Roadway – Section on Localized Shoulder

Existing Roadway before Milling

Concrete Intersections – Considerations

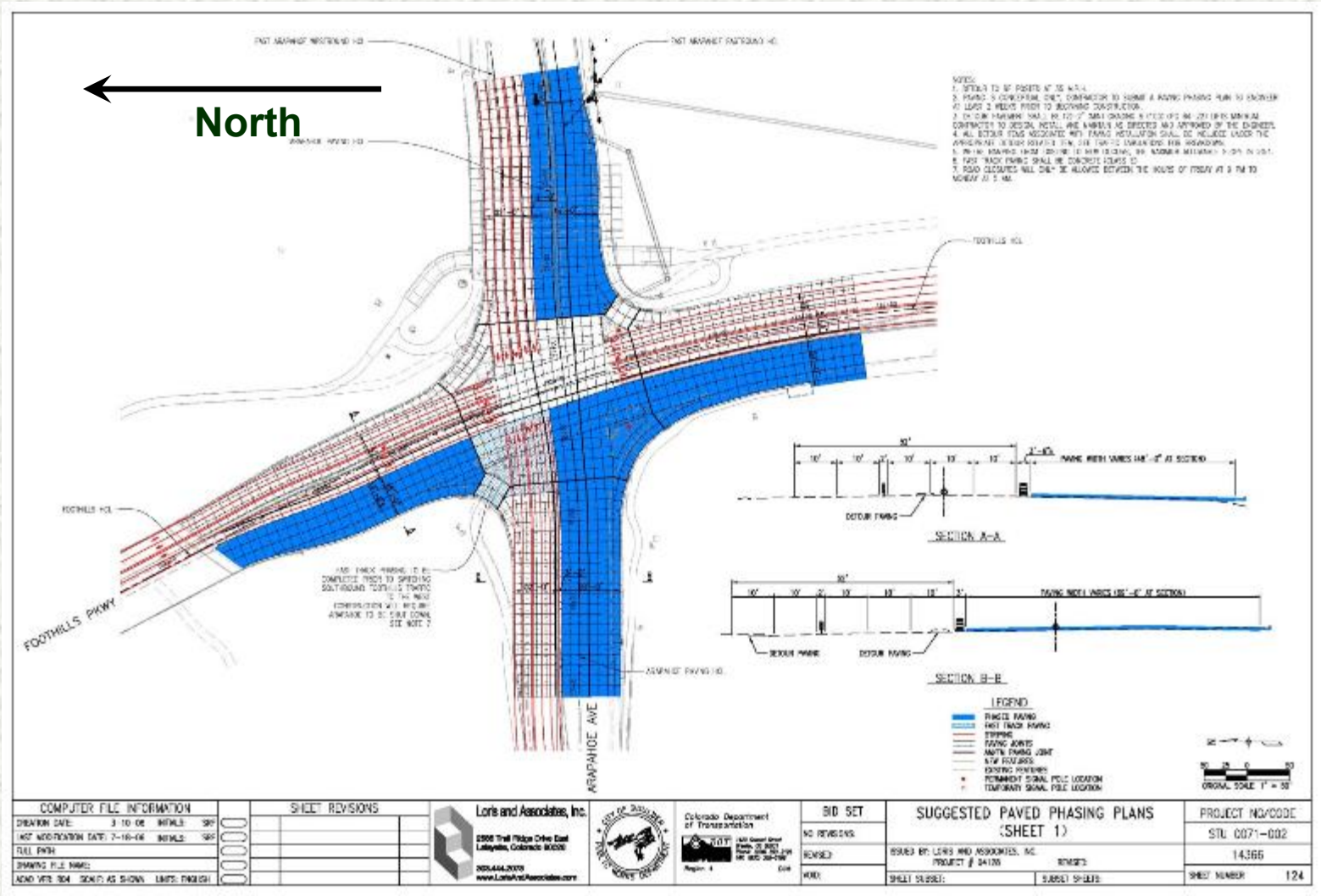
- Typically Eliminates Rutting/Shoving/Cracking Concerns
- Complete reconstruction or overlay?
- Concrete intersection construction limits
  - Stopping Distance
  - Average Queue Length
  - Limits of Pavement Distress
  - Turning Radius Minimums
- Thickness Design (base and subgrade requirements)
- Jointing detail
- Pavement profiles
- Concrete materials (high early strength for fast-track paving?)
- Concrete to asphalt transitions
- Traffic detection systems
- Coordination with local agencies/first responders

Bend Oregon Roundabout

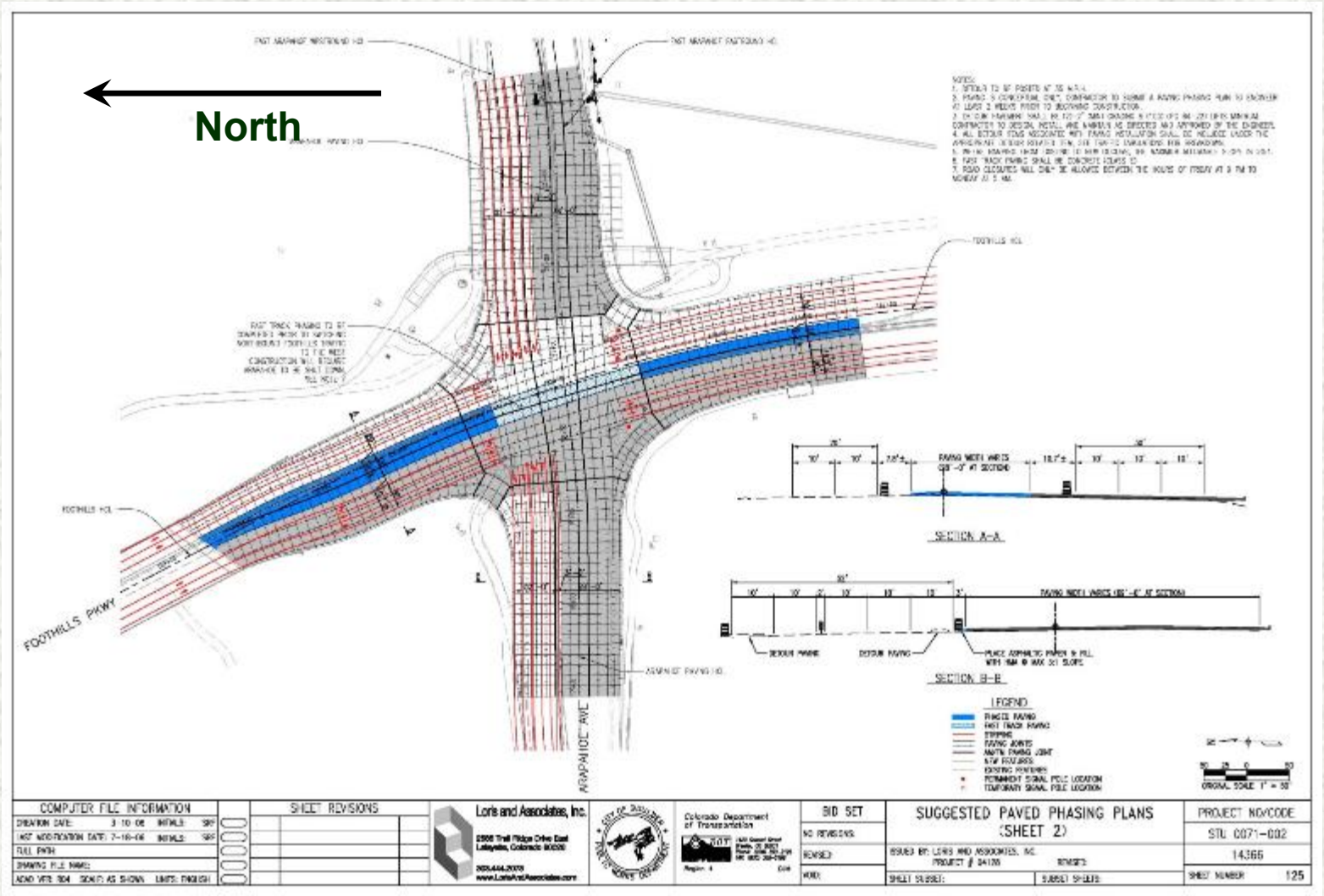
Concrete Paving for Overlays

I-68 Truck
Climbing Lane
Western MD

Phase 1 Whitetopping



Phase 2 Whitetopping



Phase 3 Whitetopping