Introduction to Multi-Lane Roundabout Design

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INTRODUCTION

- Many More Issues To Consider In Multi-Lane Roundabout Design vs. Single Lane Design
- Too Many To Discuss In 25 Minutes
- Best Place To Start Is In the Understanding Two Critical Safety Issues With MLR: (1) Deflection & (2) Vehicle Path Overlap
- Some Other Major Cap / Safety Issues Are:
  - Entry & Exit Geometry
  - Fast Path Design / Radii
  - Entry, Circulating, Exit Speeds
  - MLR Striping Design (Spiral, Arrows, Hatching)
  - Multi-Lane Signing
  - Simultaneous Truck Movements
  - Vertical MLR Design, Visibility, Ped Crossings...

Safety Issue 1: Deflection

- With Proper Entry Path Curvature = Deflection
- Good Entry Path Curvature:
  - Provides Self-Enforced Speed Reduction
  - Controls Traffic Speed by Slowing Veh at Entry
  - Creates Speed Consistency
  - Reduces Entry Circulating Crashes...
  - Safer For All Users (Veh, Peds, Cycle)
- ***Entry Path Curvature Must Be Applied PRIOR to Yield Line!***

Safety Issue: Deflection

- Improper Deflection Causes Accidents, Speed Problems, Fear, Discomfort, Rejection…
- Too Much Deflection Result in Approach Accidents
- Very Slow Circulating Speeds Cause Accidents!
- Do Not Over-Deflect the Entry (Not Too Slow) – All Benefits Achieved at About 25 MPH
- Too Little Deflection Causes:
  - Entry/Circulating Crashes & Single Veh Acc.
  - Circulating Traffic Yielding To Approaching Vehicles
  - A Fast Approach Dominating Roundabout
  - Reduced Capacity
  - Unsafe Speeds
  - Loss of Control…

Good Entry Path Curvature

Entry Curvature =
Slow Entry
(R1 & R2)

Courtesy:Mark Johnson

Entry Curvature =
Tangential Entry

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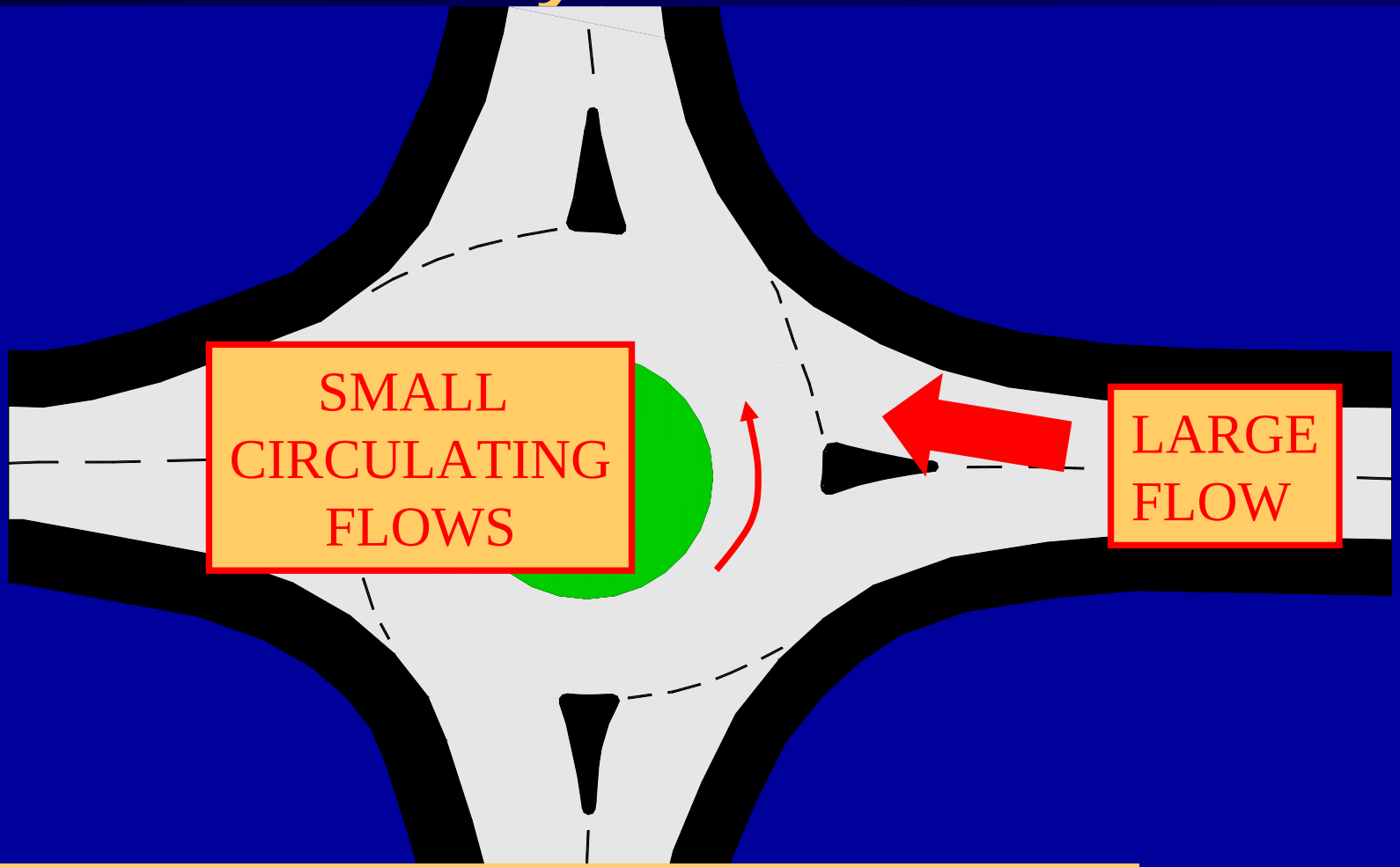
Okemos, MI

Courtesy: Ed Waddell

Effect of Entry Path Curvature

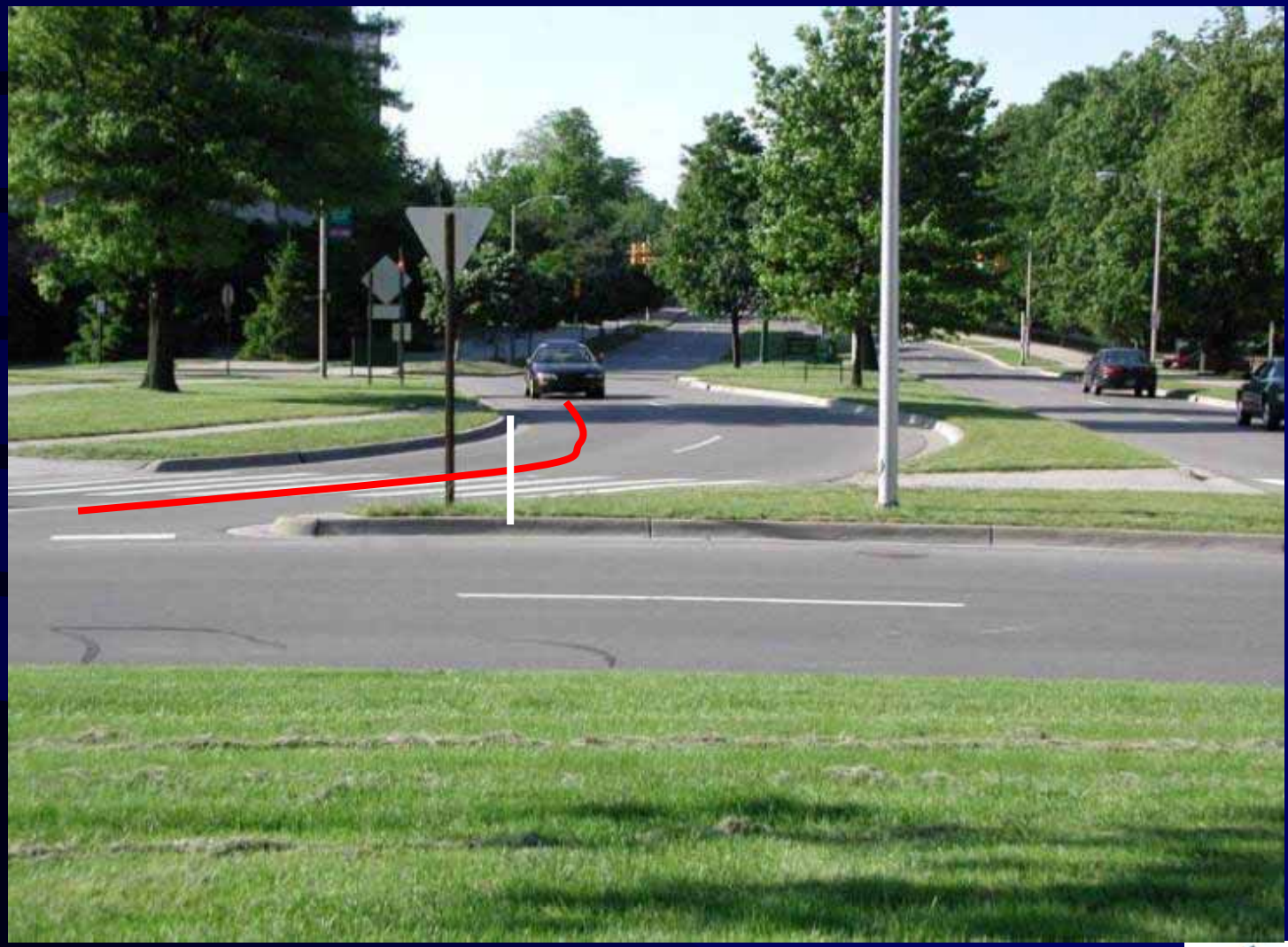


GENTLER ENTRY PATH
CURVE OPTIMUM ?

Good EPC = Deflection

Milton Keynes, U.K.

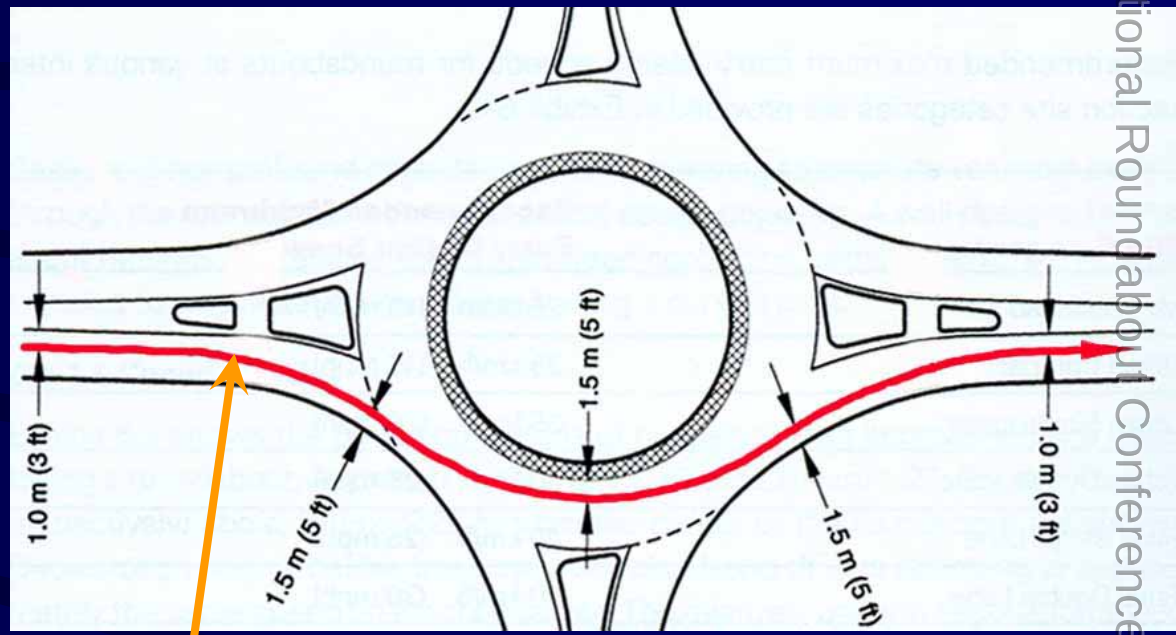
Too Much Deflection



Applying Proper Deflection

- Reduces Entry / Circulating Accidents
- Can Increase Approach Accidents
- Can Increase Single Vehicle Accidents
- Not Too Much or Too Little = Balance

- Accident Change Is Net Effect
  - Depends on Traffic Flows



EPC R1 < 328' (100m)

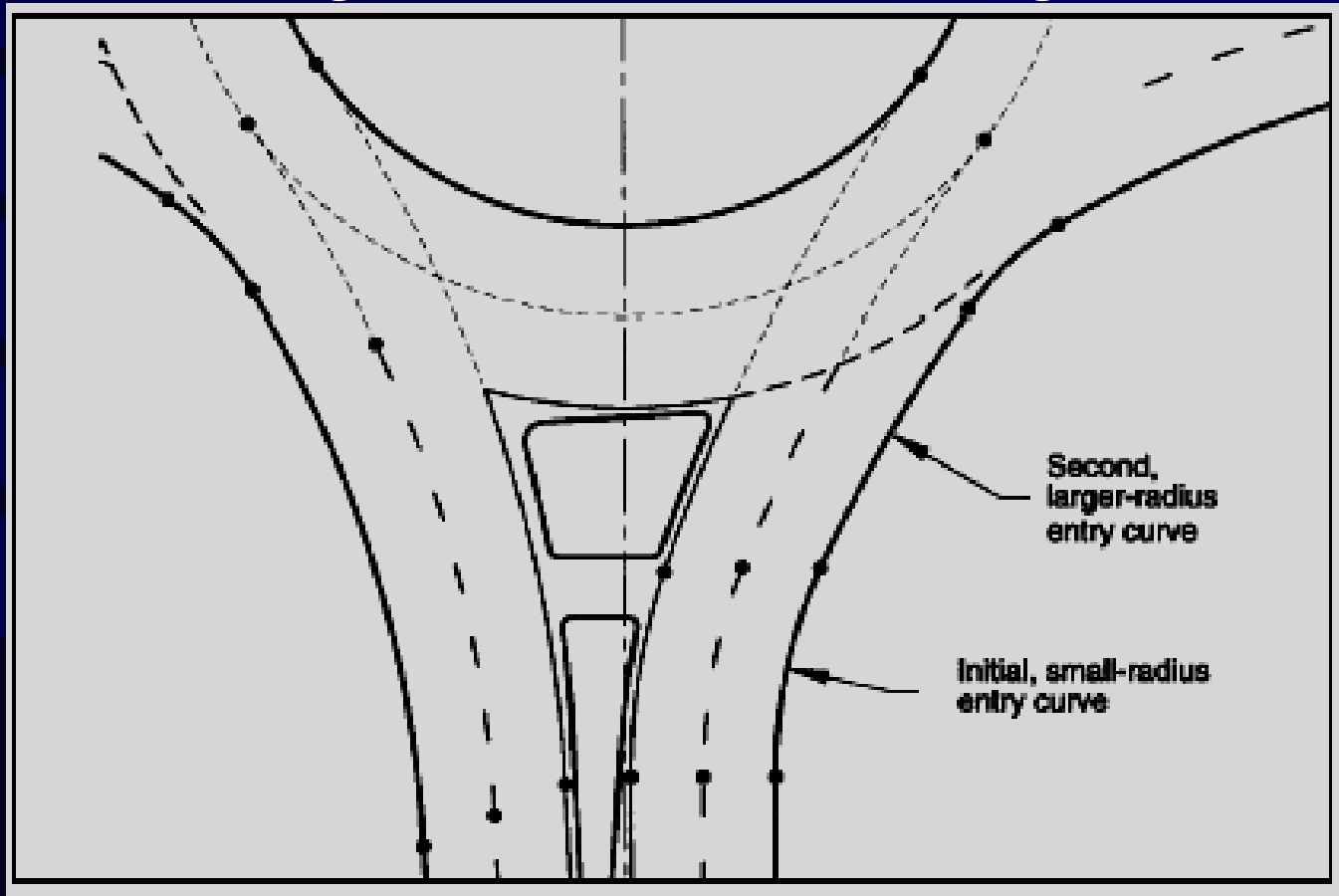
For Multi-lane Entries

Entry Path Radius on Multi-lane

- Achieving Proper Deflection With EPR & Without Entry Path Overlap Can Be Difficult
  - Large Interaction Between Geometric Parameters
- SLR Experience Little Help - Different Ball Game
  - SLR Do Not Have MLR Design Issues
  - 2 Laners Difficult → 3 Laners More Difficult
  - Solving One Problem Tends To Create Another
- Subtle Changes = Balance = Trade-off

Multi-lane Entry Geometry

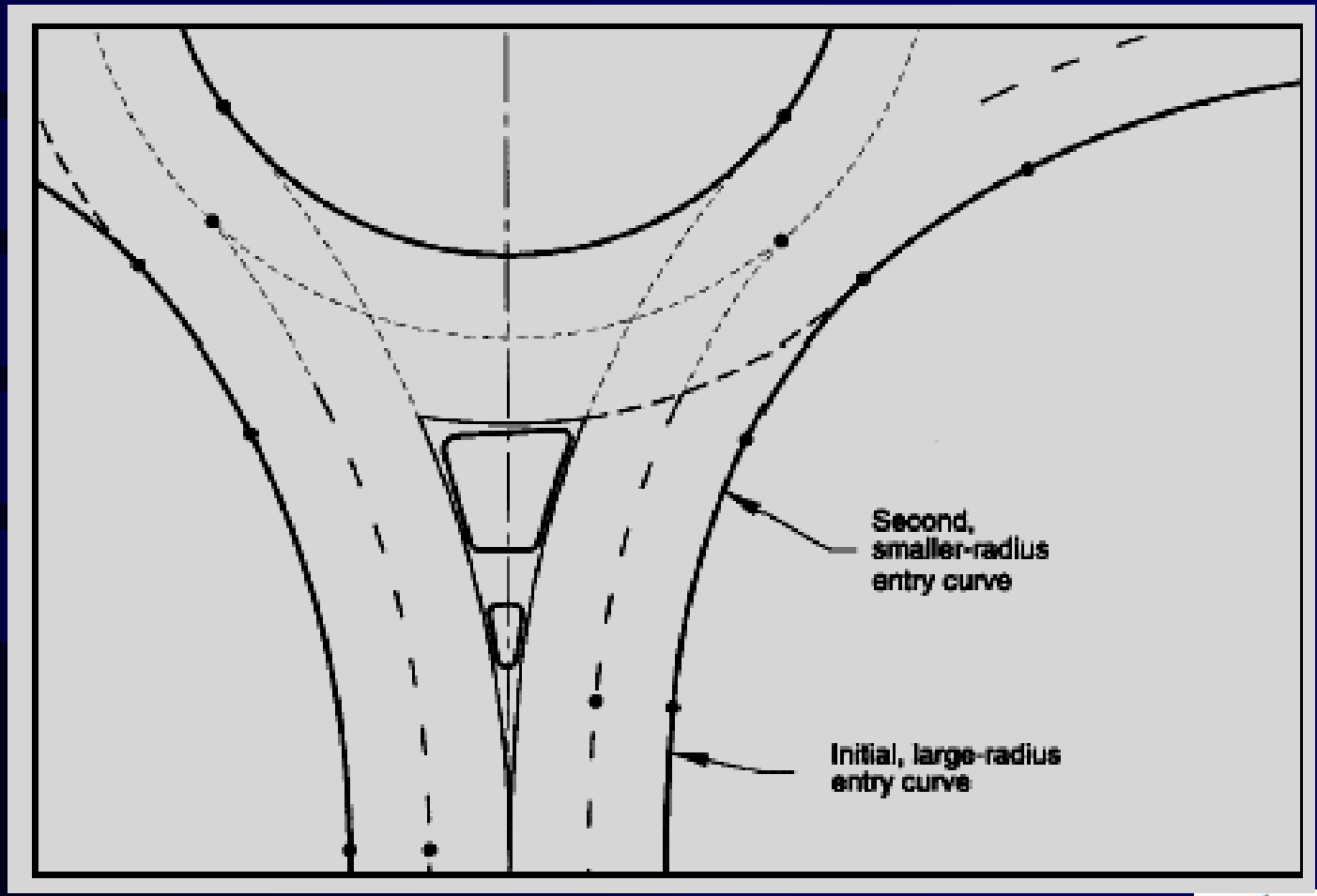
Contrasting Methods of Attaining Deflection

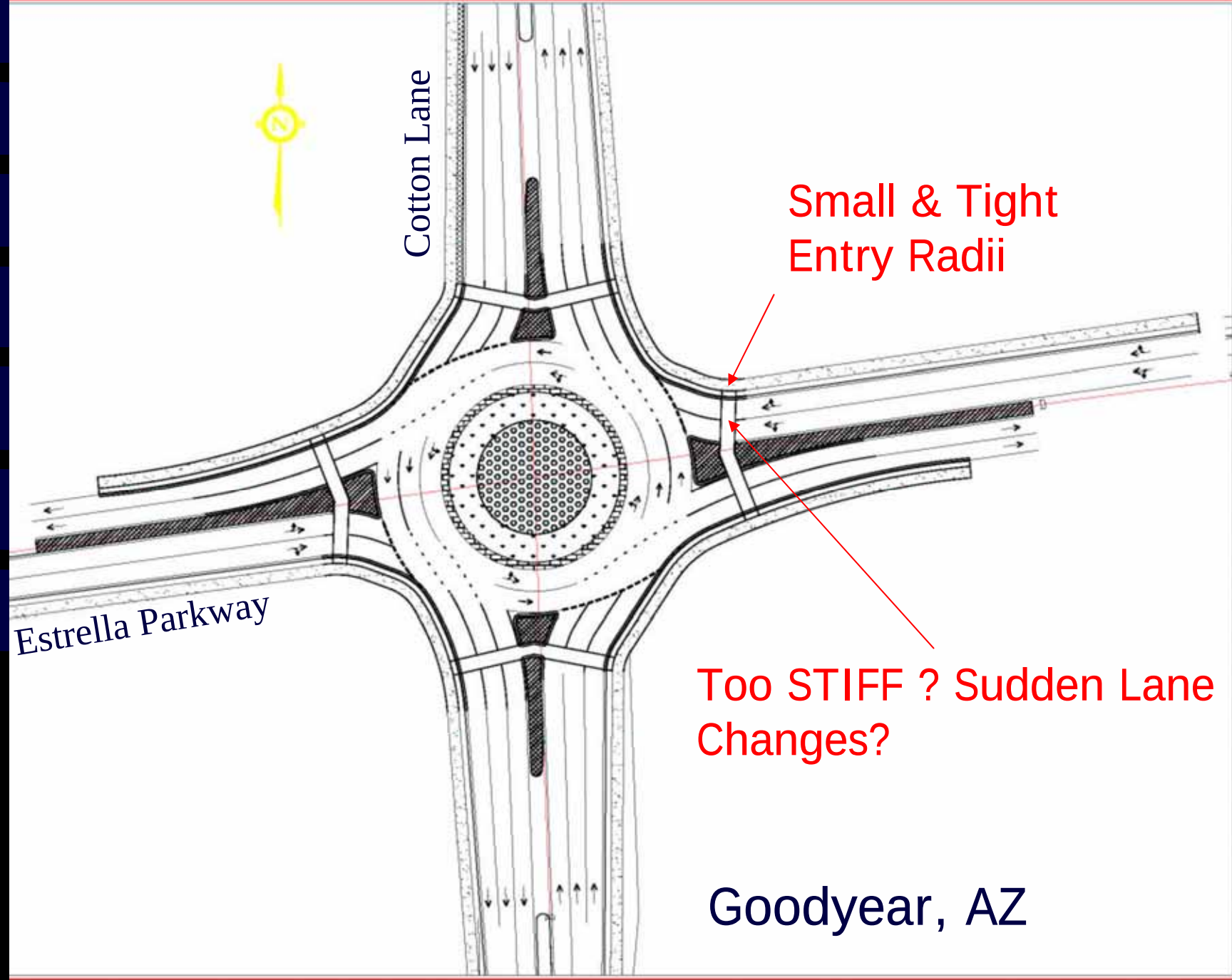


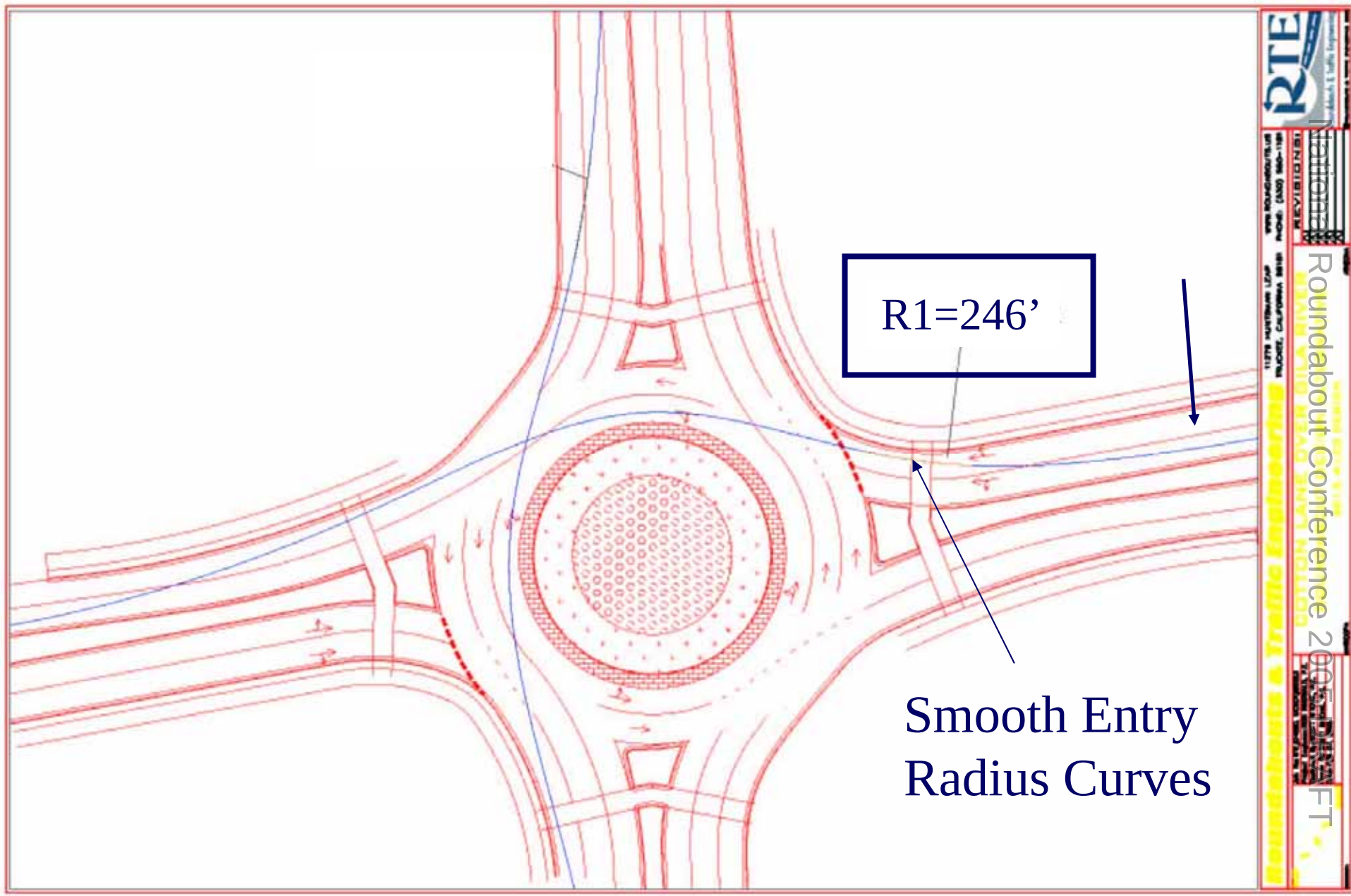
What about the length of arc?

Multi-lane Entry Geometry

Contrasting Methods of Attaining Deflection






R1=246’
Smooth Entry
Radius Curves

Iterative Design

- Adjusting One Geometric Parameter Affects Another
  - Lots of SMALL Changes Rather Than One LARGE Adjustment
  - HOLISTIC More Important
  - Get It Generally Correct Before Detail
  - Hand Sketch is VERY Beneficial: Get Roughly Right
  - CAD Afterwards
- Repeat Iteration Until Design is Polished & Refined
  - Use HOLISTIC Common Sense Checks

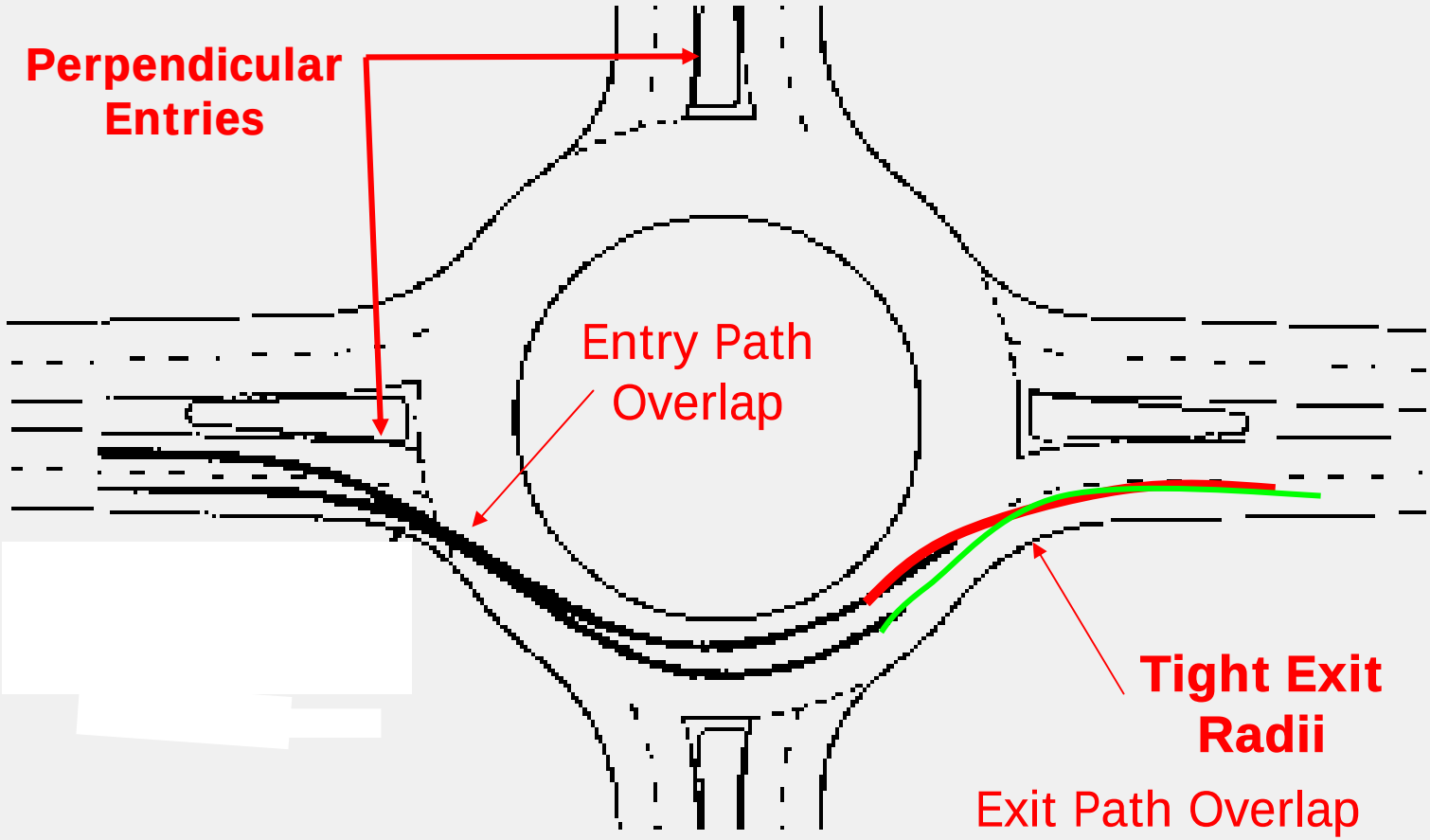
Safety Issue 2: Vehicle Path Overlap

- Large Entry Angle Causes ‘Vehicle Path Overlap’
- Small Entry Radius Causes ‘Vehicle Path Overlap’

- Large Exit Angle Causes ‘Vehicle Path Overlap’
- Small Exit Radius Causes ‘Vehicle Path Overlap’

- This Dramatically Reduces Capacity
- Causes Accidents at the Entry, Circulating, & Exit

Vehicle Path Overlap
Sudden Lane Change

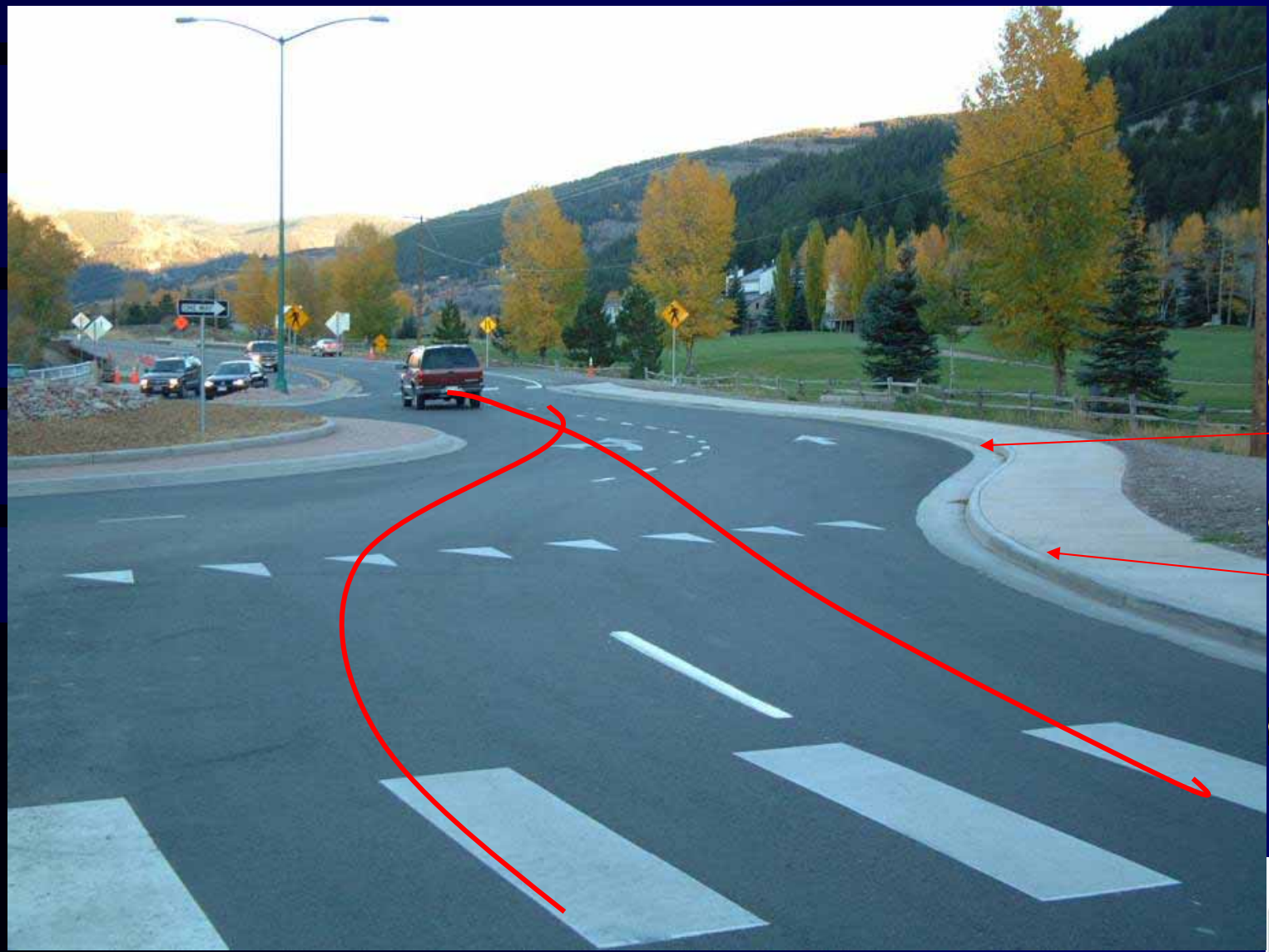


Any Problems Here?

Courtesty: Phil Demosthenes

US 6 / Post Rd - Avon, CO

Entry Deflection & Path Overlap



- Poor Deflection
- Entry Path Overlap
- Reverse Curvature
- Tight Entry Radii
- Striping…

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Any Problems Here?

- Poor Entry Deflection
- Entry Path Overlap
- Too Large or "Loose" Entry Radii
- Perpen-dicular Entry

Any Problems Here?

Reverse Curvature

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Safety Issue 2: Path Overlap

Possible Solutions:

- Increase Entry &/Or Exit Radii
- Modify Entry Angle
  - Compound Radii & Tangential Entry/Exit
- Slightly Move Roundabout
- Modify Splitter Island Design
- Modify Road Markings
  - Exit Striping
- Seeing the Problem or Safety Issue Is Key! Then Determine How to Fix It Without Creating Other Problems/Safety Issues...

CONCLUSION:

- Ensure Proper Deflection / Entry Path Curvature
- Remember: Balance is Needed
- Check Fast Path Design
- Check Speeds
- Check For Vehicle Path Overlap
- Check “Self Enforcing” Geometric Design
- Involve A Roundabout Specialist In Design & Get Design Assistance & Peer Reviews!
- Peer Review in Early Design Stages (30%)
- Peer Review Again In Final Stages

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