

The Nano-Interchange

An Innovation in Interchange Design

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JP Moon

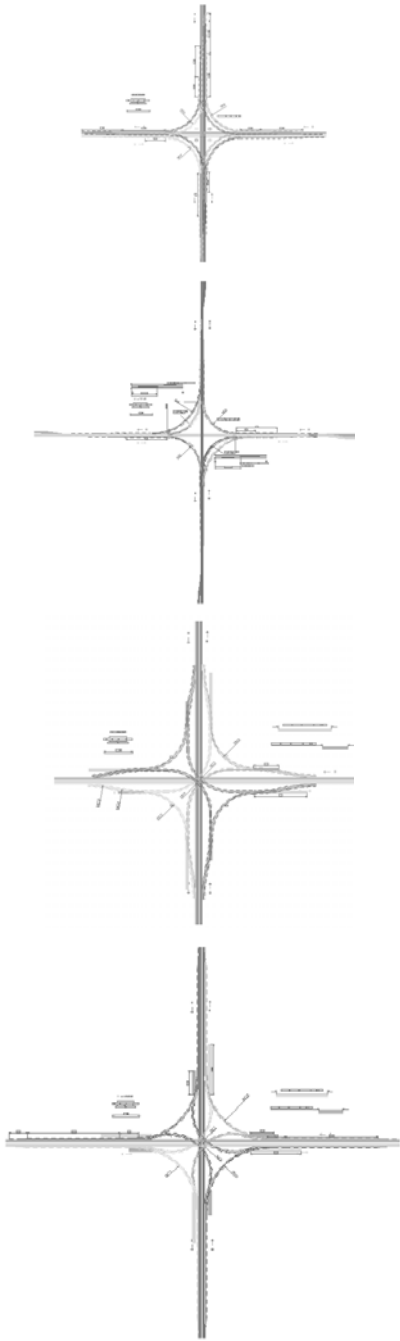
Presentation to NCSITE



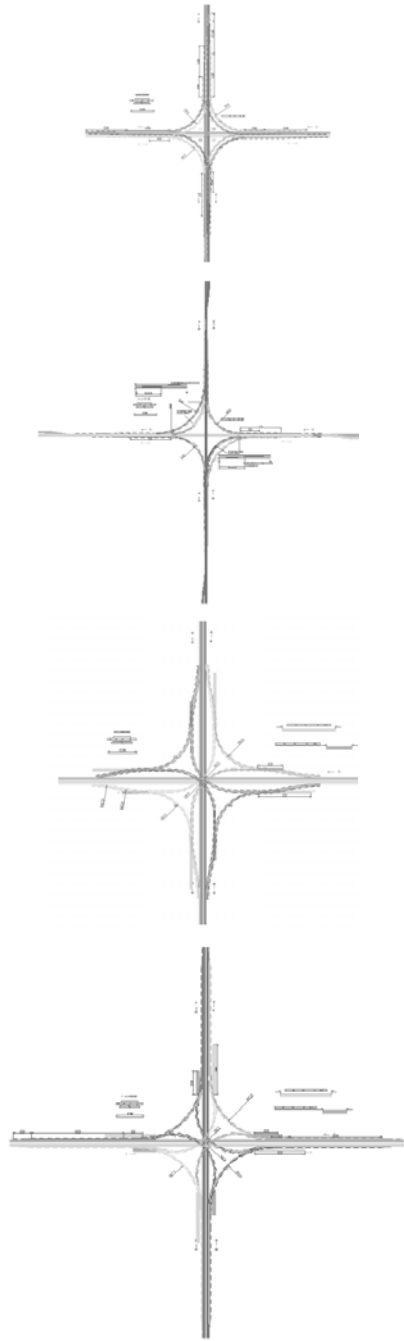
March 28, 2006

Basics of the Nano-Interchange

- The Idea
- Freeway-Freeway Interchange
- Smallest Footprint Possible
- All Direct Connections
- Left-and Right-Hand Entrances and Exits
- Continuous Flow



Meredith's Thesis Objectives



Design Criteria

Typical Section

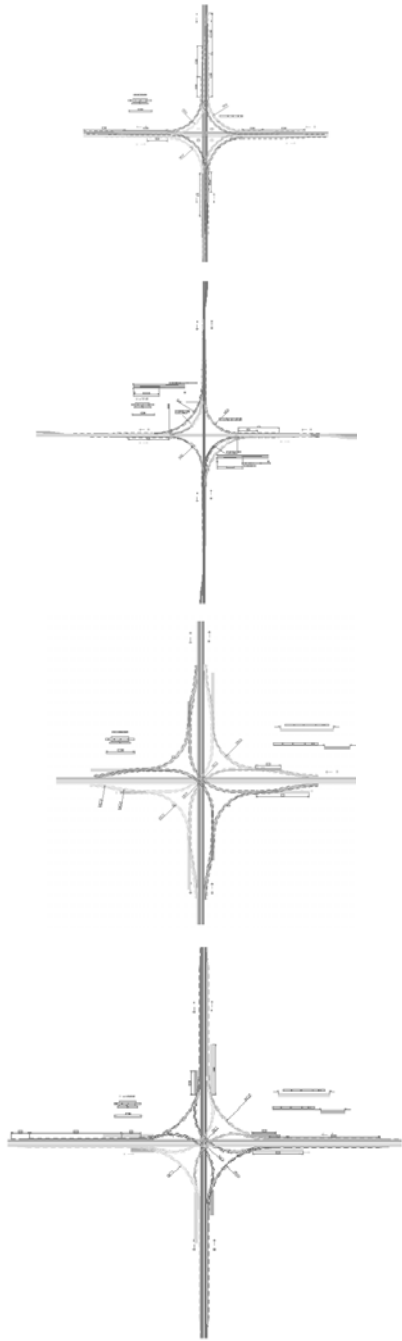
Comparison Selection

Horizontal and Vertical Alignment

Earthwork, Structures, and
Right-of-Way Estimate

Construction Cost Estimate

JP's Dissertation Objectives



Designs
R/W & Cost
Estimates

Task 1: Operational Analysis

Traffic Scenarios input into VISSIM

Task 2: Safety

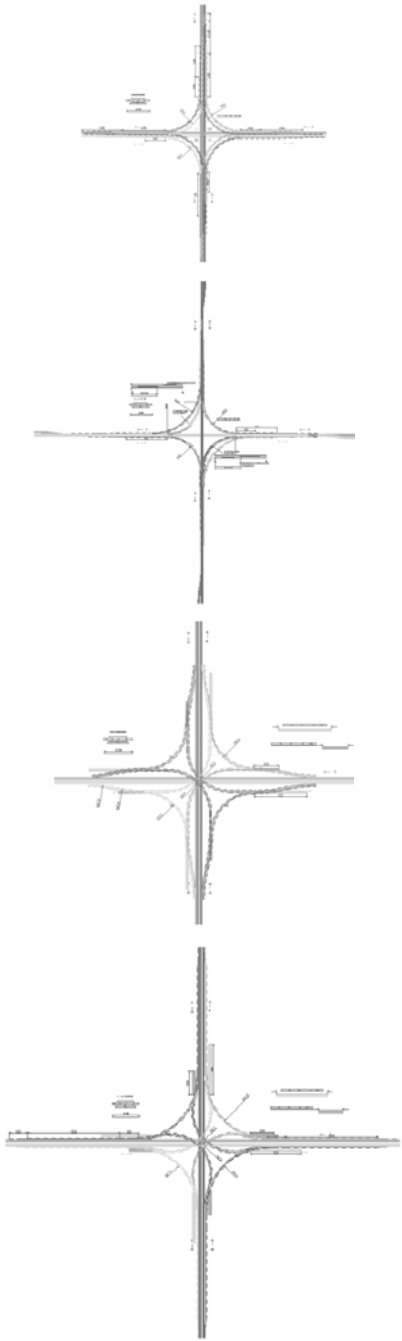
*Left-Hand vs. Right-Hand
Entrance/Exit Ramps*

Task 3: Extended Cost Estimate

Where in the World Could a Nano go?

Comparison Interchange

The Four-Level All-Directional (Stack)



Dallas, Texas

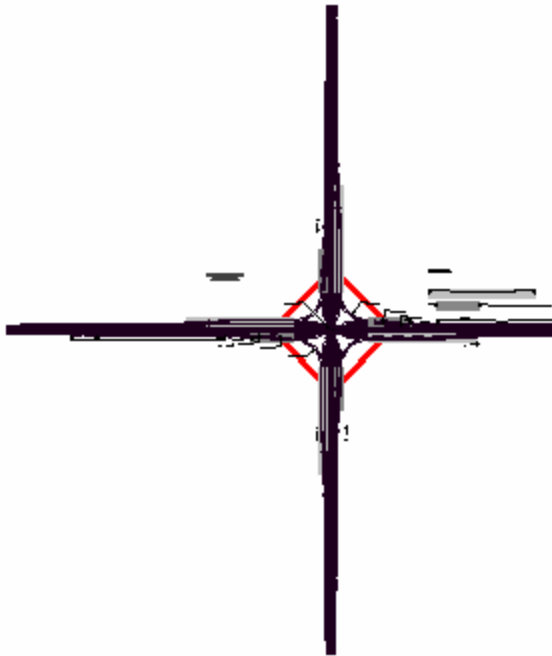


Baton Rouge, Louisiana

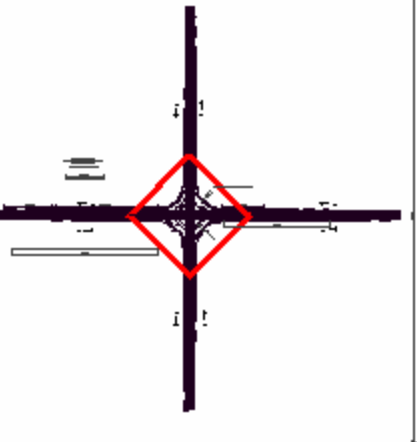
2-D Design

Ramp Design Speed: 35 mph

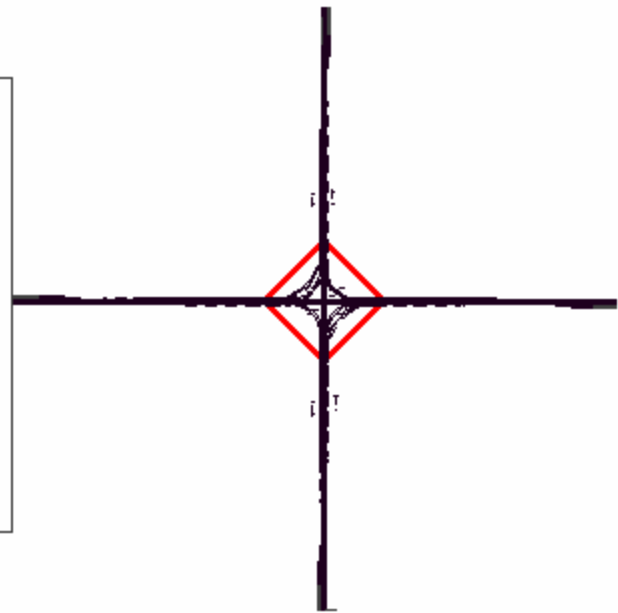
Conventional 4-Level
Ramp Design Speed = 35 mph



Nano-Interchange (Freeways Parallel)
Ramp Design Speed = 35 mph



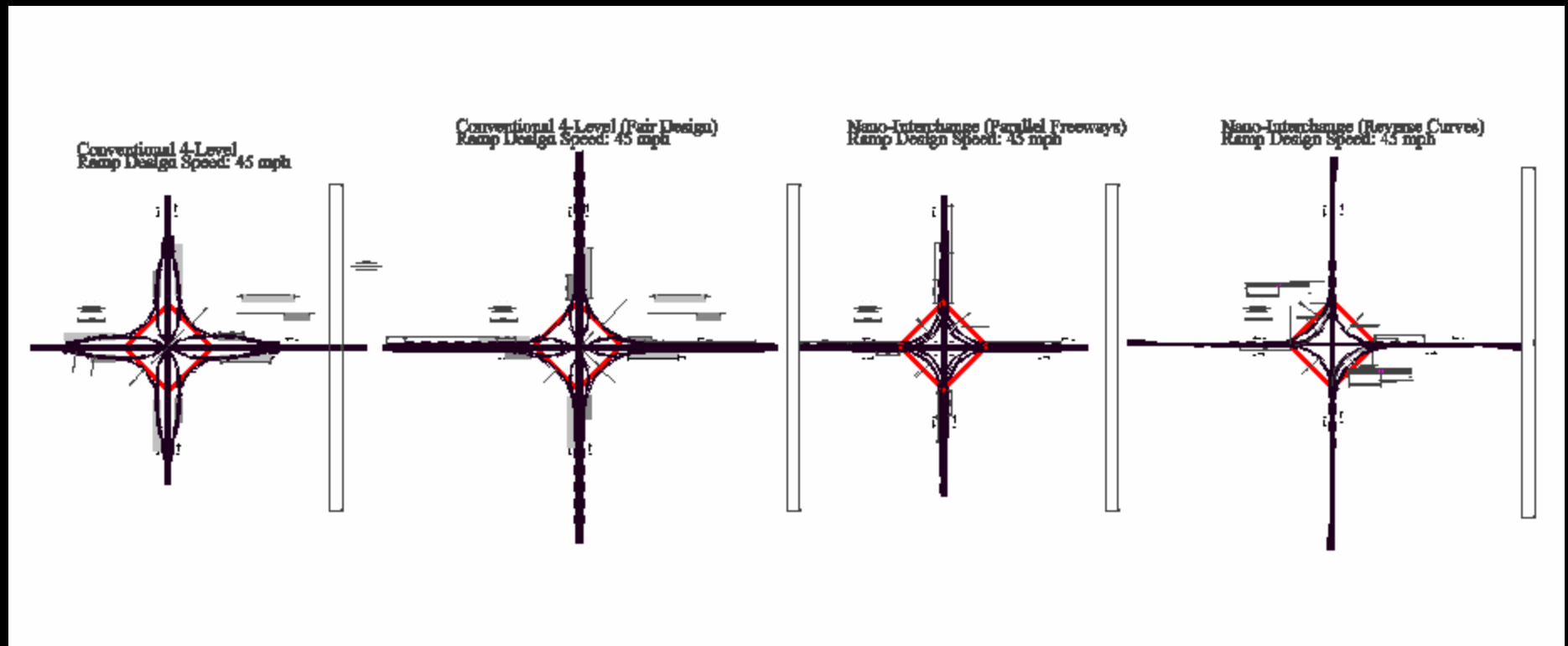
Nano-Interchange (Freeways on Reverse Curves)
Ramp Design Speed = 35 mph



Red Diamonds: 1000' square

2-D Design

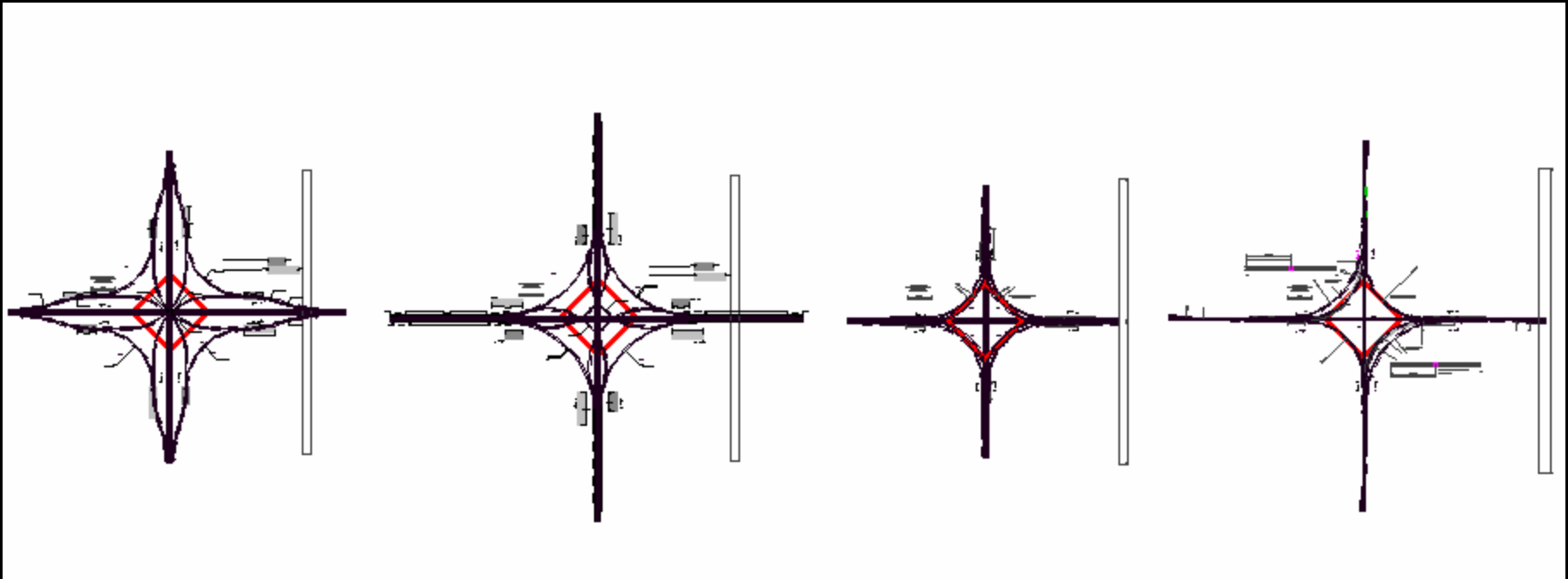
Ramp Design Speed: 45 mph



Red Diamonds: 1000' square

2-D Design

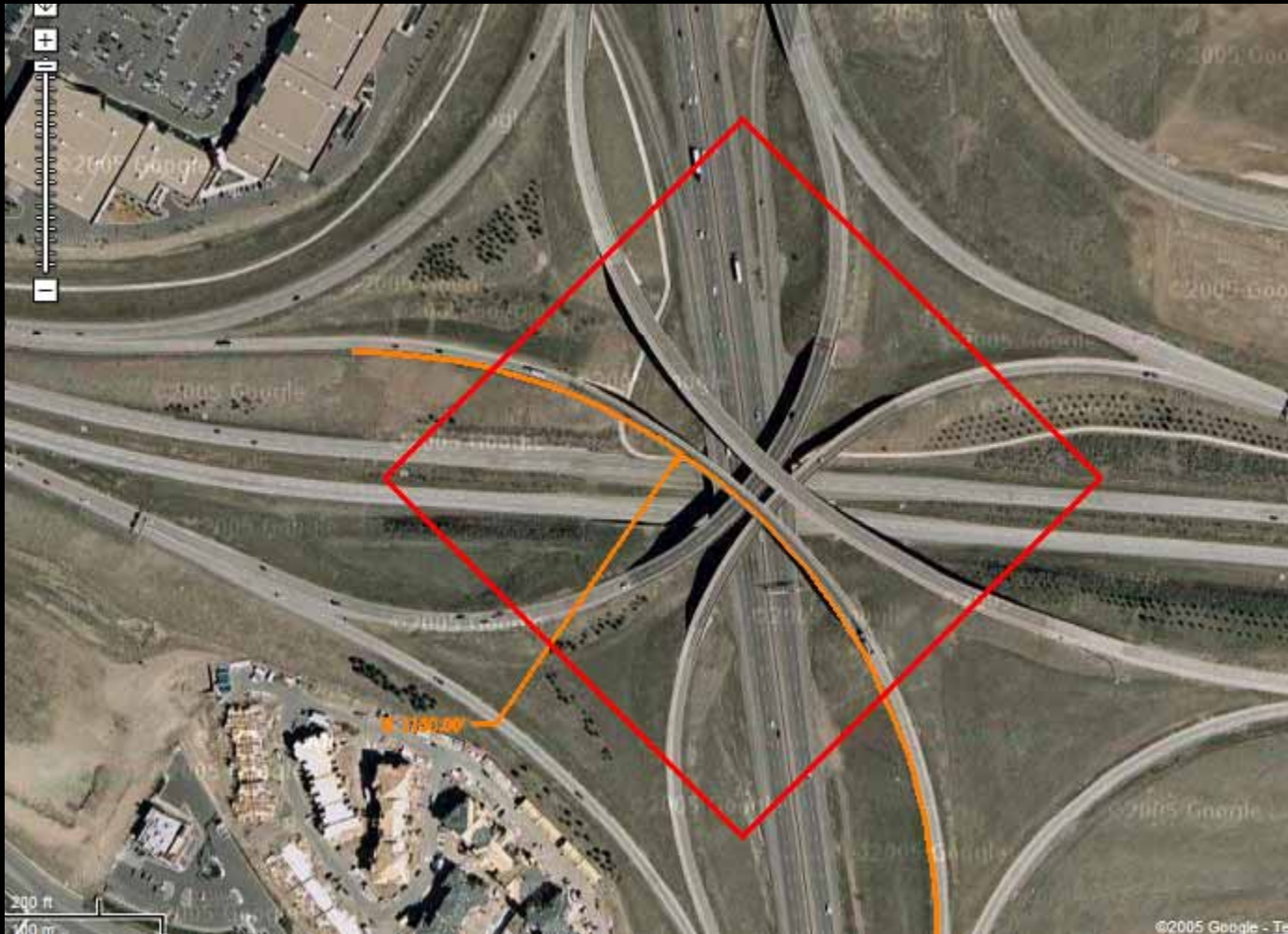
Ramp Design Speed: 55 mph



Red Diamonds: 1000' square

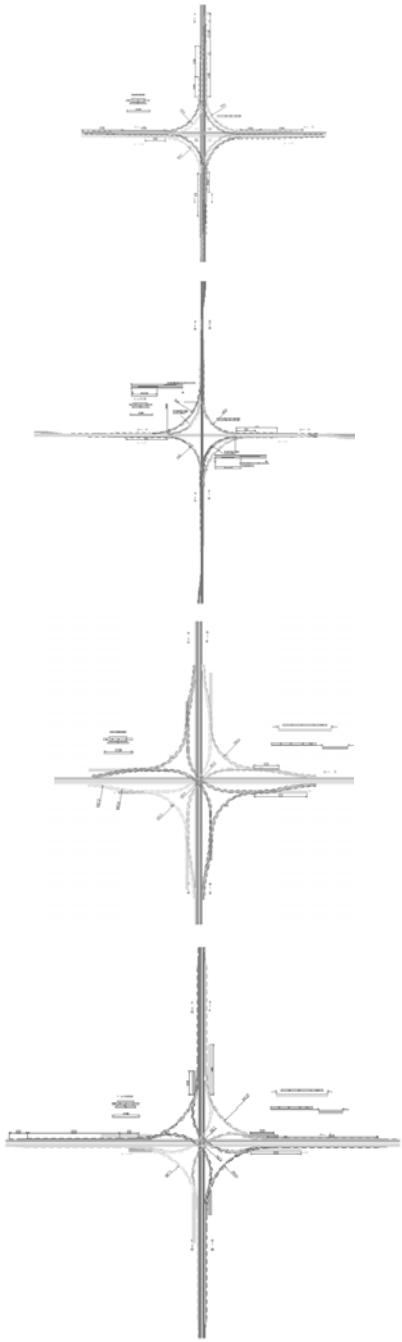
Comparison

I-25/I-87 at State Route 470: Denver, Colorado



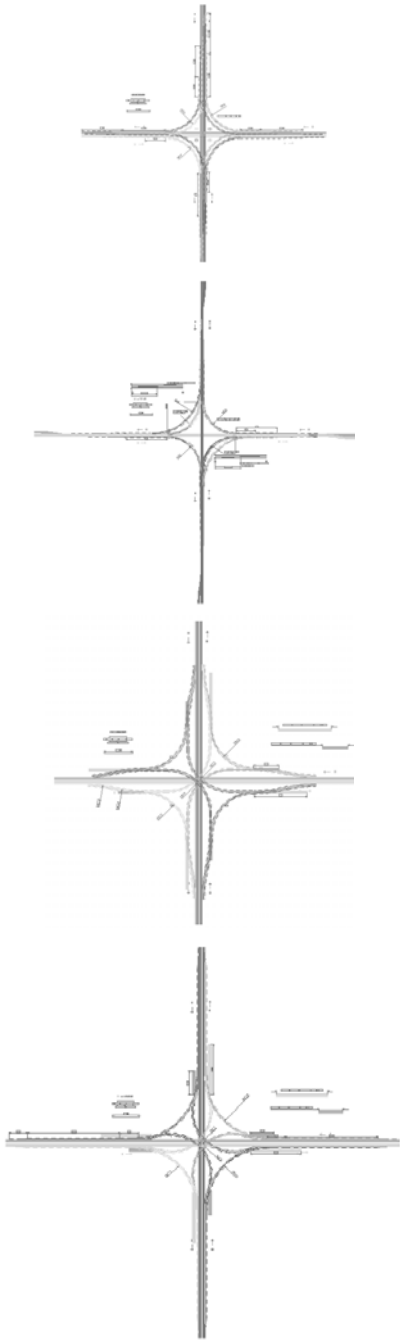
VISSIM Simulation

VISSIM



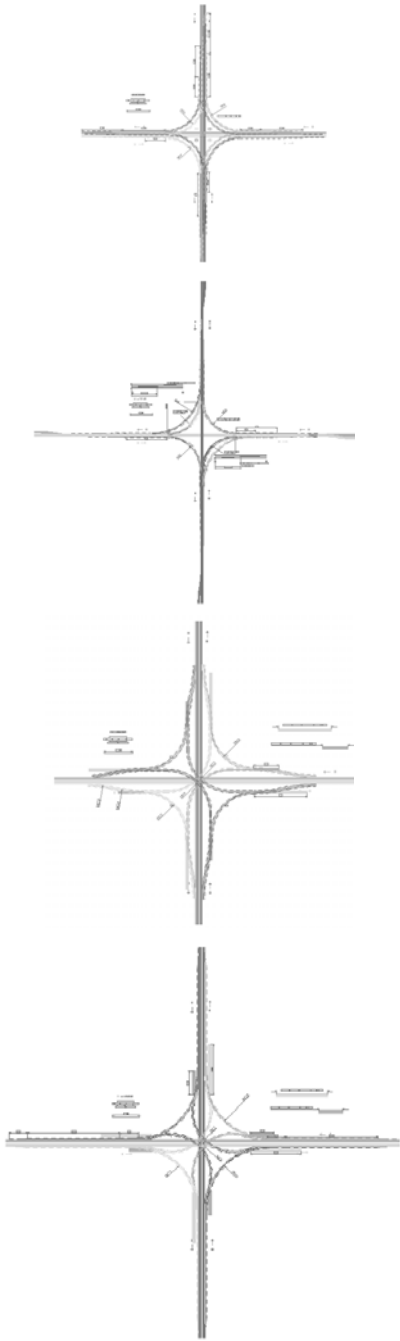
Advantages of the Nano-Interchange

- + Smaller Right-of-Way (Footprint)
- + Direct Connections, Continuous Flow
- + Shorter Travel Distances for Movements
- + High and Low Design Speeds for Ramps



Disadvantages of the Nano-Interchange

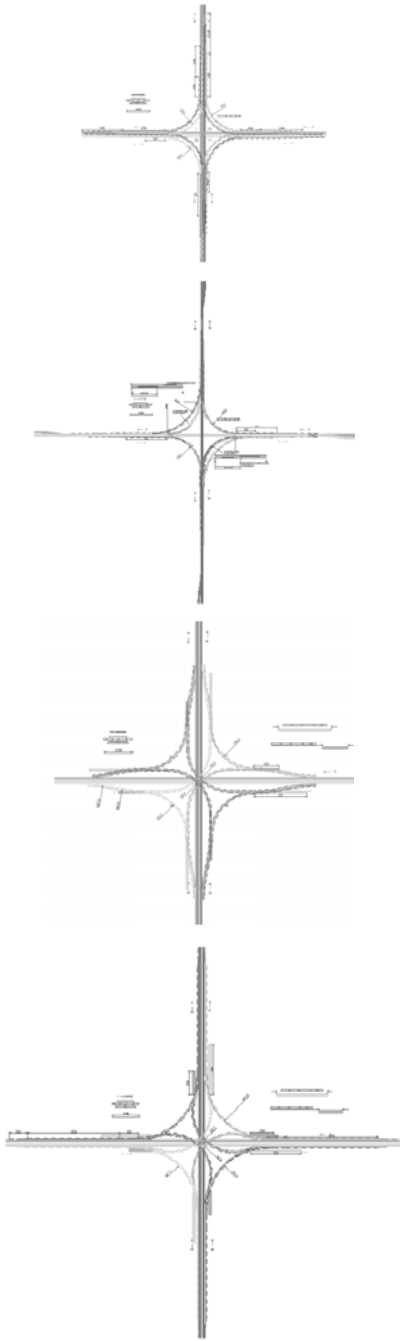
- Safety Record of Left- vs. Right-Hand En/Ex
- Violates Driver Expectancy (in NC)
- May Create Dangerous Weaving Section if used with Conventional Interchanges
- High Structure Costs



JP's Ongoing and Future Research

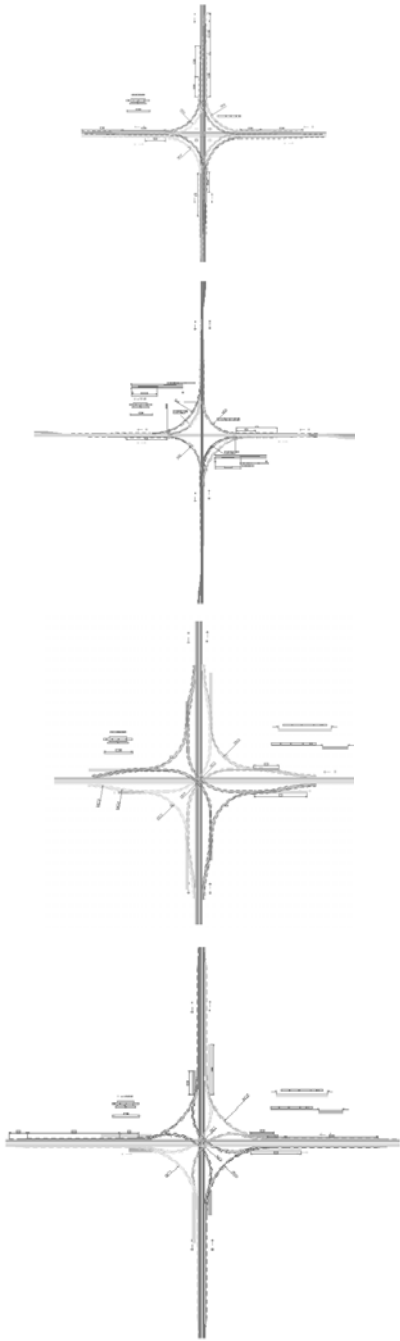
Task 1: Operational Analysis

- Scope Limited to Isolated Interchanges
- Contributing Factors Include :
 - Interchange Type
 - Variable Traffic Volumes
 - Heavy Vehicles
 - Ramp Design Speeds
- Traffic Simulation Model: VISSIM
- MOEs: Total Travel Time and Delay (Veh-Hrs)



JP's Ongoing and Future Research

Task 2: Safety Prediction Modeling

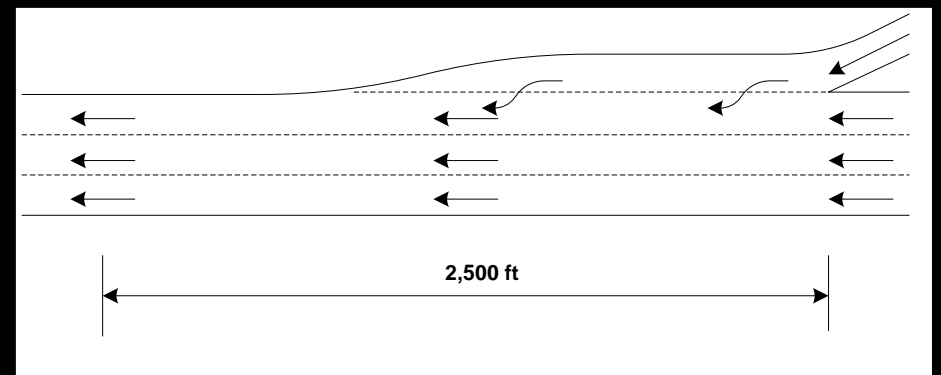
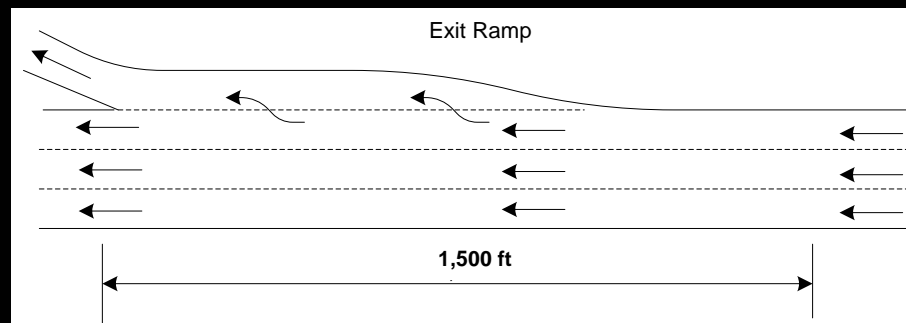


Factor	Independent Variables	Level
Geometric Design Features	Ramp type	Off and On-ramp
	Ramp position	Right-hand and Left-hand
	Mainline Speed Limit ---- Ramp Speed Limit	
	Speed-change lane length	
Traffic Volume	Mainline and Ramp AADT	
Other Features	Area type	Rural and Urban
	Opening year	

JP's Ongoing and Future Research

Task 2: Safety Prediction Modeling

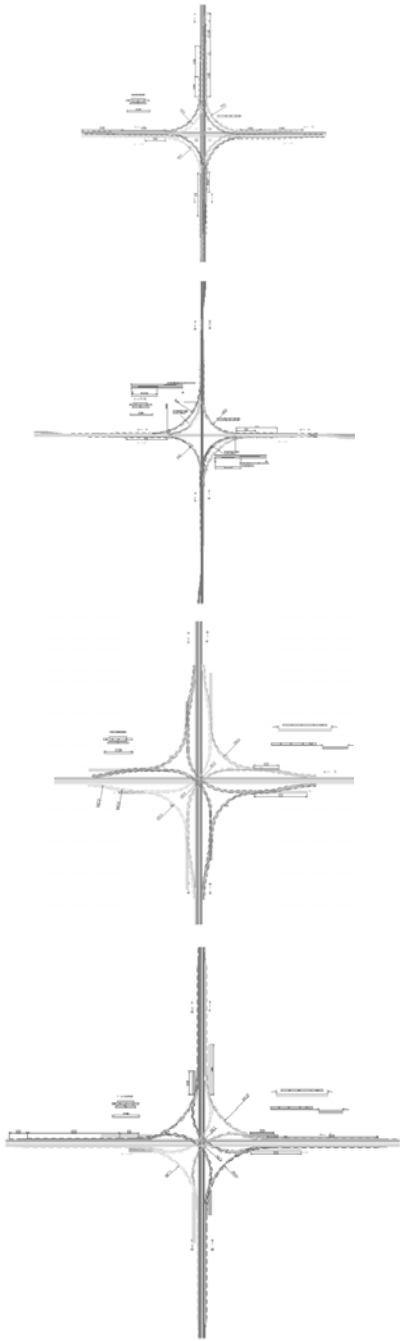
- Data Collection Areas



JP's Ongoing and Future Research

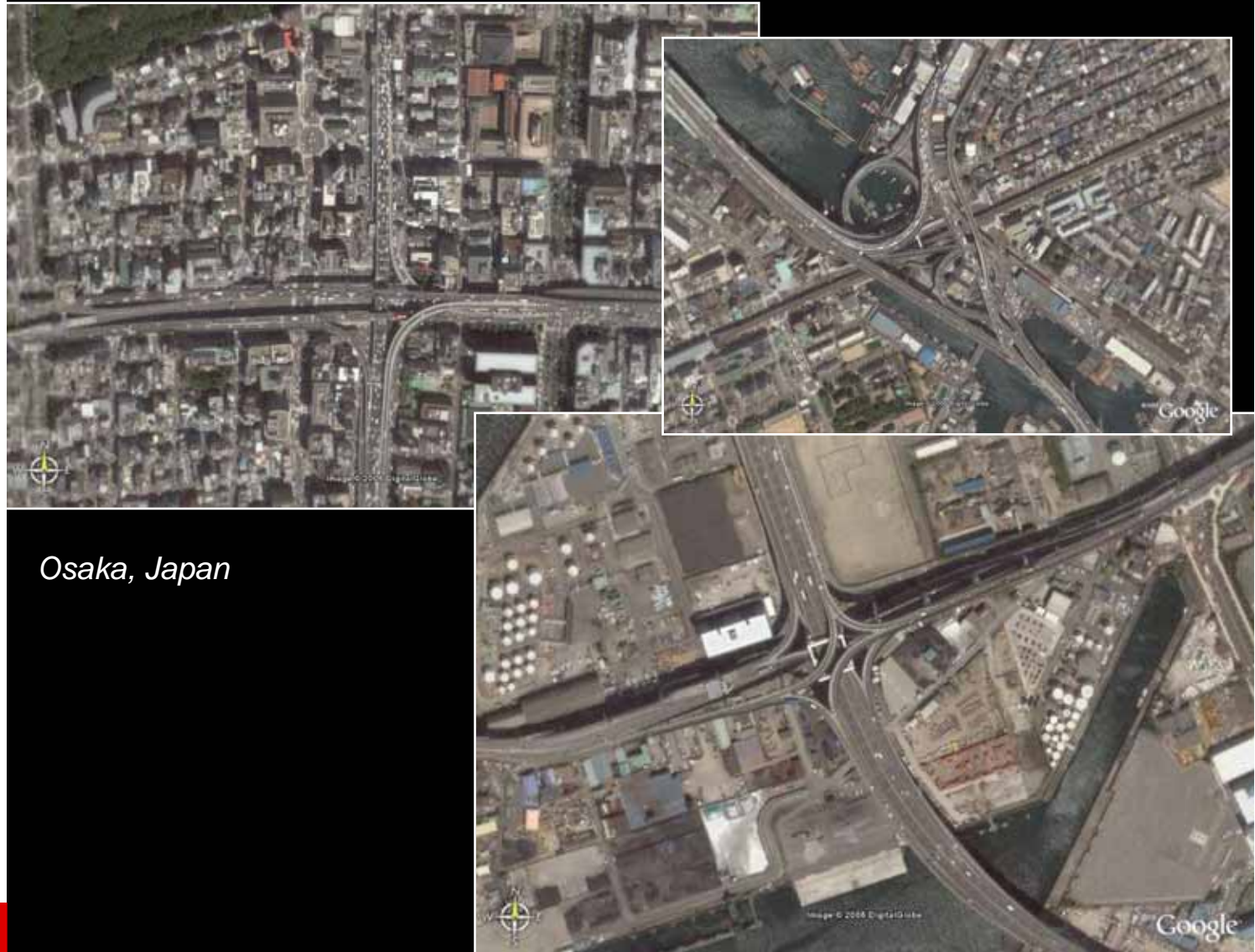
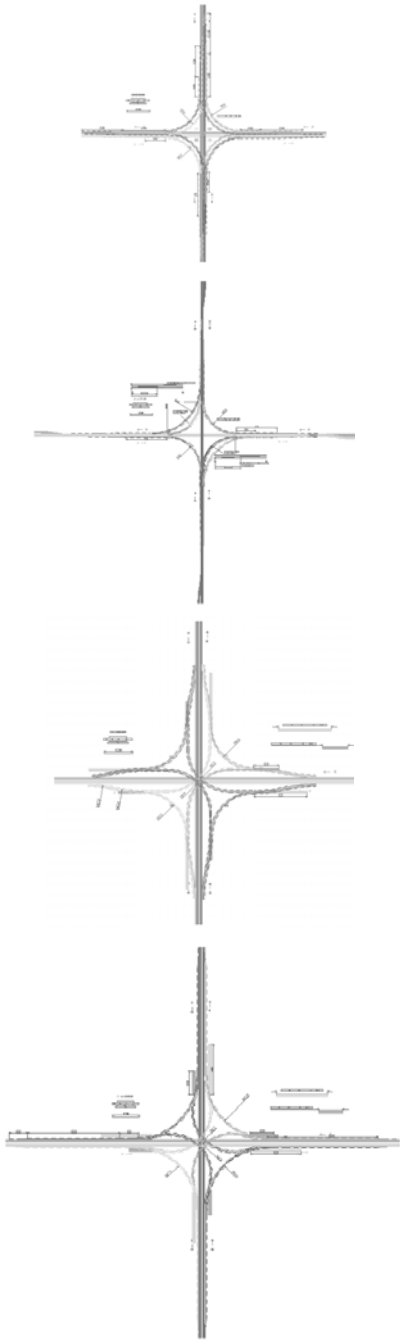
Task 3: Extended Cost Estimate

- Examine the Trade-off Between Right-of-Way and Construction Costs
- Evaluate the Application of the Nano in Major Cities Worldwide



JP's Ongoing and Future Research

Task 3: Extended Cost Estimate



Osaka, Japan

Future Research

- 3-D Modeling
- Comparison to Other Interchanges
- Signage, Drainage, Pavement Design, Etc.
- Structural Analysis/Earthquake Resistance
- Constructability
- Consideration of Adjacent Interchanges
- Financing Options

